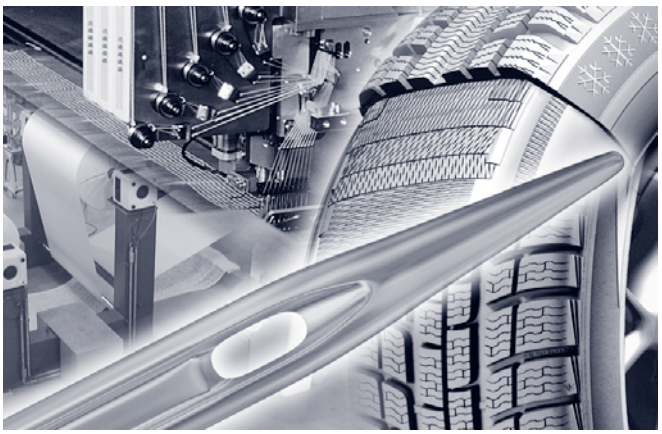
SEWING FOCUS

TECHNICAL SEWING INFORMATION

SERVICEHOUSE



Tires

Checklist for Sewing Tire Cord

Sewing Parameters:	SCHMETZ Tip:
Needle size	NM 120 – 200 SIZE 19 – 25 Depending on the thickness and strength of the material.
Needle point	In the production of tire cord, only ball points (SUK = medium ball point) and round points (R = normal round point) are used, as they can pass the fabric without any damage.
Sewing thread	Needle threads are mostly continuous multi filament threads, depending on the requested quality for the final product made from 100 % polyester, 100 % polyamide or 100 % rayon.
Machine	For sewing together pieces of tire cord, mostly special sewing automats from the special machine building are used. Alternatively, long-arm sewing machines as well as high-speed sewing machines may be used.
Other factors:	
Thread tension	The required thread tension depends on material of fabric, number of layers, sewing thread and sewing automat. It is adjusted individually on each sewing automat by a technician. The thread tension should be set in such a way that the stitch formation of the needle and looper thread can take place perfectly.
Stitch type	Double chain stitch (stitch type 401) according to DIN 61400.
Stitch density	Stitch density depends on the number of material layers, the strength of the fabric as well as the strain on the seam during the production process that follows. But: approx. 2 – 6 stitches / cm.

SCHMETZ

NEEDLES SINCE 1851

Quick Reference for Typical Sewing Problems in Tire Cord Manufacturing

Symptoms	Effect	Cause
Skip stitches/Thread breakage		
No interlacing/interlooping of needle thread and bobbin/looper thread	Reduced seam strength, especially with double chain stitch	Incorrect thread tension
Thread breakage	Sub-standard, defective seam appearance	Incorrect needle system
Ravelling of the needle thread	Thread breakage after skip stitch	Needle incorrectly fitted
	Opening of the whole seam especially with double chain stitch	Needle deflection
	Jamming of the sewing thread due to stitch holes which are stuck together	Incorrect thread guidance
	Partly or whole melting through of the needle thread	Jamming of the sewing thread between needle and fabric
		Adhesion of melted residues, clogging of the needle eye and needle groove
		Overheating of sewing machine needle
		Use of an oversized sewing thread in relation to the needle size
		Mechanical damage to needle, throat plate, feed etc.
		Wrong sized aperture of throat plate, material is pulled into it or jammed and prevents the loop formation

Solution

NM SIZE	Point style	Thread	Machine
			
Adjust needle size to the material, amount of layers and thread size **CAUTION:** Change needle regularly (after every shift or in a shorter interval depending on the stress) Use the SCHMETZ BLUKOLD needle Check needle eye and groove for damage, if in doubt: change needle	Check point for damage	Adjust sewing thread size to the needle size Optimize thread tension	Optimize the hook/looper setting Examine the thread guiding elements Adjust the sewing accessories such as throat plate, feed etc. depending on material thickness and sewing thread/needle Change worn out or defective sewing accessories regularly such as thread guiding elements, hook/looper, throat plate etc. Correct thread guidance Reduce sewing speed

