KARL MAYER

Net Textiles

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Contents

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PRODUCTION OF TEXTILE NETS

Textile nets have a wide range of end-uses. One of their main uses is to protect against adverse weather conditions, in which case, the nets are constantly subjected to many different climatic effects. This has led to the development of many new applications, both inside and outside. Warp knitting technology offers a wide range of possibilities for producing nets, which no other technology can match.
Alongside weaving and weft knitting, warp knitting is widely used to produce textile substrates for a variety of applications. Warp-knitted fabrics may be elastic or dimensionally stable, they may have open or dense constructions, and may have fine or coarse structures. They can be produced as flat, tubular or three-dimensional textiles in widths of up to six metres and above. Besides the exceptional width of the nets, another advantage is that the design of the nets can also be varied extensively, depending on the knitting process used and the construction.

Warp knitting technology enables the individual products to be adapted to suit specific requirements. All the machines can produce single or multiple webs, and it is not longer necessary to carry out costly making-up processes.

The many possibilities available for producing the nets will now be presented. An overview will be given of what warp knitting technology can achieve in terms of net production. The main processing factors and the end-uses will also be described. In addition to information on the actual products, important aspects relating to production and the basic constructions will also be presented by way of a short introduction.

REVIEW OF THE PRODUCTS

Nets for the agricultural and leisure sectors

Olive nets
Shade nets
Harvesting nets
Growing nets
Anti-bird nets
Mosquito nets
Wind-breaks
Anti-hailstone nets
Sun-screens
Privacy screens
Hay-baling nets

Packaging nets

Pallet nets
Circular bale nets

Protecting, safety and universal nets

Safety nets for buildings
Nets for protecting against rock falls
Catch nets
Container nets
Automotive nets

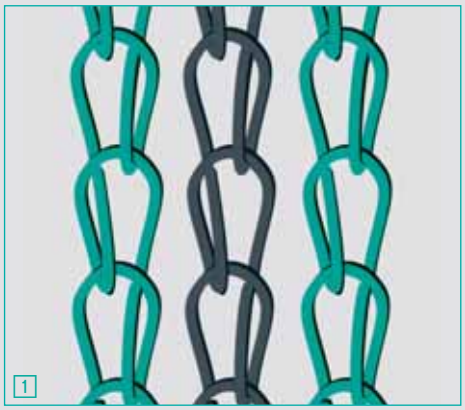
Sports nets

Goal nets
Tennis nets
Volleyball nets
Table-tennis nets
Catch nets
Nets for dividing-up sporting facilities
Screens for sporting facilities

Nets for the fishing industry

Fishing-nets
Nets for fish-farms

BASIC NET CONSTRUCTIONS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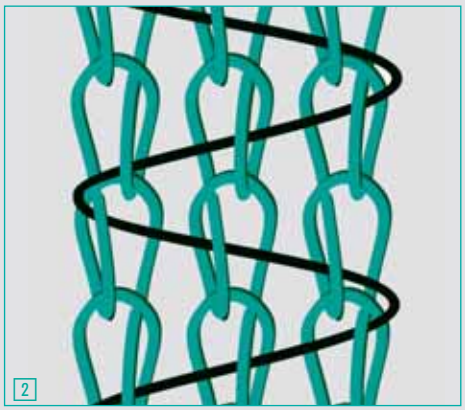
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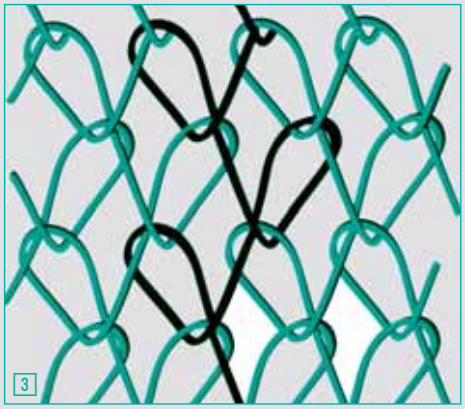
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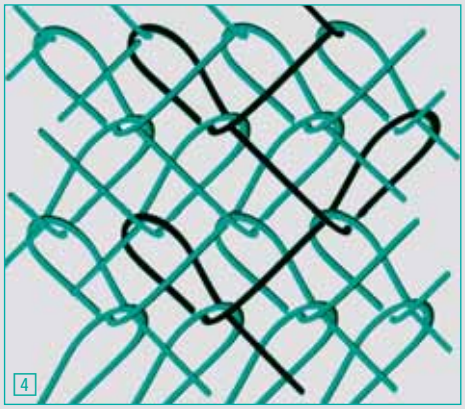
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The specific characteristics of each net will depend on a number of interdependent factors:

- the lapping
- the number of guide bars used
- the machine gauge
- the yarn threading arrangement
- the stitch density
- the type of yarn

The following characteristics of the nets can be varied by altering these parameters to suit the intended end-use::

- the level of shade provided, or sun-protection factor
- the wind permeability
- the opacity
- the stability, or elasticity, in the lengthwise and crosswise directions

Most of the nets produced on single-bar raschel machines are produced by a pillar stitch-inlay lapping or by other simple basic constructions. The loops in the various lappings can be processed so that they are open or closed. Some of the most frequently used basic lappings are:

Pillar stitch
A pillar stitch construction is the first choice for producing the nets, and it is the most frequently used lapping when manufacturing nets. In most cases, the pillar stitch is responsible for ensuring that the nets have the required lengthwise strength and stability. To produce a textile substrate, the pillar stitch construction must be combined with an inlay lapping or one of a number of other lappings (Fig. 1).

Inlay (weft)
As with the pillar stitch lapping, the inlay cannot produce a textile substrate on its own. The inlay is responsible for maintaining the crosswise stability, and can join two, three or more stitch wales together. As a general rule, the more wales that are joined together in an underlap, the more stable is the fabric (Fig. 2).

Tricot
The basic tricot lapping is produced by sideways shogging of the guide bar in relation to the adjacent needle. When worked without any additional guide bars, this lapping produces an elastic fabric. Because of its own high elasticity in the lengthwise and crosswise directions, the tricot lapping is seldom used for producing nets, unless an additional guide bar is used (Fig. 3).

2 x 1 lapping
As with the tricot lapping, the 2 x 1 lapping joins together adjacent wales. Unlike the tricot lapping, the next loop is not produced on the adjacent needle, but on the next but one needle. The same principle applies to all the other stitch lappings, with the exception of the pillar stitch construction (Fig. 4).

Combining these lappings produces a wide variety of different fabric characteristics and two, three or more lappings can be combined. This enables the specific characteristics of a product to be varied extensively.

PRODUCTION OF THE NET OPENINGS

Net openings having a variety of different sizes and shapes can be produced in a number of different ways, in which case, the choice of gauge, construction and stitch density are decisive factors in determining the shape and size of the openings.

Another factor is the yarn threading arrangement into the guide bars. This does not necessarily have to be identical to the machine gauge. Because of the many possible end-uses, threading arrangements of 1 in, 1 out, 1 in, 2 out, etc., are often used for these types of products. The advantage for the manufacturer is that a wide range of products can be produced on one machine, without having to carry out any time-consuming changeover procedures.

