MAS STANDARDS PUBLICATION

Reusable Female Absorbent Undergarment Testing Protocol

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1. SCOPE

This Standard specifies the maximum absorption capacity before leakage, rewet and wicking speed for reusable absorbent undergarment designed to be used for any type of body fluids including but not limited to menstruation and urinary incontinence applications.

Femography by MAS has designed this testing standard together with Hohenstein Laboratories GmbH & Co. KG, considering real life 3D wear scenario. The method of testing is simplified to ensure valid and repeatable test data provided the fit and size of the undergarment is accurate to the wearer.

The chosen test parameters (weight, fluid amount, wait time) are based on average data and represent a scenario close to worst case in terms of wear and flow rate of the body fluid activity.

2. NORMATIVE REFERENCES

The following reference documents 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

- AATCC 150-2018
  Dimensional changes of garments after Home Laundering (As a wash method to test after wash performance)

- ISO 6330:2021-11-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] Synthetic Blood Simulant Recipe

- 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)

3. TERMS & DEFINITIONS

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 including, but not limited to, wicking, absorbency, leak resistance etc. in a reusable absorbent undergarment.

3.2. Test Specimen/ Sample

Sample used in testing purpose to determine the required parameters.

3.3. Functional Properties

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

3.4. Menstruation

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

3.5. Urinary Incontinence

Urinary incontinence refers to involuntary urine leakage.

3.6. 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.

3.7. Waiting Time

Time period to settle liquid into the gusset composite between each interval of fluid addition.

4. PRINCIPLE

4.1. Wicking speed

A defined amount of fluid is applied to a small area of the gusset composite and the elapsed time until the fluid is completely absorbed is recorded.

4.2. Maximum Absorbent Capacity Before Leakage

The maximum absorbent capacity before leakage measures how much of liquid can be held in the gusset composite of the reusable absorbent undergarment before leaking. Amount of liquid is measured by continuously adding liquid to the gusset composite of the reusable absorbent undergarment over a defined period with a defined amount until leakage is detected.

4.3. Rewet

Rewet is the fluid retention performance of the gusset composite in a reusable absorbent undergarment. The testing principle is based on determination of the rewet based on the fluid amount that is taken up by a stack of blotting paper under defined pressure. For the real user case, it's typically how much absorbed liquid gets resurfaced to the body touching side from the top wicking material of the gusset. This measures user comfortability in terms of wet or dry feeling throughout product usage.

5. MATERIALS

5.1. Fluids

5.1.1. Synthetic Blood Simulant

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.

5.1.2. Saline for Urine Simulant

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

6. APPARATUS

6.1. **Blotting Paper approx.** 300 x 400 mm size (or alternatively filter paper)

6.2. **Graduated pipet** (Volume: 5ml; precision 0.05ml)

6.3. **Stopwatch** (precision between 0.05 -0.1 s)

6.4. **Weighing scale** (accuracy 0.001 g)

6.5. **Specimen holder "halfpipe"**, radius 125 mm, preferably 3D-printed.

