SEWING FOCUS

TECHNICAL SEWING INFORMATION

SERVICEHOUSE

Airbags

Checklist for Sewing Airbags

Sewing Parameters:	SCHMETZ Tip:
Needle size	NM 70 – 140 / SIZE 10 – 22 Depending on the thickness of the thread and the material to be sewn, also available as SERV 7 version.
Needle point	In airbag manufacturing round points (R = normal round point) or ball points (SES = light ball point) are used exclusively in order to avoid airbag fabrics to become damaged.
Sewing thread	The European automobile industry determines polyamide as the exclusive material for airbag sewing threads. For this reason bonded multi filament threads made from 100% polyamide are mostly used. In Asia and America bonded multi filament threads from 100% polyester are also in use. Seams which have to stand extreme temperatures (near the generator opening) are made by aramide threads.
Machine	CNC controlled automated sewing machines and special sewing machines are used for the production of airbags. Due to the obligation of documentation in the airbag production each sewing machine is fitted with a system for the control and documentation of safety relevant parameters.
Other factors:	
Thread tension	The necessary thread tension depends on the shape of the object to be sewn, the position of the seam and the sewing automate. It is adjusted on each sewing machine individually by a technician. The thread tension should be adjusted in such a way that the interlacing of needle thread and bobbin thread is achieved on the back side of the fabric.
Stitch type	Depending on the seam position stitch type 301 (double lockstitch) and stitch type 401 (double chain stitch) according to DIN 61400.
Stitch density	About 2 – 5 stitches/cm.

SCHMETZ

NEEDLES SINCE 1851

Quick Reference for Typical Sewing Problems in Airbag Manufacturing

Symptoms	Effect	Cause
Skip stitches/Thread breakage		
No interlacing/interlooping of needle thread and bobbin/looper thread Thread breakage	Reduced seam strength, especially with double chain stitch Sub-standard, defective seam appearance Opening of the whole seam especially with double chain stitch Thread breakage after skip stitch Defective two colour interlooping on bottom side of fabric Jamming of the sewing thread due to stitch holes which are stuck together Partly or whole melting through of the needle thread	Incorrect thread tension Incorrect needle system Needle incorrectly fitted Adhesion of melted residues, clogging of the needle eye and needle groove Use of an oversized sewing thread in relation to the needle size Needle deflection due to extremely thick layers of material Wrong sized aperture of throat plate, material is pulled into it or jammed and prevents the loop formation Overheating of sewing machine needle Mechanical damage to needle, throat plate, feed etc. Incorrect thread guidance
Needle breakage		
	Broken needle parts remain in fabric Fabric is damaged	Needle deflection too heavy Damaged point, resulting in excessive penetration force Needle size and material thickness are not adjusted to each other Use of an undersized needle

Solution

NM SIZE	Point style	Thread	Machine
			
Use the SCHMETZ SERV 7 needle Adjust needle size to the material and amount of layers Change needle regularly (after every shift or after a shorter interval depending on the stress) BLUKOLD needle with Teflon coating. This needle coating prevents or greatly reduces the adhesion of melted residues **CAUTION:** Use of the BLUKOLD needle does not reduce the needle temperature which is caused by excessive sewing speed 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 Reduce sewing speed Change worn out or defective sewing accessories regularly, such as thread guiding elements, hook/looper, throat plate etc. Check throat plate for damage
Use the SCHMETZ SERV 7 needle Adjust needle size to the material and amount of layers **CAUTION:** It is advisable to change the needle after every shift or after 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

Quick Reference for Typical Sewing Problems in Airbag Manufacturing

Symptoms	Effect	Cause
Fabric damage		
Damage to fabric Stitch holes with melted residue of fabric threads Stitch holes visible, weft or warp threads destroyed	Reduced tensile strength of the material Sub-standard, defective seam appearance Reduced seam strength	Oversized needle and/or wrong point style Excessive sewing speed Defective/worn out needles Wrong sized aperture of the throat plate Damaged sewing accessories, such as throat plate, feed etc.
Unwanted loops		
	Reduced seam strength Sub-standard, defective seam appearance	Incorrect adjustment of the sewing accessories, such as hook/looper, feed etc. Incorrect balance of thread tension Incorrect thread guidance Damaged thread guiding elements

