Laboratoire Dubois- Testing Watches and More

Wearable 2016/EPFL

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Testing Watches and More

OUTLINE

- Introduction
- Traditional watch vs wrist wearable
- Usual tests for traditional watches
- Compliance issues
- Comparing some standards
- Conclusions

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Testing Watches and More

WHO ARE WE?

- A privately owned Swiss Laboratory
- Located in La Chaux-de-Fonds
- Created 40 years ago
- Serving the traditional watch industry since about 3 decades
- Specialised in watch reliability

Testing Watches and More

WHO ARE WE?

- Organised in 5 BU
  - *Watches and micro- mechanisms*
  - *Material science*
  - *Flexible materials*
  - *Chemistry and chemical compliance*
  - *Monitoring regulations and standards*
- Acting actively on watch industry standards
  - *NIHS (Swiss Watch Industry Standards)*
  - *ISO TC 114*
- With a broad range of accredited activities according to ISO 17025

For further info, see www.laboratoiredubois.ch

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TRADITIONAL WATCH vs WRIST WEARABLE

- Both face the same environment !
  - Movements, accelerations and shocks
  - Sweat
  - Salty atmosphere
  - Water
  - Magnetic fields
  - Sun ray (UV exposure)
  - Abrasive surfaces
  - Heat
  - …

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TRADITIONAL WATCH vs WRIST WEARABLE

- *Should keep its functions during the entire lifetime*
- *Should keep a good aspect over ageing*
- *May show some kind of water resistance*
- *Should be safe and comply to legislations*

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TRADITIONAL WATCH vs WRIST WEARABLE

…this is found on the internet !

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TRADITIONAL WATCH vs WRIST WEARABLE

And even worse…

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USUAL TESTS FOR TRADITIONAL WATCHES

- The components are separated as
  - *Movement/Watch head*
  - *Watch case*
  - *Bezel*
  - *Wristlet (metal, leather, rubber…)*
  - *Clasp*
  - *Dial*
  - *Hands*

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NIHS AND ISO STANDARDS FOR WATCHES

- Watch head
  - *Mechanical reliability tests (NIHS 91-30 and 93-20)*
  - *Water resistance (ISO 22810 and 6425)*
  - *Shock resistant wrist watches (ISO 1413)*
  - *Magnetic resistant watches (ISO 764)*
  - *Wrist-chronometers with spring-balance oscillator (ISO 3159)*
- Watch case and accessories
  - *Climatic requirements for watch surrounding (NIHS 96-50)*
  - *Tests of the resistance to wear, scratching and impacts (ISO 23160)*
  - *Mineral and sapphire watch-glasses (ISO 14368)*

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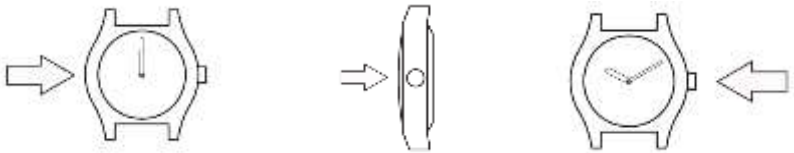
NIHS AND ISO STANDARDS FOR WATCHES

- *Shock-resistant wrist watches (ISO 1413)*
  - *Consist 2 set of impacts equivalent to a free fall of 1m on "hard wood"*
    - *First set of 3 impacts on the watch head only*

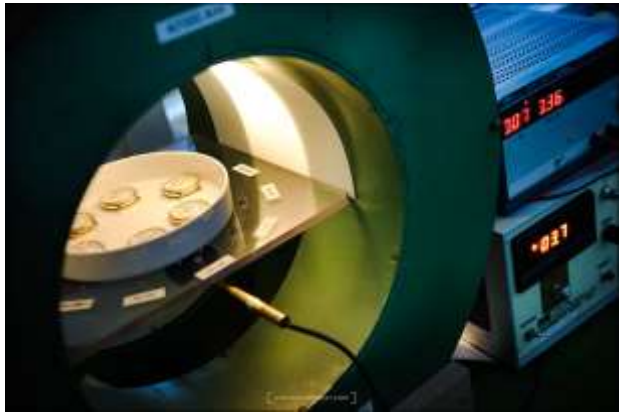


    - *Second set of 2 free fall of the entire watch*

- *If the watch comply to the requirements a marking can be added as "shock-resistant"*