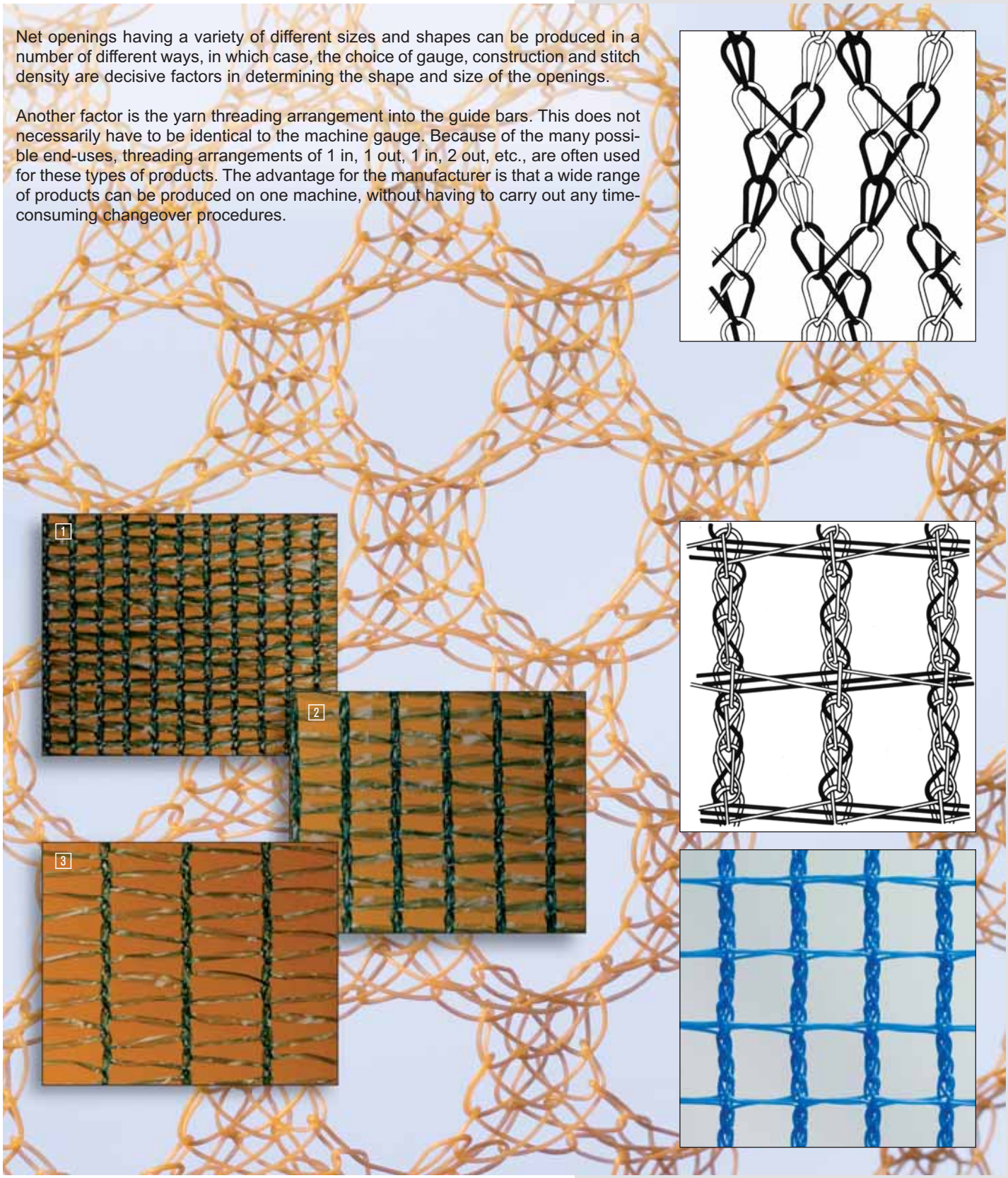


Fig. 1: Fully threaded, Fig. 2: 1 in, 1 out, Fig. 3: 1 in, 2 out

INCORPORATION OF FUNCTIONAL ZONES

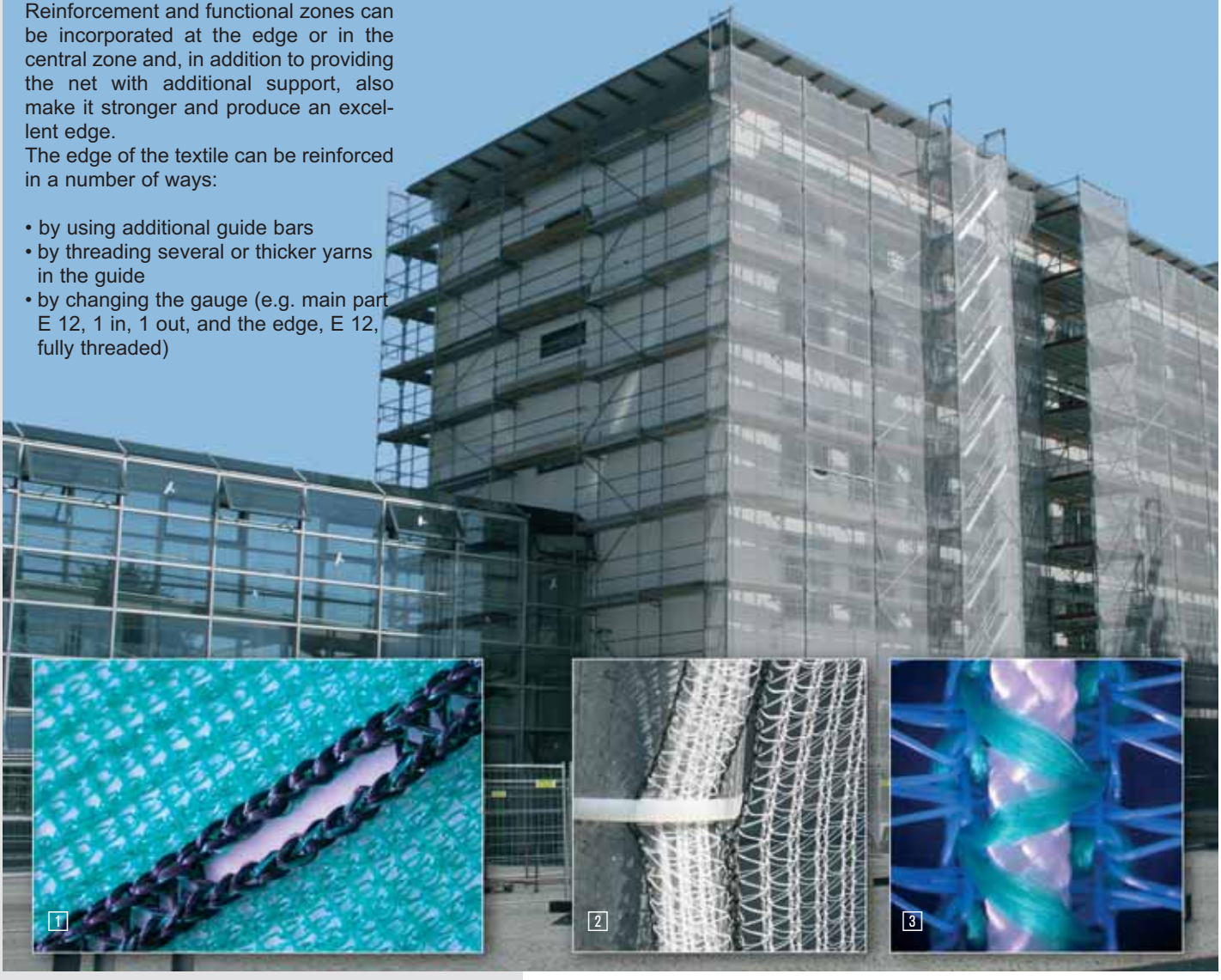
In order to improve handling and to join individual webs of net together, the knitting operative can incorporate different reinforcing strips and edgings, depending on the machine's features. These include eyelet-holes or straps, which may be located at the edge or in the middle of the net. They are usually incorporated in the vertical direction, but may sometimes be worked in the horizontal direction as well.
The functional zones in the nets can be varied and produced in a number of different ways. The three main types and their possibilities will now be described.

Reinforcing strips and functional zones
Reinforcement and functional zones can be incorporated at the edge or in the central zone and, in addition to providing the net with additional support, also make it stronger and produce an excellent edge.
The edge of the textile can be reinforced in a number of ways:

