

## **ANNEX I: Toilet Performance Testing Protocol.**

### **1. Purpose.**

This protocol is developed specifically for the pilot of separate toilets located at Laboratoire d'Ingénierie des Systèmes Biologiques et des Procédés (LISBP), INSA Toulouse.

The objective is evaluating the operation of two urine diversion toilets coupling in a pilot system which gravity and vacuum performance. Focusing on requests of the users as cleaning capacity, maintenance, safety, comfort and aesthetic standards.

### **2. Reference Standards and Specifications.**

The following documents form part of the technical specifications for conventional toilets:

- ASME A112.19.2/CSA B45.1. Ceramic Plumbing Fixtures.
- ASME A112.19.14-2006 - Six-Liter Water Closets Equipped with a Dual Flushing Device.
- AFNOR NF EN 997+A1. WC pans and WC suites with integral trap.

### **3. Description of the test.**

#### **3.1. Toilet paper test.**

##### **3.1.1. Source**

Test conforming to ASME A112.19.14-2006 section 3.2.4 with regard to paper characteristics and performance requirement. However, orientation of place the balls of paper is added with the aim identifier the area of the bowl which has the possible problems.

##### **3.1.2. Procedure.**

The paper removal test in the reduced flush cycle shall be conducted as follows:

(a) The test load shall be composed of four balls of six sheets of untreated single-ply toilet paper.

(b) Each crumpled into a loose ball measuring 2 in. to 3 in. (51 mm to 76 mm) in diameter. The standard size test sheet shall be 4.5 in x 4.5 in (114mm x 114 mm).

The four 2 in. to 3 in. (51 mm to 76 mm) balls of paper shall be dropped into the water directly above the well and shall be allowed to wet out completely. Within 5 sec after wetting occurs, the bowl shall be flushed. This procedure shall be repeated until three sets

of data are obtained. Note whether any paper is left in the bowl. Flush again and collect any paper that discharges from the outlet.

In the absence of toilet paper compliant with the dimensional requirements of 4.5 in. x 4.5 in. (114 mm x 114 mm), a paper of equivalent surface area shall be used, 20.25 square inches (130 square centimeters).

### 3.1.3. Performance requirement.

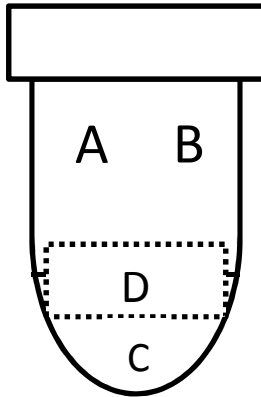
No paper shall remain in the well after each initial flush.

### 3.1.4. Expression of results.

*Table 1 Expression of results of 3.1 Toilet paper test.*

Test no.	Quadrant where paper was dropped		Replicate				Comments
	A/B	C	1		2		
			A/B	C	A/B	C	
1	xxxx						
2	Xx	xx					
3	X	xxx					

(0)= fail; (1) = success (x) = ball of paper



*Figure 1 Quadrants of toilet bowl*

### 3.2. Granule test.

#### 3.2.1. Source.

Test conforming to ASME A112.19.2/CSA B45.1 section 7.5 with regard to performance requirement and procedure. However, material specified in ASME was not providing for practical reasons (economical, protection of pipes and pumps...). Consequently, an organic polymer for packaging is used instead of cylindrical high-density polyethylene (HDPE) granules and nylon balls.



*Figure 2 Polymer used in test 3.2*

#### 3.2.2. Procedure.

Material of the test shall be conducted as follows:

- Add the granules and flush the water closet once before beginning the test to condition the granules.
- Add 10 granules to the water in the bowl.
- Allow the granules to settle to the bottom of the well.
- Trip the actuator, hold for a maximum of 1 s, and release.
- Count the granules and balls visible in the bowl after completion of the flush.

### 3.2.3. Performance requirement.

Not more than 5% of the original number shall be visible in the bowl after each flush.

### 3.2.4. Expression of results.

*Table 2 Expression of results of 3.2 Granule test*

Run no	Initial number		Final number		%Remaining		Comments
	AB	CD	AB	CD	AB	CD	
1	10	0					
2	5	5					

## 3.3. Surface wash test.

### 3.3.1. Source.

Test conforming to ASME A112.19.2/CSA B45.1 section 7.6.

