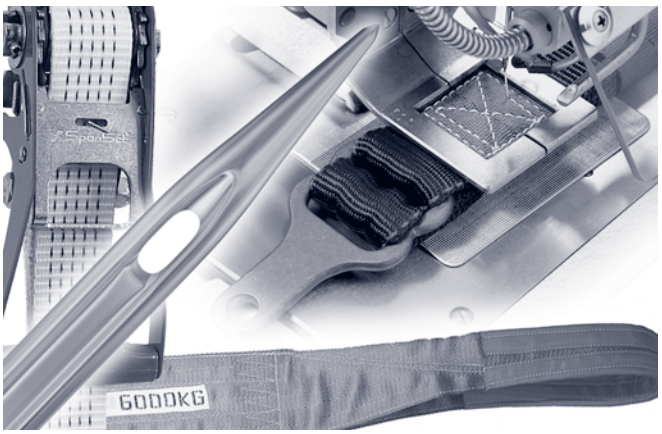
SEWING FOCUS

TECHNICAL SEWING INFORMATION

SERVICEHOUSE



Safety and Cargo Belts

Checklist for Sewing Safety and Cargo Belts

Sewing Parameters:	SCHMETZ Tip:
Needle size	NM SIZE 110 – 280 18 – 28 Depending on the thickness of the thread and the material to be sewn also in SERV 7 version.
Needle point	Only round points are used in belt manufacturing.
Sewing thread	Almost exclusive use is made of 100% polyester continuous multi filament thread. Seldom 100% polyamide thread is used.
Machine	Heavy duty industrial sewing machines, bar tack- and short seam automatic machinery as well as programmable large sewing field machines (multi directional) are used.
Other factors:	
Thread tension	The necessary thread tension depends on the fabric, the sewing thread and the sewing machine. The thread tension should be as low as possible to allow an optimal stitch formation.
Stitch type	Double lockstitch (stitch type 301) according to DIN 61400.
Stitch density	The higher the stitch density, the greater the seam strength. About 2 – 4 stitches/cm.

SCHMETZ

NEEDLES SINCE 1851

Quick Reference for Typical Sewing Problems in Safety and Cargo Belt Manufacturing

Symptoms	Effect	Cause
Skip stitches / Thread breakage		
No interlacing/interlooping of needle thread and bobbin/looper thread Needle thread breaks Ravelling of the needle thread	Thread breakage after skip stitch Sub-standard, defective seam appearance Reduced seam strength	"Tipping over" of the needle thread loop Arching up of the material due to insufficient presser foot pressure Incorrect thread tension Incorrect needle system Needle incorrectly fitted Jamming of the sewing thread between needle and fabric Adhesion of melted residues, clogging of the needle eye and needle groove
Needle breakage		
	Broken needle parts remain in fabric Material is damaged	Use of an undersized needle Needle deflection too heavy Needle size and material thickness are not adjusted to each other Damaged point, resulting in excessive penetration force

Solution

NM SIZE	Point style	Thread	Machine
			
Use the SCHMETZ SERV 7 needle Adjust needle size to the material and amount of layers Check needle eye and groove for damage, if in doubt: change needle	Check point for damage	Use a bonded sewing thread Select a well finished sewing thread Adjust sewing thread size to the needle size Optimize thread tension	Optimize the hook/looper setting Use the right presser foot and the right adjustment of the presser foot pressure Check throat plate for damage Adjust the sewing accessories, such as throat plate, feed etc. depending on material thickness and sewing thread/needle Examine the thread guiding elements
Use the SCHMETZ SERV 7 needle Adjust needle size to the material and amount of layers **CAUTION:** After every change of shifts or in short intervals according to the needle stress we recommend to change the needle			Check and adjust the material transport **CAUTION:** After a needle breakage it is necessary to check the throat plate for damage

Quick Reference for Typical Sewing Problems in Safety and Cargo Belt Manufacturing

Symptoms	Effect	Cause
Material damage		
Pulled out weft and warp threads	Reduced tensile strength of the material	Needle size too big and/or wrong point style
Material damage	Sub-standard, defective seam appearance	Wrong sized aperture of the throat plate
	Reduced seam strength	Defective/worn out needles
		Damaged sewing accessories, such as throat plate, feed etc.
Thermal damage		
	Individual layers of material are sticking together	Excessive needle temperature due to friction especially when sewing densely woven fabrics
	Melted particles cling to the fabric	Excessive sewing speed
	Needle thread breaks	Needle smeared or needle eye clogged with melted residue
	Needle eye is clogged	Melting of the thread surface and as a result mechanical breakage of the weakened thread
	Needle groove is clogged	

