

Robustness Specification for Environmental tests.

ROSE

Faster testing & more information
on only one page?

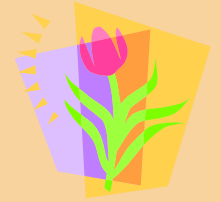


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ENVIRONMENTAL TESTING OF THE FUTURE



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**More information
on less paper?**



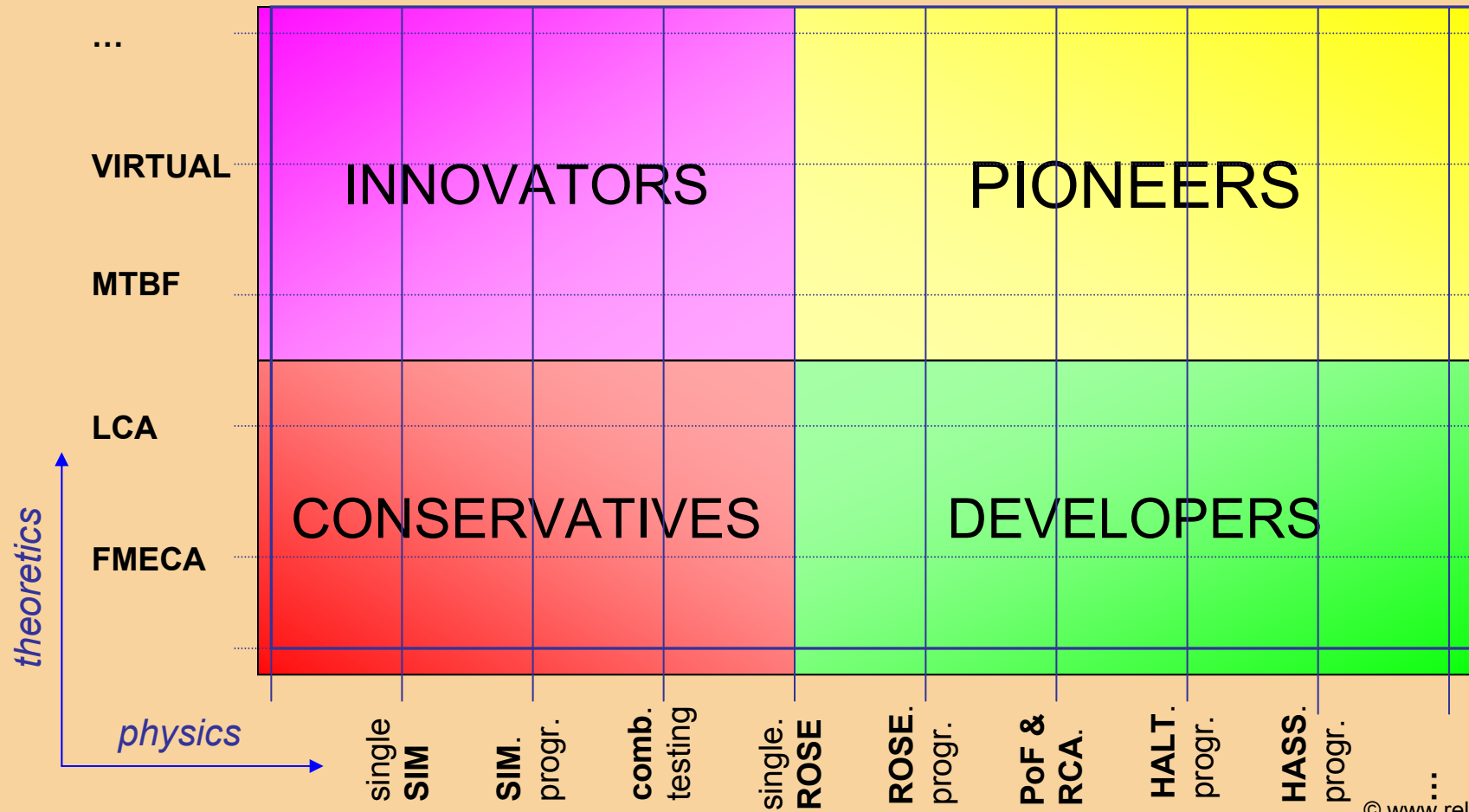
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Reliability Maturity Model



© www.reliability-test.nl

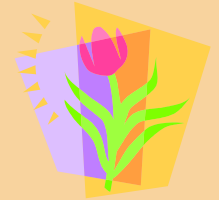


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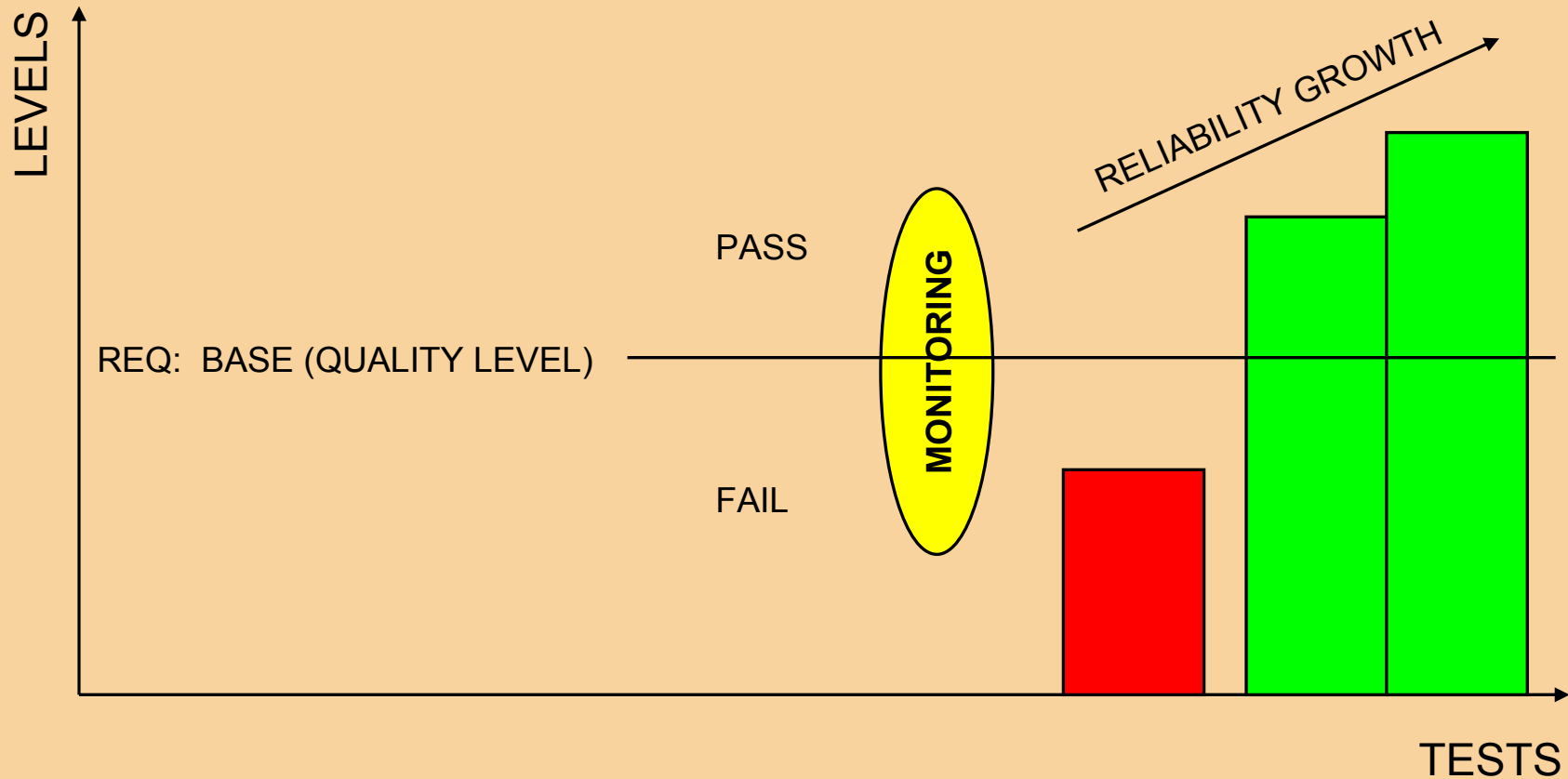
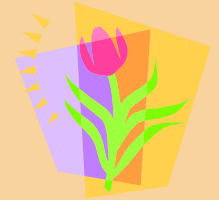
ROSE



- Position in Reliability Roadmap
- Pass/fail vs. quality levels and reliability growth
- One page overview, graphical lay out
- Different stressors (levels)
- Examples
 - BT headset
 - watch
- Conclusions, lessons learned and continuation

