

Material Data Sheet: Z-ABS

Mechanical Properties	Test Method	English	Metric
Young's Modulus	DIN EN ISO 527-2 (ASTM D638)	261 067 psi	1,80 GPa
Tensile Strength	DIN EN ISO 527-2 (ASTM D638)	5511 psi	38 MPa
Tensile Elongation	DIN EN ISO 527-2 (ASTM D638)	17 %	17 %
Charpy Impact, notched	PN-EN ISO 179-1: 2004/A1:2006 (ASTM 6110-1)	3,8 ft-lb/in ²	8 kJ/m ²
Rockwell R Hardness	PN-EN ISO 2039-1 (ASTM D785)		109
Maximum Load	PN-EN ISO 2039-1 (ASTM D785)		49 N
Efficient melting point for 3D printing*		482 - 500 F	250 - 260 °C
Glass Transition Temperature		257 F	125 °C
Vicat Softening Temperature		234 F	112 °C
Thermal Expansion		Minimal	
Odor		Nearly odorless	
Solubility		Insoluble in water	
Hazards		Product does not present any hazard while operating	

The information presented are typical values intended for reference and comparison purposes only. They should not be used for design specifications or quality control purposes. End-use material performance can be impacted(+/-) by, but not limited to part design, end-use conditions, test conditions, etc. Actual values will vary with build conditions. Tested parts were built on Zortrax M200 @ 0.2mm slice. Product specifications are subject to change without notice.

The performance characteristics of these materials may vary according to application, operating conditions, or end-use. Each user is responsible for determining that the Zortrax material is safe, lawful and technically suitable for the intended application, as well as for identifying the proper disposal (or recycling) method consistent with applicable environmental laws and regulations. Zortrax makes no warranties of any kind, express or implied including but not limited to the warranties of merchantability, fitness for a particular use.

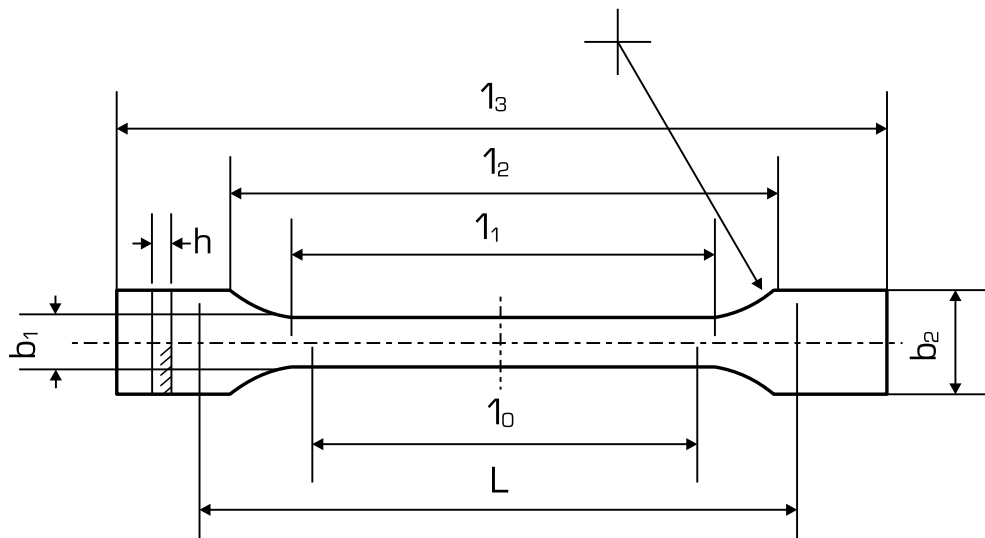
*Due amorphous nature, material does not display a true melting point.

Test Report

Plastic samples supplied by the principal were tested to determine their toughness in a static tensile test, the Charpy impact test and the Brinell hardness test.

1. Endurance Testing

Test was performed in accordance with DIN EN ISO 527-2 standard (ASTM D638). Dumbbell shaped specimens that were used to perform these tests are shown in picture 1. The INSTRON model 4481 toughness testing machine (made in UK) was used to perform the tests. Tests were carried out in room temperature. Samples were elongated with the speed of 50 mm/ min. Test results are summarized in the table 1., detailed overview of the results can be found in an annex.



