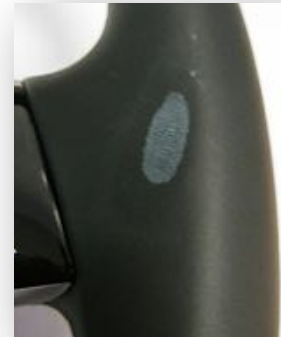
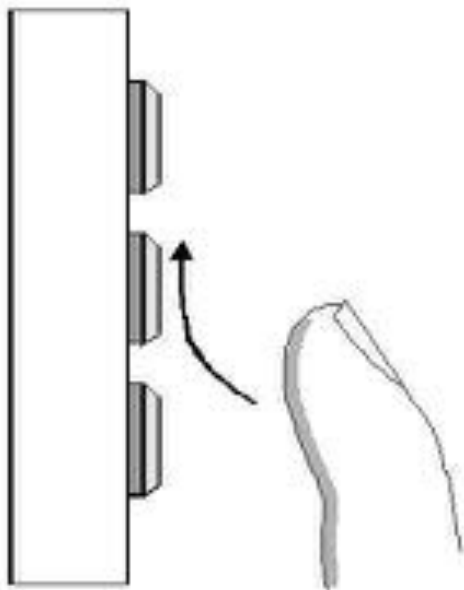


Soft-chemo-mechanical Fingertip & Hand Wear

Merging Technology of Human Physiology & Engineering



Human physiology-Based Mechanism of Soft-chemo-mechanical Fingertip & Hand Wear

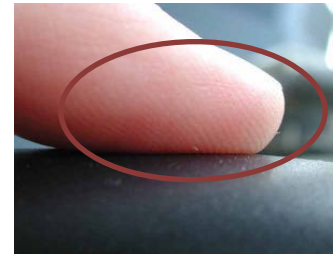
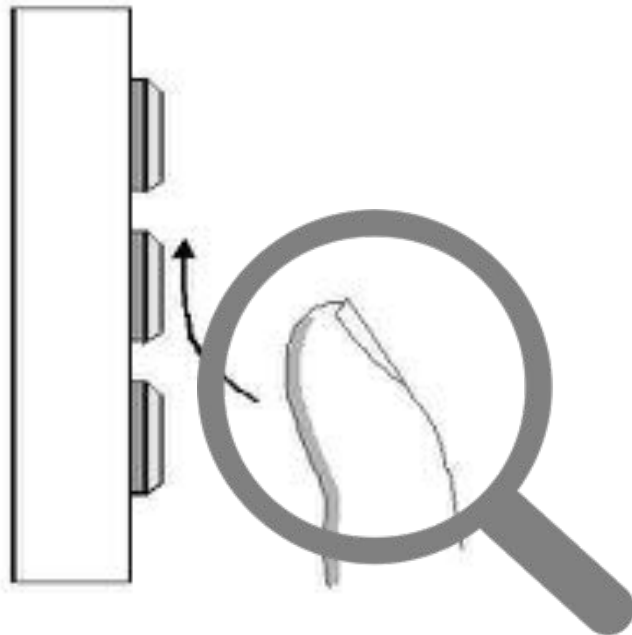


- 1) Property of fingertip
- 2) Skin layers
- 3) Skin chemistry
- 4) 2-Step combined movement: impact and friction
- 5) Impact
- 6) Friction