Solution

NM SIZE	Point style	Thread	Machine
			
Use the SCHMETZ SERV 7 needle Adjust needle size to the material and amount of layers	R Normal round point SES Light ball point **CAUTION:** After every change of shifts or in short intervals according to the needle stress we recommend to change the needle		Check and adjust the material transport Adjust the sewing accessories, such as throat plate, feed etc. depending on material thickness and sewing thread/needle
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	R Normal round point SES Light ball point are available in BLUKOLD	Select a well finished sewing thread Alternatively use an extra thread lubricant (exp. 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
Seat belts Safety belts	2	120 – 250 / 19 – 27	R normal round point SES light ball point
Seat belts for children	2	110 – 180 / 18 – 24	R normal round point SES light ball point
Light belt webbing Light tie-downs	2, 3	130 – 200 / 21 – 25	R normal round point
Medium weight belt webbing for cargo belts	2, 3 4	180 – 230 / 24 – 26 230 – 250 / 26 – 27	R normal round point
Heavy belt webbing for cargo belts and web slings	2, 3 4	230 – 250 / 26 – 27 250 – 280 / 27 – 28	R Normale Rundspitze SES light ball point

General recommendation for sizes up to NM/SIZE 140/22:
Use of the SERV 7 needle version with the appropriate point style

Contents

1. Safety and cargo belt manufacture

During the production of safety and cargo belts safety aspects like tensile strength, shear and abrasion resistance, colour-fastness and reduced elongation of the textile webbing are the main objectives.

Textile safety and cargo belts have to be produced according to DIN standards in Germany:

DIN EN 12195-2	Cargo belts consisting of man made fibres
DIN EN 1492-1	Flatly woven cargo belts consisting of man made fibres
DIN EN 1492-2	Web slings consisting of man made fibres for general purposes

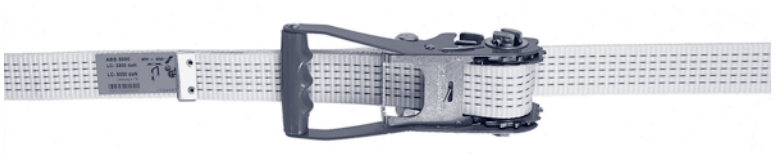
Cargo belts enable careful lifting especially of cargo with a sensitive surface. The flexible textile belts are able to adjust themselves optimal to the contours of the load. Their broad contact surfaces distribute the pressure over a larger area of the cargo surface. Additionally textile cargo belts have a lower weight in comparison to chains and steel ropes with similar carrying loads. Textile belts are produced in different belt widths (standardized 25 to 450 mm) and carrying loads (up to 10,000 kg and more). They are colour coded according to Euro standard for easier identification of the maximum carrying load. For example: red coloured belts can take a direct load of up to 5,000 kg.

Colour code according to Euro-Norm	Carrying load (kg) “direct” load
olive	500
violett	1 000
green	2 000
yellow	3 000
grey	4 000
red	5 000
brown	6 000
blue	8 000
orange	10 000
orange	over 10 000

Also in manufacturing of personal safety equipment the emphasis is set on safety technical aspects.
Source: SpanSet GmbH & Co. KG

