

LEISTER

Welding of Truck Tarpaulins - Best Practice

EXPERTISE | Welding of Technical Textiles and their Requirements



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Management Summary

Starting Situation

In the contemporary transportation industry, truck tarpaulins are crucial for protecting cargo, enhancing fuel efficiency, and maintaining the visual appeal of vehicles. Over the past 50 years, truck tarpaulins have evolved from traditional Canvas to PVC-coated synthetic fabrics. Initially, polyamide fibers lacked dimensional stability, but the development of high-strength polyester yarns addressed this issue. Today, PVC tarpaulins are durable, fire-resistant, robust, and tear-resistant, ensuring long-term durability and weather resistance.

Objectives

The objective of this guide is to provide an overview of the challenges, materials, welding techniques, and design considerations in modern truck tarpaulin production. It aims to outline best practices for improving durability, fuel efficiency, cargo protection, ease of use, and environmental impact. The guide highlights the importance of advanced materials and innovative welding processes in enhancing performance and longevity. Additionally, it addresses the specific aesthetic and functional requirements of transport companies, including custom designs and printing of logos or advertisements.

Analysis

Ensuring cargo protection requires secure, water-tight seams achieved through advanced welding techniques. Balancing temperature, speed, and pressure is crucial for durable seams, with proper preparation and test welds managed by experts. Design considerations, including seam distances and types, ensure integrity and functionality, while high-quality printing enhances branding. Rigorous quality control, sustainability initiatives, smarter manufacturing processes, and training for operators help meet industry demands. Standard tarpaulins, side curtains, sliding tarpaulins and rolling tarpaulins are produced manually to meet specific vehicle configurations and operational needs. While traditional Canvas required stitching, new materials can be welded, eliminating the need for sealing sewn seams.

Recommendations

In the highly competitive market of truck tarpaulin welding, it is important to understand the complementary technologies of hot air, wedge, low voltage wedge and high-frequency (HF) welding. While HF welding is known for its precision and ease of use, hot air welding technology offers unique advantages in terms of flexibility, efficiency, and suitability for a wide range of thermoplastic materials. By understanding the welding parameters and processes detailed in this document, we will see the described welding technologies (e.g. from Leister) as a versatile and efficient choice for tarpaulin production.

The document provides the basics for successful and efficient production.

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1. Introduction: Challenges for Modern Truck Tarpaulins

In today's transportation industry, truck tarpaulins play a crucial role. They must be durable and weather-resistant to withstand harsh conditions like UV radiation, extreme temperatures, and heavy rain, ensuring long-term cargo protection. PVC-coated fabrics provide the necessary strength and flexibility for this.

Fuel efficiency is another significant challenge. Aerodynamic designs and lightweight materials reduce air resistance and improve fuel consumption, making tarpaulins essential for enhancing vehicle performance.

Cargo protection is a primary function of truck tarpaulins. They must safeguard goods during transport from theft, contamination, and damage. This involves using reinforcement tapes, anti-vandalism tapes, and secure, waterproof seams achieved through modern welding techniques.

Ease of use and maintenance are also important. Modern fastening systems, such as quick-release fasteners and adjustable straps, ensure that tarpaulins are easy to stretch, adjust and maintain. Dirt-repellent materials keep them functional and visually appealing over time.

Environmental considerations are increasingly important. There is a growing emphasis on using eco-friendly materials that can be recycled or have lower environmental impacts during production and disposal. High performance thermoplastics and coatings with fewer harmful chemicals meet these sustainability standards.

2. Sliding Tarpaulins

Sliding Tarpaulins for quick side Opening and Loading

Sliding tarpaulins are ideal for side loading and unloading. The curtains, attached to rollers at the top, can be easily moved forward and backward.

The truck tarpaulin is tensioned lengthwise using a ratchet and vertically secured with bottom tensioners. If desired, it can be certified to the EN 12641-2 standard as an additional load securing device, combined with a certified vehicle structure for a "Code XL" certificate.

Ease and Time Savings

The simple and quick operation of the curtains and roof offers flexible loading options, saving time and providing convenience for truck drivers.

Durability

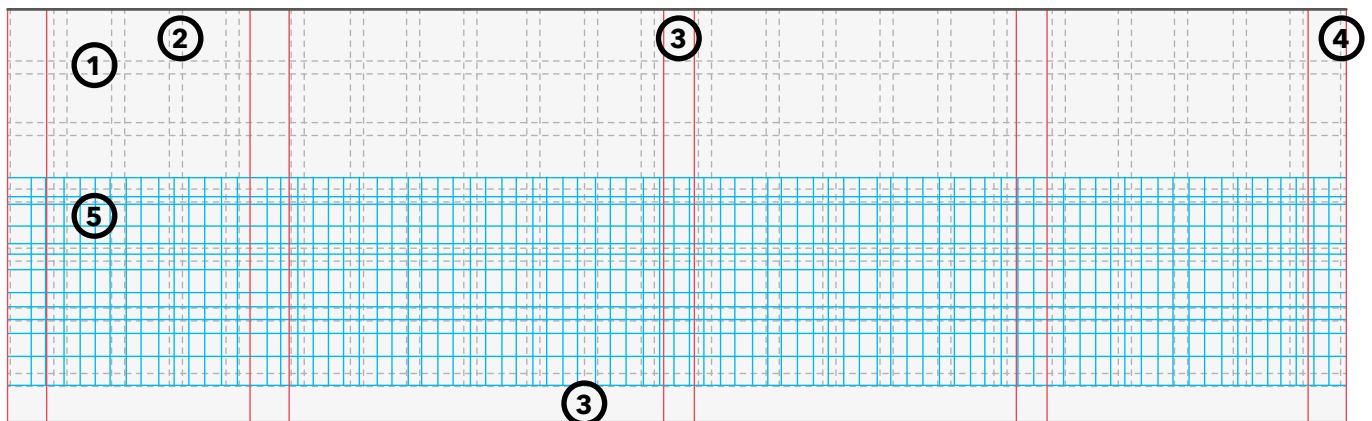
Sliding tarpaulins are robust and high-quality. They can be tensioned comparably to a solid structure using tensioning ratchets.