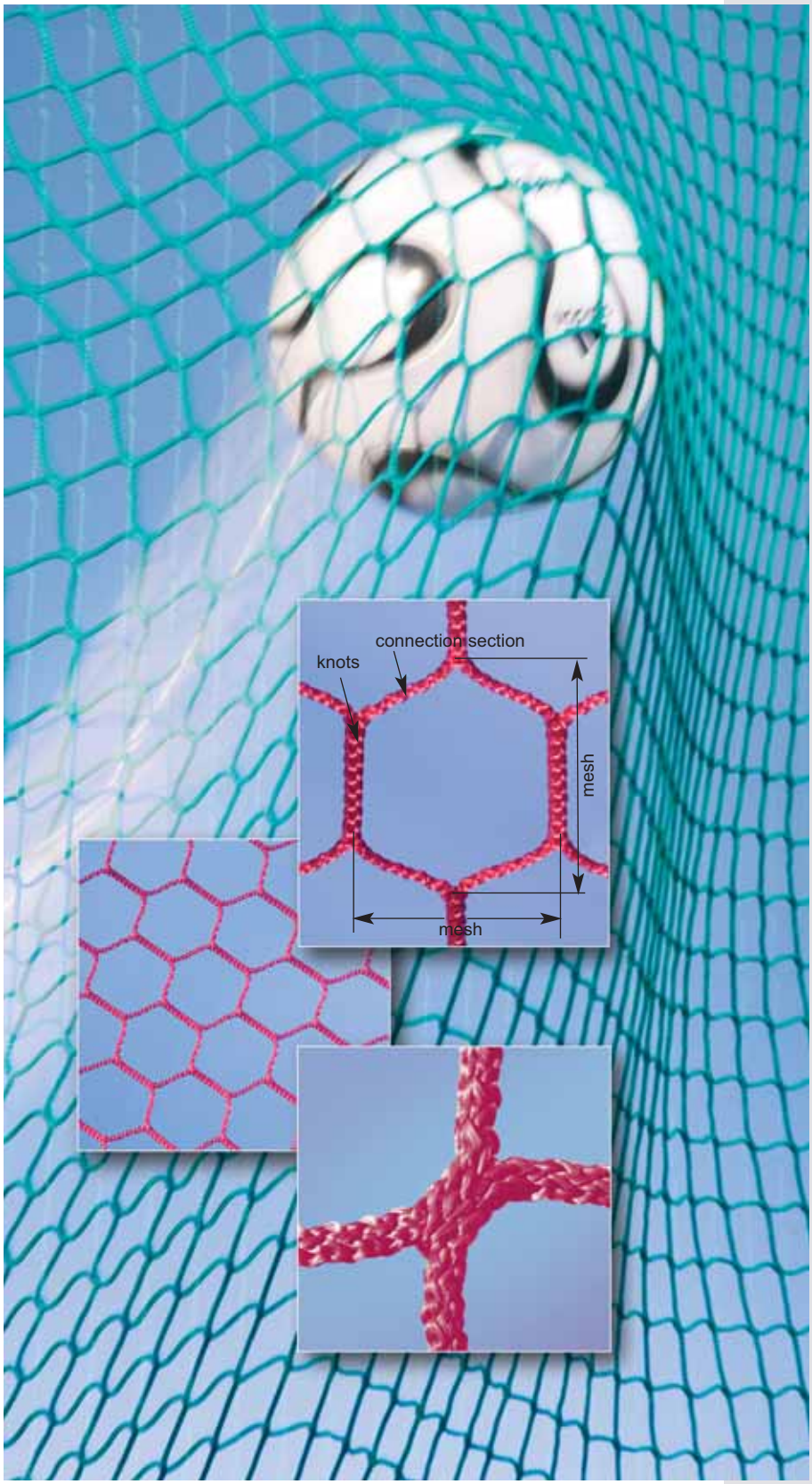
- by using additional guide bars
- by threading several or thicker yarns in the guide
- by changing the gauge (e.g. main part E 12, 1 in, 1 out, and the edge, E 12, fully threaded)

Straps
Straps (draw strings) usually run as zero inlays (filler thread) into the net during the knitting process, and are fixed in place between the underlaps of the other guide bars. These straps stabilise the nets once they have been erected, and can also be used for subsequently incorporating steel wires, cords or similar materials (Fig. 3).

Eyelet holes (buttonholes)
Various lappings can be used to work the eyelet constructions. They can be formed using loop or inlay lappings and by using one or several guide bars. The length of the eyelets and the distance between them can be increased or decreased by adjusting the lapping, and the width of the openings is determined by the threading-in arrangement and the lapping.
These additional possibilities enable the eyelet strips to be designed to suit specific applications, and the distance between the holes can be adjusted to suit the particular end-use of the net. Nets for covering scaffolding are one example of this type of net. The eyelet holes in the net are knitted-in so that they correspond to the distance between the scaffolding supports, which enables the nets to be accurately mounted and fixed to the supports (Figs. 1 and 2).



KNOTLESS NETS



The difference between knotless and knotted nets

Nets produced on warp knitting machines are 'knotless' constructions. The single- or double-bar raschel machines used to produce these nets process the yarns directly from a warp beam to produce the net. In this case, all the yarns are processed vertically into the connecting sections. The guide bars are moved to the adjacent connecting section at specific intervals, which produces the joint or so-called 'knot'. An examination of the net shows a textile having a uniform thickness, without any bumps in the 'knot section'. Consequently, this has given rise to the term, 'knotless nets'.

On the other hand, knotted nets are produced by knotting yarns that have already been twisted together in a specific cycle to form a net. The connecting sections and joining points (knots) can be varied, depending on the size of mesh required. Any adjustments are made via the lapping. This knitting technology allows the knitting operative to easily lengthen or shorten both the knots and the connecting sections for the same yarn use. The weight changes slightly when the size of the mesh is changed.

The width of warp-knitted nets is always specified along with the number of mesh openings in the net, since the maximum span width of the nets will vary according to the size of the mesh and the relationship between the knot length and the length of the connecting sections.

The characteristics of knotless nets

- a smooth textile surface is produced by the way in which the loops are joined together. This results in low energy expenditure when the net is used for fishing, since the flow resistance is low
- the size of all the mesh openings is exactly the same, and the joining points are completely slip-resistant
- good abrasion resistance, since no knots protrude from the surface
- no finishes are required, since the joining points are completely stable
- long production cycles, since the warp beams have a long running length
- economical, untwisted filament yarns can be processed
- the knotless construction reduces the risk of injury to the user during use
- high energy absorption capacity.

TYPES OF MATERIALS

Every type of raschel machine can process a wide variety of yarn types and structures. Synthetic yarns are usually used, including polyester (PES), polyamide (PA) and polyolefines such as polyethylene (PE) and polypropylene (PP) in the form of filament or spun yarns. These yarns can be used in a wide range of different shapes and constructions, and may be flat, textured, shiny, matt, circular, structured or spun-dyed. Less conventional materials, such as metal wire, reflective or conductive yarns, tape yarns, natural fibres and every other conceivable type of material can also be processed. This applies to all the products and machines described in this brochure.

Agricultural nets are usually made from polyolefine in the form of tape or monofilament yarns.

Polyethylene is usually used for the following reasons:

- **the yarn parameters (elongation and strength/stability) can be stipulated in advance**
- **low weight**
- **no water absorption**
- **flexibility**
- **high strength**
- **rot-resistance**
- **weather-resistance**
- **can be dyed in any colour.**

Depending on the requirements of the end product, polyethylene may either be processed in the form of tape or monofilament yarns, but combinations of the two are not uncommon. The choice of which yarn to use will depend partly on the characteristics of the end product, and also on the type of machinery available in the manufacturing plant.

Tape yarns

Nets made exclusively from tape yarns are intended mainly for use as shade nets. This is because the tape yarns produce a flexible, lightweight net having an excellent sun-protection factor. But this type of tape yarn construction can also be used in protective nets, such as anti-bird nets.

Monofilament yarns

Nets made from monofilaments are ideal for use as harvesting or anti-bird nets, but they are frequently also used as shade nets.
The nets produced exclusively from monofilament yarns are extremely stable and durable. However, they need to have a high density if they are to be used as shade nets, for example. This increases the weight of the net, and the high yarn consumption increases the cost.

Combination of tape and monofilament yarns

A combination of monofilament and tape yarns is suitable for a variety of end-uses, such as for harvesting nets, anti-bird nets and shade nets.
The textile produced on a double-bar machine is usually made from monofilaments as the pillar stitches and tape yarns as the inlays. With three-bar constructions, monofilaments can also be used for the inlays (i.e. monofilaments in the pillar stitches and monofilaments and tape yarns in the inlays).
This combination of yarns makes the nets more stable and durable than nets made exclusively from tape yarns. By using tape yarns as the inlay, lightweight nets having a high shade factor can be produced for a low material consumption.
Sections made from different materials can also be produced next to each other.

Depending on the final end-use, manufacturers may use polyester, polyamide or polypropylene multifilament yarns to produce universal nets and fishing-nets. However, every other type of material, as well as combinations of materials and colours, can also be used.

