

IEC 60456 Test Materials: Detergent / Test Loads

By Dr. Tom Hilgers, wfk Test Materials (*wfk Testgewebe GmbH*)

▶ Presentation - Structure

- Why use *Standard Detergent* and *Standard Loads*?
 - Test design and general requirements
 - Detergent issues
 - Load issues
- Specification of Detergent and Load Items
- Control systems to assure quality of Standard Detergent(s) and Standard Load Items

Why use

Standard Detergent and Standard Loads?

▶ Key Requirements for Test Design

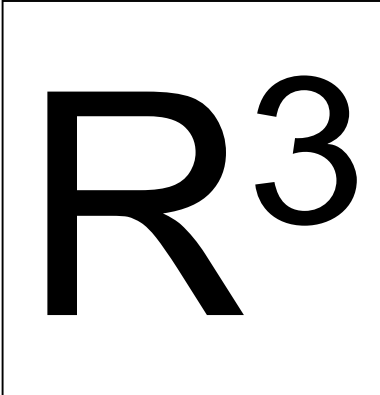
The Test shall

- ▶ be fast
- ▶ be cheap
- ▶ tell me how good the tested products are
- ▶ be repeatable
- ▶ be reproducible

▶ Key Requirements for Test Design

The Test**RESULTS** shall be the “**3 R**”:

- ▶ Repeatable
- ▶ Reproducible
- ▶ Relevant



R³

▶ Standard Test Materials

- Standard Test Materials are part of the test design.
- Characteristics are specified with requirements and tolerances.
- Most specifications set fixed values for material properties that may vary significantly in reality.
- Other specifications address specific issues related to the test design.

▶ Test Design – Test Materials

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So what does it need?



▶ Test Design – Test Materials

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So what does it need?

Test Detergent
High Antifoam!



Test Loads
Quality
Composition
Age



✓ **Test Stains**
Specifications
presented by
Felix Frey



Soil Ballast ✗
not used
(too complex)



Detergent issues



Detergent



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Consumers use market detergents,
shouldn't we do the same for testing?





Detergent



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You could think about going to your
supermarket...

Carrefour



Tops
fluid



COSTCO
WHOLESALE



Detergent



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... and choose from the products you'll find there

Carrefour



Tops



COSTCO
WHOLESALE





Detergent

... and choose from the products you'll find there

Carrefour



Tops



COSTCO
WHOLESALE



But is that the best thing to do?



Market detergent – Pros/Cons

- ☺ Market detergents are very consumer relevant.
- ☹ Market detergents are being constantly improved and therefore modified.
- ☹ Same brands may differ between regions, even within countries.





Market detergent – Pros/Cons

😊 Market detergents are very consumer relevant.

Are they really?

We tried it...





Market detergent – Pros/Cons



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- We ran performance tests acc. to IEC 60456.
- We used the a market detergent (reco dosage) compared to Standard Detergent IEC-A*.

This is what we observed...





Market detergent – Pros/Cons



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After 30 minutes





Market detergent – Pros/Cons



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After 40 minutes





Market detergent – Pros/Cons



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After 45 minutes





Market detergent – Pros/Cons



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After 50 minutes





Market detergent – Pros/Cons



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1st Rinsing !!!





Market detergent – Pros/Cons



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1st Rinsing !!!

Is that consumer relevant performance?





Market detergent – Pros/Cons



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We then looked at the cycle data...