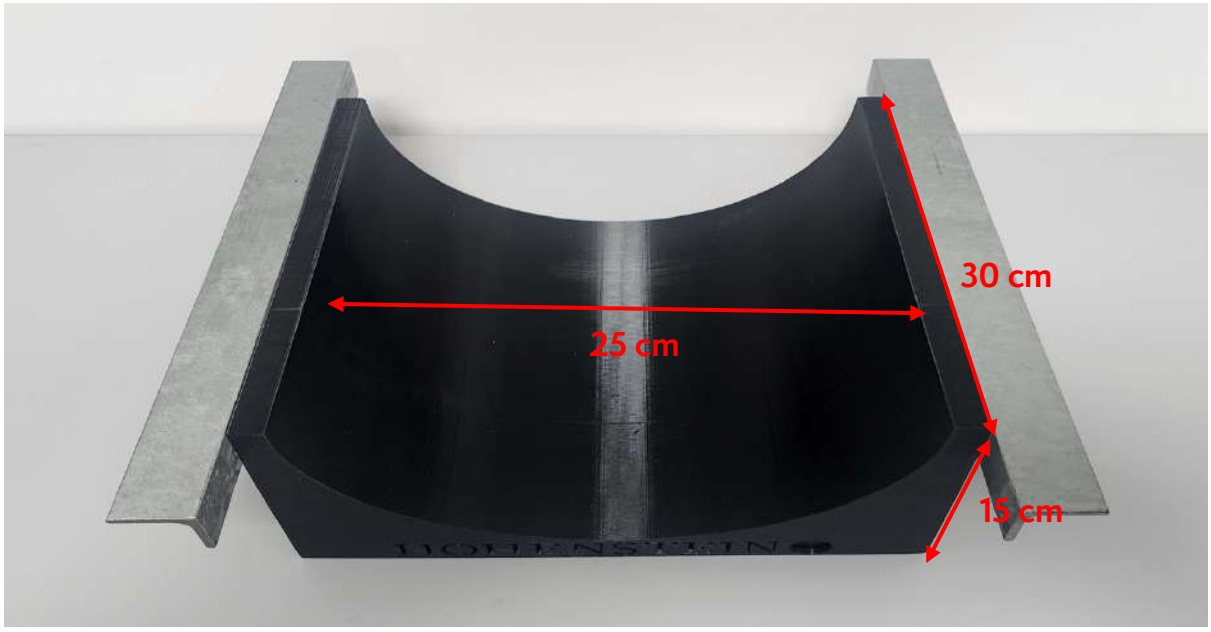


Figure 6.1: Specimen holder "halfpipe" (top view)

6.6. **Transparent stamp with a small tube**, made from acrylic tubes 200/194 mm and 20/16 mm outer/inner diameter, weight: 313 g for maximum absorbency before leakage testing.

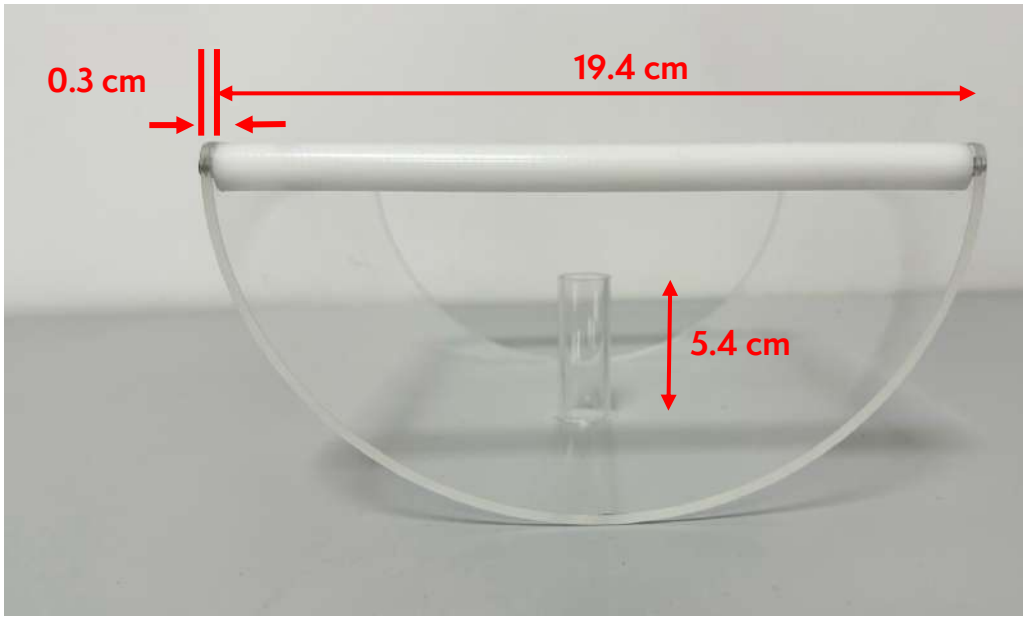


Figure 6.2: Transparent stamp with application tube (side view)