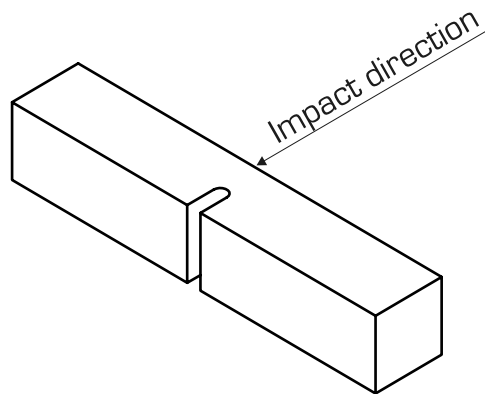
Picture 1. Dumbbell shaped specimen used for the Tensile Tes

No	Young's Modulus [MPa]	Tensile Strength [MPa]	Yield Strength [MPa]	Breaking Strength [MPa]	Elongation at Break [%]
SAMPLE	564,69 ± 12	15,28 ± 0,43	7,83 ± 0,69	14,11 ± 2,11	17,21 ± 3,45

Table 1. Test results marked in a Static Tensile Test

2. Charpy Impact Test

Test was performed in accordance with PN-EN ISO 179-1:2004/A1:2006 standard (ASTM 6110-1) ('Plastic materials: the Charpy Impact Test. The standard test for measuring impact energy – part 1 Non-Instrumental Impact Test'). In the picture 2. there is a sample of notched beam and marked impact direction of an impact hammer. Instron PW-5 impact hammer was used during this test.



Picture 2. Notched beam used for the Charpy Impact Test

The score was calculated as an average of 10 calculated impacts, where also fractured samples were counted in as approved (parts of which were still connected to each other with a thin layer of material after an impact). The impact score was estimated from the following formula:

$$a_k = \frac{A_k}{bt_k} 10^3, \text{ kJ/m}^2$$

Where: a_k – stands for the energy used to break the sample, kJ; b, t – thickness and width of a sample, mm; t_k – sample thickness under the notch

Charpy Impact Test results are presented in table 2.

Sample	Calculated impact score of notched samples in the Charpy Impact Test [kJ/m ²]
SAMPLE	7,98 ± 1,03

Table 2. Calculated impact score of notched samples

3. Ball Indentation Hardness Test

Test was performed in accordance with PN-EN ISO 2039-1 standard (ASTM D785) 'Plastic materials – determination of hardness – Part 1: Ball Indentation Hardness Test' on KB Pruftechnik durometer.

The final score is a result of calculating the average of 10 measurements. Test results are summarized in table 3.

Sample	HB Hardness was determined at a load of 49 N
SAMPLE	20,45 ± 1,15

Table 3. Samples hardness

Contact

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Zortrax S.A.

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Entered in the Register of Entrepreneurs of the National Court Register kept by the District Court in Olsztyn, VIII Commercial Division of the National Court Register, under KRS number 0000564079, with a share capital of PLN 6 962 500 paid in full.

Material Safety Data Sheet: Z-ABS

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION**Supplier:**

Zortrax S.A.
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10-457 Olsztyn
Poland

Prepared by:

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In order:

Zortrax S.A.
Wyszynskiego 1/219
10-457 Olsztyn
Poland

Material name: **ABS (Acrylonitrile Butadiene Styrene Terpolymer)**

Chemical type: **Thermoplastics**

Material trade name: **Z-ABS**

2. HAZARDS IDENTIFICATION

a. **Threshold Limit - Not established**

b. **Effect of overexposure:**

- » Eye contact - Solid may cause irritation or corneal injury due to mechanical action
- » Skin Contact - Essentially non irritating to skin, mechanical injury only
- » Skin Absorption - Unlikely due to physical properties
- » Ingestion - Unlikely due to physical state
- » Inhalation - In case of breathing in small and non-ventilated room, fumes released from heated material may cause respiratory irritation
- » Chronic Effects - Not Available
- » Mutagenicity - Not Available

3. COMPOSITION / INFORMATION ON INGREDIENTS

- a. **ABS (Acrylonitrile-Butadiene-Styrene) - 90~100 % CAS:9003-56-9**
- b. **Typical Stabilizer - 0~3%**
- c. **Typical lubricants - 0~3%**
- d. **Mineral oil - 0~2% CAS:8042-47-5**
- e. **Tallow - 0~2% CAS:67701-27-3**
- f. **Wax - 0~2% CAS:110-30-5**