Types of Welds on Sliding Tarpaulins

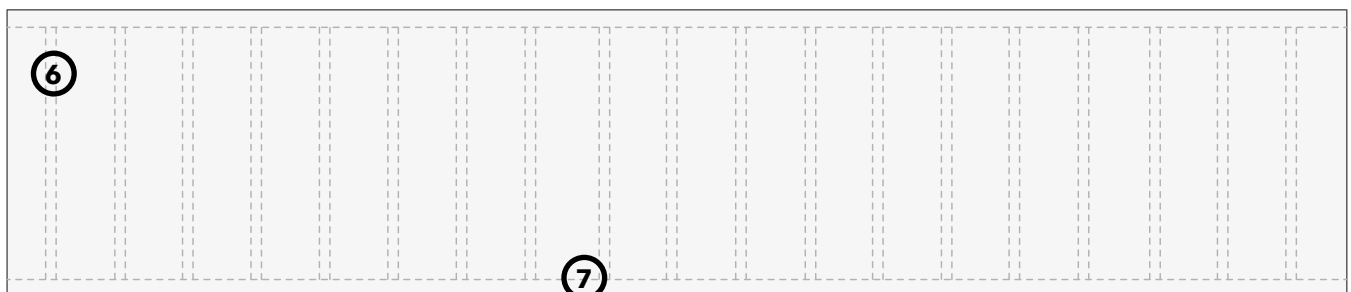
2x Side curtain

- ① Horizontal webbing: 48 mm, 1200 daN, total length approx. 160 m
- ② Vertical webbing: 48 mm, 2300 daN, total length approx. 140 m
- ③ Reinforcement tapes: Front and side, 300-400 mm wide, total length approx. 60 m
- ④ Welded-in keder rope: front and back, total length approx. 12 m
- ⑤ Anti-vandalism tape: 25 mm, at intervals of 150-200 mm, over the entire length and at a height of approx. 1500 mm, total length approx. 400 m



1x Roof section

- ⑥ Spriegel tape: 50-150 mm wide, approx. every 600 mm, total length approx. 50-60 m
 - ⑦ Open hem for cord: side, total length approx. 26 m
- Hand-welded seams for finishing details, final assembly or welding on Velcro.



3. Standard Tarpaulin

Tarpaulins for Vans and Trucks

Typically one-piece, standard tarpaulins are placed over the structure and fastened around the vehicle with the desired closure system. They are ideal for rear loading and unloading when side access is rarely needed.

Cost-effective systems for large and small vans, trailers, semi-trailers, specialty cargo, etc., provide optimal protection and serve as advertising platforms when printed. Each cover is individually measured, handcrafted, and precisely fitted. Modern welding machines process the PVC-coated tarpaulin material to create protective covers for piece goods transport.

