

Test Instruction

Instruction
Quality Management
Belassi GmbH



Test Instruction *Belassi GmbH*

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Checked: R. Beck
Released: C. Hintersteininger
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1 Purpose / Objective

1.1 Purpose

This Test Instruction specifies the requirements of a different Tests of manufacture components.

1.2 Objective

The aim is to define a clear methods and conditions for performing of the requested tests.

2 Scope

This testing instruction is valid for all new development as well as all purchased parts of Belassi. The instruction is to guarantee that products which do not adhere to the quality standards of Belassi are not brought in circulation. The decision about which examination is to be carried out for which product is made by the quality department and/or the development /technology department. Customer specification must be observed.

3 Further Applicable Documents

Document	Title of the Document
DQ001	Surface Quality Requirements_EN
DQ002	Quality Guideline_EN
TQ005	TQ005_VXX_PPAP Cover_EN_XX

4 Gender Information

Due to better legibility, we are going to abstain in this document from gender specific language. Of course, everything in this document applies on men and women the same way and is meant this way.

5 Further Agreements

If the information in this document differs from the information in the associated specification sheet, the provisions and information in the specification sheet apply.

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6 Change history

Version	Date	Page	Type of Change
V02	02.12.2020	8, 15	Chapters 9.1.11 and 9.3.14 added
V03	04.02.2021	6, 7	Update Chapter 9.1.6
V04	02.11.2021	7, 9, 13	Update Chapters 9,1,8; and 9.3.5; add chapter 9.1.12
V05	03.05.2022	15	Update Chapters 9,3,9, description added
V06	14.09.2022	14; 16	Chapter 9.3.8 (Temp req. out) & 9.3.14 Updated (Temp req. add)

7 Distribution

This document will be in the RFQ Phase distributed to the suppliers.

Responsible for the distribution is the Purchasing department.

8 Attachment

Nr.	Title of the Document

9 Description

Overview: the Belassi DVPR consists of many tests designed to check the most of Belassi engineered parts. Due to the big difference of the parts concerning complexity and use case (some are mechanical parts, some aesthetical and some are electronic parts) there may be some tests that are not fitting to the specific part. The necessity of each test must be discussed with the Belassi quality department. A specific test plan can be worked out if none or too little of the tests below are suitable for the part.

9.1 Chapter 1_General test

9.1.1 Appearance inspection

- The aim is to establish acceptance levels which shall be used to classify all surfaces, all products including metallic (plated surface) and non-metallic (painted, fabric or plastic surface) shall be classified.
- Surface classification is clearly defined on the DQ001_Surface Quality Requirement_EN

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The parts have passed the test if the parts are completely conform with the requirements of the Document:

"DQ001_Surface Quality Requirements_EN" .

9.1.2 Assembly test

The aim is to make sure that the part can be assembled in the parts interface. It is important that neither the part nor the surroundings are damaged due to the procedure. We also test if the part can be mounted in fixing position. Moreover, the torque of the screws and the mounting screws must be defined.

The parts have passed the assembly test if no interference damage or loosen is found after mounting.

9.1.2.1 Test procedure assembly and disassembly at the boat

- In this test, the assembly friendliness of the products at the boat is checked, we mount parts at the boat to prevent problems when assembling and disassembling.
- The parts have passed the mounting test if the assembly and disassembly is no problem.

9.1.3 Mechanical test

The aim is to check mechanical performance of the part. When specific definitions are required, these points must be checked here. (ex: hardness/ adhesion/bending/pressure resistance.)

The parts have passed the mechanical test if the results are satisfying concerning our drawing specification.

9.1.4 Leakage test

The aim is to make sure no leakage related with air / engine oil / fuel oil / water will happen when the boat is in the stop or operating condition that will cause any damage to the product, and the test object must be defined concerning the conditions below on the drawing,

- Define test pressure when inputting into the test component.
- Define how many seconds must be a stable input into the test part.
- Define acceptable leakage volume on the drawing.