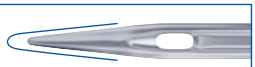
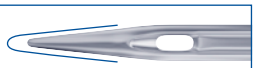
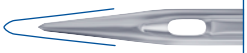
Quick Reference for Typical Sewing Problems in Tire Cord Manufacturing

Symptoms	Effect	Cause
Needle breakage		
	Broken needle parts remain in fabric	Needle deflection too heavy
	Material is damaged	Damaged point, resulting in excessive penetration force
		Needle size and material thickness are not adjusted to each other
		Use of an undersized needle
Thermal damage		
Needle with melted residue	Melted particles cling to the fabric	Excessive needle temperature due to friction especially when sewing densely woven fabrics
	Needle thread breaks	Excessive sewing speed
	Needle eye is clogged	Needle smeared or needle eye clogged with melted residue
	Needle groove is clogged	Melting of the thread surface and as a result mechanical breakage of the weakened thread

Solution

NM SIZE	Point style	Thread	Machine
			
Adjust needle size to the material and amount of layers **CAUTION:** Change needle regularly (after every shift or in a shorter interval depending on the stress)			Check and adjust the material transport Adjust the sewing accessories such as throat plate, feed etc. depending on material thickness and sewing thread/needle **CAUTION:** After a needle breakage it is necessary to check the throat plate for damage
BLUKOLD needle with Teflon coating. This needle coating prevents or greatly reduces the adhesion of melted residues **CAUTION:** The use of the BLUKOLD needle does not reduce the needle temperature which is caused by excessive sewing speeds	SUK Medium ball point R Normal round point are available in BLUKOLD	Alternatively use an extra thread lubricant (e. g. silicone oil)	Reduce sewing speed Use needle cooling through compressed air

Selection of Point Style and Needle Size

Material	Number of layers	Needle size NM / SIZE	Point style
Special tire cord made from polyester, polyamide, rayon, kevlar, cotton or a combination of these materials	2 3 – 4 4 – 6	120 – 140 / 19 – 22 130 – 150 / 21 150 – 170	SUK medium ball point 
Special tire cord made from polyester, polyamide, rayon, kevlar, cotton or a combinationof these materials with coated surface	2 3 – 4 4 – 6	130 – 150 / 21 140 – 160 / 22 – 23 160 – 180 / 23 – 24	SUK medium ball point  R normal round point 

General recommendation for synthetic, coated materials: Use of BLUKOLD needle version with the appropriate point style

SCHMETZ Tip:

In the case of uncoated materials, the needle should be as thin as possible and have an "SUK" point in order to avoid motion of the fabric threads against each other.

Contents

1. Manufacturing of tires

Every year, more than 800 million tires are produced. The increasing motorization in newly industrializing as well as developing countries is going to further increase the requirements and demand for vehicle tires in the future. Tires are used for the most diverse vehicles and airplanes: automobiles such as passenger cars, trailers or racing cars; trucks, heavy duty construction site equipment, tractors; bicycles, motor cycles; wide-bodied aircraft and gliders – to name just a few examples. Depending on the area of application, different types of tires are produced. Those differ with respect to raw material, the individual production procedures as well as the amount of work.

In general, one distinguishes between radial tires and diagonal ply tires. Diagonal ply tires are mostly used in agriculture and as motor cycle tires. With this type of tire, the cord threads of the individual layers of the carcass cross over in an acute angle. The angle of the thread for normal tires is approx. 35 – 40 degrees and for sports tires approx. 25 – 35 degrees. Several fabric layers crossways on top of each other (diagonal to the running of the tire) form the carcass. Radial tires are now the standard for automobiles and freight vehicles. The cord threads of the carcass of radial tires are arranged radially at an angle of 88 – 90 degrees. Between the carcass, which mostly consists of two layers, and the tread, an additional belt made of various textile fibers or fine steel cables is fitted.

