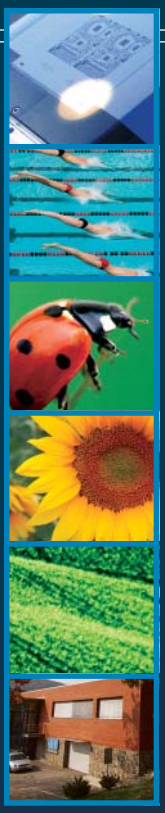
KEKO EQUIPMENT

Keko Equipment NEWSLETTER

NO. 4

KEKO EQUIPMENT

know how



Insight

You are reading our forth volume of Newsletter. In this issue we would like to present most important information about our accomplishments in the past two years and also our plans for the future. You will find in a lot of new developed machines and improvements, resulted by close relationship with our customers and also our strategic decision for development projects.

We are happy for the past two years, which have further strengthened our market position, which is more and more expanded also to different areas of applications for our equipment. Our customer needs and their feedback is giving us directions for new development and continuous improvement of our machines. Even with high growth of projects we managed to keep our delivery times very reasonable and competitive.

We achieved a yearly growth of more than 20% in our sales in the past two years, mainly as a result of implementing 4 different product groups of our equipment :

- Multi-layer technology for passive electronic components
- Multi-layer piezo products
- Fuel cells based on casting technology
- Printers for solar cells

Tape casting process applications are growing what we can notice by continuous demand from existing customers and new inquiries almost every day. I am sure, from first prototyping casters our customers will generate new products and a need for high volume production machines and their expansion.

I am sure every reader can find some beneficial information in this Newsletter, we wanted to show our new development in last two years. Custom designed equipment as a very important part of our business, is based on knowledge we always share with our customers, what guides to successfully finished projects.

Tone Konda, General Manager

Multilayer green ceramic stacking technology

Multilayer green ceramic stacking technology - Introduction

Jože Štupar, Technical Director

Keko Equipment offers the widest selection of machines in the world for the manufacture of Multilayer Ceramic Components, including passive electronic components, piezo actuators, fuel cells, and many other components that are designed based on a multilayered structure. To make the multilayer structures, green ceramic tape is used. Different metal electrodes (depending on the type of component) are (mainly) screen printed on the green tape. The individual layers are stacked and laminated together in order to achieve the multilayer structure. In this article we would like to introduce several different manufacturing processes, as well as the advantages and disadvantages of the different fabrication methods to build multilayer stacks. The processing equipment for each alternative will also be presented.

Two different green ceramic tape types are commonly used to build the multilayer stacks:

1) Ceramic tape cast on carrier film, typically PET film (Mylar)

(This tape can be produced on any of Keko Equipment's CAM-M series of casting machines)

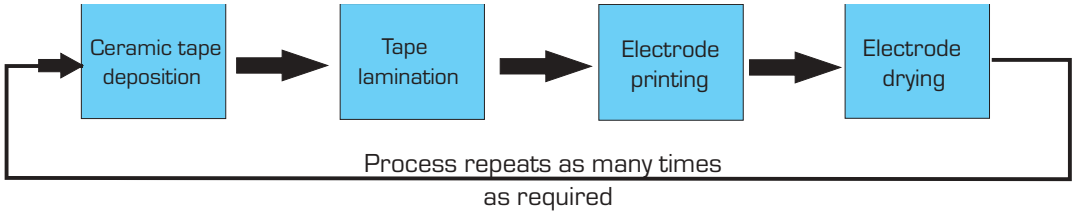
2) Free standing ceramic tape, normally cast on a continuous stainless steel belt.

(This tape can be produced on any of Keko Equipment's CAM series of steel belt casting machines)

Ceramic tape cast on Mylar is normally used for very thin layers, (as low as 2 microns) to facilitate tape handling. One of the chief disadvantages of this casting method is the cost of the additional carrier film needed. Free standing tape is normally used in applications where layer thickness is above 15 microns. The advantages include a lower cost. One of the main disadvantages is the difficulty to handle the tape. Several options exist to build the multilayer stacks when either ceramic tape on carrier film or free standing tape is used; here are the main 2 approaches as follows.

1. Print on Stack Technology

This technology is one of the oldest; it was originally developed for the production of ceramic capacitor. The basic process is as follows:



Process advantages:

- Components are built in one step, in one machine.
- (Relatively) low investment cost.
- Suitable for high production volumes and high output.
- Very thin tapes can be processed.