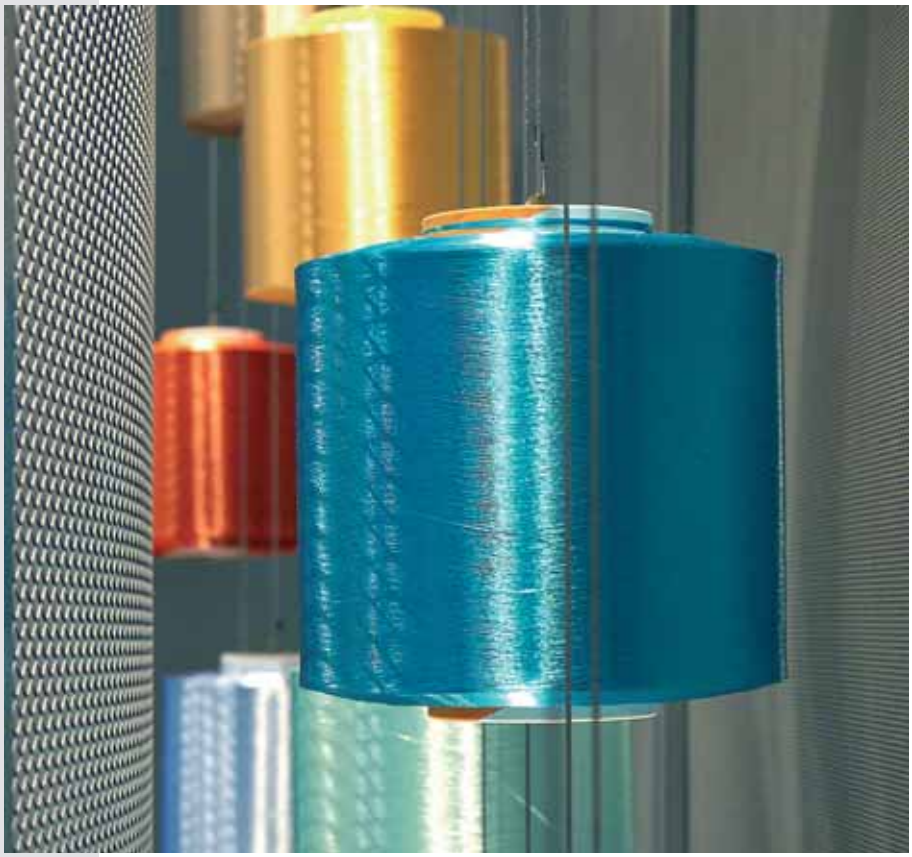


Photo: Messe Frankfurt

CIRCULAR BALE AND PALLET NETS

These lightweight polyethylene nets can be used for securing circular hay bales and for stabilising pallets and piles of boxes so that they can be transported safely. Even bales of silage can be secured with a net first to make them more stable. The lapping used to produce this type of net is a pillar stitch/inlay combination which was specially developed for this particular application, whereby the large width of the openings creates a self-adhesive effect on the circular bales. The pillar stitch wales are spaced wide apart from each other, since the machine operates at only one needle per inch (1 needle to 25.4 mm). The standard width of the nets is approx. 125 cm and the weight is 9-15 g/m^2.

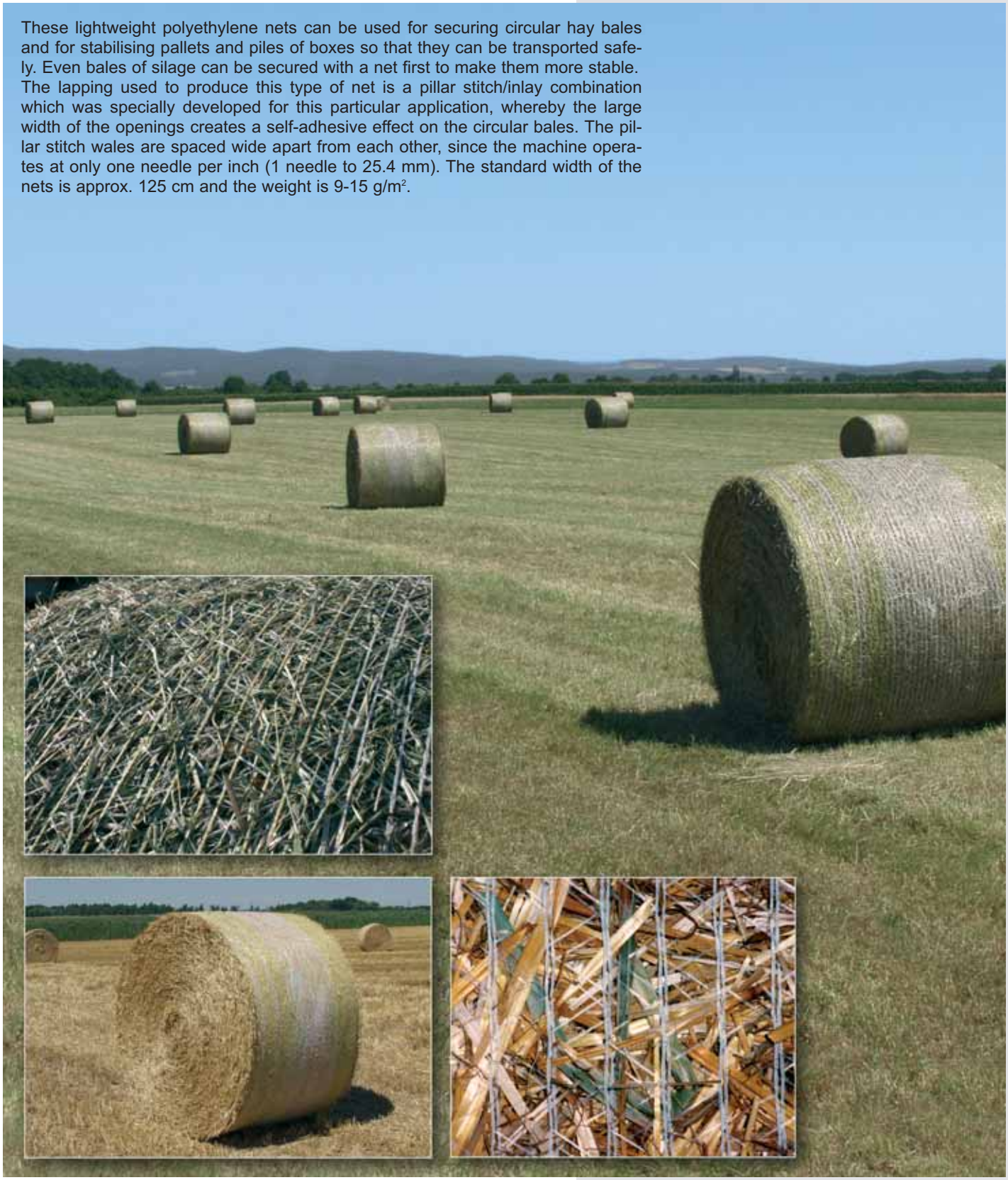


Photo: K.-H. Lahrem

NETS FOR THE AGRICULTURAL AND LEISURE SECTORS

Harvesting nets
Harvesting nets are perfect for collecting fruits which fall off the tree when they are ripe, or which have to be shaken off the tree. Olive groves are a typical example of this. The nets are placed underneath the trees until the harvesting period is over, and are used for catching the ripe fruit as it falls off the tree. This simplifies and rationalises the harvesting process considerably.
The size of openings in the net can be varied, depending on the size of the fruit. The holes are produced by varying the pillar stitch/inlay lapping. Depending on the end-use and the type of textile, the machine operates with one pillar stitch and one or more inlay guide bars. The nets are usually made from polyethylene monofilaments.

Anti-bird nets
These nets can be placed over trees and fields to protect the fruit from being eaten by birds. The textile is strong yet lightweight and protects the fruit without restricting plant growth.
The nets are usually worked with two stitch-forming guide bars, and have a basic construction in which the openings are produced. The size of the diamond-shaped openings can be increased or decreased by varying the repeat length of the connecting sections. The use of polyethylene tape yarns or monofilament yarns makes the net extremely durable and hard-wearing.

Anti-hailstone nets
Anti-hailstone nets are used to cover plants and fruit orchards to protect them from being damaged by hailstones. Covering fields with this type of net protects the plants from being damaged by hailstones, but does not restrict their growth.
The nets are primarily made from polyethylene monofilaments and are produced on two- or three-bar machines using a simple pillar stitch/inlay construction. Tricot or 2 x 1 lappings with a pillar stitch can also be worked to produce other types of anti-hailstone nets.
Depending on the stitch density and underlap length, nets having varying shade factors or air-permeability values can be produced for use as shade nets, sun-screens or wind-breaks. The pillar stitches, which are usually made from polyethylene monofilament or tape yarns, and the inlays, which usually comprise tape yarns, give