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:** It is advisable to change the needle after every shift or after a shorter interval depending on the stress	Choose the right sewing thread size according to the needle size and the fabric	Adjust the sewing accessories, such as throat plate, feed etc. depending on material thickness and sewing thread/needle Check and adjust the material transport
Use the SCHMETZ SERV 7 needle Adjust needle size to the material and amount of layers		Check and optimize thread tension	Examine the thread guiding elements

Selection of Point Style and Needle Size

Material	Number of layers	Needle size NM / SIZE	Point style
Polyamide/Polyester fabric	2	70 – 80 / 10 – 12	R normal round point SES light ball point
Polyamide/Polyester fabric	3 – 4	80 – 90 / 12 – 14	R normal round point SES light ball point
Polyamide/Polyester fabric	5 – 6	100 – 110 / 16 – 18	R normal round point SES light ball point
Polyamide/Polyester fabric	7 – 8	120 – 140 / 19 – 22	R normal round point SES light ball point

General recommendation in airbag production:
Use of the SERV 7 needle version with the appropriate point style

Contents

1. Airbag manufacture

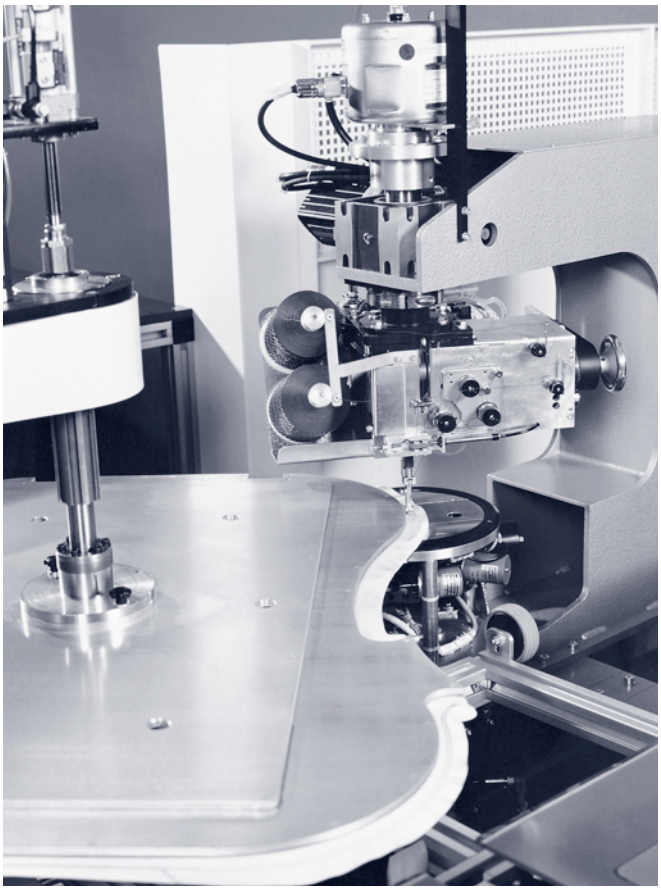
In industrial countries the comfort of a car is taken for granted in every day life – almost everybody possesses at least one. This seems to be a steady trend as the automobile industry is in constant growth. The awareness of the automobile consumer towards active and passive safety of a car has also grown. For this reason airbags are seen as a basic requirement of safety standard but not really noticed – as long as the emergency, the accident does not occur. Then the following happens: At the impact of the car the generator is triggered off. The airbag is inflated by gas. The person is hurled into the airbag cushion and thrown back. The whole process takes about 1 millisecond – faster than the blink of an eye! After a few seconds the gas escapes the airbag so that the passenger is able to leave the car quickly.