Process disadvantages:

- Limited to approximately 100 layers or less, depending on tape thickness.
- Limited to no more than three different electrode patterns.
- Not very suitable for small volume production.

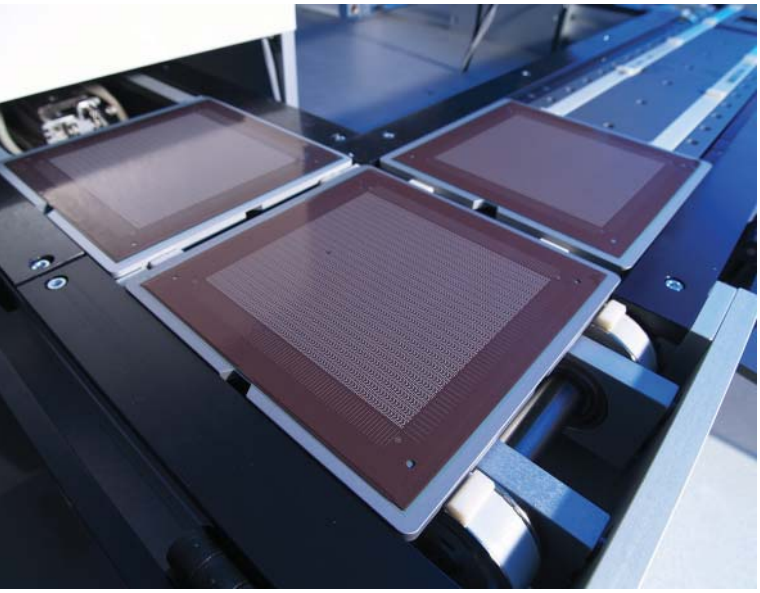
Multilayer green ceramic stacking technology - Introduction

Keko Equipment offers the following machines for the Print on Stack technology:

The PAL-9 Series: These machines use tape from a roll, either freestanding or on carrier film. Up to two different ceramic tapes can be processed at the same time and up to two different electrode patterns can be printed.

Applications: ceramic capacitors, varistors, piezo, etc.

Photo on right: A PAL-9 machine type for 8 inch stacking area with two printers, two 52 tons presses and vision print quality check.



The FSP series: These machines use individual ceramic sheets. Up to 5 different sheets can be processed and up to 3 different printing patterns can be applied at the same time.

Applications: Production of large chip ferrites production; simple (large volume) LTCC production, etc.

Photo on left: Chip ferrites production on FSP-12 machine.

2. Separate printing - Separate Stacking Technology

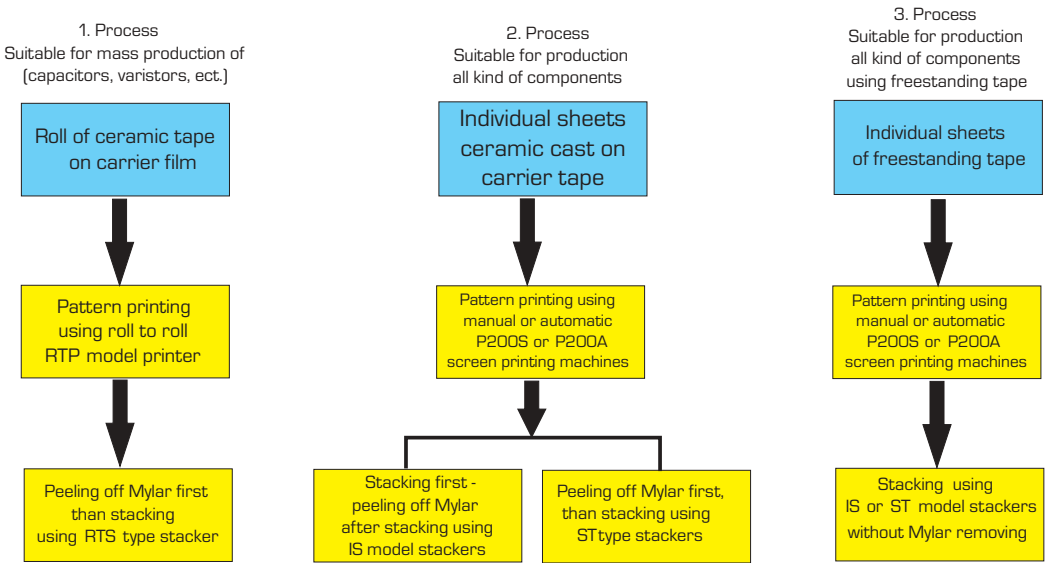
This technology is more universal and flexible compared to print on stack technology, applicable for the production of most components.

