# MAS STANDARDS PUBLICATION

## Test Protocol for Total Saturation of Absorbent Core in Reusable Absorbent Undergarments

**FEMTECHMAS-6515-1:2022**

MAS
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# 1. SCOPE

This Standard specifies the total saturation capacity test developed by MAS Holdings to identify the maximum saturation level of liquid that can be held in the absorbent composite of the female, male reusable absorbent undergarments. Total saturation capacity test is a modified version of the ISO 11948-1:1996 test that was first developed to test disposable absorbent products.

The experiment measures how much of liquid can be held by the absorbent composite in reusable absorbent undergarments when fully submerged in a simulant bath, followed by drainage of excess fluid. The Standard consists of two procedures where absorbent core can be tested (with saline or blood simulant) depending on the user case.

# 2. NORMATIVE REFERENCES

The following reference document are required for the application of this standard. Latest edition of the document with amendments should be used.

- ISO 139, Textiles
  Standard atmospheres for conditioning and testing

- ISO 11948-1:1996
  Urine-absorbing aids, Part 1: Whole-product testing ISO 139, Textiles — Standard atmospheres for conditioning and testing.

- AATCC 150-2018
  Dimensional Changes of Garments after Home Laundering (As a wash method to test after wash performance).

- ISO 6330:2012 -Textiles
  Domestic washing and drying procedures for textile testing (As a wash method to test after wash performance.) [Note: washing method shall be selected based on the care label instructions of the Undergarment]

- Test method No. 12/2015 MDS-Hi (German Healthcare Medical Service)
  (https://www.gkv-spitzenverband.de/media/dokumente/krankenversicherung_1/hilfsmittel/fortschreibu ngen_aktuell/20160311/032016_Pruefmethode_Nr_12-2015_MDS-Hi.pdf)

- Reference blood simulant (5.1.1): European patent specification EP 1 355 607 B1(https://data.epo.org/publicationserver/document?iDocId=3303810&iFormat=0)

# 3. TERMS & DEFINITION

For the purposes of this document, the following terms and definitions apply.

### 3.1. Gusset Composite

Gusset composite is a combination of multiple functional layers attached together to provide specific functional requirements in female reusable absorbent undergarments including, but not limited to, wicking, absorbency, leak resistance etc.

### 3.2. Pouch Composite

Pouch composite located in the crotch region of the male reusable absorbent underwear. Materials & structure of the pouch composite is not limited to the basic functional requirements of wicking, absorbency & leakage resistance. It can also comprise of different materials, constructions, layers & designs based on new technologies.

### 3.3. Test Specimen/ Sample

Sample used in testing purpose to determine the required parameters.

### 3.4. Functional Properties

The nature of having a certain function and/or performance features in products.

### 3.5. Menstruation

Menstruation is the regular vaginal bleeding that occurs as part of a woman's monthly cycle.

### 3.6. Post Micturition Dribble

Involuntary loss of urine that is experienced after urination. Occurs when the bladder isn't completely emptied where drips of urine being trapped in the urethra gets released on to clothing after leaving the toilet. Symptom is experienced by women and men, but more common in men.

### 3.7. Urinary Incontinence

Urinary incontinence refers to involuntary urine leakage resulting from loss of bladder control. Types of incontinence include stress, urgency, mixed & overflow incontinence.

### 3.8. Reusable Absorbent Undergarment

Reusable absorbent underwear is a pair of undergarments that can be worn during menstruation, urinary incontinence, or for any other body fluids. The reusable absorbent undergarment absorbs the body fluids utilizing a multi-layer textile material assembly built into the gusset region of the undergarment which is identified as the gusset composite. This undergarment can be washed after use to be re-used multiple times.

# 4. PRINCIPLE

## 4.1. Total Gusset Saturation Capacity

Measures level of solution that can be held in the absorbent gusset of the **female** reusable absorbent underwear when the gusset composite is submerged in blood simulant or saline solution bath, followed by draining of excess fluid.

## 4.2. Total Pouch Saturation Capacity

Measures level of solution that can be held in the absorbent pouch of the **male** reusable absorbent underwear when the pouch composite is submerged in saline solution bath, followed by draining of excess fluid.