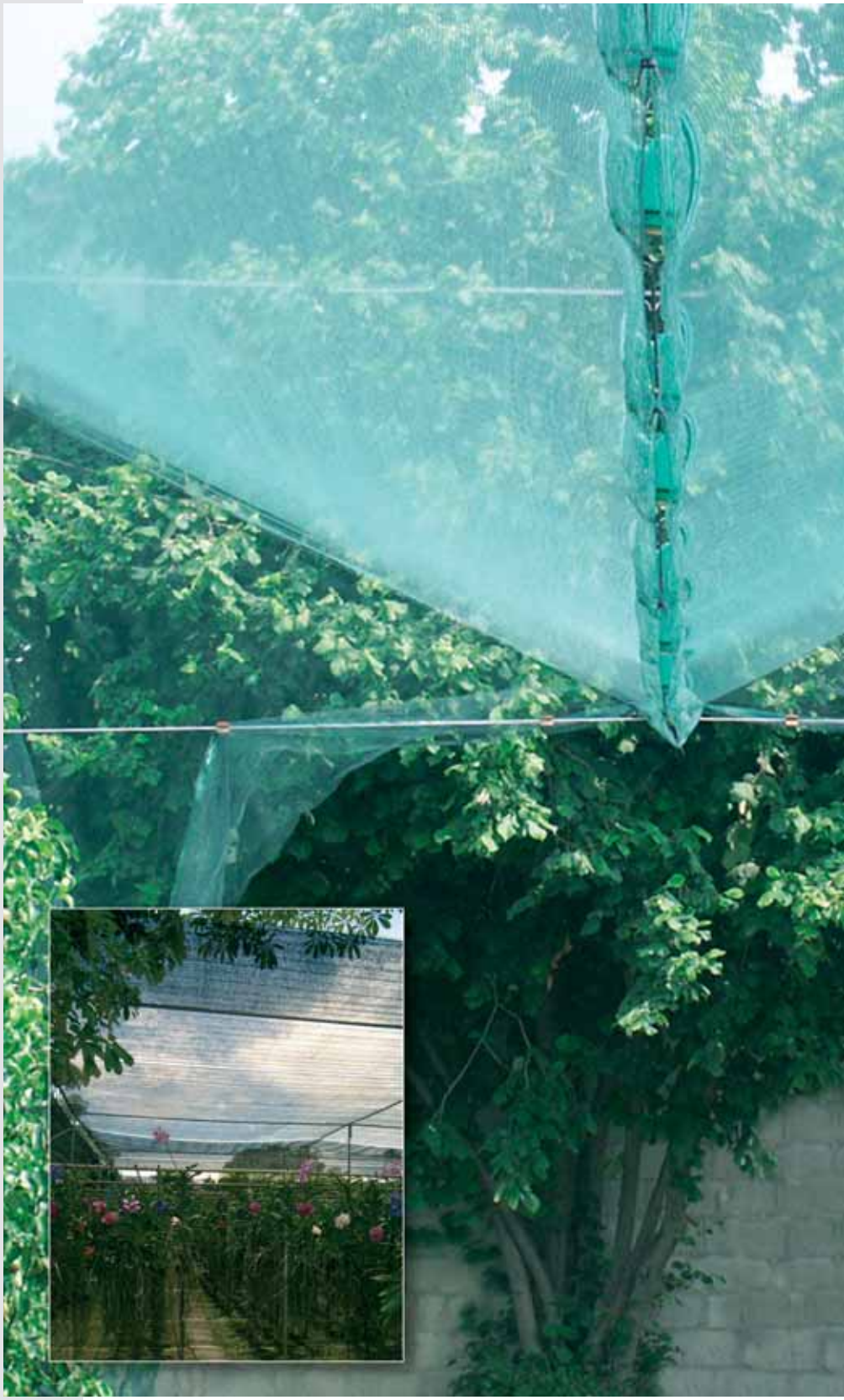


Photo: Arrigoni

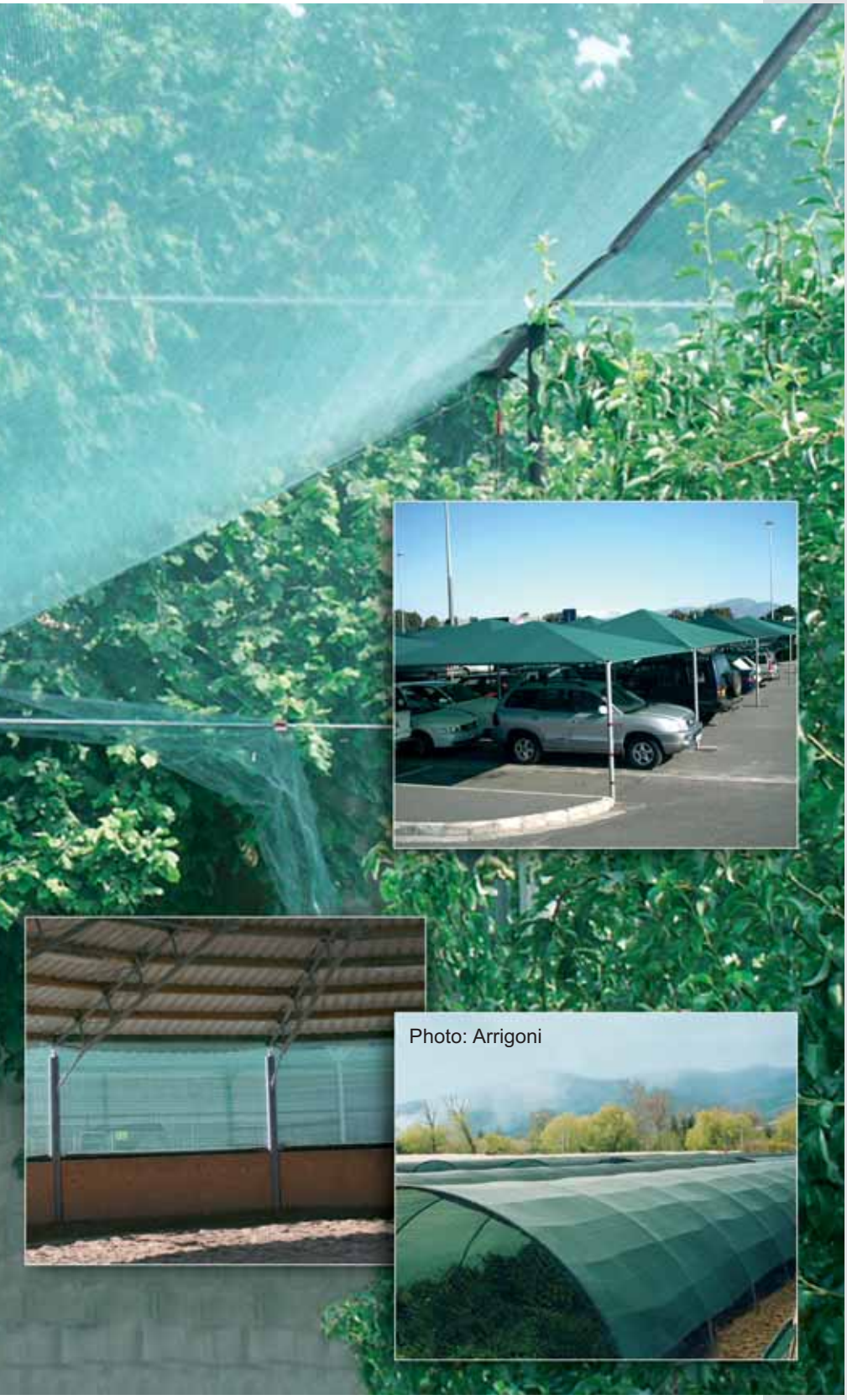


Photo: Arrigoni

the net its own special characteristics. The knitting technology also makes it possible to process a loop lapping in place of an inlay lapping, depending on the strength requirements. Nets for use outdoors can also be treated so that they are resistant to UV light. These types of nets can also be printed and erected at sporting facilities and used for advertising, for example.

Shade nets

Shade nets are used extensively in warmer countries of the world. They can be erected over hothouses and crops to protect the seedlings and plants from the effects of strong sunlight and to prevent them from drying out. They can thus be used to create optimum growth conditions for the plants. A constant level of air circulation can also be maintained in greenhouses covered with warp-knitted shade nets, which prevents excess heat from building up.

Sun protection nets

Warp-knitted nets are not only used in hot countries for protecting plants, they can also be used in a range of other, everyday uses. For example, they can be placed over play areas, car parks, patios and terraces to protect people from harmful UV rays and heat. Their low weight makes it easy for them to be erected easily over banks of seats and play areas, and they can be removed just as easily afterwards. They are a cheap and flexible alternative to traditional, static sun-screens.

Wind protection/wind-breaks

Wind-breaks are used to protect fields of young plants, trees or the harvest from being damaged by the wind. Erecting wind-breaks protects the young seedlings and the mature plants from drying out and being broken. The nets used here reduce the effects of high winds and help to keep out airborne sand and salt in areas close to the sea. Protecting plants from high winds also encourages plant growth and reduces the number of irrigation cycles required.