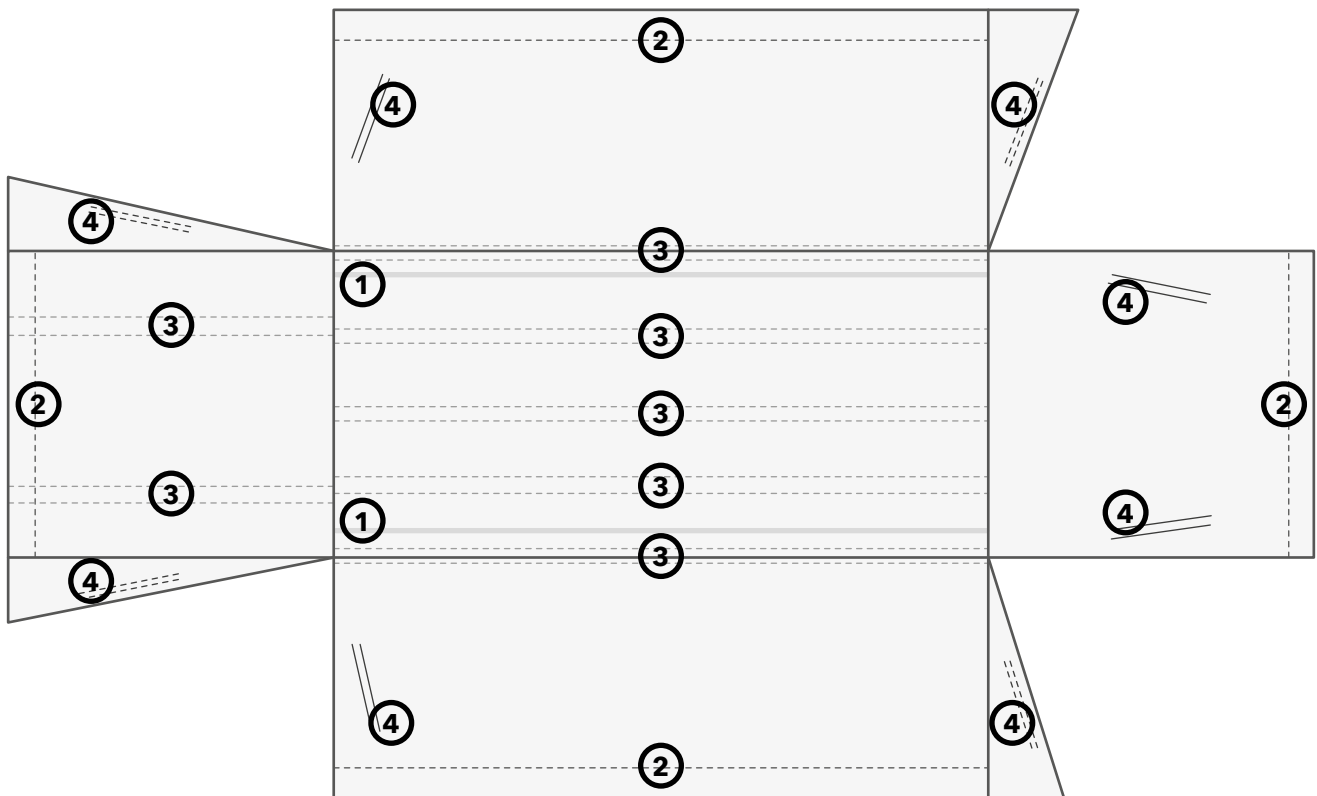
Advantages of a Standard Tarpaulin

The standard tarpaulin, previously known as the Hamburg cover, has been used since trucks existed. Today, it is mainly used on vans, offering a cost-effective and weight-saving construction. Compared to box structures, it is also repair-friendly.



Types of Seams on Standard Tarpaulins

- ① Overlap seam: The circumference of the tarpaulin may be utilized, as well as the front and rear portions, diagonal flaps, and other pertinent areas.
- ② The hem may be reinforced with additional material on the side, rear, or front to provide support for eyelets and other components.
- ③ The reinforcement tapes are to be used on the roof section, the front and side at the posts, and on the crossbeam.
- ④ The product features hand-welded seams for finishing details, final assembly, or welding on Velcro.



Conclusion

Sliding and standard tarpaulins are the most widespread truck tarpaulins. Other systems include quick sliders, flat tarpaulins, custom tarpaulins, roll tarpaulins, and so on. The names and specifics may vary by manufacturer and country.

4. Materials of Tarpaulins

Types of Materials

Truck tarpaulins are constructed from a variety of thermoplastic materials, selected for their specific properties that affect durability, welding compatibility, and overall aesthetics. The most commonly used materials are PVC and polyethylene.

POLYVINYL CHLORIDE (PVC)

PVC is the dominant material in the truck tarpaulin industry, estimated to make up over 80% of the market. Its widespread use is due to several key advantages:

- **Durability and Longevity:** PVC tarpaulins are highly robust and resistant to abrasion, tearing, and weather conditions.
- **Waterproof:** PVC is completely waterproof, reliably protecting cargo from rain and moisture.
- **UV Resistance:** PVC provides excellent protection against UV radiation, preventing the material from becoming brittle or fading.
- **Cost-Effective:** compared to some alternative materials, PVC tarpaulins are relatively inexpensive to produce.
- **Repairability:** PVC tarpaulins are easy to repair, extending its life.
- **Printability:** for branding and advertising on truck tarpaulins, PVC allows for vibrant printing.

POLYETHYLENE (PE)

Polyethylene offers good resistance to chemicals and can withstand harsh conditions. While typically less bright than PVC, it is suitable for functional applications where cost is prioritized. Key benefits include:

- **Waterproofing:** provides effective waterproofing.
- **Affordability:** cost effective material.
- **Lightweight:** easier to handle and transport.
- **Weldability:** easy to weld, ensuring strong seams.

Influence on Quality and Aesthetics of Welding

The selection of materials significantly influences the quality and aesthetics of the welding process. Durability, welding compatibility, and cost are key criteria when selecting materials for truck tarpaulins. Welding compatibility is crucial to ensure that the materials can be effectively welded using available equipment and processes. Cost considerations help balance material performance and durability with budget constraints.

To achieve high quality and aesthetically pleasing welds, it is essential to understand the welding parameters that affect the process. This leads us to the concept of the Welding Triangle, which is explained in chapter 6.

Conclusion

PVC remains the preferred material for truck tarpaulins due to its comprehensive benefits, including durability, cost effectiveness, and ease of repair. Polyethylene is also used in specific applications where its properties, such as chemical resistance and affordability, are advantageous.

5. Thermoplastic Welding Processes

Thermoplastic welding processes enable the permanent bonding of components made from thermoplastic polymers. Unlike thermosetting plastics, which harden and cannot be remelted, thermoplastics can be softened and bonded together repeatedly through the application of heat.