NIHS AND ISO STANDARDS FOR WATCHES

- *Magnetic resistant watches (ISO 764)*
  - *Exposing the watch to a DC field of 4800 A/m*



  - *Measuring the residual effect on the movement*
- *If the watch comply to the requirements a marking can be added as “magnetic-resistant”*

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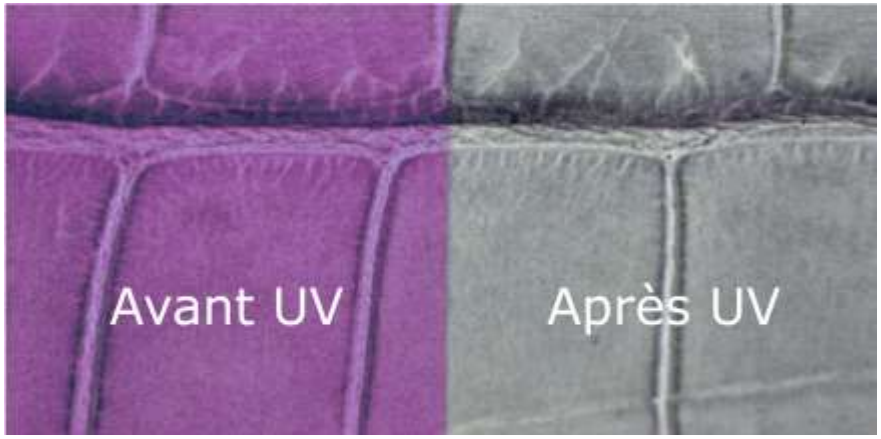
Synthetic sweat test under controlled temperature

NIHS AND ISO STANDARDS FOR WATCHES

- *Climatic requirements on watch surrounding (NIHS96-50)*

Watch case after salt spray test



UV test on leather strap

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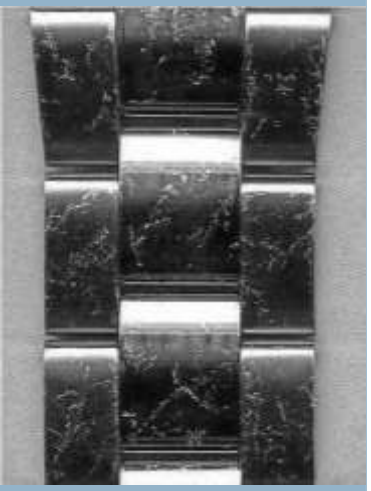
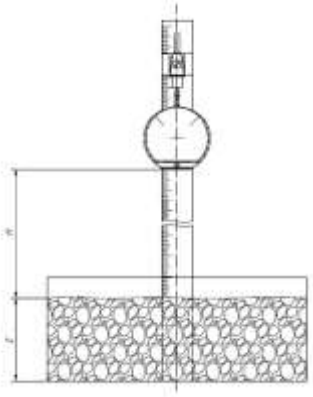