4. FIRST AID MEASURES

- a. Eye contact - Rinse opened eye for several minutes under running water. If symptoms persist, consult a doctor. Remove contact lenses, if present and easy to do.
- b. Skin contact - Essentially nonirritating to skin but rinse with copious water and soap . If skin irritation continues, consult a doctor. After contact with the molten product, cool rapidly with cold water. Do not pull solidified product away from the skin. Call a doctor immediately.
- c. Ingestion - Rinse out mouth and then drink plenty of water. Do not induce vomiting! If symptoms persist consult a doctor.
- d. Inhalation - In case of breathing, fumes released from heated material may cause respiratory irritation. In case of inhaling dense smoke, immediately remove a person to fresh air. If necessary, apply artificial respiration and seek medical attention immediately.
- e. Mutagenicity - Not Available.

5. FIRE FIGHTING MEASURES

- a. Flammable Properties
 - » Flash point - None
 - » Method used - Not applicable
 - » Auto ignition Temperature - Not applicable
- b. Extinguishing Media - Usually use water and use extinguishing media appropriate to surrounding conditions
- c. Special Fire Fighting Procedure - Cool Containers with water spray. In closed stores, provide fire fighter with self-contained breathing apparatus in positive pressure mode
- d. Usual Fire and Explosion Hazards - Irritating gases and dense smoke

6. ACCIDENTAL RELEASE MEASURES

- a. Avoid formation of dust
- b. Do not breathe dust
- c. Keep away from ignition sources
- d. Avoid contact with eyes
- e. Danger of slipping on leaked/spilled product
- f. Environmental precautions - Do not allow to enter sewers/ surface or ground water
- g. Methods and material for containment and cleaning up - Allow to solidify. Pick up mechanically

7. HANDLING AND STORAGE

- a. Handling
 - » Avoid formation of dust
 - » Keep spools lightly closed
 - » Avoid spools from getting wet
- b. Storage
 - » Kepp spools in a ventilated place
 - » Avoid spools from getting wet

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

- a. Engineering Controls - General ventilation should be sufficient for most conditions. Local exhaust ventilation may be necessary for some operations
- b. Personal Protective Equipment:
 - » Eye / Face Protection - Use safety glasses. If there is a potential for exposure to particles which could cause mechanical injury to the eye
 - » Skin Protection - No Precautions other than clean body-covering clothing should be needed
 - » Respiratory Protection - For most conditions, no respiratory protection should be needed, however, if handling at elevated temperatures without sufficient ventilation, use an approved air-purifying respirator.
- c. Exposure Guideline - Although some of the additives used in this product may have exposure guidelines, these additives are encapsulated in the product and no exposure would be expected under normal handling conditions

9. PHYSICAL AND CHEMICAL PROPERTIES

- a. Appearance - Solid
- b. Odor - Almost Odorless
- c. Odor threshold - No data available
- d. pH - Not applicable
- e. Boiling Point - Not applicable
- f. Melting point - Not applicable
- g. Flash point - Not determined
- h. Flammability (solid, gaseous) - Combustible at constant flame of fire
- i. Ignition temperature - Not determined
- j. Decomposition temperature - Not determined
- k. Auto igniting - Product is not self-igniting
- l. Danger of explosion - Not determined
- m. Oxidizing properties - Not determined

- n. Vapor pressure - Negligible
- o. Density - $> 1\text{g/cm}^3$ ($> 8.345\text{ lbs/gal}$)
- p. Evaporation rate - Negligible
- q. Solubility - Insoluble
- r. Miscibility - Insoluble
- s. Viscosity (dynamic/kinematic) - Not applicable

10. STABILITY AND REACTIVITY

- a. Stability - Stable under normal condition
- b. Chemical stability
- c. Thermal decomposition / conditions to be avoided:
 - » Avoid impact friction
 - » Avoid impact heat
 - » Avoid impact sparks
 - » Avoid impact electrostatic charges
- d. Conditions to avoid - No further relevant information available
- e. Incompatible materials - Strong oxidizing agents
- f. Hazardous decomposition products:
 - » Irritant gases/vapors
 - » Poisonous gases/vapors
 - » Smoke
 - » Carbon monoxide and carbon dioxide
 - » Hydrocarbons
 - » Hydrogen cyanide (prussic acid)
 - » Styrene
 - » Aldehyde
 - » Phenol
 - » Acrylonitrile
 - » Nitrogen oxides (NO_x)