Common Welding Techniques

- **High Frequency Welding:** High frequency welding (HF welding), also known as radio frequency welding (RF welding) or dielectric welding, joins thermoplastics using high frequency energy (usually 27.12 MHz). This energy causes the molecules of polar plastics to oscillate and generate heat through friction, resulting in a bond. Pressure is applied to the parts throughout the process to ensure a firm and clean connection.
- **Hot Air Welding:** Hot air welding uses hot air (usually between 500–620 °C) to melt the material. This versatile and straightforward process is ideal for a variety of materials. Automated systems commonly use this method, where hot air is introduced through a nozzle and joined by a pressure roller.
- **Low-Voltage Wedge Welding:** This innovative process introduces energy through a thin metal plate, allowing quick control of the heat. The precise control ensures high quality welds even with delicate materials, reduces smoke generation, and enhances workplace safety. The wedge heats up in less than a second, ensuring energy efficiency and cost savings.
- **Bar/Impulse Welding:** Bar welding uses metal bars to introduce heat in pulses, joining the materials through pressure and cooling. Despite a longer processing time, it provides clean seams and high repeatability.

By understanding these different techniques, the best method can be selected based on the material and project requirements.

Advantages and Disadvantages of the Various Technologies

Criteria	High Frequency (HF)	Hot Air	Heating Wedge	Low-Voltage Wedge	Heating Bar/ Impulse Welding
Procurement costs	− −	+	+	+	+ −
Operating costs (maintenance, energy consumption, servicing, etc.)	−	+ −	+ −	+ +	+ −
Space Requirements	−	+	+	+	+ −
Flexibility	−	+	+ −	+ −	−
Repeatability	+	+ −	+ −	+ −	+
Emissions	+	−	+ −	+	+
Closed welds	+ +	+	−	−	+
Welding speed	−	+	+	+ +	− −
Suitability	PVC, PU	PVC, PU, PE, PET, PA, PP, EPDM	PVC, PU, PE, PET, PA, PP, EPDM	PVC, PU, PE, PET, PA, PP, EPDM, TPO	PVC, PU, PE, PET, PA, PP, EPDM

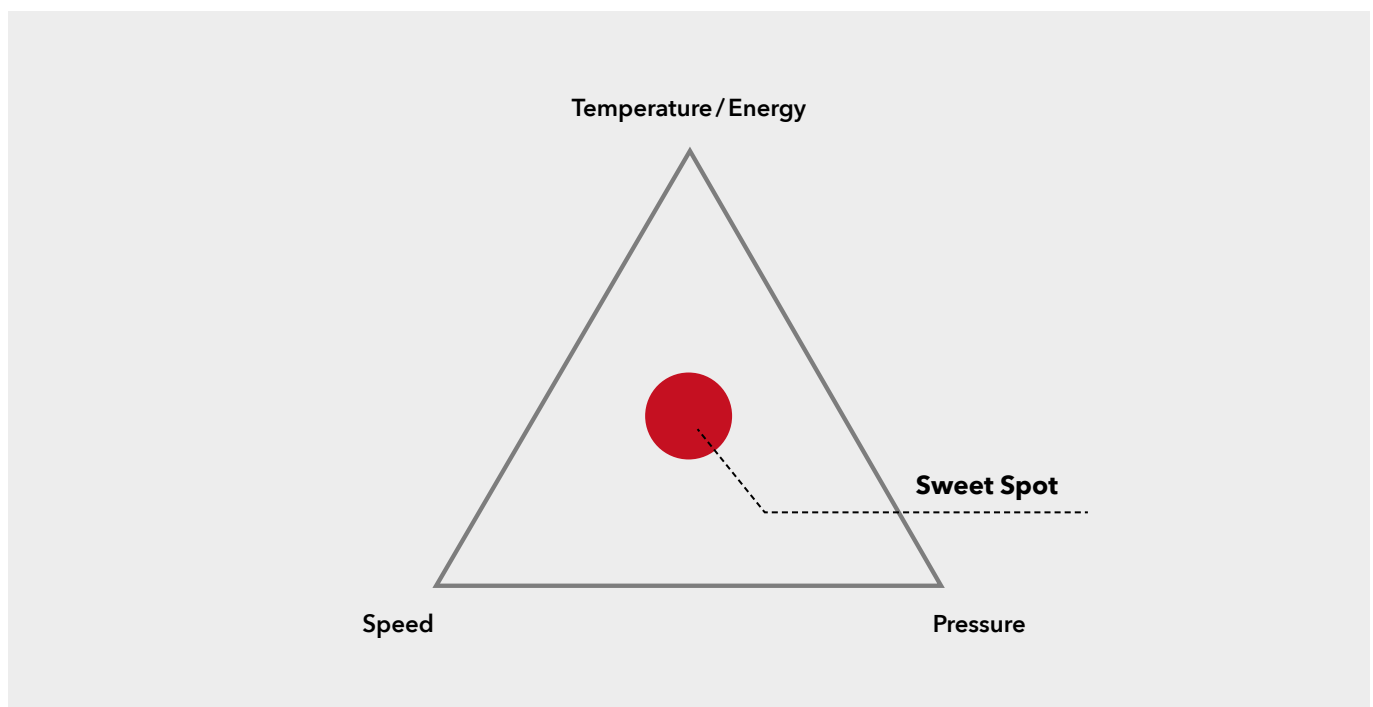
6. Welding Triangle of the Hot Air Joining Technique for Automatic Welding in Truck Tarpaulins

The welding process for truck tarpaulins basically involves the three main parameters of temperature, speed and pressure that must be correctly matched to each other in order to achieve a permanently tight seam joint. As with the three legs of a tripod, all parameters are important.