NIHS AND ISO STANDARDS FOR WATCHES

- *Tests of the resistance to wear, scratching and impacts (ISO 23160)*

Vibration wear with ceramic chips

Multidirectional mvt with fine silica powder



Free fall test in ceramic chips bed

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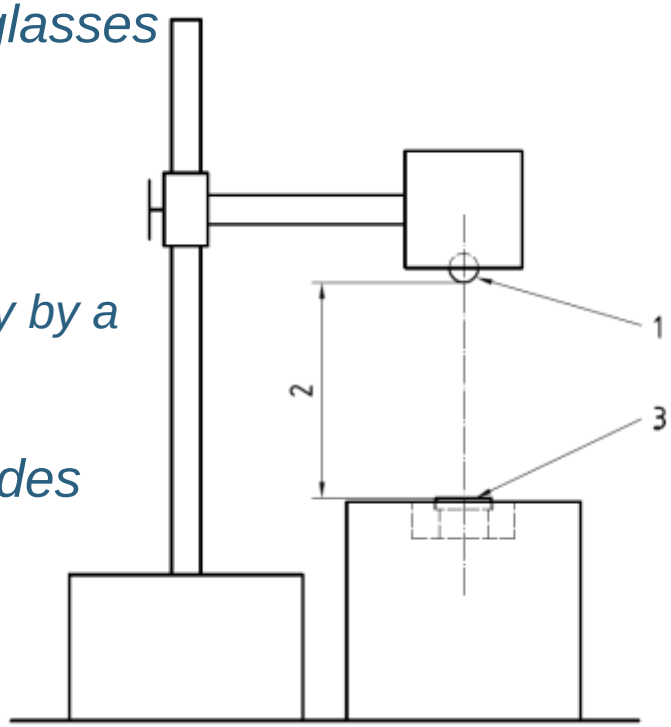
NIHS AND ISO STANDARDS FOR WATCHES

- *Mineral and sapphire watch glasses (ISO14368)*
  - *Defect assessment*
  - *Hardness measurement HK*
  - *Measuring the cracking energy by a free fall ball test*
- *The standard specify two grades of mineral glasses*



PROPRIETARY AND OTHERS TESTS

- Movement/Watch head
  - *Chronofiable ® reliability protocol*
  - *Multiple shocks protocol*
  - *Functions ageing*
  - *Mechanism ageing*
- Wristlet and clasp
  - *Random movements*
  - *Tensile torsion*
  - *Alternate movements*
  - *Clasp ageing*

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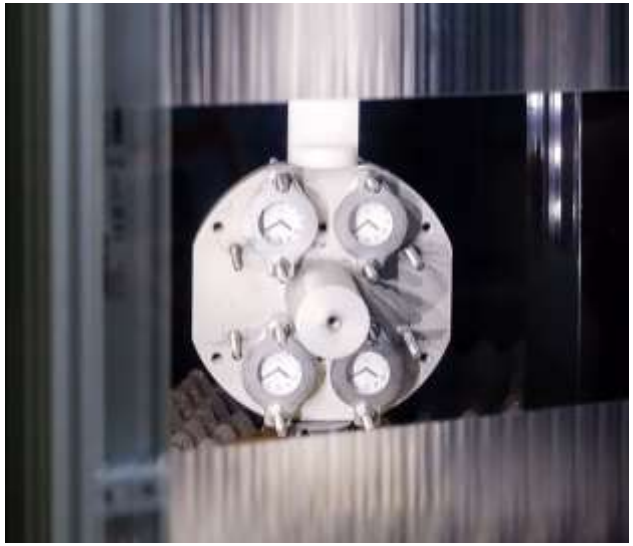
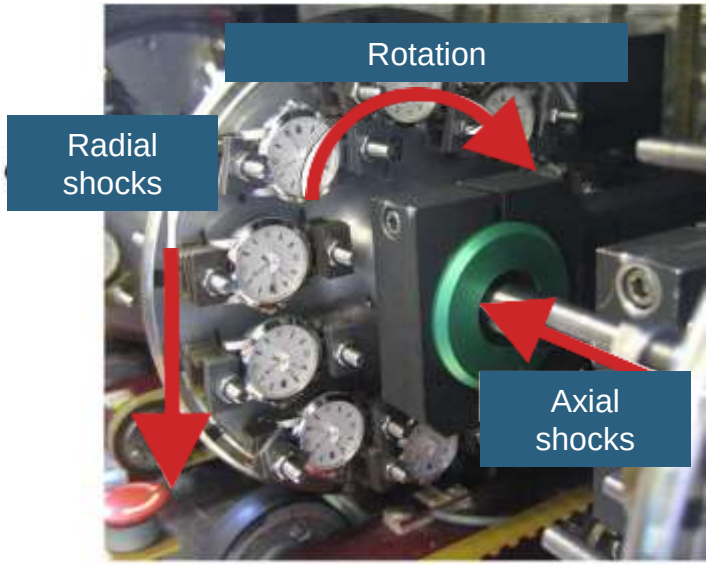
PROPRIETARY TESTS