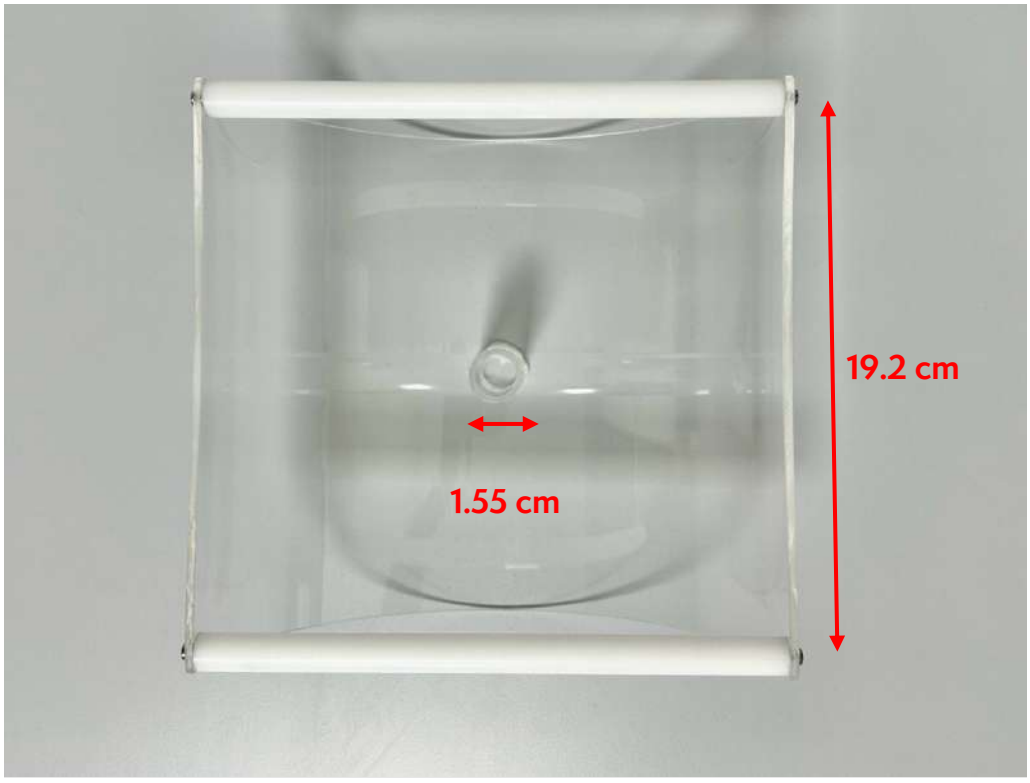


Figure 6.3: Transparent stamp with application tube (top view)

6.7. Additional weight

2 x ballast for weight adjustments

Figure 6.4: Additional ballast for weights adjustment (1000g)

Two units of ballast are used for weight-adjustment to allow the total weight of the stamp to be 1000g. Furthermore, it allows easy placement evenly on curved surfaced – i.e., on the transparent stamp the ballasts are hung on the edges of the curved surface (see figure 6).

Figure 6.5: Placements of 2 ballast on transparent stamp (top view)

On the intransparent stamp the ballasts are placed under the handle.

6.8. **Intransparent stamp without hole**, weight 1000g, preferably 3D-printed for rewet testing

Figure 6.6: Dimensions of Intransparent stamp (side view)

