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Service&Technology
Information for the sewing industry

# Machine Embroidery

## variety in form and colour

# Machine Embroidery – variety in form and colour

For centuries, embroideries have decorated our clothes and home textiles. What used to be laboriously done by hand, is done by a computer controlled machine today. Due to fast-paced embroidering machine and embroidering program developments of recent years, the expectations and requirements for embroidery threads and its applied technology have grown as well.

Basic influential factors for well-done embroideries:

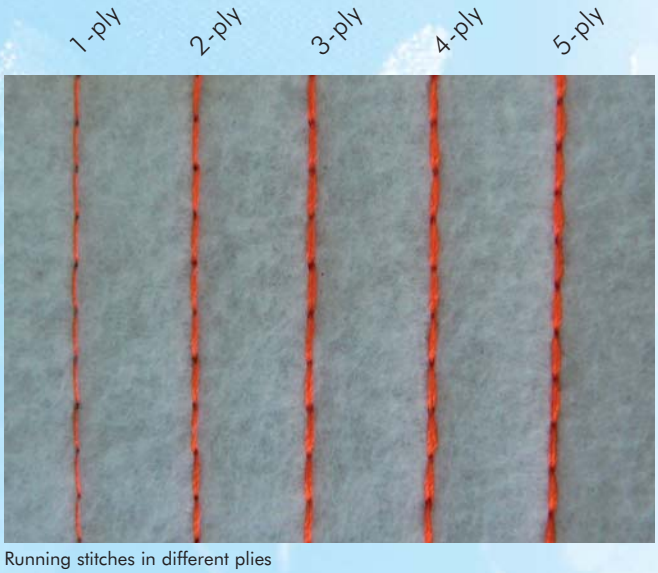
- an embroidery program which is prepared by a digitizer
- the machine and its settings
- needle type and needle size
- embroidery base/backing
- thread

## Digitizer

The digitizer prepares the embroidery programme on the computer by defining colour changes and thread cuts and the movements of the embroidery hoop over x and y coordinates. During programming stage the digitizer considers the product to be embroidered, the thread to be used and the machine type. An embroidery pattern consists of the following stitch types:

### Running Stitch (row stitch)

The embroidery running stitch is the same as the classic two-thread lock stitch of the sewing machine, which means that the individual stitches line up closely and consecutively to each other. The minimal and maximal stitch length as well as the back and forth movement of each individual stitch is defined by the digitizer. One of the most common applications for the running stitch is contouring and stitching fine details on filled areas. Because the running lines are very thin they are also used to connect between embroidered areas to avoid cutting the thread.



Running stitches in different plies

### Satin stitch

The satin stitch is formed by very narrow zigzagged stitching. This type of stitch is very versatile and is one of the most commonly used stitch types. Satin stitches can be either wide or narrow, run straight or curvy. Traditionally the satin stitch has been used for floral motifs, lettering or as a border around filled areas and appliqués. Satin stitches impart the embroidery with a certain type of liveliness when it is stitched in many different directions. This method reflects the most light and emphasizes the lustre of the embroidery thread.


Satin stitch pattern

### Fill stitch

Areas are filled with dense stitching. The needle penetration points are placed in defined intervals and angles from each other and form either a rhythmic or irregular fill pattern. The distance between the individual stitch lines designates the stitch density. For a complete coverage of the cloth, stitch density must correspond to the thread diametre. Different patterns called stencils provide the fill stitches with structure, for example a basket braiding pattern or a diamond pattern. In most punching programs stencils may be selected by a mouse-click.

Structured fill stitch

## Underlay stitching

Underlay stitching is done before being covered by cover stitches (= satin stitches or fill stitches) in a design. The underlay stitching is usually a running or satin stitch. They are not directly visible but provide stability, volume and exact contours for the embroidery and provide a neat embroidery image. Underlay stitching can have these three functions: Firstly, to lend stability to the cloth and prevent the cloth from stretching providing therefore better embroidery. The second function is to provide a base for the cover stitches, which will then appear more voluminous on the fabric. The third function is the creation of denser appearing embroidery. Satin stitches look sharper and thicker. Calculating the right amount of underlay stitching and corresponding density is important. Basically, the direction of the underlay stitching should be at a different angle than the intended cover stitching to balance out fabric stretch and to avoid single stitches from sinking in.