Source: Michelin Reifenwerke KGaA

Pict. 1: Cross-section of a car tire: A tire consists of a multitude of different construction elements. The properties of these elements require utmost precision during processing. A tire consists of the following semi-finished products:

❶ Layer of synthetic gum with high air proof

❷ Textile carcass

❸ Bead core

❹ Tire bead

❺ Side panel

❻ Tire cord compound

❼ Tread

A vehicle tire usually consists of the following constructional elements: tire bead, carcass, side panel and tread (see Pict. 1). It is the task of the tire bead to ensure that the tire sits tightly on the wheel rim. In order to exclude a change in length of the tire at the rim of the wheel, the bead has several incorporated wire wound cores. In the case of tubeless wires, the tire bead seals the enclosed air volume. The carcass, tightened by the internal pressure, constitutes the tire's load-bearing frame. This tire body, or tire cord, is, so to speak, the heart of the tire. The carcass consists of several fabric layers, which are embedded in rubber without coming into contact with one another. The number of fabric layers determines the strength of the carcass.

The side wall is a rubber covering of the carcass between bead and procured tread. It is its task to protect the carcass, the tire cord in particular, from destruction through external influences. The tread, also called protector, encircles the carcass at its outermost circumference. It represents the positive and negative connection between tire and the roadway. Depending on the tire's area of use, different rubber mixtures (e. g. for racing tires) and profiles (e. g. summer and winter tire profiles) are designed.

1.1 Typical sewing problems

The sewing of the vehicle tire mainly consists in linking the individual tire cord panels. It is therefore important to know the developmental process of the tire cord as well as the subsequent production steps.

First of all, the tire cord is woven; from different materials depending on area of use. Filament yarns made from polyamide, polyester and rayon are used as warp material. For special applications such as racing tires, aramid threads are used as well. Relatively fine cotton or elastic core spun threads are used as weft yarn, since they are not intended

as reinforcement material and are sometimes supposed to tear during tire production. For the knock-over, coarser weft yarns made from cotton thread, glass yarns and special knock-over yarn mixes are used.

Tire cord fabric mostly consists of warp material that guarantees the necessary strength of the end product and to a lesser degree it consists of weft material that secures the precise warp thread position. A further peculiarity of the tire cord fabric are its different areas with differing weft densities and weft materials. As a rule, the length of a piece of tire cord is between 1,000 and 2,000 m. At the beginning and at the end of each piece, one to three knock-over areas are woven, which are between 5 and 60 cm long, depending on the manufacturer. The weft density is increased in this area. The knock-over serves to sew together the pieces of tire cord in the adhesive dipping and hot stretch unit, as well as reference piece and quality control.

In the adhesive dipping and hot stretch unit, the fabric is being prepared for subsequent treatment in the calander plant for applying the rubber mixture. There is always around 3,000 m tire cord fabric in the adhesive dipping and hot stretch unit, which are transported at a speed of approx. 90 m/min. In order to avoid down times of the adhesive dipping and hot stretch unit, the tire cord pieces must be sewn together. This happens at a sewing station before entering the plant.

The resulting often rather high sewing speeds combined with the synthetic materials of the tire cord fabric are not always entirely unproblematic during manufacture.

Typical sewing problems in manufacturing tire cord are:

- Skip stitches/Thread breakage
- Needle breakage
- Thermal damage/Smearing of the needle

1.2 Quality seams with the right sewing parameters

Depending on the composition of the material, the knock-over or the ends of the individual tire cord pieces are sometimes sewn together with a reinforcing lining at a sewing station. Depending on sewing machine and the strain of the end product onto the material, 12 to 40 seams are put next to each other. A normal automobile tire must be able to withstand a strain of 8 to 18 tons in the hot stretch unit. A high-speed tire on the other hand undergoes a strain of approx. 38 tons.
This comparison demonstrates that the number of seams next to each other very much depends on the end product and the manufacturer's guidelines.