It is important to keep in mind that the three parameters are interdependent. This is the only way to reach the welding point (sweet spot) that gives the user the greatest possible certainty about the tightness of their weld. If any one of the

three parameters is outside the triangle, the weld is no longer reliable or may even leak. It is important to start at the welding point when defining the initial welding parameters. This means in the middle of the possible limit values.

The choice of welding machine also affects the result, as welding machines from various manufacturers differ in terms of welding performance and joining pressure. Since further aspects must be taken into consideration, it is advisable to consider the three main parameters in a broader context.



Welding triangle with the three parameters of temperature, speed and pressure

Temperature

To proceed correctly, it has proven useful in practice to first determine the temperature and air volume (energy or welding power). The correct temperature must be defined on the basis of the information provided by the membrane manufacturer and by test welding on the building site. The external conditions (see previous diagram) must be taken into account.

Nozzle Setting

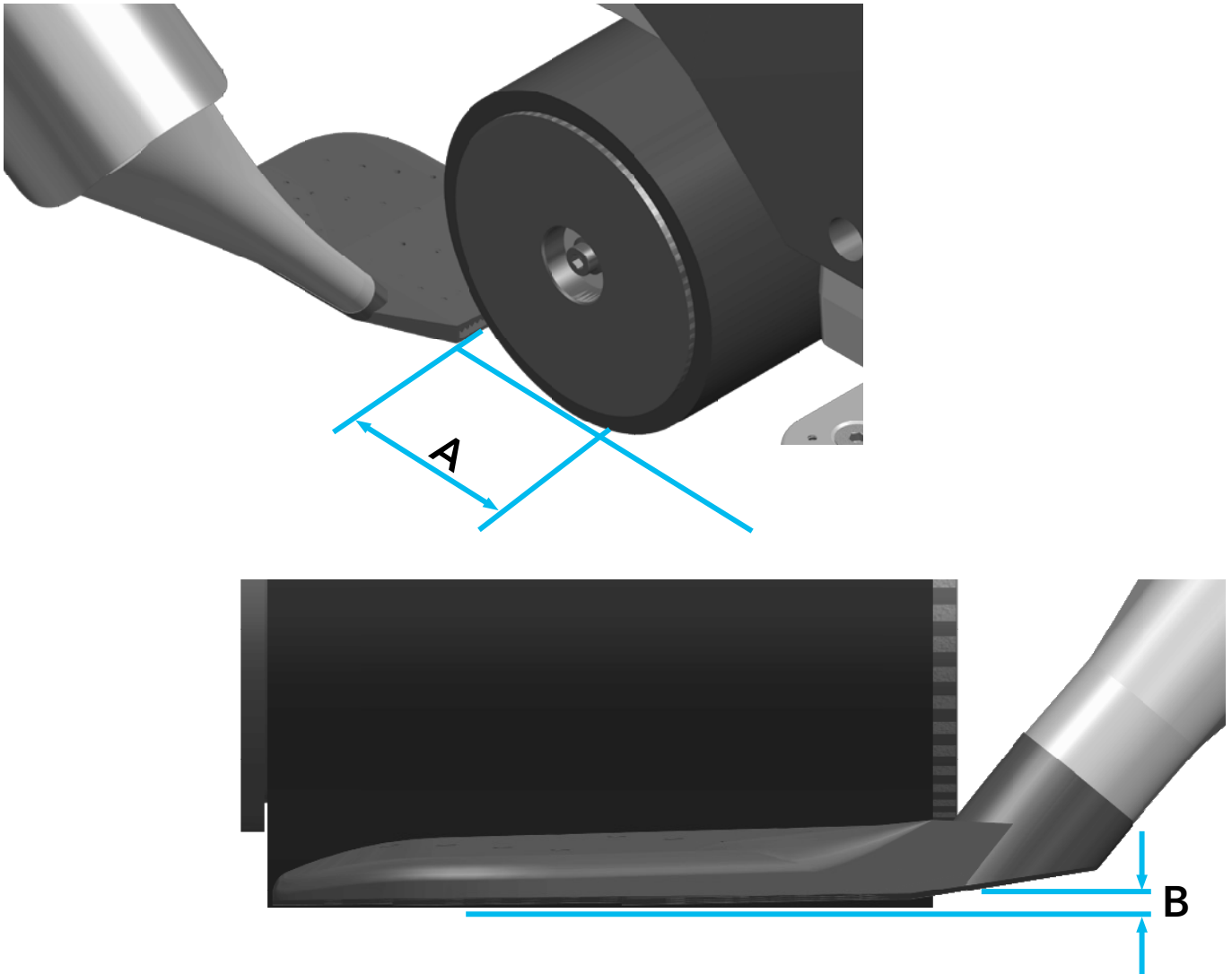
The correct nozzle setting and distance to the pressure roller are both crucial for the welding quality. This is because the hot air generated in the welding machine must be correctly introduced into the overlap. An incorrect nozzle setting has a negative impact on the welding process.