ROSE CONCEPT

NOT NEW

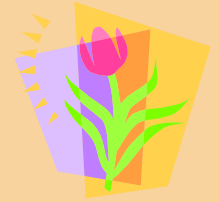


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Step-Stress



Tendency

- p/f → Levels
- single test → system thinking
- simulation → robustness
- test → customer
- standards → tailored

END USER

Testing Report 20060815.pdf

Tools Window Help

Search Select 86% Help

TESTING REPORT

PARTS : VANGUARD WATCH DATE : 15/8/2006
 VENDOR : _____ QTY : 3 SET / EACH
 REF. : _____ PAGE : 1 OF 1

TESTING DESCRIPTION	REF. To DRS	SPECIFICATION	SAMPLE NO.			STATUS
			1	2	3	
Heat Test	REQ-504		A/■	A/■	A/■	Completed
Cold Test	REQ-505		A/■	A/■	A/■	Completed
Heat Test (Non operational)	REQ-506		A/■	A/■	A/■	Completed
Cold Test (Non operational)	REQ-507		A/■	A/■	A/■	Completed
Temperature Humidity Test	REQ-547		A/■	A/■	A/■	Completed
UV Light Test	REQ-511		A/■	A/■	A/■	Completed
Key operation before & after 30k cycle	REQ-516		A/■	A/■	A/■	Completed
Shaking Test	REQ-532		A/■	A/■	A/■	Completed
Traction & Torsion Test	REQ-525 REQ-526		A/■	A/■	A/■	Completed
Pressure Intensity (static) Test Accessory	REQ-527		A/■	A/■	A/■	Completed
Crystal Hardness Test	REQ-528		A/■	A/■	A/■	Completed
Traction Test	REQ-529		A/■	A/■	A/■	Completed
Artificial Sweat Test	REQ-548		A/■	A/■	A/■	Completed

1 of 1

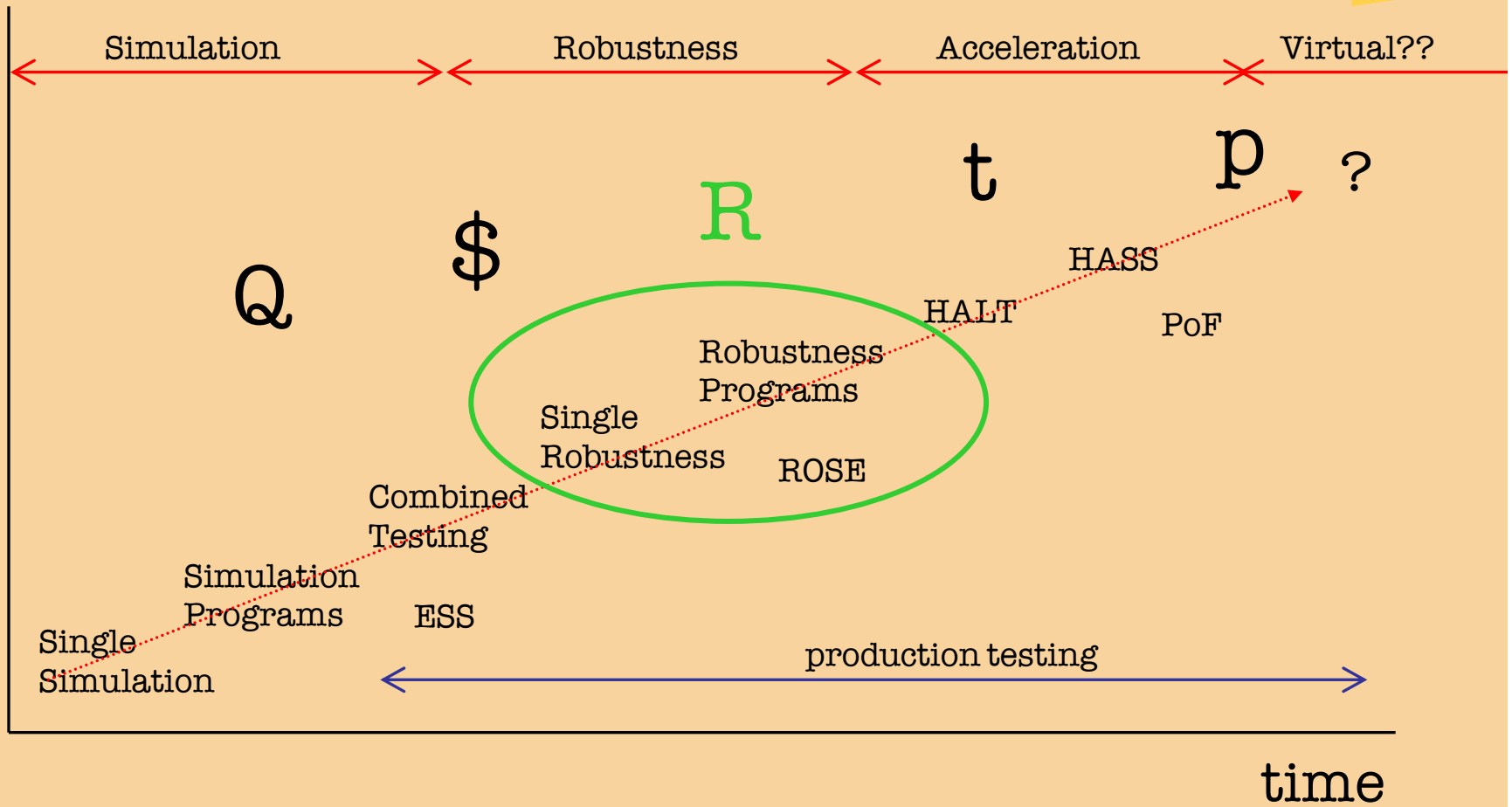


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Technique

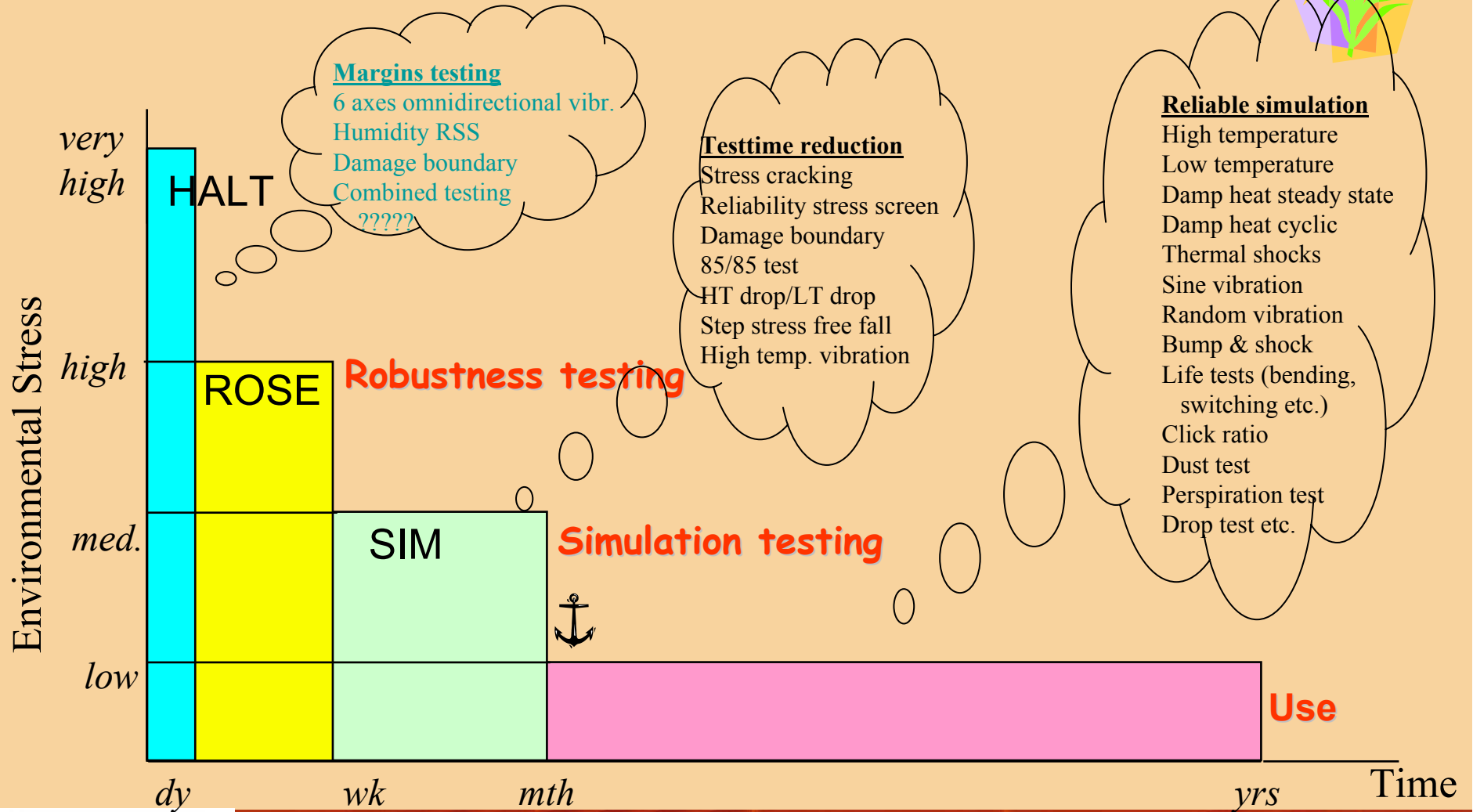


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Environmental Stress

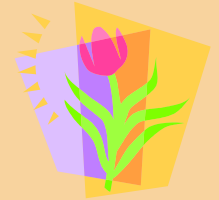


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Comparison test philosophies



