

**WORLD'S LIGHTEST PAINTBALL TANK**  
FULL COMPOSITE PAINTBALL TANKS

**STAKO** paintball



## User's Guide



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## Foreword

Paintball tank user's guide was designed by the Stako Design and Technology Department to assure safe use and proper technical awareness of people using the Stako 1.1 L tanks. The document presents the general design of the type 4 composite tank on thermoplastic liner. The design and test comply with EN 12245 and engineering knowledge. Design correctness was confirmed with a MES computer simulation using ABAQUS software and numerous tests.

## Introduction

The 1.1 l STAKO tanks are the lightest available design for an operating pressure of 300 bar. The tank can be used in a wide variety of applications, from paintball to portable equipment powered with compressed air.

Application of innovative technology using a thermoplastic liner allowed us to significantly reduce the tank weight, while maintaining high strength parameters. The tank design and the high operating pressures implies the application of proper safety measures and following of manufacturer's instructions.

This guide provides information on tank design, its manufacturing process, maintenance, repair and principles for safe use. Read the guide carefully to enjoy safe and failure -free operation.

### Basic technical parameters of the tank:

- capacity	-	1.1 L
- weight	-	0.75 kg
- diameter	-	107 mm
- length	-	225 mm
- operating pressure	-	300 bar
- test pressure	-	450 bar

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## 1. Terms, definitions, symbols

- **lot** – max. 200 tanks of the same diameter, thickness, length and design
- **burst pressure** - max pressure reached during the test at the tank bursting point
- **composite, laminate** – fibre and resin combined in specific proportions
- **liner** – thermoplastic container the only purpose of which is to assure tank tightness, not carrying any load
- **thermoplastic** – plastic material capable of softening multiple times as the temperature increases and harden as it drops.

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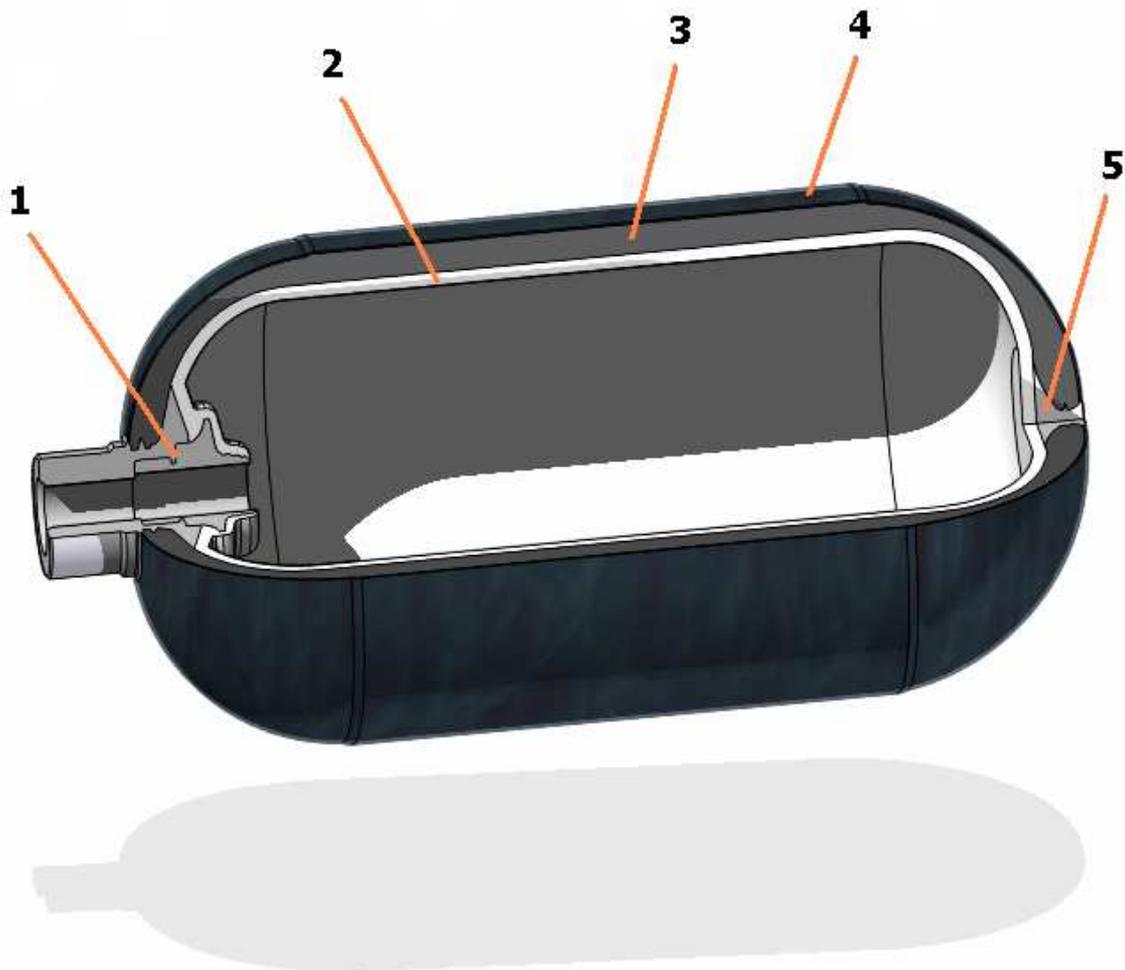
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## 2. Design and manufacture