Human physiology-Based Mechanism of Soft-chemo-mechanical Fingertip & Hand Wear

1) Property of fingertip

- Round shape with curvature
- Viscoelastic and soft
- limited size



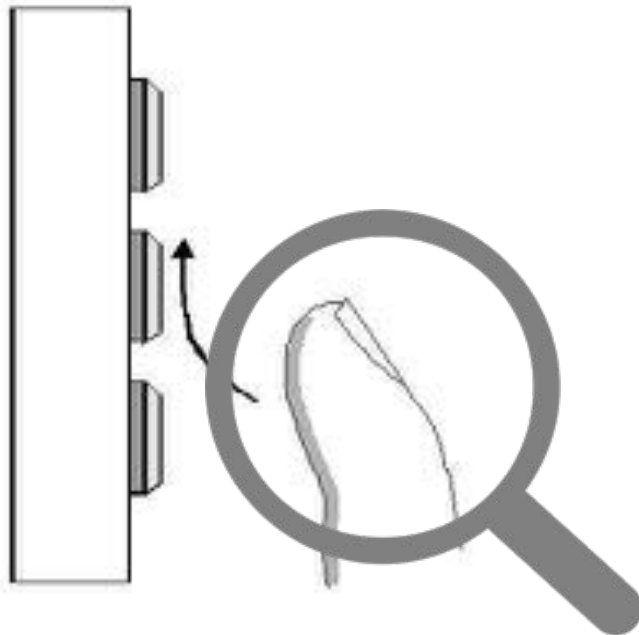
not



Leads to:

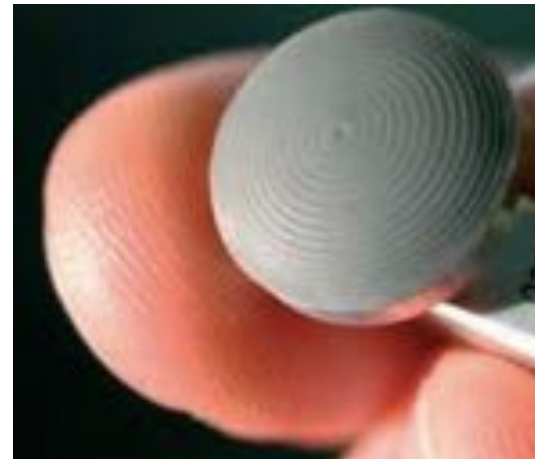
- Relaxation or creep phenomena
- Limited surface contact area

Human physiology-Based Mechanism of Soft-chemo-mechanical Fingertip & Hand Wear



2) Outer skin layer

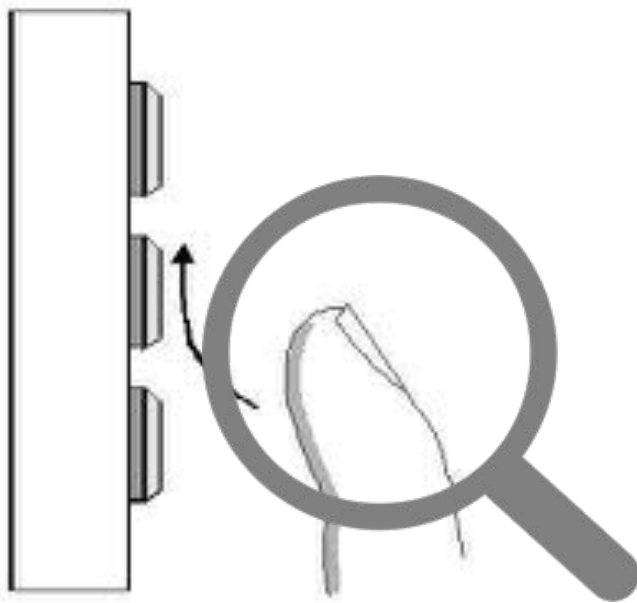
- Rough structure
- Peeled off skin fine particles
→ leads to three-body abrasion