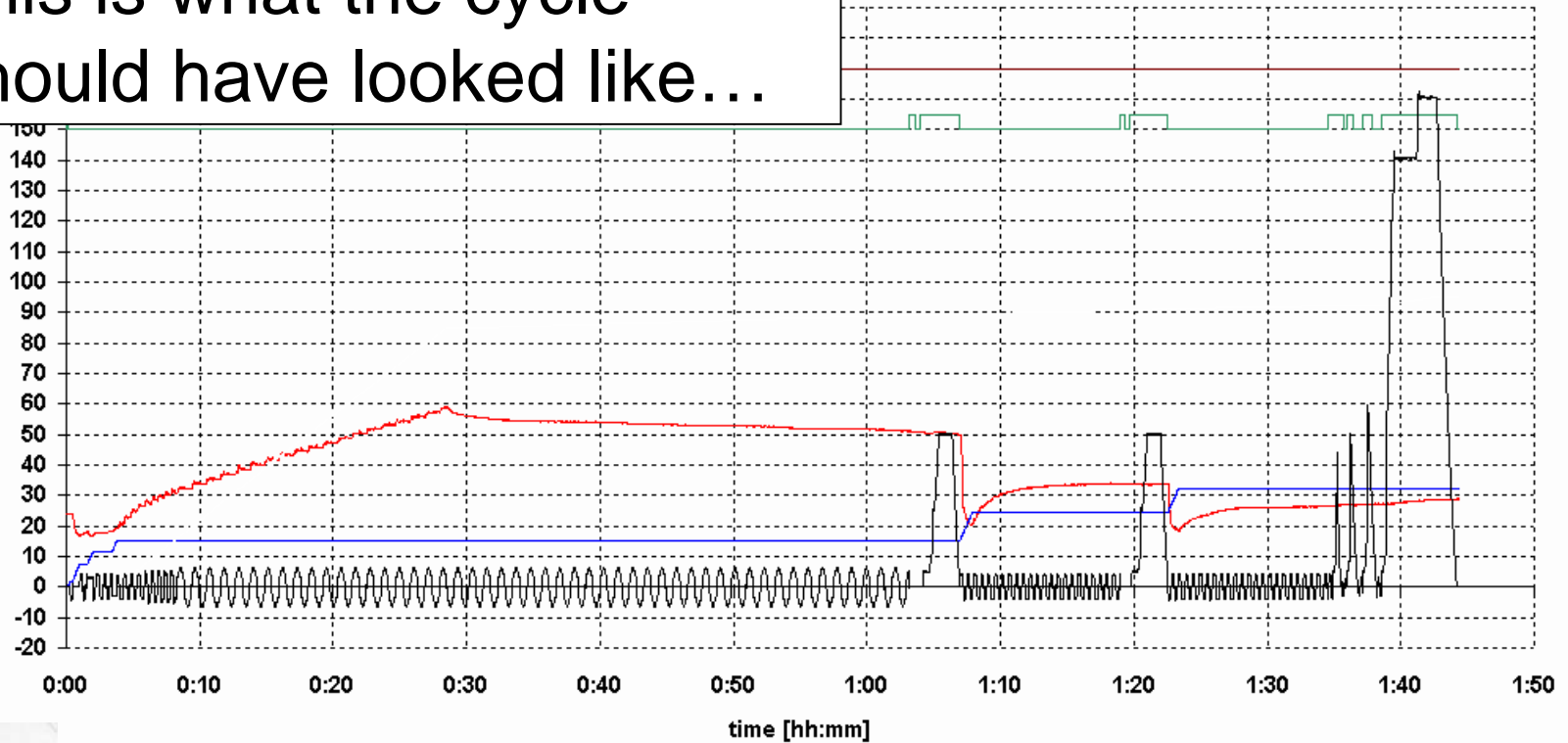


Market detergent – Pros/Cons



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This is what the cycle should have looked like...



— temperature [°C]
 — water inlet [l]
 energy [10⁴Wh]
 — pump(on/off)
 — heating (on/off)
 — drum speed [10⁴rpm]



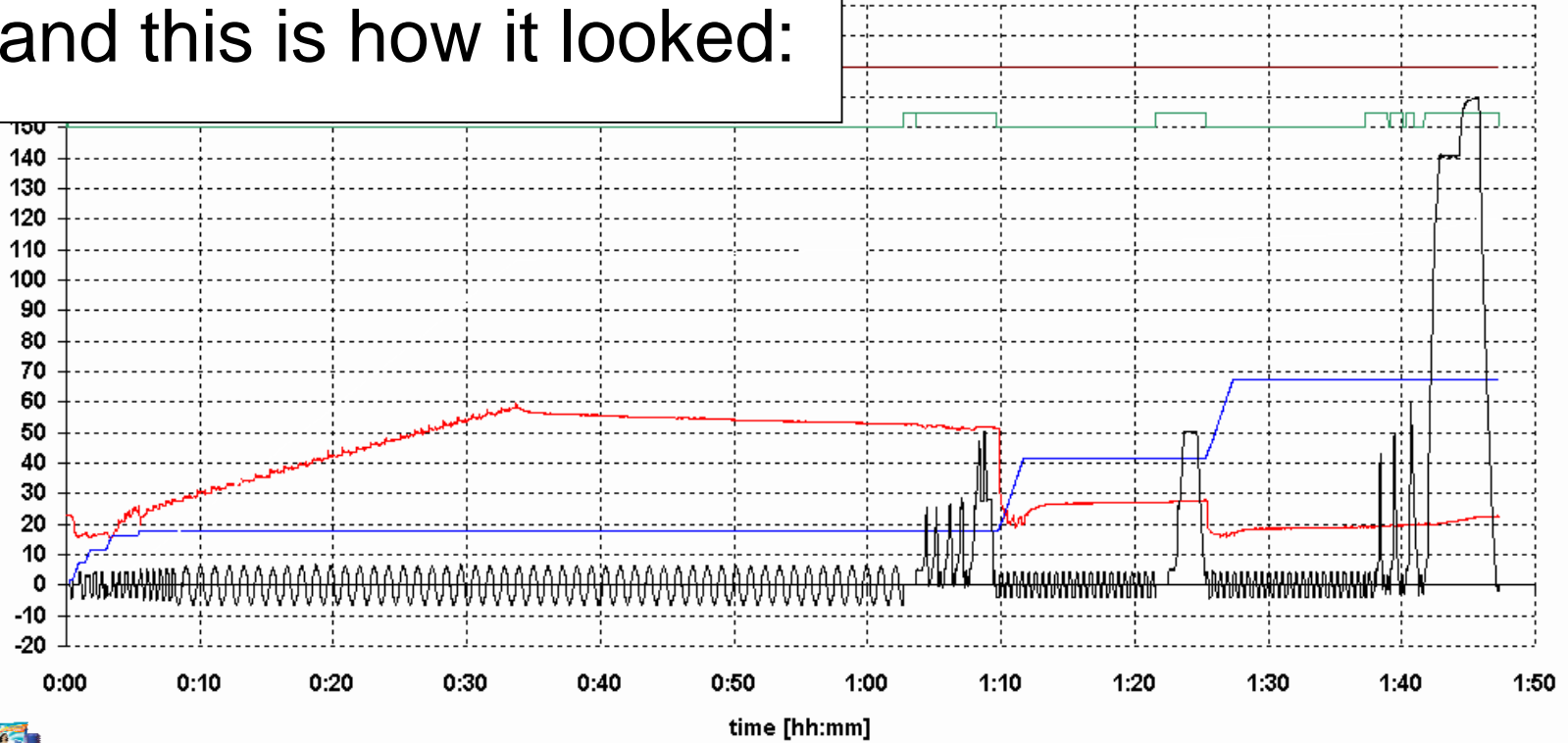


Market detergent – Pros/Cons



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... and this is how it looked:



— temperature [°C] — water inlet [l] — energy [10*Wh] — pump(on/off) — heating (on/off) — drum speed [10*rpm]



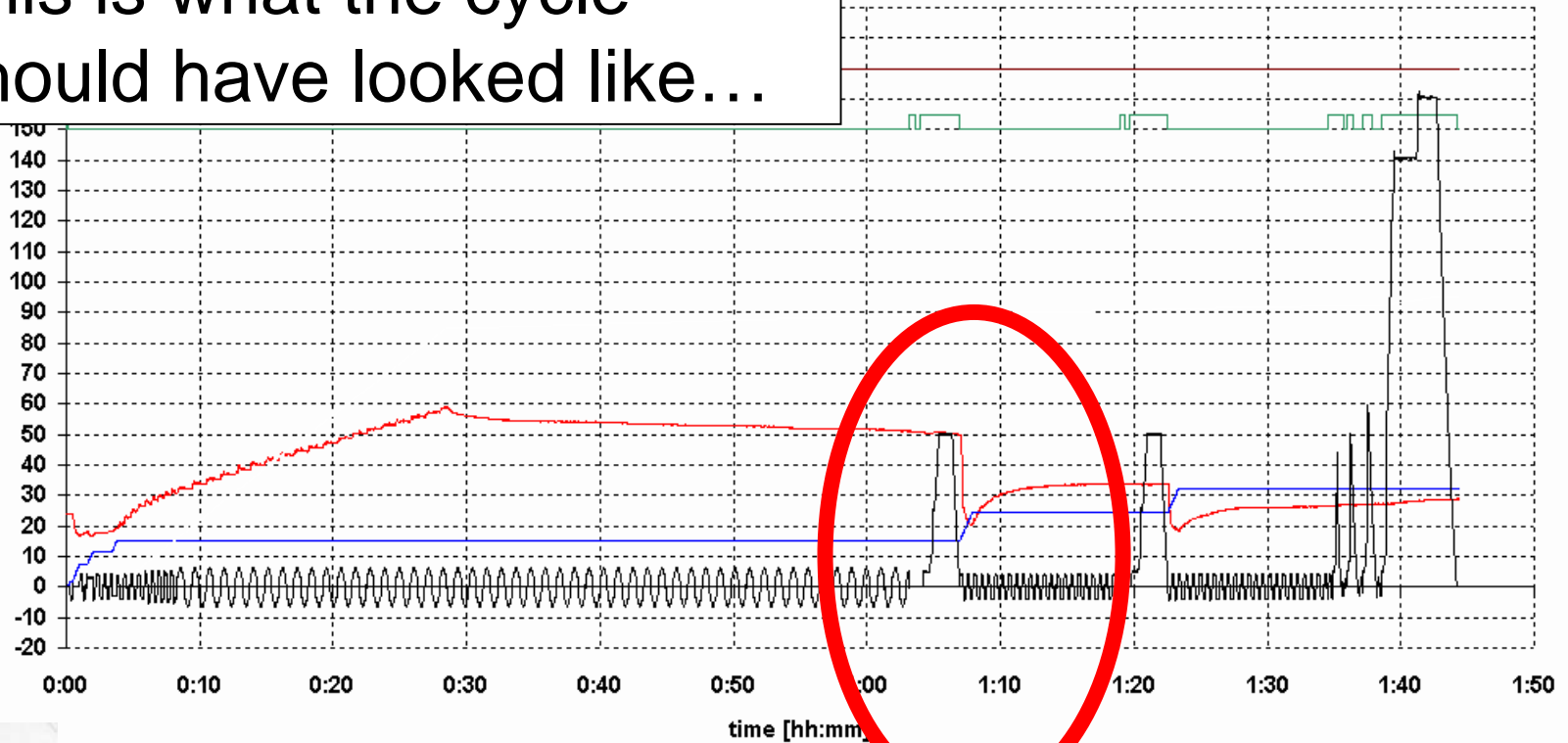


Market detergent – Pros/Cons



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wfk Test Materials

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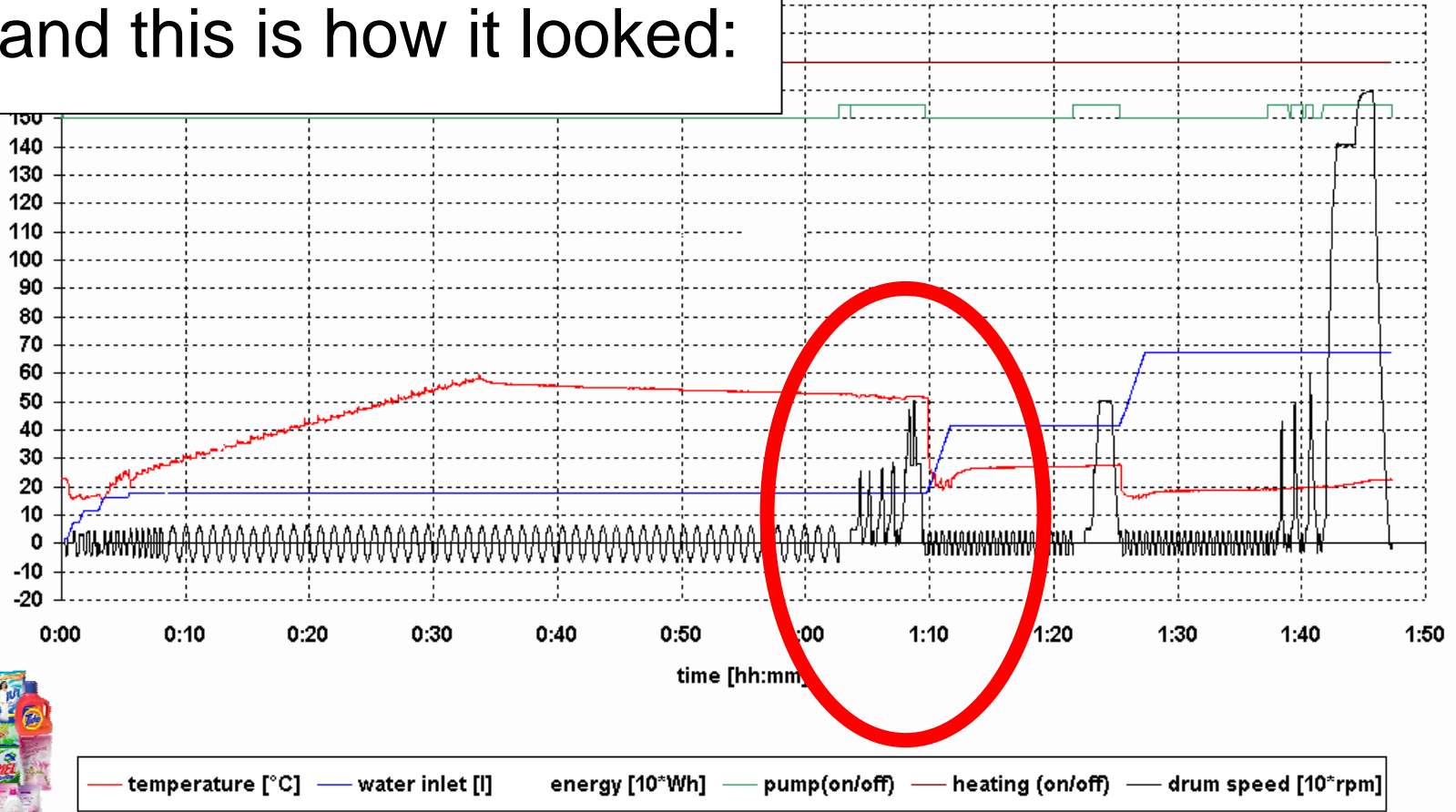


Market detergent – Pros/Cons



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... and this is how it looked:





Market detergent – Pros/Cons



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Conclusion:

- Under machine testing conditions, the market detergent showed unrealistically high foam level.
- The foaming market detergent had apparently changed the cycle in a way that would never happen with consumers.



Not very consumer relevant...





Market detergent – Pros/Cons



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Conclusion:

- The IEC Standard Detergent is manufactured and controlled to assure constant product performance, anywhere and anytime.
- The IEC Standard Detergent is designed to reflect average market formulation(s) as far as possible.
- It has specific characteristics that fulfill additional test design related requirements.



Load issues



Market detergent – Pros/Cons