It is therefore advisable to check the nozzle setting regularly according to the manufacturer's operating instructions. Some welding machine manufacturers offer a setting gauge to assist in calibrating the nozzle and make it easy to reliably adjust the machine tracking.



Nozzle adjustment gauge

It should be noted that welding machines need more energy to reach the set temperature when the ambient temperature is cold. If the set temperature cannot be reached, users can reduce the air volume. It is advisable to reduce the speed in the same proportion. Nozzle adjustment must be done according to the operating instructions.



Random example of important nozzle settings, these vary from machine to machine.

A = Distance between the nozzle and the center of the pressure roller: In this example, the distance is around 45 mm. This distance has proven itself on the basis of new findings.

B = Distance between nozzle and membrane: The nozzle is only in contact with the membrane at the tip. The remaining part of the nozzle is located in the overlap, 1 mm above the surface.

Air Volume

The air volume in hot air welding machines significantly impacts the quality and efficiency of the welding process. Key points on how air volume affects hot air welding machines include:

Welding Quality

- **Consistency of Weld Seam:** Insufficient air volume can result in inadequate material heating, causing incomplete weld seams. Conversely, excessive air volume can overheat and damage the material.

Process Speed

- **Efficiency:** Optimal air volume increases process speed by ensuring faster and more uniform material heating.
- **Throughput:** Proper air volume adjustment enhances machine throughput, reducing the need for rework and ensuring consistent weld seams.

Material Protection

- **Avoiding Damage:** Excessive air volume can damage sensitive materials, while insufficient air volume may lead to inadequate welding.

Welding Speed

The speed is constant, but can be easily adjusted during welding. However, this requires experience and is usually unnecessary since a test weld is carried out first.

Joining Pressure

With most welding machines, the joining pressure is empirically determined and specified by the manufacturer in order to achieve a tight seam joint. The correct joining pressure must be determined by test welding. It is important that the welding machine has a stable weight distribution. In practice, a triangular construction has proven to be an advantage. This design also has a positive effect on the tracking accuracy of the welding machine, which reduces the need for manual corrections.

Recommended Procedure for Test Welding

A trained welder is required to correctly assess the welding patterns. A test weld is essential to ensure that the correct initial welding parameters are achieved. This procedure creates a reliable seam joint for the production field seams. Before a test weld is carried out, the welding parameters recommended by the manufacturer should be selected as a baseline.

Operating the Welding Machine

When guiding the welding machine, make sure that the guide handle is not excessively “tilted”. The pressure roller loses contact and does not apply the necessary pressure due to the lateral load on the guide handle and the resulting leverage effect. As a result, the joining pressure is insufficient and the seam is defective.



Checking the Seam Joining

Ensuring the integrity of welded seams is critical for the performance of truck tarpaulins. This chapter outlines the key methods and parameters for checking seam quality.

Tensile Testing

A tensile testing machine applies a controlled force to the seam until failure. The following indicators are used to determine the effectiveness of the seam:

- **Shaering test, tearing outside the joint seam:**
This indicates that the seam itself is stronger than the material, which is a sign of a good seam joint.
- **Peeling test, separation of individual layers:**
For example, the detachment of the sealing layer from an internal reinforcement scrim. This also indicates a functioning seam joint.

Depending on the membrane, tearing outside the joint seam may not be necessary for a seam joint.

It is essential to avoid incorrectly set parameters, such as extreme temperatures that destroy the molecules at the beginning and end of the weld, and excessive welding speeds.



Tensile testing machine

Dimensional Checks

Verify that welded seams meet design specifications by measuring seam width and overlap. Proper dimensions ensure structural integrity and performance.



Welding Parameters for PVC-Coated Tarpaulin Material with a 40 mm Nozzle

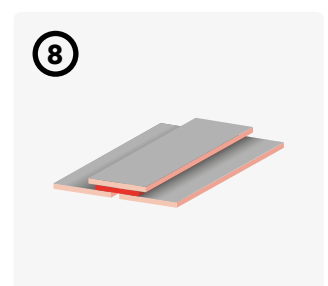
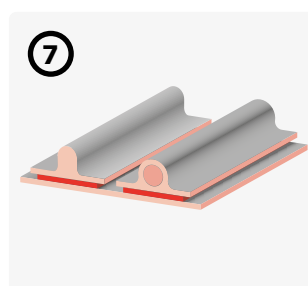
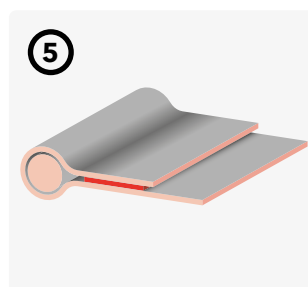
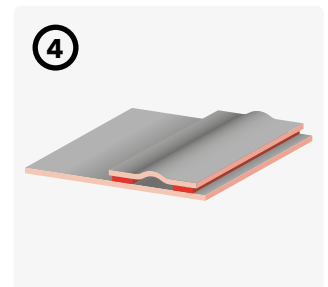
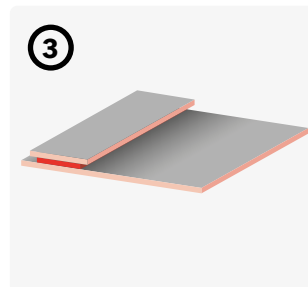
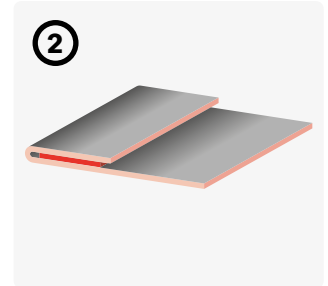
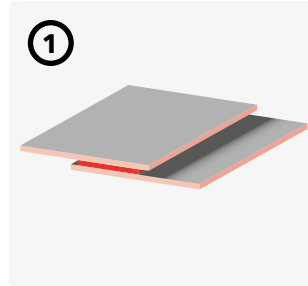
Start parameters serve as guidelines, and test welds should be performed to reflect actual conditions. Test welds must be conducted by a trained individual to accurately assess the weld quality. If weld widths deviate, adjust the speed accordingly.