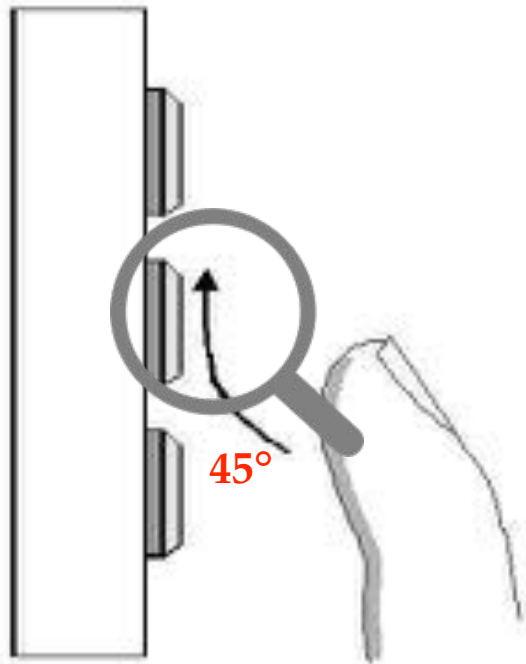
Human physiology-Based Mechanism of Soft-chemo-mechanical Fingertip & Hand Wear

3) Chemistry of the skin

- Natural products (sweat, fat)
- Artificial applied products (hand cream, sun cream, dirt, grease)



Human physiology-Based Mechanism of Soft-chemo-mechanical Fingertip & Hand Wear

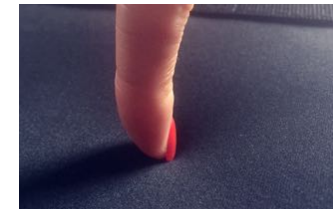


4) 2-Step combined impact-friction movement

- 45° angle: instead of 90° because human being feels hurt with “90° touch”



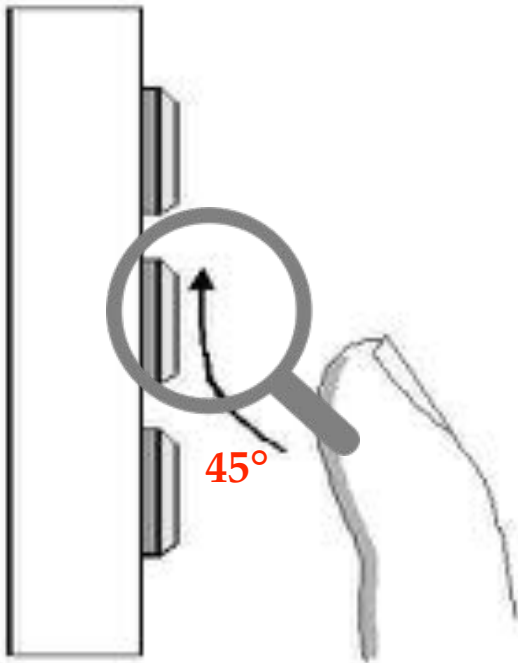
45° not 90°



- Contact force of 3.7N in average: human being will feel pain with higher force
- Dynamic speed with 6 cm/s in average: higher speed will generate heat which human being feels burned!

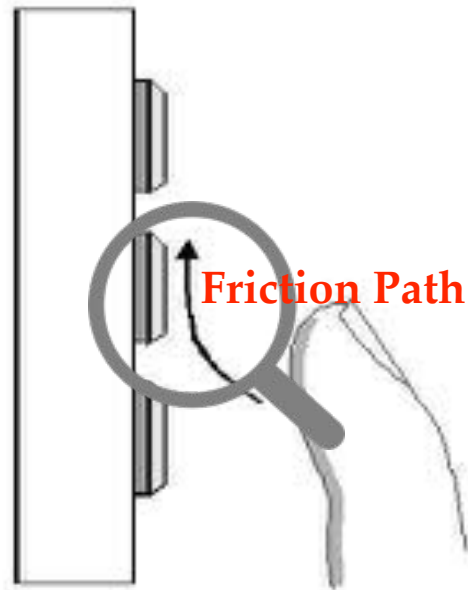
Human physiology-Based Mechanism of Soft-chemo-mechanical Fingertip & Hand Wear