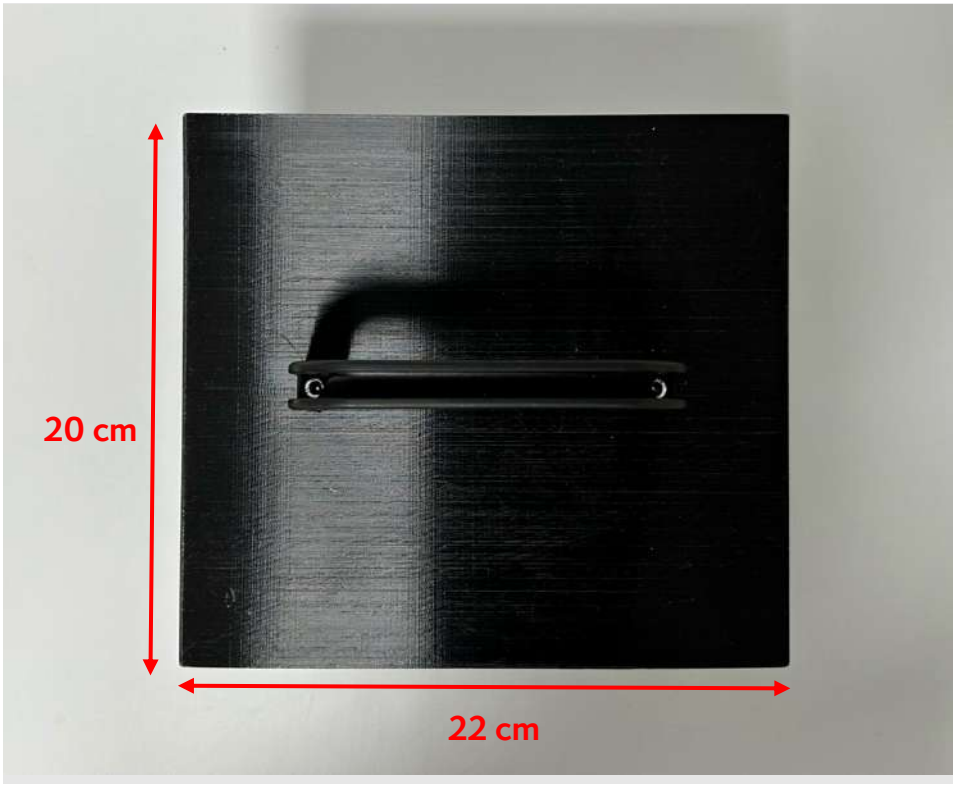


Figure 6.7: Dimensions of Intransparent stamp (top view)

7. TEST PROCEDURE

The following test procedures can be conducted with both synthetic blood simulant (5.1.1) as well as saline solution (5.1.2).

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) Cut open the garment on two side waists (left-side seam and right-side seam) so that the garment can lay properly on the curved bottom surface. The cut-open reusable absorbent undergarment with the gusset composite in the middle is the test specimen for all following test procedures.

(c) To ensure the garment testing surface is free of any contaminants, spray distilled water on to the garment test surface and clear / wipe away any visible foreign contaminants as deemed necessary specially after wash.

(d) If the test specimen is cleaned with water vapour, a wet wipe or any other form of water vapour or liquid prior to testing to remove solid residues from the testing area, it must be ensured that the test specimen is completely dry before the testing starts. Therefore, the test specimen shall be reconditioned / dried overnight or at least 8 hours under standard climate 20°C / 65 rh.

Figure 6.8: Test setup with female reusable absorbent undergarment.

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

Test for wicking time is part of the absorbency test. Wicking time is tested under the same conditions as absorbency and rewet and therefore more real life related.

Wicking time test method:

(a) Place (new/dry) test specimen into the specimen holder (6.5).

(b) Place transparent stamp (6.6) on top of the test specimen and add additional weight (6.7) so that the total mass of the transparent stamp is 1 kg. (place small dosing tube of the transparent stamp on the average mid-point of the gusset and narrowest part of the test specimen).

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

(d) Record the time elapsed until the test fluid is completely absorbed and soaked up by the test specimen.
NOTE: If the process takes more than 5 min, stop the test & record the time as 300s+

(e) Repeat the testing with 2 more specimen to obtain triple replicate readings.

7.3. Maximum Absorbent Capacity Before Leakage

The test is performed right after recording the wicking speed using the already wet test specimen.

(a) Take 1 layer of blotting paper (6.1) and note down its weight (+/- 0.01 g).

(b) Place the blotting paper in specimen holder (6.5).