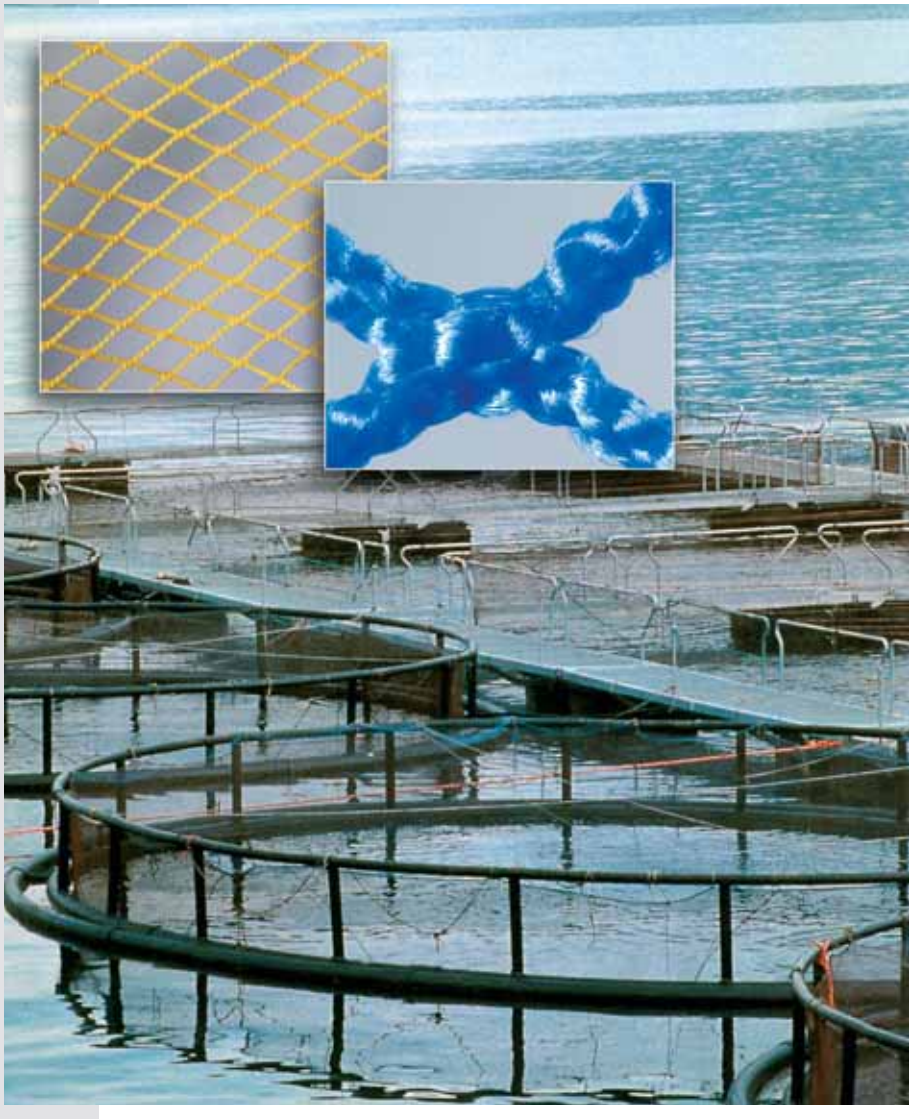
FISHING-NETS

Knotless fishing-nets are nearly always produced using the same lapping principle. Here too, the repeat consists of two zones, a ‘knot’ and a ‘connecting section’. The size of these two zones in the net can also be changed, i.e. it can be increased.

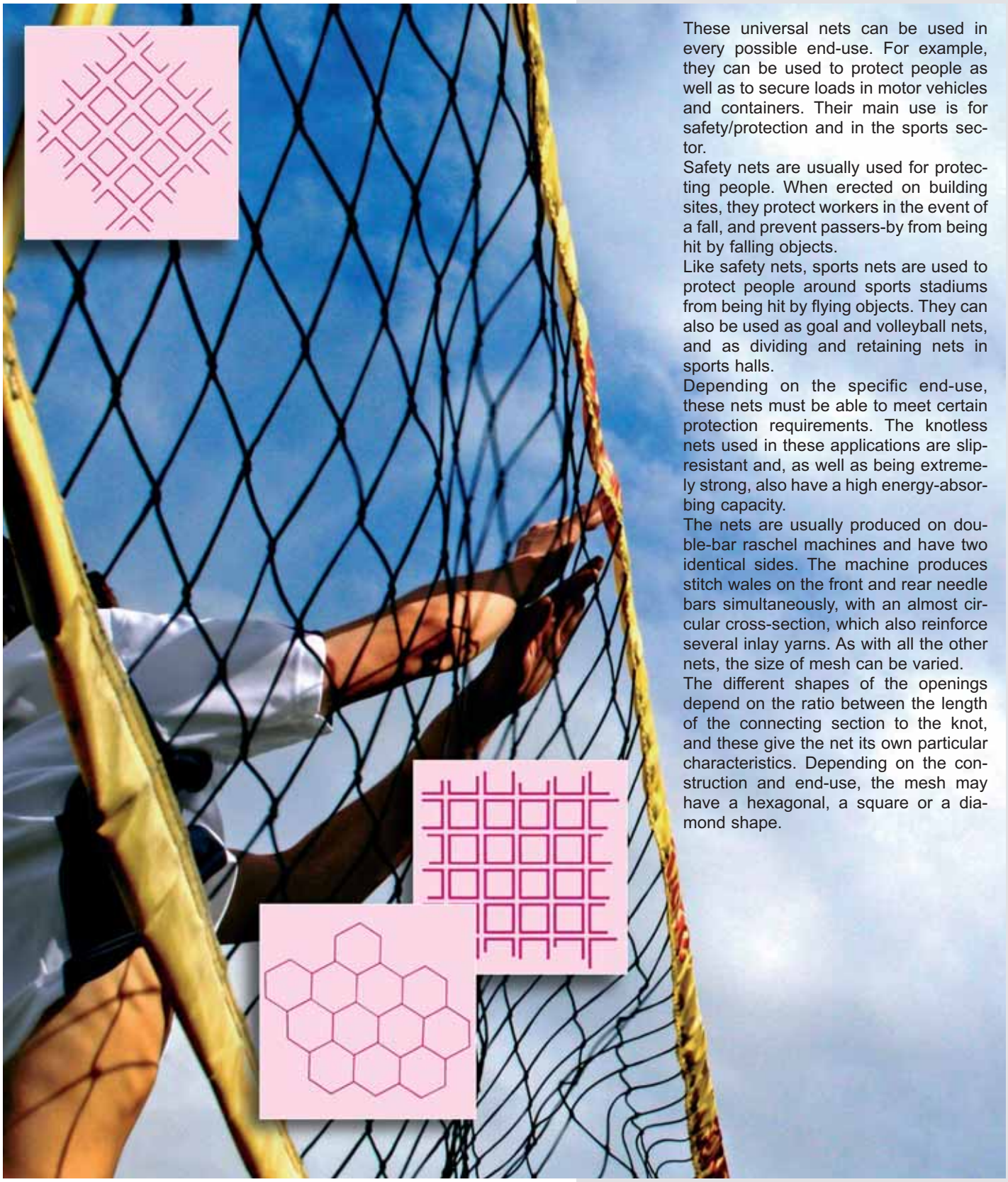
Standard and super knots
With fishing-nets, the distinction is usually made between standard and super-knotted types. Standard knots are usually used in normal applications whereas, with super knots, two of the inlay guide bars form an additional loop at the joining point (knot), which increases the volume and strength of the ‘knots’.

Single and double connecting sections
As with the knot, the design of the connecting section can also be varied. With fishing-nets, this generally consists of a pillar stitch wale. If the connecting section needs to be stronger or have a flat cross-section, the connecting section can be worked with two wales to produce a so-called ‘double connecting section’.

The yarns
Flat, untwisted polyester or polyamide multifilament yarns are usually used.



SPORTS AND SAFETY NETS



These universal nets can be used in every possible end-use. For example, they can be used to protect people as well as to secure loads in motor vehicles and containers. Their main use is for safety/protection and in the sports sector.

Safety nets are usually used for protecting people. When erected on building sites, they protect workers in the event of a fall, and prevent passers-by from being hit by falling objects.

Like safety nets, sports nets are used to protect people around sports stadiums from being hit by flying objects. They can also be used as goal and volleyball nets, and as dividing and retaining nets in sports halls.

Depending on the specific end-use, these nets must be able to meet certain protection requirements. The knotless nets used in these applications are slip-resistant and, as well as being extremely strong, also have a high energy-absorbing capacity.