The parts have passed the leakage test when the leakage volume corresponds with our specifications.

9.1.5 Salt spray test (Refer to DIN EN ISO 9227)

The aim is to ensure the high corrosion resistance and to avoid any disturbance in salt water and salty air conditions.

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According DIN EN ISO 9227,

- 360h for the engine components test,
- 720h for the boat components test and parts with direct contact to salt water.

The parts have passed the corrosion resistance test if red/black corrosion, damage, deformation, or corrosion is not found. Also, no white corrosion should occur before 72h, the white corrosion that arises after 72h shall not affect the function.

9.1.6 Boat durability test

The aim is to validate the complete construction and the single components after assembly.

Normal runtime 350h

Reduced durability under higher conditions:

- Boot sporty driver with waves around 1m ~ 200h
- Engine sporty driver with RPM higher than 5800 ~ 250h
- Water and Temperature Ambient:

%	Water Ambient	Wave Conditions	Temperature Ambient	Location
25%	freshwater	no waves	low/middle	lake at Pöchlarn
25%	freshwater	reduced waves	low/middle	Danube (river in Austria with waves)
50%	saltwater	waves	high	sea

Belassi defined 4 different part classifications (A; B; C; D) based on the safety and functional risk.

The validation – time for single components is defined based on the component class.

A+: 350h = Safety Critical Component => In case of a non-function serious potential safety risk (major injury) for the driver/passenger, with open tests from the test instruction

A: 250h = Safety Critical Component => In case of a non-function serious potential safety risk (major injury) for the driver/passenger, with all closed tests from the test instruction

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B: 200h = Design Relevant Component with high aesthetical requirements => In case of non-function/breakage the boat cannot get sold => High risk of damaging the image => No risk for the health of the driver/passenger. Component that has serious impact on the operating of the Vehicle. In case of Failure it will cause a nonfunctional MHC.

C: 150h = Important part for a comfortable ride => In case of a non-function/breakage, some not critical original functions don't work properly anymore but no safety risk for the driver/passenger
The failure needs to get corrected soon.
Component that has impact on the operating of the Vehicle. In case of Failure it will cause a malfunction during operating MHC.

D: 100h = Low Risk Part => In case of a non-function/breakage the ride can be continued. Every original function of the vehicle is ensured but the "problem" needs to be corrected during the next maintenance.
Component that has low impact on the operating of the Vehicle. In case of Failure it will not cause any bigger malfunction during operating MHC.

The Boat durability test is not only exercised for the whole boat itself, but also for single components which must pass the boat durability test if no damage, deformation, discoloration is found. Moreover, the parts must be fully functional after the test.

9.1.7 Condensation test (Refer to EN ISO 6270-2)

The aim is to evaluate and validate the surfaces of the design related components and simulate the real-life conditions in continuously high humidity.

Testing according to the EN ISO 6270-2 (Total 1500h in 100% humidity and $40\pm^{\circ}\text{C}$).

- The parts have passed the condensation test if they are inspected visually and no bubbles can be found on the surface and they must fulfil Cross cut requirements (refer to point 9.1.10) which acceptable classification is level 0.

9.1.8 Chemical resistance (Refer to ISO 16750-5)

The aim is to evaluate and validate the resistance of the surfaces of the design related components in case of contact with the different agents. => See Table 1

Simple test – General Test Conditions:

All samples must be preconditioned at $+50^{\circ}\text{C}$ for half an hour. Then the test object is brushed with the reagent.

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Then the brushed objects needs to be tested with the following conditions: Temperature: 70°C Test time: 24 Hours. - After 24 hours, the reagent is wiped off and the sample must rest for 72h and it needs to be evaluated with the photo documentation again the surface.