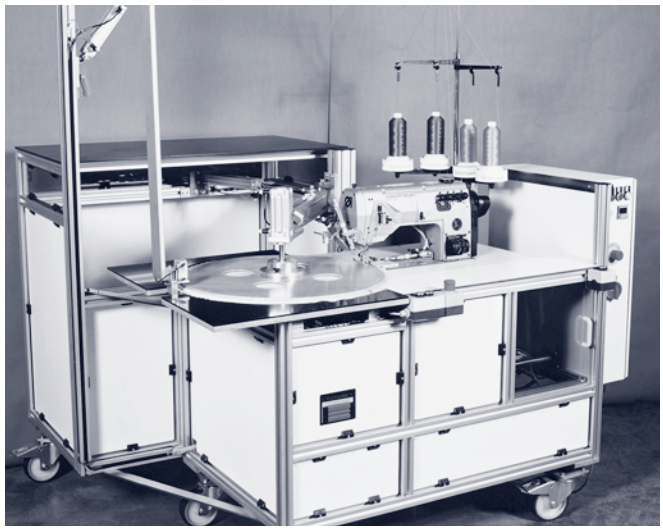
What can make the differences between life and death, calls for highest quality demands in the airbag industry. Looking closely at the process of the airbag activation it becomes clear which stresses the airbag material, the sewing thread and the seams have to take at this moment. An airbag inflates at a speed of about 300 km/h with a gas temperature of about 200° C. Faults or defects of single components can mean the death of a person in an accident.

In an American ten year survey about car accidents it was found out that 4,750 lives had been saved through the use of an airbag.

For this reason a lot of money is invested in research and new developments of airbags. A number of different airbag systems are on the market today, for example driver and passenger bags, side airbags in door panels, airbags in seatbelt systems, curtain airbags for the side windows and windscreen to name just a few.

As a technical safety product the airbag is subjected to strict quality controls. The production is a constantly controlled process strongly determined by the single sewing parameters. Here the influence of the right needle is often underestimated. For this reason it is important to take the advice to make sure that the right needle size and point style are already chosen during the preparation phase of work.





Above: KL 201: Sewing unit for closing of round and oval airbags with double chainstitch or double lockstitch.

Left: KL 121: Closing of passenger airbags with a CNC controlled sewing unit using double lockstitch or double chainstitch. Source: KSL GmbH, Lorsch

1.1 Typical sewing problems

In European airbag production polyamide fabrics are mostly used which are coated with a thin silicone layer. This silicone layer ensures that the airbag can inflate within shortest time without sticking together even after being stored folded up in a very small space for many years. Polyester materials are used more often by Asian or American airbag producers.

Due to the safety function of an airbag, very high quality parameters are determined by the producers. Fabric damage, thread breakage or other sewing problems turn the product directly into a reject. All producers are obliged to a zero defect policy. For this reason every airbag receives a barcode so that each production step is documented and can be traced later on if necessary.
Typical sewing problems occurring during airbag manufacturing are:

- Skip stitches/Thread breakage
- Needle breakage
- Fabric damage
- Unwanted loops

1.2 Quality seams with the right sewing parameters

In the event of an accident the airbag has to function defect free as there is no second chance. Arising from this great responsibility it becomes apparent how important the exact adaptation of all parameters is.

Today the research and development section within the airbag industry often determines the material and the strength of the sewing thread. As a result the needle often represents the only variable parameter.

Due to the low melting point of polyamide (PA 6 at 220° C and PA 6.6 at about 260° C) high sewing speeds give rise to thermal damage – i.e. sticking of material around the stitch hole, smearing of the needle and even complete clogging of the needle eye, with skip stitches and thread breakage as the consequence. For these reasons too high sewing speeds should be avoided in the airbag production.

Enormous potential for the thread manufacturers: Automotive components like airbags or seats demand for high performance sewing threads with customized functions. Source: Coats Mez

Needle

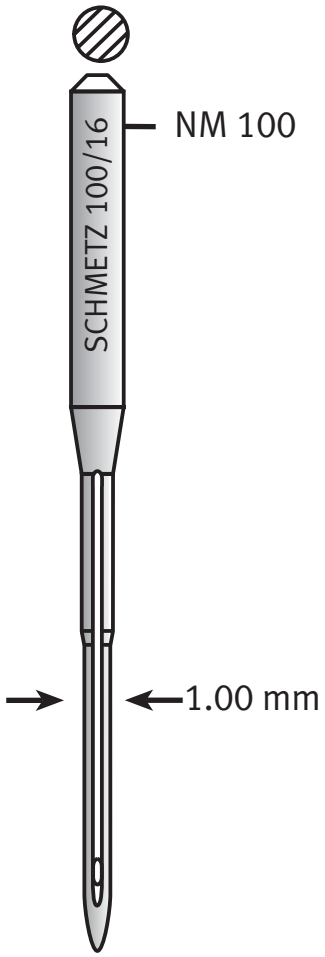
2. Selection of the right needle

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. Every skip stitch, fabric damage or thread breakage turns an airbag into a reject thus lowering the productivity at increasing production costs. Already during the preparation phase of the work it is important to take the influence of the needle and its point style on the quality of the seams into consideration.