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The data shown in the next slides are taken from older studies and tests based on IEC 60456 edition 3.

The observations were discussed in IEC SC 59D working groups several years ago, the load related issues were taken care of in additional specifications in IEC 60456 edition 4.

The ‘reduced range of age’ requirement mentioned as proposal in some of the charts was implemented as mandatory requirement in edition 4.

Studies before 4th edition!

▶ Load impact

Conditions: Same machine, same laboratory, etc.

Mashine		X	X
Load ID		A	K
Load size	kg	4,5	4,5
Water consumption main wash	l	17,2 ± 0,6	16,5 ± 1,0
Total water consumption	l	67,0 ± 1,4	62,7 ± 3,2
Total energy consumption	kWh	1,13 ± 0,05	1,09 ± 0,09
Relative energy consumption	kWh/kg	0,25	0,24
Energy Efficiency (EU Label)	Class	C	C
Carbon black / Mineral oil	%	42,1 ± 0,9/0,7	38,4 ± 4,1/3,3
Blood	%	82,9 ± 0,4/0,3	81,2 ± 1,7/1,4
Cocoa	%	48,9 ± 2,0/1,6	42,7 ± 5,7/4,6
Red wine	%	76,6 ± 0,4/0,3	75,0 ± 2,2/1,7
Sum of reflectances (test machine)	%	250,4 ± 1,8	237,3 ± 6,1
Sum of reflectances (reference machine)	%	253,0 ± 2,7	253,0 ± 2,7
Cleaning performance ratio		0,99	0,938
Cleaning performance (EU Label)	Class	C	E

Source: BAM, Federal Material Research Institute, Berlin, Germany

Studies before 4th edition!