1. Front head with UNF 5/8' 18/1" thread
2. Thermoplastic liner
3. Carbon-epoxy composite
4. fibreglass-epoxy protective layer
5. Technological head

The design of the STAKO Paintball container is based on a thermoplastic polymer made of high-quality polyethylene by Borealis. The material used in automotive industry meets strict requirements



related to strength, durability, resistance to UV radiation and resistance to various chemicals. The use of thermoplastic liner enables significant tank weight reduction.

The correct liner shape is obtained using an RTM process. The process conditions are subject to detailed control and supervision, this enables obtaining the high and repeatable strength and quality parameters of the produced plastic. Each manufactured liner is inspected for the quality of the obtained structure, accuracy of head element fusion and airtightness.

Liners, that passed through quality control are subject to a further process preparing them for the winding process (e.g. head installation).

The heads used for the tanks are made of 6061 T6 aluminium alloy. Basic 6061 T6 aluminium alloy parameters are:

- tensile yield	275 MPa
- tensile strength	320 MPa
- ultimate elongation	12%
- hardness	90 HB

Each aluminium material batch used for composite tanks is subject to delivery inspection at the STAKO strength and durability testing laboratory.

The main liner with installed heads is placed on a continuous fibre winding machine. Toray carbon fibre and Bakelite epoxy resin are used for winding composite tanks.

During the process the continuous carbon fibre soaked with appropriate amount of epoxy resin is wound on the liner. The machine operators continuously check the fibre saturation and quality of epoxy resin in the impregnating bath. Each fibre is tightened with a constant force appropriate for the given type of tank. This force is recorded in the machine memory in the form of a text file. The file also contains information about other winding process parameters. These parameters are: process time, epoxy resin temperature, ambient temperature, ambient humidity, amount of fibre used per each tank.

Once the winding process is complete, a file corresponding to the given tank number is saved, this facilitates checking the correctness of winding.

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An unique tank label is then applied onto the epoxy-carbon layer, which is then protected with an epoxy-fibreglass layer. This layer also constitutes an additional protection of the tank against scratches and impacts.

The ready tank is then subject to epoxy resin hardening process, which assures proper hardness and durability. The final element of the tank manufacturing process is paint coating.

