# CE MD TEST REPORT

## On Behalf of

Foshan Jinmai Trading Co., LTD

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|---|---|
| Product Name: | Electric pedal assisted bicycle |
| Brand Name: | CMACEWHEEL |
| Model Number: | GW20\KS26\GT20\Y20\T20\X26\N26\K20\T12\GT11\P20 \KO20\ F26\RX20\DP20\TP26\AC16\BT20 |
| Prepared For: | **Foshan Shunde zhiqudong E-commerce Co., Ltd.** |
| Address: | **No. 6 Xincun South, Junan town, Shunde Foshan, Guangdong, China** |
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| Date of Receipt: | July 23, 2020 |
| Test Date | July 25, 2020 to August 6, 2020 |
| Date of Report | August 12, 2020 |
| Report No.: | YB201019140ZS-CE-B1 |

# TEST REPORT
# EN 15194:2017
## Cycles - Electrically power assisted cycles - EPAC Bicycles

**Report Number..... :** YB200118135WY-CE-B1

**Date of issue ..... :** August 12, 2020

**Tested by (name).....** Nina Deng

**Compiled by (name).....** Jack Li

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**Name of Testing Laboratory preparing the Report ..... :** Shenzhen Youbest Testing Technology Co., Ltd.

**Applicant's name ..... :** Foshan Shunde zhiqudong E-commerce Co., Ltd.

**Address ..... :** No. 6 Xincun South, Junan town, Shunde Foshan, Guangdong, China

**Test specification:**

Standard.....: EN 15194:2017
EN ISO 12100:2010

**Test procedure..... :** TYPE TEST

**Non-standard test method.....** N/A

**Test Report Form No..... :** EN 15194:2017

**Test Report Form(s) Originator.....** TÜV Rheinland InterCert Kft., Division MEEI

**Master TRF..... :** Dated 2019-05-14



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**Copy of marking plate:**
**The artwork below may be only a draft.**

**Electric pedal assisted bicycle**
**KS26**
Input power: DC48V 250W IPX4
EN 15194:2017
Production date: xxxxxxxx
**Foshan Shunde zhiqudong E-commerce Co., Ltd.**

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| **Possible test case verdicts:**<br>**- test case does not apply to the test object.....** N/A<br>**- test object does meet the requirement.....** P (Pass)<br>**- test object does not meet the requirement.....** F (Fail) |
| **Testing..... :**<br>**Date of receipt of test item..... :** September 1-7, 2020<br>**Date (s) of performance of tests.....** September 7, 2020 |
| |
| **General remarks:** |
| "(See Enclosure #)" refers to additional information appended to the report.<br>"(See appended table)" refers to a table appended to the report.<br><br>**Throughout this report a ☐ comma / ☒ point is used as the decimal separator.** |
| **When differences exist; they shall be identified in the General product information section.** |
| **Name and address of factory (ies)..... Foshan Shunde zhiqudong E-commerce Co., Ltd.No. 6 Xincun South, Junan town, Shunde Foshan, Guangdong, China** |
| **General product information and other remarks:**<br>The products are **Electric pedal assisted bicycle**<br>Chargers for EPAC are considered to be operated in a residential (household) environment. |

| EN 15194:2017 | | | |
|---|---|---|---|
| Clause | Requirement | Remark | Result |
| **4** | **Safety requirements and/or protective measures** | | - |
| **4.1** | **General** | | P |
| | EPAC shall be designed according to the principles of EN ISO 12100 for relevant but not significant hazards, which are not dealt with by this document. It includes evaluation of such risks for all relevant components. | | P |
| | Means shall be provided to the user to prevent an unauthorized use of the EPAC e.g. key, locks, electronic control device | | P |
| **4.2** | **Electrical requirements** | | P |
| **4.2.1** | **Electric circuit** | | P |
| | The electrical control system shall be designed so that, should it malfunction in a hazardous manner, it shall switch off power to the electric motor without causing a hazardous situation and it requires user interaction to switch on again. | | P |
| | NOTE The mechanical brakes serve as an emergency stop device and provide fast and safe stopping in emergency situations. | | P |
| **4.2.2** | **Controls and symbols** | | P |
| | If symbols are used, their meaning shall be described in the instructions for use. “On” “Off” symbols, lightings symbols, start-up assistance symbols, audible warning device symbols design shall be in accordance with those described in Annex I and Annex J. | | P |
| | A master control device shall be fitted to switch on and shut off the assistance, which shall be apparent, easy to reach and unmistakable. | | P |
| | This master control device shall be activated by voluntary action to enable all assistance modes (start up and pedalling) before use of the EPAC. | | P |
| **4.2.3** | **Batteries** | | P |
| **4.2.3.1** | **Requirements** | | P |
| | a) The EPAC and batteries pack shall be designed in order to avoid risk of fire and mechanical deterioration resulting from abnormal use. Compliance is checked by the test described in 4.2.3.2. | | P |
| | b) During the test the EPAC and the batteries shall not emit flames, molten metal or poisonous ignitable gas in hazardous amounts and any enclosure shall show no damage that could impair compliance with this European Standard. Safety and compatibility of the battery/charger combination shall be ensured, according to the manufacturer's specifications | | P |

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| Clause | Requirement | Remark | Result |
| | c) The battery terminals shall be protected against creating an accidental short circuit. | | P |
| | d) An appropriate care shall be taken to ensure that the batteries are protected against overcharging. An appropriate overheating and short circuit protection device shall be fitted | | P |
| | Batteries and the charger unit shall be labelled in order to be able to check their compatibility. | | P |
| **4.2.3.2** | **Test method** | | P |
| | Compliance with 4.2.3.1 a) is verified by the following test: | | P |
| | a) Battery terminals are short-circuited with the batteries in a fully charged condition. | | P |
| | b) Motor terminals are short-circuited; all commands are in “ON” position, while the batteries are fully charged. | | P |
| | c) The EPAC is operated with the electric motor or drive system blocked until the motor torque stops or the battery is fully discharged | | P |
| | d) The battery is charged for double the recommended charging period or for 24 h whichever is greater. | | P |
| **4.2.4** | **Battery charger** | | P |
| | Chargers for EPAC are considered to be operated in a residential (household) environment. | | P |
| | NOTE 1 For integrated battery charger with a 230V a.c. input the charger and the EPAC and for external battery charger supplied with an EPAC the requirements of the Low Voltage Directive are applicable. | | P |
| | NOTE 2 For external chargers with d.c. output less than 42,4 Volt, e.g. EN 60335–2–29 is applicable. | | P |
| **4.2.5** | **Electric cables and connections** | | P |
| **4.2.5.1** | **General** | | P |
| | All connectors for cable and wire shall be selected to prevent corrosion of electrical contact conductance. | | P |
| **4.2.5.2** | **Requirements** | | P |
| | Cable and plug temperature shall be lower than that specified by the manufacturer of the cables and plugs. Damage to cable and plug insulation shall be prevented | | P |
| | The cable cross sections shall be selected in accordance to EN 60335-1:2012, If these requirements are not met, a temperature rise test shall be performed, in accordance to 4.2.5.3. | | P |
| | NOTE Cables used exclusively for communication lines are excluded. | | P |

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| Clause | Requirement | Remark | Result |
| **4.2.5.3** | **Test method** | | P |
| | At an ambient room temperature (20 ± 5) °C, discharge the fully charged EPAC battery to the discharging limit specified by the EPAC or ESA manufacturer at the maximum current allowable by the system and record it. Measure the cable and plug temperatures and ensure, by examination, that there is no deterioration of the insulation on either assembly. | | P |
| | The increase of outer surface temperature of parts that can be touched shall be ≤ 60 K while in use on performance test rig | | P |
| **4.2.6** | **Wiring** | | P |
| | Requirements on wiring shall be checked according to the following sequence at an ambient room temperature (20 ± 5) °C. | | P |
| | a) Wire ways shall be smooth and free from sharp edges | | P |
| | b) Wires shall be protected so that they do not come into contact with burrs, cooling fins or similar sharp edges that may cause damage to their insulation. Holes in metal through which insulated wires pass shall have smooth well-rounded surfaces or be provided with bushings | | P |
| | c) Wiring shall be effectively prevented from coming into contact with moving parts. Compliance with a), b), c) shall be checked by inspection. | | P |
| | d) Separate parts of the EPAC that can move in normal use or during user maintenance relative to each other, shall not cause undue stress to electrical connections and internal conductors, including those providing ground continuity. | | P |
| | If an open coil spring is used to protect wire, it shall be correctly installed and insulated. Flexible metallic tubes shall not cause damage to the insulation of the conductors contained within them. | | P |
| | Compliance with d) shall be checked by inspection and by the following test method. | | P |
| | If flexing occurs in normal use, the appliance is placed in its normal operational position and is supplied at rated voltage under normal operation. | | P |
| | The movable part is moved backwards and forwards through the largest angle permitted by its construction, so that the conductor is flexed | | P |
| | For conductors that are flexed in normal use, flex movable part for 10 000 cycles at a test frequency of 0,5 Hz. | | P |
| | For conductors that are flexed during user maintenance, flex the movable part for 100 cycles at the same frequency. | | P |

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| Clause | Requirement | Remark | Result |
| **4.2.7** | **Power cables and conduits** | | P |
| | Conduit entries, cable entries and knockouts shall be constructed or located so that the introduction of the conduit or cable does not reduce the protection measures adopted by the manufacturer. | | P |
| | Compliance is checked by inspection. | | P |
| | Guidance for power cables size selection is given in HD 60364-5-52:2011, 5.22.1.2, 523.1523.3 | | P |
| | The insulation of internal wiring shall withstand the electrical stress likely to occur in normal use. | | P |
| | The wiring and its connections shall withstand the electrical strength test. The test voltage expressed in V shall be equal to (500+2*ur) for 2 min and applied between live parts and other metal parts only. | | P |
| **4.2.8** | **External and internal electrical connections** | | P |
| | Electrical connection shall comply with HD 60364-5-52:2011, 526.1 and 526.2. | | P |
| **4.2.9** | **Moisture resistance** | | P |
| | The electrical components of a fully assembled EPAC shall be tested and shall comply with IPX4 requirements according to EN 60529:1991. | **IP44** | P |
| **4.2.10** | **Mechanical strength test** | | P |
| | The electrical components including the battery shall have adequate mechanical strength and be constructed to withstand such rough handling that may be expected in normal use. Compliance is checked by: | | P |
| | — Applying impacts to the battery pack mounted on the EPAC by means of the spring hammer as specified in EN 60068-2-75. The battery pack is rigidly supported and three impacts are applied to every point of the enclosure that is likely to be weak with an impact energy of (0,7 ± 0,05) J. After the test the battery pack shall show no damage that could impair compliance with this European Standard; | | P |
| | — Detachable batteries are submitted to free fall on a rigid surface as specified in EN 22248 at a height of 0,90 m in three different positions. The positions shall be one surface, one edge and one corner of the enclosure that is likely to be weak. | | P |
| | After the test the battery pack shall show no damage that could lead to emission of dangerous substances (gas or liquid) ignition, fire or overheating. | | P |
| | NOTE 1 Other standards and transportation regulation given in national and international regulations, give additional requirements for general design of the battery and battery pack. | | P |

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| Clause | Requirement | Remark | Result |
| | NOTE 2 It is advised that the bicycle manufacturer make a risk analysis for the battery and battery holder interface with regard to bicycle tip over. It may be possible for damage to occur to the battery or battery interface when the bicycle falls over (see also the Introduction). | | P |
| **4.2.11** | **Maximum speed for which the electric motor gives assistance** | | P |
| **4.2.11.1** | **Requirements** | | P |
| | The electrical motor assistance shall stop when the EPAC reaches a speed of 25 km/h or lower speed if limited by design. | | P |
| | The maximum speed of the EPAC for which the electric motor gives assistance shall not differ by more than +10 % from the maximum assistance speed indicated in the marking required by Clause 5 when determined according to the test method described in 4.2.11.2. | | P |
| **4.2.11.2** | **Test method** | | P |
| **4.2.11.2.1** | **Test conditions** | | P |
| | a) The test shall be performed either on a test track, a test bench or on a stand that keeps the motor driven wheel free of the ground. | | P |
| | b) The speed-measuring device used for the test shall have the following characteristics:<br>1) Accuracy: ± 2 %;<br>2) Resolution: 0,1 km/h. | | P |
| | c) The ambient temperature shall be between 5 °C and 35 °C | | P |
| | d) Maximum wind speed: 3 m/s. | | P |
| | e) The battery shall be fully charged according to the manufacturer instructions. | | P |
| **4.2.11.2.2** | **Test procedure** | | P |
| | The cut-off speed can be measured by measuring either the motor torque output or the motor current. Other appropriate method the pertinence of which has been demonstrated can be used. | | P |
| | The following example describes the cut-off speed test. | | P |
| | a) Pre-condition the EPAC by running it for 5 min at 80 % of the maximum assistance speed as declared by the manufacturer | | P |
| | b) Record continuously the current and note the speed at which the current drops to a value equal to or less than “no load current point”. | | P |

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| Clause | Requirement | Remark | Result |
| | c) While pedalling, ride steadily to reach a speed equal to 1,25 times (if possible by design) the maximum assistance speed as declared by the manufacturer. | | P |
| | d) Verify that the noted value in b) is the no load current point. | | P |
| **4.2.12** | **Start-up assistance mode** | | P |
| **4.2.12.1** | **Requirements** | | P |
| | An EPAC can be equipped with a start-up assistance mode that operates up to a maximum speed of 6 km/h. | | P |
| | This mode shall be activated by the voluntary and maintained action of the user either when riding without pedalling or when the user is pushing the cycle | | P |
| **4.2.12.2** | **Test method** | | P |
| **4.2.12.2.1** | **Test conditions** | | P |
| | a) The test may be performed either on a test track, a test bench or on a stand that keeps the motor driven wheel free of the ground | | P |
| | b) The speed-measuring device shall have the following characteristics:<br>1) accuracy: ± 2 %;<br>2) resolution: 0,1 km/h. | | P |
| | c) The ambient temperature shall be between 5 °C and 35 °C. | | P |
| | d) Maximum wind speed: 3 m/s. | | P |
| | e) The battery shall be fully charged according to the manufacturer's instructions | | P |
| **4.2.12.2.2** | **Test procedure** | | P |
| | a) Pre-condition the EPAC by running it for 5 min at 80 % of the maximum assistance speed as declared by the manufacturer, then stop. | | P |
| | b) Activate the start-up assistance mode and verify that the speed increases up to 6 km/h maximum designed speed or lower value. | | P |
| | c) Verify that the speed reduces progressively to 0 km/h when the start-up assistance mode is deactivated and that the current drops to a value equal to or less than the no load current point when the motor driven wheel freewheels. | | P |
| | d) Activate the start-up assistance mode and maintain it for 1 min | | P |
| | e) Verify that speed is equal to or less than 6 km/h. | | P |
| | f) Verify that the start-up assistance mode is activated only when the actuation of the device to initiate it is maintained. | | P |

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| Clause | Requirement | Remark | Result |
| **4.2.13** | **Power management** | | P |
| **4.2.13.1** | **Requirements** | | P |
| | a) When tested by the method described in 4.2.13.2 the recordings shall show that assistance shall be provided only when the cyclist pedals forward. This requirement shall be checked according to the test methods described in 4.2.13.2.3; | | P |
| | b) assistance shall be cut off when the cyclist stops pedalling forward and the cut-off distance shall not exceed 2 m; | | P |
| | c) If all braking devices (e.g. levers, back pedal) are equipped with cut-off switches, the cut off distance shall not exceed 5 m; | | P |
| | d) the power output or assistance shall be progressively reduced (see Annex B) and finally cut off as the EPAC reaches the maximum assistance speed as designed. This requirement shall be checked according to the test methods described in 4.2.13.2; | | P |
| | e) the assistance shall be progressively and smoothly managed (e.g. no hunting); | | P |
| | f) two independent applying actions shall be required to start the electrical assistance mode (e.g. power switch and forward pedalling activation); a traffic caused stop (e.g. traffic lights) is not subject to this requirement; | | P |
| | g) after a deactivation of the electrical assistance mode due to any hazardous electric drive malfunction, the electric drive shall not start automatically without rider intervention (pedalling is not considered as rider intervention). | | P |
| **4.2.13.2** | **Test method – Electric motor management** | | P |
| **4.2.13.2.1** | **Test conditions** | | P |
| | a) The test may be performed either on a test track, a test bench or on a stand which keeps the motor driven wheel free of the ground; | | P |
| | b) The test track shall be according to 4.2.13.2.2; | | P |
| | c) The time-measuring device shall have an accuracy of ± 2 %; | | P |
| | d) The ambient temperature shall be between 5 °C and 35 °C; | | P |
| | e) Maximum wind speed shall not exceed 3 m/s; | | P |
| | f) The battery shall be fully charged according to the manufacturer's instructions; | | P |
| | g) Speed measurement shall have an accuracy of ± 2 %. | | P |

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| Clause | Requirement | Remark | Result |
| | The test to ensure the compliance to this clause shall be adapted to the technology used; for example: — pedal backwards and check the no load current point (see 3.48); | | P |
| | or — pedal backwards and check that no torque is delivered on the driving wheel. | | P |
| | For the test, the worst case conditions of gear ratio and speed shall be applied. The worst condition for speed is defined as 90 % of cut off speed (see 3.23). | | P |
| **4.2.13.2.2** | Test track | | P |
| | The gradient of the track shall not exceed 0,5 %. If the gradient is less than 0,2 % carry out all runs in the same direction. If the gradient lies between 0,2 % and 0,5 % carry out alternate runs in opposite directions. | | P |
| | The surface shall be hard, of concrete or fine asphalt free from loose dirt or gravel. The minimum coefficient of friction between the dry surface and the bicycle tyre shall be 0,75. | | P |
| **4.2.13.2.3** | Test procedure | | P |
| | a) Pedal backwards and check that no electric motor assistance is provided. The test to ensure the compliance to this clause shall be adapted to the technology used. | | P |
| | b) Check the cut off distance:<br>1) pedal so that the EPAC reach 90 % of the cut off speed;<br>2) stop pedalling without braking;<br>3) measure the cut off distance;<br>4) carry out the test three times; the result is the average of this measurement after rejection of invalid points. | | P |
| | c) If braking device cut-off switches are fitted, actuate each brake device separately and verify the initiation of the cut off signal while pedalling. | | P |
| **4.2.14** | **Maximum power measurement — Measurement at the engine shaft** | | P |
| | The maximum continuous rated power shall be measured according to EN 60034-1 when the motor reaches its thermal equilibrium as specified by the manufacturer. | | P |
| | NOTE Thermal equilibrium: temperatures of motor parts do not vary more than 2K per hour. | | P |
| | In circumstance where the power is measured directly at the shaft of the electronic motor, the result of the measurement shall be divided by 1,10 to consider the measurement uncertainty and then divided by 1,05 to include for example the transmission losses, unless the real values of these losses are determined. | | P |
| **4.2.15** | **Electro Magnetic Compatibility** | | P |

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| Clause | Requirement | Remark | Result |
| **4.2.15.1** | **Emission** | | P |
| | The EPAC and ESA shall fulfil the requirements of Annex C. | | P |
| **4.2.15.2** | **Immunity** | | P |
| | The EPAC and ESA shall fulfil the requirements of Annex C. | | P |
| **4.2.15.3** | **Battery charger** | | P |
| | As an EPAC is not intended to be used while charging on the electric network, for integrated charger the whole EPAC plus integrated charger shall be tested for EMC according to the applicable standards based on the European EMC directive. | | P |
| | NOTE The following European Standards are applicable for battery chargers to be used in residential environment: EN 55014–1, EN 55014–2, EN 61000–3-2, EN 61000–3-3. | | P |
| **4.2.16** | **Failure mode** | | P |
| **4.2.16.1** | **Requirements** | | P |
| | It shall be possible to ride the EPAC by pedalling even if the assistance failed. | | P |
| | This requirement shall be checked as described in 4.2.16.2. | | P |
| **4.2.16.2** | **Test method** | | P |
| | a) Remove or disconnect the battery pack | | P |
| | b) Ride the bicycle up to 10 km/h. | | P |
| **4.2.17** | **Anti-tampering measure** | | P |
| **4.2.17.1** | **General** | | P |
| | Anti-tampering measures apply to tampering or modifications that general consumers carry out concerning the control unit, drive unit or other parts of power assisting system by using commercially available tools, equipment or parts. | | P |
| **4.2.17.2** | **Prevention of tampering of the motor** | | P |
| | The following anti-tampering requirements shall be taken into account: | | P |
| | a) Anti-tampering relevant parameters indicated below shall only be accessible to the manufacturer or authorized persons and changes of software configuration parameters require programming tools that are not commercially available or security protected: | | P |
| | 1) maximum speed with motor assistance (all systems), | | P |
| | 2) parameters affecting the maximum vehicle speed limited by design, | | P |

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| Clause | Requirement | Remark | Result |
| | 3) maximum gear ratio (system with middle motors), | | P |
| | 4) maximum motor power (all systems), | | P |
| | 5) maximum speed of starting up assistance; | | P |
| | b) Assumable manipulations on the approval relevant configuration shall be prevented or compensated by effective counter measures, i.e. plausibility logics to detect manipulations on sensors; | | P |
| | c) Closed set of components (i.e. operation only with released battery); | | P |
| | d) Protection against opening of relevant components without traces (sealing). | | P |
| **4.3** | **Mechanical requirements** | | P |
| **4.3.1** | **General** | | P |
| **4.3.1.1** | **Definition of brake tests** | | P |
| | Brake tests to which accuracy requirements apply, as in 4.3.1.4, are those specified in 4.3.5.3 to 4.3.5.6 inclusive. | | P |
| **4.3.1.2** | **Definition of strength tests** | | P |
| | Strength tests to which accuracy requirements apply, as in 4.3.1.4, are those involving static, impact or fatigue loading as specified in 4.3.5.6 to 4.3.12, 4.3.13 inclusive and 4.3.19.2. | | P |
| **4.3.1.3** | **Numbers and condition of specimens for the strength tests** | | P |
| | In general, for static, impact and fatigue tests, each test shall be conducted on a new test sample, but if only one sample is available, it is permissible to conduct all of these tests on the same sample with the sequence of testing being fatigue, static and impact. | | P |
| | When more than one test is conducted on the same sample, the test sequence shall be clearly recorded in the test report or record of testing. | | P |
| | NOTE It will be noted that if more than one test is conducted on the same sample, earlier tests can influence the results of subsequent tests. Also, if a sample fails when it has been subjected to more than one test, a direct comparison with single testing is not possible. | | P |
| | In all strength tests, specimens shall be in the fully-finished condition | | P |
| **4.3.1.4** | **Accuracy tolerances of test conditions for brake tests and strength tests** | | P |

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| Clause | Requirement | Remark | Result |
| | Unless stated otherwise, accuracy tolerances based on the nominal values shall be as follows:<br>Forces and torques 0/+5 %<br>Masses and weights ±1 %<br>Dimensions ±1 mm Angles ±1°<br>Time duration ±5 s<br>Temperatures ±2 °<br>C Pressures ±5 % | | P |
| **4.3.1.5** | **Fatigue test** | | P |
| | The force for fatigue tests shall be applied and released progressively, not to exceed 10 Hz. The tightness of fasteners according to manufacturer's recommended torque can be re-checked not later than 1 000 test cycles to allow for the initial settling of the component assembly. (This is considered applicable to all components, where fasteners are present for clamping.) The test bench shall be qualified to meet dynamic requirements of 4.3.1.4. | | P |
| **4.3.1.6** | **Fatigue test for composite components** | | P |
| | For fatigue test for composite components, the initial value of displacement (peak-to-peak value) is taken after 1 000 cycles and before 2 000 cycles. | | P |
| **4.3.1.7** | **Plastic material test ambient temperature** | | P |
| | All strength tests involving any plastic materials shall be pre-conditioned for two hours and tested at an ambient temperature of 23 °C ± 5 °C. | | P |
| **4.3.1.8** | **Crack detection methods** | | P |
| | Standardized methods should be used to emphasize the presence of cracks where visible cracks are specified as criteria of failure in tests specified in this standard. | | P |
| | NOTE For example, suitable dye-penetrant methods are specified in EN ISO 3452-1 [18], EN ISO 3452-2 [19], EN ISO 3452-3 [20] and EN ISO 3452-4 [21]. In addition, white paint or surface treatment can be used to aid in detection for composite materials. | | P |
| **4.3.2** | **Sharp edges** | | P |
| | Exposed edges that could come into contact with the rider's hands, legs, etc., during normal riding or normal handling and normal maintenance shall not be sharp, e.g. deburred, broken, rolled or processed with comparable techniques. | | P |
| **4.3.3** | **Security and strength of safety-related fasteners** | | P |
| **4.3.3.1** | **Security of screws** | | P |

