



SCOTT Group Proprietary Tests vs. International Safety Standards

SCOTT Sports SA – Bike Tech Workshop 2019

Introduction EFBE – History

- Founder Manfred Otto and interdisciplinary team of mechanical, electronics and physics engineers from Aachen university
- Development of proprietary high-speed, high-precision, low-cost servo-pneumatic system
- Introduction of first “pedalling forces” fatigue test stand at IFMA 1992
- Incorporation of EFBE Prüftechnik GmbH 1995, installation of brake test stand in Osaka
- 2001 first frame tests for SCOTT Sports SA
- 2016 incorporation of EFBE Co., Ltd., Taichung



Introduction EFBE – EFBE today

- Service provider exclusively to E-Bike and Bicycle industry world-wide
- Development of test methods and test equipment
- Test Services according to ISO, National and European standards and EFBE's proprietary EFBE TRI-TEST®
 - TRI-TEST: Fatigue Tests, Maximum Load Tests, Overload Tests
- Development and implementations of brand / manufacturers' standards
- Manufacture, service and calibration of test stands
- Supplier audits, QA management services
- Labs in Europe and Asia:
 - EFBE Prüftechnik GmbH, Waltrop (Ruhr Area, Western Germany)
 - EFBE Co., Ltd., Taichung (Taiwan)

Standards today

- Human Powered Bicycles:
 - ISO 4210:2014, Part 1 ... 9 (City/Trekking, MTB, Road + Young Adult)
 - 16 CFR 1512, various ASTM for cond. 0 ... 3 (acc. ASTM F2043 - 13)
 - AS/NZS 1927:2010, GB 3565:2005, JIS D 9301:2013, ...
- Electrically Assisted Bikes (EPAC)
 - EN 15194:2017 (replaced EN 15194:2009)
 - Draft for E-MTB: prEN 17404:2019
 - Future: ISO 4210-10
- Cargo Bikes (E-DIN 79010), Trailers, Accessories, ...

Problems European / International Standards

- Standardisation is based on industry consensus
- Process too slow to cover current market trends (E-MTB, Gravel, ...)
- Standards define minimum safety requirements applicable to entry level product, not high-end sporting goods



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Relevance of Standards (EN / ISO)

- Compliance with standards does not make a product safe!
- Example: Frame test “forgotten” in EN 14764:2005 and EN 15194:2009



- If “science and technology” indicate that EN 14764 is insufficient, a frame tested according to the standard may be unsafe!

Usage Categories

- Necessity to define intended use
- Necessity to account for “Foreseeable Use” (including misuse)
- EN/ISO standards stop at category 3
 - MTB according to ISO 4210 is XC bike
 - AM, Trail, Enduro, DH uncovered by existing standards



FIG. 3 Condition 2 icon



FIG. 4 Condition 3 icon



FIG. 5 Condition 4 icon

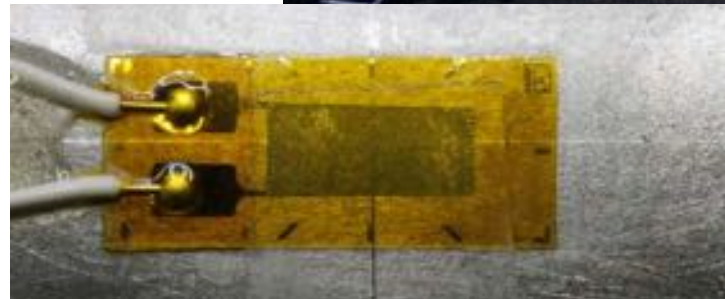
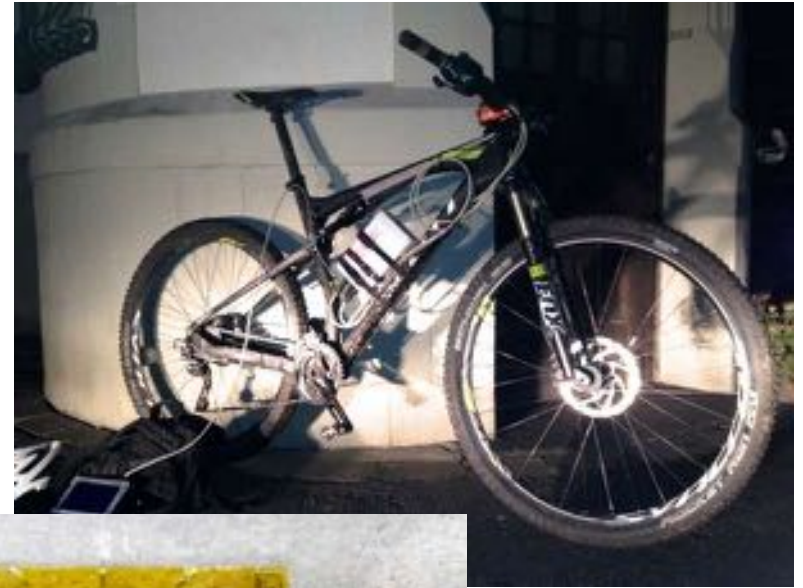