5) First-step: impact



- The impact of the fingertip will create a signal back to the brain informing the human being that the fingertip has in touch with a product. It stays on the contact surface for min. 0.2s due to relaxation or creep phenomena (tactile response time to the brain)
- The special touch by the fingertip: creates dynamic force instead of static force due to viscoelastic feature of the fingertip:
 - leads to a high surface contact pressure due to limited viscoelastic contact surface area
 - causing surface deterioration, especially for polymers/composites/coatings
 - penetration of the liquids (e.g. sweat, cream) into the surface materials/coatings

Human physiology-Based Mechanism of Soft-chemo-mechanical Fingertip & Hand Wear



6) 2nd-Step: friction

- Friction is always followed after the impact
- Friction is a sliding motion within which slipping does not happen
- Transition from static to dynamic friction due to the viscoelastic feature of fingertip
- 3-body friction: surface + liquid + fingertip

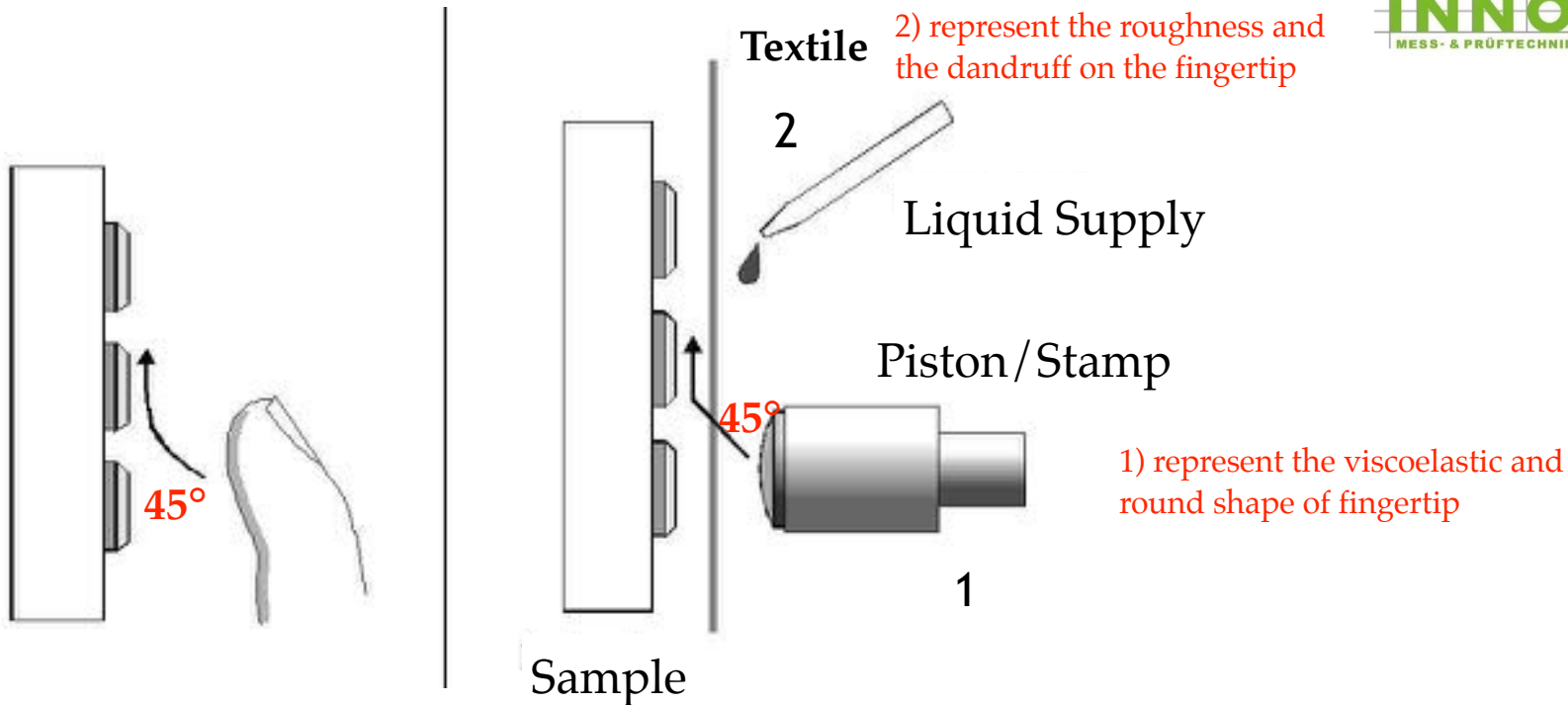
Conclusion:

a Complicated Human
Physiological Movement

Questions:

- Does any conventional abrasion test involve any of those features? **No!**
- Does any conventional abrasion test involve 2-step movement? **No!**

Translation of Human Touch into a Simulation Machine

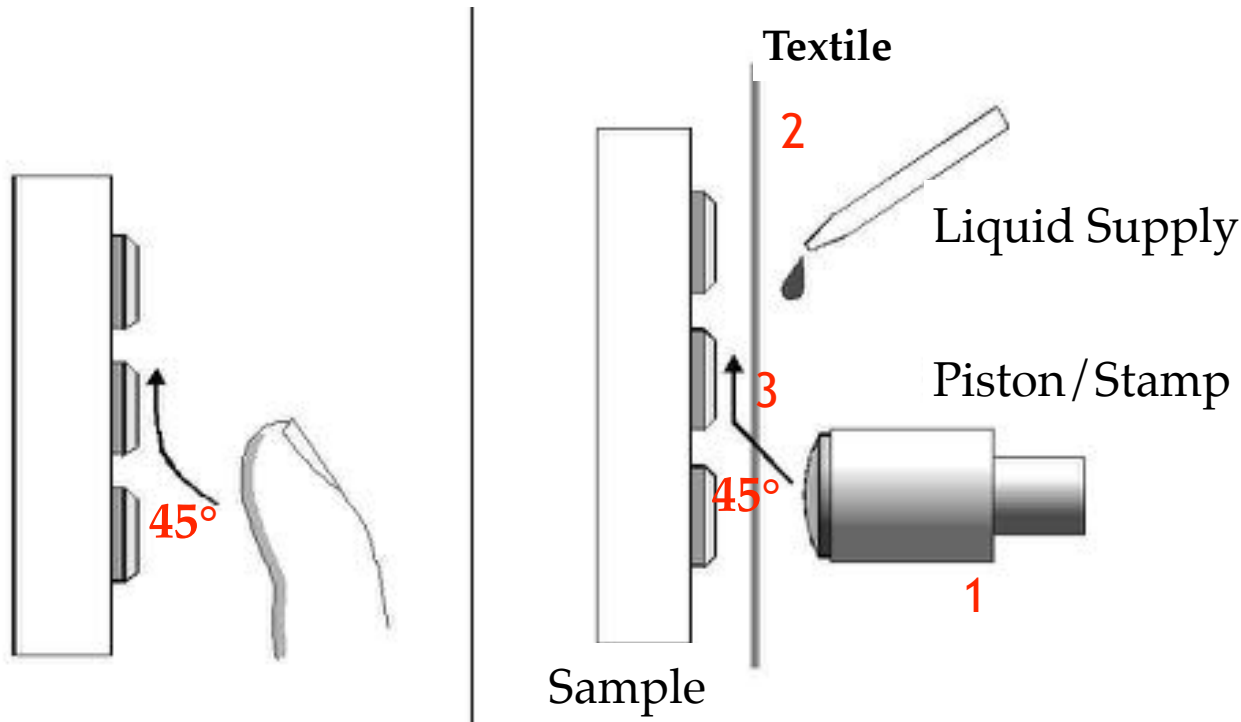


1) Piston/Stamp

- Viscoelastic silicon
- Round form

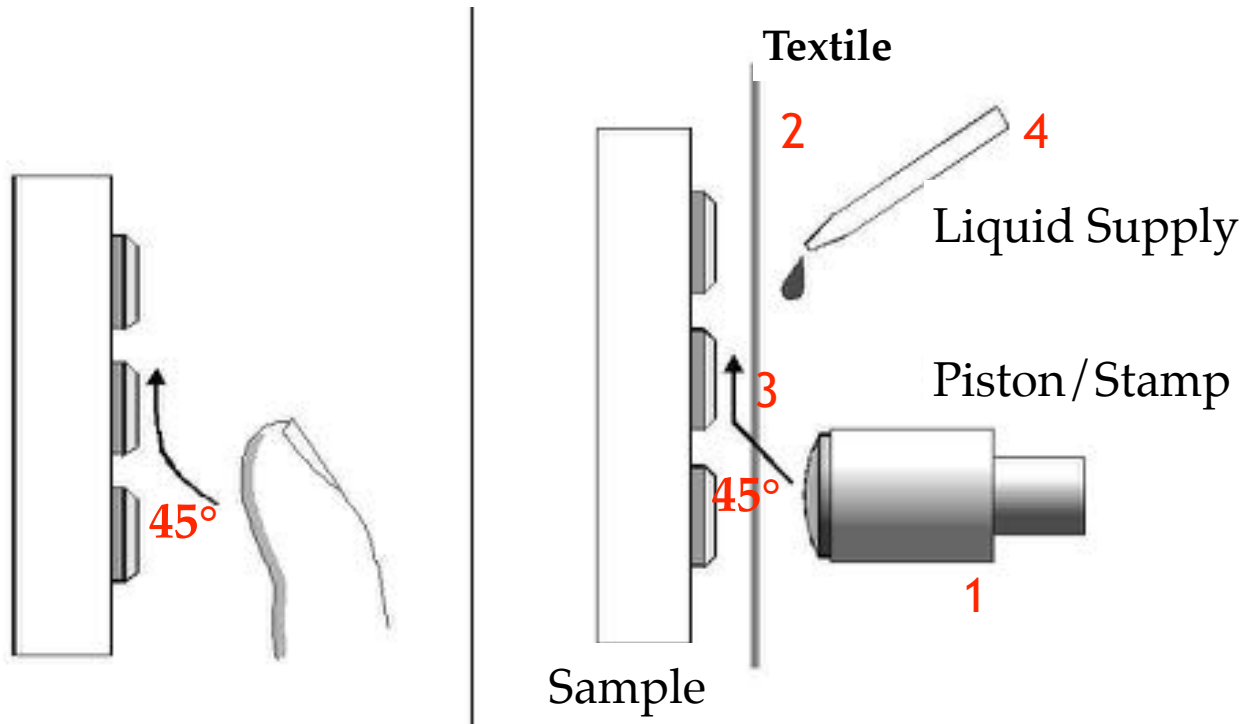
2) Textile

- Rough Structure: Wool with fat included