Due to the very comprehensive and variable fields of application of the end product, it is very difficult to fix any sewing parameters. Variously composed, often synthetic materials result in differing sewability.

Due to these demands and decisions the necessity arises to adjust all sewing parameters like sewing machine, sewing speed, sewing thread and needle individually according to the final product. The guidelines of the tire manufacturers often determine the material and the sewing thread. As a result the needle often represents the only variable instrument.

Needle

2. Selection of the right needle

The determination of the right needle size and point style for the material to be sewn is among the most important decisions and responsibilities a quality assurance is faced with. The influence of the needle on the quality of the finished seam is often underestimated. It is possible to achieve big improvements in the production process and in the product quality by choosing the right needle size, needle type and point style.

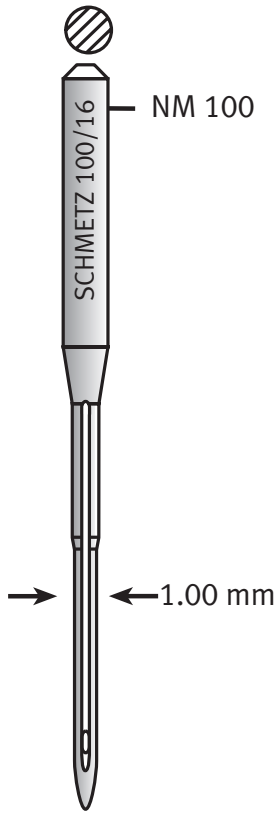
Already during the preparation phase of work great consideration should be taken when choosing the needle in dependence to the material to be sewn, the number of layers, the

sewing thread and the finishing of the fabric surface. If this process is neglected there can be no guarantee of a damage-free and high quality sewing.

In tire cord production the importance lies in producing hard-wearing, undamaged seams with high sewing speeds. This calls for a needle that can withstand a lot of strain and friction temperatures without any problems.

2.1 Needle size

The needle expands the fabric threads during penetration of the fabric. Choosing a too large needle diameter results in exceeding the physical tolerance limits in respect to the elongation of the fabric threads. This results in “bursting” i.e. damage of the fabric threads.
Depending on the thickness and finish of the material and given sufficient inherent elasticity in the fabric threads, no damage is to be expected if a suitable needle size is used. An overview of the recommended needle sizes can be found in the table on page 6.

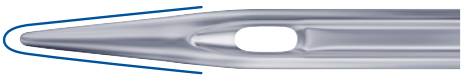


2.2 Point style

In the production of tire cords, mostly ball points are used. In the case of stronger, coated fabrics the normal round point “R” can also be used. The use of cutting points is not recommended as they damage the material or cut the material threads and thus jeopardize the quality of the end product.
The point style should always be chosen according to the material, the thickness of material and the number of layers.

In the production of tire cords, which, depending on the manufacturer, consists of polyester, polyamide, rayon, cotton or similar material combinations, we recommend using the medium ball point “SUK”. The fabric mostly consists of warp thread. There will be a weft thread insertion at intervals of only 5 to 7 cm. This results in a decreased yarn slippage resistance of the tire cord fabric in its uncoated state. The medium ball point displaces the fabric threads with its rounded point by pushing the material threads to one side. This damage-free displacement is extremely important since any damage to the fabric threads immediately leads to a rejection of the tire cord fabric. If the fabric threads are damaged, the fabric will no longer be resilient, a characteristic required later.

SUK medium ball point



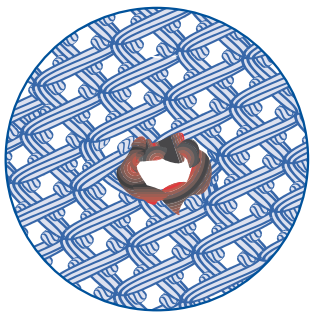
The normal round point “R” has a pointed conical form. This point should only be used with already coated, tougher tire cord fabrics.
The normal round point “R” is the standard point style. The point supplement “R” is therefore not always explicitly used by the Ferd. Schmetz GmbH.