Example Parameters

Weight	Material	Temperature	Speed	Air Volume
600 g/m ²	PVC	600 °C	7 m/min	100%
900 g/m ²	PVC	620 °C	7 m/min	100%
Mesh 350 g/m ²	PVC	500 °C	6 m/min	80%
Print material 400 g/m ²	PVC	550 °C	6 m/min	90%

7. Types of Seams

- ① **Overlap seams:** These are the most common seams and provide a strong, waterproof seal. They are ideal for preventing water ingress and protecting the cargo. Overlap seams are primarily used in larger projects like truck tarpaulins, tents, and advertising banners.
- ② **Hem seams:** Fully welded hems are mainly used for advertising banners and cover tarpaulins. The hem seam serves to reinforce the edges of the tarpaulin. Eyelets are often punched into these seams.
- ③ **Reinforcement tapes:** Fully welded reinforcement tapes are used for reinforcement and as fastening and tensioning straps for sliding curtains for truck tarpaulins.
- ④ **Reinforcing tapes and spriegel:** Reinforcing tapes and spriegel welded on both sides are used in sliding curtains for truck tarpaulins and serve to reinforce the sliding curtain or roof system.
- ⑤ **Keder seams:** Used in sliding curtains for truck tarpaulins, advertising banners, and tents.
- ⑥ **Open hems:** Can be applied to advertising banners, standard tarpaulins, cover tarpaulins, etc., often used to insert a rope.
- ⑦ **Anti-Vandalism tapes:** Used in side curtains of truck tarpaulins to protect against cargo theft.
- ⑧ **Butt seams with tape:** Rarely used for truck tarpaulins, but frequently used for inflatable objects.



8. Standards and Recommendations for Manufacturing Truck Tarpaulins

The manufacturing of truck tarpaulins is essential to protect cargo and ensure safe transportation. Standards establish minimum requirements that ensure the quality and durability of these tarpaulins. Below are the key aspects of the standards and recommendations for the construction and maintenance of truck tarpaulins, presented clearly and practically for manufacturers.

Materials

Tarpaulins must be made of materials that meet specific strength requirements:

Requirement	Specification
Tensile strength	2850 N/5 cm at room temperature; 2200 N/5 cm at -25 °C
Tear resistance	185 N at room temperature; 120 N at -25 °C
Adhesion	at least 100 N/5 cm
Flex resistance	no cracks after 100,000 flex cycles
Fire behavior	Combustion speed less than 100 mm/min
Surface weight	greater than 650 g/m ²

Construction of the Tarpaulin

Tarpaulins can be made of multiple pieces, but the seams must be as strong as the main material. This is ensured by thermal welding of the seams. Additionally, tarpaulins must be reinforced with vertical and horizontal belts:

Reinforcement	Specification
Vertical belts	Minimum strength of 2300 daN, placed at intervals ≤ 600 mm
Horizontal belts	Minimum strength of 1200 daN, placed at intervals ≤ 600 mm

Each tarpaulin must be clearly marked with the following information:

Label information	Details
Standard number	EN 12641-1
Manufacture date	year and month
Manufacturer's name	name or trademark
Material surface weight (g/m ²)	-
Minimum permissible temperature	-25 °C or -40 °C

Strength Tests

To ensure the durability and safety of tarpaulins various strength tests must be conducted, including tensile strength, tear resistance, and dimensional checks as discussed in the "Checking the Seam Joining" section.

Structural Strength and Verification

Standards also cover the vehicle structure:

- **Structural strength:** Vehicles must withstand lateral, longitudinal, and vertical forces.
- **Load calculation:** Guidelines for calculating the stresses and loads the vehicle structure must bear.
- **Verification and tests:** Detailed methods to verify that vehicles comply with standards, including specific tests for anchoring points.

Class L and Class XL

The EN 12642 standard classifies vehicle structures into two classes:

- **Class L:** for standard structures.
- **Class XL:** for reinforced structures that withstand greater forces during transport.

Maintenance Recommendations

Regular maintenance is crucial to ensure that tarpaulins and their anchorages continue to function properly:

- **Periodic Inspections:** conduct regular inspections to detect possible damage or wear.
- **Proper Repairs:** follow specific guidelines for repairing tarpaulins and anchoring points, ensuring that materials of equal or higher quality are used.