Simulation testing	ROSE testing	HALT testing
<ul style="list-style-type: none">– longer testing,– pass/fail,– proven,– standards,– non-destructive– RCA when necessary– existing tests– Single stress– good simulation– field experiences,	<ul style="list-style-type: none">– fast testing,– levels,– “new”– based on standards– destructive (TTF)– RCA always necessary– existing tests– single stress	<ul style="list-style-type: none">– fast testing,– levels,– “new”– no standards– destructive (TTF)– RCA always necessary– new test– combined stress

Goals of ROSE



- more insight in product quality and robustness
- quantification of product quality & comparisons (progress/competitors)
- time reduction: faster testing and “better” results
- cost reduction: prevent overkill
- mmt summary: one page overview



What is ROSE



- Method to determine product robustness
 - Presentation - One page overview
 - Destruction – Upper operating/destruct limits
 - Based on standard tests and equipment
- No HALT/HASS
 - ROSE is in between
 - HALT/HASS is 6 axis omnidirectional vibration
 - HALT/HASS is forced temperature changes

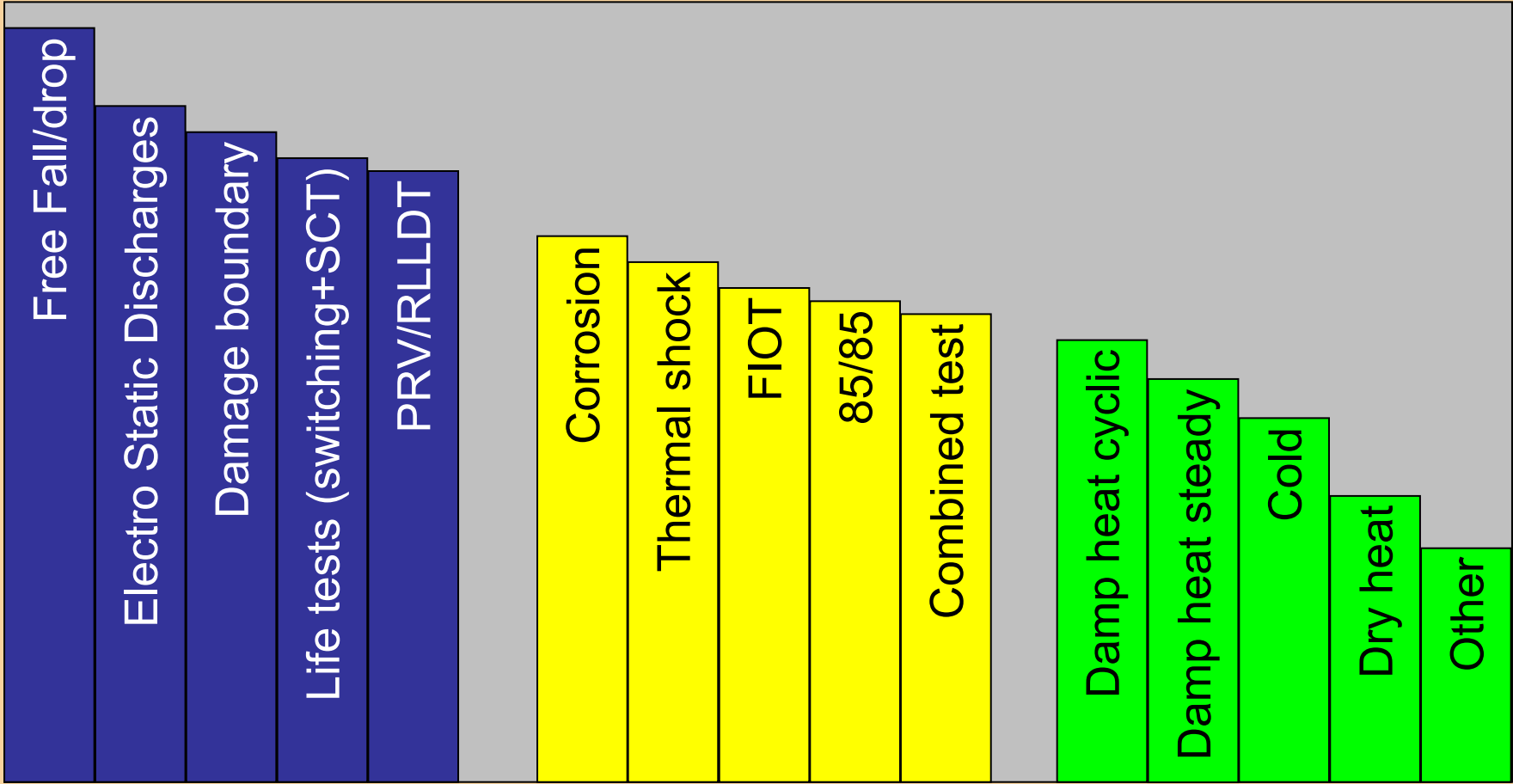


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Effectiveness of environmental stress at SEMC



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UDL/UOL



- Upper Destructive/Operating Limit
 - 1. time (continued testing)
 - 2. stress (increase level)
 - 3. stressor (different test parameters)

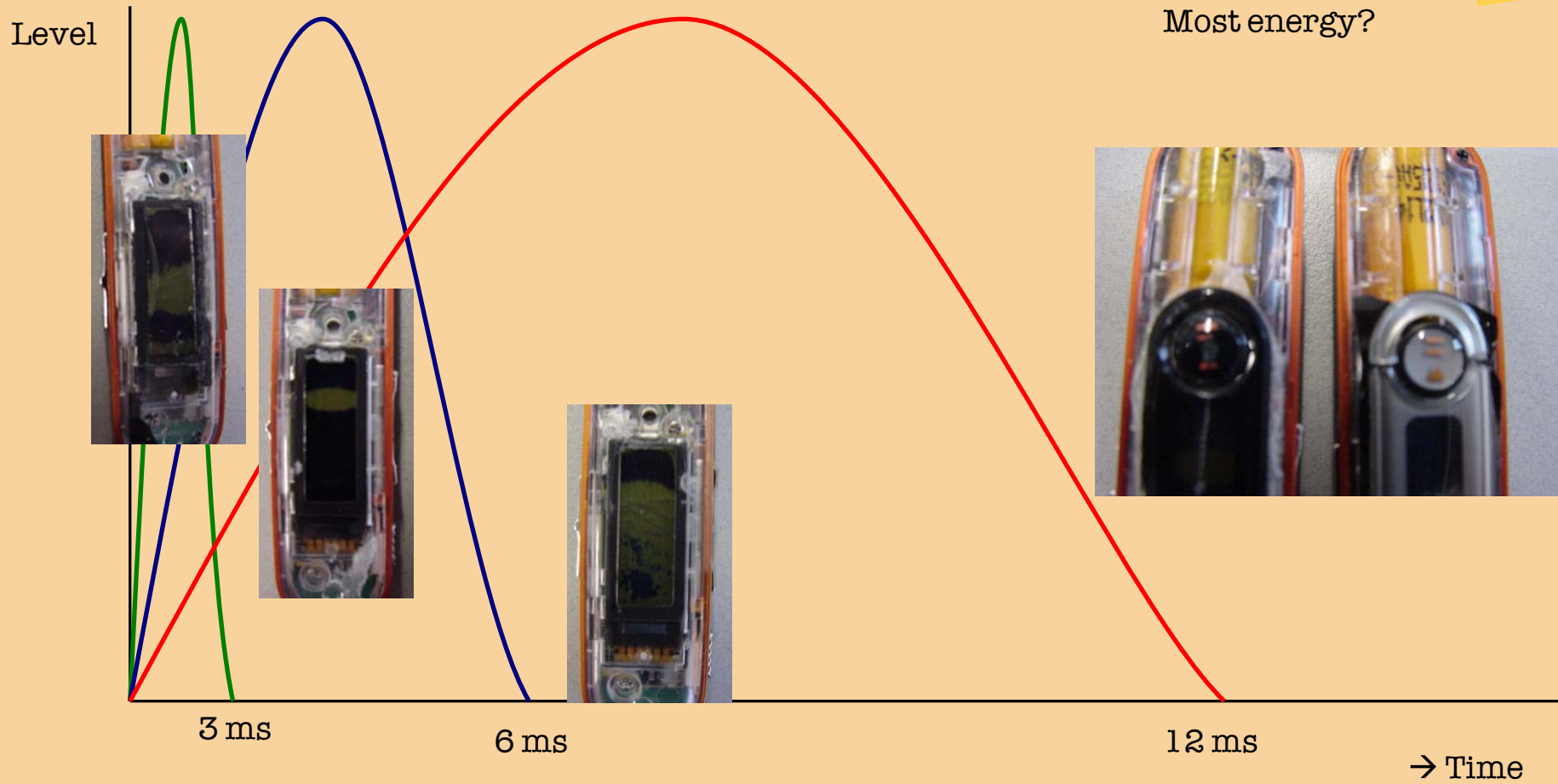
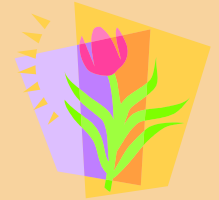
Stressors – Bump test