R normal round point

2.3 BLUKOLD needle

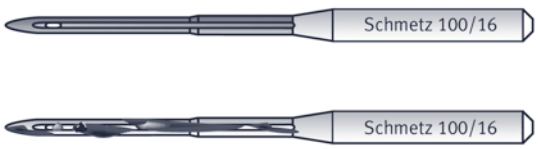
The high sewing speed as well as the demands that are made on the sewing of tire cords through the use of coated, synthetic materials call for a needle that can produce the desired quality seams continually and without interruption.

Synthetic materials or material combinations with a high percentage of synthetics as well as materials special finishing often cause specific sewing problems. The coating of tire cord fabrics is often marked by a low melting point. Due to the high temperatures that the needle reaches during the sewing process material can easily melt at the stitch hole.



The heated needle has melted a hole into the fabric.

Melted residue settles at the needle and impairs the sewing process. This leads to thread breakage, skip stitches, smeared needles and a defective seam appearance.
BLUKOLD special needles have a phosphorated surface and a Teflon® coating. This coating either does not permit any melted residue at all or else they appear much later than with a conventional (e .g. chromed) needle. That means a BLUKOLD needle can sew – compared to a chromium plated needle – for twice a length of time or twice the seam length. The anti-adhesive coating with Teflon ensures that the needle remains “clean” for longer. Skip stitches and thread breakage will be minimized.



Melted residue (below) either does not settle at the BLUKOLD needle (illustration above) at all or much later.

SCHMETZ Tip:

When sewing synthetic materials, the use of BLUKOLD needles avoids melted residue at the needle.

2.4 Changing of the needle

The regular changing of the needle should be a stated requirement in the performance specification of every quality control system. A continuous sewing process with a “zero defect” final product is only possible if the needle is changed regularly. Worn out, smeared or bent needles cause skip stitches, fabric damage and other rejection criteria. In order to avoid this it is advisable to change the needle regularly at the beginning of every shift or if the needle is strained excessively by high numbers of fabric layers or fast sewing speeds.
If in doubt about the time of use or the degree of wear it is advisable to change the needle at an early stage in order to avoid sewing problems.

Sewing thread

3. Selection of sewing threads and stitch parameters

In the production of tires the choice of sewing thread very much depends on the end product’s area of application. Polyester, polyamide and Rayon are used as sewing threads. The tire cord material and the sewing thread are often adjusted to one another. Its precise composition significantly determines the future quality and performance of the tire.
Therefore, the precise fabric composition varies from one manufacturer to the next. Apart from rubber mixture, this is what marks the difference and specialty of the various tire suppliers.

3.1 Composition and size of the sewing thread

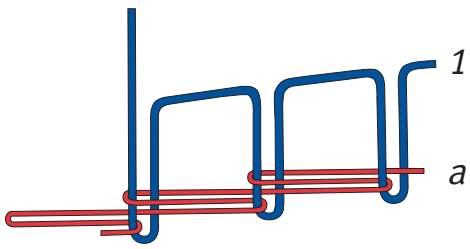
In order to join the two tire cord pieces, mostly synthetic sewing threads are used. The type of fabric and sewing thread materials are determined by the temperature during rubber coating and subsequent vulcanizing. For example, at lower temperatures of around 260 °C, mostly polyamide threads are used. At higher processing temperatures of around 600 °C to 800 °C, an HMLS (high modulus, low shrinkage) polyester thread is used. The characteristics of this thread are a combination of high strength, high dimensional stability and low shrinkage. Together with its high tensile strength, these characteristics are of great importance for the seams of the tire cord pieces. This is because they have to resist high elastic forces during subsequent tire production and later in the tire.