The selection of the right needle always has to be done in accordance with the type of fabric, the finishing of the fabric or its surface and the number of layers. But the automobile manufacturers determine the material, the sewing thread and the size of the sewing thread therefore limiting the ability of the airbag industry to select a reduced needle size with a smaller needle eye. Nevertheless it should always be taken care that the thinnest possible needle in SERV 7 version still matching the sewing thread size is chosen.

2.1 Needle size

The needle expands the fabric threads during penetration of the fabric. Choosing a too large needle diameter can result in exceeding the physical tolerance limits in respect to the elongation of the fabric threads. This results in a “bursting” of the fabric threads, that means fabric damage and by this the airbag is turned into a reject. 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

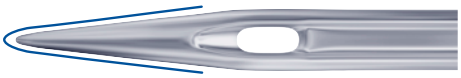
In airbag manufacturing round points or ball points are used exclusively. The use of cutting points would damage the fabric by cutting the fabric threads. This would lead to the result that the fabric would not match the quality demands of an airbag. The point style should always be chosen according to the material, the height of the material and the number of layers.

The normal round point “R” or the light ball point “SES” should be used for the sewing of densely woven polyamide fabrics, depending on the number of material layers and weave constructions.

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 of the airbag fabric is achieved.

R normal round point

SES light ball point



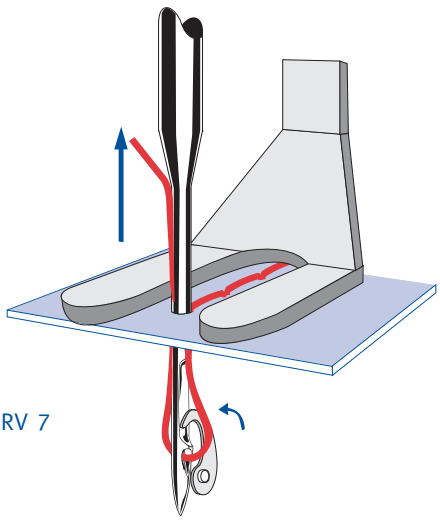
2.3 SERV 7 needle construction

The outstanding sewing requirements in airbag production call for a needle working against skip stitches and needle breakages. Only with a high performance needle quality seams are possible, helping to achieve the goal of a “zero defect” final product.

Varying sewing requirements and different numbers of material layers demand a needle which produces seams of the desired quality without problems. Especially the multi directional sewing in the airbag production requires a special stability of the needle. For this sewing application the SERV 7 needle offers the perfect seam quality.

Skip stitches are a frequent problem in airbag production. Skip stitches occur during stitch formation when the thread loop is not caught by the hook or looper, interrupting the interlocking or interlooping of the upper and lower thread. Skip stitches turn an airbag into a reject during quality control as a skip stitch has a high effect on the strength and appearance of a seam. An airbag with a faulty seam cannot fulfil the necessary safety demands.

SERV 7 is a special needle to prevent skip stitches and needle breakages. This needle type comes in various needle sizes and different point styles. 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”. This characteristic is very important for multi directional sewing as 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:

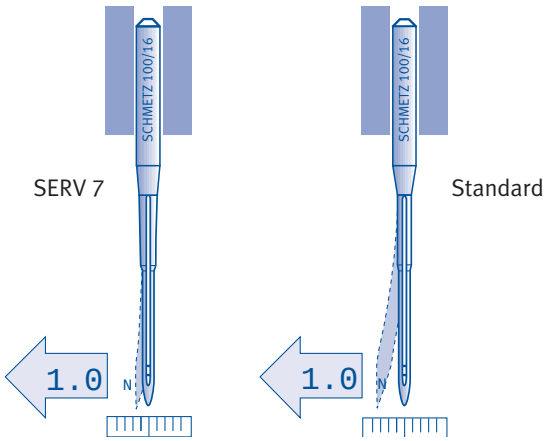
Benefit 1: SERV 7 hump scarf produces optimum loop formation and prevents skip stitches.