### 3.3.2. Procedure.

- Scrub the flushing surface of the test bowl clean with a mild liquid dishwashing detergent.
- Rinse and dry the flushing surface.
- Draw a continuous horizontal ink line around the circumference of the flushing surface, approximately 25 mm (1.0 in) below the rim jets, with a dry erase marker.
- Trip the actuator, hold for a maximum of 1 s, and release.
- Observe the line during and after the flush.
- When the flush cycle is complete, measure and record the length and position of any ink line segments remaining on the flushing surface.

These steps shall be repeated until three sets of data are obtained.

### 3.3.3. Performance requirement.

The total length of the ink line segments remaining on the flushing surface after each flush shall not exceed 51 mm (2.0 in) when averaged over three test runs. No individual segment shall be longer than 13 mm (0.5 in).

#### 3.3.4. Expression of results.

*Table 3 Expression of results of 3.3 Surface wash test.*

Run no.	Number of ink line segments remaining on the flushing surface	Number of segments in each quadrant	Length of each segment, mm (in)	Combined length of segments, mm (in)
1		A		
		B		
		C		
		D		
2		A		
		B		
		C		
		D		
3		A		
		B		
		C		
		D		
Longest segment, mm (in)				
Average combined length, mm (in)				

#### 3.4. Wash of the bowl.

##### 3.4.1. Source.

Test conforming to AFNOR *NF EN 997+A1* section 6.2 and 6.17.10.

##### 3.4.2. Procedure.

Moisten the complete inner surface of the WC pan below the flushing rim and above the water in the trap. Immediately afterwards, sprinkle 20 g of sieved sawdust (2 mm) as completely and evenly as possible over the moistened surface. Operate the flushing device and record any area of unflushed surface.

Repeat the procedure five times.

#### 3.4.3. Performance requirement.

Arithmetic average of any unflushed area below the ring and above the surface of the trap shall be no greater than 50 cm<sup>2</sup> after five flushing operations.

#### 3.4.4. Expression of results.

*Table 4 Expression of results of 3.4 Wash of the bowl.*

Test no.	Area recorded (cm <sup>2</sup> )
1	
2	
3	
4	
5	
Average (cm <sup>2</sup> )	

### 3.5. Solids discharge and real performance.

#### 3.5.1. Source.

Several tests in the norms evaluate the discharge of solids and cleaning performance of the toilet, some of them have already been described previously. However, none performs a test to represent what happens in the reality. For this reason a test, which tries to reproduce human behavior, is developed.

#### 3.5.2. Procedure.

Two peristaltic pumps simulate human urine and feces in the pilot system. Characteristics of feces (density, appearance, texture) are recreated with dehydrated sludge (1000-1250 g/L) coming from the wastewater treatment plant SIVOM de la Saudrune at Cugnaux and characteristics of urine are recreated with dissolution of the colorant Orange II (CAS 633-96-5), concentration 0.13 g/L.

- Scrub the flushing surface of the test bowl clean with a mild liquid dishwashing detergent.

- Switch on the pump of urine and feces during the necessary time for the discharge of 250 ml of urine and 150 g of feces in the bowl.
- Stop the pump and active the flushed device.
- Note the dirty areas after one flush in the table of results 3.5.4.

For considering the different scenarios:

- Carry out also this test with toilet paper which characteristics according to test 3.1.
- Carry out only with urine pump.
- Carry out only with feces pump.

### 3.5.3. Performance requirement.

No rest of paper, artificial urine and feces shall remain in the well after each initial flush.

### 3.5.4. Expression of results.

(0)= No rest of paper, artificial urine and feces remained after initial flush in each quadrant of the bowl *Figure 1 Quadrants of toilet bowl*

(1)= Paper, artificial urine or feces remained after initial flush in each quadrant of the bowl. *Figure 1*

*Table 5 Expression of results of 3.4 Wash of the bowl.*

Run no	Rest of urine		Rest of feces		Rest of paper		Comments
	AB	CD	AB	CD	AB	CD	
1							
2							
3							
4							
5							