# Following information is required by the digitizer to achieve best results:

## Size of the finished embroidery

Width and height (x and y), since faxed or emailed templates can lead to inaccuracies. Often text templates are too small or the sketch has far too many details for the intended pattern size. In such a case, details must be simplified.

## Final product and application areas

- The choice of the stitch is directly connected to the later use: Long stitches make a glossy and posh look – but are not suited for heavy handling (work clothes, denim jeans, back of jackets or coats, bags).
- For embroidering caps, the pattern should be punched from the centre towards the sides in order to minimise stretch on the cylinder frame. Correspondingly, embroidery is done from the centre to the outside.
- On fabrics with regular structures (for example twill, cord or denim), the main embroidery direction should not be parallel to the structure but at an angle.

## Embroidery material

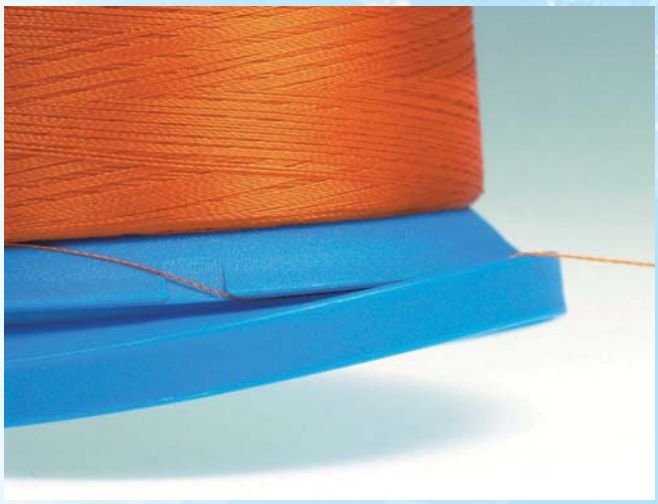
- The underlay stitches are determined by the material to be embroidered. Otherwise, with structured surfaces there is the risk that stitches submerge and the finished embroidery is uneven.
- In the case of embroideries where the backing is removed afterwards (heat or water backing fleece or film), underlay stitching must also hold the embroidery together.
- Stitch density must be higher with contrast colours than with similar toned colours.

## Number of colours and needles

- The number of needles of a machine determines how many colours can be used in a pattern.
- Fewer colours mean shorter setup times and lower logistics costs.
- Various effects can be achieved with one colour only by stitching in different directions and overstitching with a looser stitch density.
- If the colour numbers are determined early in the punching process, these can be directly assigned to specific needle positions.

## Thread size / thread quality

- The standard thread size for machine embroidery is 40.
- For extremely small lettering (manageable up to a size of 2 mm height) AMANN's article Serafil is advisable in the tickets 120/2 and 200/2, corresponding to the embroidery tickets 60 and 75.
- The intended look and the mechanical stress that is expected for the finished part determines the thread raw material (for example polyester, cotton, viscose or metallic thread).
- AMANN's durable ISACORD is universally suitable for all embroidery applications. By ISACORD's multi-tasking properties, it is possible to run all embroideries with only one type of thread. Locked capital is reduced to a minimum by this. The snap spool gives further possibilities for savings; it prevents the thread from falling off the spool while being stored.
- For high-fashion and very shiny embroideries AMANN offers the classic ISAFIL as rayon line. ISAFIL is a well performing viscose thread with the desired sparkling shine and most brillant colours. It is made-up on snap spools as well.