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.

SCHMETZ Tip:

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



Sewing thread

3. Selection of sewing threads and stitch parameters

All airbag threads have to be audited in a complicated process according to VDA 6.1, QS 9000 or ISO TS 16949 by an airbag manufacturer before they are allowed to be used. The reason: An airbag has to function as long as an automobile is in use. Its life time is about 15 years.

3.1 Composition and size of the sewing thread

In Europe needle threads made out of continuous filaments of 100 % polyamide are used exclusively. The material pureness of the thread is a rule for many automobile producers (especially) in Europe. The reason for this is the easy recycling of the airbag later on. In America and Asia continuous filament threads made of 100 % polyester are also used.

The polyamide and polyester sewing threads have a high tensile strength, high abrasion resistance and can take high thermal stresses which is of great importance for the longevity and durability of an airbag seam. PA 6.6 threads with a melting point of about 253° C or PA 4.6 threads with a higher melting point of about 285° C are used.

For seams near the generator opening (in and out flow of the airbag) which have to take extreme heat stresses, special heat resistant threads are used. These are for example aramide threads which do not burn but decompose into a kind of ash residue at a temperature of about 370° C.

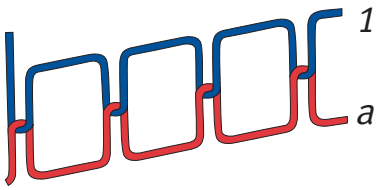
During multi directional sewing operations and when sewing a tight radius (air exit holes of airbag) it is advisable to use bonded sewing threads. The adhesion of the 3 or 4 single strands of the thread creates a closed yarn which does not open. This makes disturbance free multi directional sewing possible. In practice needle threads are always bonded.

Airbag threads are always sewn as a two colour seam, that means: The needle thread has a different colour than the bobbin thread. The stitch formation takes place on the bottom side of the fabric and not as usual, in the middle of the fabric layers. This makes the examination of the correct seam of the sewn airbag possible. The two colours of the threads clearly show the determined stitch formation. The thread size NM 20/3 is mostly used for the needle and bobbin thread. Sometimes the thread size NM 40/3 is also used for the bobbin thread.

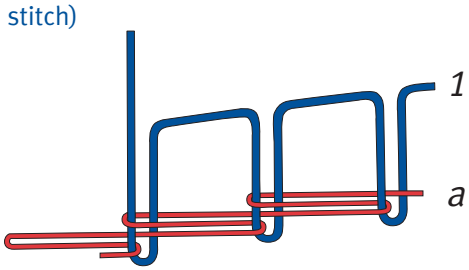
3.2 Stitch type

In airbag production two stitch types are usually used: the double lockstitch (stitch type 301) and the double chain stitch (stitch type 401).
The double lockstitch is optimal as it creates a very safe stitch. If the thread breaks – which may only occur after a few years of storing – the seam does not necessarily open completely in actual use. The seam strength is only slightly reduced. The double lockstitch is mainly used on special sewing machines.

Stitch type 301 – double lockstitch



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



The double chain stitch (stitch type 401) is mostly used on CNC sewing automates as it allows a higher productivity. It is used for example for the closing seams of the airbag.
A combination of these two stitch types can often be seen on two or more needle sewing systems.

3.3 Stitch density

Each airbag producer chooses a different stitch density. The stitch density is dependant on the material, the number of layers, the sewing thread, the stitch type, the position of the seam, the seam strength and the safety regulations of the individual automobile manufacturers.

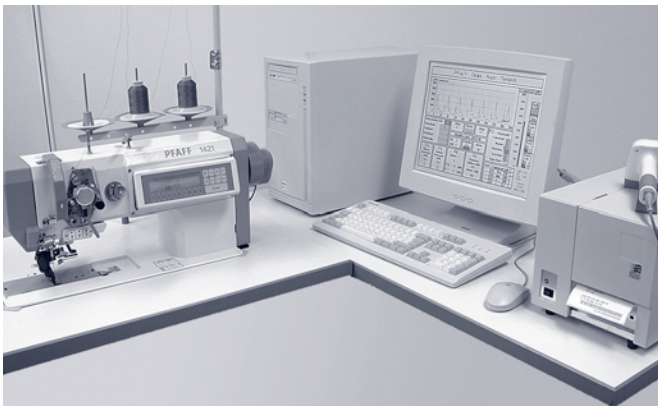
For the closing seams of the driver and passenger airbags 3 to 5 stitches/cm are adjusted. There are certain seams in the airbag production which should rip during the inflation of the airbag with a stitch density of 2 stitches/cm. These “ripping” seams are short seams which divide the airbag into individual compartments. During the inflation of the airbag the seams rip open and cause most of the gas to flow or be transferred to the sides of the airbag first. As a result the impact of the sudden inflation of the airbag is kept away from the passenger in order to prevent further injuries.