Table 1:				
Group	ID	Chemical agents	Description of Active Substance	Product Name
Fuels	AC	Petrol	a complex mixture of about 150 different hydrocarbons	Gasoline 95
Other op. agents	DG	Acetone	Acetone	Acetone 819
Oil and lubricants	BA	engine oil	Multigrade oil	5W30
Other operating agents	CB	brake fluid	mixed hydrocarbons C6-C7,n-alkanes,isoalkanes and cycloalkanes	brake cleaner "Förch" R510
Oil and lubricants	BE	Bearing grease	Molybdenum disulphide lubricant.	Molykote BR2
Cold cleaning agent	DF	Pre-treatment agent, after-treatment agent	Hydrocarbons, C9-C10, n-alkanes, iso-alkanes, cyclic, < 2% Aromatics	Sika® Remover-208
Other agents		Dichtol	n-butyl acetate and butan-1-ol	Dichtol WFT Macro (1546)
Cold cleaning agent	DK	denaturate alcohol	Isopropyl alcohol	Höfer Chemie Isopropanol 99,9%
Cleaning agents	DB	Vehicle washing chemicals	Isotridecanol, ethoxylated; amines, C12-14 alkyl dimethyl N-oxides	Förch R528 Car-Wash shampoo
Other agents	EC	Cosmetic products of creams	Water, Glycerine, C12-15 Alkyl Benzoate, Octocrylene, Alcohol Denat., Caprylic/Capric Triglyceride, Homosalate, Ethylhexyl Salicylate, Glyceryl Stearate Citrate, Butyl Methoxydibenzoylmethane, Panthenol, Hydrogenated Coco-Glycerides, Myristyl Myristate, Tocopheryl Acetate, Tetrasodium	Nivea sun milk art. No 85666
Other agents	EC	Cosmetic products of creams	Water, liquid paraffins, crystalline wax, glycerine, lanolin, phanteol, citric acid, magnesium stearate, aluminium stearate, benzyl benzoate, alcohol, perfume	Nivea cream art. No. 80104
Other agents	EF	Coffee	contains besides caffeine a number of natural substances Coffee oils like triglycerides and various fatty acids like linoleic acid and palmitic acid	coffee and condensed milk

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The parts passed the chemical resistance test if no damage, deformation, discoloration is found through visual inspection after the general test.

9.1.9 UV-resistance test (Refer to DIN ISO 4892-2)

The aim is to evaluate and validate the surfaces of the design related components and simulate the ageing of the surfaces. According DIN ISO 4892-2 for 1500 hours. Photo documentations need to be done after every 500 Hours.

The parts have passed the UV - resistance test if no damage, deformation, discoloration is found by the visual inspection and must be measured for all dimensional requirements.

9.1.10 Cross cut test (Refer to ISO 2409)

The test applies to a multi-coat and single coat system and assess the resistance to separation of individual layers of the coating from each other and is not suitable for a total thickness greater the 250micron.

The parts have passed the Cross-cut test if no peel off is found by the visual inspection and they must fulfil the acceptance classification Level 0.

9.1.11 Impact test

The aim is to evaluate and validate the surfaces of the design related components and simulate the physical Impact and damage resistance of the surfaces. Ball drop test with the defined highness with the defined power and defined Ball (Weight & Diameter). => this drop test need to be repeated 20 times.

In case of a break the test needs to be interrupted and the cycles need to be noticed.

Test Conditions for the Impact test:

- ⇒ Sample preparation: dimensions: 79x79mm quadrats plates with the finished surface.
- ⇒ Test Conditions:
Drop Height: 2m; Weight of the Ball: 1,5 Kg; Diameter: 20mm; Energy: 30 Joule.

9.1.12 Non-Destructive Tests for a Porosity and Crack detection in the Materials inside

The aim is to control and evaluate the inside of the part - materials for a potentially failure inside like a porosity, cavity, crack which can have a critical effect for the lifetime of the parts due to the stress at usage.

Belassi prefer the **computer tomography test** (CT) method as a non-destructive test for the different casted, forged and every other applicable parts.

Evaluation need to be done according the drawing/customer specification (CT).