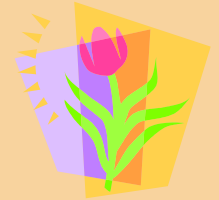
Test	Variables	Values	Remarks
Bump test	<input checked="" type="checkbox"/> Number of bumps	<input checked="" type="checkbox"/> 3000 bumps <input type="checkbox"/> 4500 bumps <input type="checkbox"/> 6000 bumps <input type="checkbox"/> 9000 bumps	1/3 or 1/6 bumps in each direction
	<input type="checkbox"/> Impact level	<input type="checkbox"/> 15 g <input checked="" type="checkbox"/> 25 g <input checked="" type="checkbox"/> 30 g? necessary? <input type="checkbox"/> 40 g	
	<input type="checkbox"/> Pulse duration	<input type="checkbox"/> 3 ms <input checked="" type="checkbox"/> 6 ms <input type="checkbox"/> 11 ms	



Pulse effects



Stressors – Free fall test



Test	Variables	Values	Remarks
Drop test	<input checked="" type="checkbox"/> Number of drops	<input type="checkbox"/> 10 falls <input checked="" type="checkbox"/> 20 falls <input type="checkbox"/> 40 falls	
	<input type="checkbox"/> Impact level	<input type="checkbox"/> 1.00 meter <input checked="" type="checkbox"/> 1.50 meter <input type="checkbox"/> 1.80 meter	
	<input type="checkbox"/> Surface	<input type="checkbox"/> rubber <input type="checkbox"/> wood <input checked="" type="checkbox"/> steel/concrete	
	<input type="checkbox"/> Temperature	<input checked="" type="checkbox"/> room <input type="checkbox"/> -20°C <input type="checkbox"/> +70°C	



ENVIRONMENTAL TESTING OF THE FUTURE



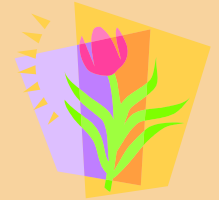
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Step stress (other format)



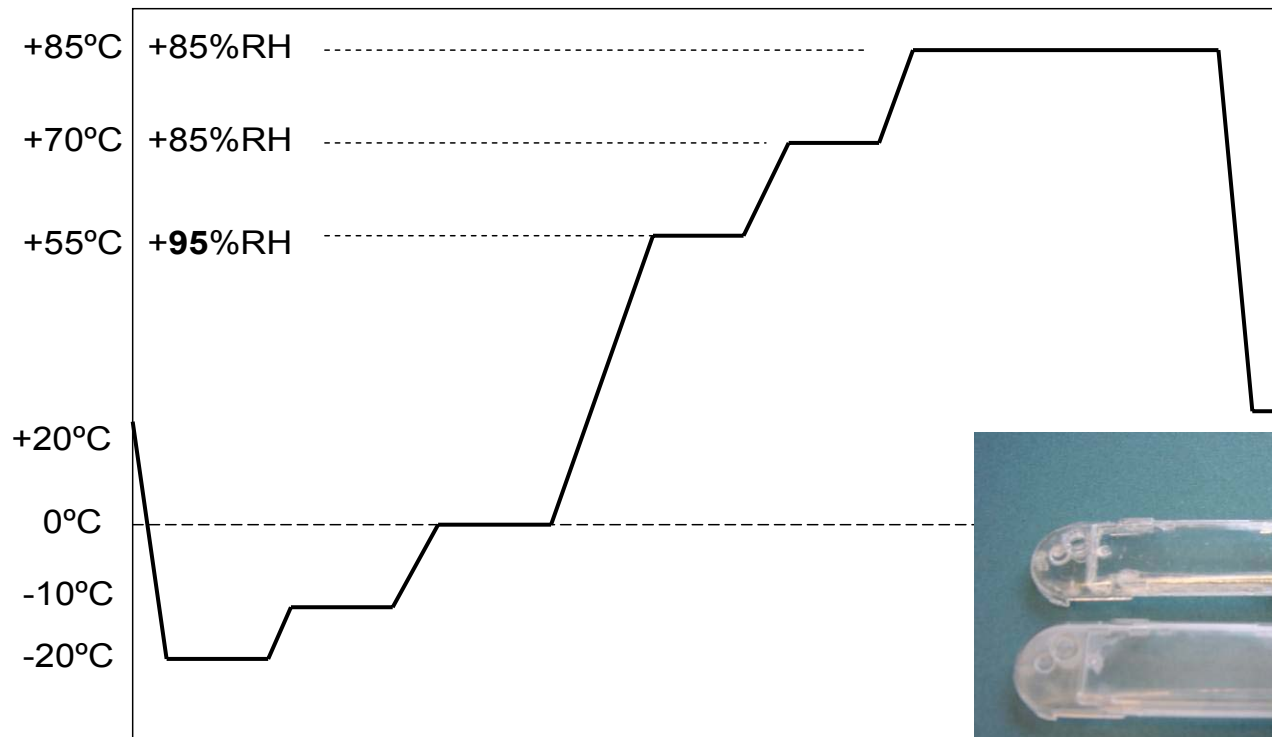
	1,5 meter	1,65 meter	1,80 meter
50 drops			② robust
30 drops		base / robust	
20 drops	① base		

Stressors – High temp/hum.



Test	Variables	Values	Remarks
Temphum test	<input checked="" type="checkbox"/> Temperature	<input type="checkbox"/> 0, -10, -20°C <input checked="" type="checkbox"/> +55, 70, 85°C	
	<input type="checkbox"/> Humidity	<input type="checkbox"/> none <input checked="" type="checkbox"/> 85% RH <input type="checkbox"/> 95% RH	
	<input type="checkbox"/> Slope	<input checked="" type="checkbox"/> not specified <input type="checkbox"/> 5°C/min	

Step-stress approach



Stressors – Random vibration



Test	Variables	Values	Remarks
Random vibration test	<input checked="" type="checkbox"/> Duration	<input type="checkbox"/> 3x 0,5 hours <input checked="" type="checkbox"/> 3x 2,0 hours <input type="checkbox"/> tbd	
	<input type="checkbox"/> Impact level	<input type="checkbox"/> 0,96 g rms <input checked="" type="checkbox"/> 3,13 g rms <input type="checkbox"/> tbd	
	<input type="checkbox"/> Fixation	<input checked="" type="checkbox"/> fixed <input type="checkbox"/> pseudo	
	<input type="checkbox"/> Type	<input type="checkbox"/> single <input checked="" type="checkbox"/> combined with temp	
	<input type="checkbox"/> Temperature	<input checked="" type="checkbox"/> 55°C* <input type="checkbox"/> 70°C	* Use max. product temp.