▶ Load impact

	Load A	Load B
Energy cons./(kWh/kg)		
Machine under test:	0,18	0,20
→ Energy class	A	B
Sum of reflectance readings		
Machine under test:	245,9	259,1
Reference machine:	239,9	247,1
Performance ratio	1,025	1,049
→ Performance class	B	A

Studies before 4th edition!

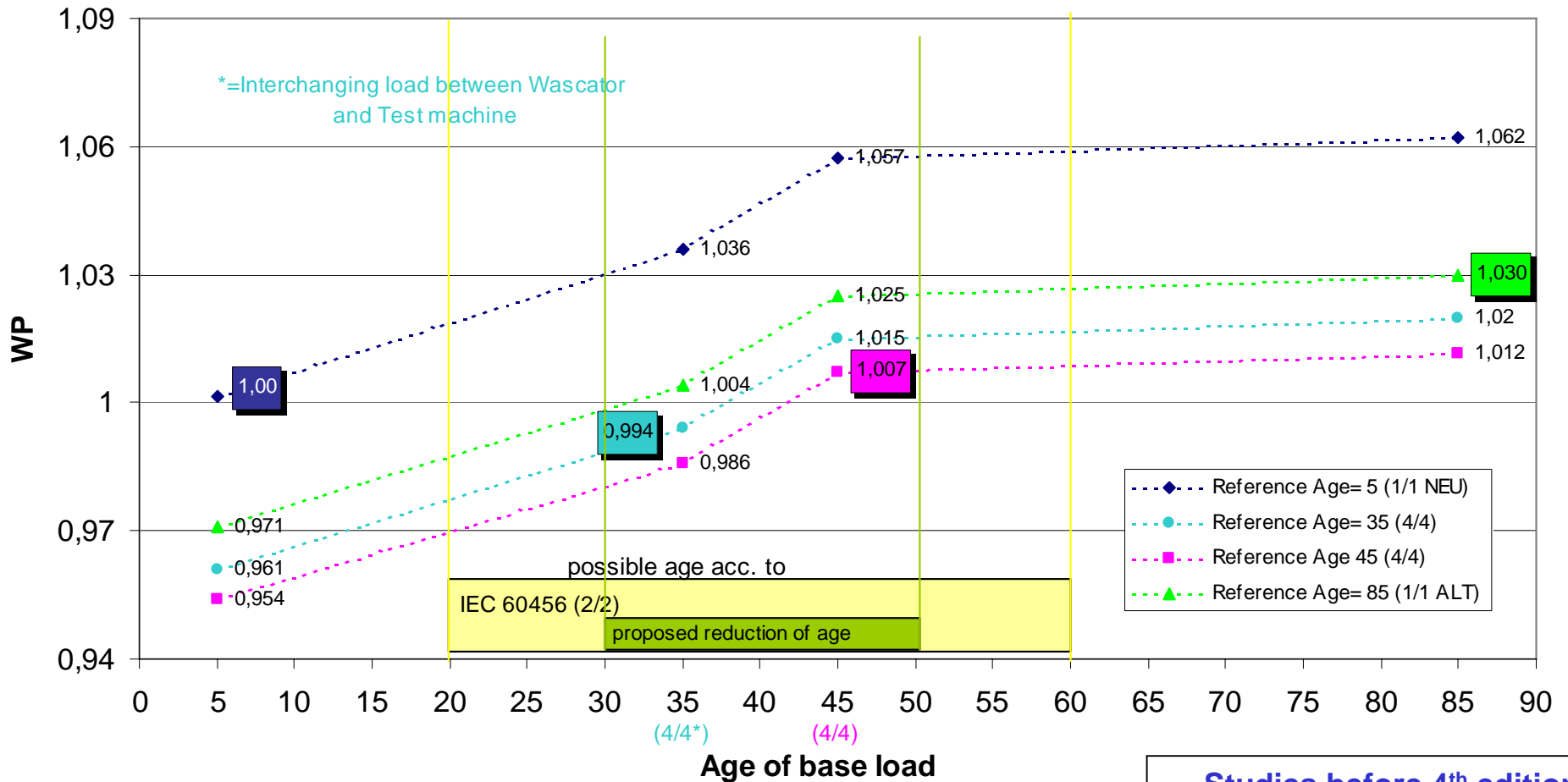
▶ Load impact

	Load A		Load B
Alkalinity/mL (0,1 N HCl)			
Machine under test:	2,92	>	2,70
Reference machine:	1,58	<	1,60

Studies before 4th edition!