Web sling acc. to DIN EN 1492-2

Cargo belt acc. to DIN EN 1492-1



Tie-down acc. to DIN EN 12195-2

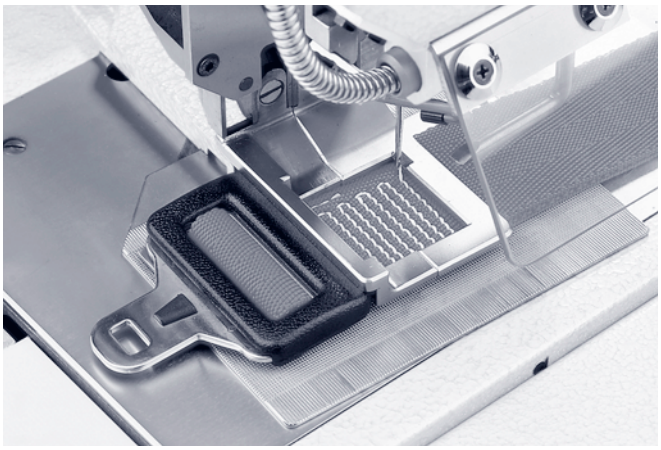
Source: SpanSet GmbH & Co. KG

The textile webbings for safety and cargo belts are made of high strength multifilament yarns. Due to its physical and chemical characteristics polyester (PES) is mainly used. Polyamide (PA) und Polypropylene (PP) only play a minor role as relevant textile materials. The materials used for the production of belts have different resistances towards chemicals. Polyamide for example is resistant against alkaline but sensitive to mineral acids. Polyester is resistant against mineral acids but destroyed by bases. Polypropylene is only slightly sensitive to acids or bases. For this reason it is highly suited for usages where the resistance to chemicals (with the exception of some organic solvents) is of great importance.

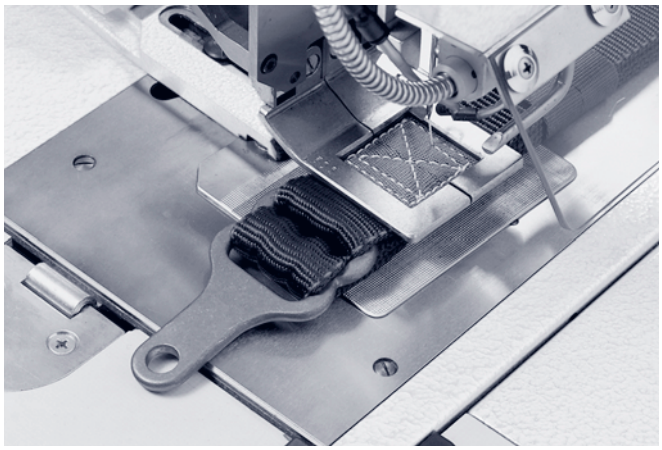
Seat belts just like personal safety equipment are safety technical elements with the emphasis on their functional and ergonomical aspects.

1.1 Typical sewing problems

Automated sewing machines for multi directional sewing are often used in safety and cargo belt manufacturing. Additionally normal, heavy duty sewing machines are also used. Here the seam pattern is achieved by sewing forwards and backwards. A correct seam appearance is only possible when sewing forwards: The sewing thread is slightly twisted and closed (or: twisted together) by the hook during the stitch formation which has a positive effect on the seam strength and seam appearance.
The Z-twist construction of the thread is self-adjusting to the rotating direction of the hook of the double lockstitch sewing machine during the forward sewing operation. As a result the thread is turned around its own axis into the twisting direction during its passage through the needle and its path around the hook.
When sewing backwards the thread is slightly opened against its twisting direction influencing the seam strength and seam appearance in a negative way. For this reason bonded threads should be used for this kind of sewing operation.
Depending on the stitching direction during multi directional sewing the needle thread loop can “tip over” causing thread breakage or thread ravelling.



Pic. 1: Safety and cargo belts for minor loads are sewn on short seam automates.



Pic. 2: The seam pattern in this picture is called “house” or “box-x”.
Source: Dürkopp-Adler AG

One of the problems occurring most often is the heavy building-up of needle heat caused by the friction during needle penetration through the webbing, especially when working with big needle sizes and densely woven fabrics. Thread breakage by melting may occur as a result. Well finished sewing threads can help to minimize this problem.

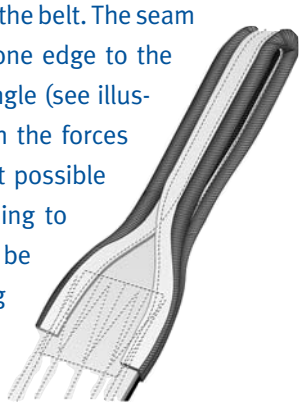
Typical sewing problems occurring during safety and cargo belt manufacturing are:

- Thermal damage
- Skip stitches / Thread breakage
- Needle breakage

1.2 Quality seams with the right sewing parameters

During the production of safety and cargo belts highest standards are set for the properties of the seams with regard to safety and strength. This demands an exact adaptation of all sewing parameters like machine, sewing speed, needle and sewing thread. The elastic properties of the belt webbing and the sewing thread have to be adjusted to each other in the best possible way.
Safety and cargo belts for minor loads are sewn by a short seam automate. Here different seam patterns can be achieved on a sewing field with a size up to 100 x 80 mm² (see pic. 1). In picture 2 a rectangle is sewn with two diagonal seams. This seam pattern which is made on automates from the company Dürkopp-Adler is called “house” sewing or “box-X”.