(c) Place (new/dry) test specimen on top of the blotting paper and make sure that on both sides of the gusset is placed on top of the blotting paper to detect leakage.

(d) Place transparent stamp (6.6) on top of the test specimen and add additional weight (6.7) so that the total mass of the transparent stamp is 1 kg. (place small dosing tube of the transparent stamp on the average mid-point of the gusset and narrowest part of the test specimen).

(e) Add 1.5 ml of test fluid within ten seconds with a pipette into the small tube of the transparent stamp.

(f) Allow the fluid to settle by waiting for 5 min.

(g) Lift the transparent stamp for 5 seconds, completely off the test specimen, and then place it back again.

(h) If the garment exceeds 15ml of absorbed fluid, add increment of 3ml of fluid per 5min interval until the following observation listed in (i).

(i) Repeat e) f) g) until the blotting paper shows wet, around the gusset composite area, especially next to at least one of the side edges of the gusset.

(j) Note down the amount of fluid added prior to observing leakage around the gusset, without considering the last released amount of fluid, as per the step (e) or (h), that resulted in leakage.

(k) Continue with the rewet testing (7.3) right after detecting leakage and leave the test specimen as it is in the specimen holder.

(l) Repeat the testing with 2 more specimen to obtain triple replicate readings.

7.4. Rewet

Rewet Testing should be performed right after recording the maximum absorption capacity before leakage (7.2) using the already wet test specimen. This measures the rewet of the garment at the point of leakage, this can typically be considered as the worst-case scenario for the user.

However, the same test can be conducted to test the rewet at different intervals. For example, once you identify the maximum absorption capacity in ml, the same test can be conducted using only 25%, 50%, 75% of that maximum absorption capacity amount in ml to test the rewet at different intervals before leakage.

Rewet test method at the point of leakage:

(a) Take 4 layers of blotting paper and note down its weight (+/- 0.01 g).

(b) Place the 4 layers of blotting paper onto the wet test specimen from procedure 7.2. (c) Place intransparent stamp (6.8) on top of the wet test specimen and add additional weight (6.7) so that the total mass of the intransparent stamp is 1 kg.

(c) Wait for 5 minutes.

(d) Weigh blotting paper underneath the test specimen(Δ1) (from procedure 7.2)

(e) Weigh 4-layered blotting paper stack after placing it on top of the wet test specimen(Δ2) (g) Repeat the testing with 2 more specimen to obtain triple replicate readings.

Rewet test method at different intervals before the final leakage point (25%, 50%, 75% etc.)

25%:

- Maximum absorbent capacity before leakage (ml) /4) =Y
- Repeat 7.2 until garment absorb Y ml fluid.
- Repeat 7.3 rewet test.
- Repeat the testing with 2 more specimen to obtain triple replicate readings.

50% and 75% should be conducted same as 25% considering.

- 50% as (Maximum absorbent capacity before leakage (ml) /2) =Y
- 75% as (Maximum absorbent capacity before leakage (ml) / (3/4)) =Y

7.5. Testing Codes

Use following codes in the Test Request Form.

Code	Test
FEMTECHMAS-6513-1:2023-7.2	Wicking time per ml
FEMTECHMAS-6513-1:2023-7.3	Maximum Absorption Capacity Before Leakage
FEMTECHMAS-6513-1:2023-7.4	Rewet

8. CALCULATION & EXPRESSION OF RESULTS

8.1. Wicking time per ml (s/1.5ml)

Wicking time is defined as the time taken to wick 1.5ml of fluid into the gusset composite of the undergarment, with 't' being the average value of the elapsed time in seconds.

Specimen	Specimen 01	Specimen 02	Specimen 03
Time (s)			
Average time (s)			

8.2. Maximum Absorption Capacity Before Leakage

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

Specimen	Absorbed Volume (mL)
Specimen 01	
Specimen 02	
Specimen 03	
Average	
Standard Deviation	

8.3. Rewet

The result is the sum of test fluid rewet weight of the 2 blotting papers (Δ1, Δ2).