Thread storage with the snap groove

# Embroidery machine

Production requirements determine the size of the embroidery machine. All stitches in machine embroidering are produced by movements of the embroidery hoop under the needle. The computer moves the embroidery hoop (as programmed in the embroidery program) in the x and y direction through servo-motors. Stitching speed is variable and can be controlled as required.

Components of the machine are:

## Embroidery head

- So many (identical) embroideries can be produced at the same time. The greater the amount of heads, then more the number of needles will be moving at the same time.
- There are machines with one head only (for samples, low-volume series and for domestic application). Multi-head machines are available from 2 to more than 50 heads.

## Number of needles per embroidery head

- The number of needles per embroidery head determines how many colours can be stitched in one pattern without re-threading the machine.
- The more needles there are, the greater the designers' and the digitizers' freedom of design. However, this increases the changeover times (in the case of model change) and cost (for logistics and the embroidery thread management).
- The number of needles varies between 1 and 18.
- To reduce changeover times it may be practical to have standard colours that will be used in most patterns (for example black and white), and to assign standard needle positions for those colours. These need not be changed in case of a pattern change.

## Embroidery hoop

- The individual embroidery hoop should be as small as possible to minimize warpage through fixing and embroidering. The material must be tightly clamped in the frame without creases. Elastic and fine materials should be stabilized with backing prior to fixing in the frame.
- For caps there are special cap frames. The cap frame moves in x direction following a circular path (according to the shape of the cap) so that the needle penetrates the material at a right angle always and that the cap is not distorted through fixing in the frame.
- Border frames are used mostly for larger size embroideries and embroidered emblems.

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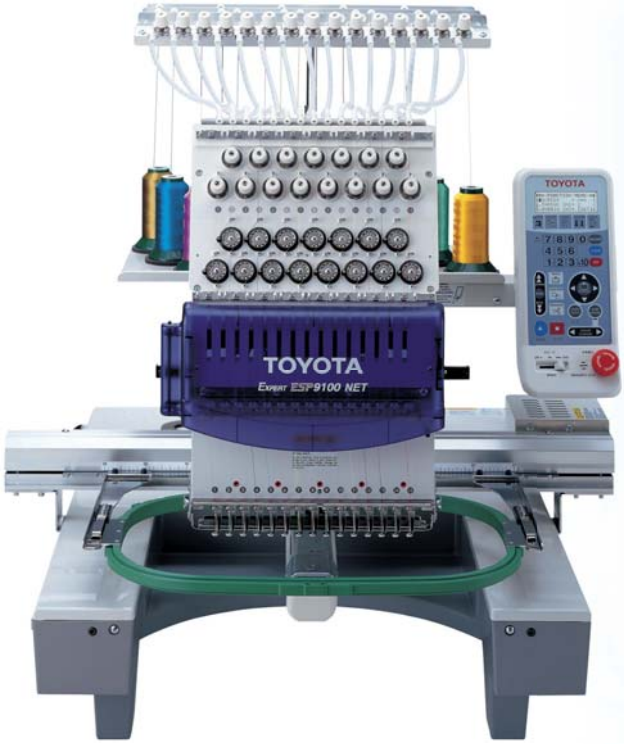
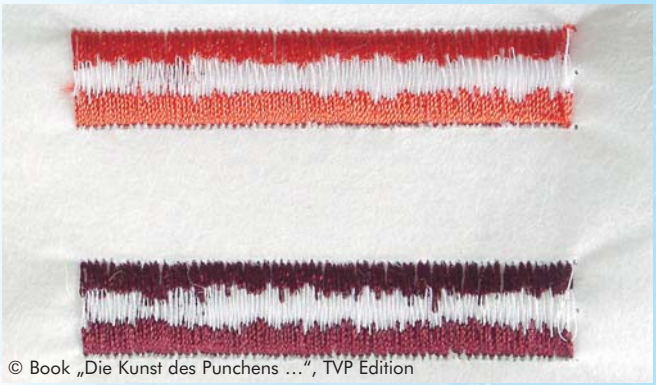



© Toyota

## Setting the thread tension

- The needle thread tension is set through the tension controller on the machine head. The bobbin thread tension is controlled through the tension spring on the bobbin case.
- The needle thread and bobbin thread tensions must correspond with each other. An even look is achieved if the bobbin thread covers about 1/3 of the width of a satin stitch.
- Well balanced thread tensions can easily be transferred to other needles with the help of a tension meter; this leads to a consistent look with all colours.