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| Clause | Requirement | Remark | Result |
| | Any screws used in the assembly of suspension systems or screws used to attach bracket attached electric generators, brake-mechanisms and mud-guards to the frame or fork, and the saddle to the seat-post shall be provided with suitable locking devices, e.g. lock-washers, lock-nuts, thread locking compound or stiff nuts | | P |
| **4.3.3.2** | **Minimum failure torque** | | P |
| | The minimum failure torque of bolted joints for the fastening of handle bars, handlebar-stems, bar-ends, saddle and seat-posts shall be at least 50 % greater than the manufacturer's recommended tightening torque. | | P |
| **4.3.3.3** | **Folding bicycles mechanism** | | P |
| | If provided, folding bicycle mechanism shall be designed so that EPAC can be locked for use in a simple, stable, safe way and when folded no damage shall occur to any cables. No locking mechanism shall contact the wheels or tyres during riding, and it shall be impossible to unintentionally loosen or unlock the folding mechanisms during riding. | | P |
| **4.3.4** | **Protrusions** | | P |
| | These requirements are intended to address the hazards associated with the users of EPACs falling on projections or rigid components (e.g. handlebars, levers) on EPAC possibly causing internal injury or skin puncture. Tubes and rigid components in the form of projections which constitute a puncture hazard to the rider should be protected. The size and shape of the end protection has not been stipulated, but an adequate shape shall be given to avoid puncturing of the body. Screw threads which constitute a puncture hazard shall be limited to a protrusion length of one major diameter of the screw beyond the internally threaded mating part. | | P |
| **4.3.5** | **Brakes** | | P |
| **4.3.5.1** | **Braking-systems** | | P |
| | EPAC shall be equipped with at least two independently actuated braking-systems. At least one shall operate on the front wheel and one on the rear wheel. The braking-systems shall operate without binding and shall be capable of meeting the braking-performance requirements of 4.3.5.9. | | P |
| | No hand shall need to be taken from the handlebar to operate the brake levers. | | P |
| | If additional braking-systems are implemented, they shall meet the brake requirements of 4.3.5 | | P |
| | Brake-blocks containing asbestos shall not be used. | | P |

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| Clause | Requirement | Remark | Result |
| **4.3.5.2** | **Hand-operated brakes** | | P |
| **4.3.5.2.1** | **Brake-lever position** | | P |
| | The brake levers for front and rear brakes shall be positioned according to the legislation or custom and practice of the country in which EPAC is to be sold, and EPAC manufacturer shall state in the manufacturer's instructions which levers operate the front and rear brakes (see also Clause 6 i)). | | P |
| **4.3.5.2.2** | **Brake-lever grip dimensions** | | P |
| **4.3.5.2.2.1** | **Requirement** | | P |
| | The dimension, *d,* measured between the outer surfaces of the brake-lever in the region intended for contact with the rider's fingers and the handlebar or any other covering present shall over a distance of not less than 40 mm as shown in Figure 1 not exceed 90 mm. | | P |
| | Conformance shall be established by the method detailed in 4.3.5.2.2.2. | | P |
| **4.3.5.2.2.2** | **Test method for the brake-lever similar** | | P |
| | Fit the gauge illustrated in Figure 2 — over the handlebar-grip or the handlebar (when the manufacturer does not fit a grip) and the brake-lever as shown in Figure 3 — so that the face A is in contact with the handlebar or grip and the side of the brake-lever. Ensure that the face B spans an area of that part of the brake-lever which is intended for contact with the rider's fingers without the gauge causing any movement of the brake-lever towards the handlebar or grip. Measure the distance *a*, the distance between the last part of the lever intended for contact with the rider's fingers and the end of the lever. | | P |
| | The measurement ought to be conducted only on a fully-assembled bicycle | | P |
| **4.3.5.3** | **Attachment of brake assembly and cable requirements** | | P |
| | Cable pinch-bolts shall not sever any of the cable strands when assembled to the manufacturer's instructions. In the event of a cable failing, no part of the brake mechanism shall inadvertently inhibit the rotation of the wheel. | | P |
| | The cable end shall either be protected with a cap that shall withstand a removal force of not less than 20 N or be otherwise treated to prevent unravelling. | | P |
| **4.3.5.4** | **Brake-levers – Position of applied force** | | P |

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| Clause | Requirement | Remark | Result |
| | For the purposes of braking tests in this standard, for brake-levers similar to Type A, the test force shall be applied at a distance, *b*, which is equal to either dimension *a* as determined in 4.3.5.2.2.2 or 25 mm from the free end of the brake-lever, whichever is the greater | | P |
| **4.3.5.5** | **Brake-block and brake-pad assemblies – Safety test** | | P |
| **4.3.5.5.1** | **Requirement** | | P |
| | The friction material shall be securely attached to the holder, backing-plate, or shoe and there shall be no failure of the braking system or any component thereof when tested by the method specified in 4.3.5.5.2. | | P |
| **4.3.5.5.2** | **Test method** | | P |
| | Conduct the test on a fully-assembled bicycle with the brakes adjusted to a correct position with a rider or equivalent mass on the saddle. The combined mass of the bicycle and rider (or equivalent mass) shall be 120 kg. | | P |
| | Actuate each brake-lever with a force of 180 N applied at the point as specified in Figure 4 or a force sufficient to bring the brake-lever into contact with the handlebar grip, whichever is the lesser. Maintain this force while subjecting the bicycle to five forward and five rearward movements, each of which is not less than 75 mm distance. | | P |
| | Then conduct the test described in 4.3.5.7 or 4.3.5.8 as appropriate depending on the style of brake, and then the test described in 4.3.5.9. | | P |
| **4.3.5.6** | **Brake adjustment** | | P |
| | Each brake shall be equipped with an adjustment mechanism either manual or automatic. | | P |
| | Each brake shall be capable of adjustment with or without the use of a tool to an efficient operating position until the friction material has worn to the point of requiring replacement as recommended in the manufacturer's instructions. Also, when correctly adjusted, the friction material shall not contact anything other than the intended braking surface. | | P |
| | The brake blocks of a bicycle with rod brakes shall not come into contact with the rim of the wheelswhen the steering angle of the handlebars is set at 60°, nor shall the rods be bent, or be twisted after the handlebars are reset to the central position. | | P |
| **4.3.5.7** | **Hand-operated braking-system – Strength test** | | P |
| **4.3.5.7.1** | **Requirement** | | P |

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| Clause | Requirement | Remark | Result |
| | When tested by the method described in 4.3.5.7.2, there shall be no failure of the braking-system or of any component thereof. | | P |
| **4.3.5.7.2** | **Test method** | | P |
| | Conduct the test on a fully-assembled bicycle. After it has been ensured that the braking system is adjusted according to the recommendations in the manufacturer's instructions, apply a force to the brake-lever at the point as specified in Figure 4. This force shall be 450 N, or such lesser force as is required to bring: | | P |
| | a) a brake-lever into contact with the handlebar grip or the handlebar where the manufacturer does not fit a grip; | | P |
| | b) brake extension-lever level with the surface of the handlebar or in contact with the handlebar; | | P |
| | c) a secondary brake lever to the end of its travel. | | P |
| | Repeat the test for a total of 10 times on each brake-lever, secondary brake lever or extension lever | | P |
| **4.3.5.8** | **Back-pedal braking system – Strength test** | | P |
| **4.3.5.8.1** | **General** | | P |
| | If a back-pedal braking system is fitted, the brake shall be actuated by the operator's foot applying force to the pedal in a direction opposite to that of the drive force. The brake mechanism shall function regardless of any drive-gear positions or adjustments. The differential between the drive and brake positions of the crank shall not exceed 60°. | | P |
| | The measurement shall be taken with the crank held against each position with a pedal force of at least 250 N. The force shall be maintained for 1 min in each position. | | P |
| **4.3.5.8.2** | **Requirement** | | P |
| | When tested in accordance with 4.3.5.8.3, there shall be no failure of the brake system or any component thereof. | | P |
| **4.3.5.8.3** | **Test method** | | P |
| | Conduct the test on a fully-assembled bicycle. After it has been ensured that the braking system is correctly adjusted, and with the pedal cranks in a horizontal position , apply a vertically-downward force to the centre of the left-hand pedal spindle. Increase the force progressively to 1 500 N and maintain fully for 1 min. | | P |
| **4.3.5.9** | **Braking performance** | | P |
| **4.3.5.9.1** | **General** | | P |

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| Clause | Requirement | Remark | Result |
| | The progressive characteristics of the brake are determined by linearity measurements. A final, simple track test checks for smooth, safe, stopping characteristics. | | P |
| | Conduct the braking-performance test on a fully-assembled bicycle after the brakes have been subjected to the strength test detailed in 4.3.5.7, 4.3.5.8. Before testing the bicycle, inflate the tyres and adjust the brakes all according to the manufacturer's instructions, but in the case of rim-brakes to the maximum clearance specified by the manufacturer. | | P |
| **4.3.5.9.2** | **Requirements** | | P |
| | Where EPAC is fitted with secondary brake-levers attached to brake-levers, bar-ends or aerodynamic extensions, separate tests shall be conducted for the operation of the secondary brake-levers in addition to tests with the normal levers. | | P |
| | When tested in accordance with 4.3.5.9.5, the bicycle shall fulfil the requirements shown in Table 1.<br><br>**Table 1 — Calculated braking performance value**<br>Condition / Brake in use / Minimum braking performance value, $B_p$<br>Dry / Front only / 340<br>Dry / Rear only / 220<br>Wet / Front only / 220<br>Wet / Rear only / 140<br>NOTE These values are based on the reference mass "m" (100 kg). | | P |
| **4.3.5.9.3** | **Linearity requirements** | | P |
| | When tested by the methods described in 4.3.5.9.5.6 c) 1) and 2), the braking force FBr average shall be linearly proportional (within ± 20 %) to the progressively increasing intended operating forces FOp intend. The requirement applies to braking forces FBr average equal to and greater than 80 N (according to Annex F). | | P |
| **4.3.5.9.4** | **Ratio between wet and dry braking performance requirements** | | P |
| | In order to ensure safety for both wet and dry braking, the ratio of braking performance wet: dry shall be greater than 4:10. | | P |
| | The methods for calculating this ratio are given in 4.3.5.9.5.6 g). | | P |

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| Clause | Requirement | Remark | Result |
| **4.3.5.9.5** | **Test method** | | P |
| **4.3.5.9.5.1** | **General** | | P |
| | The test machine enables the braking distances for both brakes or the rear brake alone to be calculated from measurements of the individual braking forces of the front and rear brakes on a drum or belt. | | P |
| **4.3.5.9.5.3** | **Test machine** | | P |
| | The test machine shall incorporate a system that drives the wheel under test by tyre contact and a means of measuring the braking-force, | | P |
| | The specific requirements are as follows: | | P |
| | a) the linear surface velocity of the tyre shall be 12,5 km/h and shall be controlled within ± 5 %; | | P |
| | b) a means of laterally restraining the wheel under test shall be provided which does not influence the measurement of braking force; | | P |
| | c) a means of laterally applying forces to the brake-levers at the point specified in Figure 4 shall be provided, with the width of the contact on the lever not greater than 5 mm. In the case of back-pedal brake, a means of applying forces to a pedal is also required. | | P |
| **4.3.5.9.5.4** | **Instrumentation** | | P |
| | The test machine shall be instrumented to include the following: | | P |
| | a) a device to record the surface velocity of the tyre, accurate to within ± 2 %; | | P |
| | b) a device to record the braking force (see Figures 14 and 15, for example), accurate to within ± 5 %; | | P |
| | c) a device to record the operating force applied to the hand-lever or pedal, accurate to within ± 1 %; | | P |
| | d) a water spray system, to provide wetting of the brakes of the bicycle, consisting of a water reservoir connected by tubing to a pair of nozzles arranged as shown in Figure 8. Each nozzle shall provide a flow of water at ambient temperature of not less than 4 ml/s. The wheel shall be suitably enclosed to ensure that, in addition to the rim, any hub- or disc-brake is thoroughly wetted before a test begins; | | P |
| | e) a system for loading the wheels of the bicycle against the driving mechanism (see 4.3.5.9.5.5). | | P |
| **4.3.5.9.5.5** | **Vertical force on the tested wheel** | | P |
| | The wheel to be tested shall be forced vertically downwards so that no skidding of the wheel occurs when tested according to 4.3.5.9.5.6 c) 1) and 2). | | P |

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| Clause | Requirement | Remark | Result |
| | It is permitted that the necessary force be applied anywhere on the bicycle (wheel-axle, bottom bracket, seat-post, etc.) provided that it is exerted vertically downwards. | | P |
| **4.3.5.9.5.6** | **Test method** | | P |
| | a) General: Test the front and rear wheels individually | | P |
| | b) Running-in the braking surfaces: Conduct a running-in process on every brake before the performance test is performed. | | P |
| | In order to determine the operating force to be used during the running-in process, mount and load the bicycle on the test machine with the belt or drum running at the specified speed and apply an operating force to the brake-lever or the pedal that is high enough to achieve a braking force of 200 N ± 10 %. Maintain this operating force for at least 2,5 s, and note the value of the applied operating force. | | P |
| | Repeat the procedure (applying the operating force determined as above accurate to within ± 5 %) 10 times, or, with more repetitions if necessary, until the mean braking force from anyone of the three latest tests does not deviate by more than ± 10 % from the mean braking force from these same three tests. | | P |
| | c) The performance tests: | | P |
| | 1) Testing under dry conditions: | | P |
| | For hand operated brakes, with a vertical force applied to the bicycle sufficient to prevent skidding of the tyre on the wheel under test, accelerate the driving mechanism to the specified velocity, then apply the operating-force in a series of 20 N increments from 40 N to either 180 N or to the force necessary to achieve a braking force of at least 700 N, whichever is the lesser. However, if the wheel locks, if any possible brake-overload device is actuated, or if the hand-lever comes into contact with the handlebar, do not increase the force further. For each increment of applied operating force, perform three tests within 1 min. Before applying the nextlevel of operating force, allow the brake to cool for 1 min. | | P |

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| Clause | Requirement | Remark | Result |
| | For back-pedal brakes, with a vertical force applied to the bicycle sufficient to prevent skidding of the tyreon the wheel under test, accelerate the driving mechanism to the specified velocity, then apply the operating-force in a series of 50 N increments from 100 N to either 350 N or to the force necessary to achieve a braking force of at least 400 N, whichever is the lesser. However, if the wheel locks, if any possible brake-overload device is actuated, do not increase the force further. For each increment of applied operating force, perform three tests within1 min. Before applying the next level of operating force, allow the brake to cool for 1 min. | | P |
| | The applied operating forces shall lie within ± 10 % of the intended operating forces, shall be applied as specified in Figures 5 and 6 and 4.3.5.9.5.3 c), shall be recorded with an accuracy of ± 1 %, and shall be fully applied within 1,0 s of the commencement of braking. | | P |
| | For each increment of operating force, record the braking force value, $F_{Br\ rec}$, for a period of between 2,0 s and 2,5 s, with measurement starting 0,5 s to 1,0 s after the commencement of braking. Record $F_{Br\ rec}$ as the average braking force during this measurement period. | | P |
| | The time at which the measurement of the braking force is started shall be related to the speed at which the operating force is applied. If the operating force is fully applied in less than 0,5 s after the commencement of braking, start the measurement after 0,5 s. However, if the operating force is fully applied between 0,5 s and 1,0 s after the commencement of braking, start the measurement when the operating force is fully applied. | | P |
| | 2) Testing under wet conditions: | | P |
| | The method shall be as given in 4.3.5.9.5.6 c) 1) with the addition that wetting of the brake system shall commence not less than 5,0 s before the commencement of braking and shall continue until the measurement period has ended. | | P |
| | d) Correction of braking force: | | P |
| | Each recorded braking force, FBr rec, shall be corrected for any difference between the recorded operating force and the intended operating force. The corrected braking force shall be calculated by multiplying the recorded braking force, FBr rec, with a correction factor which is the ratio between the intended operating force, FOp intend, and the recorded operating force, FBr rec. | | P |

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| Clause | Requirement | Remark | Result |
| | e) Test results: Select from the record the maximum output braking force, FBr max, for each combination of wheel (front or rear) and each test condition (wet or dry). | | P |
| | Where a manufacturer specifies that his EPAC can carry a mass such that the sum of that mass plus the mass of EPAC is in excess of 100 kg to some value M, apply M as total mass. | | P |
| | f) Linearity Plot the calculated FBr average values (the arithmetic mean of the three corrected braking forces at each level of operating force) against the equivalent operating force values, FOp intend, in order to assess the linearity against the requirement in 4.3.5.9.3. Plot the results on a graph, showing the line of best fit and the ± 20 % limit lines obtained by the method of least squares outlined in Annex G. | | P |
| | g) Ratio between wet and dry braking For each FOp where FDBr average is > 200 N, determine (using the following formula) whether or not the requirements of have been met: For symbols see 4.3.5.9.5.2. | | P |
| | h) Simple track test (see 4.3.18). After completion of the machine test, conduct a brief, simple track test with progressively increasing operating forces to determine whether or not the brakes bring the bicycle to a smooth, safe stop. | | P |
| **4.3.5.10** | **Brakes – Heat-resistance test** | | P |
| **4.3.5.10.1** | **General** | | P |
| | This test applies to all disc- and hub-brakes but to rim-brakes only where they are known or suspected to be manufactured from or include thermoplastic materials. | | P |
| | Each brake on the bicycle shall be tested individually, but where the front and rear brakes are identical only one brake need be tested. | | P |
| **4.3.5.10.2** | **Requirement** | | P |
| | Throughout the test described in 4.3.5.10.3, the brake-lever shall not touch the handlebar-grip, the operating force shall not exceed 180 N, and the braking force shall not deviate outside the range 60 N to 115 N. | | P |
| | Immediately after having been subjected to the test described in 4.3.5.10.3, the brakes shall achieve at least 60 % of the braking performance which was recorded at the highest operating force used during the performance tests 4.3.5.9.5.6 c) 1) and 2). | | P |
| **4.3.5.10.3** | **Test method** | | P |

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| Clause | Requirement | Remark | Result |
| | Drive the wheel and tyre assembly with the brake applied on a machine such as those described in 4.3.5.9.5.3 at a velocity of 12,5 km/h ± 5 % with a rearward, cooling air-velocity of 12,5 km/h ± 10 %, so that a total braking energy of E Wh ± 5 % specified in Table 2 is developed. The duration of the test shall be 15 min ± 2 min. | | P |
| | Allow the brake to cool to ambient temperature and then repeat the test cycle. | | P |
| | A maximum of 10 interruptions per test cycle is permitted, each with a maximum duration of 10 s. | | P |
| | When the test has been carried out, subject the brakes to the applicable parts of the tests described in 4.3.5.9.5.6 c) 1) and 2). | | P |
| | Calculate the braking energy from the following formula: $E = F_{Br} \times V_{Br} \times T\,(Wh)$ | | P |
| | When the test has been carried out, the brakes shall be subjected to the applicable parts of the test described in 4.3.5.9.5, in order to check that the requirement 4.3.5.10.2 is fulfilled. | | P |
| **4.3.5.11** | **Back-pedal brake linearity test** | | P |
| | This test shall be conducted on a fully assembled EPAC. The output force for a back-pedal brake shall be measured tangentially to the circumference of the rear tyre, when the wheel is rotated in the direction of forward movement, while a force of between 90 N and 300 N is being applied to the pedal at right angles to the crank and in the direction of braking. | | P |
| | The braking force reading shall be taken during a steady pull and after one revolution of the wheel. A minimum of five results, each at a different pedal force level, shall be taken. Each result shall be the average of three individual readings at the same load level. | | P |
| | The results shall be plotted on a graph, showing the line of best fit and the ± 20 % limit lines obtained by the method of least squares outlined in Annex F. | | P |
| **4.3.6** | **Steering** | | P |
| **4.3.6.1** | **Handlebar – Dimensions** | | P |
| | Adjust the handlebar height to its highest normal riding position and the saddle to its lowest normal riding position as specified by the manufacturer). Measure the vertical distance from the centre and top of the handlebar grips to a point where the saddle surface is intersected by the seat post axis. This dimension shall not exceed 400 mm. | | P |
| **4.3.6.2** | **Handlebar grips and plugs** | | P |

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| Clause | Requirement | Remark | Result |
| **4.3.6.2.1** | **Requirements** | | P |
| | The ends of the handlebar shall be fitted with handgrips or end plugs. When tested by the method described in 4.3.6.2.2 and 4.3.6.2.3, the handgrips or plugs shall withstand the specified removal forces. | | P |
| **4.3.6.2.2** | **Freezing test method** | | P |
| | Immerse the handlebar, with handlebar grips or plugs fitted, in water at room temperature for one hour and then place the handlebar in a freezer until the handlebar is at a temperature lower than −5 °C. Remove the handlebar from the freezer and allow the temperature of the handlebar to reach −5 °C, and then apply a force of 70 N to the grip or plug in the loosening direction as shown in Figure 10. Maintain the force until the temperature of the handlebar has reached +5 °C. | | P |
| | It shall be permitted to create a hole in the plug to allow for the testing fixture to be fitted so long as the hole does not affect the seat of the plug in the handlebar and the fixture does not contact the handlebar during the test. | | P |
| **4.3.6.2.3** | **Hot water test method** | | P |
| | Immerse the handlebar, with handlebar grips fitted, in hot water of +60 °C ± 2 °C for one hour. Remove the handlebar from the hot water, allow the handlebar to stabilize at ambient temperature for 30 min, apply a force of 100 N to the grip in the loosening direction as shown in Figure 10. Maintain this force for 1 min. | | P |
| **4.3.6.3** | **Handlebar stem – Insertion-depth mark or positive stop** | | P |
| | The handlebar-stem shall be provided with one of the two following alternative means of ensuring a safe insertion depth into the fork steerer: | | P |
| | a) it shall contain a permanent, transverse mark, of length not less than the external diameter of the stem, that clearly indicates the minimum insertion depth of the handlebar-stem into the fork steerer. The insertion mark shall be located at a position not less than 2,5 times the external diameter of the handlebar-stem from the bottom of the stem, and there shall be at least one stem diameter's length of contiguous, circumferential stem material below the mark; | | P |
| | b) it shall incorporates a permanent stop to prevent it from being drawn out of the fork steerer such as to leave the insertion less than the amount specified in a) above. | | P |
| **4.3.6.4** | **Handlebar stem to fork steerer – Clamping requirements** | | P |

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| Clause | Requirement | Remark | Result |
| | The distance g, between the top of the handlebar stem and the top of the fork steerer to which the handlebar stem is clamped shall not be greater than 5 mm. | | P |
| | The upper part of the fork steerer to which the handlebar stem is clamped shall not be threaded. | | P |
| | The dimension *g* shall also ensure that the proper adjustment of the steering system can be achieved. | | P |
| | For aluminium and composite fork steerer any internal device that could damage the internal surface of the fork steerer shall be avoided. | | P |
| **4.3.6.5** | **Steering stability** | | P |
| | The steering shall be free to turn through at least 60° either side of the straight-ahead position and shall exhibit no tight spots, stiffness or slackness in the bearings when correctly adjusted. | | P |
| | A minimum of 25 % of the total mass of EPAC and rider shall act on the front wheel when the rider is holding the handlebar grips and sitting on the saddle, with the saddle and rider in their most rearward positions. | | P |
| **4.3.6.6** | **Steering assembly – Static strength and safety tests** | | P |
| **4.3.6.6.1** | **Handlebar and stem assembly – Lateral bending test** | | P |
| **4.3.6.6.1.1** | **General** | | P |
| **4.3.6.6.1.2** | **Requirement** | | P |
| | When tested by the method described in 4.3.6.6.1.3, there shall be no cracking or fracture of the handlebar, stem or clamp-bolt and the permanent deformation measured at the point of application of the test force shall not exceed 15 mm. | | P |
| **4.3.6.6.1.3** | **Test method** | | P |