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In the second line Belassi accept as alternative the following non-destructive test:

- X-Ray Check according the drawing/customer specification (RT)

In special cases it is acceptable to control the parts with other applicable test method like:

- Ultrasonic Test – Evaluation acc. the drawing/customer specification (UT)
- Eddy Current method – Evaluation acc. the drawing/customer specification

Independent from the method the supplier of Belassi is responsible for the test, for the effectiveness of the test, for the evaluation and for the agreement about the accepted deviations with Belassi!

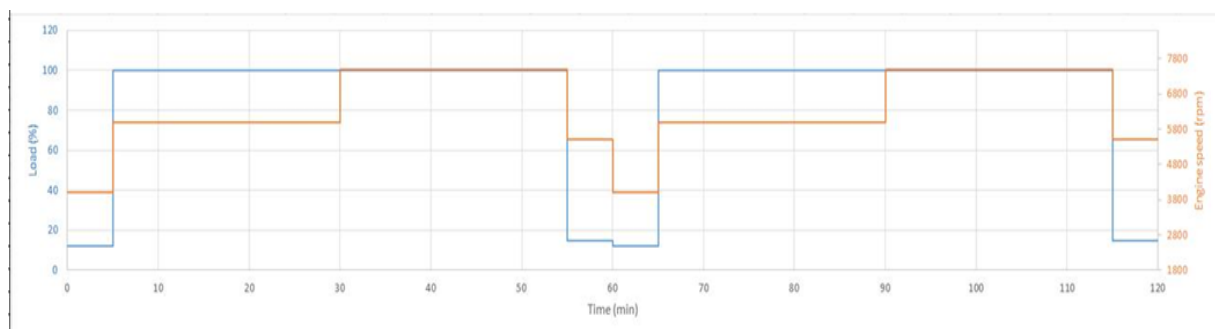
9.2 Chapter 2_Engine part test

9.2.1 Piston Marking test

The purpose is to test the scuff situation for pistons and cylinder during the critical running condition, and the test result could be the reference data for the piston profile modification.

The parts need to run this cycle at 50% timing at max. torque and another 50% at rated power. Every cycle is one hour and totally run cycles must be 100 (100 hours).

Time		Load	Speed	
min	hours	%	rpm	
0	0	12	4000	IDLE
5	0.08333	12	4000	IDLE
5	0.08333	100	6000	Max. Torque
30	0.5	100	6000	Max. Torque
30	0.5	100	7500	Rated power
55	0.91667	100	7500	Rated power
55	0.91667	15	5500	Cooling
60	1	15	5500	Cooling
60	1	12	4000	IDLE
65	1.08333	12	4000	IDLE
65	1.08333	100	6000	Max. Torque
90	1.5	100	6000	Max. Torque
90	1.5	100	7500	Rated power
115	1.91667	100	7500	Rated power
115	1.91667	15	5500	Cooling
120	2	15	5500	Cooling



The parts have passed the Piston marking test if no damage, deformation, wear is found by the visual inspection.

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9.2.2 Engine 350h durability test

The purpose is to estimate the performance of engine and the components mechanical structure in the accelerated ageing durable cycle conditions to realize whole engine and components could reach the expectation after durability test.

In the Engine durability test, the test object must survive different engine rotation speeds and loadings. Each cycle is 37 minutes and total need to run is 628 cycles(350hr).

Prüfstandszyklus Neu ab 74,5H			
Time	RPM	TPS	
33;	4000	13	
50;	5500	22	
05:00	6000	40	
02:00	7700	90	
7;	8050	50	
10:00	5000	25	
13:00	5500	30	
05:00	6500	35	
30;	4000	13	

The parts have passed the Engine 350h durability test if no damage, deformation, which is found by the visual inspection. Moreover, the parts must be fully functional after the test.

9.2.3 Engine - Power test, Exhaust emission test (Refer to EN ISO 8665, ISO 18845:2015)

Test is done by external Laboratory.