$m = \Delta 1 + \Delta 2$

The fluid rewet is determined as follows:

$\Delta 1 = m_{wet1} - m_{dry1}$

$\Delta 2 = m_{wet2} - m_{dry2}$

with Δ1 being the 1 layer of blotting paper under the test specimen and Δ2 being the average value of the 4-layered blotting paper stack on top of the test specimen (7.3) The rewet in % (percent) is determined as follows:

$$\% \text{ Rewet} = \frac{m}{\text{Total amount of added fluid}} \times 100$$

Specimen	Bottom Blotting paper			Top Blotting paper			Total Rewet Weight (g)	Added Total Volume of Fluid (mL)	Rewet Percentage (%)
	Dry weight (g)	Wet weight (g)	Rewet weight (g)	Dry weight (g)	Wet weight (g)	Rewet weight (g)			
Specimen 01									
Specimen 02									
Specimen 03									
Average									
Std Deviation									

8.4. Additional records in test report

When recoding results in 7.2, measure & record the following in the test report:

a) Leakage points on the gusset.
b) Dimensions of the gusset (measure length between the widest points in the longer side & the width between the narrowest point in the shorter side).

Identifying the fluid dispersion point:

- Identify the region of the gusset which sits right underneath the vaginal opening.
- Now locate the mid-point of that identified region of the gusset.
- The identified mid-point is considered as the fluid dispersion point in female pads & underwear.

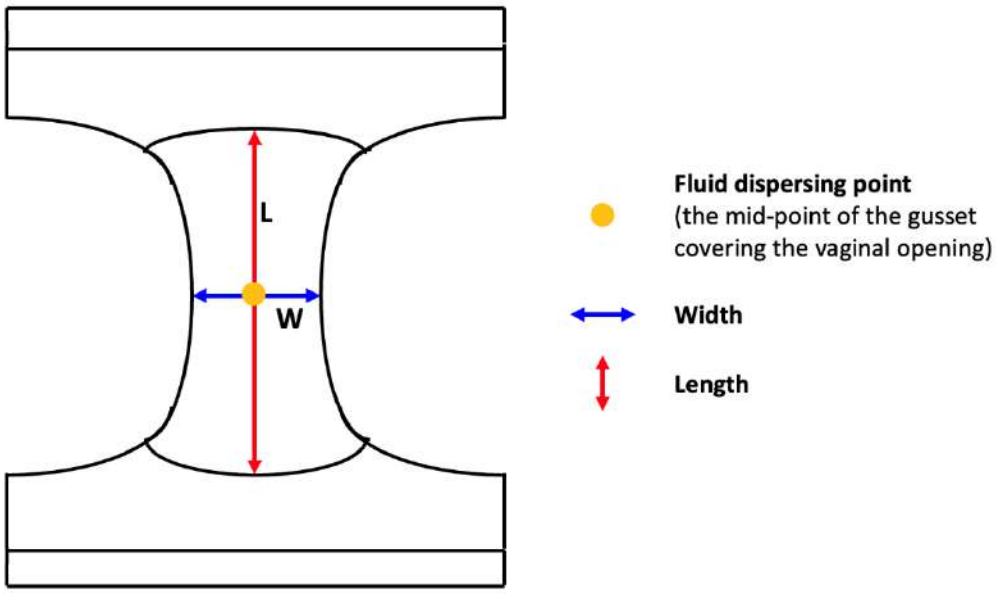


Figure 7.4.1: Identifying the fluid dispersing point in female reusable absorbent underwear.

9. BIBLIOGRAPHY

- ISO 139, Textiles — Standard atmospheres for conditioning and testing
- AATCC 150-2018 — Dimensional Changes of Garments after Home Laundering
- ISO 6330:2021 -Textiles — Domestic washing and drying procedures for textile testing.
- Test method No. 12/2015 MDS-Hi (German Healthcare Medical Service)

10. REFERENCES

1. 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].

2. 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].