▶ Load age impact

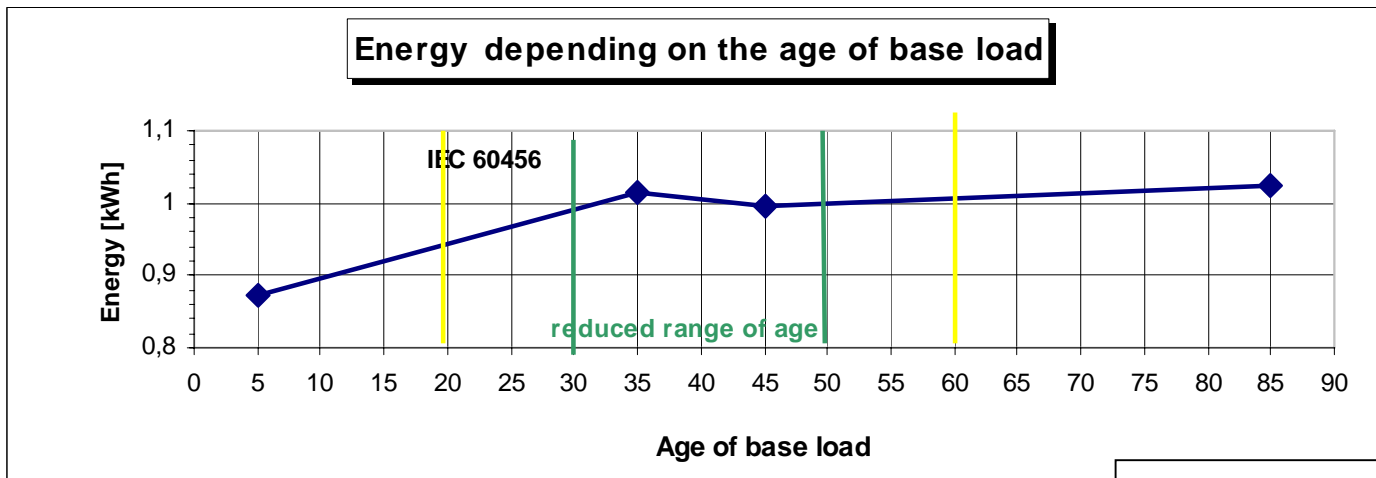
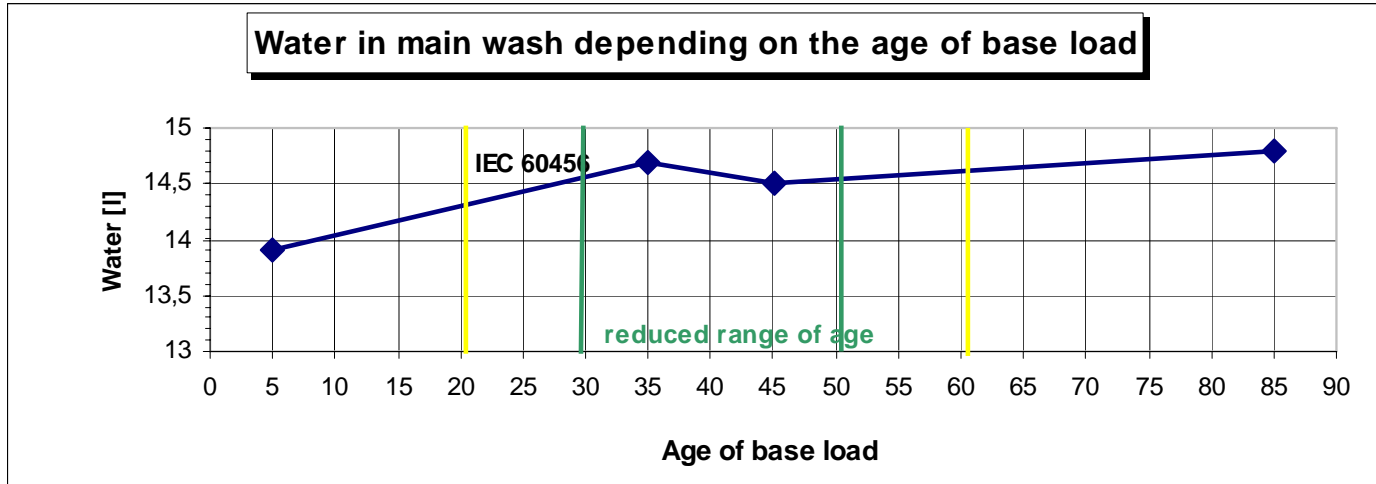
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Studies before 4th edition!