Check Cycles and evaluation acc. EG 2013/53/EU

9.2.4 Flush test

- The aim is to test the drive train components which should not be damaged during the washing process (flush instruction refers to the manual of regular service interval).
- Total Flushes: 350 times, implement 1 flush/per hour during 9.1.6 Boat durability test.
- Flush Circle: 5 min /per cycle, and cool down 15 min brake after each flushing cycle.

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9.3 Chapter 3_ Electronic test

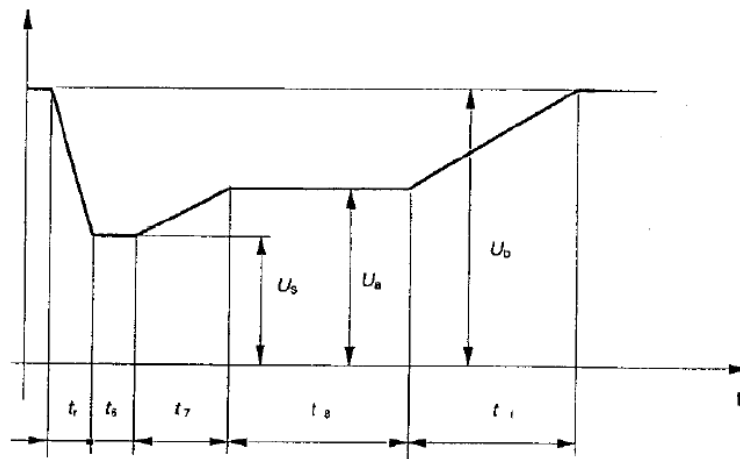
9.3.1 Over voltage test

The test object is working for one hour at a room temperature ($23 \pm 5^\circ\text{C}$) with a constant overvoltage of 18V (for 12V supply voltage)

The parts have passed the over voltage test if no damage, deformation, or discoloration can be found by visual inspection. Moreover, the parts must be fully functional after the test.

9.3.2 Supply voltage collapse test

The test object must correspond to this voltage profile.



Working voltage U_N	Voltage profile [in V]			Times of start pulse [in ms]				
	U_b	U_s	U_a	t_r	t_s	t_7	t_8	t_f
12V supply voltage	12	4,5	6,5	5	15	50	3 000	100

The parts have passed the Supply voltage collapse test if no damage, deformation, or discoloration can be found by visual inspection. Moreover, the parts must be fully functional after the test.

9.3.3 Reversal voltage test

As to the speedometer for nominal voltage 12V, the test voltage of 13,5V should be connected, with the reverse electrode for 1 min.

The parts have passed the Reversal voltage test if no damage, deformation, or discoloration can be found by visual inspection. Moreover, the parts must be fully functional after the test.

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9.3.4 Disconnection test

In this test, the circuit of the test object is connected and disconnected in turn for 10 seconds each over a total test time of 60 seconds.

The parts have passed the disconnection test if no damage, deformation, or discoloration can be found by visual inspection. Moreover, the parts must be fully functional after the test.

9.3.5 Temperature resistance test

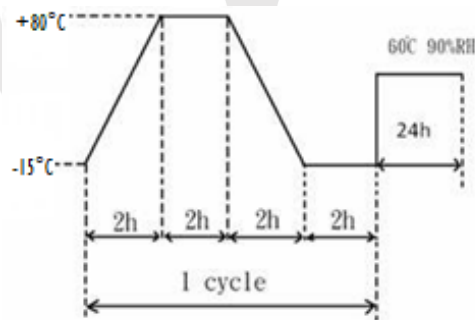
For an electric & electronic component:

Voltage: DC13.5 \pm 0.5V

Testing Temp.: -15 \pm 2 $^{\circ}$ C ~ +80 \pm 3 $^{\circ}$ C

Duration: 24 h (3 Cycle) + 24 h (60 $^{\circ}$ C 90%RH); Total 48 h,

Cycle (Pic.1): 2 h (-15 $^{\circ}$ C up to +80 $^{\circ}$ C); 2 h (Remain +80 $^{\circ}$ C); 2 h (+80 $^{\circ}$ C down to -15 $^{\circ}$ C); 2 h (Remain -15 $^{\circ}$ C); Total 8 h



For a mechanical component:

The mechanical components need to be Tested with the following conditions:

The Parts need to be prepared on the normal room temperature for the test.