# 5. MATERIALS

## 5.1. Gusset/ Pouch composite

**Figure 5.1a:** Cut separated gusset composite from female reusable absorbent undergarment.

**Figure 5.1b:** Cut separated pouch composite from male reusable absorbent undergarment.

## 5.2. Fluids

### 5.2.1. Saline for Urine Simulant

0.9% saline solution (9 g of NaCl per litre of distilled water)

### 5.2.2. Synthetic blood solution:

Dissolve 3 g CMC (Carboxy Methyl Cellulose, 0.60-0.95 degree of substitution, CAS 9004-32-4, Sigma-Aldrich resp. Merck) and 9 g NaCl per litre of distilled water under stirring and heating up to 35 °C. Liquid is used after cooling to room temperature.

**NOTE:** Use saline solution for male & female urinary incontinence reusable absorbent products and use the synthetic blood solution for female reusable absorbent products developed for menstruation.

# 6. APPARATUS

## 6.1 Container

Not less than the length and width of the gusset to be tested, able to accommodate 100 mm deep test fluid.

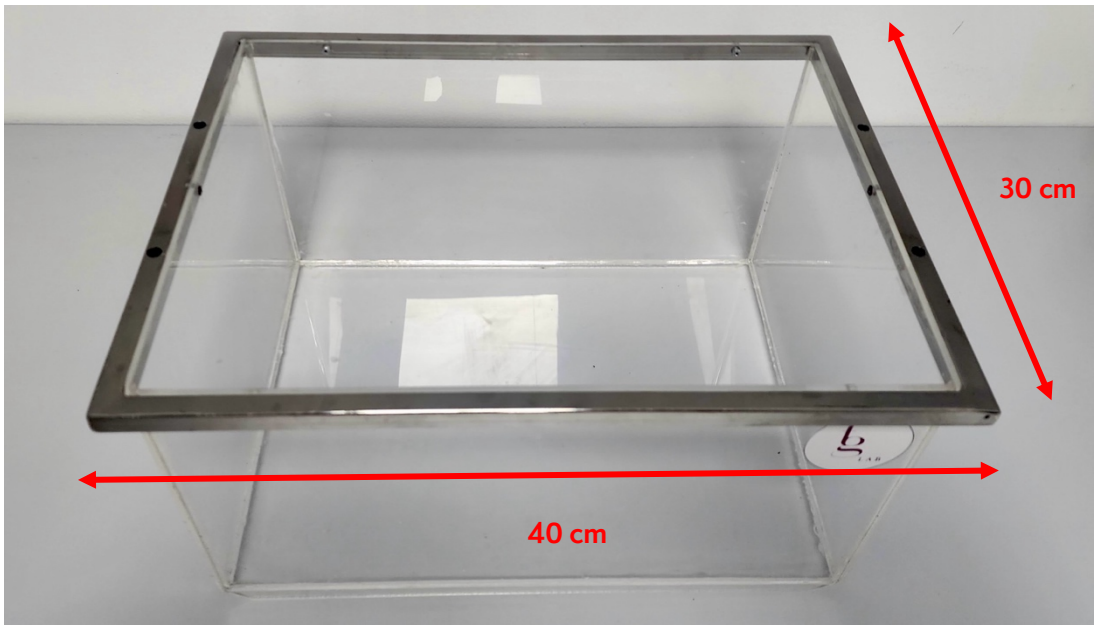



**Figure 6.1.1:** Transparent container with approx. dimensions of 40cm (L) x 30cm (W) x 20 cm (H) (top view)

## 6.2 Drainage screen:

The drainage screen is made of welded together rods(square)with diameter of (1.5-2.0) cm.