- Dandruff supplier
- liquid carrier



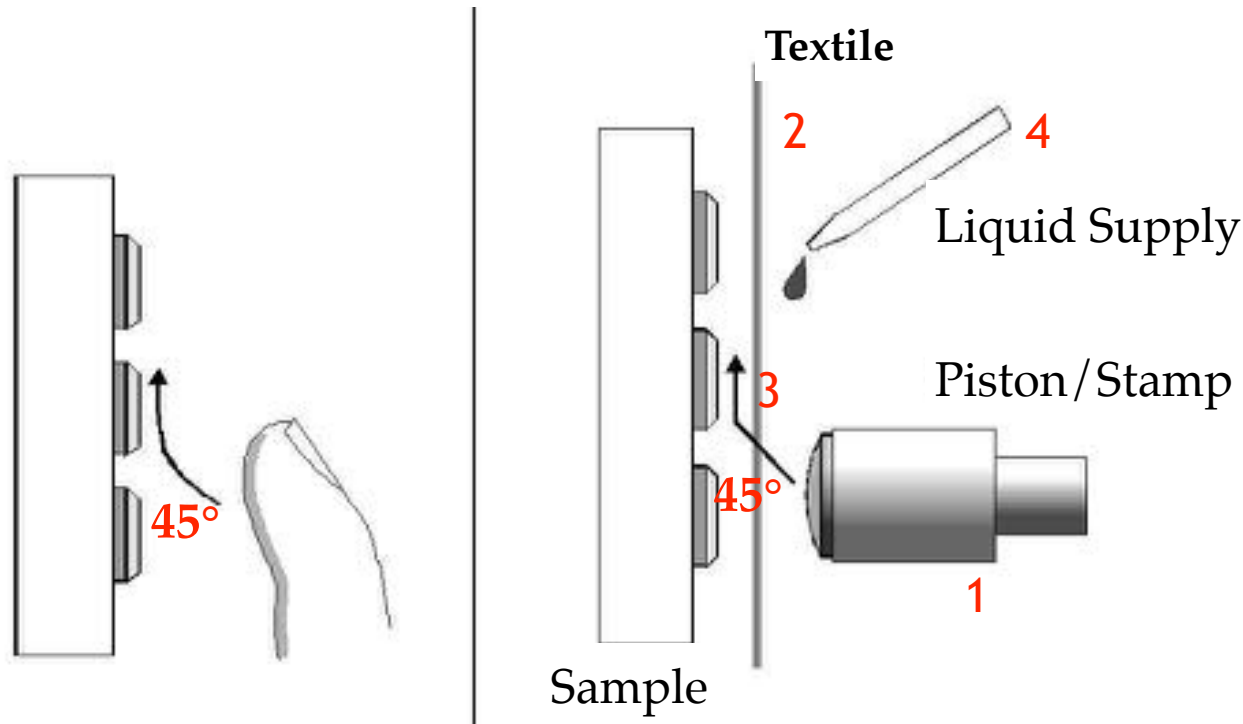
3) 2-Step Movement:

- 45° impact on the surface
- Generating a compressive force/ viscoelastic impact
- Defined load and speed
- Piston is retracted to the initial position



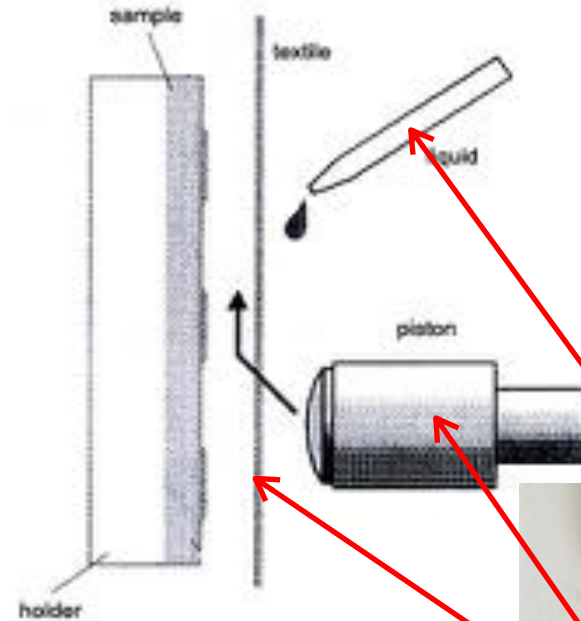
4) Chemistry Environment:

- artificial sweat, toothpaste, detergent, various lotions.....



The combination of all factors will simulate the real human touch and lead to the damage pattern!

ABREX®: Simulation Machine for Human Fingertip & Hand Wear



ABREX®: Simulation Machine for Human Fingertip & Hand Wear

- DIN EN 60068-2-70 / IEC 68-2-70 / JIS C 60068-2-70
- BMW GS 97034 / GS 97045
- DBL 7384 (Daimler)
- WSS-M2P188-A (Ford)
- ...