Belts used for heavy loads are mostly sewn by a seam pattern which uses the whole width of the belt. The seam runs across the whole belt from one edge to the other and backwards in a slight angle (see illustration). Through this construction the forces are spread evenly and the highest possible seam strength is reached. According to DIN EN 1492-1 the following is to be observed during the manufacturing of cargo belts: The stitches must not reach the edges of the belt or affect them in any way; exceptions are the stitches which are needed for the sling reinforcement. Slings have to be reinforced for protection of their inside against damage during lifting as well as in the tie up point for the tying process. Reinforcing materials are for example a tube or a piece of belt webbing, leather or other similar lasting materials.



During the straining of a belt the fabric yarns situated in the middle of the belt take the highest strains. For this reason the beginning and the end of the seam must be at the edge of the belt to prevent the seam from opening.

Modern sewing automates are equipped with a thread burning device. The thread is welded at the end of the seam to prevent the seam from opening. This makes bar tacking at the beginning and the end of a seam unnecessary.
The amount of stitches/cm is dependant on the load capacity of the belt. Remember: The higher the load capacity the higher the amount of stitches/cm.

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 selection of the right needle depends on the strength of the sewing thread, the type of fabric, the number of layers and the material combinations. The selection of the right needle point depends on the material to be sewn.

2.1 Needle size

The selection of the right needle size is dependant on the sewing thread in order to reach the seam strength for the load capacity of the belt.

The size of the needle eye is usually about 40 % of the needle size. The size of the needle eye and the size of the sewing thread have to be adjusted to each other exactly so that it is possible for the thread to pass the needle eye with the lowest possible friction. This becomes logical when you take into account that one single part of a top thread passes 25 – 60 times through a needle eye when using a double lockstitch before a stitch is formed together with the bobbin thread. During this process the thread experiences a lot of strain and can lose up to 10 % of its strength.
The needle expands the fabric threads during penetration. If the physical tolerance limits are exceeded in respect to the elongation of the fabric threads, material damage will be the result. The threads of the fabric will “burst”, i.e. be damaged. The threads of the fabric can also be shifted strongly. This results in a decrease of the tensile strength of the belt.
An overview of the suggested needle sizes can be found in the table on page 6.

2.2 Point style

The textile structure of belts call for needles which can pass through material layers easily with little exertion of force and without deflection of the needle, regardless of their density, thickness and firmness.
The penetration resistance which the needle has to overcome is dependant on the textile fabric, the number of layers, the thickness and the finishing of the fabric.
Round points are mainly used in the manufacturing of safety and cargo belts. As an exception other point styles may be used depending on the properties and characteristics of the material to be sewn and the manufacturing technique.

The normal round point “R” is the standard point style and has a pointed conical form. The point supplement “R” is not always used. The normal round point “R” pierces the weave yarns. By this a very straight seam is achieved.

In comparison to the normal round point “R” the light ball point “SES” has a small hemisphere at its point preventing from piercing of the weave yarns. By this a damage free displacement of the weave yarns is possible.

R normal round point

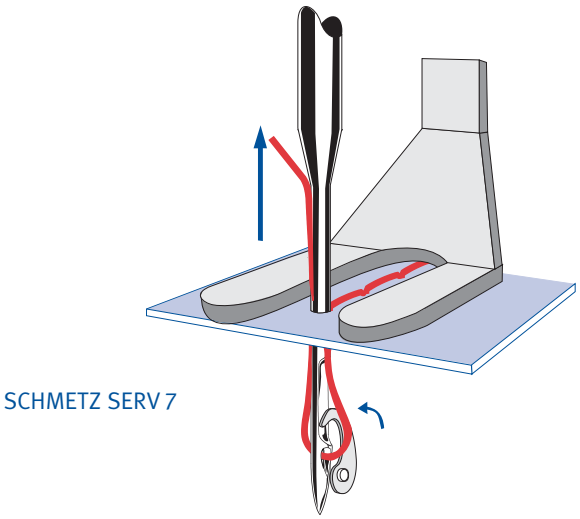
SES light ball point

For the sewing of leather/textile combinations a normal round point (with or without point supplement “R”) is used in order to prevent fabric damage. The use of a needle with a cutting edge – typical for sewing leather – would damage the fabric with its cutting properties. This is inadmissible in the belt production.

Generally the intactness of the needle point is of high importance. Needles with minor damage to their tip can cause more damage than choosing the wrong needle size or the wrong point style.