For reasons of economy, tire cord fabric and sewing thread is increasingly made from polyester. Due to its environmental impact during the manufacturing process as well as for cost reasons, the previously high percentage of polyamide and Rayon is decreasing.

3.2 Stitch type

In the production of tire cord, mostly double chain stitches are used (stitch type 401). This stitch type offers high seam elasticity and is particularly suitable for seams that later are subject to much stretching. Another benefit during tire production arises because the bobbins are able to process the yarn directly from the cone. Production interruptions due to a change of cone and bobbin winding (considerable for 6 to 12 bobbins!) can thus be avoided. In addition, the double chain stitch allows higher sewing speed than a lock stitch.

Stitch type 401 – double chain stitch
(2-thread chain stitch)



3.3 Stitch density

Stitch density should be coordinated with material, the number of layers, the sewing thread and the desired strength of the seam. Depending on further strains on the seam during the production process, a higher stitch density should be selected for greater strain. As a general rule: The higher the stitch density (stitches/cm) the higher the seam strength.

For the joining of tire cord pieces, a stitch density of 2 to 6 stitches/cm should be selected. They are individually set depending on the consumer's demands, past experiences and desired quality.

3.4 Thread tension

It is impossible to give a general statement on the thread tension in the field of sewing tire cord. The perfect relation between sewing thread, needle, sewing machine and object to be sewn is always important for the thread tension. The amount of layers and the consistency of fabric are also influencing factors. For this reasons the thread tension is always adjusted individually on each sewing automat by a technician. General rule: The thread tension should be set in such a way that the stitch formation of the needle and looper thread can take place in an optimal way.

Machine

4. Sewing machines for the manufacturing of tire cord

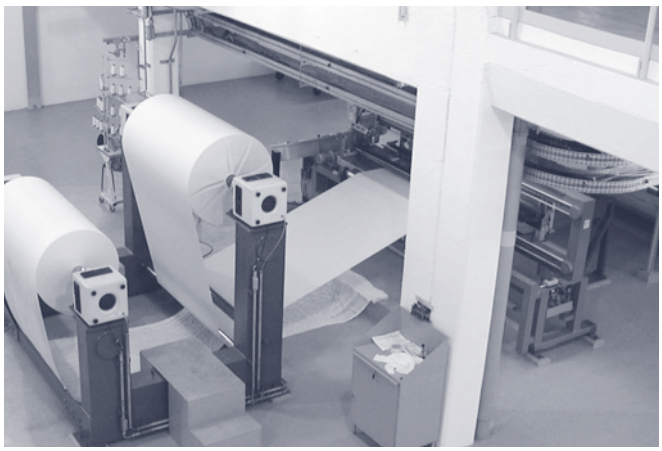
For sewing together tire cord pieces, mostly special sewing automats from special machine building are used (see pict. 1+2). These sewing machines work with six to twelve needles, which rack out the sewing field using a bridge construction. It is thus possible to produce up to 12 seams in one single process. Since tire cord pieces are connected by up to 40 seams, this construction also offers a time advantage during production.

Alternatively, long-arm sewing machines as well as high-speed sewing machines are used for medium to heavy areas. These machines, too, are equipped with as many needles as possible.