The nets are usually produced on double-bar raschel machines and have two identical sides. The machine produces stitch wales on the front and rear needle bars simultaneously, with an almost circular cross-section, which also reinforce several inlay yarns. As with all the other nets, the size of mesh can be varied.

The different shapes of the openings depend on the ratio between the length of the connecting section to the knot, and these give the net its own particular characteristics. Depending on the construction and end-use, the mesh may have a hexagonal, a square or a diamond shape.

Photo: www.photocase.com

WARP KNITTING MACHINES FOR PRODUCING NETS

Several raschel machines, which operate using different knitting techniques, can be used for producing the nets. We would like to describe two of these techniques in this brochure:

- single-bar raschel machines (single-face raschel machines)
- double-bar raschel machines (double-face raschel machines)

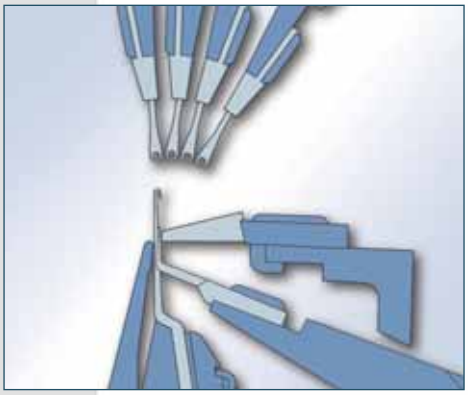
Single-bar raschel machines

Agricultural, safety and fishing-nets can be produced using this technology. The loop heads (Fig. 1) can be seen on the front of the textile and the underlaps can be seen on the reverse side (Fig. 2).

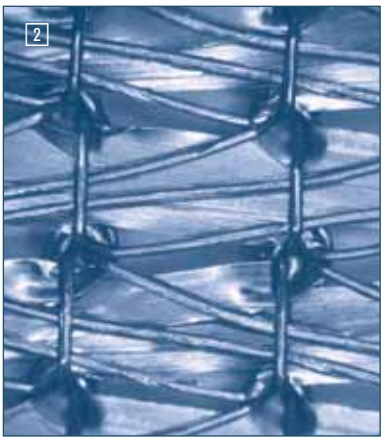
The RS 4 N-F

is an all-round, four-bar machine, which is used for producing agricultural, protective, shade nets, etc.

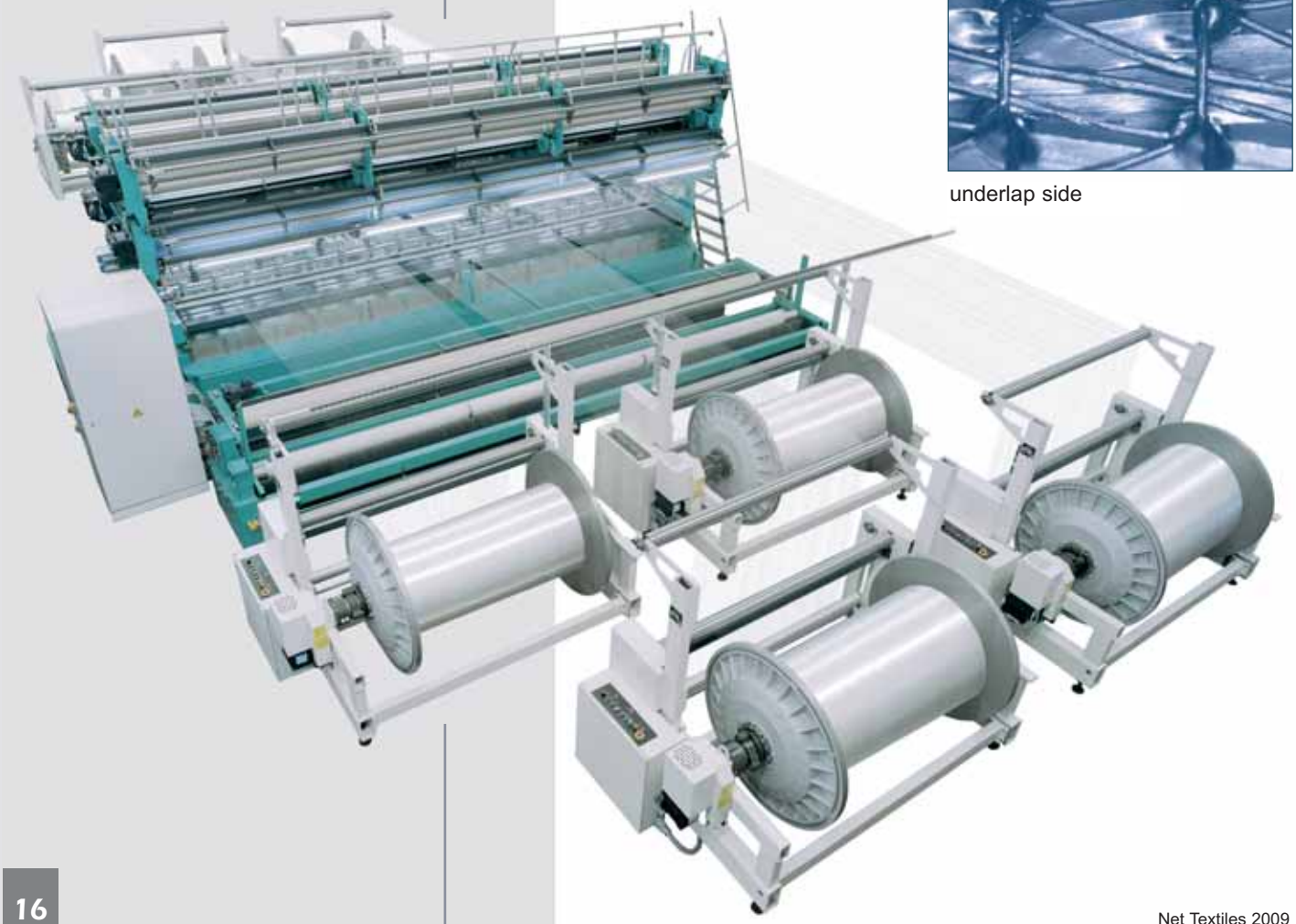
Widths: 170" (432 cm) and 260" (660 cm)
Gauges: E 6 and E 12



loop-head side



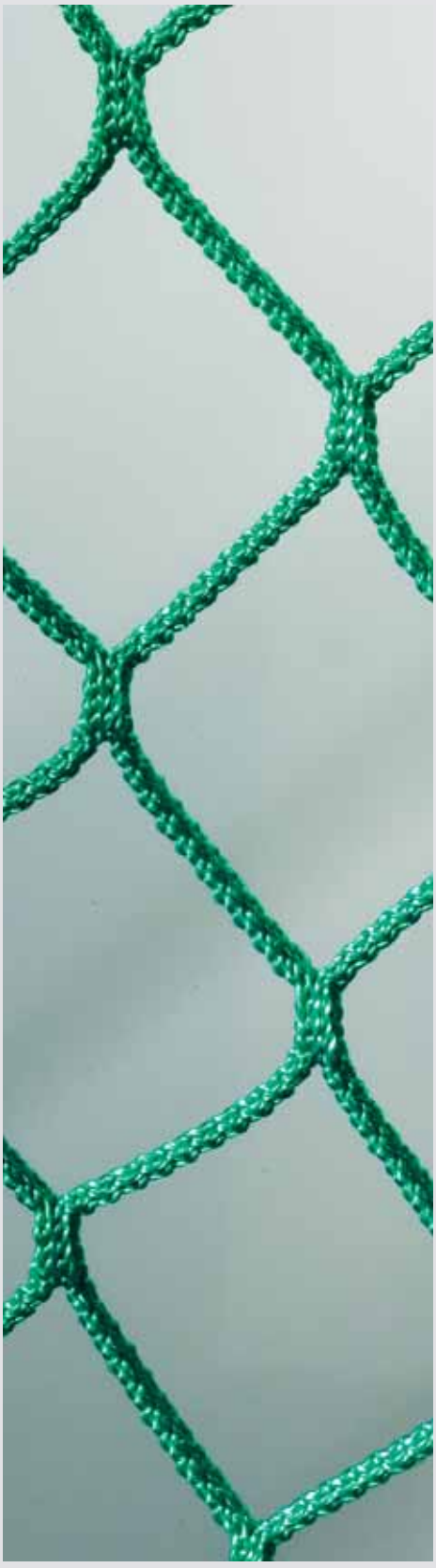
underlap side



Double-bar raschel machines

Double-bar raschel machines produce knotless nets having an almost circular cross-section. Sports and safety nets are examples of this type of net.
Unlike single-bar machines, double-bar machines form loops on both needle bars. The articles produced in this way are instantly recognisable, since they have two identical sides on which the loop heads can be seen. In each case, the underlaps lie between the front and the rear loop head. The nets produced on these machines have a higher volume than that of those produced on single-bar machines.