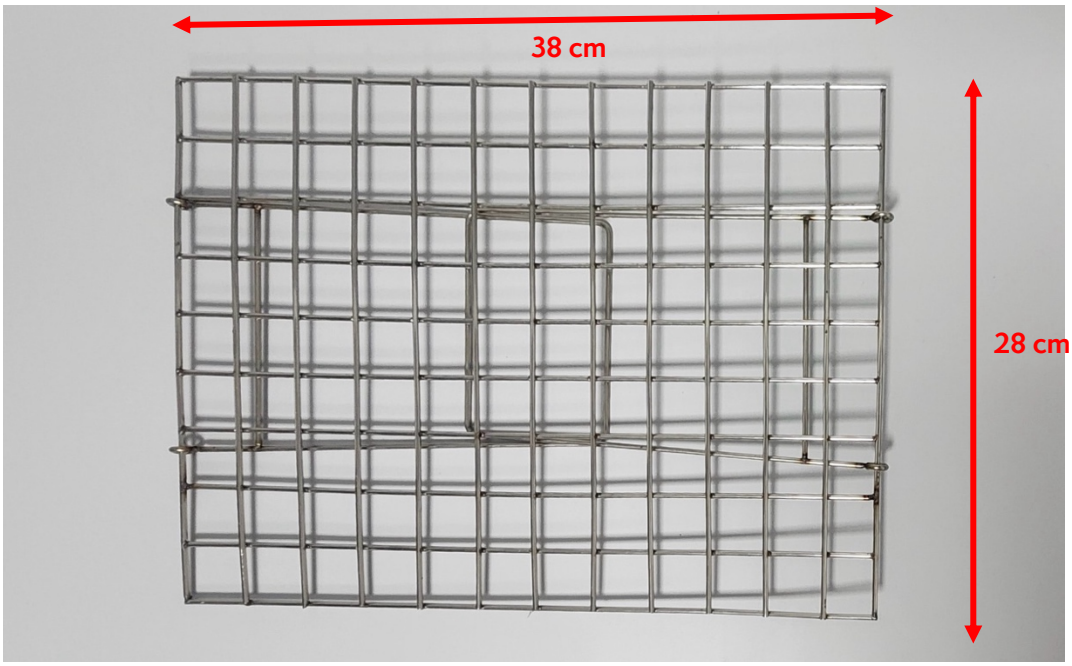



**Figure 6.2.1:** Stainless drainage screen with handles (top view).

**6.3** **Metallic block:** of mass 1 kg

**Figure 6.3.1:** 1 kg of metallic block with handle (Isometric view).

**6.4** **Stopwatch (precision between 0.05 -0.1 s)**

**6.5** **Standard Beaker**

**6.6** **Weighing scale (accuracy 0.001 g)**

**6.7** **Gusset lifting mesh.**

**6.8** **Plastic tile** ~ (dimensions: 50 cm (L) x 40 cm (W) x 0.1cm (T))

# 7 TEST PROCEDURE

## 7.1 Sample Preparation

(a) Prior to testing all samples, they must at least be washed one time/cycle according to ISO 6330 / AATCC 150 (30 °C gentle, line-drying) procedure 3M A or acc. to the labelled care instructions and conditioned at least 24 h acc. to ISO 139.

(b) Separation of gusset composite from Female reusable absorbent undergarment: Cut open the undergarment from two side waists (left-side seam and right-side seam) & lay the garment flat. Next cut & separate the gusset composite form the attached body fabric.

(c) Separation of pouch composite from Male reusable absorbent undergarment: Cut open the undergarment from two side waists (left-side seam and right-side seam) so that the garment can lay flat. Next cut & separate the pouch composite form the attached body fabric.

## 7.2 Wicking time per ml (s/1.5ml)

(a) Place the (new/dry) gusset/pouch composite on a flat surface.

(b) Add 1.5 ml of test fluid within one second on to the gusset/ pouch composite & start the stopwatch at the beginning of fluid addition.

(c) Measure the time taken to completely absorb 1.5ml into the absorbent gusset/ pouch composite.

(d) Record the time elapsed until the test fluid is completely absorbed and soaked up by the test specimen.

(e) Repeat the testing with 2 more specimen to obtain triple replicate readings.
**NOTE:** If the process takes more than 5 min, stop the test & record the time as 300s+

## 7.3 Total Gusset/ Pouch Saturation Capacity (Modified ISO 11948-1)

(a) Fill the container with the test fluid to a depth of at least 100 mm.

(b) Keep the gusset/ pouch lifting mesh on the bottom of the container.