▶ Load age impact

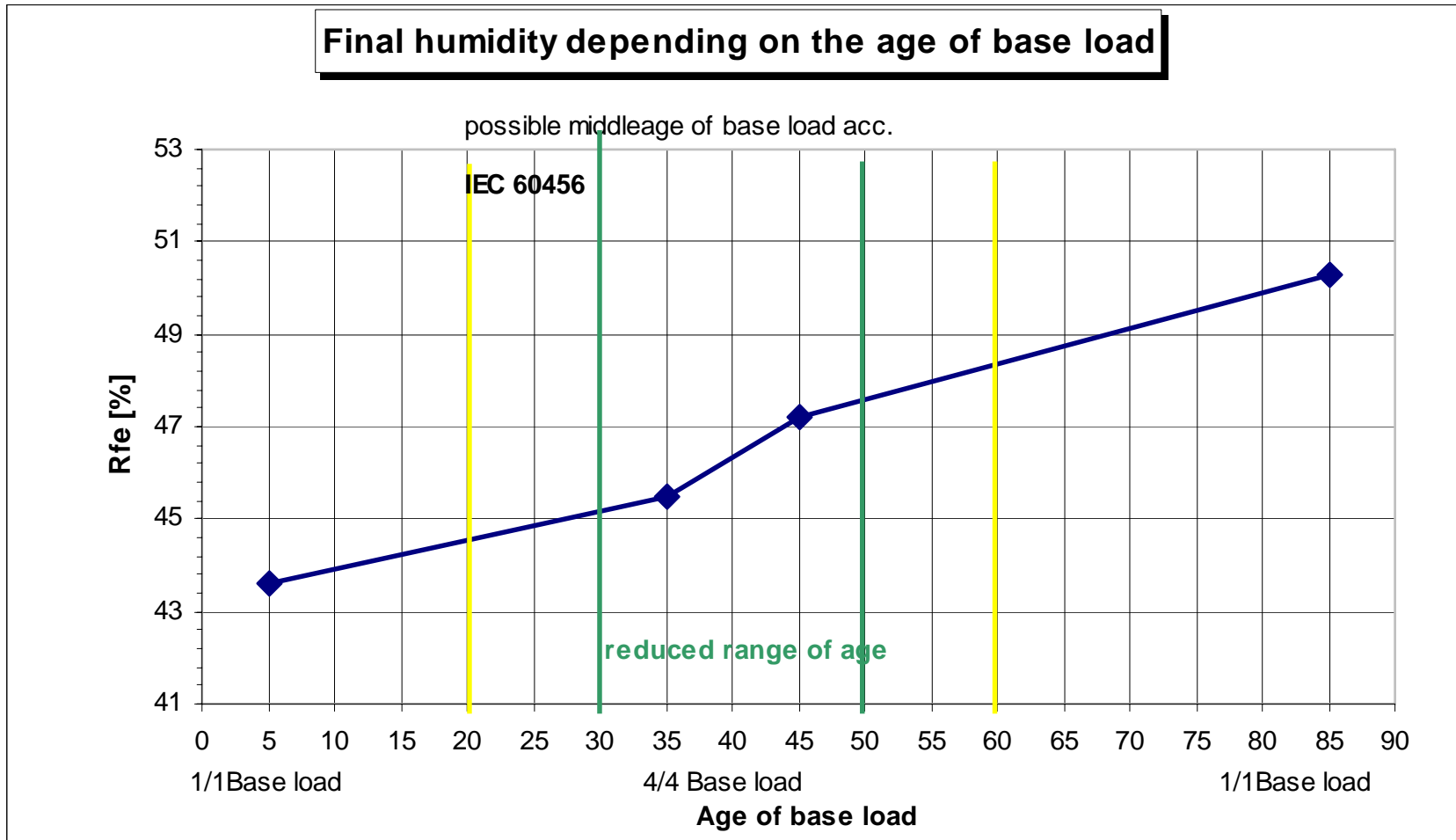
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Studies before 4th edition!

▶ Load age impact

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Studies before 4th edition!

▶ Load issues

Studies discussed in AHAM HLW-1 Revision Task Force revealed that complex load compositions with many different load items lead to a higher degree of uncertainty.

AHAM therefore changed their cotton test load requirements from a complex system to the IEC specifications of bed sheets, pillowcases and towels.

▶ Load issues

Conclusion:

- Load characteristics have significant impact on several performance parameters assessed in the test.
- These issues are addressed in the standard by
 - restrictive material requirements,
 - composing loads out of items of different age (average age requirement),
 - restrictive loading requirements.

Specifications for Standard Detergent and Standard Loads

► Load Specs (4th edition) and QC

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Table B.1 – Specification of the cotton base load textiles

Criterion for conditioned new textiles	Bed sheets	Pillowcases	Huckaback hand towels
Substrate	Long staple pure cotton		
Yarn	Ring spun		
Yarn twist (T/m)			
Warp	600 ± 20		610 ± 20
Weft	500 ± 15		490 ± 15
Yarn Count (tex)			
Warp	33 ± 1		36 ± 1
Weft	33 ± 1		97 ± 1
Weave	Plain weave linen 1/1		Huckaback
Pick count (pick/cm)			
Warp	24 ± 1		20 ± 1
Weft	24 ± 1		12 ± 1
Mass per unit area (g/m²)	185 ± 10		220 ± 10
Dimensions (mm)			
Length	2 400 ± 150	800 ± 50	1 000 ± 50
Width	1 600 ± 40	800 ± 20	500 ± 30
Weight per piece (g)	725 ± 15	240 ± 5	110 ± 3
Finish	Desizing, boiling off, singeing, bleaching, no filling or stiffening size		



► Load Specs (4th edition) and QC

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Table B.1 (continued)