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| Clause | Requirement | Remark | Result |
| | Assemble the handlebar and stem in accordance with the manufacturer's instructions and, unless the handlebar and stem are permanently connected, e.g. by welding or brazing, align the grips portion of the handlebar in a plane perpendicular to the stem axis. For stems which have a quill for insertion into a fork steerer, clamp the quill securely in a fixture to the minimum insertion depth, or, for stem extensions which clamp directly onto an extended fork steerer attach the extension to a fork steerer according to the manufacturer's instructions and clamp this fork steerer securely in a fixture to the appropriate height. Apply a force of F2 at a distance of 50 mm from the free end of the handlebar and parallel to the axis of the fork steerer as. Maintain this force for 1 min. | | P |
| **4.3.6.6.2** | **Handlebar-stem – Forward bending test** | | P |
| **4.3.6.6.2.1** | **General** | | P |
| | Conduct the test in two stages on the same assembly as follows. | | P |
| **4.3.6.6.2.2** | **Requirement for Stage 1** | | P |
| | When tested by the method described in 4.3.6.6.2.3, there shall be no visible cracks or fractures and the permanent deformation measured at the point of application of the test force and in the direction of the test force shall not exceed 10 mm. | | P |
| **4.3.6.6.2.3** | **Test method for Stage 1** | | P |
| | For stems which have a quill for insertion in to a fork steerer, clamp the quill securely in a fixture to the minimum insertion depth or, for stem extensions which clamp directly on to an extended fork steerer, clamp the handlebar-stem extension securely on to a suitable, solid-steel bar and clamp the bar in securely in a fixture, the projecting length of the bar not being critical. | | P |
| | Apply a force $F_3$ of 1 600 N through the handlebar attachment point in a forward and downward direction and at 45° to the axis of the quill or steel bar as shown in Figure 13 and maintain this force for 1 min. Release the test force and measure any permanent deformation. | | P |
| | If the handlebar-stem meets the requirement of 4.3.6.6.2.2, conduct Stage 2 of the test. | | P |
| **4.3.6.6.2.4** | **Requirement for Stage 2** | | P |
| | When tested by the method described in 4.3.6.6.2.5, there shall be no visible cracks or fractures. | | P |

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| Clause | Requirement | Remark | Result |
| **4.3.6.6.2.5** | **Test method for Stage 2** | | P |
| | With the handlebar-stem mounted as in Stage 1, apply a progressively increasing force in the same position and direction as in stage 1 until either the force reaches a maximum of F4 or until the handlebar-stem deflects 50 mm measured at the point of application of the test force and in the direction of the test force. If the stem does not yieldor continue to yield, maintain the force for 1 min. | | P |
| **4.3.6.6.3** | **Handlebar to handlebar-stem – Torsional safety test** | | P |
| **4.3.6.6.3.1** | **Requirement** | | P |
| | When tested by the method described in 4.3.6.6.3.2, there shall be no movement of the handlebar relative to the handlebar-stem. | | P |
| **4.3.6.6.3.2** | **Test method** | | P |
| | The exact method of applying the torque will vary with the type of handlebar, and an example is shown | | P |
| | If bar-ends are fitted by the manufacturer, the test forces shall be applied to them in the test. If according to the manufacturer's instructions bar-ends may be used, simulated bar-ends) shall be used for the test. | | P |
| **4.3.6.6.4** | **Handlebar-stem to fork steerer – Torsional safety test** | | P |
| **4.3.6.6.4.1** | **Requirement** | | P |
| | When tested by the method described in 4.3.6.6.4.2, there shall be no movement of the handlebar-stem relative to the fork steerer. | | P |
| **4.3.6.6.4.2** | **Test method** | | P |
| | Assemble the fork steerer correctly in the frame and attach the handlebar-stem to the fork steerer with the locking system tightened in accordance with the manufacturer's instructions, and apply a torque of $T_2$ once in each direction of possible rotation by applying a force on test-bar in a plane perpendicular to the axis of the fork-steerer/handlebar-stem. Maintain each torque for 1 min. | | P |
| **4.3.6.6.5** | **Bar-end to handlebar – Torsional safety test** | | P |
| **4.3.6.6.5.1** | **Requirement** | | P |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | When tested by the method described in 4.3.6.6.5.2, there shall be no movement of the bar-end in relation to the handlebar. | | P |
| **4.3.6.6.5.2** | **Test method** | | P |
| | Secure the handlebar in a suitable fixture and assemble the bar-end on the handlebar tightening the fixings in accordance with the bar-end manufacturer's instructions. Apply a force of F5 in accordance with the following: | | P |
| | a) the bar-end's length is more than 100 mm, at a distance of 50 mm from the free end of the bar-end); | | P |
| | b) the bar-end's length is from 50 mm to 100 mm, at a distance of 50 mm from the axis of the handlebar); | | P |
| | c) the bar-end's length is less than 50 mm, apply a load to the mid-point of the bar end). | | P |
| **4.3.6.7** | **Handlebar and stem assembly – Fatigue test** | | P |
| **4.3.6.7.1** | **General** | | P |
| | Handlebar-stems can influence test failures of handlebars and for this reason, a handlebar shall always be tested mounted in a stem, but it is permitted to test a stem with a solid bar in place ofthe handlebar and bar-ends with dimensions corresponding to handlebars/bar-ends suitable for that stem. | | P |
| | When the fatigue test is for the stem only, the manufacturer of the stem shall specify the types and sizes of handlebar for which the stem is intended and the test shall be based on the most severe combination. Conduct the test in two stages on the same assembly. | | P |
| **4.3.6.7.2** | **Requirement for Stage 1 and Stage 2** | | P |
| | When tested by the method described in 4.3.6.7.3 or 4.3.6.7.4, there shall be no visible cracks or fractures in any part of the handlebar and stem assembly or any bolt failure. | | P |
| | For composite handlebars or stems, the running displacements (peak-to-peak value) at the points where the test forces are applied shall not increase by more than 20 % of the initial values. | | P |
| **4.3.6.7.3** | **Test method for Stage 1** | | P |
| | Unless the handlebar and stem are permanently connected, e.g. by welding or brazing, align the grips of portion of the handlebar in a plane perpendicular to the stem axis ) and secure the handlebar to the stem according to the manufacturer's instructions. | | P |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | Clamp the handlebar stem securely in a fixture to the minimum insertion depth, or in the case of a stem extension which is intended to be clamped to an extended fork steerer secure the extension using the manufacturer's recommended tightening procedure to an extended fork steerer which is secured in fixture to the appropriate length. | | P |
| | For handlebars where the manufacturer states that they are not intended for use with bar-ends, apply fully-reversed forces of F6 at a position 50 mm from the free end each side of the handlebar for 100 000 cycles, with the forces at each end of the handlebar being out of phase with each other and parallel tothe axis of the handlebar stem as. The maximum test frequency shall be maintained as specified in4.3.1.5. | | P |
| **4.3.6.7.4** | **Test method for Stage 2** | | P |
| | Apply fully-reversed forces of F7 at a position 50 mm from the free end each side of the handlebar for 100 000 cycles, with the forces at each end of the handlebar being in phase with each other and parallel to the axis of the handlebar. The maximum test frequency shall be maintained as specified in 4.3.1.5. | | P |
| **4.3.7** | **Frames** | | P |
| **4.3.7.1** | **Suspension-frames – Special requirement** | | P |
| | The design shall be such that if the spring or damper fails, neither the tyre shall contact any part of the frame nor the assembly carrying the rear wheel become detached from the rest of the frame. | | P |
| **4.3.7.2** | **Frame – Impact test (falling mass)** | | P |
| **4.3.7.2.1** | **Requirements** | | P |
| | When tested by the method described in 4.3.7.2.3, there shall be no visible cracks or fractures of the frame | | P |
| | The permanent deformation measured between the axes of the wheel axles shall not exceed the following values: | | P |
| | a) 30 mm where a fork is fitted; | | P |
| | b) where a dummy fork is fitted in place of a fork, the values are given in Table 9. | | P |
| **4.3.7.2.2** | **General** | | P |

**Table 9 — The values of permanent deformation**

| Fork type | Real fork | Dummy fork |
|---|---|---|
| Permanent deformation | 30 mm | 10 mm |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | Manufacturers of frames are permitted to conduct the test with a dummy fork (see Annex E) fitted in place of a front fork. | | P |
| | Where a frame is convertible for male and female riders by the removal of a bar, test it with the bar removed. | | P |
| | Where a suspension fork is fitted, test the assembly with the fork extended to its unloaded free length. Where a rear suspension system is incorporated in the frame, secure the suspension in a position equivalent to that which would occur with a 90 kg rider seated on the bicycle. If the type of suspension system does not permit it to be locked, then replace the spring/damper unit by a solid link of the appropriate size and with end fittings similar to those of the spring/damper unit. | | P |
| **4.3.7.2.3** | **Test method** | | P |
| | Assemble a roller of mass less than or equal to 1 kg and with dimensions conforming to those shown in Figure 19 in the fork. The hardness of roller shall be not less than 60 HRC at impact surface. If a dummy fork is used in place of a fork the bar shall have a rounded end equivalent in shape to the roller. Hold the frame-fork or frame-bar assembly vertically by clamping to a rigid fixture by the rear-axle attachment | | P |
| | Rest a striker of mass 22,5 kg on the roller in the fork drop-outs or on the rounded end of the dummy fork and measure the wheelbase. Raise the striker to a height of $h_1$ above the low-mass roller and release it to strike the roller or the steel bar at a point in line with the wheel centres and against the direction ofthe fork rake or rake of the bar. The drop heights are given in Table 10. The striker will bounce and this is normal. When the striker has come to rest on the roller or dummy fork, measure the wheelbase again. If the fork fails, the frame shall be tested with a dummy-fork.<br>**Table 10 — Drop heights**<br>Drop height, $h_1$ : 360 mm | | P |
| **4.3.7.3** | **Frame and front fork assembly – Impact test (falling frame)** | | P |
| **4.3.7.3.1** | **General** | | P |
| | Manufacturers of complete EPACs shall conduct the test with the frame fitted with the appropriate front fork. | | P |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | Where a frame is convertible for male and female riders by the removal of a bar, test it with the bar removed. | | P |
| | Where a suspension fork is fitted, it shall be at its unloaded length prior to the impact. If the spring damper unit can be locked, it shall be locked in its unloaded length position. If the spring/damper cannot be locked, use one of the two following alternative procedures: | | P |
| | a) secure the fork at its extended length by an external locking method, or | | P |
| | b) replace the fork by a rigid fork which is known to meet the requirements of the impact test described in 4.3.8.5 and of a length which is consistent with an 90 kg rider seated in a normal riding position on the bicycle when it is equipped with the suspension fork. | | P |
| | Where a rear suspension system is incorporated in the frame, secure the spring/damper unit in a position equivalent to that which would occur with an 90 kg rider seated on the bicycle; if the type of suspension system does not permit it to be locked, then replace the spring/damper unit by a solid link of the appropriate size and with end fittings similar to those of the spring/damper unit. | | P |
| **4.3.7.3.2** | **Requirement** | | P |
| | When tested by the method described in 4.3.7.3.3, there shall be no visible cracks or fractures in the assembly and after the second impact there shall be no separation of any parts of any suspension system. The permanent deformation measured between the axes of the wheel axles shall not exceed the values specified in Table 11.<br>**Table 11 — The values of permanent deformation**<br>Permanent deformation: 60 mm | | P |
| **4.3.7.3.3** | **Test method** | | P |
| | Conduct the test on the assembly used for the test in 4.3.7.2. | | P |
| | mount the frame-fork assembly at its rear axle attachment points so that it is free to rotate about the rear axle in a vertical plane. Support the front fork on a flat steel anvil so that the frame is in its normal position of use. Securely fix mass M1 to the seat-post with the centre of gravity at distance D (= 75 mm) along the seat-post axis from the insertion point, and fix masses of M1, M2, and M3 to the top of the steering head, the seat-post, and the bottom bracket respectively | | P |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | Measure the wheelbase with the three masses in place. Rotate the assembly about the rear axle until the distance between the low-mass roller and the anvil is $h_2$ then allow the assembly to fall freely to impact on the anvil. | | P |
| | Repeat the test and then measure the wheelbase again with the three masses in place and the roller resting on the anvil. | | P |
| **4.3.7.4** | **Frame – Fatigue test with pedalling forces** | | P |
| **4.3.7.4.1** | **General** | | P |
| | In tests on suspension-frames with pivoted joints, adjust the spring, air-pressure, or damper to provide maximum resistance, or, for a pneumatic damper in which the air-pressure cannot be adjusted, replace the suspension-unit with a rigid link, ensuring that its end fixings and lateral rigidity accurately simulate those of the original unit. For suspension-frames in which the chain-stays do not have pivots but rely on flexing, ensure that any dampers are set to provide the minimum resistance in order to ensure adequate testing of the frame. | | P |
| | Where a suspension-frame has adjustable brackets or linkages to vary the resistance of the bicycle against the ground-contact forces or to vary the attitude of the bicycle, arrange the positions of these adjustable components to ensure maximum forces in the frame. | | P |
| **4.3.7.4.2** | **Requirement** | | P |
| | When tested by the method described in 4.3.7.4.3, there shall be no visible cracks or fractures in any part of the frame, and there shall be no separation of any parts of the suspension system. | | P |
| | For composite frames, the running displacements (peak-to-peak values) at the points where the test forces are applied shall not increase by more than 20 % of the initial values (see 4.3.1.6). | | P |
| **4.3.7.4.3** | **Test method** | | P |
| | Use a new frame/fork assembly fitted with standard head-tube bearings for the test. The front fork may be replaced by a dummy fork (see Annex F) of the same length and at least the same stiffness as the original fork. | | P |
| | If a genuine fork is used, failures of the fork are possible, therefore, it is recommended that for convenience, a dummy fork stiffer and stronger than the genuine fork is used. | | P |
| | Where a frame is convertible for male and female riders by the removal of a bar, test it with the bar removed. | | P |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | Mount the frame assembly on a base as shown in Figure 3 with the fork or dummy fork secured by its axle to a rigid mount of height Rw (the radius of the wheel/tyre assembly ± 30 mm) and with the hub free to swivel on the axle. Secure the rear drop-outs by means of the axle to a stiff, vertical link of the same height as that of the front, rigid mount, the upper connection of the link being free to swivel about the axis of the axle but providing rigidity in a lateral plane, and the lower end of the link being fitted with a ball-joint. | | P |
| | Fit a crank, chain-wheel and chain assembly or, preferably, a strong, stiff, replacement assembly to the bottom bracket below | | P |
| | a) If a crank/chain-wheel assembly is used, incline both cranks forwards and downwards at an angle of 45° (accurate ± 2,0°) to the horizontal and secure the front end of the chain to the middle chain-wheel of three, the smaller chain-wheel of two, or the only chain-wheel. Attach the rear end of the chain to the rear axle and perpendicular to the axis of the axle. | | P |
| | b) If an adaptor assembly is used (as shown in Figure 3), ensure that the assembly is free to swivel about the axis of the bottom-bracket and that both replacement arms are 175 mm long (*L*) and that they are both inclined forwards and downwards at an angle of 45° (accurate ± 2,0°) to the horizontal. Secure the position of the crank replacement arms by a vertical arm (which replaces the chain-wheel) and a tie-rod which has ball-joints at both ends and which is attached to the rear axle perpendicular to the axis of the rear axle. The length of the vertical arm ($R_c$) shall be 75 mm and the axis of the tie-rod shall be parallel to and 50 mm from the vertical plane through the centre-line of the frame. | | P |
| **4.3.7.5** | **Frame – Fatigue test with horizontal forces** | | P |
| **4.3.7.5.1** | **General** | | P |
| | Where a frame is convertible for male and female riders by the removal of a bar, remove the bar. | | P |
| | It is not necessary for a genuine fork to be fitted, provided that any substitute fork is of the same length as the intended fork and it is correctly installed in the steering-head bearings. For a suspension fork, lock it at a length equivalent to that with an 90 kg rider seated on the bicycle either by adjusting the spring/damper or by external means. | | P |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | In tests on suspension frames with pivoted joints, lock the moving part of the frame into a position as would occur with a 90 kg rider seated on the bicycle. This may be achieved by locking the suspension unit in an appropriate position or, if the type of suspension system does not permit it to be locked, then the suspension system may be replaced by a solid link of the appropriate compressed size. Ensure that the axes of the front and rear axles are horizontally in line. For suspension-frames in which the chain-stays do not have pivots but rely on flexing, ensure that any dampers are set to provide the minimum resistancein order to ensure adequate testing of the frame. | | P |
| | Where a suspension frame has adjustable brackets or linkages to vary the resistance of the bicycle against the ground-contact forces or to vary the attitude of the bicycle, arrange the positions of these adjustable components to ensure maximum forces in the frame. | | P |
| **4.3.7.5.2** | **Requirement** | | P |
| | When tested by the method described in 4.3.7.5.3, there shall be no visible cracks or fractures in the frame and there shall be no separation of any parts of any suspension system. | | P |
| | For composite frames, the running displacement (peak-to-peak value) at the point where the test forces are applied shall not increase by more than 20 % of the initial values (see 4.3.1.6). | | P |
| **4.3.7.5.3** | **Test method** | | P |
| | Mount the frame in its normal attitude and secured at the rear drop-outs so that it is not restrained in a rotary sense (i.e. preferably by the rear axle). Ensure that the axes of the front and rear axles are horizontally in line. | | P |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |

| | | | |
|---|---|---|---|
| | Apply cycles of dynamic, horizontal forces of F8 in a forward direction and F9 in a rearward direction to the front fork drop-outs for C1 cycles as shown in Table 14 and Figure 22, with the front fork constrained in vertical direction but free to move in a fore/aft direction under the applied forces. The maximum test frequency shall be maintained as specified in 4.3.1.5.<br>**Table 14 — Forces and cycles on front fork drop-outs**<br>EPAC / Front wheel driven EPAC / Other driving systems<br>Forward force, $F_8$ N: 600 / 500<br>Rearward force, $F_9$ N: 600 / 500<br>Test cycles, $C_1$: 100 000 / 100 000 | | P |
| **4.3.7.6** | **Frame – Fatigue test with a vertical force** | | P |
| **4.3.7.6.1** | **General** | | P |
| | Where a frame is convertible for male and female riders by the removal of a bar, remove the bar. | | P |
| | Where a suspension frame has adjustable brackets or linkages to vary the resistance of the bicycle against the ground-contact forces or to vary the attitude of the bicycle, arrange the positions of these adjustable components to ensure maximum forces in the frame. Secure the rear suspension as described in 4.3.7.4.1. | | P |
| | If a suspension fork is fitted lock it at a length equivalent to that with an 90 kg rider seated on the bicycle either by adjusting the spring/damper or by external means. | | P |
| **4.3.7.6.2** | **Requirement** | | P |
| | When tested by the method described in 4.3.7.6.3, there shall be no visible cracks or fractures in the frame and there shall be no separation of any parts of the suspension system. | | P |
| | For composite frames, the running displacement (peak-to-peak value) at the point where the test forces are applied shall not increase by more than 20 % of the initial value (see 4.3.1.6). | | P |
| **4.3.7.6.3** | **Test method** | | P |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | Mount the frame in its normal attitude and secured at the rear drop-outs so that is not restrained in a rotary sense (i.e. preferably by the rear axle) as shown in Figure 23. Fit a suitable roller to the front axle in order to permit the frame to flex in a fore/aft sense under the test forces. | | P |
| **4.3.8** | **Front fork** | | P |
| **4.3.8.1** | **General** | | P |
| | 4.3.8.2, 4.3.8.4, 4.3.8.5 and 4.3.8.6 apply to all types of fork. | | P |
| | In the strength tests, 4.3.8.4, 4.3.8.5, 4.3.8.6 and 4.3.8.7, a suspension-fork shall be tested in its free, uncompressed length condition. | | P |
| **4.3.8.2** | **Means of location of the axle and wheel retention** | | P |
| | The slots or other means of location for the wheel-axle within the front fork shall be such that when the axle or cones are firmly abutting the top face of the slots, the front wheel remains central within the fork. | | P |
| | The front fork and wheel shall also fulfil the requirements of 4.3.9.4 and 4.3.9.5 | | P |
| **4.3.8.3** | **Suspension-forks – Special requirements** | | P |
| **4.3.8.3.1** | **Tyre-clearance test** | | P |
| **4.3.8.3.1.1** | **Requirement** | | P |
| | When tested by the method described in 4.3.8.3.1.2, the tyre shall not contact the crown of the fork nor shall the components separate. | | P |
| **4.3.8.3.1.2** | **Test method** | | P |
| | For the tyre-clearance test, a suspension-fork shall first be checked and adjusted if necessary according to the items listed in following a) to f): | | P |
| | a) Inflate the tyre to its maximum pressure; | | P |
| | b) Place the fork in uncompressed condition to have the highest displacement between suspension stanchion legs and suspension lower legs; | | P |
| | c) If the suspension-fork can be locked, place the fork in the open position; | | P |
| | d) If the fork has a spring adjust device, place it in the softest position; | | P |
| | e) If the fork has a pneumatic device, blow up the one or the two chambers at their minimum pressures according the manufacturer's instruction; | | P |
| | f) If the fork has a rebound device, place it on the slowest position. | | P |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | With a wheel and tyre assembly fitted to the fork, apply a force of 2 800 N to the wheel in a direction towards the fork-crown and parallel to the axis of the fork steerer. Maintain this force for 1 min. | | P |
| **4.3.8.3.2** | **Tensile test** | | P |
| **4.3.8.3.2.1** | **Requirement** | | P |
| | When tested by the method described in 4.3.8.3.2.2, there shall be no detachment or loosening of any parts of the assembly and the tubular, telescopic components of any fork-leg shall not separate under the test force. | | P |
| **4.3.8.3.2.2** | **Test method** | | P |
| | Mount the fork steerer securely in a suitable rigid mount, keeping any clamping forces away from the fork-crown, and apply a tensile force of 2 300 N distributed equally between the two drop-outs in a direction parallel to the axis of the fork steerer and in the direction away from the fork-crown. Maintain this force for 1 min. | | P |
| **4.3.8.4** | **Front fork – Static bending test** | | P |
| **4.3.8.4.1** | **Requirement** | | P |
| | When tested by the method described in 4.3.8.4.2, there shall be no fractures or visible cracks in anypart of the fork, and the permanent deformation, measured as the displacement of the axis of the wheel-axle or simulated axle in relation to the axis of the fork steerer, shall not exceed 10 mm. | | P |
| **4.3.8.4.2** | **Test method** | | P |
| | Mount the fork according to Annex G and fit a loading-attachment and swivel on an axle located in the axle slots of the blades. Locate a deflection measuring device over the loading-attachment in order to measure deflection and permanent deformation of the fork perpendicular to the steerer axis and in the plane of the wheel. | | P |
| **4.3.8.5** | **Front fork – Rearward impact test** | | P |
| **4.3.8.5.1** | **Forks made entirely of metal** | | P |
| **4.3.8.5.1.1** | **Crown/steerer joint assembled by welding or brazing** | | P |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | When tested by the method described in 4.3.8.5.3, there shall be no fractures or visible cracks in anypart of the fork, and the permanent deformation, measured as the displacement of the axis of the wheel-axle or simulated axle in relation to the axis of the fork steerer, shall not exceed 45 mm. | | P |
| | If the fork is used in the frame impact test (falling-mass), 4.3.7.2, there is no need to perform this test. | | P |
| **4.3.8.5.1.2** | **Crown/steerer joint assembled by press-fitting, bonding, or clamping** | | P |
| | When tested by the method described 4.3.8.5.4 a), if there are any fractures or visible cracks in any part of the fork, and the permanent deformation, measured as the displacement of the axis of the wheel-axle or simulated axle in relation to the axis of the fork steerer, exceeds 45 mm, the fork shall be considered to have failed. If the fork meets these criteria then it shall be subjected to a second test as described in 4.3.8.5.4 b), after which, it shall exhibit no fractures, then it shall be subjected to a third test as described in 4.3.8.5.4 c), irrespective of the amount of permanent deformation, there shall be no relative movement between the steerer and the crown. | | P |
| **4.3.8.5.2** | **Forks which have composite parts** | | P |
| | When tested by the method described in 4.3.8.5.3, there shall be no fractures in any part of a fork and the permanent deformation, measured as the displacement of the axis of the wheel-axle or simulated axle in relation to the axis of the fork steerer, shall not exceed 45 mm. After which, it shall exhibit no fractures, then it shall be subjected to a second test as described in 4.3.8.5.4 c) Torque on fork, irrespective of the amount of permanent deformation, there shall be no relative movement between the steerer and the crown. | | P |
| **4.3.8.5.3** | **Test method 1** | | P |
| | Mount the fork according to Annex G as shown in Figure 25. Assemble a roller of mass less than or equal to 1 kg and with dimensions conforming to those shown in Figure 26 in the fork. The hardness of the roller shall be not less than 60 HRC at impact surface. | | P |
| | Rest a striker of mass 22,5 kg ± 0,1 kg on the roller in the fork drop-outs such that it is exerting a force against the direction of travel and in the plane of the wheel. Position a deflection measuring device under the roller and record the position of the roller in a direction perpendicular to the axis of the fork steerer and in the plane of the wheel and note the vertical position of the fork. | | P |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |

| | | | |
|---|---|---|---|
| | Remove the deflection measuring device, raise the striker through a height of h4 and release it to strike the roller against the rake of the fork. The drop heights are given in Table 17. The striker will bounce and this is normal. When the striker has come to rest on the roller, measure the permanent deformation under the roller.<br>**Table 17 — Drop heights**<br>Forks made entirely of metal: Drop height, $h_4$ = 360 mm; Forks which have composite parts: Drop height, $h_4$ = 360 mm | | P |
| | | | P |
| **4.3.8.5.4** | **Test method 2** | | P |
| | a) This test is described in 4.3.8.5.3 | | P |
| | b) This test is similar to that described in 4.3.8.5.3 except that the dropping height shall be increased to 600 mm instead that given in Table 17. The section applies to forks in 4.3.8.5.1.2. | | P |
| | c) Apply a torque of $T_3$ to the assembly and maintain for 1 min in each direction of possible rotation about the steerer axis. The torque is given in Table 18, and a typical example of test equipment is illustrated in Figure 27. | | P |
| **4.3.8.5.5** | **Test method 3** | | P |
| | Apply a torque of T to the assembly and maintain for 1 min in each direction of possible rotation about | | P |
| **4.3.8.6** | **Front fork – Bending fatigue test plus rearward impact test** | | P |
| **4.3.8.6.1** | **Requirement** | | P |
| | When tested by the method described in 4.3.8.6.2, there shall be no fractures in any part of the fork, and the permanent deformation, measured as the displacement of the axis of the wheel-axle or simulated axle in relation to the axis of the fork steerer, shall not exceed 45 mm. | | P |
| | For composite forks, the running displacement (peak-to-peak value) at the points where the test forces are applied shall not increase by more than 20 % of the initial values (see 4.3.1.6). | | P |
| **4.3.8.6.2** | **Test method** | | P |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | Apply cycles of fully-reversed, dynamic forces of $F_{12}$ in the plane of the wheel and perpendicular to the fork steerer tube to a loading attachment and swivel on an axle located in the axle-slots of the blades for 100 000 test cycles. The forces are given in Table 19. The maximum test frequency shall be maintained as specified in 4.3.1.5.<br>**Table 19 — Forces on loading attachment**<br>Force, $F_{12}$ ±500 N | | P |
| | When the fork has failed conclude the test if the running displacement (peak-to-peak value) at the point where the test forces are applied increases by more than 20 % for rigid forks or more than 40 % for suspension forks from the initial values. | | P |
| | Stop the test after 100 000 cycles and inspect the sample carefully for fractures. If fractures are found, conclude the test. | | P |
| **4.3.8.7** | **Forks intended for use with hub- or disc-brakes** | | P |
| **4.3.8.7.1** | **General** | | P |
| | When a fork is intended for use with a hub- or disc-brake and whether supplied as original equipment or as an accessory, the fork manufacturer shall provide an attachment point on the fork-blade for the torque-arm or calliper. | | P |
| | In tests conducted by the methods described in 4.3.8.7.3 and 4.3.8.7.5 and where more than one mounting-point is provided for a hub- or disc-brake, the following shall apply: | | P |
| | a) Where a complete EPAC is supplied, the test adaptor shall be secured to the mounting-point used on EPAC. If bracket is supplied, it shall be used to perform the test; | | P |
| | b) Where a fork is supplied as an accessory with more than one mounting-point, separate tests shall be conducted on each of the mounting-points on separate forks. | | P |
| **4.3.8.7.2** | **Static brake-torque test** | | P |
| | When tested by the method described in 4.3.8.7.3, there shall be no fractures or visible cracks in any part of the fork. | | P |
| **4.3.8.7.3** | **Fork for hub/disc-brake – Static brake-torque test** | | P |

| EN 15194:2017 | | | |
|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | Mount the fork in a fixture representative of the head-tube according to Annex G and gripped in the normal head-bearings, fit an axle to the fork, and mount on the axle a pivoted, straight adaptor as shown in Figure 29 to provide a torque-arm of L2 in length (see Table 20) and a suitable attachment for the brake mounting-point. If the wheel size is not listed in Table 20, the length L2 shall be equal to one half of the wheel diameter | | P |
| | Mount the fork in a fixture representative of the head-tube according to Annex G and gripped in the normal head-bearings, fit an axle to the fork, and mount on the axle a pivoted, straight adaptor as shown in Figure 29 to provide a torque-arm of $L_2$ in length (see Table 20) and a suitable attachment for the brake mounting-point. If the wheel size is not listed in Table 20, the length $L_2$ shall be equal to one half of the wheel diameter | | P |
| **4.3.8.7.4** | **Fork for hub/disc-brake – Brake mount fatigue test** | | P |
| | When tested by the method described in 4.3.8.7.5, there shall be no fractures or visible cracks in any part of the fork and, in the case of suspension-forks, there shall be no separation of any parts. | | P |
| **4.3.8.7.5** | **Fork for hub/disc-brake – Brake mount fatigue test** | | P |
| | Mount the fork in a fixture representative of the head-tube according to Annex G and gripped in the normal head-bearings, fit an axle to the fork, and mount on the axle a pivoted, straight adaptor as shown in Figure 30 to provide a torque-arm of $L_2$ in length (see Table 21) and a suitable attachment for the brake mounting-point. | | P |
| | Apply repeated, horizontal, dynamic forces of 600 N rearward to the end of the torque-arm parallel to the plane of the wheel (as shown in Figure 30) for $C_2$ cycles (see Table 21). The maximum test frequency shall be maintained as specified in 4.3.1.6 | | P |
| **4.3.8.8** | **Tensile test for a non-welded fork** | | P |
| **4.3.8.8.1** | **General** | | P |
| | This test is for forks where the blades and/or the fork steerer are secured in the fork-crown by press-fitting, clamping, adhesives, or any method other than brazing or welding. | | P |
| **4.3.8.8.2** | **Requirement** | | P |
| | When tested by the method described in 4.3.8.8.3, there shall be no detachment or loosening of any parts of the assembly. | | P |
| **4.3.8.8.3** | **Test method** | | P |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | Mount the fork steerer securely in a suitable rigid mount, keeping any clamping forces away from the fork-crown, and apply a tensile force of 5 000 N distributed equally to both drop-outs for 1 min in a direction parallel to the axis of the fork steerer. | | P |
| **4.3.9** | **Wheels and wheel/tyre assembly** | | P |
| **4.3.9.1** | **Wheels/tyre assembly – Concentricity tolerance and lateral tolerance** | | P |
| **4.3.9.1.1** | **Requirements** | | P |
| | When measured by the method described in 4.3.9.1.2, the run-out shall not exceed the values which are given in Table 22. | | P |
| **4.3.9.1.2** | **Test method** | | P |
| | The run-out tolerances represent the maximum variation of position of the rim when measured perpendicular to the axle at a suitable point along the rim (see Figure 31) (i.e. full indicator reading) of a fully assembled and adjusted wheel during one complete revolution about the axle without axial movement. Both sides of the rim shall be measured and the maximum value shall be taken as result. | | P |
| | The measurement of both axial run-out (lateral) and radial run-out (concentricity) shall be done with a tyre fitted and inflated to the maximum inflation pressure, but for rims where concentricity cannot be measured with the tyre fitted, it is permissible to make measurements with the tyre removed. | | P |
| **4.3.9.2** | **Wheel/tyre assembly – Clearance** | | P |
| | Alignment of the wheel assembly in EPAC shall allow not less than the clearance values given in Table 23 between the tyre and any frame or fork element or a front mudguard and its attachment bolts. | | P |
| **4.3.9.3** | **Wheel/tyre assembly – Static strength test** | | P |
| **4.3.9.3.1** | **Requirement** | | P |
| | When a fully assembled wheel fitted with a tyre inflated to the maximum inflation pressure is tested by the method described in 4.3.9.3.2, there shall be no failure of any of the components of the wheel, and the permanent deformation, measured at the point of application of the force on the rim, shall not exceed the values which are given in Table 24. | | P |
| **4.3.9.3.2** | **Test method** | | P |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | Clamp and support the wheel suitably as shown in Figure 32. Apply a pre-load of 5 N on the rim at one spoke perpendicular to the plane of the wheel as shown in Figure 32. Record the zero position of the rim at the point of load application as shown. Then apply a static force of $F_{13}$ given in Table 25 for a duration of 1 min. Reduce the load to 5 N and allow a 1 min settling time. After this settling time and with the 5 N load still applied, re-measure the position of the rim. | | P |
| | The wheel shall be fitted with the appropriate size tyre and inflated to the maximum pressure, determined by the lowest value between maximum inflation pressures recommended on the rim or the tyre. | | P |
| **4.3.9.4** | **Wheels – Wheel retention** | | P |
| **4.3.9.4.1** | **General** | | P |
| | Wheel retention safety is related to the combination of wheel, retention device, and drop-out design. | | P |
| | Wheels shall be secured to EPAC frame and fork such that when adjusted to the manufacturer's instructions they comply with 4.3.9.4.2, 4.3.9.4.3 and 4.3.9.5. | | P |
| | Wheel nuts shall have a minimum removal torque of 70 % of the manufacturer's recommended tightening torque. | | P |
| | Where quick-release axle devices are used they shall comply with 4.3.9.5. | | P |
| **4.3.9.4.2** | **Wheel retention – Retention devices secured** | | P |
| **4.3.9.4.2.1** | **Requirement** | | P |
| | When tested by the method described in 4.3.9.4.2.2, there shall be no relative motion between the axle and the front fork/frame. | | P |
| **4.3.9.4.2.2** | **Test method** | | P |
| | Apply a force of 2 300 N distributed symmetrically to both ends of the axle for a period of 1 min in the direction of the removal of the front and rear wheel independently. | | P |
| **4.3.9.4.3** | **Front wheel retention – Retention devices unsecured** | | P |
| | EPAC shall be equipped with secondary retention system that retains the front wheel in the dropouts when the primary retention system is in the open (unlocked) position and wheel off the ground. | | P |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | Where threaded axles and nuts are fitted, and the nuts are unscrewed by at least 360° from the finger tight condition and the brake system disconnected or released, the wheel shall not detach from the front fork when a force of 100 N is applied radially outwards, in line with the drop-out slots, and maintained for 1 min. | | P |
| | Where quick-release is fitted, and the quick-release lever is fully open and the brake system is disconnected or released, the wheel shall not detach from the front fork when a force of 100 N is applied to the wheel radially outwards, in line with the drop-out slots, and maintained for 1 min. | | P |
| **4.3.9.5** | **Wheels – Quick-release devices – Operating features** | | P |
| | Any quick-release device shall have the following operating features: | | P |
| | a) it shall be adjustable to allow setting for tightness; | | P |
| | b) its form and marking shall clearly indicate whether the device is in the open or locked position; | | P |
| | c) if adjustable by a lever, the force required to close a properly set lever shall not exceed 200 N and, at this closing force there shall be no permanent deformation of the quick-release device; | | P |
| | d) the releasing force of the clamping device when closed shall not be less than 50 N; | | P |
| | e) if operated by a lever, the quick-release device shall withstand without fracture or permanent deformation a closing force of not less than 250 N applied with the adjustment set to prevent closure at this force; | | P |
| | f) the wheel retention with the quick-release device in the clamped position shall be in accordance with 4.3.9.4.2, 4.3.9.4.3; | | P |
| | g) the front wheel retention with the quick-release device in the open position shall be in accordance with 4.3.9.4.3. | | P |
| | If applied to a lever, the forces specified in c), d), and e) shall be applied 5 mm from the tip end of the lever. | | P |
| **4.3.10** | **Rims, tyres and tubes** | | P |
| **4.3.10.1** | **General** | | P |
| | Non-pneumatic tyres are excluded from the requirements of 4.3.10.2 and 4.3.10.3. | | P |
| **4.3.10.2** | **Tyre inflation pressure** | | P |

| EN 15194:2017 | | | |
|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | The maximum inflation pressure recommended by the manufacturer shall be permanently marked on the side wall of the tyre so as to be readily visible when the latter is assembled on the wheel. If the rim manufacturer recommends a maximum tyre inflation pressure, it shall be clearly and permanently marked on the rim and also specified in the manufacturer's instructions. | | P |
| | It is recommended that the minimum inflation pressure specified by the tyre manufacturer also be permanently marked on the side wall of the tyre. | | P |
| **4.3.10.3** | **Tyre and rim compatibility** | | P |
| | Tyres that comply with the requirements of ISO 5775-1 and rims that comply with the requirements of ISO 5775-2 are compatible. The tyre, tube and tape shall be compatible with the rim design. When inflated to 110 % of the maximum inflation pressure, determined by the lower value between maximum inflation pressures recommended on the rim or the tyre, for a period of not less than 5 min, the tyre shall remain intact on the rim. | | P |
| **4.3.10.4** | **Rim-wear** | | P |
| | In the case where the rim forms part of a braking system and there is a danger of failure due to wear, the manufacturer shall make the rider aware of this danger by durable and legible marking on the rim, in an area not obscured by the tyre, (see also Clause 6 z) and 5.1). | | P |
| | Where the rim is made of composite materials, the manufacturer shall include in the manufacturer's instructions warnings of the danger of rim failure caused by wear of the braking surfaces. | | P |
| **4.3.10.5** | **Greenhouse effect test for composite wheels** | | P |
| **4.3.10.5.1** | **General** | | P |
| | This requirement is to ensure wheels made from composite materials that are subjected to high temperature conditions (i.e. such as car storage in direct sunlight) do not suffer concealed damage that could subsequently affect the safety performance of the wheel during normal use. | | P |
| **4.3.10.5.2** | **Requirement** | | P |
| | When a fully assembled wheel made of composite material, fitted with the appropriate size tyre and inflated according to the lowest value between maximum inflation pressure recommended on the rim or the tyre, is tested by the method described as 4.3.10.5.3, there shall be: | | P |

| EN 15194:2017 | | | |
|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | — no failure of any of the components of thewheel;<br>— no tyre separation from the rim during thetest;<br>— no increase in rim width greater than 5 % of the initial maximal width value;<br>— compliance of lateral and concentricitytolerance according to 4.3.9.1;<br>— compliance of tyre and rim compatibilityaccording to 4.3.10.3;<br>— compliance of static strength according to4.3.9.3. | | P |
| **4.3.10.5.3** | **Test method** | | P |
| | A fully assembled wheel, fitted with the appropriate size tyre and inflated according to the lowest value between minimum and maximum inflation pressure recommended on the rim or the tyre, shall be used for the test. Lateral run-out shall be in accordance with 4.3.9.1 and maximum width of the rim shall be recorded. | | P |
| | A specific bench as shown in Figure 34 could be used to measure the maximum width all around the rim with tyre and pressure (continuous measuring). | | P |
| | The wheel is laid down on the ground of a climate chamber pre heated at 80 °C, leant on axle and tyre support points, sprocket side of the wheel as shown in Figure 33, during 4 h. At the end of the 4 h, the wheel should be taken out of the climate chamber and let cool down at room temperature during 4 h to re-measuring the rim width and its conformance to 4.3.10.5.1 and 4.3.10.5.2. | | P |
| **4.3.11** | **Front mudguard** | | P |
| **4.3.11.1** | **Requirements** | | P |
| | If front mudguard is fitted, when tested by the method described in the two-stage tests in 4.3.11.2 (for mudguard with stays) or 4.3.11.3 (for mudguard without stays), the front mudguard shall not prevent rotation of the wheel or obstruct steering. | | P |
| **4.3.11.2** | **Front mudguard with stays test methods** | | P |
| **4.3.11.2.1** | **Stage 1: Test method – Tangential obstruction** | | P |
| | Insert a 12 mm diameter steel rod between the spokes, in contact with the rim and below the front mudguard stays as shown in Figure 35, and rotate the wheel to apply a tangentially-upward force of 160 N, against the front mudguard stays and maintain this force for 1 min. | | P |
| | Remove the rod and determine whether or not the wheel is free to rotate and whether or not any damage to the front mudguard adversely affects wheel rotation (blocking of the wheel) and the steering. | | P |

| EN 15194:2017 | | | |
|---|---|---|---|
| Clause | Requirement | Remark | Result |
| **4.3.11.2.2** | **Stage 2: Test method – Radial force** | | P |
| | Press the front mudguard at a distance of 20 mm from its free end (not taking the flap into consideration) with a 20 mm diameter, flat-ended tool radially towards the tyre with a force of 80 N as shown in Figure 36. | | P |
| | While the force is maintained, rotate the wheel manually in the direction of forward movement of the bicycle and determine whether or not the wheel is free to rotate, and whether or not any damage to the front mudguard adversely affects wheel rotation (blocking of the wheel) and the steering. | | P |
| **4.3.11.3** | **Front mudguard without stays test methods** | | P |
| | Press the front mudguard at a distance of 20 mm from its free end with a 20 mm diameter, flat-ended tool radially towards the tyre with a force of 80 N as shown in Figure 36. | | P |
| | While the force is maintained, rotate the wheel manually in the direction of forward movement of the bicycle and determine whether or not the front mudguard is rolled up the wheel, and whether or not any damage to the front mudguard adversely affects wheel rotation (blocking of the wheel) or obstructs the steering. Contact between tyre and mudguard is allowed. | | P |
| **4.3.12** | **Pedals and pedal/crank drive system** | | P |
| **4.3.12.1** | **Pedal tread** | | P |
| **4.3.12.1.1** | **Tread surface** | | P |
| | The tread surface of a pedal shall be secured against movement within the pedal assembly. | | P |
| **4.3.12.1.2** | **Toe Clips** | | P |
| | Pedals intended to be used without toe-clips, or for optional use with toe-clips, shall have: | | P |
| | a) tread surfaces on the top and bottom surfaces of the pedal; or | | P |
| | b) a definite preferred position that automatically presents the tread surface to the rider's foot. | | P |
| | Pedals designed to be used only with toe-clips or shoe-retention devices shall have toe-clips or shoe-retention devices securely attached and need not comply with the requirements of 4.3.12.1.2 a) and b). | | P |
| **4.3.12.2** | **Pedal clearance** | | P |
| **4.3.12.2.1** | **Ground clearance** | | P |

| EN 15194:2017 | | | |
|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | With EPAC un-laden, the pedal at its lowest point and the tread surface of the pedal parallel to the ground and uppermost where it has only one tread surface, EPAC shall be capable of being leaned over at an angle of $\theta$ from the vertical before any part of the pedal touches the ground. The values are given in Table 26. | | P |
| | | | P |
| | When EPAC is equipped with a suspension system, this measurement shall be taken with the suspension adjusted to the softest condition and with EPAC depressed into a position such as would be caused by a rider weighing 90 kg. | | P |
| **4.3.12.2.2** | **Toe clearance** | | P |
| | EPACs shall have at least *C* clearance between the pedal and front tyre or mudguard (when turned to any position). The clearance shall be measured forward and parallel to the longitudinal axis of EPAC from the centre of either pedal-axle to the arc swept by the tyre or mudguard, whichever results in the least clearance (see Figure 37). The values are given in Table 27. | | P |
| **4.3.12.3** | **Pedal – Static strength test** | | P |
| **4.3.12.3.1** | **Requirement** | | P |
| | When tested by the method described in 4.3.12.3.2, there shall be no fractures, visible cracks, or distortion of the pedal or spindle that could affect the operation of the pedal and pedal-spindle. | | P |
| **4.3.12.3.2** | **Test method** | | P |
| | Screw the pedal-spindle securely into a suitable rigid fixture with its axis horizontal, as shown in Figure 38, and apply a vertically-downward force $F_{14}$ according to Table 28 for 1 min to the centre of the pedal as shown in Figure 38. Release the force and examine the pedal assembly and the spindle. | | P |
| **4.3.12.4** | **Pedal – Impact test** | | P |
| **4.3.12.4.1** | **Requirement** | | P |
| | When tested by the method described in 4.3.12.4.2, there shall be no fractures of any part of the pedal body, the pedal-spindle or any failure of the bearing system. | | P |
| **4.3.12.4.2** | **Test method** | | P |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | Screw the pedal-spindle securely into a suitable rigid fixture with its axis horizontal as shown in Figure 40 and release a striker of the design shown in Figure 39 and mass 15 kg from a height of 400 mm to strike the pedal at the centre of the pedal. The width of the striker shall be wider than the width of the tread surface. | | P |
| **4.3.12.5** | **Pedal – Dynamic durability test** | | P |
| **4.3.12.5.1** | **Requirement** | | P |
| | When tested by the method described in 4.3.12.5.2, there shall be no fractures or visible cracking of any part of the pedal, the pedal-spindle nor any failure of the bearing system. | | P |
| **4.3.12.5.2** | **Test method** | | P |
| | Screw each pedal securely into a threaded hole in a rotable test-shaft as shown in Figure 41 and suspend a mass of $M_4$ at the centre of the pedal width by means of a tension-spring to each pedal, the object of the springs being to minimize oscillations of the load. The masses are given in Table 29. | | P |
| | Drive the shaft at a speed not exceeding 100 min−1 for a total of 100 000 revolutions. If the pedals are provided with two tread surfaces, they shall be turned through 180° after 50 000 revolutions. | | P |
| **4.3.12.6** | **Drive-system – Static strength test** | | P |
| **4.3.12.6.1** | **Requirement** | | P |
| | a) Drive-system with chain | | P |
| | When tested by the method described in 4.3.12.6.2, there shall be no fracture of any component of the drive system, and drive capability shall not be lost. | | P |
| | b) Drive-system with belt | | P |
| | When tested by the method described in 4.3.12.6.3, there shall be no fracture of any component of the drive system, and the belt shall not slip/skip, fracture or cause any loss in drive capability. | | P |
| **4.3.12.6.2** | **Test method for drive-system with chain** | | P |
| **4.3.12.6.2.1** | **General** | | P |
| | Conduct the drive system static load test on an assembly comprising the frame, pedals, transmission system, rear wheel assembly, and, if appropriate, the gear-change mechanism. Support the frame with the central plane vertical and with the rear wheel held at the rim to prevent the wheel rotating. | | P |

| EN 15194:2017 | | | |
|---|---|---|---|
| Clause | Requirement | Remark | Result |
| **4.3.12.6.2.2** | **Single-speed system** | | P |
| | With the left-hand crank in the forward position, apply a force, $F_{15}$, increasing gradually to 1 500 N vertically downwards to the centre of the left-hand pedal. Maintain this force for 1 min. | | P |
| | Should the system slip or the drive-sprockets tighten such that the crank rotates while under load to a position more than 30° below the horizontal, remove the test force, return the crank to the horizontal position or some appropriate position above the horizontal to take account of yield or movement and repeat the test. | | P |
| | On completion of the test on the left-hand crank repeat the test with the right-hand crank in the forward position and with the force applied to the right-hand pedal. | | P |
| **4.3.12.6.2.3** | **Multi-speed system** | | P |
| | a) Conduct the tests described in 4.3.12.6.2.2 with the transmission correctly adjusted in its highest gear; | | P |
| | b) Conduct the tests generally as described in 4.3.12.6.2.2 with the transmission correctly adjusted in its lowest gear but, where appropriate, with the maximum force, F1, adjusted to suit the particular gear ratio, thus: | | P |
| | The maximum force, F15, shall be a function of the lowest gear ratio, Nc/Ns, | | P |
| **4.3.12.6.3** | **Test method for drive-system with belt** | | P |
| | The sample in its fully finished condition (with teeth if any) shall be submitted to a water spray conditioning equivalent to IPX4 specified in EN 60529:1991, 14.2.4, during 10 min. Application of the loading shall be done within 20 min after conditioning. | | P |
| | a) If the drive-system is a single-speed system, conduct the tests as described in 4.3.12.6.2.2. | | P |
| | b) If the drive-system is a multi-speed system, conduct the tests as described in 4.3.12.6.2.3. | | P |
| **4.3.12.7** | **Crank assembly – Fatigue test** | | P |
| **4.3.12.7.1** | **Requirement** | | P |
| | When tested by the method described in 4.3.12.7.2, there shall be no fractures or visible cracks in the cranks, the bottom-bracket spindle or any of the attachment features, or loosening or detachment of the chain-wheel from the crank. | | P |
| **4.3.12.7.2** | **Test method** | | P |