FIG. 6 Condition 5 icon

© ASTM
International
ASTM F2043-13

Measurement and evaluation of operational loads

- Identification of suitable places for instrumentation (keeping in mind and checking against established tests)
- Instrumentation of the relevant parts (strain gauges, optical fiber sensors, ...)
- Amplification, filtering and recording of signals (DAQ)
- System to archive recorded data together with relevant metadata (special events, ...)



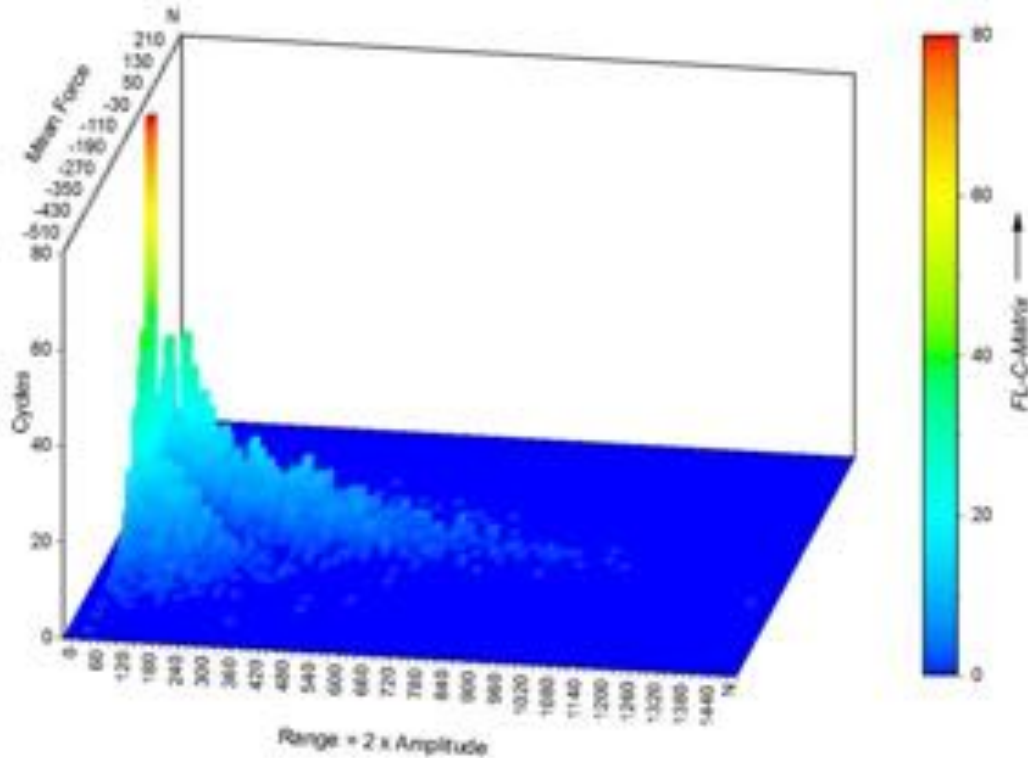
Measurement and evaluation of operational loads

- Execution of test rides, data acquisition, data management
- Individual assessment of special events (crashes, ...)
- Evaluation of strain / time data by means of suitable counting algorithms (rainflow, ...)
- Extrapolation, Superposition to generate test program
 - If the operational loads are characterised by special events / singular peak stresses, a sufficiently large pool of data is required (MTB!)
 - Planning and selection of suitable test riders, courses/trails, conditions etc. required to get valid results