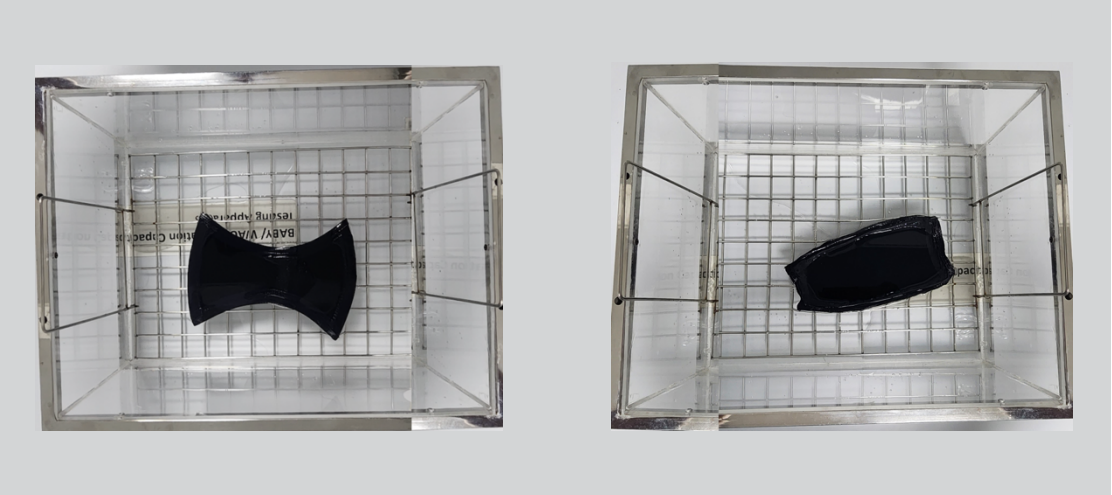


**Figure 7.2.1:** Cut & separated absorbent gusset (left) & absorbent pouch (right) submerged in the saline solution bath (top view).

(c) Using the weighing scale measure the dry weight of the gusset/ pouch to be tested, condition with an accuracy of 0.1 g.

(d) Place the gusset/ pouch flat on the fluid surface. Gusset barrier side up. Gusset wicking layer side touching the fluid surface. Submerge the gusset fully inside the fluid bath.

(e) Leave the gusset/ pouch for 20 min + 30 s undisturbed to absorb fluid.

(f) Lift the gusset/ pouch from the container using gusset lifting mesh and keep on the drainage screen (wicking layer side touching the drainage screen) and place plastic tile on the gusset/ pouch (barrier layer side) and keep 1kg metallic block on top of the plastic tile and allow excess fluid to drain back within 2 minutes.

(g) Keep the glass beaker on the weighing scale and tare the weighing scale.

(h) Place the drained gusset/ pouch inside the glass beaker and measure the wet weight of the gusset with an accuracy of 0.1 g.

(i) Do the body fabric absorbency correction (see section 7.2).

(j) Calculate the saturation gain and total ml absorbed as specified.

(k) Repeat the experiment three times and calculate the average and standard deviation of the absorbed volume of the solution and mention the absorbed values of each gusset/ pouch and the average with the standard deviation.

## 7.4 Testing Codes

| Code | Test |
|---|---|
| FEMTECHMAS-6515-1:2022-6.2-S (Modified ISO 11948-1) | Total Gusset saturation Capacity- Saline |
| FEMTECHMAS-6515-1:2022-6.2-B (Modified ISO 11948-1) | Total Gusset saturation Capacity- Blood Simulant |

*Previously testing codes were FEMTECHMAS004S for Saline & FEMTECHMAS004B for Blood Simulant.

# 8 CALCULATION & EXPRESSION OF RESULTS

## 8.1 Saturated weight gain (initial)

The saturated gain for each of the gusset/ pouch composite is calculated using the following equation:

*Initial Gusset or Pouch Weight Gain (g) = Wet Weight (g) – Dry Weight (g)*

| Specimen | Specimen 01 | Specimen 02 | Specimen 03 |
|---|---|---|---|
| Dry weight (g) | | | |
| Wet weight (g) | | | |
| Initial Weight Gain (g) | | | |

## 8.2 Body fabric weight gain

Since it is required to have body fabric attached to the gusset/ pouch for the washing purpose, body fabric absorbency should be deducted from the initial weight gain.

To calculate body fabric absorbency correction, the following parameters must be calculated.

(a) Volume of fluid absorbed by 100 $cm^2$ body fabric.
Cut a 100$cm^2$ body fabric piece & measure the dry weight. Then follow the steps in section 7.2 (total gusset saturation capacity) to calculate the volume absorbed by the body fabric (wet weight). Now calculate the weight gain.