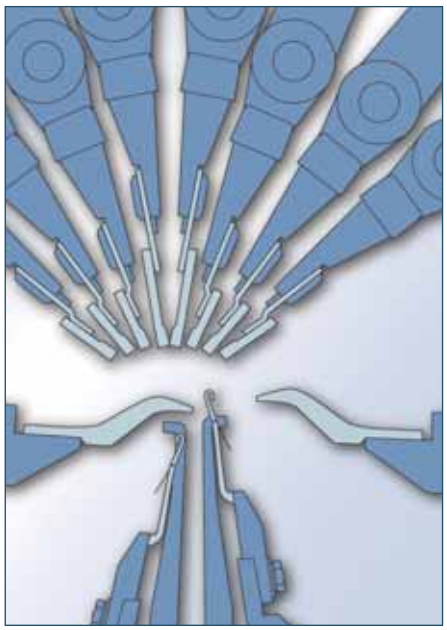
However, there is an exception to this rule. Single-bar textiles can be produced on certain double-bar machines - with double the fabric width. This is based on the principle of a textile web being produced on each needle bar. During the knitting process, an additional pattern bar joins the two textile webs together on one side. This principle can also be used to produce two separate textile webs simultaneously.



The HDR 8

is a double-bar raschel machine for producing nets having a circular cross-section, such as safety, universal and sports nets. This machine operates with eight guide bars.

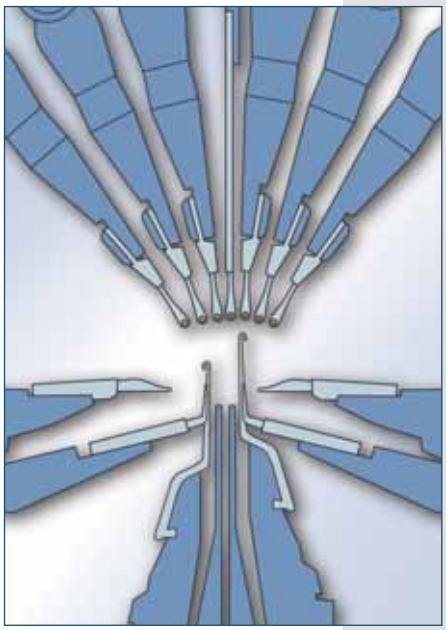
Width: 130" (330 cm)
Gauges: E 8 and E 9



The RDS 7

is a double-bar raschel machine, which produces single-bar shade nets with double the fabric width.

Width: 193" (490 cm)
Gauge: E 6



YARN FEED SYSTEMS

Various systems are available for feeding the tape yarns, monofilaments or filament yarns to the machine's knitting elements to produce the nets. Every system involves feeding the yarns to the knitting point via yarn combs and tensioners. Depending on the lapping, the guide bars knit the yarns supplied from the various guide bars to produce different textile products.

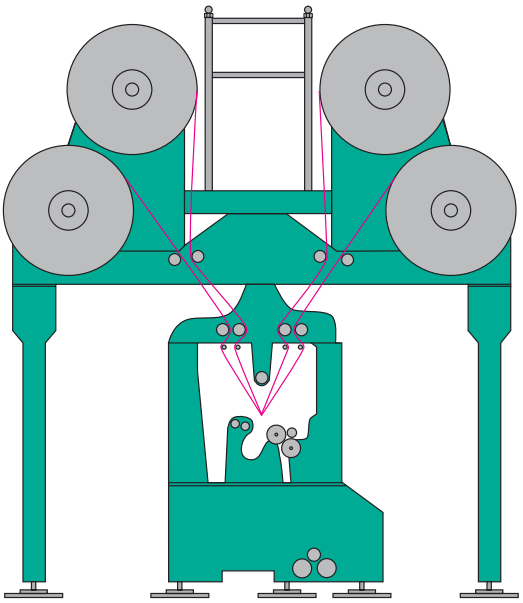
The distinction can be made between the following feed systems:

- an FTL unit
- a frame carrying sectional warp beams
- a combination of a sectional warp beam frame and an FTL unit
- feed units with beam let-off frames
- feed units with a creel

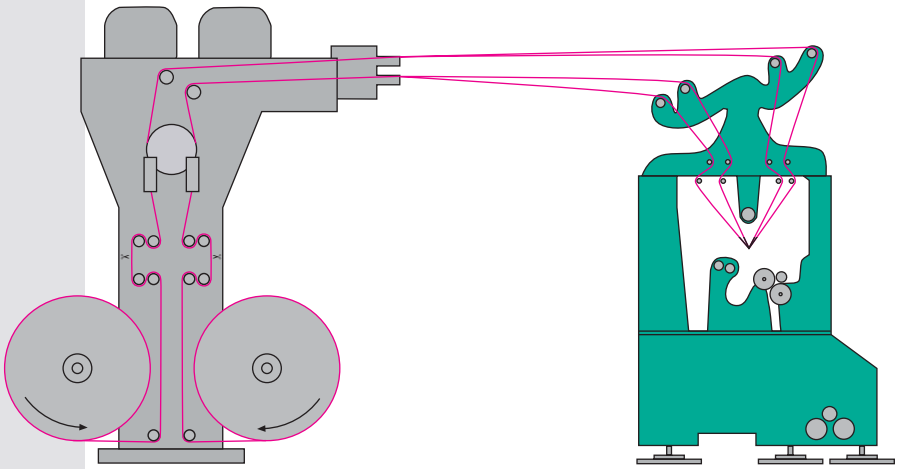
The yarn may be supplied in the form of a roll of film, on packages or on sectional warp beams, in which case the appropriate feed system must be used, or else further processes must be carried out to prepare the yarn.

Operating with sectional warp beams
Wound packages (tape or monofilament yarns) are a basic prerequisite for processing sectional warp beams. These can either be produced by companies in-house or else bought-in from outside suppliers. To produce the sectional warp beams, the wound material has to be processed onto sectional warp beams on a warping machine. The sectional warp beams are then mounted onto a frame, which is placed over the machine. The yarn is fed directly from the sectional warp beams via tensioning bars and combs to the knitting point. The number of beam mountings on the frame usually depends on the number of (ground) guide bars. Each beam station can carry several sectional warp beams, depending on the width of the machine, the number of yarns or monofilaments required, and the size of the sectional warp beams.

Operating with sectional warp beams and an FTL unit
Combining a frame with an FTL unit enables an article containing tape yarns as well as monofilament yarns to be produced. The tape yarns are fed from the FTL unit and the monofilaments are fed from the frame.



frame carrying the sectional warp beams



FTL aggregate

Operating with the FTL unit
The FTL unit is usually located behind the machine and is used for feeding the exact amount of tape yarns required to the machine.
The film is unwound from the roll of film and slit into predetermined widths. The cut tapes are then fed to a stretching zone, where they are stretched monoaxially, and the exact amount required is fed to the raschel machine.
The FTL system is based on a modular design, and can be supplied as a single unit or as twin or triple versions. Working out how many units are needed will depend on the width of the machine, the number of guide bars, the machine gauge, and the final width of the tape yarns.

Lieferwerke = feed units

Operating with feed units and a creel

Using a creel is always recommended if the yarn is wound on packages. The pakkages are mounted in the creel and the exact amount required is fed via feed units to the machine.

A variety of creels having different types of package mountings are available. The size of the creel and the number of package positions will depend on the number of yarns required.

The feed units are used to take-off the yarns from the creel and feed the tape yarns or monofilaments to the knitting point at the correct tension. The number of feed units used will depend on the number of guide bars. Each feed position is driven separately by means of a geared motor.

This process is extremely efficient, since the packages can be used directly. However, the fact that a creel takes up a great deal of space must also be taken into account.

Operating with feed units and beam let-off frames

If the aim is to achieve longer running times by using larger beams, the alternative is to position the beams on separate let-off frames rather than on a frame above the machine. The beams that are mounted on let-off frames are larger than standard sectional warp beams.

They are arranged either in front of or behind the machine. In this case, the yarns are fed to the knitting machine via feed units.

The feed units are used to take-off the yarns from the beam let-off frames and to feed the tape yarns or monofilaments to the knitting point at the correct tension. The number of feed units used will depend on the number of guide bars. Each feed position is driven separately by means of a geared motor.

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