Test Condition: 70 $^{\circ}$ C – 24 h.

Cooling the test object at room Temperature 24h.

Evaluation.

The parts have passed the Temperature resistance test if no damage, deformation, or discoloration can be found by visual inspection. Moreover, the parts must be fully functional and satisfied with dimensional requirement.

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9.3.6 Salty water injection test

In the Salty water injection test, the test object is operated at working voltage ($DC13.5 \pm 0.5V$) when we inject saltwater into the parts and are checking whether it burns or explodes.

The parts have passed the Saltwater injection test if no damage, deformation, or discoloration can be found by visual inspection.

9.3.7 Waterproof & Dust test-IPXX

Atmospheric condition:

- Temp.: $(23 \pm 5) ^\circ C$
- Relative Humidity: 25% to 75%
- Pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar)

IP6X (ISO 20653):

- Cycle: 6 sec. injection, 15 min. stopping; Total 20 cycle (5Hr, 2min)
- Requirements: Dust shall not penetrate.

IPX8 (ISO 20653):

- Submersion: Up to 1M.
- Duration: 1Hr.
- Temp.: $(23 \pm 5) ^\circ C$ fresh water

The parts have passed the Waterproof & Dust test if the parts are fully functional after the drive test.

9.3.8 Mechanical shock test

In the shock test, the test object has to survive 30 shocks on the axes (x,y,z) at the room temperature $20^\circ - 25^\circ$ Celsius.

Requirement:

Acceleration m/s^2	Time for half-sine ms
500	6

- The part passed the shock test if no damage, deformation, or discoloration is found through visual inspection.
Moreover, the parts must be fully functional after the test.

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9.3.9 Climate test

- In the Climate test, the test object is operated at working voltage ($DC13.5 \pm 0.5V$) constantly.
- In case of a Display/Screen part, the maximal performance/light need to be use during the whole test.
- Total 30 cycles are necessary for the test component.

4.1.2.1 Variant A (Single Parts)

1 cycle (see also Diagram 1) takes 12 hours and includes the following temperature and climatic conditions:

- 40 minutes	Holding time	at +23° C and 30 % rel. humidity
- 90 minutes	Cooling-off phase	from +23 to -15° C at 30 % rel. humidity
- 60 minutes	Holding time	at -15° C and max. 30 % rel. humidity
- 80 minutes	Heating-up phase	to +50° C and 80 % rel. humidity
- 120 minutes	Holding time	at +50° C and 80 % rel. humidity
- 30 minutes	Heating-up phase	to +80° C and 30 % rel. humidity
- 240 minutes	Holding time	at +80° C and 30 % rel. humidity
- 60 minutes	Cooling-off phase	to +23° C and 30 % rel. humidity

The actual water content of the air must not exceed 95 g/m³ during the phase of heating up to +80° C, 30 % rel. humidity. At no time during testing of parts from the vehicle interior may the specimen parts exhibit signs of condensation.



The parts passed the climate test if no damage, deformation, or discoloration is found through visual inspection. Moreover, the parts must be fully functional during and after the test.

9.3.10 EMC test (Refer to ISO/IEC 61000)

Electromagnetic compatibility (EMC) is the ability of electrical equipment and systems to function acceptably in their electromagnetic environment, by limiting the unintentional generation, propagation and reception of electromagnetic energy which may cause unwanted effects such as electromagnetic interference (EMI) or even physical damage in operational equipment.¹

Belassi requires a confirmation about the positive EMC test acc. ISO/IEC 61000 Norm and submission of the test report each applicable purchased parts and components.