Process advantages:

- Can be applied to all components
- Suitable for small and large production volumes.
- More flexible compared to print on stack technology.
- Simple to very sophisticated machines are available.
- Possibility to build stacks with a high number of layers.

Process disadvantages:

- More machines are needed to get the same result compared to print on stack technology.
- (Relatively) high investment cost for large automated production lines.



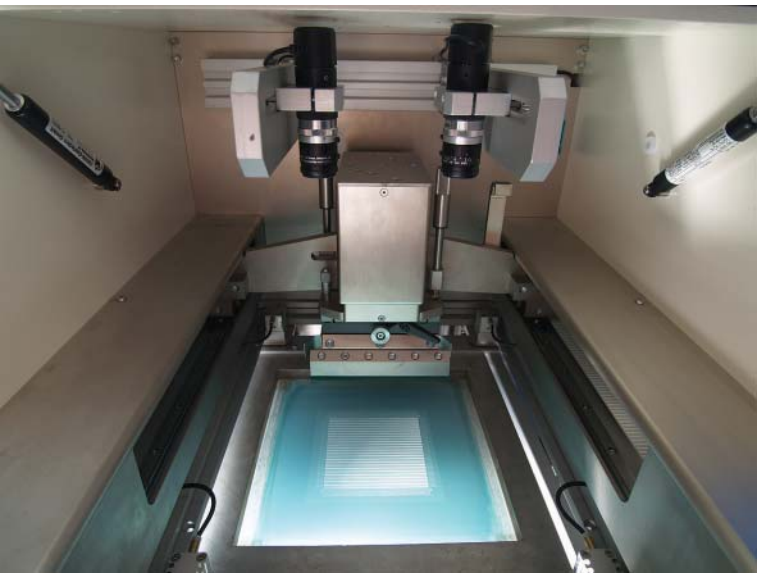


Photo on left: An automatic screen printer with screen alignment cameras inside the printer

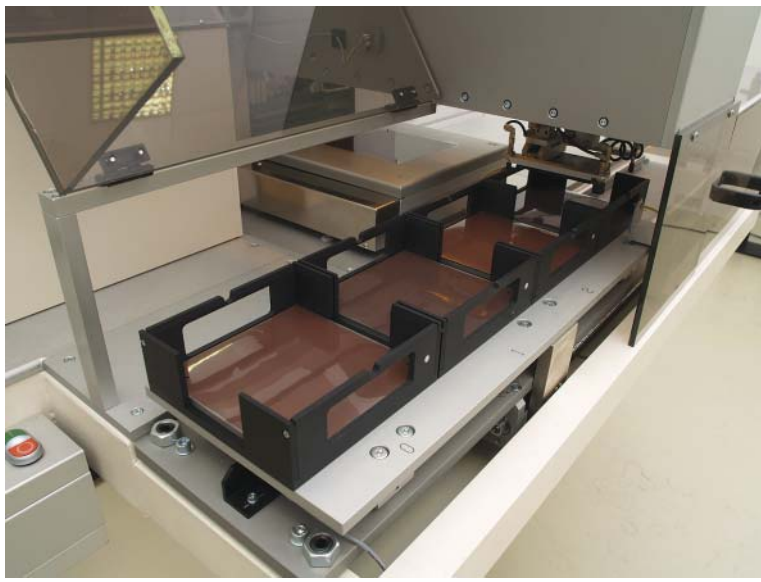


Photo on right: Automatic sheet loading from cassettes on IS-6AV stacker

Conclusion:

Machines and process type selection depends of many factors, including: component type, tape properties and production volume. Process can be more or less automated. Contact Keko Equipment for your particular application.

Piezo components production equipment

Piezo components production news

Piezoelectric actuators are devices that produce a small displacement with a high force capability when voltage is applied. There are many applications where a piezoelectric actuator may be used, such as ultra-precise positioning and in the generation and handling of high forces or pressures in static or in dynamic situations.

Actuator configuration can vary greatly depending on application. Piezoelectric stack actuators are manufactured by stacking up piezoelectric green ceramic layers, the axis of the stack being the axis of linear motion when a voltage is applied.

These devices can also be ultrasonic. Ultrasonic actuators are specifically designed to produce strokes of several micrometers at ultrasonic (>20 kHz) frequencies. They are especially useful for controlling vibration, positioning applications and quick switching

Please refer to the previous volume of our newsletter for a detailed explanation of the Piezo effect.