(b) Area of the absorbent composite
Since it's difficult to calculate the area due to the shape of the absorbent composite (an approximate calculation of the area of the absorbent composite region can be made.

$$\text{Body fabric weight gain} = \left( \frac{\text{Volume of fluid absorbed by 100 } cm^2 \text{ body fabric (g)}}{100\ cm^2} \right) X \text{ Area of the absorbent composite } (cm^2)$$

$$\textit{Final Gusset Weight Gain (g)} = \text{Initial Gusset Weight Gain (g)} - \text{Body Fabric Weight Gain (g)}$$

| Specimen | Specimen 01 | Specimen 02 | Specimen 03 |
|---|---|---|---|
| Initial Weight Gain (g) | | | |
| Body fabric absorbency gain (g) | | | |
| Final Gusset Weight Gain (g) | | | |

## 8.3 Total Saturated weight gain (final)

$$\textit{Total Garment Saturation Capacity (ml)} = \frac{\text{Final Weight Gain (g)}}{\text{Density of the Fluid (gcm}^{-3}\text{)}}$$

The result is the average of the three replicates of the test fluid amount until total saturation.

| Specimen | Total Garment Saturation Capacity (ml) |
|---|---|
| Specimen 01 | |
| Specimen 02 | |
| Specimen 03 | |
| Average | |
| Standard Deviation | |

### Density of the Fluids

- 0.9 % saline solution– 1.005 $gcm^{-3}$
- Synthetic blood solution- 1.012 $gcm^{-3}$

# 9 BIBLIOGRAPHY

- ISO 139, Textiles — Standard atmospheres for conditioning and testing
- AATCC 150-2018 — Dimensional Changes of Garments after Home Laundering
- ISO 6330:2012 -Textiles — Domestic washing and drying procedures for textile testing.
- Test method No. 12/2015 MDS-Hi (German Healthcare Medical Service)

# 10 REFERENCES

1. International Organization for Standardization (1996). ISO 11948-1:1996- Urine-absorbing aids Part 1: Whole-product testing. [online] ISO.org. International Organization for Standardization. Available at: https://www.iso.org/standard/20546.html [Accessed 4 Nov. 2023].

2. American Association of Textile Chemists and Colorists (2018). AATCC Test Method 150-2018t, Dimensional Changes of Garments after Home Laundering. [online] members.aatcc.org. American Association of Textile Chemists and Colorists. Available at: https://members.aatcc.org/store/tm150/556/ [Accessed 4 Nov. 2023].

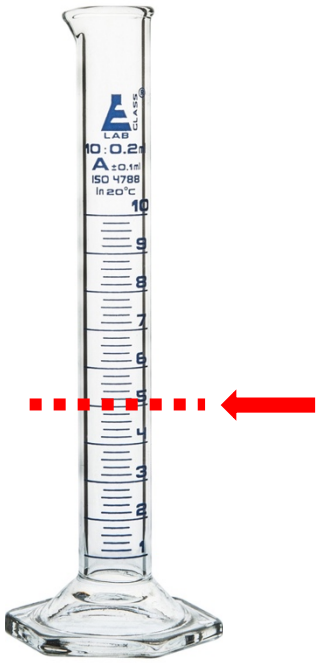
3. FemTech at MAS (2022). FemTech Standards Publication: Reusable Absorbent Undergarment Testing Protocol. [online] MAS Innovation (Pvt) Ltd. Available at: https://femtech.twinery.co/wp-content/uploads/2022/06/Global-Test-Protocol-for-Reusable-Absorbent-Undergarment.pdf [Accessed 4 Nov. 2023].

# ANNEX: INFORMATIVE

Test Protocol Part 2 - Additional Garment Form Testing
This part of the standard specifies the functional properties other than described in part 1. This Includes:

- Water Vapor Resistance Ret (Breathability) of the undergarment Microbiological Testing
- Odour testing-GC and Sensory evaluation.
- Dimensional stability after repeated home laundering Appearance after repeated home laundering.
- Biological evaluation of garments -Cytotoxicity, Skin irritation, and Skin Sensitization
- Drying rate and time of undergarments.
- Sensations of skin touch material of the reusable absorbent undergarment.
- pH-value of the undergarment crotch.

Standardization of blood simulant



Instructions on standardizing blood simulant.

1. Measure the dry weight of the 10ml graduated cylinder.
2. Tare the scale to zero.
3. Now insert blood simulant to the 5ml level mark on the graduated cylinder (highlighted in red)
4. Measure the weight graduated cylinder with 5ml blood simulant.
5. Note down the weight of the blood simulant.

**Note:**

- State the weight of the blood simulant on the test report **before the starting the experiment** (in test calibration samples)
- Do not measure 5ml from the pipette and fill the graduated cylinder.

## ABOUT US

MAS is a pioneer in innovation in apparel solutions in the hygiene space.

Our purpose is to bring normalcy to women & men suffering from urinary incontinence, and everything in between, supporting them throughout their daily life. The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through processes.

## CONTACT US

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