© Book „Die Kunst des Punchens …", TVP Edition

Check of the threds tension: 1/3 of the satin stitch should be visible as bobbin thread

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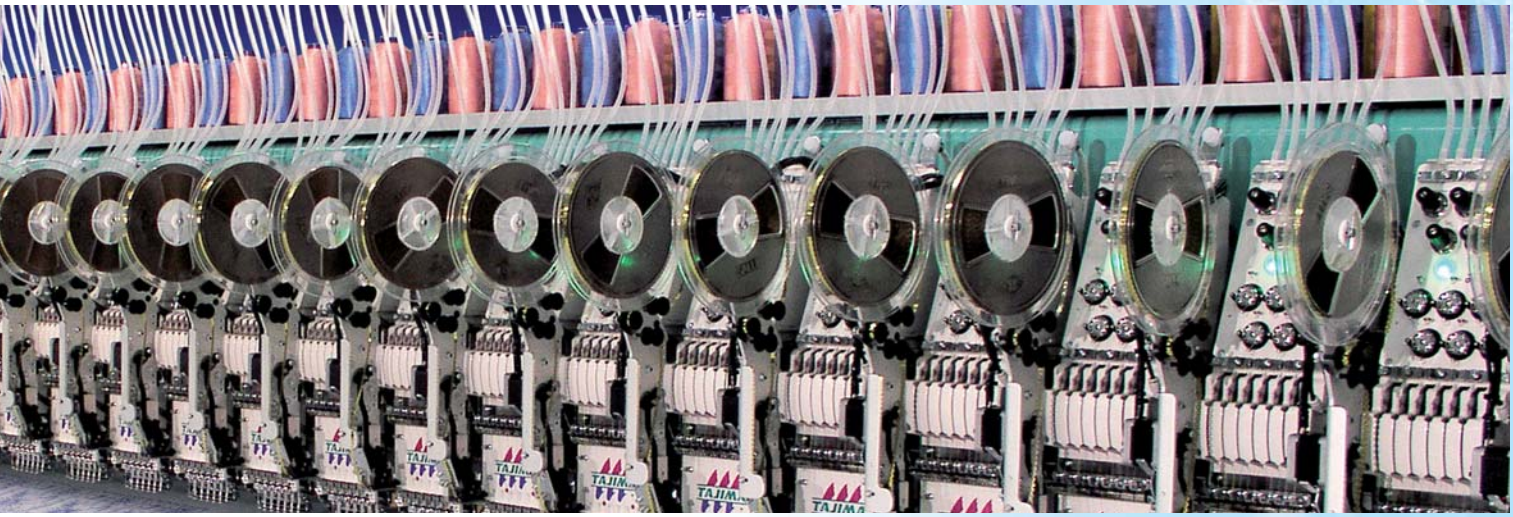


# Embroidery needles

The embroidery needle can have high effect to the quality, however in practice it has not been given enough attention. Only the best quality products should be used that are fitting to the machine type, ticket of thread and embroidered material. The needles should be regularly replaced because over time they become blunt and the eye can get rough.

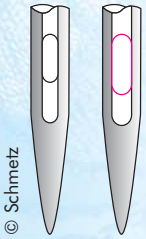
The needle is defined by the following parameters:

- Needle system
- Needle point
- Needle size

DBxK5 is an established standard system (except for Fortron) for embroidery machines. The two numbers' larger eye in relation to the needle size as well as the larger groove profile results in an easier and gentler transmission of the thread. An optimized hollow profile prevents skip stitches. A thick shaft affects a greater bend-resistance and therefore less needle breakage. Manufacturers offer additional shapes for special applications.