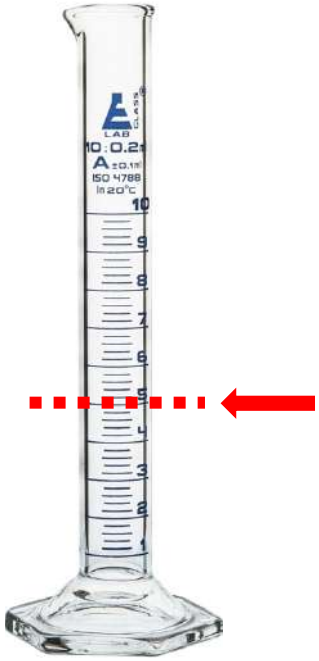
ANNEX A: INFORMATIVE

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.

ANNEX B: DIMENSIONS OF THE TEST APPARATUS

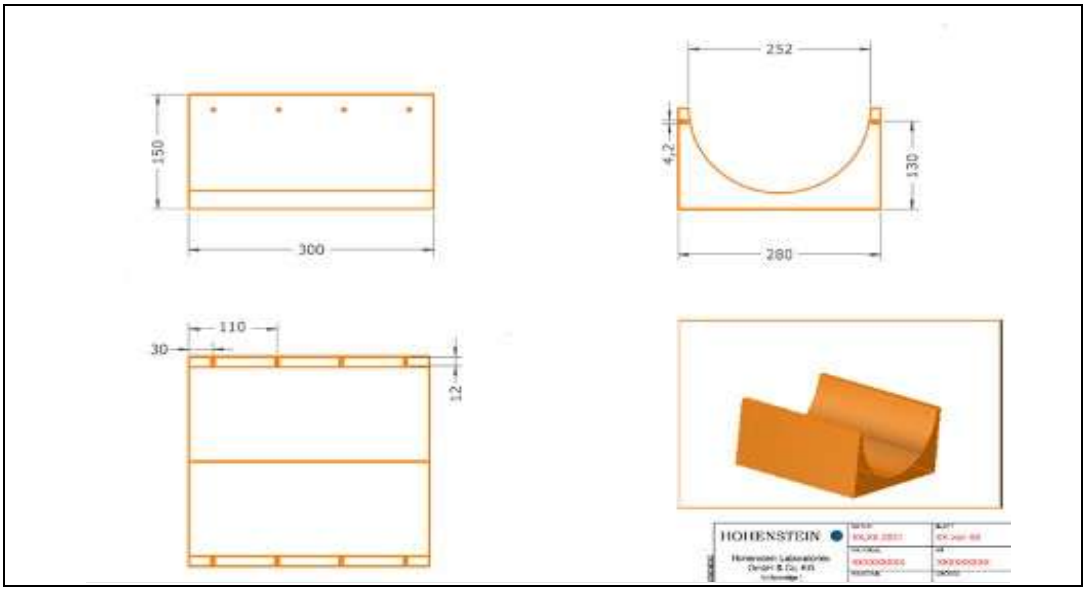


Figure B1: Dimensions of specimen holder.