ROSE



- Between simulation tests and HALT
- Understanding of failure mechanisms

- 1 page overview
- Insight in quality levels
- Insight in failure mechanisms

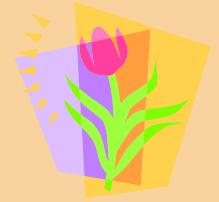


ENVIRONMENTAL TESTING OF THE FUTURE

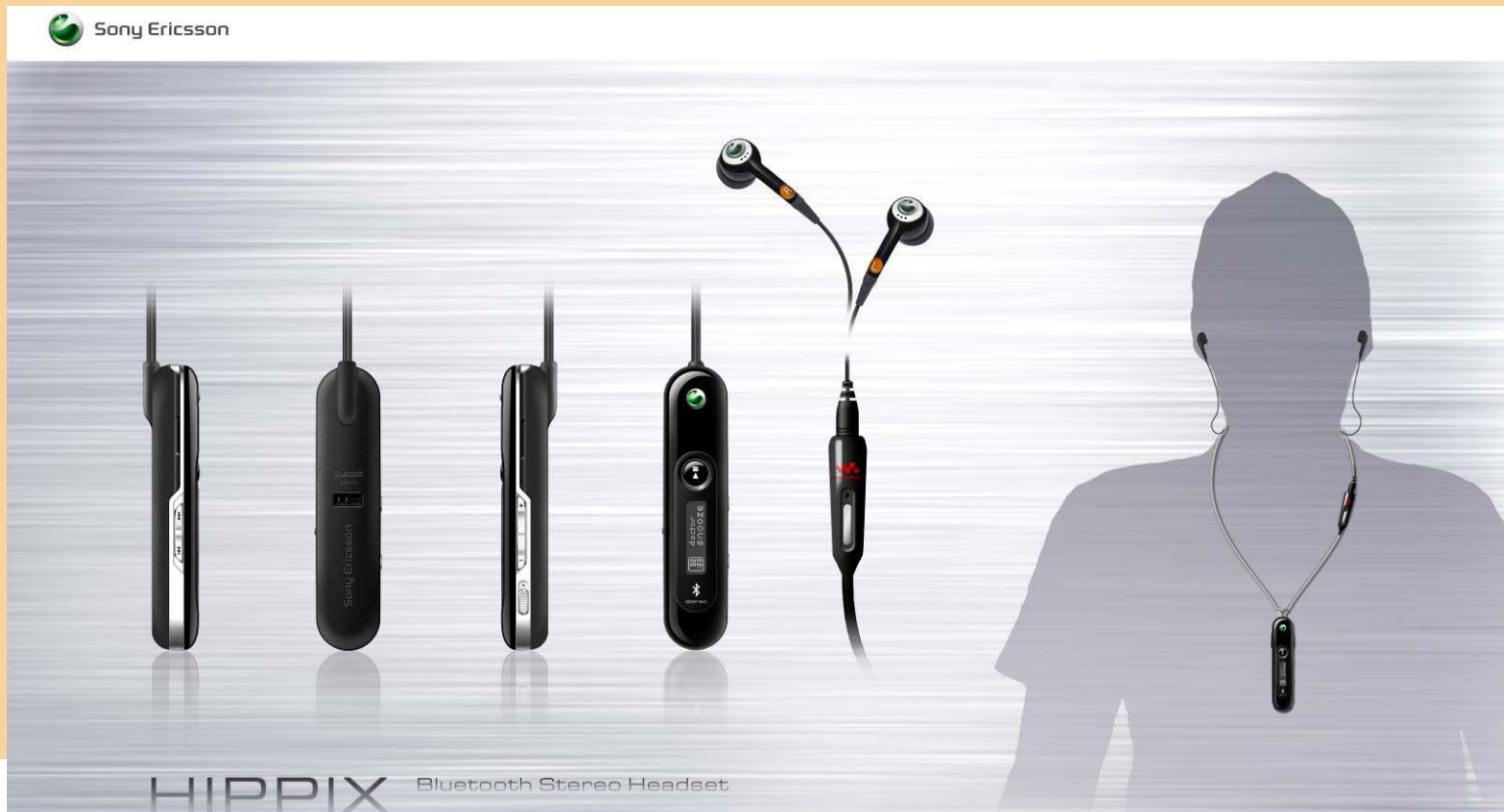


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Example



- HBH-DS970
- BT voice streaming headset (with display and cord/cables)



29-May-2005 Creative Design Center

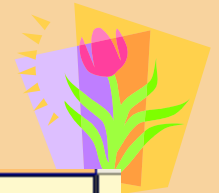


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Observations



1	REFERENCE TESTING HIPPIX TP WK609					
2	Update: 23-03-2006					
3						
4	ROSE results	Legend:	Results are sorted in order of risk. High risk areas are colored red. (A=blocking, B=major, C=minor)			
5	Results in italics and marked with * are results from previous test					
6	Test	Result (Sim.)	Robustness	Risk	Remarks	Action
7	Cable Bending Test	NG	Low	A	Cable breakage After 2700 movements (required 15000) the cable nearby operation button was broken. The strain relief was pulled out of the plastics on the other side of operation button.	Redo on PP samples
8	85/85 Test	NG		A	Deformation inner frame. After 1-1,5 of 4 days heavy deformation of inner structure frame. Level determined and start already with light deformation at 70°C (50% and 85& RH).	New material proposed. Re-test in PP.
9	<i>IP-water (IPx2) test*</i>	<i>NG*</i>	<i>Low</i>	<i>B</i>	*Water remainders visible. <i>Water ingress between front panel and frame which is visible in the viewing area. After drying product works ok, but remainders of the water are reducing display readability.</i>	Redo on PP samples
10	Bump Test	OK	Low	B	LC breakage In the 3rd production lot, the 30g level the LC is broken on 1st and 2nd samples. Expected that simulation level 30 g will be met, but is not proven.	Redo on PP samples
11	Free Fall Test	OK	Low		During test incidentally very light cracking sound, after test good. Tested 20x at 1.5 meter. In another FF test from Foster crack in T-top, however not noticable for consumer. Robustness however low.	

EXAMPLE

Values are edited for reference and education



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Hippix ES series W604



ROBUSTNESS LEVELS HIPPIX ES W604															Update: 15-02-2006	
(see comments for observations)																
SEMC																
Targetted	200%															
Robustness Level																
SEMC Base	100%	1,5 m	6 m/s, 200g	6 hrs	6 hrs											
Quality Level																
Test	Free Fall Test	Damage Boundary Test	Random Vibration	Pseudo Random Vibration	Eraser Test	ABREX Abrasion Test	Cable Bending Test	Lock Durability	85/85 Test	Salt Mist Test	Rain Test	Dust Test	Rotated Drop Test	Bump Test	High Temp Vibration	
Robustness level	ongoing	33%	17%	83%	150%	133%	10%	200%	60%	100%	100%	100%	ongoing	not done	not done	
Overall ROSE indicator:				0,88												
Explanation: when a product meets full basic quality level over all tests (100%) the indicator is 1,00. Values are edited for reference and education																
Robust products are over 1,30 (over 30% margin to fail in general, which means averaged use situations)																
When the indicator is below 1,0 the basic quality level is not met and the product should not be released without exemption.																

EXAMPLE

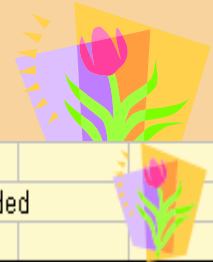


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Hippix TP series W609



ROBUSTNESS LEVELS HIPPIX TP W609																Update: 23-03-2006	
(see comments for observations, shaded areas are based on previous test results)																Results salt mist, cable and bump added	
SEMC																	
Targetted	200%	1,8,m, 20x	8m/s,300g	tbd	tbd	200x	60k	tbd	2000x	4 dys	steady 24 h	2 min	tbd	500x	4500x,40g	6 hr	
Robustness Level																	
SEMC Base	100%	1.5m, 20x	6 m/s, 200g	6 hrs	6 hrs	100x	30k	15000	1000x	2 dys	purge 24 hr	80 s	24 hrs	200x	3000x,30g	1,5 hrs	
Quality Level																	
Test		Free Fall Test	Damage Boundary Test	Random Vibration	Pseudo Random Vibration	Eraser Test	ABREX Abrasion Test	Cable Bending Test	Lock Durability	85/85 Test	Salt Mist Test	Rain Test	Dust Test	Rotated Drop Test	Bump Test	High Temp Vibration	
Robustness level	100%	116%	100%	100%	150%	133%	18%	18%	100%	100%	100%	100%	100%	100%	110%	140%	
Overall ROSE indicator for TP:						1,14	ES=0,88	Target:	1,30								
Explanation: when a product meets full basic quality level over all tests (100%) the indicator is 1,00																	
Robust products are over 1,30 (over 30% margin to fail in general, which means averaged use situations)																	
When the indicator is below 1,0 the basic quality level is not met and the product should not be released without exemption.																	

EXAMPLE

Values are edited for reference and education



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Hippix RTL series W628



ROBUSTNESS LEVELS HIPPIX PP W628

(see comments for observations, shaded areas are based on previous test results)



Update: 13 september 2006

Results Free fall, d-bound, Hightempvibration, lock durability, R

		8m/s, 393g														
SEMCRobustness Level	Targetted 200%	1,8m, 20x	8m/s, 300g	tbd	tbd	200x	60k	tbd	2000x	4 dys	steady 24 h	2 min	tbd	500x 0,5m	4500x, 40g	6 hr
SEMCRobustness Level	100%	1,5m, 20x	6,61, 232g	6 hrs	6 hrs	150x	40k	15000	1800x	2 dys	pourge 24 h	80 s	24 hrs	200x	3000x, 30g	15 hrs
SEMCRobustness Level								2700		?						
SEMCRobustness Level								500x		?						
SEMCRobustness Level										1,0 dy						
SEMCRobustness Level										70C						
Test		Free Fall Test	Damage Boundary Test	Random Vibration	Pseudo Random Vibration	Eraser Test	ABREX Abrasion Test	Cable Bending Test	Lock Durability	85/85 Test	Salt Mist Test	Rain Test	Dust Test	Rotated Drop Test	Bump Test	High Temp Vibration
Robustness level		1%	250%	100%	100%	150%	133%	18%	180%	100%	150%	80%	100%	200%	110%	200%
Test operated by:		S2T	S2T	S2T	S2T	n/a	n/a	PENDING	S2T	SEMCR	n/a	n/a	n/a	S2T	n/a	S2T

EXAMPLE

Overall ROSE indicator for TP: **1,36** ES=0,88, TP=1,14 Target: 30

Explanation: when a product meets full basic quality level over all tests (100%) the indicator is 1,00.