| EN 15194:2017 | | | |
|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | Mount the assembly of the two pedal-spindle adaptors, the two cranks, the chain-wheel set (or other drive component), and the bottom-bracket spindle located on its normal-production bearings in a fixture with bearing housings representative of the bottom-bracket (as shown in Figure 42). Incline the cranks at 45° to the horizontal. | | P |
| | Prevent rotation by locating a suitable length of drive chain around the largest or only chain-wheel and securing it firmly to a suitable support, or, for any other type of transmission (e.g. belt- or shaft-drive) by securing the first stage of the transmission. | | P |
| | It is permissible to have the left crank in either of the two positions shown in Figure 42, provided the test force is applied in the appropriate direction as specified in the next paragraph. | | P |
| | Apply repeated, vertical, dynamic forces of $F_{16}$ alternately to the pedal-spindle adaptors of the left- and right-hand cranks at a distance of 65 mm from the outboard face of each crank (as shown in Table 30 and Figure 42) for *C* test cycles (where one test cycle consists of the application of the two forces). The direction of the force on the right-hand crank shall be downwards and that on the left-hand crank shall be upwards for a rearward-pointing crank or downwards for a forward-pointing crank. During application of these test forces, ensure that the force on a pedal-spindle adaptor falls to 5 % or less of the peak force before commencing application of the test force to the other pedal-spindle adaptor. The maximum test frequency shall be maintained as specified in 4.3.1.5. | | P |
| **4.3.13** | **Drive-chain and drive belt** | | P |
| **4.3.13.1** | **Drive-chain** | | P |
| | Where a chain-drive is used as a means of transmitting the motive force, the chain shall operate over the front and rear sprockets without binding. | | P |
| | The chain shall conform to the tensile strength and push-out force requirements of ISO 9633. | | P |
| **4.3.13.2** | **Drive belt** | | P |
| **4.3.13.2.1** | **Requirement** | | P |
| | Where a belt-drive is used as a means of transmitting the motive force, the drive belt shall operate over the front and rear pulleys without binding. And when tested by the methods described in 4.3.13.2.2, there shall be no evidence of cracking, fracture or delamination of the belt drive. | | P |
| **4.3.13.2.2** | **Test method** | | P |

| EN 15194:2017 | | | |
|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | Set up a fixture with two drive pulleys that are similar or identical as shown in Figure 43. At least one pulley should be free to rotate. Increase the tensile load gradually until the tension load of the belt reaches 4 000 N. | | P |
| **4.3.14** | **Chain-wheel and belt-drive protective device** | | P |
| **4.3.14.1** | **Requirement** | | P |
| | EPAC shall be equipped with one of the following; | | P |
| | a) a chain wheel disc or drive pulley disk which conforms to 4.3.14.2; or | | P |
| | b) a chain and drive belt protective device which conforms to 4.3.14.3; or | | P |
| | c) where fitted with positive foot-retention devices on the pedals, a combined front gear-change guide which conforms to 4.3.14.4 shall be used. | | P |
| **4.3.14.2** | **Chain-wheel disc and drive pulley disc diameter** | | P |
| | A chain-wheel disc shall exceed the diameter of the outer chain-wheel, when measured across the tips of the teeth by not less than 10 mm (see Figure 44). | | P |
| | A drive pulley disc shall exceed the diameter of the front pulley, when measured across the tips of the teeth by not less than 10 mm (see Figure 45). Where the design is such that the pedal-crank and chain-wheel are too close together to accommodate a full disc, a partial disc may be fitted which closely abuts the pedal-crank | | P |
| **4.3.14.3** | **Chain and drive belt protective device** | | P |
| | A chain protective device shall, as a minimum, shield the side-plates and top surface of the chain and the chain-wheel for a distance of at least 25 mm rearwards along the chain from the point where the chain-wheel teeth first pass between the side-plates of the chain and forwards round the outerchain-wheel to a horizontal line passing through the bottom-bracket axle centre (see Figure 46 a)). | | P |
| | A drive belt protective device shall, as a minimum, shield the side and top surface of the drive belt and the front pulley for a distance of at least 25 mm rearwards along the drive belt from the point where the tip circle of the pulley is intersected by the tip line of the belt (line C in Figure 46 b)) and forwards round the front pulley to a horizontal line passing through the bottom-bracket axle centre (see Figure 46 b)). | | P |
| **4.3.14.4** | **Combined front gear-change guide** | | P |

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| Clause | Requirement | Remark | Result |
| | When the chain is located in the outer gear position, some portion of the combined front gear change guide shall be above the chain in the region 25 mm from the point where the chain wheel first passes between the side plates of the chain, parallel to the chain side plates in the direction towards the rear wheel of the bicycle (see Figure 47). | | P |
| | In addition some portion of the combined front gear change guide shall be present below the chain in the region beyond 25 mm from the point where the chain wheel first passes between the side plates of the chain, parallel to the chain side plates in the direction towards the rear wheel of the bicycle (see Figure 47). | | P |
| | It is recommended that the gap between front-gear and front gear-change guide specified by the manufacturer is properly set. | | P |
| **4.3.15** | **Saddles and seat-posts** | | P |
| **4.3.15.1** | **Limiting dimensions** | | P |
| | No part of the saddle, saddle supports, or accessories to the saddle shall be more than 125 mm above the top saddle surface at the point where the saddle surface is intersected by the seat-post axis. | | P |
| **4.3.15.2** | **Seat-post – Insertion-depth mark or positive stop** | | P |
| | The seat-post shall be provided with one of the two following alternative means of ensuring a safe insertion-depth into the frame: | | P |
| | a) it shall contain a permanent, transverse mark of length not less than the external diameter or the major dimension of the cross-section of the seat-post that clearly indicates the minimum insertion-depth of the seat-post into the frame. For a circular cross-section, the mark shall be located not less than two diameters of the seat-post from the bottom of the seat-post (i.e. where the diameter is the external diameter). For a non-circular cross-section, the insertion-depth mark shall be located not less than 65 mm from the bottom of the seat-post (i.e. where seat-post has its full cross-section); | | P |
| | b) it shall incorporate a permanent stop to prevent it from being drawn out of the frame such as to leave the insertion less than the amount specified in a) above. | | P |
| **4.3.15.3** | **Saddle/seat-post – Safety test** | | P |
| **4.3.15.3.1** | **General** | | P |
| | If a suspension seat-post is involved, the test may be conducted with the suspension-system either free to operate or locked. If it is locked, the pillar shall be at its maximum length. | | P |

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| Clause | Requirement | Remark | Result |
| **4.3.15.3.2** | **Saddles with adjustment-clamps** | | P |
| | When tested by the method described in 4.3.15.3.4, there shall be no movement of the saddle adjustment clamp in any direction with respect to the seat-post, or of the seat-post with respect to the frame, nor any failure of saddle, adjustment clamp or seat-post. If the saddle design is such that it cannot accurately test the saddle/seat-post clamp, it shall be possible to use a fixture which is representative of the saddle dimensions | | P |
| **4.3.15.3.3** | **Saddles without adjustment-clamps** | | P |
| | Saddles that are not clamped, but are designed to pivot in a vertical plane with respect to the seat-post, shall be allowed to move within the parameters of the design and shall withstand the tests described in 4.3.15.3.4 without failure of any components | | P |
| **4.3.15.3.4** | **Test method** | | P |
| | With the seat-post correctly assembled to EPAC frame at minimum insertion depth of the seat-post, and the clamps tightened to the torquerecommended by the bicycle manufacturer, apply a force of $F_{18}$ vertically downwards at a point 25 mm from either the front or rear of the saddle, whichever produces the greater torque on the saddle-clamp. The saddle shall be positioned in the seat post clamp assembly as defined by the saddle manufacturer's rail markings or instructions. Maintain this force for 1 min. Remove this force and apply a lateral force of $F_{19}$ horizontally at a point 25 mm from either the front or rear of the saddle, whichever produces the greater torque on the clamp, and maintain this force for 1 min (see Figure 48). The forces are given in Table 31. | | P |
| **4.3.15.4** | **Saddle – Static strength test** | | P |
| **4.3.15.4.1** | **Requirement** | | P |
| | When tested by the method described in 4.3.15.4.2, the saddle cover and/or plastic moulding shall not disengage from the chassis of the saddle, and there shall be no cracking or permanent distortion of the saddle assembly. | | P |
| **4.3.15.4.2** | **Test method** | | P |

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| Clause | Requirement | Remark | Result |
| | With the saddle positioned in a suitable fixture representative of a seat-post clamp assembly and in a maximum rearward direction as defined by the saddle manufacturer's rail markings or instructions, and the clamps tightened to the torque recommended by the bicycle manufacturer, apply forces $F_{20}$ of 400N in turn under the rear and nose of the saddle cover, as shown in Figure 49, ensuring that the force is not applied to any part of the chassis of the saddle. The load application point is on the longitudinal plane of the saddle at 25 mm from the back (/front) of the saddle. If the saddle design is such that it cannot accept a centreline load application, the load shall be symmetrically applied at two points of the saddle. | | P |
| **4.3.15.5** | **Saddle and seat-post clamp – Fatigue test** | | P |
| **4.3.15.5.1** | **General** | | P |
| | Seat-posts can influence test failures of saddles: for this reason, a saddle shall be tested in combination with a seat-post as recommended by the saddle manufacturer. | | P |
| **4.3.15.5.2** | **Requirement** | | P |
| | When tested by method described in 4.3.15.5.3, there shall be no fractures or visible cracks in the seat-post or in the saddle, and no loosening of the clamp. | | P |
| **4.3.15.5.3** | **Test method** | | P |
| | Insert the seat-post to its minimum insertion depth in a rigid mount representative of that on the bicycleand with its axis at 73° to the horizontal. The saddle shall be positioned in the seat post clamp assembly in a maximum rearward direction as defined by the saddle manufacturer's rail markings or instructions. Adjust the saddle to have its upper surface in a horizontal plane and tighten the clamp to the torque recommended by the bicycle manufacturer. Apply a repeated, vertically-downward force of 1 000 N for 200 000 cycles, in the position shown in Figure 51 by means of a pad 300 mm long x 80 mm diameter to prevent localized damage of the saddle cover. The maximum test frequency shall be maintained as specified in 4.3.1.5. | | P |
| **4.3.15.6** | **Seat-post – Fatigue test** | | P |
| **4.3.15.6.1** | **General** | | P |
| | In the following test, if a suspension seat-post is involved, the test shall be conducted with the suspension system adjusted to give maximum resistance. | | P |
| | Conduct the test in two stages on the same assembly as per 4.3.15.6.2 and 4.3.15.6.4. | | P |

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| Clause | Requirement | Remark | Result |
| **4.3.15.6.2** | **Requirement for stage 1** | | P |
| **4.3.15.6.2.1** | **Seat-post without suspension system** | | P |
| | When tested by the method described in 4.3.15.6.3, there shall be no visible cracks or fractures in the seat-post, nor any bolt failure. | | P |
| | For composite seat-post, the peak deflection of seat-post during the test shall not increase by more than 20 % of the initial value | | P |
| **4.3.15.6.2.2** | **Seat-post with suspension system** | | P |
| | When tested by the method described in 4.3.15.6.3, there shall be no visible cracks or fractures in the seat-post, nor any bolt failure. The design shall be such that in the event of failure of the suspension system, the two main parts do not separate nordoes the upper part (i.e. the part to which the saddlewould be attached) become free to swivel in the lowerpart. | | P |
| **4.3.15.6.3** | **Test method for stage 1 (fatigue test)** | | P |
| | A seat post shall be inserted to the minimum insertion depth in a suitable fixture with a representative seat collar and clamped to the manufacturers recommended torque. The seat post shall be fixed at an angle of 73° from horizontal, as shown in Figure 52. | | P |
| | Secure an extension-bar to the saddle attachment point by the appropriate attachment fitting such that the bar extends rearwards and downwards at an angle of 10° below the horizontal to permit the application of a vertical test force at a distance of 70 mm from the centre of the saddle-clamp where the centre-line of the clamp intersects the axis of the bar, as shown in Figure 52. | | P |
| | Apply a repeated, vertically downward, dynamic force of F21 to the point described above and shown in Figure 52 for 100 000 cycles. The forces are given in Table 32. The maximum test frequency shall be maintained as specified in 4.3.1.5. | | P |
| **4.3.15.6.4** | **Requirement for stage 2** | | P |
| **4.3.15.6.4.1** | **Seat-post without suspension system** | | P |
| | When tested by the method described in 4.3.15.6.5, there shall be no fractures, and the displacement shall not exceed 10 mm during testing. | | P |
| **4.3.15.6.4.2** | **Seat-post with suspension system** | | P |

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| Clause | Requirement | Remark | Result |
| | When tested by the method described in 4.3.15.6.5, there shall be no fractures. The design shall be such that in the event of failure of the suspension system, the two main parts do not separate nor does the upper part (i.e. the part to which the saddle would be attached) become free to swivel in the lower part. | | P |
| **4.3.15.6.5** | **Test method for stage 2 (static strength test)** | | P |
| | A seat post shall be inserted to the minimum insertion depth in a suitable fixture with a representative seat collar and clamped to the manufacturers recommended torque. The seat post shall be fixed at an angle of 73° from horizontal, as shown in Figure 53. | | P |
| **4.3.16** | **Spoke protector** | | P |
| | EPAC bicycles with multiple free-wheel/cassette sprockets shall be fitted with a spoke-protector guard to prevent the chain interfering with or stopping rotation of the wheel through improper adjustment or damage | | P |
| **4.3.17** | **Luggage carriers** | | P |
| | If luggage carriers are fitted or provided they shall comply with EN ISO 11243. | | P |
| **4.3.18** | **Road-test of a fully-assembled EPAC** | | P |
| **4.3.18.1** | **Requirements** | | P |
| | When tested by the method described in 4.3.18.2, there shall be no system or component failure and no loosening or misalignment of the saddle, handlebar, controls or reflectors. | | P |
| | The EPAC shall with or without assistance exhibit stable handling in braking, turning and steering, and it shall be possible to ride with one hand removed from the handlebar (as when giving hand signals), without difficulty of operation or hazard to the rider | | P |
| **4.3.18.2** | **Test method** | | P |
| | First, check and adjust, if necessary, each EPAC selected for the road test to ensure that the steering and wheels rotate freely without slackness, that brakes are correctly adjusted and do not impede wheel rotation. Check and adjust wheel alignment and, if necessary, inflate tyres to the recommended pressure as marked on the side-wall of the tyre. Check and correct, if necessary, transmission-chain adjustment, and check any gear-control fitted for correct and free operation. | | P |
| | Carefully adjust the saddle and handlebar positions to suit the rider. | | P |

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| Clause | Requirement | Remark | Result |
| | The test shall be carried out with the permissible total weight specified by the manufacturer in 6 n). Ensure that the EPAC is ridden for at least 1km. | | P |
| **4.3.19** | **Lighting systems and reflectors** | | P |
| **4.3.19.1** | **General** | | P |
| | EPAC shall be equipped with reflectors at the front, rear and side. EPAC shall be equipped with lighting systems and reflectors in conformity with the national regulations in the country in which EPAC is marketed, because national regulations for lighting systems and reflectors differ from country to country. | | P |
| **4.3.19.2** | **Wiring harness** | | P |
| | When a wiring harness is fitted, it shall be positioned to avoid any damage by contact with moving parts or sharp edges. All connections shall withstand a tensile force in any direction of 10 N. | | P |
| **4.3.19.3** | **Lighting systems** | | P |
| | The lighting system consists of a front and a rear light. These devices shall comply with the provisions in force in the country in which the product is marketed. If there are no forced provisions of these devices, the lighting system shall comply with the requirements of ISO 6742-1. | | P |
| **4.3.19.4** | **Reflectors** | | P |
| **4.3.19.4.1** | **General** | | P |
| | These devices shall comply with the provisions in force in the country in which the product is marketed. If there are no forced provisions of these devices, the retro-reflective devices shall comply with the requirements of ISO 6742-2. | | P |
| **4.3.19.4.2** | **Rear reflectors** | | P |
| | Rear reflectors shall be red in colour. | | P |
| **4.3.19.4.3** | **Side reflectors** | | P |
| | The retro reflective device(s) shall be either | | P |
| | a) a reflectors fitted on the front half and on the rear half of EPAC. At least one of these shall be mounted on the spokes of the wheel. Where EPAC incorporates features at the rear wheel other than the frame and mudguard stays, the moving reflector shall be mounted on the front wheel; or | | P |
| | b) a continuous circle of reflective material applied to both sides of each wheel within 10 cm of the outer diameter of the tyre. | | P |
| | All side reflectors shall be of the same colour, either white (clear) or yellow. | | P |

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| Clause | Requirement | Remark | Result |
| **4.3.19.4.4** | **Front reflectors** | | P |
| | Front reflectors shall be white (clear) in colour | | P |
| **4.3.19.4.5** | **Pedal reflectors** | | P |
| | Each pedal shall have reflectors, located on the front and rear surfaces of the pedal. The reflector elements shall be either integral with the construction of the pedal or mechanically attached, but shall be recessed from the edge of the pedal, or of the reflector housing, to prevent contact of the reflector element with a flat edge placed in contact with the edge of the pedal. | | P |
| **4.3.20** | **Warning device** | | P |
| | Where a bell or other suitable device is fitted, it shall comply with the provisions in force in the country in which the product is marketed. | | P |
| **4.3.21** | **Thermal hazards** | | P |
| | A warning shall be placed on the surface if the temperature of the hot accessible surface could be above 60 °C (see EN ISO 7010:2012, symbol W017). Brake systems are excluded from this requirement. | | P |
| **4.3.22** | **Performance levels (PLrs) for control system of EPACs** | | P |
| | The safety related parts of the control systems of the EPAC shall comply with the required performance level (PLr) given in Table 34 in accordance with EN ISO 13849-1. | | P |
| | Should risk assessment indicate that additional or different PLr are required for a particular application, these should be determined in accordance with EN ISO 13849 (all parts). Such PLr will be outside the scope of this standard. | | P |
| | The manufacturer of the EPAC shall record the process adopted for verification of compliance with PLr for each relevant safety function. | | P |
| **4.4** | **List of significant hazards** | | P |
| | The following significant hazards have been considered in this standard: | | P |
| | a) Mechanical hazards: high deceleration, high acceleration, Protrusion, instability; kinetic energy; rotating elements and moving elements, rough, slippery surface, sharp edges; | | P |
| | b) Electrical hazards: electromagnetic phenomena; electrostatic phenomena; overload; short-circuit; thermal radiation; | | P |
| | c) Thermal hazards: explosion; flame; radiation from heat sources; | | P |
| | d) Ergonomic hazards: effort; lighting; posture; | | P |

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| Clause | Requirement | Remark | Result |
| | e) Hazards associated with the environment in which the machine is used: water (rain and projection); | | P |
| | f) Combination of hazards: braking under wet and dry condition, handgrips, motor management system, engine power management, installed braking power. | | P |
| **5** | **Marking, labelling** | | P |
| **5.1** | **Requirement** | | P |
| | The EPAC shall be marked visibly, legibly and indelibly with the following minimum particulars: | | P |
| | — contact and address of the manufacturer or authorized representative; | | P |
| | — EPAC according to EN 15194; | | P |
| | — appropriate marking required by legislation (CE); | | P |
| | — year of construction, that is the year in which the manufacturing was completed (it is not possible to use a code); | | P |
| | — cut off speed XX km/h; | | P |
| | — maximum continuous rated power XX kW; | | P |
| | — maximum permissible total weight (e.g. marked near the seat post or handlebar); | | P |
| | — designation of series or type; | | P |
| | — individual serial number if any; | | P |
| | — mass if EPAC mass is more than 25 kg; | | P |
| | — mass of the EPAC in the most usual configuration. | | P |
| | The frame shall be: | | P |
| | a) visibly and permanently marked with a successive frame number at a readily visible location such as near the pedal-crank, the seat-post, or the handlebar; | | P |
| | b) visibly and durably marked, with the name of the manufacturer of complete EPAC or the manufacturer's representative and the number of this document, i.e. EN 15194.; the method of testing for durability is specified in 5.2. | | P |
| | Where appropriate, if EPAC is equipped with a coupling device for a trailer the following values shall be given: | | P |
| | c) total weight of the trailer; | | P |
| | d) vertical load on the coupling system. | | P |
| | For components, currently there are no specific requirements, but it is recommended that the following safety critical components be clearly and permanently marked with traceable identification, such as a manufacturer's name and a part number: | | P |

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| Clause | Requirement | Remark | Result |
| | e) front fork; | | P |
| | f) handlebar and handlebar-stem; | | P |
| | g) seat-post; | | P |
| | h) brake-levers, brake blocks and/or brake-block holders; | | P |
| | i) outer brake-cable casing; | | P |
| | j) hydraulic-brake tubing; | | P |
| | k) disc-brake callipers, brake-discs, and brake pads; | | P |
| | l) chain; | | P |
| | m) pedals and cranks; | | P |
| | n) bottom-bracket spindle; | | P |
| | o) wheel-rims. | | P |
| **5.2** | **Durability test** | | P |
| **5.2.1** | **Requirement** | | P |
| | When tested by the method described in 5.2.2, the marking shall remain easily legible. It shall not be easily possible to remove any label nor shall any label show any sign of curling. | | P |
| **5.2.2** | **Test method** | | P |
| | Rub the marking by hand for 15 s with a piece of cloth soaked in water and again for 15 s with a piece of cloth soaked in petroleum spirit. | | P |
| **6** | **Instruction for use** | | P |
| | Each EPAC shall be provided with a set of instructions in the language of the country to which EPAC will be supplied. Different countries may have local requirements regarding this type of information (see EN 82079-1). Instructions for use shall be delivered obligatory in paper form. For more detailed information and enabling an access for vulnerable people instructions for use should be available additionally in electronic form on demand. Instructions for use shall contain the following information on: | | P |
| | a) Concept and description of electric assistance including varying levels of motor assistance; | | P |
| | b) Recommendation for cleaning and the use of high pressure cleaners; | | P |
| | c) Control and tell tales; | | P |
| | d) Specific EPAC recommendation for use (e.g. removal of the battery, temperature range for the use of the bicycle including battery, use of start-up assistance mode); | | P |

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| Clause | Requirement | Remark | Result |
| | e) Specific EPAC warnings (e.g. always remove the battery during maintenance, inappropriate use including manipulation of the electric management system); | | P |
| | f) Recommendations about battery charging and charger use (e.g. temperature range for the battery storage, indoor or outdoor charging) as well as the importance of following the instruction contained on the label of the battery charger; | | P |
| | g) The meaning of symbol and tell tales used shall be explained in the instruction for use. Warning about contact with hot surfaces as for example disc brakes after heavy use; | | P |
| | h) The type of use for which EPAC has been designed (i.e. the type of terrain for which it is suitable) with a warning about the hazards of incorrect use; | | P |
| | i) Preparation for riding - how to measure and adjust the saddle height to suit the rider with an explanation of the insertion-depth warning marks on the seat-post and handlebar-stem. Clear information on which lever operates the front brake, which lever operates the rear brake, the presence of any brake-power modulators with an explanation of their function and adjustment, and the correct method of using a back-pedal brake if fitted; | | P |
| | j) Indication of minimum saddle height and the way to measure it; | | P |
| | k) The recommended method for adjusting any adjustable suspension system fitted; | | P |
| | l) Recommendations for safe riding, the use of a bicycle helmet, regular checks on brakes, tyre pressure, steering, rims and caution concerning possible increased braking distances in wet weather; | | P |
| | m) The safe use and adjustment of foot-securing devices if fitted (i.e. quick-release pedals and toe-clips); | | P |
| | n) The permissible total payload (rider plus luggage) and the empty weight of the EPAC; | | P |
| | o) Recommendation about usage for bicycle trailer or trailer bicycle if allowed by EPAC manufacturer; | | P |
| | p) An advisory note to draw attention to the rider concerning possible national legal requirements when EPAC is to be ridden on public roads (e.g. lighting and reflectors); | | P |
| | q) Recommended tightening of fasteners related to the handlebar, handlebar-stem, saddle, seat-post, wheels, and aerodynamic extension if fitted with torque values for threaded fasteners; | | P |