### 3. Tank label

<b>COMPOSITE - VESSEL 1.1 L 300 bar</b>		
Manufacturer code:	Operating pressure at 15°C: PS 300 bar	Operating temp. range: TS -20/ +50 °C
Manufacturing date:	Test pressure: PT 450 bar	Liner: Thermoplastic
Serial number:	Volume in Liters: 1.05 +5%	Aluminium alloy: 6061
Date of expiry:	Weight empty in kg: 0.75	Design Standard: EN 12245: 2002
	Thread identification: UNF 5/8 18/1"	Directive No.: 1999/36/WE (Modul B)
	Max thread torque: 100 Nm	Conformity mark: D TT-0045

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Each composite tank compliant with EN 12245 is designated for identification and defining the operating conditions. Every person using or operating a pressurized device such as the tank must follow all the guidelines and scheduled maintenance dates.

- manufacturer code                      code defining the manufacturer's assortment item
- manufacturing date                      tank production date
- serial number                              individual lot and container serial number used for its identification. It enables tracking the tank production process.
- date of expiry                              tank validity date. It is forbidden to fill the tank after this date, even if its condition does not show any signs of wear and tear. After this date, contact the manufacturer to establish further handling and disposal procedures.
- operating pressure                      value of the tank operating pressure at 15°C. A slight increase of pressure can take place during filling due gas temperature increase when pressurizing
- test pressure                                value of test pressure obtained on each tank
- max thread torque                        maximum valve tightening torque. The valve must be tightened

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without the use of any tools. Tighten the valve by hand. Use of appropriate socket and o-ring assures tightness. If the connection is not tight check the quality of the o-ring used.

- operating temp. range range of temperature of safe tank use. Do not expose the tank to direct sunlight or high temperatures. **Do not leave the tank out in the sun!** The surface temperature can significantly exceed the temperature specified by the producer and cause damage the internal liner.

#### 4. Material and tank tests

Portable pressurized devices such as the 1.1 l composite tank are subject to technical acceptance inspection by authorized bodies. The entire manufacturing process, used materials and the ready tank (prototype and production batch) are subject to rigorous tests as per EN 12245. Each material batch delivered to the plant and used for manufacturing the tank must be subject to detailed inspection and the results must be recorded in the batch acceptance documents. A production batch must not exceed 200 tanks. Each production batch is subject to the following tests:

- **visual inspection** 100% of the batch
- **tank dimensions check** 100% of the batch
- **weight inspection** 100% of the batch
- **water capacity test** 100% of the batch
- **designation compliance** 100% of the batch
- **hydraulic test** 100% of the batch is pressurised with water. The tank is subject to a test pressure of 450 bar for approximately 30 seconds. Tightness, temporary and permanent deformation are checked during the test. The results are stored in a database with tank serial number.
- **air test** 100% of the batch is pressurised with air. The tank is subject to a test pressure of 7 bar for approximately 30 seconds. The results are stored in a database with tank serial number.
- **burst test** 1 / 200 pieces. One tank from every batch is subject to maximum bursting pressure using oil. The pressure is applied continuously until the tank is destroyed. The maximum pressure obtained during the test is recorded, this



pressure must not be lower than 2 x test pressure, i.e. 900 bar. STAKO tanks exceed this limit significantly

**- cycling test**

1/1000 pieces. One tank from every batch is subject to cyclical pressure changes at ambient temperature from not more than 20 bar to 450 bar for the period of 5000 cycles, which in case of STAKO tanks equals to three fillings per day during the entire product life. During this period the tank there must be no leak or failure.