11. TOXICOLOGICAL INFORMATION

- a. **LD/LC50 values that are relevant for classification:**
 - » Oral LD50 > 5000 mg/kg (rat)
 - » Dermal LD50 > 2000 mg/kg (rabbit)
- b. **Primary irritant effect:**
 - » On the skin: Dust particles may mechanically irritate the skin
 - » On the eye: Dust particles may mechanically irritate the eye
- c. **Sensitization - No sensitizing effects known**
- d. **Subacute to chronic toxicity - No data available**
- e. **Additional toxicological information - When used and handled according to specifications, the product does not have any harmful effects according to our experience and the information provided to us**
- f. **Carcinogenic categories:**
 - » IARC (International Agency for Research on Cancer) - None of the ingredients is listed
 - » NTP (National Toxicology Program) - None of the ingredients is listed

12. ECOLOGICAL INFORMATION

- a. **Environmental Fate:**
 - » Movement & Partitioning - No bioconcentration is expected because of the high molecular weight (MW>1000). In the terrestrial environment, material is expected to remain in the soil. In the aquatic environment, material will sink and remain in the sediment
 - » Degradation & Persistence - This water insoluble polymeric solid is expected to be inert in the environment. Surface degradation is expected with exposure to sunlight. No appreciable biodegradation is expected
- b. **Ecotoxicity - Not Expected to be acutely toxic, but pellets, if ingested by waterfowl or aquatic life, may mechanically cause adverse effects**

13. DISPOSAL CONSIDERATIONS

- a. **Disposal : Do not dump into any sewers, on the ground, or into any body of water.**
- b. **All disposal methods must be in compliance with all Federal, State/Provincial and local laws and regulations. Regulations may vary in different locations. Waste characterizations and compliance with appliance laws are the responsibility solely of the waste generator.**
- c. **For unused & uncontaminated product, the preferred options include sending to a licensed, permitted:**
 - » Recycler
 - » Reclaim
 - » Incinerator or other thermal destruction device

14. TRANSPORT INFORMATION

- a. **UN-Number:**
 - » DOT, ADR, IMDG, IATA – Not applicable
- b. **UN proper shipping name:**
 - » DOT, ADR, IMDG, IATA – Not applicable
- c. **Transport hazard class:**
 - » DOT, ADR, IMDG, IATA - Not applicable
- d. **Environmental hazards - Not applicable**
- e. **Special precautions for user - Not applicable**
- f. **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code - Not applicable**
- g. **Transport/Additional information - Not dangerous according to the above specifications**

15. REGULATORY INFORMATION:

- a. **Safety, health and environmental regulations/legislation specific for the substance or mixture US EPA TSCA:**
 - » CERCLA Section 103 (40CFR302.4) - Not Listed
 - » SARA Section 311/312 (40CFR370.21) – Not listed
 - » SARA Section 313 (40CFR372.65) – Not listed
 - » SARA Section 355 (extremely hazardous substances) – Not listed
 - » TSCA (Toxic Substances Control Act) – Not listed
 - » STATE REGULATIONS (California Proposition 65) – Not listed
- b. **EUROPEAN REGULATIONS:**
 - » EC NUMBER - Not assigned
 - » Directive 96/82/EC - does not apply
- c. **Carcinogenicity categories:**
 - » MAK (German Maximum Workplace Concentration) - None of the ingredients is listed
- d. **Product resp. its monomers are listed in:**
 - » Toxic Substance Control Act TSCA (USA)
 - » Canadian Domestic Substance List DSL
 - » Existing and New Chemical Substance List ENCS (Japan)
 - » Korean Existing Chemicals List KECL
 - » Australian Inventory of Chemical Substances AICS (Australia)
- e. **Chemical safety assessment - A Chemical Safety Assessment has not been carried out**

16. OTHER INFORMATION:

Product should be handled, stored, and used in accordance with the generally accepted industrial hygiene practices and in conformity with all the applicable legal regulations.

The information provided herein is based on the knowledge possessed at this present time from the view point of safety requirements. It should, therefore, not be construed as guaranteeing specific properties.

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