- *Chronofiable® reliability protocol, includes heat and moisture cycles*

Simulation of 6 months wearing effects in 21 days



450 and 550 G



25 and 100 G

S SCHWEIZERISCHER PRÜFSTELLENDIENST
T SERVICE SUISSE D'ESSAI
S SERVIZIO DI PROVA IN SVIZZERA
S SWISS TESTING SERVICE
Nº 0104

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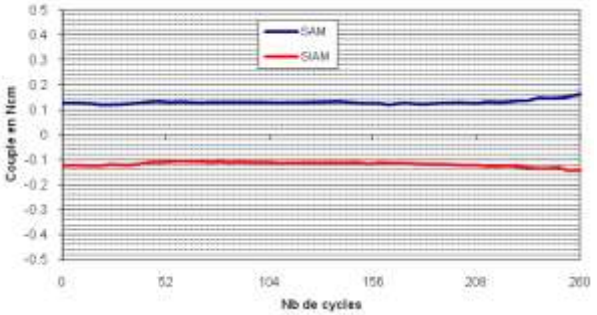
PROPRIETARY TESTS

- *Multiple shock customized protocols*
  - *Accredited STS from 10 to 1000G*
  - *Tests on watch heads, smart watches, movements in containers, micro mechanisms, sensors, MEMS…*

PROPRIETARY TESTS

- *Functions ageing*

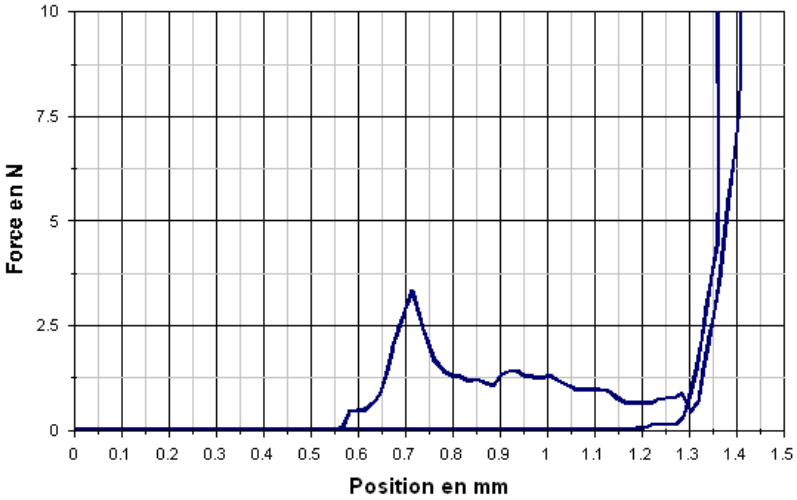


Applying cycles on rotating bezel

Ageing setting stem (winding, pull-push, date, hand-setting)

PROPRIETARY TESTS

- *Functions ageing*



Chronograph push-piece: recording push force as function of position

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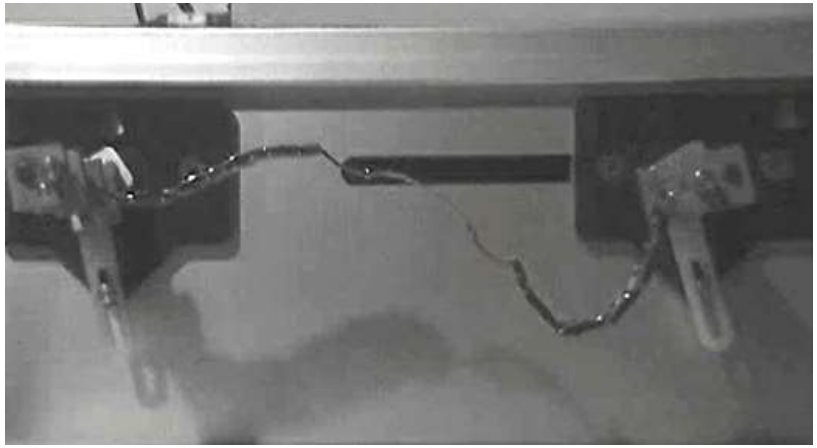
OTHERS TESTS