Criteria for washed textiles ^a	Bed sheets	Pillowcases	Huckaback hand towels
Water uptake in % ^b	138 ± 10	138 ± 10	250 ± 15
Shrinkage ^c warp in %			
After 5 th cycle as compared to new textiles	-5 ± 1	-7 ± 1	-16,5 ± 1
After 25 th cycle as compared to after 5 th cycle	-3 ± 1	-3 ± 1	-3 ± 1
Shrinkage weft in %			
After 5 th cycle as compared to new textiles	-5 ± 1	-7 ± 1	-11 ± 1
After 25 th cycle as compared to after 5 th cycle	-3 ± 1	-3 ± 1	-3 ± 1
Description of preparation of seams and yarns			
<p>SHEETS: Short edges (cut edges) are double hemmed, hem size 10 mm, the long edges (selvedges) are not hemmed. Sewing material is polyester cotton, single seam, lock stitch, distance of seam from edge is 9 mm, stitch length 3 mm.</p> <p>PILLOW CASES: A piece of 80 cm × 160 cm is folded to 80 cm × 80 cm, the two edges (cut edges) next to the closed edge are lock stitched with a distance to the edge of 1 cm. The pillow case is then turned inside out and the open edge (selvedges) lock stitched 0,5 cm from the edge. Sewing material is polyester cotton, single seam, lock stitch, stitch length 3 mm.</p> <p>TOWELS: All 4 edges are double hemmed, hem size is 5 mm. Sewing material is polyester cotton, single seam, lock stitch, distance of seam from edge is 4 mm, stitch length 3 mm.</p>			
<p>^a Wash cycles are carried out in the reference washing machine: Cycles 1 to 5: pre-treatment according to 6.3.1, but without being followed by normalization. Cycles 6 to 25: test cycles according to 8.3.4 in reference washing machine using the 60 °C cotton reference programme (without prewash but including rinsing and spinning) but without any normalization between cycles.</p> <p>^b The procedure used (DIN 53923 – see Bibliography) is established for the determination of water absorption capacity of textiles with high water absorption capacity. Water absorption capacity is the amount of water that a textile fabric, conditioned at (20 ± 2) °C / (65 ± 2) % RH, takes up during storage in water of 20 °C for 60 s. The sample with the conditioned mass, <i>mc</i>, is fixed on a sieve of stainless steel and dipped into a flat dish with 20 °C water. After 60 s the sample is taken out of the water, drop dried for 120 s and then weighted again (<i>m60</i>). The water absorption capacity <i>wac</i> is (<i>m60</i> – <i>mc</i>) × 100: <i>mc</i>. The data are measured after 25 cycles as specified in footnote ^a.</p> <p>^c Determination of shrinkage according to ISO 3759 after the washing process as defined in footnote ^b.</p>			



► Load Specs (4th edition) and QC

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Load item quality is assured by

- Controlled production process (yarn, weaving, finishing, sewing).
- Examination of mass and dimensions of ready produced items.
- Textile testing of produced batches.
- Application tests according to IEC 60456 with Strip ratios as quality requirements.



▶ Detergent Specs and QC

A.1 Reference detergent A*

This detergent A* replaces previous detergent A.

Table F.1 – Composition of the reference detergent A*

Ingredient	%	Tolerance (±)
Linear sodium alkyl benzene sulfonate	8,8	0,5
Ethoxylated fatty alcohol C _{12/14} (7 EO)	4,7	0,3
Sodium soap (tallow soap)	3,2	0,2
Foam inhibitor concentrate (12 % silicon on inorganic carrier)	3,9	0,3
Sodium aluminium silicate zeolite 4 A (80 % active substance)	28,3	1,0
Sodium carbonate	11,6	1,0
Sodium salt of a copolymer from acrylic and maleic acid (granulate)	2,4	0,2
Sodium silicate (SiO ₂ :Na ₂ O = 3,3:1)	3,0	0,2
Carboxymethylcellulose	1,2	0,1
Phosphonate (DEQUEST 2066, 25 % active acid)	2,8	0,2
Optical whitener for cotton (stilbene type)	0,2	0,02
Sodium sulfate	6,5	0,5
Protease (Savinase 8.0)	0,4	0,04
Sodium perborate tetrahydrate (active oxygen 10,00 – 10,40 %)	20,0	
Tetra-acetythylenediamine (active content 90,0 – 94,0 %)	3,0	



▶ Detergent Specs and QC

Detergent specifications continued

NOTE 1 The reference detergent is distributed in three separate parts:

- basic powder with enzyme and foam inhibitor;
- sodium perborate tetrahydrate;
- bleach activator tetra-acetythylenediamine.

The proportions of ingredients of the ready detergent are:

- 77 % basic powder with enzyme and foam inhibitor;
- 20 % sodium perborate tetrahydrate;
- 3 % bleach activator tetra-acetythylenediamine.

NOTE 2 Due to variability, which may result from the manufacturing procedure of detergent or of its ageing, for comparative measurements, use of a reference detergent supplied by a single manufacturer from a recent production batch is recommended. It is also recommended that the detergent and perborate be kept separately in small quantities (e.g. 1 kg) and be used within a limited time.

NOTE 3 It is recommended that the detergent manufacturer should indicate the pH of the product supplied. Further product specifications are under consideration.

NOTE 4 The ingredients have to be thoroughly mixed prior to the use. The maximum storage time after mixing is seven days.

NOTE 5 The amount of detergent is determined according to the following formula:

$$\text{Amount} = 54 \text{ g} + 16 \text{ g/kg of rated capacity.}$$

NOTE 6 If a pre-wash is to be included, the total quantity of detergent used must be 1,25 times the figures above. The total detergent quantity is to be split between pre-wash and main wash in accordance with the manufacturer's instructions. If there are no instructions, the split must be 1:2 for pre-wash: main wash.



▶ Detergent Specs and QC

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Detergent quality is assured by

- Controlled production process (incl. QC of raw materials).
- Chemical analysis.
- Solubility tests (now included in edition 5)
- Application tests according to IEC 60456 with Strip ratios as quality requirements.



▶ wfk Testgewebe GmbH

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<http://www.testgewebe.de/en/presentations>

Thank you for your attention!