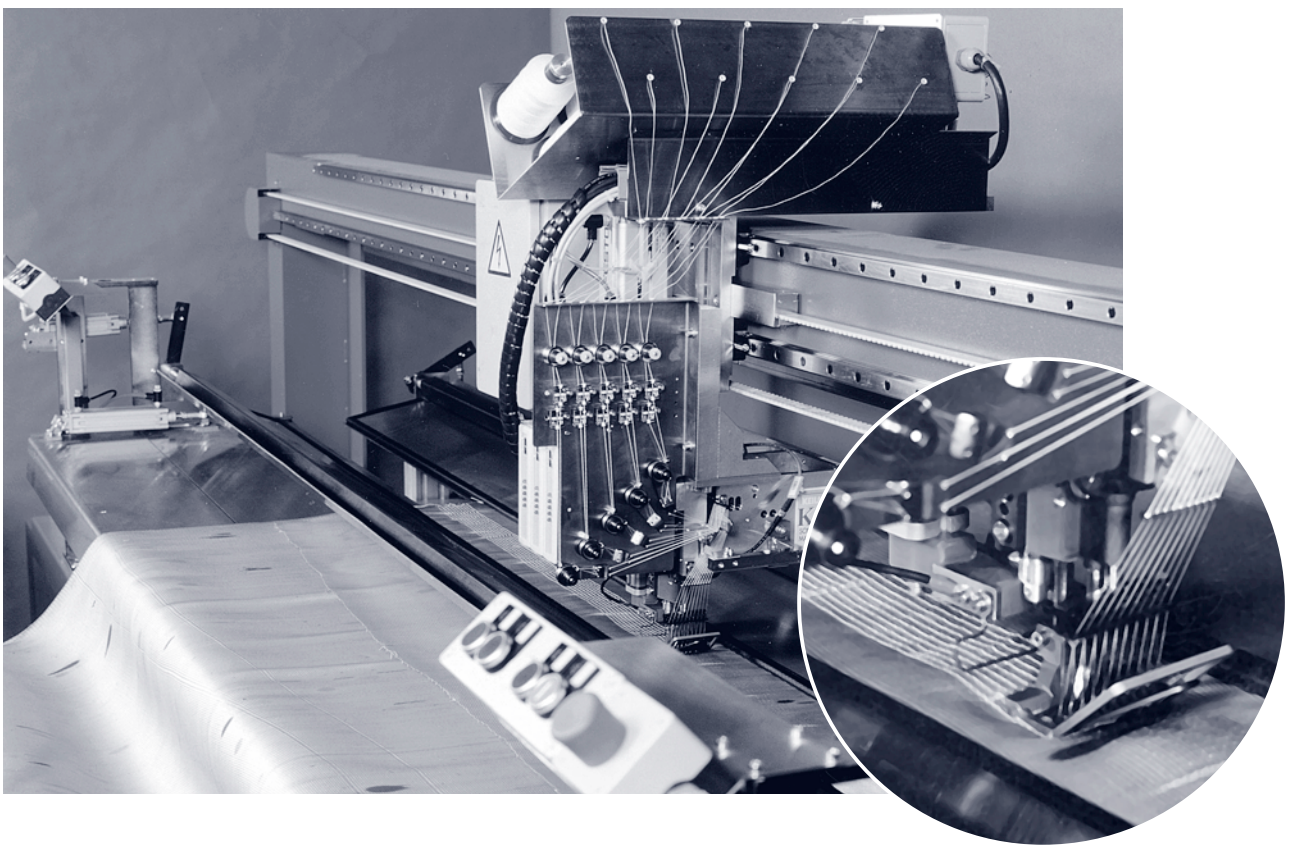
Flatbed Sewing Machine Closing and double lapped seams

Long-Arm Sewing Machine Closing and double lapped seams

Special Sewing Automat Closing and double lapped seams
(see pict. 2)



Pict. 2: Sewing automat Source: KSL GmbH, Lorsch



Pict. 1: Tire cord sewing unit KL 222 Source: KSL GmbH, Lorsch

4.1 Feed

Choosing the right feeding system is very important in order to guarantee an even material feed. Here the kind of material and the amount of layers which have to be transported have to be taken into consideration. Therefore, every sewing automat and every sewing machine is equipped with a special feed and additional fittings for the relevant sewing operation.