All tank batch tests are recorded and periodically inspected by TÜV office:

**TÜV Nord GmbH**  
**Am TÜV 1**  
**D-30519 Hannover**  
**Germany**

The prototype batch of 1.1 l tanks by STAKO successfully passed the following acceptance tests under the supervision of TÜV inspectors:

Test type	Number of tanks	Result
Burst test	3	1244 / 1216 / 1271 bar
Cycle test	2	5000 cycles 457 bar
High temperatures at operating pressure	2	1000 h/ 70°C Bursting pressure 1238/1326 bar
Drop test	2	Bursting pressure 1340 bar 5000 cycles 451 bar
Scratch tests	2	Scratch depth 2.3 mm 5000 cycles 302 bar Bursting pressure 683 bar
Cycling at high temperatures	1	5000 cycles 308 bar 67°C 5000 cycles 304 bar - 56 °C Bursting pressure 1117 bar
Fire tests	2	Horizontally 3 min 34 seconds Vertically 3 min 20 seconds
Bullet piercing test	1	passed
Permeability tests	2	passed
Thread breaking torque	1	passed
Head strength	1	passed



# ZERTIFIKAT

**EG-Baumusterprüfung  
nach Richtlinie 1999/36/EG**

Zertifikat-Nr.: D-0045 - 320

**Name und Anschrift des  
Herstellers:**

**STAKO s. c.  
ul. Poznańska 54  
PL – 76-200 Slupsk**

Hiermit wird bescheinigt, dass das unten genannte EG-Baumuster die Anforderungen der Richtlinie 1999/36/EG erfüllt.

Geprüft nach Richtlinie 1999/36/EG: **EG Baumusterprüfung (Modul B)**

Prüfbericht-Nr.: **4834 P 5026/4/1 vom 15.10.2004**

Beschreibung des Baumusters: **Druckgefäß (Gasflasche aus Verbundwerkstoff),  
Zeichnung Nr. R-778.02, Fluid: N<sub>2</sub>, Air, Druck [PW] 300  
BAR, Prüfdruck [PH] 450 BAR, Temperaturbereich: -20 /  
50°C, Fassungsraum [L] 1,1 +/- 5% Liter, Durchmesser:  
107 +/- 5 % mm, Länge: 225 +/- 2% mm, ohne  
Ausrüstung.**

Auslegungsstandard: **EN 12245**

Fertigungsstätte: **siehe Hersteller**

Gültig bis **14.10.2009**

Hannover, 06.12.2004

TÜV CERT-Zertifizierungsstelle  
für ortsbewegliche Druckgeräte  
der TÜV NORD GRUPPE



Dipl.-Ing. **Manfred Goldmeier**

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## 5. Tank use

The 1.1 L composite tank is designed only for storing compressed air as per EN 12021. The tank must be filled only by appropriately trained personnel. Filling equipment must be certified for use. It is forbidden to load the tank to a pressure exceeding 300 bar as specified by the manufacturer. Maintain all safety measures when filling the tank. Due to the tank design air bubbles might be released at the head, this phenomena stops as the filling is complete. **We do not recommend emptying the tank completely. Keep a minimum pressure of 2÷3 bar in the tank.**

It is forbidden to fill the tank with liquids, gas mixtures (especially flammable) or place solids in the tank. The tanks must be used only with equipment with appropriate homologation and acceptance certificates. Tank operating pressure - 300 bar at 15 °C. Operating pressure -20 / + 50 °C. In case of applications other than Paintball the tank mounting must be arranged with STAKO. Do not make any incisions or holes on any surface of the tank. During transportation the tank must be secured against mechanical damage, influence of vehicle consumables, such as battery acid, brake fluid, fuel and liquids containing glycols and oils.

When transporting and using the tank, its must be protected against impacts or dropping. Any damage to the tank must be classified according to the instructions provided in later part of this guide. Using a tank the damage of which was classified as dangerous or indirectly dangerous is only permissible after conducting tests at STAKO.

Do not expose the tank to high temperatures exceeding 50°C or open flame.

To assure long and safe tank life its surface must be kept clean. In case the valve is to be removed, make sure the tank is depressurised. Replace the valve only after cleaning the valve and tank threads. When replacing the valve **do not use** any thread sealing materials. Sealing is assured only by using an appropriate o-ring. Do not use any tools to tighten the valve or fix the tank in place using torque specified on tank label.