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| Clause | Requirement | Remark | Result |
| | r) The method for determining the correct adjustment of quick-release devices, such as “the mechanism should emboss the fork-ends when closed to the locked position”; | | P |
| | s) The correct method of assembling any parts supplied unassembled; | | P |
| | t) Lubrication - where and how often to lubricate, and the recommended lubricants; | | P |
| | u) The correct chain tension and how to adjust it (if appropriate); | | P |
| | v) Adjustments of gears and their operation (if appropriate); | | P |
| | w) Adjustment of brakes and recommendations for the replacement of the friction components; | | P |
| | x) Recommendations on general maintenance; | | P |
| | y) The importance of using only genuine replacement parts for safety-critical components; | | P |
| | z) Care of the wheel-rims and a clear explanation of any danger of rim-wear (see also 4.3.10.4 and 5.1): | | P |
| | For composite rims wear damage may be invisible to the user, the manufacturer shall explain the consequences of rim wear and how the cyclist can assess the degree of wear or should recommend returning the composite rim to the manufacturer for inspection. | | P |
| **Annex A** | **Example of recommendation for battery charging** | | P |
| **Annex B** | **Example of relation between speed, torque and current** | | P |
| **Annex C** | **Electromagnetic compatibility of EPAC and ESA** | | P |

| EN ISO 12100:2010 | | | |
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| Clause | Requirement | Remark | Result |
| 6 | Risk reduction | | - |
| 6.1 | General | | - |
| | The objective of risk rduction can be achieved by the elimination of hazards, or by separately or simultaneously reducing each of the two elements that determine the associated risk:<br>-severity of harm from the hazard under consideration<br>-probability of occurrence of that harm<br>All protective measures intended for reaching this objective shall be applied in the following sequence, referred to as the three-step method(see also Figures 1 and 2) | This requirement is complied with. See related clauses. | Pass |
| 6.2 | Inherently safe design measures | | - |
| 6.2.1 | General | | - |
| | Inherently safe design measures are the first and most important step in the risk reduction process because protective measures inherent to the characteristics of the machine are likely to remain effective,whereas experience has shown that even well-designed safeguarding may fail or be violated and information for use may not be followed. | Appropriate machine design has been performed by the manufacturer. | Pass |
| | Inherently safe design measures are achieved by avoiding hazards or reducing risks by a suitable choice of design features of the machine itself and/or interaction between the exposed persons and the machine.<br>NOTE See 6.3 for safeguarding and complementary measures that can be used to achieve the risk reduction objectives in the case where inherently safe design measures are not sufficient (see 6.1 for the three-step method). | Appropriate machine design has been performed by the manufacturer. | Pass |
| 6.2 | Consideration of geometrical factors and physical aspects | | - |
| 6.2.2.1 | Geometrical factors such factors include the following. | | - |

| EN ISO 12100:2010 | | | |
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| Clause | Requirement | Remark | Result |
| | a) The form of machinery is designed to maximize direct visibility of the working areas and hazard zones from the control position—reducing blind spots, for example—and choosing and locating means of indirect vision where necessary(mirrors, etc.) so as to take into account the characteristics of humanvision, particularly when safe operation requires permanent direct control by the operator, for example:<br>-the travelling and working area of mobile machines;<br>-the zone of movement of lifted loads or of the carrier of machinery for lifting persons:<br>-the area of contact of the tool of a hand-held or hand-guided machine with the material being worked.<br>The design of the machine shall be such that, from the main control position, the operator isable to ensure that there are no exposed persons in the danger zones. | Appropriate machine design has been performed by the manufacturer. | Pass |
| | b) The form and the relative location of the mechanical components parts: for instance, crushing and shearing hazards are avoided by increasing the minimum gap between the moving parts, such that the part of the body under consideration can enter the gap safely, or by reducing the gap so that no part of the body can enter it (see ISO 13854 and ISO 13857). | Appropriate machine design has been performed by the manufacturer. | Pass |
| | c) Avoiding sharp edges and corners, protruding parts: in so far as their purpose allows, accessible parts of the machinery shall have no sharp edges, no sharp angels, no rough surfaces, no protruding parts likely to cause injury, and no openings which can“trap”parts of the body or clothing. In particular, sheet metal edges shall be deburred, flanged or trimmed, and open ends of tubeswhich can cause a“trap”shall be capped. | Appropriate machine design has been performed by the manufacturer. | Pass |
| | d) The form of the machine is designed so as to achieve a suitable working position and provide accessible manual controls (actuators). | Appropriate machine design has been performed by the manufacturer. | Pass |
| 6.2.2.2 | Physical aspects | | - |
| | Such aspects include the following: | | - |
| | a) limiting the actuating force to a sufficiently low value so that the actuated part does not generate a mechanical hazard; | The actuating force has been limited to be a sufficiently low value so that the actuated part dose not generate a mechanical hazard. | Pass |
| | b)limiting the mass and/or velocity of the movable elements, and hence their kinetic energy; | This have been limited. | Pass |

| EN ISO 12100:2010 | | | |
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| Clause | Requirement | Remark | Result |
| | - c) limiting the emissions by acting on the characteristics of the source using measures for reducing<br>1) noise emission at source (see ISO/TR 11688-1),<br>2) the emission of vibration at source, such as redistribution or addition of mass and changes of process parameters [for example, frequency and/or amplitude of movements (for hand-held and hand-guided machinery, see CR 1030-1)],<br>3)the emission of hazardous substances, including the use of less hazardous substancesor dust-reducing processes (granules instead of powders, milling instead of grinding), and<br>4)radiation emissions including, for example, avoiding the use of hazardous radiation sources, limiting the power of radiation to the lowest level sufficient for the proper functioning of the machine, designing the source so that the beam is concentrated on the target, increasing the distance between the source and the operator or providing for remote operation of the machinery [measures for reducing emission of non-ionizing radiation are given in 6.3.4.5 (see also EN 12198-1 and EN 12198-3)]. | The emissions by acting on the characteristics of the source have been limited. | Pass |
| 6.2.3 | Taking into account the general technical knowledge regarding machine design This general technical knowledge can be derived from technical specifications for design (e.g.standards, design codes, calculation rules).These should be used to cover : | | - |
| | a) mechanical stresses such as | | - |
| | -stress limitation by implementation of correct calculation, construction and fastening methods as regards, e.g. bolted assemblies, welded assemblies | Has been taken into account. | Pass |
| | -stress limitation by overload prevention, (e.g. "fusible" plugs, pressure-limiting valve, breakage points, torque-limiting devices); | Has been taken into account. | Pass |
| | - avoiding fatigue in elements under variable stresses（notably cyclic stresses）; | Has been taken into account | Pass |
| | - static and dynamic balancing of rotating elements; | Has been taken into account | Pass |
| | b) materials and their properties such as | | - |
| | - resistance to corrosion, ageing, abrasion and wear; | It has appropriate coating | Pass |
| | - hardness, ductility, brittleness; | The materials have been treated by appropriate methods | Pass |
| | - homogeneity | The materials have been treated by appropriate methods | Pass |
| | - toxicity | The materials is non-toxicity | Pass |
| | - flammability | The materials no flammability | Pass |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | c) emission values for: | | - |
| | - noise; | No noise will result in hazard in this machine. | Pass |
| | - vibration; | No vibration will result in hazard in this machine. | Pass |
| | - hazardous substances; | No hazardous substances will result in hazard in this machine. | Pass |
| | - radiation. | No radiation will result in hazard in this machine. | Pass |
| | When the reliability of particular components or assemblies is critical for safety (e.g. ropes, chains, lifting accessories for lifting loads or persons), stress values shall be multiplied by appropriate working coefficients. | Appropriate working coefficients have been taken into account during design and calculation. | Pass |
| 6.2.4 | Choice of an appropriate technology | | - |
| | One or more hazards can be eliminated or risks reduced by the choice of the technology to be used in certain applications, e. g.: | | - |
| | a)on machines intended for use in explosive atmospheres:<br>-fully pneumatic or hydraulic control system and machine actuators:<br>-"intrinsically safe" electrical equipment (see IEC60079-11) | | Not applicable |
| | b)for particular products to be processed such as a solvent:equipment assuring that the temperature will remain far below the flash point. | | Not applicable |
| | c)alternative equipment to avoid high noise level,e.g.:<br>-electrical instead of pneumatic equipment<br>- in certain conditions,water cutting instead of mechanical equipment. | | Not applicable |
| 6.2.5 | Applying the principle of the positive mechanical action | | - |
| | Positive mechanical action is achieved when a moving mechanical component inevitably moves another component along with it,either by direct contact or via rigid elements. An example of this positive opening operation of switching devices in an electrical circuit<br>(see IEC 60947-5-1 and ISO 14119) | The principle of the positive mechanical action of a component on another component has been applied | Pass |
| 6.2.6 | Provisions for stability | | - |
| | Machines shall be designed to have sufficient stability to allow them to be used safely in their specified conditions of use. | Satisfied it. | Pass |
| | Factors to be taken into account include | | - |
| | -geometry of the base;<br>-weight distribution,including loading;<br>-dynamic forces due to movements of parts of the machine itself,or of elements held by the machine which may result in an overturning moment;<br>-vibration | Taken into account during design. | Pass |

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| Clause | Requirement | Remark | Result |
| | -oscillations of the centre of gravity; | | Not applicable |
| | -characteristics of the supporting surface in case of traveling or installation on different sites (e.g.ground conditions,slope); | Taken into account during design. | Pass |
| | -external forces (e.g.wind pressure,manual forces) | Taken into account during design. | Pass |
| | Stability shall be considered in all phases of the life of the machine,including handling, traveling,installation,use,de-commissioning and dismantling. | Taken into account during design. | Pass |
| | Other protective measures for stability relevant to safeguarding are given in 6.3.2.6 | Please see the related clause. | Pass |
| 6.2.7 | Provision for maintainability | | - |
| | When designing a machine,the following maintainability factors shall be taken into account: | | - |
| | -accessibility,taking into account the environment and the human boby measurements,including the dimensions of the working clothes and tools used; | These factors have been taken into account during design. | Pass |
| | -ease of handling,taking into account human capabilities; | These factors have been taken into account during design. | Pass |
| | -limitation of the number of special tools and equipment; | These factors have been taken into account during design. | Pass |
| 6.2.8 | Observing ergonomic principles | - | - |
| | Ergonomic principles shall be taken into account in designing machinery to reduce mental or physical stress and strain of the operator. | Appropriate ergonomic principles have been taken into account in designing machinery | Pass |
| | These principles shall be considered when allocating functions to operator and machine(degree of automation) in the basic design. | These principles have been taken into account during allocating functions to operator and machine. | Pass |
| | Account shall be taken of body sizes likely to be found in the intended user population, strengths and postures, movement amplitudes, frequency of cyclic actions (see ISO 10075 and ISO 10075-2) | All these factors have been taken into account during design. | Pass |
| | All elements of the “operator-machine” interface such as controls, signaling or data display elements, shall be designed to easily understood so that clear and unambiguous interaction between the operator and the machine is possible.(see EN 614-1, ISO 6385, EN 13861 and IEC 61310-1) | All arrangement and design of manual controls have been checked in compliance with. | Pass |
| | Designer’s attention is especially drawn to following ergonomic aspects of machine design | | - |
| | a)Avoiding stressful postures and movements during use of the machine(e.g.by providing facilities to adjust the machine to suit the various operators). | Stressful postures and movements during use of the machine have been avoided. | Pass |

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| Clause | Requirement | Remark | Result |
| | b) Designing machines, and more especially hand-held and mobile machines to enable them to be operated easily taking into account human effort, actuation of controls and hand, arm and leg anatomy. | This machine has been adjusted to the human strength and convenient movement. | Pass |
| | c) Limit as far as possible noise, vibration and thermal effects such as extreme temperatue | This machine with low noise, low vibration. | Pass |
| | d) Avoid linking the operator's working rhythm to an automatic succession of cycles. | This situation has been avoided. | Pass |
| | e) Providing local lighting on or in the machine for the illumination of the working area and of adjusting, setting-up, and frequent maintenance zones when the design features of the machine and/or its guards render the ambient lighting inadequate. Flicker, dazzling, shadows and stroboscopic effects shall be avoided if they can cause a risk. If the position of the lighting source has to be adjusted, its location shall be such that it does not cause any risk to persons making the adjustment. | | Not applicable |
| | f) Select, locate and identify manual controls(actuators) so that | | - |
| | - they are clearly visible and identifiable and appropriately marked where necessary(see 6.4.4) | All design and arrangement are compliance with this requirement. | Pass |
| | - they can be safely operated without hesitation or loss of time and without ambiguity(e.g. a standard layout of controls reduces the possibility of error when an operator changes from a machine to another one of similar type having the same pattern of operation) | All design and arrangement of the control logic have been checked in compliance with this requirement. | Pass |
| | -their location(for push-buttons) and their movement (for levers and handwheels) are consistent with their effect (see IEC 61310-3) | All the function has been checked in compliance with this requirement. | Pass |
| | Where a control is designed and constructed to perform several different actions, namely where there is no one-to-one correspondence (e.g. keyboards), the action to be performed shall be clearly displayed and subject to confirmation where necessary. | | Not applicable |
| | Controls shall be so arranged that their layout, travel and resistance to operation are compatible with the action to be performed, taking account of ergonomic principles. | All the arrangement of the control logic have been checked in compliance with this requirement | Pass |
| | Constraints due to the necessary or foreseeable use of personal protective equipment(such as footwear, gloves)shall be taken into account. | There factors have been taken into account during design. | Pass |
| | g)Select, design and locate indicators, dials and visual display units so that | | - |
| | -they fit within the parameters and characteristics of human perception | | Pass |
| | -information displayed can be detected, identified and interpreted conveniently, i.e. long lasting, distinct, unambiguous and understandable with respect to the operator's requirements and the intended use; | All the information displayed comply with this requirement | Pass |

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| Clause | Requirement | Remark | Result |
| | -the operator is able to perceive them form the control position | | Pass |
| 6.2.9 | Preventing electrical hazard | | - |
| | For the design of the electrical equipment of machines IEC 60201-1 gives general provisions, especially in clause 6 for protection against electric shock. | Please also make reference to EN 60204-1 test report. | Pass |
| | For requirements related to specific machines, see corresponding IEC standards(e.g. series of IEC 61029, IEC 60745, IEC 60335). | | Not applicable |
| 6.2.10 | Preventing and hydraulic hazards | | - |
| | Pneumatic and hydraulic equipment of machinery shall be designed so that: | | - |
| | -the maximum rated pressure cannot be exceeded in the circuits(e.g. by means of pressure limiting devices) | Appropriate limiting devices have been provided. | Pass |
| | -no hazard results from pressure surges or rises, pressure losses or drops or losses of vacuum; | No such hazards exist. | Pass |
| | -no hazardous fluid jet or sudden hazardous movement of the hose (whiplash)results from leakage or component failures; | | Not applicable |
| | -air receivers, air reservoirs or similar vessels(e.g. in gas loaded accumulators)comply with the design rules for these elements; | The devices are designed appropriately. | Pass |
| | -air elements of the equipment, and especially pipes and hoses, be protected against harmful external effects; | The pipes have been protected by appropriated devices. | Pass |
| | -as far as possible, reservoirs and similar vessels (e.g. in gas loaded accumulators)are automatically depressurized when isolating the machine from its power supply (see 6.3.5.4) and, if it is not possible, means are provided for their isolation, local depressurizing and pressure indication (see also ISO 14118, clause 5) | This requirement is complied with | Pass |
| | - all elements which remain under pressure after isolation of machine from its power supply be provided with clearly identified exhaust devices, and a warning label drawing attention to the necessity of depressurizing those elements before any setting or maintenance activity on the machine. See also ISO 4413 and ISO 4414 | This requirement is complied with by appropriate design. | Pass |
| 6.2.11 | Applying inherently safe design measures to control system | | - |
| 6.2.11.1 | General | | - |
| | The design measures of the control system shall be chosen so that their safety-related performance privides a sufficient amount of risk reduction (see ISO 13849-1 or IEC 62061) | Inherently safe design measures to control system have applied. | Pass |
| | The correct measures of the control systems can avoid unforeseen and potentially hazardous machine behaviour. | Inherently safe Design measures to control system have applied. | Pass |
| | -an unsuitable design or modification (accidental or deliberate) of the control system logic; | No this kind of hazard in this machine | Pass |

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| Clause | Requirement | Remark | Result |
| | - a temporary or permanent defect or a failure of one or several components of the control system; | | Pass |
| | - a variation or a failure in the power supply of the control system; | No this kind of hazard in this machine. | Pass |
| | - inappropriate selection, design and location of the control devices; | No this kind of hazard in this machine. | Not applicable |
| | Typical examples of hazardous machine behaviour are: | | - |
| | - unintended/unexpected start-up (see ISO 14188) | No this kind of hazard. | Pass |
| | - uncontrolled speed change; | No this kind of hazard. | Pass |
| | - failure to stop moving parts; | No this kind of hazard. | Pass |
| | - dropping or ejection of a mobile part of the machine<br>or of a workpiece clamped by the machine; | No this kind of hazard. | Pass |
| | - machine action resulting from inhibition (defeating or failure) of protective devices | No this kind of hazard. | Pass |
| | In order to prevent hazardoues machine behaviour and to achieve safety functions, the design of control systems shall comply with the principles and methods presented in this subclause 6.2.11 and in 6.2.12. | The design of control systems comply with the related principles and methods | Pass |
| | These principles and methods shall be applied singly or in combination as appropriate to the circumstances (see ISO 13849-1 and EN 60204-1 and IEC 62061). | Please see the related clause. | Pass |
| | Control systems shall be designed to enable the operator to interact with the machine safely and easily; this requires one or several of the following solutions; | | - |
| | -systematic analysis of start and stop conditions; | Systematic analysis have been applied. | Pass |
| | -provision for specific operating modes (e.g. start-up after normal stop. restart after cycle interruption or after emergency stop. removal of the workpieces contained in the machine, operation of a part of the machine in case of a failure of a machine element) | Enough provisions have been provided. | Pass |
| | -clear display of the faults; | | Pass |
| | -measures to prevent accidental generation of unexpected start commands (e.g. shrouded start device) likely to cause dangerous machine behaviour (see ISO 14118 figure 1) | Main switch with lock and related devices are provided. | Pass |
| | -maintained stop commands (e.g. interlock) to prevent restarting that could result in dangerous machine behaviour (see ISO 14118:2000,figure 1) | This requirement is complied with. | Pass |
| | An assembly of machines may be divided into several zones for emergency stopping, for stopping as a result of protective devices and/or for isolation and energy dissipation. | | Not applicable |

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|---|---|---|---|
| Clause | Requirement | Remark | Result |
| | The different zones shall be clearly defined and it shall be obvious which parts of the machine belong to which zone. | | Not applicable |
| | Likewise it shall be obvious which control devices (e.g. emergency stop devices, supply disconnecting devices) and/or protective devices belong to which zone. | | Not applicable |
| | The interfaces between zones shall be designed such that no function in one zone creates hazards in another zone which has been stopped for an intervention. | | Not applicable |
| | Control systems shall be designed to limit the movements of parts of the machinery, the machine itself, or workpieces and/or loads heldby the machinery, to the safe design parameters (e.g. range, speed, acceleration, deceleration, load capacity). Allowance shall be made for dynamic effects (e.g. the swinging of loads). | | Not applicable |
| | For example: | | - |
| | -the traveling speed of mobile pedestrian controlled machinery other than remote-controlled shall be compatible with walking speed. | | Not applicable |
| | -the range, speed, acceleration and deceleration of movements of the person-carrier and carrying vehicle for lifting persons shall be limited to non-hazardous values, taking into account the total reaction time of the operator and the machine. | | Not applicable |
| | -the range of movements of parts of machinery for lifting loads shall be kept within specified limits. | | Not applicable |
| | When machinery is designed to use synchronously different elements which can also be used independently the control system shall be designed to prevent risks due to lack of synchronization. | | Not applicable |
| 6.211.2 | Starting of internal power source/switching on an external power supply. | | - |
| | The starting of an internal power source or switching-on of an external power supply shall not result in a hazardous situation. For example:<br>-starting the internal combustion engine shall not lead to movement of a mobile machine;<br>-connection to mains electricity supply shall not result in the starting of working parts of a machine. See EN 60204-1, 7.5 (see alsoAnnexes A and B). | Please also make reference to EN 60204-1 test report. | Pass |
| 6.2.11.3 | Starting/stopping of a mechanism | | - |
| | The primary action for starting or accelerating the movement of a mechanism should be performed by passage from state 0 to state 1(if state 1 represents the highest energy state) | This requirement has been taken into account during design. | Pass |

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| Clause | Requirement | Remark | Result |
| | The primary action for stopping or slowing down should be performed by removal or reduction of voltage or fluid pressure, or, if binary logic elements are considered, by passage from state 1 to 0 (if state 1 represents the highest energy state). | The type of stopping of this machine belongs to state 1and state 0. | Pass |
| | When, in order for the operator to maintain permanent control of deceleration, this principle not observed(e.g. a hydraulic braking vice of a self-propelled mobile machine),the machine shall be equipped with a means of slowing and stopping in case of failure of the main braking system | No such situation exist. | Pass |
| 6.2.11.4 | Restart after power interruption | | - |
| | If it may generate a hazard,the spontaneous restart of a machine when it is re—energized alter power interruption shall be prevented (e.g. by use of a self-maintained relay, contactor or valve). | The spontaneous restart of amachine when it is re-energized after power interruption has been prevented by contactor. | Pass |
| 6.2.11.5 | Interruption of power supply situations resulting from interruption or excessive fluctuation of the power supply. At least the following requirements shall be met: | Machinery shall be designed to prevent hazardous | Pass |
| | -the stopping function of the machinery shall remain； | | Pass |
| | -all devices whose permanent operation is required for safety shall operation an effective way to maintain safety(e.g. locking, clamping devices,cooling or heating devices, power-assisted steering of self-propelled mobile machinery); | | Pass |
| | -parts of machinery or workpieces and/or loads held by machinery which are liable to move as a result of potential energy shall be retained for the time necessary to allow them to be safely lowered | No such situation exists. | Pass |
| 6.2.11.6 | Use of automatic monitoring | | - |
| | Automatic monitoring is intended to ensure that a safety function(s) implemented by a protective measure do(es) not fail to be performed if the ability of a component or an element to perform its function is diminished ,or if the process conditions are | Appropriate automatic monitoring has been used. | Pass |
| | Automatic monitoring either detects a fault immediately or carries out periodic checks so that a fault is detected before the next demand upon the safety function. | Appropriate automatic monitoring has been used | Pass |
| | In either case, the protective measure can be initiated immediately or delayed until a specific event occurs (e.g. the beginning of the machine cycle) The protective measures may be, e.g.: | Appropriate automatic monitoring has been used. | Pass |
| | -the stopping of the hazardous process； | Emergency stop is provided | Pass |
| | -preventing the re-start of this process after the first stop following the failure; | Reset before restart is necessary | Pass |

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| Clause | Requirement | Remark | Result |
| | -the triggering of an alarm | | Not applicable |
| 6.2.11.7 | Safety functions implemented by programmable electronic control systems | | Pass |
| 6.2.11.7.1 | General | | Pass |
| | A control system including programmable electronic equipment(e.g. programmable controllers)can be used to implement safety functions machinery | | Pass |
| | equipment(e.g. programmable controllers) can be used to implement safety functions machinery | safety functions are considered during design | Pass |
| | The design of the programmable electronic control system shall be such that the probability of random hardware failures and the likelihood of systematic failures that can adversely affect the performance of the safety—related control function(s)are sufficiently low | safety functions are considered during design | Pass |
| | Where a programmable electronic control system performs a monitoring function, the system behaviour on detection of a fault shall be considered(see also IEC 6I 508 series for further guidance) | satisfied this | Pass |
| | The programmable electronic control system should be installed and validated to ensure that the specified performance(e.g. safety integrity level(SIL)in IEC 6I 508 series)for each safety function has been achieved | it be installed and validated to ensure that the specified performance | Pass |
| | Validation comprises testing an analysis(e.g. static,dynamic or failure analysis)to show that all parts interact correctly to perform the safety function and that unintended functions do not occur | All parts interact correctly to perform the safety function and that unintended functions do not occur | Pass |
| 6.2.11.7.2 | Hardware aspects | | - |
| | The hardware(including e.g. sensors, actuators,logic solvers)shall be selected (and/or designed)and installed to meet both the functional and performance requirements ofthe safety function(s)to be performed, in particular,by means of: | The hardware has been selected and installed to meet both the functional and performance requirements of the safety functions to be performed | Pass |
| | -architectural constraints(e.g. the configuration of the system, its ability to tolerate faults，its behaviour on detection of a fault)： | Appropriate devices are provided | Pass |
| | -selecting (and/or designing) equipment and devices with an appropriate probability of dangerous random hardware failure; | Appropriate devices are provided | Pass |
| | Incorporating measures and techniques within the hardware to avoid systematic failures and control systematic faults. | Appropriate devices are provided. | Pass |
| 6.2.11.7.3 | Software aspects | | - |