2.3 SERV 7 needle construction

SERV 7 is a special needle to prevent skip stitches and needle breakages. This needle type comes in various point styles for the particular requirements of different materials. The distinctive features of SERV 7 needles are their specially shaped hump scarf and their extra blade reinforcement. The hump scarf extends the loop so that the hook or looper can catch it easily. This greatly reduces skip stitches.
The SERV 7 blade reinforcement makes the needle especially stable and far less likely to “bend”. Needle breakages are thus minimized and the centric penetration produces a better seam appearance. The low deflection of the needle also prevents skip stitches.


SCHMETZ SERV 7

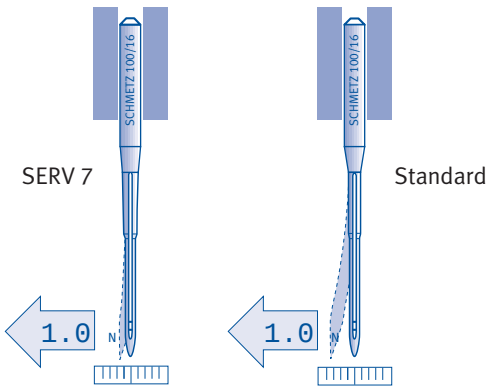
SCHMETZ Tip:

Benefit 2: SERV 7 needle has higher stability increasing needle life.

The special stability of the SERV 7 needle is particularly valuable for sewing thick and dense fabrics, multiple layers of fabric and when using synthetic sewing threads with strong elongation.

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. The different sewing processes depending on the number of fabric layers, material thickness and combinations require a change of the needle at the beginning of every shift or – under particularly high needle stress – every two hours.
When sewing fabrics made out of synthetic fibres the needle is worn out faster than when sewing fabrics made out of natural fibres. A worn out needle can pull fabric threads or filaments. As a consequence the seam is influenced negatively.



SCHMETZ Tip:

Benefit 1: SERV 7 hump scarf produces optimum loop formation and prevents skip stitches.

Sewing thread

3. Selection of sewing threads and stitch parameters

To the quality assurance the requirement for the resistance to stress and the safety of the seams are of equal importance as the requirement for straight and damage-free seam results.

The material and the quality of the sewing thread determine the final seam quality substantially.
In the belt manufacturing continuous multifilament sewing thread made out of 100 % polyester, seldom 100 % polyamide is used exclusively. Additionally sewing threads made out of polyester and polyamide in this special field of application have to have a high tensile strength, high abrasion resistance (against abrasion coming from outside and for lasting seam quality), high thermal resistance, optimal slippage properties and complete evenness. It is only possible to create a permanent and safety relevant seam under these conditions.
In order to achieve a sufficient seam strength the same thread sizes have to be used for the top and bottom thread. This ensures that the strain on the seam is distributed evenly.

3.1. Composition and size of the sewing thread

In the belt manufacturing all seams have to be made out of a sewing thread consisting of the same material as the belt. In order to make the control of the seams easier during production and later during inspections while in use it is possible that the sewing threads have a different colour than the belt.

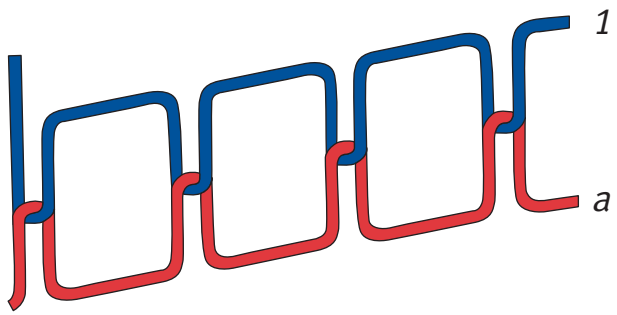
The definition of multiple sewing threads is specified as: Nm 10/3. That means: The thread consists of 3 single strands of Nm 10.

Information on sewing thread innovations specifically for this area of application can be obtained from your sewing thread manufacturer.

3.2 Stitch type

The use of the double lockstitch is determined by standardization for the manufacturing of safety and cargo belts. When using the double chain stitch there is an increased danger that the seam will open at its beginning or end due to damaged stitches. As the surface of a belt has to have a high abrasion resistance the use of the double chain stitch is not advisable as the stitch formation of needle and looper thread takes place on the surface of the fabric.