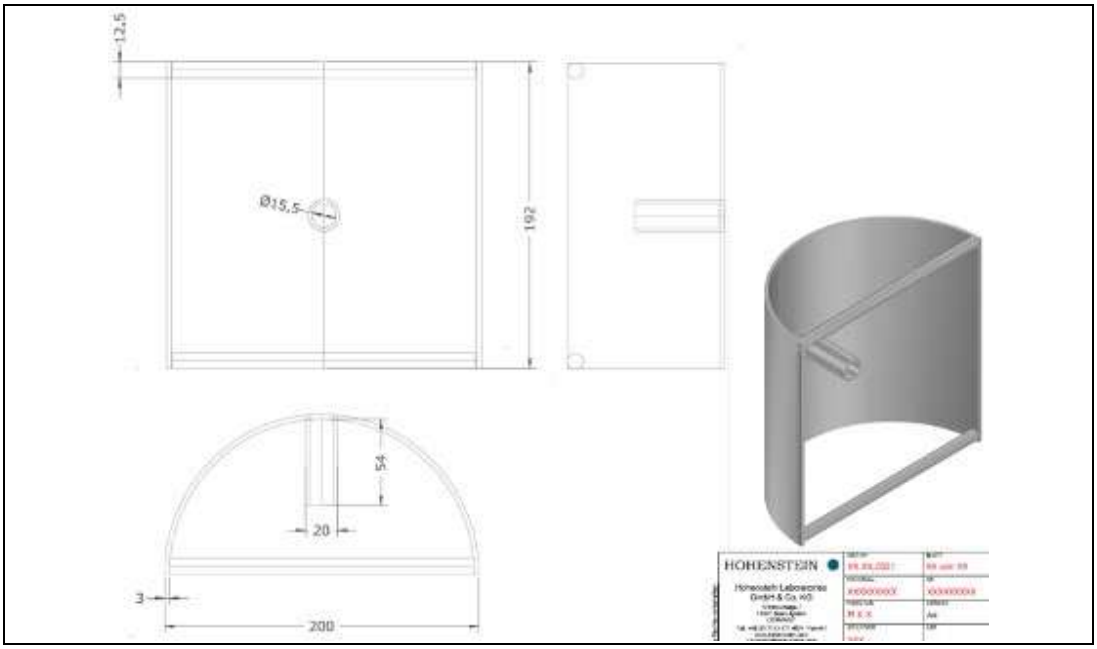


Figure B2: Dimensions of transparent stamp with application tube.

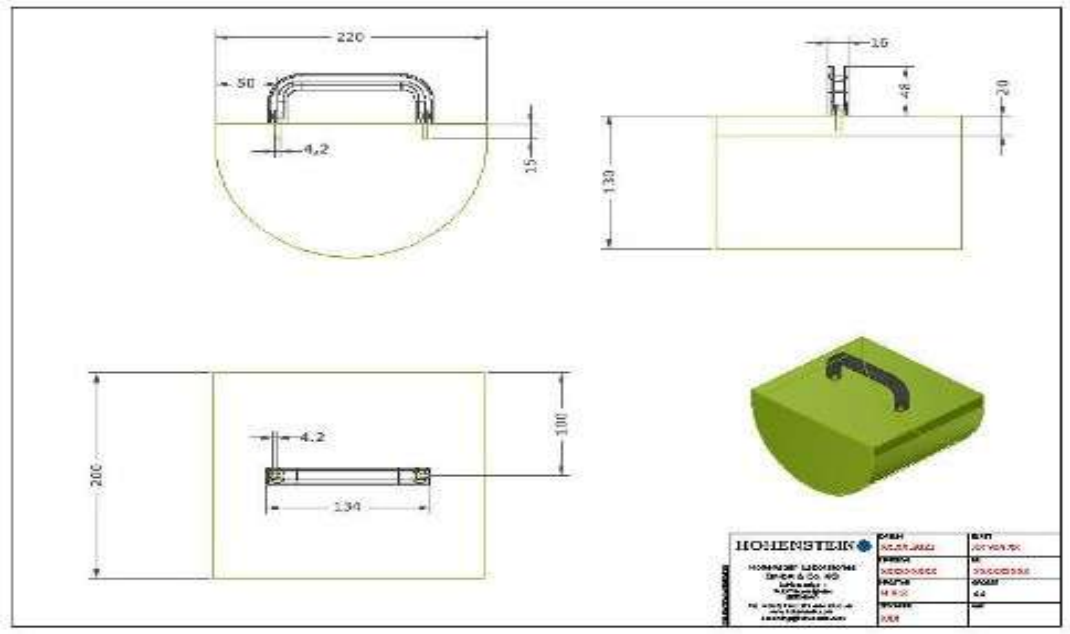


Figure B3: Dimensions of Intransparent stamp.

ABOUT US

Femography by MAS is a pioneer in innovative apparel solutions addressing female health. Our purpose is to bring normalcy to women's lives from menarche to menopause, and everything in between, supporting them through the ups & downs of womanhood. The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our processes.

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