Nowadays, for high speed, high precision movements in nanometer resolution, more and more piezo components are being used. Keko equipment is a worldwide leader in the development and manufacturing of equipment for the production of piezo components.

In this issue we would like to introduce the recently developed equipment for piezo components production.

The numbers of layers on a piezo actuator are directly tied to the translation movement required. For piezo components with a high number of layers (1000 or more) specially designed machines are required, we offer these alternatives:

1. From mini stacks

This concept is to produce stacks of up to 100 layers. These “mini-stacks” are subsequently stacked and laminated together in a cavity in order to achieve the requested layer count.

2. Stacking single layers

For this technology a high layer stacker is needed. Individual sheets are placed in a cavity. Once the requested number of layers is reached, the cavity is transferred to a thermal press where all layers are laminated together. A completely new production line has developed for this technology.

Photo on right:
Automatic screen printer P-200AV

Automatically prints individual sheets. Sheets are taken from a cassette, accurately aligned with a vision system, screen printed, placed in a drier and placed back into a cassette after drying.

Piezo components production equipment

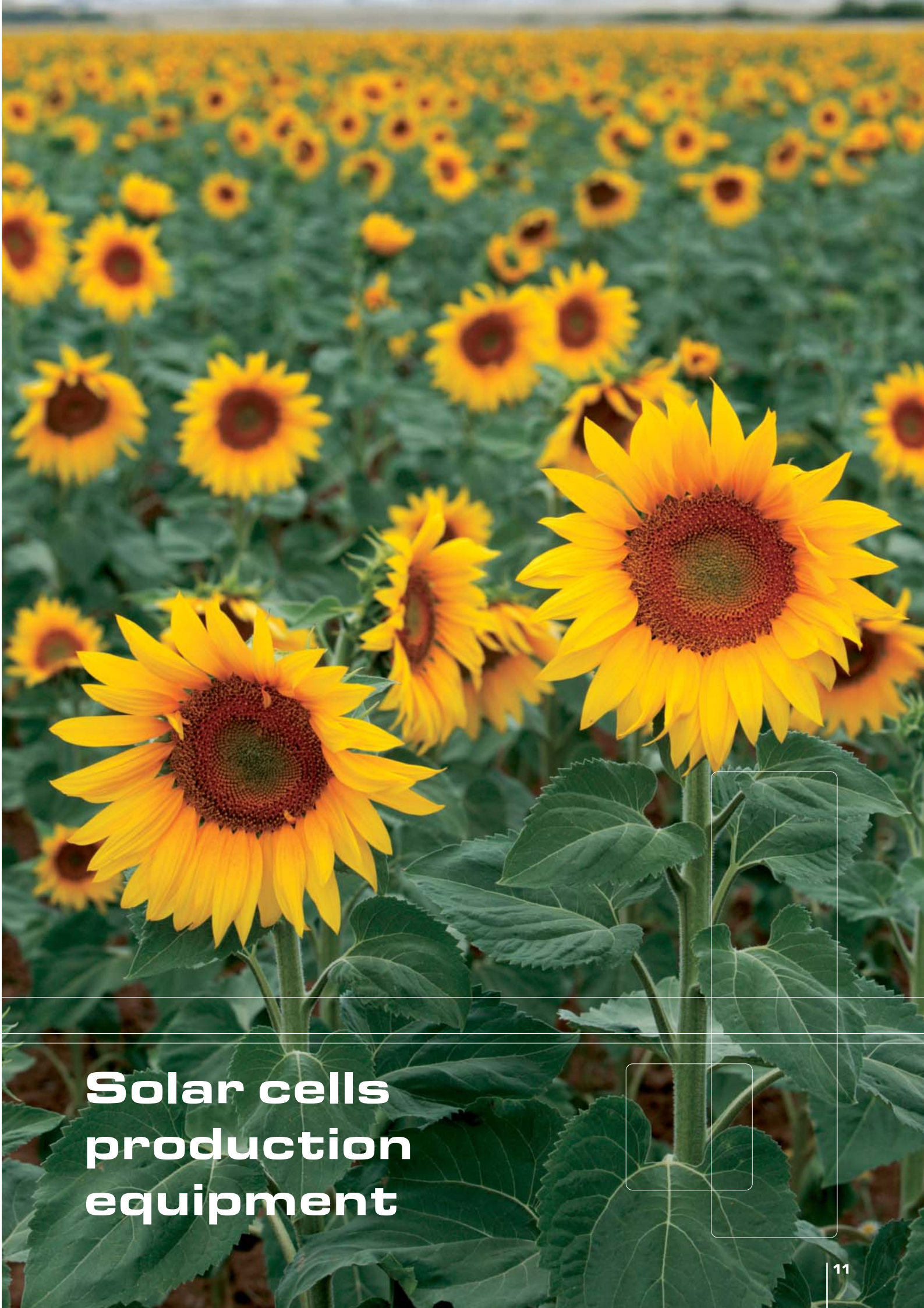
High layer stacker STH-6V

This unit automatically stacks single printed sheets, according to a programmed design. In the automatic version, printed sheets are taken directly from cassettes. In the manual version, the sheets are manually placed on a vision alignment table. After alignment is done the Mylar (carrier film) is removed, the sheet is then placed in a cavity and is tacked to the previous layer.

Lamination press TPR

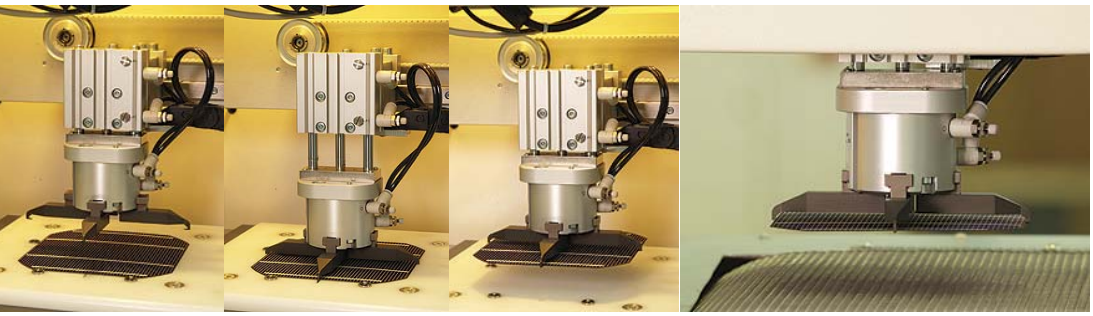
The cavity (from the stacker) containing the tacked sheets is transferred to the TPR lamination press, where the sheets are laminated (using heat and pressure) to form a monolithic ceramic block.

Optionally, a vacuum assisted pressing process is available.



Solar cells production equipment

Solar cells production equipment



The manufacturing of Solar Cells is a fast growing market where many opportunities await. One of our main goals in the near future is to capture a larger portion of this developing market. We believe that our vast screen printing, testing and automation experience will facilitate this goal.