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| Clause | Requirement | Remark | Result |
| | The software (incfuding internal operating software(or system sofiware) and application software) shall be designed so as to satisfy the performance specification for the safety functions (see also IEC 61508-3) | It has PLC. | Pass |
| | Application software | | - |
| | Application software should not be re-programmable by the user. | Not applicable | Not applicable |
| | This may be achieved by use of embedded software in a non re-programmable memory (e.g. micro-controller, application specific integrated circuit (ASIC) | Not applicable | Not applicable |
| | When the application requires reprogramming by the user, the access o the software dealing with safety functions should be restricted e.g. by :<br>-locks;<br>-passwords for the authorized persons | | Not applicable |
| 6.2.11.8 | Principles relating to manuai control | | - |
| | a)Manual control devices shall be designed and located according to the relevant ergonomic principles given in 6.2.8 | Manual control devices have been designed and located according to the relevant ergonomic principles given in 4.8.7 | Pass |
| | b)A stop control device shall be placed near each start control device. Where the start /stop function is performed by means of a hold-to-run control, a separate stop control device shali be provided when a risk can<br>result from the hold-to-run control device failing to deliver a stop command when released. | A stop control device has been placed near each start control device. | Pass |
| | c) Manual controls shall be located out of reach of the danger zones (see IEC 61310-3), except for certain controls where, of necessity, they are located within a<br>danger zone, such as emergency stop or teach pendant. | Manual controls have been located out of reach of the danger zones. | Pass |
| | d)Whhenever possible. control devices and control positions shall be located so that the operator is able to observe the working area or hazard zone. | The control devices and control positions have been located so that the operator isable to observe the working area or hazard zone. | Pass |
| | The driver of a ride-on mobile machine shall be able to actuate all control devices required to operate the machine from the driving position, except for functions which can be controlled more safely from other positions. | | Not applicable |

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| Clause | Requirement | Remark | Result |
| | On machinery intended for lifting persons, controls for lifting and lowering and, if appropriate, for moving the carrier, shall generally be located in the carrier.<br>If safe operation requires controls to be situated outside the carrier, the operator in the carrier shall be provided with the means of preventing hazardous movements. | | Not applicable |
| | e) if it is possible to start the same hazardous element by means of several controls, the control circuit shall be so arranged that only one control is effective at a given time. This applies especially to machines which can be manually controlled unit (teach pendant, for instance), with which the operator may enter danger zones. | | Not applicable |
| | f) Control actuators shall be designed or guarded so that their effect, where a risk is involved, cannot occur without intentional operation (see ISO 9355-1 and ISO 447) | This requirement is complied with. | Pass |
| | g) For machine functions whose safe operation depends on permanent, direct control by the operator, measures shall be taken to ensure the presence of the operator at the control position, e.g. by the design and location of control devices. | This requirement is complied with. | Pass |
| | g) For machine functions whose safe operation depends on permanent, direct control by the operator, measures shall be taken to ensure the presence of the operator at the control position, e.g. by the design and location of control devices. | This requirement is complied with. | Pass |
| | h) For cableless control an automatic stop shall be performed when correct control signals are not received, including loss of communication(seeEN 60204-1) | | Not applicable |
| 6.2.11.9 | Control mode for setting, teaching, process changeover, fault-finding, cleaning or maintenance | | Not applicable |
| | Where, for setting, teaching, process changeover, fault-finding, cleaning or maintenance of machinery, a guard has to displaced or removed and /or a protective device has to be disabled, and where it is necessary for the purpose ofthese operations for the machinery or part of the machinery to be put in operation, safety of the operator shall be achieved using a specific control mode which simultaneously: | | Not applicable |
| | -disables all other control modes; | | Not applicable |
| | -permits operation of the hazardous elements only by continuous actuation of an enabling device, a hold-to-run control device or a two –hand control device; | | Not applicable |
| | -permits operation of the hazardous elements only in reduced risk conditions (e.g. reduced speed, reduced power/force, step-operation, e. g. with a limited movement control device) | | Not applicable |

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| Clause | Requirement | Remark | Result |
| | Prevents any operation of hazardous functions by voluntary or involuntary action on the machine's sensors. | | Not applicable |
| | This control mode shall be associated with one or more of following measures: | | Not applicable |
| | -restriction of access to the danger zone as far as possible. | | Not applicable |
| | -emergency stop control within immediate reach of the operator; | | Not applicable |
| | Portable control unit(teach pendant)and/or local controls allowing sight of the controlled elements.(see IEC60204-1:9.2.4) | | Not applicable |
| 6.2.11.10 | Selection of control and operating modes | | - |
| | If machinery has been designed and built to allow for its use in several control or operating modes requiring different protective measures and /or work procedures(e.g. to allow for adjustment, setting, maintenance, inspection),it shall be fitted with a mode selector which can be locked in each position. | | Not applicable |
| | Each position of the selector shall be clearly identifiable and shall exclusively allow one control or operating mode. | | Not applicable |
| | The selector may be replaced by another selection means which restricts the use of certain functions of the machinery to certain categories of operators(e.g. access codes for certain numerically controlled functions). | | Not applicable |
| 6.211.11 | Applying measures achieve electromagnetic Compatibility | | - |
| | For guidance on electromagnetic compatibility, see IEC60204-1, and IEC61000-6 series | | Not applicable |
| 6.2.11.12 | Provision of diagnostic systems to aid fault-finding | | - |
| | Diagnostic systems to aid fault finding should be included in the control system so that there is no need to disable any protective measures | | Not applicable |
| 6.2.12 | Minimizing the probability of failure of safety functions | | - |
| 6.2.12.1 | General | | - |
| | Safety of machinery is not only dependent onthe reliability of the control systems but also on the reliability of all parts of the machine. The continued operation of the safety functions is essential for the safe use of the machine. This can be achieved by: | | Pass |
| 6.2.12.2 | Use of reliable components | | - |

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| Clause | Requirement | Remark | Result |
| | "Reliable component"means components which are capable of withstanding all disturbances and stresses associated with the usage of the equipment in the conditions of intended use (including the environmental conditions),for the period of time or the probability of operations fixed for the use, with a low probability of failures generating a hazardous malfunctioning of the machine. Components shall be selected taking into account all factors mentioned above(see also 6.213 | Reliable components have been used | Pass |
| 6.2.12.3 | Use of"oriented failure mode"components | | - |
| | "Oriented failure mode"components or systems are those in which the predominant failure mode is known in advance and which can be used so that such a failure leads to a non-hazardous alteration of the machine function | | Not applicable |
| | The use of such components should always be considered particularly in cases where redundancy is (see 6.2.12.4)not employed | | Not applicable |
| 6.2.12.4 | Duplication(or redundancy)of components or subsystems | | Not applicable |
| | In the design of safety-related parts of the machine, duplication(or redundancy) of components may be used so that if one component fails, another component( or other components) continue(s) to perform its(their) function, thereby ensuring that the safety function remains available | | Not applicable |
| | In order to allow the proper action to be initiated, omponent failure shall be preferably detected by automatic monitoring (see 6.2.1 1.6) or in some circumstances by regular inspection, | | Not applicable |
| | provided that the inspection interval is shorter than the expected lifetime of the components. | | Not applicable |
| | Diversity of design and/or technology can be used to avoid common cause failures (e.g. from electromagnetic disturbance) or common mode failures. | | Not applicable |
| 6.2.13 | Limiting exposure to hazards through reliability of quipment | | - |
| | Increased reliability of all component parts of machinery reduces the frequency of incidents requiring rectification, thereby reducing exposure to hazards. | This requirement is complied with. | Pass |
| | This applies to power systems (operative part) as well as to control systems, to safety functions as well as to other functions of machinery. | This requirement is complied with. | Pass |
| | Safety-critical components (as e.g. certain sensors) with known reliability shall be used. | Safety-critical components are used in this machine. | Pass |

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| Clause | Requirement | Remark | Result |
| | The elements of guards and of protective services shall be particularly reliable, as their failure can expose persons to hazards, and also as poor reliability would encourage attempts to defeat them. | This requirement is complied with. | Pass |
| 6.2.14 | Limiting exposure to hazards through mechanization or automation of loading(feeding) /unloading (removal) operations | | - |
| | Mechanization and automation of machine loading/unloading operations and more generally of handling operations (of work pieces, materials, substances) limit the risk generated by these operations by reducing the exposure of persons to hazards at the operating points. | This requirement is complied with. | Pass |
| | Automation can be achieved e.g. by robots, handling devices. transfer mechanisms, air blast equipment. | This requirement has been complied with by design. | Pass |
| | Mechanization can be achieved, e.g. by feeding slides, push rods, hand-operated indexing tables. | This requirement has been complied with by design. | Pass |
| | While automatic feeding and removal devices have much to offer in preventing accidents to machine operators, they can create danger when any faults are being rectified. | Appropriate provisions have been provided. | Pass |
| | Care shall be taken to ensure that the use of these devices does not introduce further hazards (e.g. trapping, crushing) between the devices and parts of the machine or workpieces/materials being processed. | These devices will not introduce further hazards | Pass |
| | Suitable safeguards (see 6.3) shall be provided if this cannot be ensured. | Please see the related clause | Pass |
| | Automatic feeding and removal devices with their own control systems and the control systems of the associated machine shall be interconnected after thoroughly studying how all safety functions are performed in all control and operation modes of the whole equipment. | This requirement has been complied with by design | Pass |
| 6.2.15 | Limiting exposure to hazards through location of the setting and maintenance points outside of danger zones. | | Pass |
| | The need for access to danger zones shall be minimized by locating maintenance, lubrication and setting points outside these zones. | This requirement has been complied with by design. | Pass |
| 6.3 | Safeguarding and complementary protective measures | | - |
| 6.3.1 | General | | - |
| | Guards and protective devices shall be used to protect persons whenever inherently safe design does not reasonably make it possible either to remove hazards or to sufficiently reduce risks. Complementary protective measures involving additional equipment (e.g. emergency stop equipment )may have to be implemented. | Appropriate guards and protective devices have been used to protect persons whenever inherently safe design does not reasonably make it possible either inherently safe either to remove hazards or to sufficiently reduce risks. | Pass |

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| Clause | Requirement | Remark | Result |
| | The different kinds of' guards and protective devices are defined in 3.27 and 3.28. | Please see the related clause | Pass |
| | Certain safeguards may be used to avoid exposure to more than one hazard (e.g. a fixed guard preventing access to a zone where a mechanical hazard is present being used to reduce noise level and collect toxic emissions) | Such safeguards exist | Pass |
| 6.3.2 | Selection and implementation of guards and protective devices | | - |
| 6.3.2.1 | General | | - |
| | This subclause gives guidelines for the selection and the implementation of guards and protective devices the primary purpose of which is to protect persons against hazard generated by moving parts, according to the nature of those parts(see figure 4)and to the need for access to the danger zone(s) | Please see the related clause | Pass |
| | The exact choice of a safeguard for a particular machine shall be made on the basis of the risk assessment for that machine | Please see the related clause. | Pass |
| | In selecting an appropriate safeguard for a particular type of machinery or hazard zone, it shall be borne in mind that a fixed guard is simple and shall be used where access of an operation (operation without any malfunction) of the machinery. | | Pass |
| | As the need for frequency of access increase this inevitably leads to the fixed guard not being replaced | This requirement is complied with | Pass |
| | This requires the use of an alternative protective measure (movable interlocking guard, sensitive protective equipment.) | Movable interlocking guard is used. | Pass |
| | A combination of safeguards may sometimes be required. For example, where, in conjunction with a fixed guard, a mechanical loading(feeding) device is used to feed a workpiece into a machine, thereby removing the need for assessto the primary hazard zone, a trip device may be requiring hazard between the secondary drawing-in or shearing hazard between the mechanical loading(feeding) device, when reachable, and the fixed guard. | | Not applicable |
| | Consideration shall be given enclosure of control positions or intervention zones to provide combined protection against several hazards which may include: | This requirement has been taken into consideration. | Pass |
| | - hazards from falling or ejected objects(e.g. falling object protection structure) | No such hazards exist in this machine. | Pass |
| | - emission hazards(e.g. protection against noise, vibration, radiation , harmful substances) | No such hazards exist in this machine. | Pass |
| | - hazards due to the environment(e.g. protection against heat, cold, foul weather) | No such hazards exist in this machine. | Pass |
| | - hazards due to tipping over or rolling over of machinery(e.g. roll-over or tip-over protection structure) | No such hazards exist in this machine. | Pass |

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| Clause | Requirement | Remark | Result |
| | The design of such enclosed work stations(e.g. cabs and cabins) shall take into account ergonomic principles concerning visibility,lighting, atmospheric conditions, access, posture. | No such hazards exist in this machine. | Pass |
| 6.3.2.2 | Where access to the hazard zone is not required during normal operation | | - |
| | Where access to the hazard zone is not required during normal operation of the machinery, safeguard should be selected fiom the following: | | - |
| | a) fixed guard (see also ISO 14120) | Fixed guards are provided. | Pass |
| | b) interlocking guard with or without guard locking (see also 6.3.3.2.3, ISO 14119, ISO 14120); | Provided. | Pass |
| | c) self-closing guard (see ISO 14120, 3.3.2) | | Not applicable |
| | d) sensitive protective equipment, e.g. electro-sensitive protective equipment (see IEC 61496) or pressure sensitive mat (see ISO 13856) | | Not applicable |
| 6.3.2.3 | Where access to the hazard zone is required during normal operation | | - |
| | Where access to the hazard zone is required during normal operation of the machinery , safeguards should be selected fiom the following: | | - |
| | a)interlocking guard with or without guard locking (see also ISO 14119, ISO 14120 and 6.3.3.2.3 of this standard); | | Not appficable. |
| | b)sensitive protective equipment, e.g electro-sensitive protective equipment (see IEC 61496) | | Not applicable |
| | c)two-hand control device (see ISO 13851) | | Not applicable |
| 6.3.2.4 | Where access to the hazard zone is required for machine setting, teaching, process changeover, fault finding, cleaning or maintenance. | | - |
| | As far as possible, machines shall be designed so that the safeguards provided for the protection of the production operator may ensure also the protection of personnel in charge of setting, teaching, process Changeover, fault finding, cleaning or maintenance without hindering them in performing their task. | | Not applicable |
| | Such tasks shall be identified and considered in the risk assessment as parts of the use of the machine (see 5.2) | | Not applicable |
| 6.3.2.5 | Selection and implementation of sensitive protective equipment | | - |
| 6.3.2.5.1 | Setection | | - |
| | Due to the great diversity ofthe technologies on which their detection function is based, all types of sensitive protective equipment are far from being equally suitable for safety applications. | | Not applicable |

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| Clause | Requirement | Remark | Result |
| | The following provisions are intended to provide the designer with criteria for selecting , for each application, the most suitable device(s). | | Not applicable |
| | Types of sensitive protective equipment include, e.g.: | | - |
| | - light curtains; | | Not applicable |
| | - scanning devices as, e.g. laser scanners; | | Not applicable |
| | - pressure sensitive mats; | | Not applicable |
| | - trip bars, trip wires. | | Not applicable |
| | Sensitive protective equipment can be used: | | - |
| | - for tripping purposes; | | Not applicable |
| | - for presence sensing; | | Not applicable |
| | - for both tripping and presence sensing | | Not applicable |
| | - to re-initiate machine operation, a practice which is subject to stringent conditions. | | Not applicable |
| | The following characteristics of the machinery, among others, can preclude the sole use of sensitive protective equipment: | | Not applicable |
| | - tendency for the machinery to eject materials or component parts; | | Not applicable |
| | - necessity to guard against emissions (noise, radiation, dust, etc.) | | Not applicable |
| | - erratic or excessive machine stopping time; | | Not applicable |
| | -inability of a machine to stop part-way through a cycle. | | Not applicable |
| 6.3.2.5.2 | Implementation | | - |
| | consideration should be given to : | | - |
| | a) size, characteristics and positioning of the detection zone (see ISO 13855, which deals with the positioning of some types of sensitive protective equipment) | | Not applicable |
| | b)reaction of the device to fault conditions (see IEC 61496 for electro-sensitive protective equipment) | | Not applicable |

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| Clause | Requirement | Remark | Result |
| | c)possibility of circumvention | | Not applicable |
| | d)detection capability and its variation over the course of time (e.g. as a result of its susceptibility to different environmental conditions such as the presence of reflecting surfaces, other artificial light sources, sunlight or impurities in the air. | | Not applicable |
| | sensitive protective equipment shall be integrated in the operative part and associated with the control system of the machine so that : | | - |
| | - a command is given as soon as a person or part of a person is detected ; | | Not applicable |
| | - the withdrawal of the person or part of a person detected does not, by itself, restart the hazardous machine function(s);therefore, the command given by the sensitive protective equipment shall be maintained by the control system until a new command is given ; | | Not applicable |
| | - restarting the hazardous machine function(s) results from the voluntary actuation , by the operator, of a control device placed outside the hazard zone , where this zone can be observed by the operator ; | | Not applicable |
| | -the machine cannot operate during interruption of the detection function of the sensitive protective equipment,except during muting phases ; | | Not applicable |
| | - the position and the shape of detection field prevents,possibly together with fixed guards , a person or part of a person from entering the hazard zone ,or being present in it , without being detected . | | Not applicable |
| 6.3.2.5.3 | Additional requirements for sensitive protective equipment when used for cycle initiation . | | - |
| | In this exceptional application, starting of the machine cycle is initiated by the withdrawal of a person or of the detected part of a person from the sensing field of the sensitive protective equipment , without any additional start command , hence deviating from the general requirement given in the second point of the dashed list in 6.3.2.5.2, above .After switching on the power supply ,or when the machine has been stopped by the tripping function of the sensitive protective equipment , the machine cycle shall be initiated only by voluntary actuation of a start control . | | Not applicable |

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| Clause | Requirement | Remark | Result |
| | Cycle initiation by sensitive protective equipment shall be subject to the following conditions : | | - |
| | a)only active optoelectronic protective devices (AOPDs) complying with IEC 61496 series shall be used ; | | Not applicable |
| | b) the requirements for an AOPD used as a tripping and presence-sensing device (see IEC 61496 ) are satisfied<br>-in particular, location, minimum distance (see ISO 13855),detection capability,<br>reliability and monitoring of control and braking systems; | | Not applicable |
| | c) the cycle time of machine is short and the facility to re-initiate the machine upon clearing of the sensing field is limited to a period commensurate with a single normal cycle; | | Not applicable |
| | d) entering the sensing field of the AOPD(s) or opening interlocking guards is the only way to enter the hazard zone; | | Not applicable |
| | e) if there is more than one AOPD safeguarding the machine, only one of the AOPD(s) is capable of cycle re-initiation; | | Not applicable |
| | f) with regard to the higher risk resulting from automatic cycle initiation, the AOPD and the associated control system comply with a higher safety-related performance than under normal conditions. | | Not applicable |
| 6.3.2.6 | Protective measures for stability | | - |
| | If stability cannot be achieved by inherently safe design measures such as weight distribution(see 4.6), it will be necessary to maintain it by protective measures such as the use of : | | - |
| | - anchorage bolts; | | Pass |
| | - locking devices | | Not applicable |
| | - movement limiters or mechanical stops; | | Not applicable |
| | - acceleration or deceleration limiters; | | Not applicable |
| | - load limiters; | | Not applicable |
| | - alarms warning of the approach to stability or tipping limits; | | Not applicable |
| 6.3.2.7 | Other protective devices | | - |

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| Clause | Requirement | Remark | Result |
| | When a machine requires continuous control by the operator(e. g. mobile machines, cranes) and an error of the operator can generate a hazardous situation, this machine shall be equipped with the necessary devices to enable the operation to remain within specified limits, in particular | | Not applicable |
| | - when the operator has insufficient visibility of the hazard zone; | | Not applicable |
| | - when the operator lacks knowledge of the actual value of a safety-related parameter (e. g. a distance, a speed, the mass of a load, the angle of a slope) | | Not applicable |
| | -when hazards may result form operation other then | | Not applicable |
| | those controlled by the operator; | | - |
| | The necessary devices include: | | - |
| | - devices for limiting parameters of movement (distance, angle, velocity , acceleration) | | Not applicable |
| | - overloading and moment limiting devices: | | Not applicable |
| | - devices to prevent collisions or interference with other machines; | | Not applicable |
| | -device for preventing hazards to pedestrian operators of mobile machinery or other pedestrians: | | Not applicable |
| | - torque limiting devices, breakage points to prevent excessive stress of components and assemblies; | | Not applicable |
| | - devices for limiting pressure. temperature; | | Not applicable |
| | - devices for monitoring emissions; | | Not applicable |
| | - devices prevent operation in the absence of the operator at the control position; | | Not applicable |
| | - device to prevent lifting operations unless stabilizers are in place; | | Not applicable |
| | - devices to ensure that components are in a safe position before traveling; | | Not applicable |
| | Automatic protective measures triggered by such devices which take operation of the machinery out of the control of the operator (e.g. automatic stop of hazardous movement) should be preceded or accompanied by a warning signal to enable the operator to take appropriate action (see 6.4.3) | | Not applicable |

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| Clause | Requirement | Remark | Result |
| 6.3.3 | Requirements for the design of guards and protective devices | | - |
| 6.3.3.1 | General requirements | | - |
| | Guards and protective devices shall be designed to be suitable for the intended use taking into account mechanical and other hazards involved. Guards and protective devices shall be compatible with the working environment of the machine and designed so that they cannot be easily defeated. They shall provide the minimum possible interference with activities during operation and other phases of machine life, in order to reduce any incentive to defeat them. | Guards and protective devices have been appropriately designed. | Pass |
| | Guards and protective devices shall : | | - |
| | - be of robust construction. | This requirement has been taken into account during design. | Pass |
| | - not give rise to any additional hazard; | This requirement has been taken into account during design. | Pass |
| | -not be easy to by-pass or render non-operational; | This requirement has been taken into account during design. | Pass |
| | -be located at an adequate distance from the danger zone (see ISO 13857 and ISO 13855). | This requirement has been taken into account during design. | Pass |
| | -cause minimum obstruction to the view of the production process: | This requirement has been taken into account during design. | Pass |
| | -enable essential work to be carried out on installation and/or replacement of tools and also for maintenance by allowing access only to the area where the work has to be done, if possible without the guard or protective device having to be moved; | This requirement has been taken into account during design. | Pass |
| | For openings in the guards see ISO 13857 | This requirement has been taken into account during design. | Pass |
| 6.3.3.2 | Requirements for fixed guards | | - |
| 6.3.3.2.1 | Functions of guards | | - |
| | The functions that guards can achieve are: | These functions are achieved by fixed guards. | Pass |
| | -prevention of access to the space enclosed by guard and/or .<br>-containment/capture of materials, workpieces, chips, liquids which may be ejected or dropped by the machine and reduction of emissions(noise, radiation, hazardous substances such as dust, fumes, gases)which may be generated by the machine. | These functions are achieved by fixed guards. | Pass |