Examples of Soft-chemo-mechanical Fingertip & Hand Wear

Used by Design group / Quality assurance group / R&D on the finished parts or lab samples



Examples of Soft-chemo-mechanical Fingertip & Hand Wear

ATM Machine



Virgin
Condition:

After:

Remote Control



Examples of Soft-chemo-mechanical Fingertip & Hand Wear

Banknote

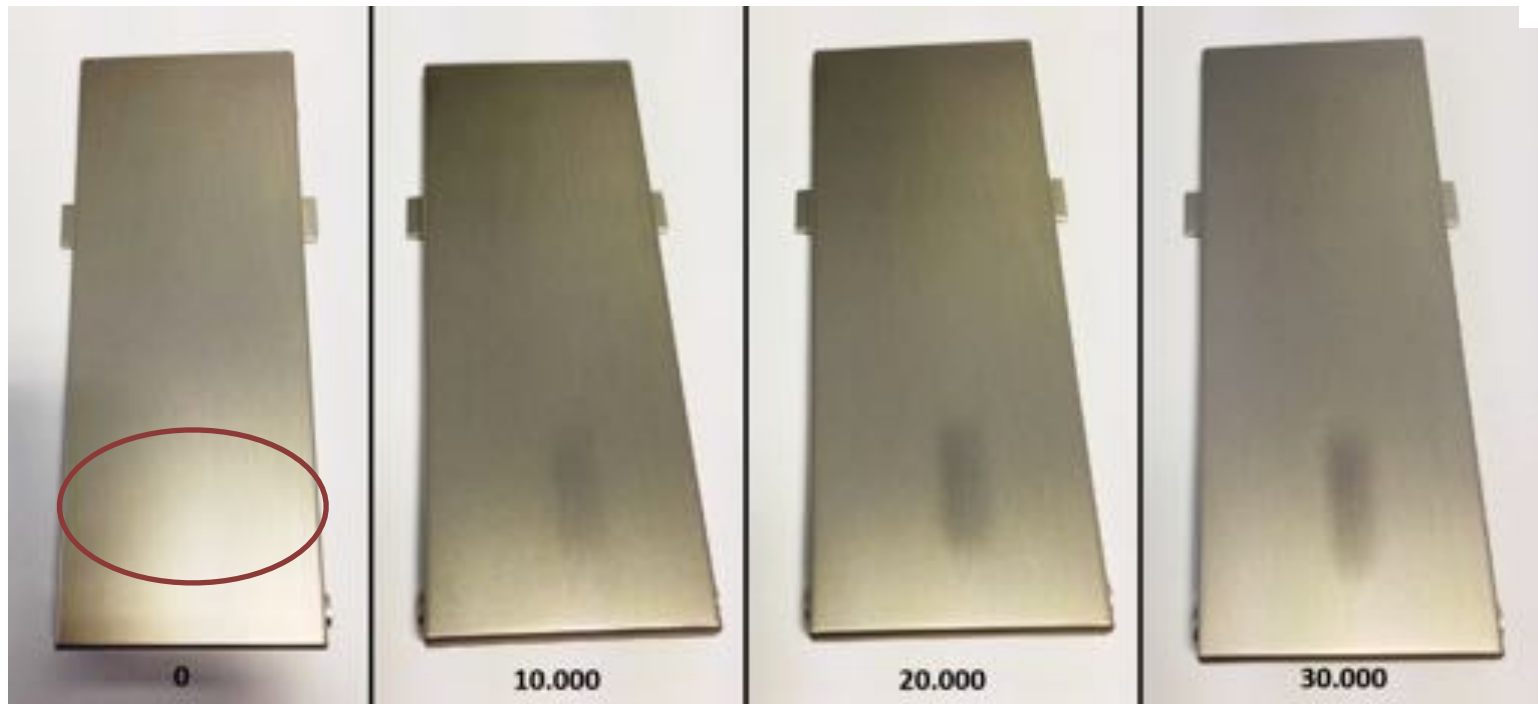
Dry ABREX®
abrasion



Wet ABREX®
abrasion



Machine component



Leather Steering Wheel

- Damage after 30,000 cycles
- Humidification with artificial sweat