## Special embroidery eye

This eye is two sizes larger, for example a needle size 70/10 has the eye of a needle size 90/14. The size of the eye is 2 numbers larger in relation to the needle size.





The optimal point of the embroidery needle should be for universal applications. On the one hand, the needle point should avoid pricking the material thread and provide maximum protection for the embroidery base. On the other hand, the point has to very precisely work the outlines and favourably influence the embroidery. If the incorrect point form is utilized, then you risk damage to the material, such as for instance broken meshes. Uneven outlines of embroidery are often caused by the needle. Basically, there are 3 needle point shapes that are roughly assigned to the following applications:

Round point: Fabric and leather
Ball point: Knitted and woven fabrics
Cutting points: Leather (make sure to reduce the stitch density in order not to perforate the material).

The needle size is given in Nm (Number metric). Nm indicates the diameter of the needle or the shaft (diameter = Nm/100 in mm). The measurement is taken directly above the eye. The needle size must correspond to the material and yarn you intend to embroider. It should on the one hand be as small as possible to prevent damage to the embroidery base, and on the other hand as big as required to prevent skip stitches and thread breakage. If the material is damaged during embroidering, try and user a smaller needle size because the needle size has a greater influence than the needle point.

The following table serves as a needle guide for various materials and embroidery thread thicknesses.

| Material | | Needle size | | Needle point |
|---|---|---|---|---|
| | | Nm | Size | |
| RG | **Knitwear** | | | |
| | Knitted ware/woven fabric, jersey | 65 – 80 | 9 – 12 | Medium ball point |
| | Finely knit goods | 65 – 80 | 9 – 12 | Small ball point |
| FFG | **Woven fabric** | | | |
| | Fabrics for shirts / blouses | 65 – 80 | 9 – 12 | Medium ball point |
| | Denim | 70 – 85 | 11 – 13 | Medium ball point |
| | Terry cloth | 70 – 85 | 10 – 13 | Medium ball point |
| | Micro-fibre | 65 – 75 | 9 – 11 | Normal ball point |
| | Silk | 65 – 75 | 9 – 11 | Medium ball point |
| R | **Leather goods** | | | |
| | Coated, stabilised materials | 65 – 80 | 9 – 12 | Sharp ball point |
| | Coated materials / synthetic leather | 70 – 85 | 10 – 13 | Sharp ball point |
| | Fine leather goods | 70 – 85 | 10 – 13 | Sharp ball point |



| Thread size | Needle system DBxK5 recommended needle size | |
|---|---|---|
| | Nm | Size |
| Thread size 12 (wool) | 80 – 100 | 12 – 16 |
| Thread size 25/30 (viscose, cotton, metallic) | 75 – 90 | 11 – 14 |
| Thread size 40 (polyester, viscose, metallic) | 70 – 80 | 10 – 12 |
| Thread size 50 (cotton, metallic) | 70 – 80 | 10 – 12 |
| Thread size 60 (polyester) | 65 – 70 | 9 – 10 |
| Thread size 75 (polyester) | 60 – 65 | 8 – 9 |

## Backing material

Almost any material can be embroidered better if the material is stabilised with backing material. Embroidery distortion is reduced if backing material is used. All loosely woven materials require backing to make clear and even outlines. Otherwise, the stitches would adapt to the material structure. There are different variations of embroidery backing materials:

### Tear away backing

This backing material is used mainly for woven fabrics and for strong knitted fabrics. It can be fixed to the material with a temporary adhesive (which reduces warpage even further) or just fixed in the frame together with the fabric. And as the name suggests: Remaining backing parts can be torn away after embroidering. Also on delicate materials, only the backing needs to be fixed in the frame for embroideries. The material to be embroidered is then fixed to it with temporary adhesive; this prevents frame marks on the material.