- *Wristlet and clasp*
  - *Random movements*
  - *Pull-Twist test*
  - *Alternate movements*



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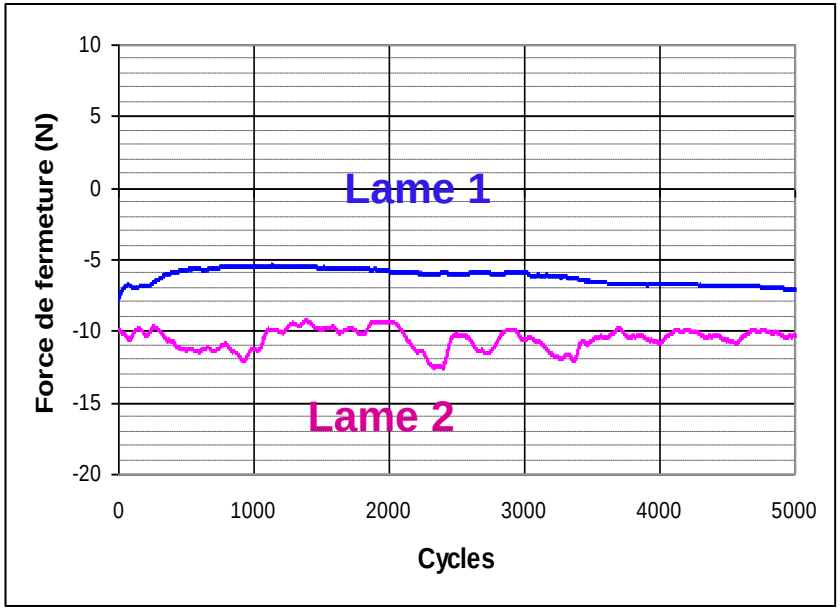
OTHERS TESTS

- *Wristlet and clasp*
  - *Clasp ageing*



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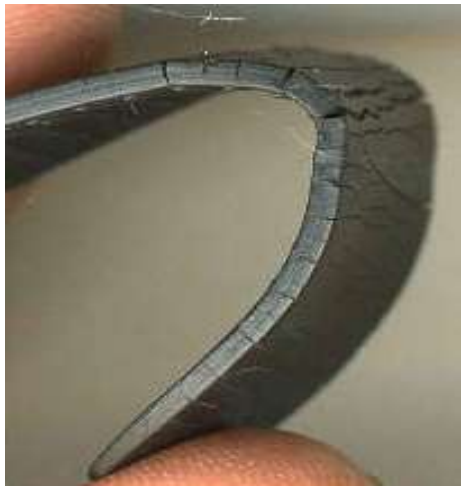
OTHER TESTS

- *Wristlet and clasp*
  - *Wear*
  - *Mechanical strength*
  - *Resistance to ozone cracking (ISO1431-1)*



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COMPLIANCE ISSUES

- Mechanical vs quartz watches
  - *Pure mechanical watches shall comply in Europe with REACH regulation*
  - *Quartz watches shall comply with RoHS and REACH*
- Wearables shall comply to both
- REACH restrictions are quite simples for metallic items
  - *Lead and Cadmium content are limited*
  - *Limitation of nickel release for items in direct and permanent contact with the skin EN 1811*

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COMPLIANCE ISSUES

- REACH restrictions are much more complex for leather, textile and rubber materials in contact with skin, for example
  - *Chromium VI in leathers (ISO 17075)*
  - *Azo dyes in leather and textiles*
  - *PAHs (polycyclic aromatic hydrocarbons) in rubber and plastics*
- Products for children face higher requirements
- WEEE directive for electrical & electronic equipment apply for wearables and quartz watches