High speed and long-arm sewing machines:

Compound feed with alternating presser foot top feed (Triple feed)
For sewing heavy or feed critical materials with uniformly long stitches

Compound feed with alternating presser foot top feed with roller top feed
Especially for smooth sewing of material causing particular feed difficulties (e. g. coated fabrics)

Needle feed, roller top feed and/or roller bottom feed
The roller feed allows smooth sewing of particularly difficult to feed materials while keeping stitch length even

In the case of special sewing automats:
The feed is electronically regulated using synchronously working tooth belt (inline movement of needle and looper).

4.2 Throat plate/Throat plate aperture size

Every sewing machine and every sewing automat is fitted with specific sewing accessories for the particular use or the sewing operation for which they are intended. These sewing accessories include the feed of the machine and the throat plate. The throat plate aperture size is adjusted in such a way that all needle sizes which can be fitted into the machine can pass easily. The throat can be changed according to demand.

It should be taken care that the size of the throat plate aperture is not too large for the chosen needle size. Otherwise there is the danger of the material being pulled into the aperture of the throat plate. This causes fabric damage, skip stitches and thread breakages. Then a high quality seam and an unproblematic manufacturing process will be no longer possible.
If the aperture size of the throat plate is chosen too small in relation to the needle size or if the needle is deflected the needle cannot pass freely. This can lead to fabric damage as well as needle breakages.
This emphasizes that choosing the right sewing accessories and changing them regularly is also an possibility to reduce sewing problems and should be a stated requirement in the performance specification of every quality control system.

4.3 Sewing speed

When sewing together tire cord pieces it is important that the two ends are sewn together quickly in order to guarantee a disturbance-free operation of the adhesive dipping and hot stretch unit.
The sewing speed should always be coordinated with material, machine and number of layers.
When sewing, it is possible to achieve a sewing speed of up to 2,800 stitches/min. It is important to note that thermal damage in the form of needle smearing and material damage is the result of too high speeds when working with synthetic materials. Therefore, sewing speed is usually between 800 and 1,200 stitches/min.
A guiding principle is: optimal quality together with high productivity.

5. Our advice

You can achieve damage-free quality seams if all the sewing parameters are precisely coordinated with one another.

Material, needle, thread and machine are the key variables. The **SCHMETZ** SERVICE**HOUSE** offers various service packages:

From recommending the ideal needle for your fabrics to sending out sample needles and providing assistance with special sewing requirements. In addition the **SCHMETZ** SERVICE**HOUSE** offers competent on-site advice on your production line and training courses for your employees.

Challenge us –
let us show you our competence!

Form to copy and fax:
+ 49 (0) 24 06 / 85 -186

Do you have further questions about sewing tire cord?
Would you like support in solving your individual sewing problem?
Would you like recommendations on needle selection and sewability of your fabrics in advance of production?
Challenge the SERVICE**HOUSE** experts and take advantage of our offer.

We will be pleased to send you information on:

Our range of service:

Company name

Attention

Position

Address

Postcode/City

Country

Phone

Fax

E-Mail

CONSULTING

SAMPLE NEEDLES
Sample needles, tips and information

DOCUMENTED SEWING REPORTS
Sewing reports tailored to match your sewing goods as well as solutions for your complex sewing demands

EXPRESS CONSULTING
Express consulting by phone, fax or e-mail

INFORMATION

SEWING FOCUS
Sewing information for special industries and applications

PRODUCT FOCUS
Product information for special industries and applications

GUIDE TO SEWING TECHNIQUES
Manual for sewing industry

TRAINING/SYMPOSIUM

TRAINING-ON-SITE
Industry specific training including the latest information on needles, threads, machines and applications

SYMPOSIUM
Interdisciplinary knowledge sharing and exchange of expertise for skilled sewing industry staff

FERD. SCHMETZ GmbH SERVICE**HOUSE**
Bicherouxstraße 53-59, 52134 Herzogenrath, Germany
Phone +49 (0)2406 / 85-185, Fax +49 (0)2406 / 85-186
Internet http://www.schmetz.com, E-Mail: servicehouse@schmetz.com

SCHMETZ
NEEDLES SINCE 1851