© Freudenberg

### Cutaway backing

Cutaway fleece is mainly used to embroider knitted goods in order to prevent mesh damage while tearing off the fleece. The left over fleece is cut off after embroidering, for example with dressing scissors (with rounded tips) or with a seam cutter (where one side is protected by a ball to prevent cutting the material).

© Schneider-Wohlenberg

If regular scissors are used the material might get damaged by the tips. Also, the cutaway fleece can be fixed to the material with a temporary adhesive. And the way of fixing only the backing in the frame works just like with the tear away backing.

### Fused backing

This is available as non-woven, woven or knitted lining. Fused backing is especially recommended for very small embroideries and extremely thin fabrics. It is practical with all turned over or lined articles that are embroidered before they are sewn because the interlining also is a suitable embroidery base.

### Water-soluble backing and films

Water-soluble stabilisers can be used everywhere where any balance of the embroidery backing has to be avoided. Excess backing is trimmed off after embroidering and the remaining backing (also under the embroidery) dissolves completely during laundering. This type of backing is also good for embroideries that are to be especially pliable. Usually, water-soluble fleece is used as backing and a film is used to cover tuft materials in order to prevent stitches from sinking in.

### Heat soluble films and gauze

Materials of this type are primarily used in lace embroidery without base materials. After the embroidering process, the lace is heat treated; high temperatures cause the backing materials to turn to ash and can be shaken or brushed off. Embroideries for this type of application must be digitized "joined", otherwise they will loosen after the embroidery base is removed.

### Filmoplast

Filmoplast is a user-friendly combination of backing and adhesive. Filmoplast is fixed in the frame alone, the protective film is removed as necessary and the material for embroidering is stuck to the remaining adhesive backing. This allows clean and easy working, especially if ready made garments are embroidered. After embroidering, the embroidery is torn off from the adhesive backing and the resulting hole can be closed with a patch of Filmoplast. So, the framed Filmoplast piece can be reused several times.

# Embroidery thread

Which embroidery thread is used depends on requirements with regards look or performance characteristics of the finished embroidery. No matter what you would like to embroider, the AMANN embroidery thread range offers convincing solutions:

## ISACORD 40

ISACORD 40 is the universal and extremely reliable embroidery thread made from trilobal polyester. It is suitable for all embroideries (such as T-shirts, shirts, pullovers, jeans and caps); especially recommended for applications with very demanding chemical and mechanical stress (i.e. work and rental wear or towels). ISACORD is available in 390 solid and 12 multi colours.

## ISAFIL 30 and 40

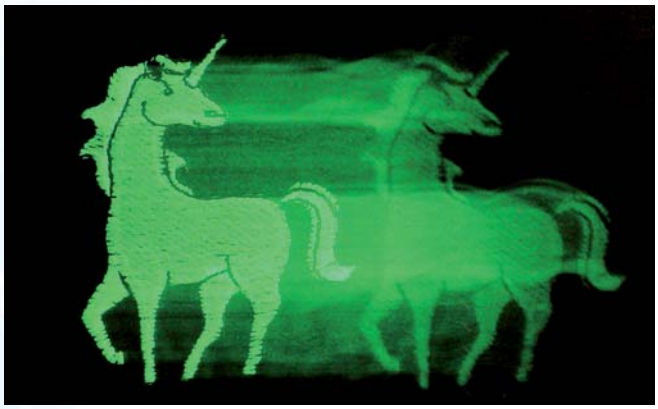
ISAFIL, AMANN's viscose embroidery thread, is characterised by its brillance and good performance on the machine. It can be used for all embroideries where lively colour appearance and high shine are requested - e.g. ladies' wear or laces. Embroideries made with viscoes thread are mechanically less stressable than those made with polyester. Neither are they chlorine fast. Currently ISAFIL is availabe in 110 colours.

## ISAMET 40

ISAMET is a metallic embroidery thread based on a polyamide core which is wrapped with a band of polyester foil. It is often used for embroideries on uniforms but also as brilliant accents in all other embroideries. The range of 35 colours includes not only gold and silver tones but also coloured and mixed variants. Worth mentioning is ISAMET New, which combines metallic shine with a rainbow luster.