Stitch type 301 – double lockstitch



Continuous filament								
Thread Type	Polyester				Polyamide			
	Thread Size		Needle Size		Thread Size		Needle Size	
	No*	tex*	NM	SIZE	No*	tex*	NM	SIZE
	6	170						
	7	140						
Coarse	8	125	180-250	24-27				
	9	110						
	10	100	160-200	23-25				
	11	92			11		160-180	23-24
	12	84						
	13	76			13			
	15	68	130-160	21-23	15			
	18	56						
	20	50	120-140	19-22	20		140-160	22-23
					30		120-140	19-22

* No = label number
* tex = Definition of size 1 g / 1,000 m (e. g. 200 tex = 1,000 m of thread weigh 200 g)
Nm (for thread) = Numbering of length 1 m / 100 g (e. g. Nm 8 = 8 m of thread weigh 100 g)

In the stitch type double lockstitch the intersection of the needle and bobbin thread is in the centre of the fabric to be sewn. This creates an even seam appearance and gives the hint that a proportionate amount of thread is used for the needle and bobbin thread.

In an optimal stitch formation the strain on the seam is distributed evenly on the top and bottom thread. This results in maximal seam elasticity and tensile strength.

3.3 Stitch density

A cargo or safety belt has to stand the highest strains in its length direction. For this reason the seams have to have a high length elongation and stability which also depends on the stitch density and machine adjustment.
As a general rule: The higher the stitch density (stitches/cm) the higher the seam strength. One needs to consider: Due to the use of big needle sizes and heavy yarn sizes the stitch density should not remain under 2 – 4 stitches/cm. A too high stitch density can cause perforation or pulled fabric threads. Highly deflected warp threads of the belt result in the loss of strength of the belt.
The amount of stitches/cm is dependant on the strength of the belt. As a rule: The higher the strength of the belt, the higher the amount of stitches/cm.

3.4 Thread tension

The necessary thread tension depends on the material, the sewing thread and the sewing machine. Sufficient thread reserve in the seam dealing with high and extreme stresses is an important criteria for the desired seam elasticity and seam tensile strength.
A sewing thread is expected to exhibit a certain amount of elongation or inherent elasticity. The amount of retraction following elongation must not be too high or it will influence the seam quality in a negative way. Hence the thread tension should be set as low as possible, but with consideration so that the seam does not drift apart.

Machine

4. Sewing machines for safety and cargo belt manufacturing

Heavy 1-needle-double lockstitch machines with special feeds and additional accessories for the specific sewing operations are most often used in belt manufacturing.

Flatbed Sewing Machine
Closing and attaching seams on heavy cargo belts
Closing seams on cargo belts

Long-Arm Sewing Machine
Closing and attaching seams
Heavy and three dimensional cargo belts

Free-Arm Sewing Machine
Closing and attaching seams
Heavy and three dimensional cargo belts
Attaching of belt parts

Short Seam Automate
(without illustration)
Closing seams on seat belts and cargo belts for low stresses

Programmable Large Sewing Field Automate
(without illustration)
Attaching seams on belt systems

4.1 Feed

To ensure uniform material feed there are various forms of machine accessories and feeds.
For example:

Bottom feed and differential alternating presser foot top feed
For smooth sewing of heavy materials with uniformly long stitches

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

Automatic clamp feed
For smooth sewing without displacement according to the predetermined sewing pattern

4.2 Throat plate / Throat plate aperture size

It should be taken care that the size of the throat plate aperture is adjusted to the chosen needle size. If thicker needles are changed for thinner ones (also from thin needles to thick ones) the size of the throat plate aperture should also be changed.
The diameter of the throat plate aperture should not be larger than the factor 1.2 to 1.4 than the needle size.

4.3 Sewing speed

As a rule, high sewing speeds are not used in the safety and cargo belt production. Usually up to 2,500 stitches/min with needle cooling and up to 1,000 stitches/min without needle cooling are reached. In general the sewing speed depends on the thickness and the structure of the fabric to be sewn. At most sewing machines or automates it is possible to adjust the sewing speed according to the demands. High sewing speeds with a low number of stitches in the seam do not usually give any economical advantage.

Due to the strong needle sizes and the extreme density of the material to be sewn a high amount of friction occurs between the needle and the material. If the sewing speeds are exceeded thermal damage like needle smearing and/or thread breakage through melting occurs. In such cases it is necessary to reduce the sewing speed due to the physical properties of the material. Even the cooling of the needle by air or the use of silicon oil as a thread lubricant will not result in the reduction of the needle temperature in such a situation.

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 belts?
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

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Country

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