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| Clause | Requirement | Remark | Result |
| | Additionally, they may need to have particular propertied relating to electricity, temperature, fire, explosion, vibration. visibility(see ISO 14120) and operator position ergonomics(e.g. usability, operator's movements, posture, repetitive movements). | These functions are achieved by fixed guards. | Pass |
| 6.3.3.2.2 | Requirements for fixed guards | | - |
| | Fixed guards shall be securely held in place: | | - |
| | - either permanently (e.g. by welding)<br>-or by means of fasteners (screws, nuts) making removal/opening impossible without using tools; they should not remain closed without their fasteners (see ISO 14120) | All the fixed guards are securely held in place by appropriate fasteners. | Pass |
| 6.3.3.2.3 | Requirements for movable guards | | - |
| | a)movable guards which provide protection against hazards generated by moving transmission parts shall: | | - |
| | -as far as possible remain fixed to the machinery or other structure (generally by means of hinges or guides) when open; | Gemels are used for the movable guards. | Pass |
| | -be interlocking guards (with guard locking when necessary ) (see ISO 14119) | | Not applicable |
| | b) movable guards against hazards generated by non-transmission moving parts shall be designed and associated with the machine control system so that; | | - |
| | - moving parts cannot start up while they are within the operator's reach and the operator cannot reach moving parts once they have start up; this can be achieved by interlocking guards, with guard locking when necessary. | Interlocking guards are provided to comply with these requirements. | Pass |
| | - they can be adjusted only by an intentional action, such as the use of tool or a key; | This requirement is complied with. | Pass |
| | -they absence or failure of one of their components prevents starting of the moving parts or stops them; this can be achieved by automatic monitoring (see 4.11.6) | This requirement is complied with. | Pass |
| 6.3.3.2.4 | Requirements for adjustable guards | | - |
| | Adjustable guards may only be used where the hazard zone cannot for operational reasons be completely enclosed; | | Not applicable |
| | They shall: | | - |
| | -be designed so that the adjustment remains fixed during a given operation | | Not applicable |
| | -be readily adjustable without the use of tools; | | Not applicable |
| 6.3.3.2.5 | Requirements for interlocking guards with a start function (control guards) | | Not applicable |
| | An interlocking guard with a start function may be used provided that | | Not applicable |

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| Clause | Requirement | Remark | Result |
| | - all requirements for interlocking guards are satisfied (see ISO 14119) | | Not applicable |
| | - the cycle time of the machine is short | | Not applicable |
| | -the maximum opening time of the guard is present to a low value (e.g. equal to the cycle time). When this time is exceeded, the hazardous function(s) cannot be initiated by the closing of the interlocking guard with a tart function and resetting is necessary before restarting the machine. | | Not applicable |
| | - the dimensions or shape of the machine do not allow a person, or part of a person, to stay in the hazard zone or between the hazard zone and the guard while the guard is closed (see ISO 14120) | | Not applicable |
| | - all other guards whether fixed (removable type) or movable are interlocking guards; | | Not applicable |
| | -the interlocking device associated with the interlocking guard with a start function is designed in such a way – e.g. by duplication of position detectors and use of automatic monitoring (see 4.11.6)- that its failure cannot lead to an unintended/unexpected start-up; | | Not applicable |
| | -the guard is securely held open(e.g. by a spring or counterweight )such that it cannot initiate a start while falling by its own weight; | | Not applicable |
| 6.3.3.2.6 | Hazards from guards | | - |
| | Care shall be taken to prevent hazards which might be generated by: | | - |
| | - the guard construction (e.g. sharp edges or corners, material); | This requirement has been taken into account during design. | Pass |
| | - the movements of the guards (shearing or crushing zones generated by power-operated guards and by heavy guards which are liable to fall ) | This requirement has been taken into account during design. | Pass |
| 6.3.3.3 | Technical characteristics of protective devices | | - |
| | Protective devices shall be selected or designed and connected to the control system so as to ensure correct implementation of their safety function (s) is ensured. | This requirement has been taken into account during design. | Pass |
| | Protective devices shall be selected on the basis of their having met the appropriate product standard (for example, IEC 61496 for active optoelectronic protective devices) or shall be designed according to one or severalof the principles formulated in ISO 13849-1 or IEC62061. | This requirement has been taken into account during design. | Pass |
| | Protective devices shall be installed and connected to the control system so that they cannot be easily defeated. | This requirement has been taken into account during design. | Pass |
| 6.3.3.4 | Provisions for alternative types of safeguards. | - | - |

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| Clause | Requirement | Remark | Result |
| | Provisions should be made to facilitate the fitting of alternative types of safeguards on machinery where it is known that this fitting will be necessary because the work to be done on it will vary. | | Not applicable |
| 6.3.4 | Safeguarding for reducing emissions | | - |
| 6.3.4.1 | General | | - |
| | If the measures for the reduction of emissions at source mentioned in 6.2.2.2 are not adequate, the machine shall be provided with additional protective measures (see 6.3.4.2 to 6.3.4.5). | No such hazard exists. | Pass |
| 6.3.4. | Noise | | - |
| | Additional protective measures include, for example:<br>-enclosures (see ISO 15667)<br>-screens fitted to the machine;<br>-silencers (see ISO 14163) | No such hazard exists. | Pass |
| 6.3.4.3 | Vibration | | - |
| | Additional protective measures include, for example, damping devices for vibration isolation between the source and the exposed person such as resilient mounting or suspended seats. | No such hazard exists. | Pass |
| | For measures for vibration isolation of stationary industrial machinery see EN 1299 | No such hazard exists. | Pass |
| 6.3.4.4 | Hazardous substances | | - |
| | Additional protective measures include, for example: | | - |
| | -encapsulation of the machine (enclosure with negative pressure); | | Not applicable |
| | - local exhaust ventilation with filtration. | | Not applicable |
| | - wetting with liquids; | | Not applicable |
| | - special ventilation in the area of the machine (air curtains , cabins for operators) | | Not applicable |
| 6.3.4.5 | Radiation | | - |
| | Additional protective measures include, for example: | | - |
| | - use of filtering and absorption; | | Not applicable |
| | - use of attenuating screens or guards | | Not applicable |
| 6.3.5 | Complementary protective measures | | - |
| 6.3.5.1 | General | | - |

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| Clause | Requirement | Remark | Result |
| | Protective measures which are neither inherently safe design measures, nor safeguarding (implementation of guards and/or protective devices),nor information for use may have to be implemented as required by the intended use and the reasonably foreseeable misuse of the machine. Such measures include, but are not limited to, the ones dealt with in 6.3.5.2 to 6.3.5.6 | It meet the requirement. | Pass |
| 6.3.5.2 | Components and elements to achieve the emergency stop function | | - |
| | If following a risk assessment, a machine needs to be fitted with components and elements to achieve an emergency stop function to enable actual or impending emergency situations to be averted, the following requirements apply: | | - |
| | -the actuators shall be clearly identifiable, clearly visible and readily accessible | The actuators can be clearly identifiable, clearly visible and readily aessible | Pass |
| | -the hazardous process shall be stopped as quickly as possible without creating additional hazards. If this is not possible or the risk cannot be reduced, it should be questioned whether implementation of an emergency stop function is the best solution; | The hazardous process can be topped as quickly as possible without creating additional hazards | Pass |
| | -the emergency stop control shall trigger or permit the triggering of certain safeguard movements where necessary. | No this situation exists | Pass |
| | Once active operation of the emergency stop device has ceased following an emergency stop command, the effect of this command shall be sustained until it is rest. | Reset is necessary before re-start. | Pass |
| | This reset shall be possible only at that location where the emergency stop command has been initiated. The reset of the device shall not restart the machinery, but only permit restarting. | This requirement is complied with by appropriate design of the emergency stop | Pass |
| | More details for the design and selection of electrical components and elements to achieve the emergency stop function are provided in EN 60204 series. | Please see the related clauses. | Pass |
| 6.3.5.3 | Measures for the escape and rescue of trapped persons- | | - |
| | Measures for the escape and rescue of trapped persons may consist e.g. of: | | - |
| | -escape routes and shelters in installations generating operator-trapping hazards | | Not applicable |
| | -arrangements for moving some elements by hand, after an emergency stop | | Not applicable |

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| Clause | Requirement | Remark | Result |
| | -arrangements for reversing the movement of some elements | | Not applicable |
| | - anchorage points for descender devices; | | Not applicable |
| | -means of communication to enable trapped operators to call for help | | Not applicable |
| 6.3.5.4 | Measures for isolation and energy dissipation | | - |
| | Especially with regard to their maintenance and repair, machines shall be equipped with the technical means to achieve the isolation from power supply(ies) and dissipation of stored energy as a result of following actions: | | - |
| | a) isolating(disconnecting,separating)the machine(or defined parts of the machine) from all power supplies; | A main switch with lock is provided. | Pass |
| | b) locking (or otherwise securing ) all the isolating units in the isolating position; | Please see the report for EN 60204 | Pass |
| | dissipating or , if this is not possible or practicable, restraining (containing) any stored energy which may give rise to a hazard; | Please see the report for EN 60204 | Pass |
| | verifying, by means of a safe working procedure, that the actions taken according to a), b) and c) above have produced the desired effect. | Please see the report for EN 60204 | Pass |
| | See ISO 14118, clause 5 and EN 60204-1: 5.5 and 5.6 | | Pass |
| 6.3.5.5 | Provisions for easy and safe handling of machines and their heavy component parts | | Pass |
| | Machines and their component parts which cannot be moved or transported by hand shall be provided or capable of being provided with suitable attachment devices for transport by means of lifting gear. | Appropriate attachments are provided. | Pass |
| | These attachments may be, among others, | | Pass |
| | standardized lifting appliances with slings, hooks,eyebolts, or tapped holes for appliance fixing; | | Pass |
| | appliances for automatic grabbing with a lifting hook when attachment is not possible from the ground. | Such devices are used. | Pass |
| | guiding grooves for machines to be transported by a fork truck; | | Not applicable |
| | lifting gear and appliances integrated into the machine. | | Not applicable |
| | Parts of machinery which can be removed manually in operation shall be provided with means for their safe removal and replacement; (See also 6.4.4c item 3). | | Pass |
| 6.3.5.6 | Measures for safe access to machinery | | - |

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| Clause | Requirement | Remark | Result |
| | Machinery shall be so designed as to enable operation and all routine tasks relating to setting and/or maintenance, to be carried out,as far as possible, by a person remaining at ground level. | These requirements have been taken into account during design. | Pass |
| | Where this is not possible, machines shall have built-in platforms, stairs or other facilities to provide safe access for those tasks ,but care should be taken to ensure that such platforms or stairs do not give access to danger zones of machinery. | | Not applicable |
| | The walking areas shall be made from materials which remain as slip resistant as practicable under working conditions and, depending on the height from the ground , suitable guard-rails(see ISO14122-3)shall be provided. | | Not applicable |
| | In large automated installations, particular attention shall be given to safe means of access such as walkways, conveyor bridges or crossover points. | | Not applicable |
| | Means of access to parts of machinery located at a height shall be provided with collective means of protection against falls(e.g. guard-rails for stairways, stepladders and platforms and/or safety cages for ladders) | | Not applicable |
| | As necessary, anchorage points for personal protective equipment against falls from a height shall also be provided(e.g. in carriers of machinery for lifting persons or with elevating control stations) | | Not applicable |
| | Openings shall whenever possible open towards a safe position, They shall be designed to prevent hazards due to unintended opening. | | Not applicable |
| | The necessary aids for access shall be provided(e.g. steps, handholds).Control devices shall be designed and located to prevent their being used as aids for access. | | Not applicable |
| | When machinery for lifting goods and/or persons includes landings at fixed levels, these shall be equipped with inter locking guards preventing falls when the platform is not present at the level. | | Not applicable |
| | Movement of the lifting platform shall be prevented while the guards are open. | | Not applicable |
| | For detailed provisions see ISO 14122. | | Not applicable |
| | Information for use | | - |
| 6.4 | General requirements | | - |
| 6.4.1 | Drafting information for use is an integral part of the design of a machine(see figure2). | Please see the related clause. | Pass |

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| Clause | Requirement | Remark | Result |
| 6.4.1.1 | Information of use consists of communication links, such as texts, words, signs, signals, symbols or diagrams, used separately or in combination to convey information to the user. It is directed to professional and/or non-professional users. | All the information is stated in the appropriate place. | Pass |
| 6.4.1.2 | Information shall be provided to the user about the intended use of the machine, taking into account, notably, all its operating modes. | | - |
| | The information shall contain all directions required to ensure safe and correct use of the machine. With this in view, it shall inform and warn the user about residual risk. | All the information is stated in the appropriate place. | Pass |
| | The information shall indicate, as appropriate, | | - |
| | - the need for training, | All the information is stated in the appropriate place. | Pass |
| | - the need for personal protective equipment, | All the information is stated in the appropriate place. | Pass |
| | - the possible need for additional guards devices (see Figure 2, Footnote d). | All the information is stated in the appropriate place. | Pass |
| | It shall not exclude uses of the machine that can reasonably be expected from its designation and description and shall also warn about the risk which would result from using the machine in other ways than the ones described in the information, especially considering its reasonably foreseeable misuse. | All the information is stated in the appropriate place. | Pass |
| 6.4.1.3 | Information for use shall cover, separately or in combination, transport, assembly and installation, commissioning, use of the machine (setting, teaching/programming or process changeover, operation, cleaning, fault-finding and maintenance) and, if necessary, dismantling, disabling and scrapping. | All the information is stated in the appropriate place. | Pass |
| 6.4.2 | Location and nature of the information for use | | - |
| | Depending on the risk , the time when the information is needed by the user and the machine design , it shall be decided whether the information – or parts thereof – are to be given: | All the information is stated in the appropriate place. | Pass |
| | - in /on the machine itself (see 6.3 and 6.4.4) | Adequate information stated in the machine itself. | Pass |
| | -in accompanying documents ( in particular instruction handbook , see 6.4.5) | Adequate information is stated in the accompanying documents | Pass |
| | - on the packaging | Adequate information is stated on the packaging | Pass |
| | - by other means such as signals and warnings outside the machine. | Adequate information is stated | Pass |

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| Clause | Requirement | Remark | Result |
| | Standardized phrases shall be considered where important messages such as warnings need to be given (see also IEC 62079) | This requirement is considered. | Pass |
| 6.4.3 | Signals and warning devices | | - |
| | Visual signals (e.g. flashing lights ) and audible signals (e.g. sirens) may be used to warn of an impending hazardous event such as machine start-up or overspeed. | Signals and warning devices are provided. | Pass |
| | Such signals may also be used to warn the operator before the triggering of automatic protective measures (see last paragraph of 5.2.7) | Please see the related clause. | Pass |
| | It is essential that these signals: | | - |
| | - be emitted before the occurrence of the hazardous event; | This requirement is taken into account during design and selection of the warning devices. | Pass |
| | - be unambiguous; | This requirement is taken into account during design and selection of the warning devices. | Pass |
| | - be clearly perceived and differentiated from all other signals used;<br>- be clearly recognized by the operator andother persons. | This requirement is taken into account during design and selection of the warning devices. | Pass |
| | The warning devices shall be designed and located such that checking is easy. | This requirement is taken into account during design and selection of the warning devices. | Pass |
| | The information for use shall prescribe regular checking of warning devices. | This requirement is taken into account during design and selection of the warning devices. | Pass |
| | The attention of designers is drawn to the risks from “sensorial saturation” which results from too many visual and/or acoustic signals, which may also lead to defeating the warning devices. | This requirement is taken into account during design and selection of the warning devices. | Pass |
| 6.4.4 | Markings, signs (pictograms), written warnings | | - |
| | Machinery shall bear all markings which are necessary: | | - |
| | a) for its unambiguous identification, at least<br>- name and address of the manufacturer;<br>- designation of series or type;<br>- serial number, if any. | Adequate information is provided. | Pass |
| | b) in order to indicate its compliance with mandatory requirements; | | - |
| | - marking;<br>-written indications (e.g. for machines intended for use in potentially explosive atmosphere) | Adequate information is provided. | Pass |
| | c) for its safe use, e.g. : | | - |

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| Clause | Requirement | Remark | Result |
| | - maximum speed of rotating parts;<br>- maximum diameter of tools;<br>-mass (expressed in kilograms) of the machine itself and/or of removable parts<br>- maximum working load;<br>- necessity of wearing personalprotective equipment;<br>- guard adjustment data;<br>- frequency of inspection. | Adequate information is provided. | Pass |
| | Information printed directly on the machine should be permanent and remain legible throughout the expected life of the machine. | This requirement is complied with. | Pass |
| | Signs or written warnings only saying “danger” shall not be used. | This requirement is complied with. | Pass |
| | Readily understandable signs (pictograms) should be used in preference to written warnings. | This requirement is complied with. | Pass |
| | Signs and pictograms should only be used if the are understood in the culture in which the machinery is to be used. | This requirement is complied with. | Pass |
| | Markings shall comply with recognized standards (see ISO 2972, ISO 7000, particularly for pictograms, symbols, colours) See EN 60204 series as regards marking of electrical equipment. | This requirement is complied with. | Pass |
| 6.4.5 | Accompanying documents ( in particular, instruction handbook) | | - |
| 6.4.5.1 | Contents | | - |
| | The instruction handbook or other written instructions (e.g. on the packaging ) shall contain among others: | | - |
| | a) information relating to transport, handling and storage of the machine e.g. : | All the related information is stated in the instruction handbook | Pass |
| | - storage conditions for the machine; | All the related information is stated in the instruction handbook | Pass |
| | -dimensions , mass value(s), position of the centre (s) of gravity; | All the related information is stated in the instruction handbook | Pass |
| | -indications for handling (e.g. drawings indicating application points for lifting equipment) | All the related information is stated in the instruction handbook | Pass |
| | b) information relating to installation and commissioning of the machine, e.g. | | - |
| | - fixing/anchoring and vibration dampening requirements | All the related information is stated in the instruction handbook | Pass |
| | - assembly and mounting conditions; | All the related information is stated in the instruction handbook | Pass |
| | - space needed for use and maintenance; | All the related information is stated in the instruction handbook | Pass |

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| Clause | Requirement | Remark | Result |
| | - permissible environmental conditions (e.g. temperature, moisture, vibration, electromagnetic radiation); | All the related information is stated in the instruction handbook | Pass |
| | -instructions for connecting the machine to power supply (particularly about protection against electrical overloading); | All the related information is stated in the instruction handbook | Pass |
| | - advice about waste removal /disposal; | All the related information is stated in the instruction handbook | Pass |
| | -if necessary, recommendations about protective measures which have to be taken by the user; e.g. additional safeguards, safety distances, safety signs and signals. | All the related information is stated in the instruction handbook | Pass |
| | c) information relating to the machine itself, e.g. : | | - |
| | -detailed description of the machine, its fittings, its guards and/or protective devices; | All the related information is stated in the instruction handbook | Pass |
| | -comprehensive range of applications for which the machine is intended, including prohibited usages, if any , taking into account variations of the original machine if appropriate. | All the related information is stated in the instruction handbook | Pass |
| | -diagrams (especially schematic representation of safety functions); | All the related information is stated in the instruction handbook | Pass |
| | - data about noise and vibration generated by the machine, about radiation, gases, vapours, dust emitted by it, with reference to the measuring methods used. | All the related information is stated in the instruction handbook | Pass |
| | -technical documentation about electrical equipment (see EN 60204 series) | All the related information is stated in the instruction handbook | Pass |
| | -documents attesting that the machine complies with mandatory requirements; | All the related information is stated in the instruction handbook | Pass |
| | d)information relating to the use of the machine, e.g. about: | All the related information is stated in the instruction handbook | Pass |
| | - intended use;<br>- description of manual controls (actuators);<br>- setting and adjustment;<br>- modes and means for stopping(especially emergency stop )<br>- risks which could not be eliminated bythe protective measures taken by thedesigner;<br>- particular risks which may be generated by certain applications, by the use of certain fittings, and about specific safeguards whichare necessary for such applications.<br>-reasonably foreseeable misuse and prohibited usages;<br>- fault identification and location , repair, and re-starting after an intervention;<br>- personal protective equipment which need tobe usd and training required. | All the related information is stated in the instruction handbook | Pass |

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| Clause | Requirement | Remark | Result |
| | e) information for maintenance e.g. | All the related information is stated in the instruction handbook | Pass |
| | -nature and frequency of inspections for safety functions;<br>-instructions relating to maintenance operations which require a definite technical knowledge or particular skills and hence should be carried out exclusively by skilled persons (e.g. maintenance staff, specialists)<br>- instructions relating to maintenance actions (e.g. replacement of parts ) which do not require specific skills and hence may be carried out by users (e.g. operators)<br>-drawings and diagrams enabling maintenance personnel to carry out their task rationally (especially fault-finding tasks)<br>f) information relating to de-commissioning , dismantling and disposal;<br>g) information for emergency situations , e.g. :<br>- type of fire-fighting equipment to be used.<br>- warning about possible emission or leakageof harmful substance(s), and if possible, indication of means to fight their effects. | All the related information is stated in the instruction handbook | Pass |
| | h) maintenance instructions provided for skilled persons (second dash in e))and maintenance instructions provided for unskilled persons (third dash in e)), that should appear clearly separated from each other. | All the related information is stated in the instruction handbook | Pass |
| 6.4.5.2 | Production of the instruction handbook | All the related information is stated in the instruction handbook | Pass |
| | a) type and size of print shall ensure the best possible legibility. Safety warnings and/or cautions should be emphasized the use of colours, symbols and/or large print. | All the related information is stated in the instruction handbook | Pass |
| | b) information for use shall be given in the language(s) of the country in which the machine will be used for the first time and in the original version.<br>If more than one language are to be used, each language should be readily distinguished from the other(s), and efforts should be made to keep the translated text and the relevant illustration together. | All the related information is stated in the instruction handbook | Pass |
| | c) whenever helpful to the understanding, text should be supplemented with written details enabling, for instance, manual controls (actuators) to be located and identified; they should not be separated from the accompanying text and should follow sequential operations. | All the related information is stated in the instruction handbook | Pass |

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| Clause | Requirement | Remark | Result |
| | d) consideration should be given to presenting information in tabular form where this will aid understanding.Tables should be adjacent to the relevant text. | All the related information is stated in the instruction handbook | Pass |
| | e) the use of colours should be considered, particularly in relation to components requiring quick identification. | All the related information is stated in the instruction handbook | Pass |
| | f) when information for use is lengthy, a table of contents and/or an index should be given. | All the related information is stated in the instruction handbook | Pass |
| | g) safety-relevant instructions which involve immediate action should be provided in a form readily available to the operator. | All the related information is stated in the instruction handbook | Pass |
| 6.4.5.3 | Drafting and editing information for use | | - |
| | a) relationship to model : the information shall clearly relate to the specific model of machine and, if necessary, other appropriate identification (for example, by serial number). | All the related information is stated in the instruction handbook | Pass |
| | b) communicate principles : when information for use is being prepared, the communication process “see-think-use” should be followed in order to achieve the maximum effect and should follow sequential operations. The questions “how ?” and “why ?” should be anticipated and the answers provided. | All the related information is stated in the instruction handbook | Pass |
| | c) information for use shall be as simple and as brief as possible, and should be expressed in consistent terms and units with a clear explanation of unusual technical terms. | All the related information is stated in the instruction handbook | Pass |
| | d) when it is foreseen that a machine will be putto non-professional use, the instructions should be written in a form that is readily understood by the non-professional users. If personal protective equipment is required forthe safe use of the machine, clear advice should be given, e.g. on the packaging as well as on the machine, so that this information is prominently displayed at the point of sale. | All the related information is stated in the instruction handbook | Pass |
| | e) durability and availability of the documents : documents giving instructions for use should be produced in durable form (i.e. they should be able to survive frequent handling by the user). It may be useful to mark them “keep for future reference”. Where information for use is kept in electronic form (e.g. CD, DVD, tape) information on safety-related issues that need immediate action shall always be backed up with a hand copy that is readily available. | All the related information is stated in the instruction handbook | Pass |
| 7 | Documentation of risk assessment and risk reduction | | - |
| | The documentation shall demonstrate the procedure that has been followed and the results that have been achieved. This includes, when relevant, documentation | | - |

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| Clause | Requirement | Remark | Result |
| | a)the machinery for which the risk assessment has been made (for example, specifications, limits, intended use); | See the risk assessment report in detail. | Pass |
| | b) any relevant assumptions that have been made (loads, strengths, safety factors, etc.); | See the risk assessment report in detail. | Pass |
| | c) the hazards and hazardous situations identified and the hazardous events considered in the risk assessment | See the risk assessment report in detail. | Pass |
| | d) the information on which risk assessment was based (see 5.2): | See the risk assessment report in detail. | Pass |
| | 1) the data used and the sources (accident histories, experience gained from risk reduction applied to similar machinery, etc.); | See the risk assessment report in detail. | Pass |
| | 2) the uncertainty associated with the data used and its impact on the risk assessment; | See the risk assessment report in detail. | Pass |
| | e) the risk reduction objectives to be achieved by protective measures; | See the risk assessment report in detail. | Pass |
| | f) the protective measures implemented to eliminate identified hazards or to reduce risk; | See the risk assessment report in detail. | Pass |
| | g) residual risks associated with the machinery; | See the risk assessment report in detail. | Pass |
| | h) the result of the risk assessment (see Figure 1); | See the risk assessment report in detail. | Pass |
| | i) any forms completed during the risk assessment. | See the risk assessment report in detail. | Pass |

# EUT PHOTOGRAPHS

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