## ISA TEXLIGHT

This effect thread glows in the dark! A glowing detail in embroideries on clothes worn in bars, lounges or clubs.



## Serafil 120/2 and Serafil 200/2

Serafil is specifically suited for filigree embroideries with tiny details. Where small lettering and detailed monograms are needed, this polyester embroidery thread provides the necessary fineness – combined with unlimited stitchability. Serafil 120/2 corresponds to embroidery thread size 60, Serafil 200/2 to embroidery thread size 75. Serafil 200/2 can even be embroidered with a needle size 55 and is therefore made for finest embroideries. Serafil is available in 72 colours.

Smallest fonts with Serafil 120/2 and 200/2

## N-Tech CS 80 and N-Tech CS 70

This thread made from DuPont™ NOMEX® is flame-retardant and self-extinguishing, common requirements in the petrochemical industry. Through the higher diametre – which corresponds to an embroidery thread size 30 – less stitches than usual are necessary. The bobbin thread – which of course must be flame-retardant as well – is a finer size, which pays off with a larger spool capacity. The N-Tech CS 70 colour range includes 14 colours.


Our sewing threads can be used for embroideries as well, for example if a dull effect or a textile look are intended.

## Rasant 75 and Rasant 120

As embroidery, this cotton corespun shows a dull, slightly woolly surface. Size 120 corresponds to embroidery thread size 40, size 75 to embroidery thread size 25. This size produces some beautiful rustic effects which are extremely resistant and durable. Rasant 75 is available in 139 colours, Rasant 120 even in 285 colours.

## Saba$^{C}$

An outstanding colour variety (for example 475 colours for ticket no. 80 and 120) and a wide size range make Saba$^{C}$ the all-rounder among our threads. Depending on the digitizer, it can produce a rough look similar to hand stitching, but also extremely detailed wide-spread embroideries with a non-glossy surface, representing animal furs for example. This polyester core-spun thread is chlorine proof and stable to boiling.


Rasant


Saba$^{C}$

## Bobbin Threads

AMANN offers a suitable bobbin thread for every application. Depending on technical demands or personal preferences you may choose from a large variety.

### ISA 150 and ISA 180

Both threads have been specially developed for the use as self-winding bobbin thread for embroideries. They have an attractive price and are available in colours white and black.

### ISABOB

ISABOB is a pre-wound bobbin thread on bobbins size "L" as it is used on most embroidery machines. Time and money savings are possible through the elimination of the work step "self-winding", the even unwinding flow and higher bobbin run lengths compared to self-wound bobbins.

### Saba$^{C}$ 150

Whenever a colour matching back side of an embroidery is required, Saba$^{C}$ 150 is used. This well-developed and trusted thread from the sewing thread range is available in 475 colours. It can perfectly be used as bobbin thread fro machine embroideries.