Robust products are over 1,30 (over 30% margin to fail in general, which means averaged use situations)

When the indicator is below 1,0 the basic quality level is not met and the product should not be used.

Values are edited for reference and education



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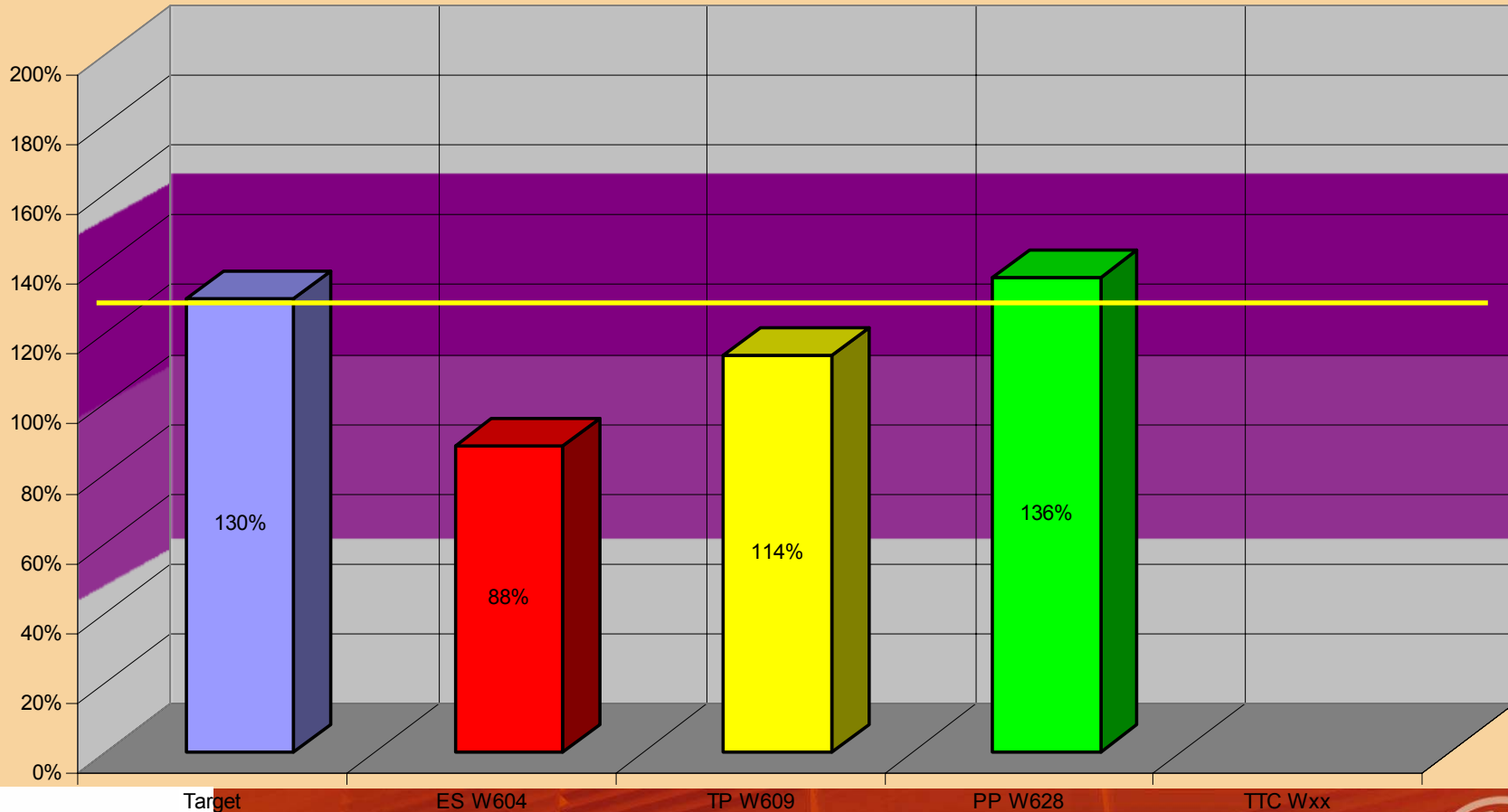


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Robustness Growth



HIPPIX ROBUSTNESS PROGRESS



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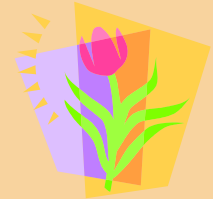
Vanguard



- Bluetooth watch
- Duration:
Simulation: 3 weeks
Robustness: 1 week



Original – Pass/Fail



TESTING REPORT

PARTS : VANGUARD WATCH

DATE : 15/8/2006

VENDOR : _____

QTY : 3 SET / EACH

REF. : _____

PAGE : 1 OF 1

TESTING DESCRIPTION	REF. To DRS	SPECIFICATION	SAMPLE NO.			STATUS
			1	2	3	
Heat Test	REQ-504	50°C, 50%RH, 3Hrs	A/■	A/■	A/■	Completed
Cold Test	REQ-505	0°C, 3Hrs	A/■	A/■	A/■	Completed
Heat Test (Non operational)	REQ-506	50°C, 50%RH, 16.5Hrs	A/■	A/■	A/■	Completed
Cold Test (Non operational)	REQ-507	0°C, 16.5Hrs	A/■	A/■	A/■	Completed
Temperature Humidity Test	REQ-547	0°C -50°C, 95%RH, 16.5Hrs	A/■	A/■	A/■	Completed
UV Light Test	REQ-511	72Hrs, Every 24Hrs check record	A/■	A/■	A/■	Completed
Key operation before & after 30k cycle	REQ-516	Push button activation force 0.3-0.7kg Push crown activation force 0.7-1.5kg	A/■	A/■	A/■	Completed
Shaking Test	REQ-532	Duration 50k cycle	A/■	A/■	A/■	Completed
Traction & Torsion Test	REQ-525 REQ-526	Tension=5kg, Torsion=6kg.cm, Duration 5k cycle	A/■	A/■	A/■	Completed
Pressure Intensity (static) Test Accessory	REQ-527	1. Casing: 10mm steel ball, 120N (12kg) for 1 min.. 2. Push buttons: 10mm steel ball, 70N(7kg) for 1 min. 3. Push crown: 10mm steel ball, 70N(7kg) for 1 min	A/■	A/■	A/■	Completed
Crystal Hardness Test	REQ-528	Steel ball: Dia.25mm, Mass=63.7g Drop height: 11.2 –66cm	A/■	A/■	A/■	Completed
Traction Test	REQ-529	Pulling force 3kg(30N) for 10second	A/■	A/■	A/■	Completed
Artificial Sweat Test	REQ-548	40°C for 24Hrs with mixture solution	A/■	A/■	A/■	Completed



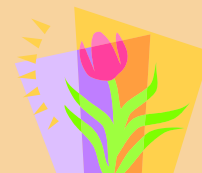
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ROSE - Robustness



ROSE FOR VANGUARD WATCHES (FOSSIL-SONYERICSSON)

(Robustness Specification for Environmental testing)

Use View Comments (Alt_V C) to toggle between test details.

Samples: FP3

Revision: PA4

Date: 9-nov-06

Update:



Retest FP3															
Robustness limit	3h 80°	5x 1m concr.	6h 5-500Hz	xh wood	85°C, 95%	256x	8 m/s	300g	24 steady	3x 2hr	free	5x 1m concr.	150x	40k	1120 W/m2
(Upper Test Level)					70°C, 95%			Crown							
					60°C, 95%			Crown				Crown			
Simulation level	3h 50°C	3x 1m wood	18h 50Hz	xh free	50°C, 95%	150x	6 m/s	200g	24 purge	3x30min, 3,13	fixed 0,96	3x 1m rubber	90x	30k	5750W/m2
(Required conform GRETA)							Cover/key	Wrist band							
										Wrist band	clock				
	Temperature Test	Drop Test	Vibration Test	Shaking Bump Test	Temp/Hum test	Thermal Shock Test	Damage Boundary	Salt Mist Test	High Temp Vibration	Random Vibration	Drop Test	Eraser Test	Abrasion Test	Solar/UV Test	
	FOSSIL			SEMC							EXPERIMENTAL				

KPI for ROSE (experimental)

170

170

90

85

30

120

110,8333



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And in new designs?