Standards provide essential guidance to ensure that truck tarpaulins meet the necessary safety and quality standards. By following these guidelines, manufacturers can guarantee durable and safe products, while transporters can trust that their cargo will be protected during transit.

References: SN EN 12641-1:2020, SN EN 12641-2:2020, SN EN 12642:2017, SN EN 12640:2020, BKTex Richtlinie document.

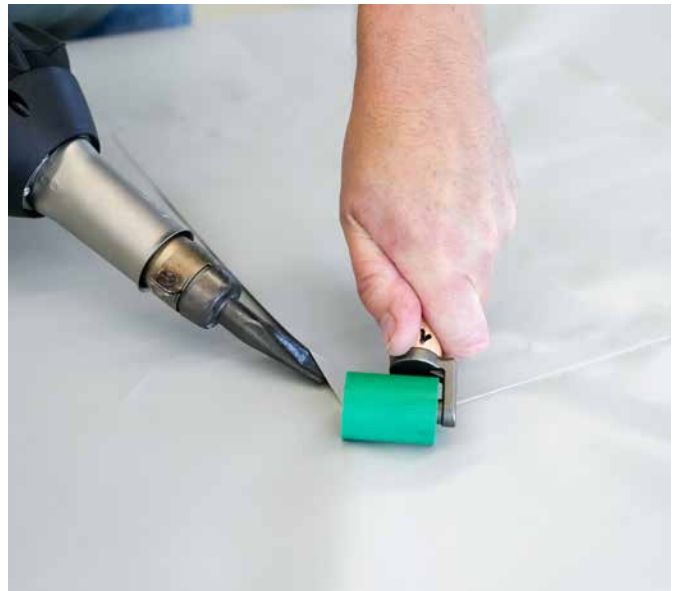
9. Special Cases

Repair of Older or Damaged Tarpaulin

Certain situations require special approaches for welding and construction. When repairing older tarpaulins, it is important to properly clean and prepare the material. For damaged tarpaulins, reinforcing the repaired areas with additional material and using reinforced seams can extend the lifespan of the tarpaulin.



Original damage pattern



Weld a new patch



Proper repair

Repair Instructions

- Carefully remove improperly applied patches without further damaging the underlying tarpaulin.
- Thoroughly clean the area around the damaged spot with a degreasing agent, such as brake cleaner (acetone-free), to a width of more than 150 mm.
- Thermally weld a new patch made of identical tarpaulin material quality over the damaged spot. The new patch must overlap the tear by at least 150 mm on each side.
- Thermally weld any open tear or damage, whether open to the inside or outside.

Complex Shapes and Corners

Welding tarpaulins with complex shapes and corners requires precise control of welding parameters. Ensuring uniform pressure and consistent temperature, along with careful handling of the material, helps create strong seams in these challenging areas. Using special nozzles and welding techniques can facilitate the process.

10. Printing

Although graphics are not explicitly covered by the mentioned standards, they are an important aspect of designing truck tarpaulins. Incorporating graphics can enhance both the aesthetics and functionality of the tarpaulin.

- **Print Quality:** Prints should use inks and techniques that do not compromise the integrity of the tarpaulin material. It is important that the inks are UV and weather-resistant to maintain their appearance over a long period.
- **Placement of Graphics:** Graphics should be strategically placed to avoid collisions with seams and fastening points. This ensures that the aesthetic design does not interfere with the functionality and durability of the tarpaulin.
- **Durability:** Graphics must be durable and resistant to fading, wear, and damage caused by constant exposure to external elements. Using high quality printing techniques helps to maintain the visibility and a of the graphics throughout the tarpaulin's lifespan.



11. Sustainability

Sustainability is becoming more and more important. The industry is focusing on environmentally friendly materials to reduce environmental impact. Low-VOC (volatile organic compounds) materials minimize harmful emissions, creating a healthier work environment. Recyclable thermoplastics support a circular economy by reducing waste and conserving resources.

In summary, these innovations are revolutionizing the truck tarpaulin industry by enhancing precision, efficiency, safety, durability, flexibility, and sustainability. The integration of high-performance materials, environmentally friendly practices, and advanced monitoring technologies ensures that the industry meets the evolving demands for high quality, reliable, and environmentally friendly products.

12. Conclusion

This document underscores the critical importance of modern truck tarpaulins in the transportation industry, emphasizing their transformation into multifunctional components essential for operational efficiency and sustainability. It outlines the impact of selecting appropriate materials such as PVC and advanced thermoplastics on durability, weldability, and environmental resistance. The necessity of advanced welding techniques, including hot air and high frequency welding, is highlighted to ensure secure, waterproof seams.

Design considerations, quality assurance, and adherence to industry standards are crucial for ensuring functionality and reliability. Additionally, the document points to the future of the industry, characterized by a commitment to sustainability. Ultimately, the reader gains a clear understanding that integrating advanced technologies, materials, and sustainable practices is vital to enhancing the performance and longevity of truck tarpaulins, meeting the evolving demands of the transport sector.

Sources

Text Sources

SN EN 12640 2020, SN EN 12641-1 2020, SN EN 12641-2 2020, SN EN 12642 2017, ISO 2411:2017, BKTex-Richtlinie

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