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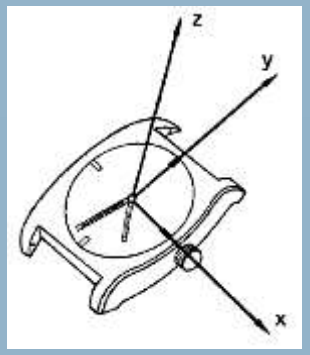
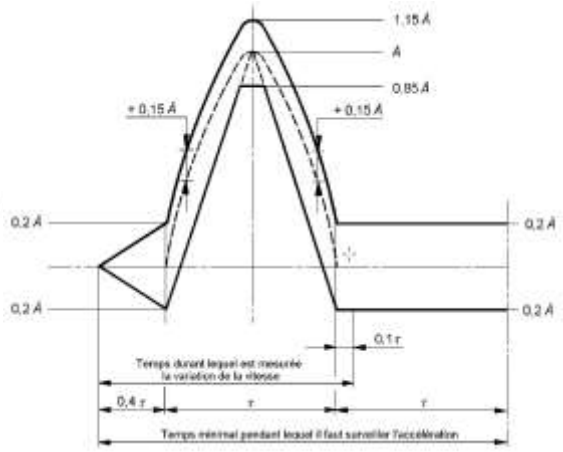
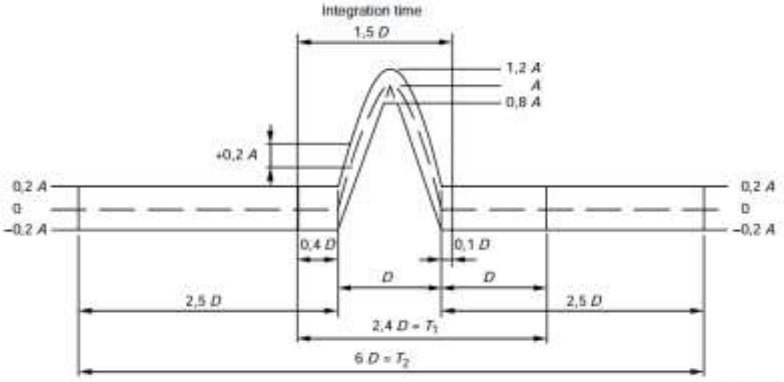


Mechanical Shocks NIHS 91-30 vs IEC 60068-2-27

COMPARING STANDARDS





Désignation du choc	Accélération (Valeur crête) A (g)	Durée τ (ms)	Variation de vitesse Δ V (m/s)
(25/5)	25	5	0,8
(100/2)	100	2	1,3
(500/0,7)	500	0,7	2,2

Peak acceleration (A)		Corresponding duration of the nominal pulse (D)	Half-sine $\Delta V = 2/\pi\ AD \times 10^{-3}$
m/s^2	g_n	ms	m/s
250	25	6	1
1 000	100	2	1,3
5 000	500	1	3,2

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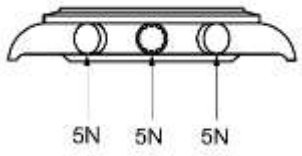
Water resistance ISO 22810 vs IEC 60529

COMPARING STANDARDS

- The watch ISO 22810 comprises the following set of tests:
  - Water overpressure, min 2, typ. 3 bar/10 min
  - Low depth immersion 10cm/1h min
  - Low depth immersion 10cm/5min while applying an orthogonal load



  - Low depth immersion 10cm/5 min at different temperatures sequentially 40-20-40 °C
- If the watch comply to the requirements, it can be marked “water resistant”

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Water resistance ISO 22810 vs IEC 60529

COMPARING STANDARDS

- The IEC 60529 (IP code) proposes 8 requirement levels for water resistance

Second characteristic numeral	Test means	Water flow rate	Duration of test	Test conditions, see
7	Immersion tank Water-level on enclosure: 0,15 m above top 1 m above bottom	–	30 min	14.2.7
8	Immersion tank Water-level: by agreement	–	by agreement	14.2.8

- Only 8+ level would offer similar severity as the watch standard

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CONCLUSIONS

- Non expressed customer expectations beside functions are almost similar for traditional watches and wristlet wearables
- Legislation requirements although poorly communicated to the customers are highly overlapping

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CONCLUSIONS

- A common set of requirements lead to an non common set of standards through differences in technologies and professional sectors
- The Wearable community may take advantages being aware of existing standards in traditional watch industry.

Many thanks for your attention

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