3.4 Thread tension

It is impossible to give a general statement on the thread tension in airbag manufacturing. The necessary thread tension always depends on the shape of the material to be sewn, the position of the seam, the sewing thread and the sewing automate. It is adjusted individually on each sewing automate by a technician. The thread tension should be set in such a way that the stitch formation of the needle and bobbin thread can take place perfectly on the bottom side of the fabric.
It is advisable to use a thread tension measuring device in order to create reproducible and pursuable tension values.

SCHMETZ Tip:

SCHMETZ SERVICE**HOUSE** is pleased to assist with any questions on optimizing stitch type, stitch density, needle and sewing thread!



Pfaff 3715 Workstation for documented seams

Source: G. M. Pfaff AG

Machine

4. Sewing machines for airbag manufacturing

In airbag production CNC sewing automates are mainly used. These sewing automates which are produced by leading manufacturers are often reconstructed by specialty machine manufacturers. This is done according to the individual demands of the airbag producer or the automobile manufacturer. For smaller sewing operations manual special sewing machines are used.
The CNC sewing automates run as one or two needle sewing systems, seldom also in three or four needle sewing systems. Special sewing machines are fitted with one or two needle sewing systems. There is an obligation of documentation of the production processes during the airbag production, especially during the sewing processes. For this reason all sewing automates and special sewing machines are fitted with a system for the control and documentation of safety relevant parameters. This makes it possible to notice faults on the airbag, for example thread breakage, skip stitches, end of thread or needle breakage, during production directly. The quality control systems also represent a security for the producer. In case of a complaint it is possible to find out and compare the data of the airbag due to the documentation seam number or bar coding present on every airbag.

Flatbed Sewing Machine — Closing and attaching seams

Free-Arm Sewing Machine — Securing seams of closing seams on round parts

Multi-Needle Sewing Automate — Closing and attaching seams
(without illustration)

4.1 Feed

In airbag production it is important that the object to be sewn and its individual layers of material do not slip out of position. For this reason the material has to be transported smoothly which proves to be difficult due to its surface finish with silicon.

Almost every machine producer has created its own, often patented feed system.
For example:

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

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

4.2 Throat plate/Throat plate aperture size

All sewing machines and sewing automates are fitted with specific sewing accessories for the particular use or the sewing operation for which they are intended. Especially in the special construction of the CNC sewing automates for the airbag production these devices are often patented.

These accessories include amongst others, the type of feed on the machine and the throat plate aperture. The throat plate and the throat plate aperture size are mostly adjusted to the needle size, which can be fitted in the machine, and can be changed if necessary. Care should be taken that the aperture of the throat plate is not chosen too large for the needle size. This causes the material to be pulled into the aperture of the throat plate and as a result cause sewing problems, for example skip stitches, needle breakage or fabric damage.
If the aperture size of the throat plate is chosen too small the needle cannot pass freely which can also lead to skip stitches or needle breakage. This emphasizes that choosing the right sewing accessories and changing them regularly is also an important factor for quality control and a help to avoid sewing problems.

4.3 Sewing speed

As a rule high sewing speeds are not usually reached in airbag production. The polyamide fabric (PA 6 or PA 6.6) or the polyester fabric (PES) can only be sewn undamaged at decreased sewing speeds.
Thermal damage like needle smearing and/or material damage are the result of too high speeds. However undamaged material has the highest priority in the quality assurance of the airbag industry.

In principle 1,000 – 2,100 stitches/min are reached during normal sewing operations. When sewing bends or during multi directional sewing the sewing speed should be decreased, when using CNC automates it can be increased.

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 airbags?
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