When not in use the tank must be stored in a dry, shaded place at the temperature between 5 and 25 °C, in any position, at a minimum pressure of 2 - 3 bar inside the tank.

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## 6. Periodical inspections

As per ISO 11623 the tank manufacturer does not schedule any obligatory periodical inspections during the Paintball tank life. After the expiry date, report to the tank manufacturer for instructions regarding further handling and disposal of the tank.

## 7. Tank damage and assessment criteria

**Composite tanks** as per EN 12245 are subject to detailed tests that simulate majority of damage types that can occur during tank use. Therefore, the tank is tested for those types of damage. Do not be alarmed by slight damage to the tank or small scratches, as they have no impact on its durability or strength. However, if there are any doubts concerning the damage type, contact the tank manufacturer to establish the inspection procedure.

Below please find most common types of damage to the tank and steps to be taken.

Small blemish due to manufacturing reasons or slight impact to the tank



Classification – **not dangerous**, do not undertake any repair steps

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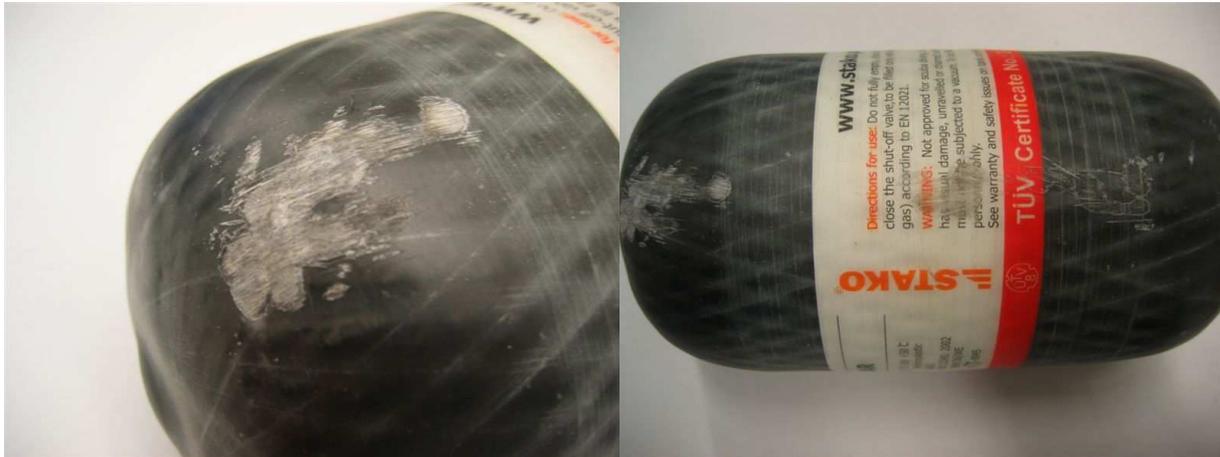


Large blemish and visible fracture of the tank due to a drop from large height



Classification – **indirectly dangerous**, tank must be inspected by a specialist prior to refilling

Visible, deep abrasion of tank surface, exposing the fibres



Classification - **dangerous**, do not fill or use the tank

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Small scratches on tank surface the depth of which does not exceed 0.5 mm and epoxy resin fractures



Classification - **not dangerous**, do not undertake any repair steps

Deep scratches and fractures on tank surface exposing the fibres



Classification - **dangerous**, do not fill or use the tank

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## Tank fibre delamination



Classification - **dangerous**, do not fill or use the tank

Other types of damage, such as damage due to fire, caustic substances, acids, dangerous chemicals must be inspected by STAKO. Do not inspect such types of damage on your own, as they might result in unnoticeable changes in tank structure.

## 8. Repairs

Any and all repairs of the composite tanks must be carried out by STAKO. Small damage can be repaired by the user only upon prior consultation with STAKO and receiving appropriate repair instructions. Use only materials and products recommended by the manufacturer for repairs.

## 9. Contact

For additional information on the tank please visit our website at or contact us directly:

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