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9.3.1.1 Description of Function test of the boat

Belassi performs during the validation a functional test of the complete boat.

This functional test is a combination test of different electric/electronic and mechanical components on the boat in real-life and every possible combination functions at the same time to ensure the safe and stable performance of the boat.

Purchased parts can be released only after successful complete validation.

9.3.1.2 Hardware in Loop test

All electric/electronic components are connected with the laboratory test bench and tested with a simulation of failure conditions and functions, the positive result is mandatory for the general PPAP approval for the single component.

9.3.1.3 Abrasion test acc. EN 60068-2-70 / IEC 68-2-7 Ü

The above-mentioned International standard contains a standardised test procedure for testing the durability of markings, and inscriptions on flat and curved surfaces, which subjected to abrasion by wiping with fingers and hands e.g. manually operated controls and Keyboards. The method is also suitable for testing the Resistance to contamination with liquids, as it can occur in normal use.

Specified test conditions:

- with Saltwater: Concentrate: NaCl 50 g/L
- The inspection stamp made of elastic material with a Shore A-hardness of 47 ± 5 (e.g. synthetic rubber)
- Severity: Force: 5 N
- Test size: 50 000 Cycles

The test facility shall provide a test stamp with a push rod at an angle of $45^\circ \pm 5^\circ$ pressed onto the surface to be tested.

The Frictional travel must be between 1 and 4 mm.

The part passed the Abrasion test if no damage, deformation, or discoloration is found through visual inspection. Moreover, the parts must be fully functional after the test.

9.3.1.4 Vibration test (Refer to JIS D 1601)

In the vibration test, the test object is operated at working voltage ($DC13.5 \pm 0.5V$), and according to Type4_Class B of classification of vibration conditions:

The whole test needs to be performed by the temperature range: $-15^\circ C$ to $+70^\circ C$

The temperature needs to be rise during the Test period from $-15^\circ C$ to $+70^\circ C$, then reduce from $+70^\circ C$ to room Temperature: $23^\circ C$.

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Released: C. Hintersteiner
Date: 04.11.2021

DQ003_V06_Test Instruction_EN

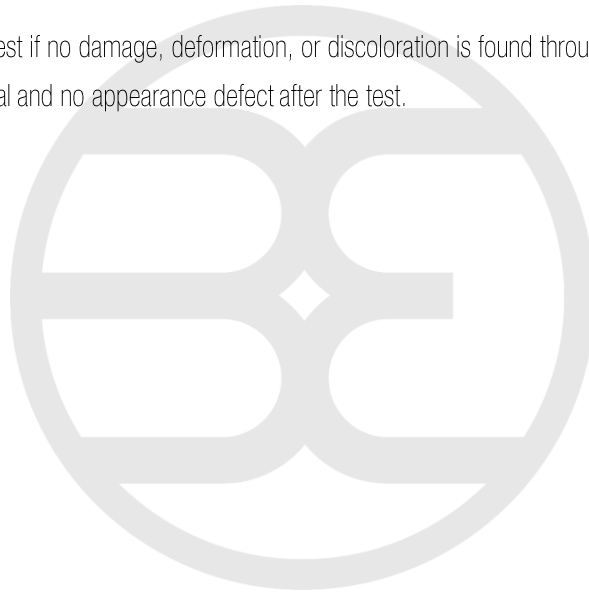
Test Instruction

Instruction
Quality Management
Belassi GmbH



- Voltage : $DC13.5 \pm 0.5V$; Acceleration : 7G
- Axial : X 、 Y ; Frequency : 20~500Hz ; Duration : 4Hr
- Axial : Z ; Frequency : 5~500Hz ; Duration : 8Hr
- In case of a Display/Screen part, the maximal performance/light need to be use during the whole test.

The part passed the Vibration test if no damage, deformation, or discoloration is found through visual inspection. Moreover, the parts must be fully functional and no appearance defect after the test.



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