# Embroidering tips in brief

| Problem | Cause | Suggested solution |
|---|---|---|
| **Thread breaks** | Needle thread tension too high | Reset needle thread tension, 125 cN is considered as standard value for general embroidery work |
| | Wrong or incompletely threaded | Check thread path and correct if necessary |
| | Thread guiding elements have sharp edges or show burrs | Polish thread paths |
| | Hook shows burr (caused for example by hitting needle) | Polish hook |
| | Stitch density too high/too many stitch layers on top of each other | Change stitching program and punch less densely |
| | Stitching speed too fast for large stitches | For especially long stitches reduce machine speed |
| | Insufficient thread quality | Use branded threads featuring a high tensile strength such as ISACORD or ISAFIL |
| **Thread jam at the needle** | Needle size too small, eye too small | Use thicker needle, use DBxK5 system needle with a larger eye in order to keep the needle size as small as possible |
| | Unfavourable stitching direction (for example satin stitch backwards) | Reverse stitching direction with underlay stitches if necessary |
| | Poor thread quality | Use brand threads such as ISACORD or ISAFIL |
| | Embroidery base material weaved or knitted very tight | If possible punch longer stitches or use a stronger needle |
| **Skip stitches** | Needle defective (bent) | Replace needle |
| | Incorrect needle size | Select needle size to match the material to be embroidered and the thread. If the needle eye is too big in relation to the thread size, skip stitches may occur. |
| | Needle not set correctly | Check fit of needle. The needle must be fully inserted to the needle bar and must be threaded vertically from front to back (twelve o'clock position). |
| | Threading path incorrect | Check if correctly threaded and if a thread loop may have been caught somewhere. |
| | Unfavourable stitching direction on difficult base material | First try and rotate pattern and base material by 90°.<br>If necessary, change stitching direction of fill and satin stitches in digitizing program. |
| | Hook setting incorrect | Adjust hook (or have adjusted) so that the tip of the hook can safely take up the needle thread loop. |
| **Material damage** | Needle (point) broken | Replace needle |
| | Wrong needle form used | Select needle point according to material. |
| | Stitch density too high for material/too many stitches in the same place | Reduce stitch density, work with shorter stitch lengths on inner radiuses, offset penetration points. |
| **Loopiness** | Thread tension too low | Increase thread tension. |
| | Stitch length too long | In punching program, set maximum stitch length correctly (usually no more than 7 mm). |
| | Unfavourable stitching direction (for example diagonally backwards) | Reverse stitching direction, if necessary with additional underlay stitches |

| Problem | Cause | Suggested solution |
|---|---|---|
| **Material around the embroidery shows puckering** | Embroidery hoop too big | Use smallest possible embroidery hoop |
| | Woven material not fixed sufficiently | Material + backing must be clamped tight like a drum |
| | Knitted fabrics were stretched for fixing in the frame | For knitted fabrics only the backing in the frame and then fix the material it by using a temporary adhesive avoiding distortion |
| | Fleece not firm enough | Double thin backing or use more stable backing |
| | Fabric warps despite fleece | Bond fleece and fabric with a temporary or permanent adhesive in order to further reduce warpage. |
| | Thread tension too high | Check needle thread and bobbin thread tension. |
| **Uneven embroidery** | Unfavourable stitching direction (for example diagonally backwards) | Change stitching direction (either by punching or by framing and embroidering the material offset by 90°). |
| | Stitch length too long or too short | Adjust minimum and maximum stitch length in punch program. |
| | Stitch density and thread size do not match | Select actually used thread size in punch program or adjust stitch density accordingly. |
| | Underlay stitches missing or do not fulfil their purpose | Check underlay stitches in punch program. Contour underlay stitching is recommended for letters while frame-type underlay stitching is recommended for areal embroideries.<br>Note: false underlay stitching is worthless. |
| | Stitches sink into the material (for example terry cloth, velour or velvet) | Applying a water or heat soluble film to the top side prevents the stitches from sinking. |
| | Thread tension balance incorrect | Reset thread tension. In a row of satin stitches, the bobbin thread should cover 1/3 of the width of the stitch. |
| **Asynchronous embroidery (outlines)** | Too much warpage of material in embroidery hoop | Improve framing method |
| | Warpage not considered in punching process | Apply warpage compensation in punch program |
| | Hoop has loosened | Tighten frame screw further, wrap frame with textile tape for more stability |
| | Punching fault | Check punching program on the computer (for example if the outline segment can be offset completely). |
| **Stiff embroidery** | Backing too stiff | Use thinner backing or less layers of backing. |
| | Stitch density too high/thread too thick | Match stitch density and thread size. |
| **Annoying markings from frame** | Frame too even/too hard for material | Wrap inner hoop with textile tape.<br>Slight markings can be removed with steam. |
| | Delicate material (for example tuft fabrics) | Work with temporary adhesives or Filmoplast so that the material itself needs not be framed in the hoops but only the backing. |

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