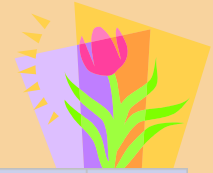


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ROSE - Robustness



ROSE FOR VANGUARD WATCHES (FOSSIL-SONYERICSSON)

(Robustness Specification for Environmental testing)

Use View Comments (Alt_V C) to toggle between test details.

Samples: FP3

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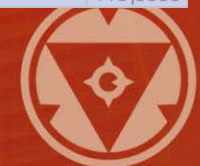
Retest FP3															
Robustness limit	3h 80°	5x 1m concr.	6h 5-500Hz	xh wood	85°C, 95%	256x	8 m/s	300g	24 steady	3x 2hr	free	5x 1m concr.	150x	40k	1120 W/m2
(Upper Test Level)					70°C, 95%			Crown							
					60°C, 95%			Crown				Crown			
Simulation level	3h 50°C	3x 1m wood	18h 50Hz	xh free	50°C, 95%	150x	6 m/s	200g	24 purge	3x30min, 3,13	fixed 0,96	3x 1m rubber	90x	30k	5750W/m2
(Required conform GRETA)							Cover/key	Wrist band							
										Wrist band	clock				
	Temperature Test	Drop Test	Vibration Test	Shaking Bump Test	Temp/Hum test	Thermal Shock Test	Damage Boundary	Salt Mist Test	High Temp Vibration	Random Vibration	Drop Test	Eraser Test	Abrasion Test	Solar/UV Test	
	FOSSIL			SEMC							EXPERIMENTAL				

KPI for ROSE (experimental)

170 170 90 85 30 120 110,8333



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First time right?



ROSE FOR VANGUARD WATCHES (FOSSIL-SONYERICSSON)

(Robustness Specification for Environmental testing)

Use View Comments (Alt_V C) to toggle between test details.

FP2

08/08/2007



	TX off								Virgin							
Robustness limit	3h 80°	5x 1m concr.	6h 5-500Hz	xh wood	85°C, 85%	256x	8 m/s	300g	24 steady	3x 2hr	3x30m free	5x 1m concr.	7 days	1120 l/m2	6 days	
(Upper Test Level)					70°C, 85%		7,1 m/s	271 g								
Simulation level	3h 50°C	3x 1m wood	18h 50Hz	xh free	50°C, 95%	150x	6 m/s	200g	3x30min, 3,13	3x30 fixed 0,96	3x 1m Concr	3 days	575l/m2			
(Required conform GRETA)					0°C											
					min 20°C										1 day	
	Tempera- ture Test	Drop Test	Vibration Test	Shaking Bump Test	Temp/Hum test	Thermal Shock Test	Damage Boundary	Salt Mist Re-test	High Temp Vibration	Random Vibration	Drop Test Re-test	Organic Fat Test	Solar/UV Test	Moisture Heat Test		
	FOSSIL				SEMC											
					S2T	Emmen	S2T	S2T		S2T	S2T	S2T	Emmen	Emmen	S2T	
KPI for ROSE (exp)					150	70	100	200	200	200	200	200	170	90	100	129,2857

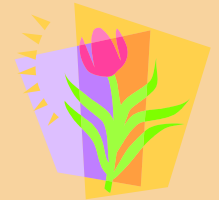


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Competitor



COMPETITOR TESTING

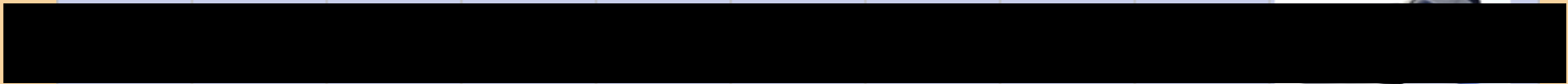
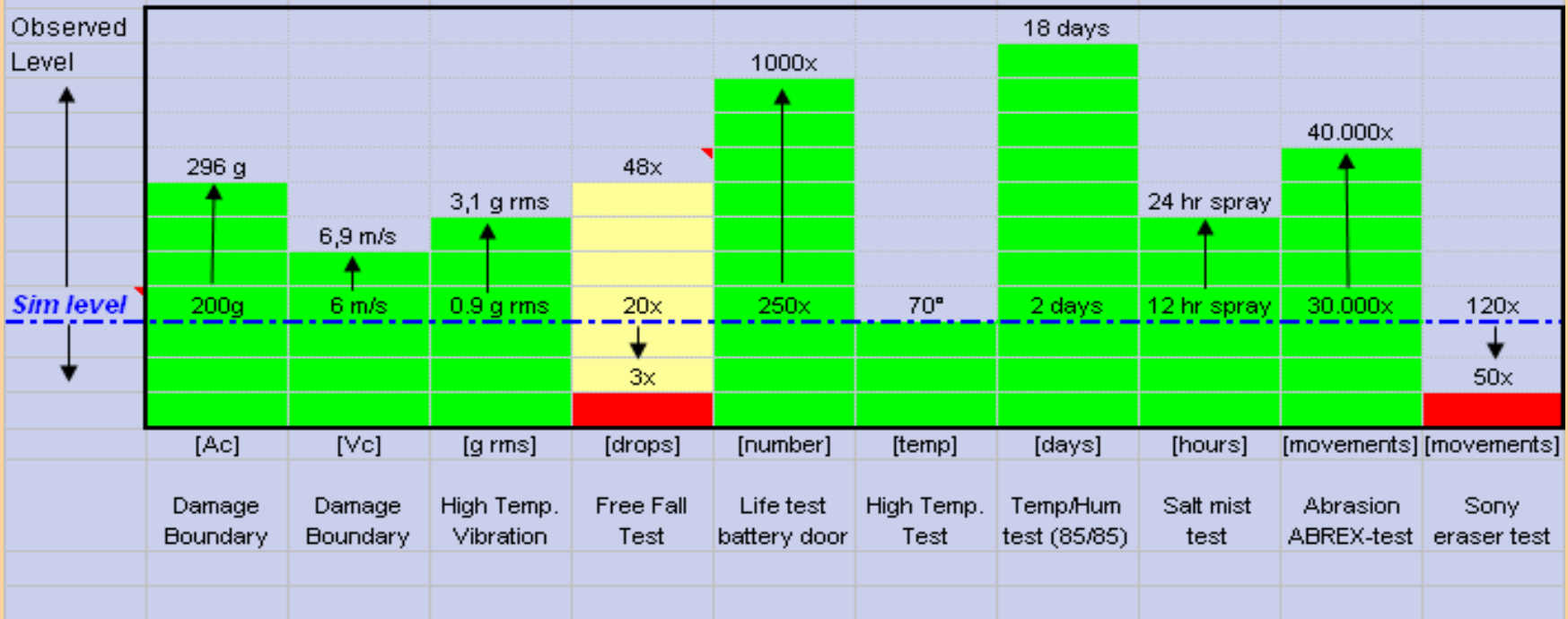


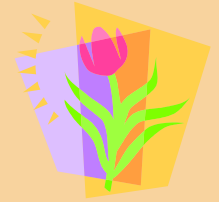
Table: Robustness levels.



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Development and application



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Practice



- Duration:
 - Simulation: > 3 weeks (BSM)
 - Robustness: 3 days
- >80 % of fail modes simulation discovered
 - Clippix > 90%
- Levels and focus areas clear/assigned
- 3/5 main field problems anticipated (ev. group)
- Typical failure mechanisms determined
 - design inputs

Development/continuation



- First projects: technical focus
 - feasibility ROSE testing
- Latter projects: time focus
 - from min. 3 weeks to max. 1 week
- Current projects: cost focus
 - ongoing (10 k to 3 k?)