Operational Loads – EFBE nine-point-eight-one



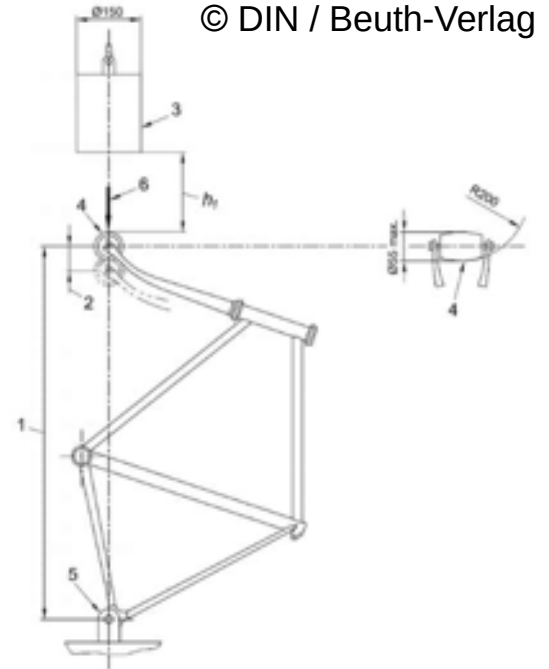
Result: Rainflow-Matrix



- Example: Handlebar loads for 1 h bike park, DH
 - Matrices can be
 - extrapolated, i.e. may be scaled up to represent x km or y hours under certain use conditions;
 - superimposed, i.e. combined with other matrices for other operational conditions
- “Synthetic user”

Failure Mode

- Product has to be safe in foreseeable use, but not “indestructible”
- Target: Benign failure mode when overloaded
- Problem: Standard (e.g. fork impact) tests penalise safe failure modes by limiting plastic deformation, i.e. ductile, benign and visible response to overload / misuse



Handling Peak Loads – Safe \neq Indestructable



Safe Failure Mode

\neq



Unsafe Failure Mode

© unknown – MTB-News.de

Relevant Load Case – Jump / Drop

- Wheelbase extension typical scenario
- Not well represented by “falling frame” impact test



Peak loads / Maximum/Overload Tests



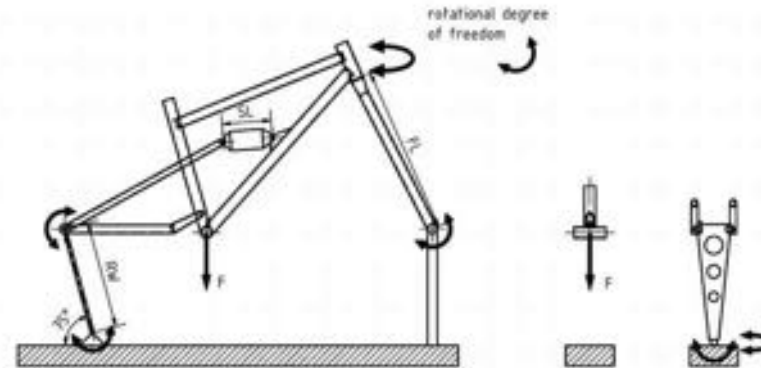
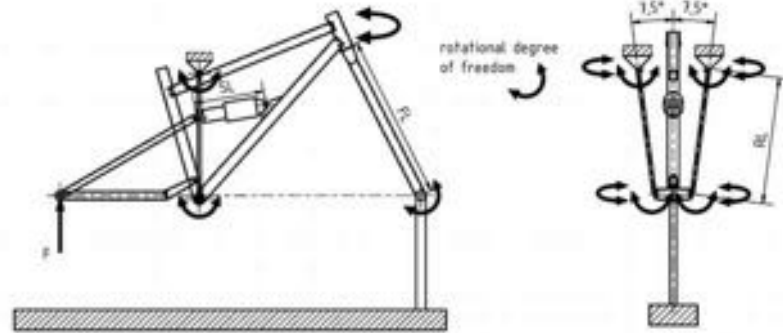
Bubba Warren @ Whistler,
August 2017

Outcome: Broken Ankle

© Jay Wallace / Island Images

Missing Load Cases – Example: Compression

- Vertical axle load fatigue test in addition to standardised load cases
- Static maximum and overload test



Missing Load Cases – Example: Lateral Loads

- MTB use brings significant lateral loads not represented anywhere in existing standards



Missing Load Cases – Example: Lateral Loads

- lateral load test in addition to standardised load cases