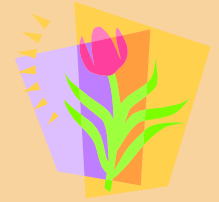


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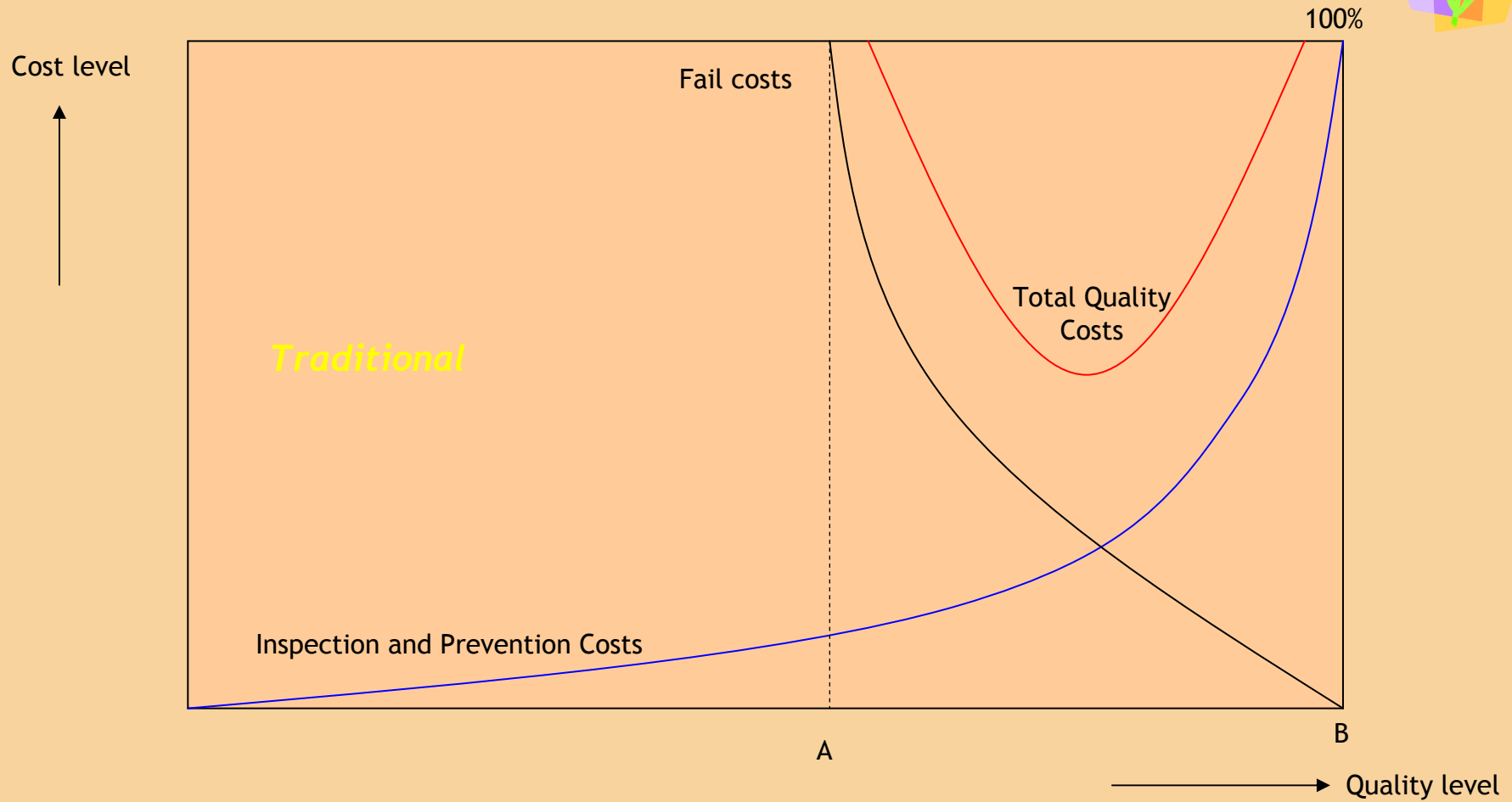
Costs and pay-back



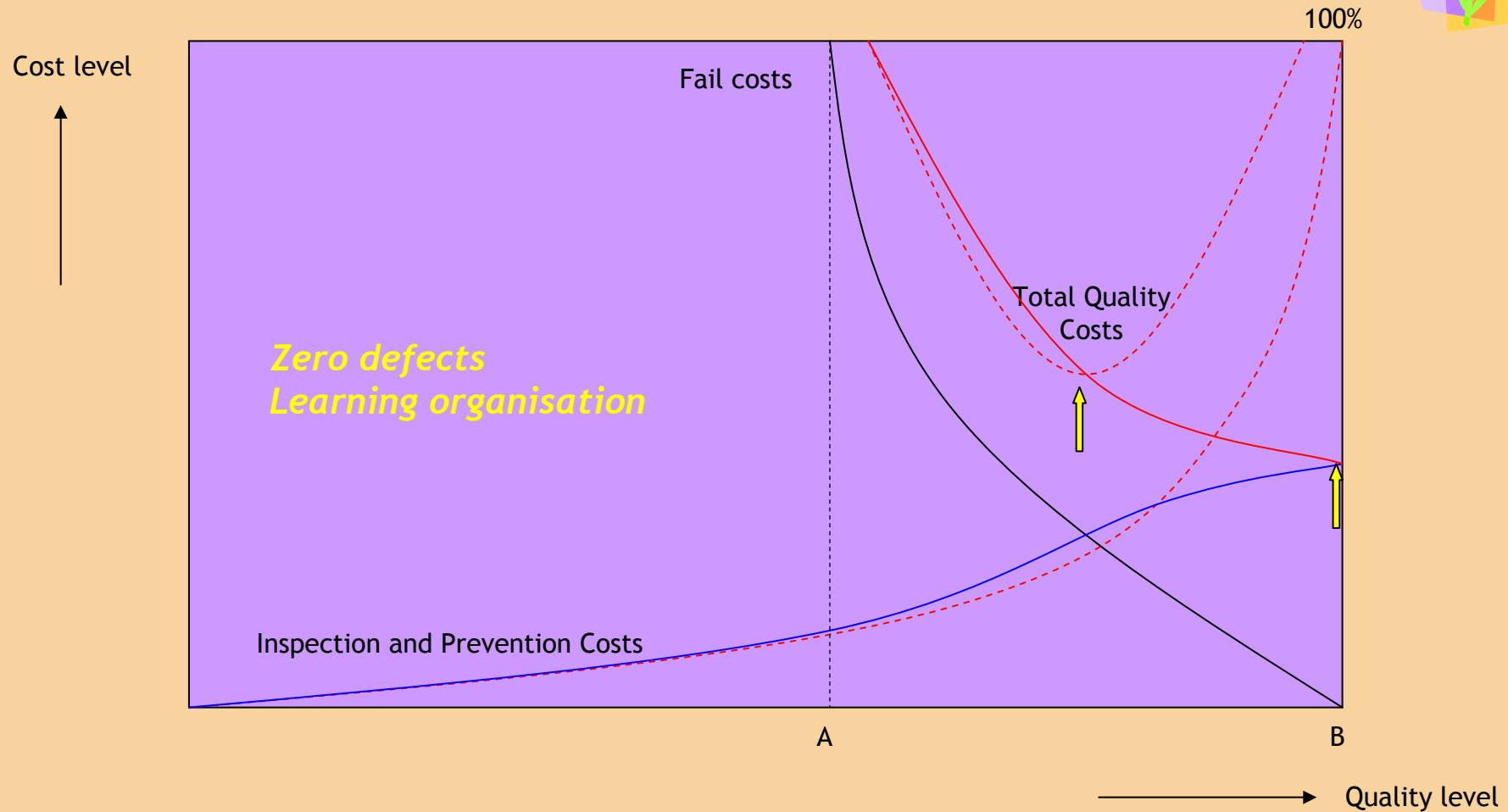
- Juran
- Schneiderman



Quality Costs by Juran



Quality Costs by Scheiderman



Conclusions/summary



- **Clear: one page overview product quality**
 - gives insight in strong and weak parts, as well as relationships
 - enables comparisons (previous revisions and competitors)
- **Levels: quantification (KPI) for reliability level**
 - reliability progress measurable
 - quantifiable control over all product revisions
- **Insight: no pass/fail, but margin to fail**
 - knowing how far from base quality level gives insight in work to be done
 - no need to do all tests again, concentrate on low robust/improvement areas (focus)
 - shows and prevents overkill in design
- **Effective: selected/limited tests**
 - more frequent tests gives more insight in progress and focus areas
 - more effective testing, insight in failure mechanisms
 - overall shorter leadtime
- **cultural fit**
 - concrete vs discrete: no p/f, but levels (digital vs analog)

- Insight
- Focus
- Time/Costs

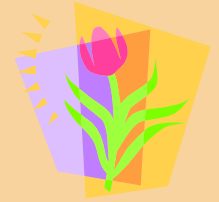


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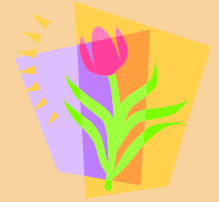
Lessons learned



- Root cause analysis very important and will be more detailed
- Monitoring very important
- One page overview works very fine
- Due time significantly reduced
- Difficult to address right failure mechanisms
- Additional to simulation testing (share between partners)
- Other way of thinking, paying back in costs (Schneiderman)
- Test labs need to be prepared (equipment/competence!!)
- Predecessor of HALT
- Management commitment/ philosophy to find failures (e.g. China)



Today's request



when testing, in your daily work:

- think once about what will happen with extended test
- think about what will happen at changed conditions
- keep an eye on ROSE and HALT, but do not forget your current position and capabilities
- **Be aware that you are using it already....**



Thanks