Two years ago, we successfully developed a semi-automatic solar cells screen printer. The wafers are manually loaded on the printing table. After the table alignment is done (with a vision system) the wafer is printed. A pick and place unit picks the printed wafer and places it on the IR dryer belt. The next logical step is to use what we've learned from this unit to develop a fully automatic printing line. The final version will have 3 identical units. Each unit will consist of a wafer transportation system, wafer vision alignment, screen printing, breakage test and IR drier.

Our next developing step will be a wafer testing and inspection line.

An in-line IR dryer was simultaneously developed. Efficient IR lamps and high air flow ensure short drying time with minimum material stress. A stand alone, two -zone IR drier is also available, it can be used with manual printers and for different applications.

A short cycle time (between prints) of approximately 3 seconds is expected. The machine will print on either 5 or 6 inch wafers automatically. Initial test results look very promising. The machine will print twice the wafer electrodes on the bottom side, turn the wafer automatically and print the top electrode. The wafer will be then placed on the firing kiln conveyor. The automatic machine is expected to be available in the first half of 2008.

Solid Oxide Fuel Cells (SOFC) Production Equipment

Solid oxide fuel cells (SOFC) production equipment

One of the most promising sources for clean energy in the future might come from fuel cells, particularly high temperature fuel cells with relatively high efficiency. These types of fuel cells are capable of producing electricity not only from hydrogen or methanol, but also from natural gas, gasoline, diesel or biogas.

The main raw materials to produce Solid Oxide Fuel Cells are metal oxides, usually ZrO2. Oxide powder mixed with a binder is cast on tape casting machines in order to produce the electrolyte layer. Keko equipment developed several tape casting machines for SOFC tape production. Since the tape is thick and heavy, only horizontal versions of our casting machines are use for this application. Due to the long tape drying time, the drying section of the tape casters can be up to 20 meters long. Casting width can be up to 450 mm.

Slurry is supplied from a pressure vessel to the casting head. A laser sensor and precise slurry level feedback accurately maintain a constant slurry level throughout the tape casting process.

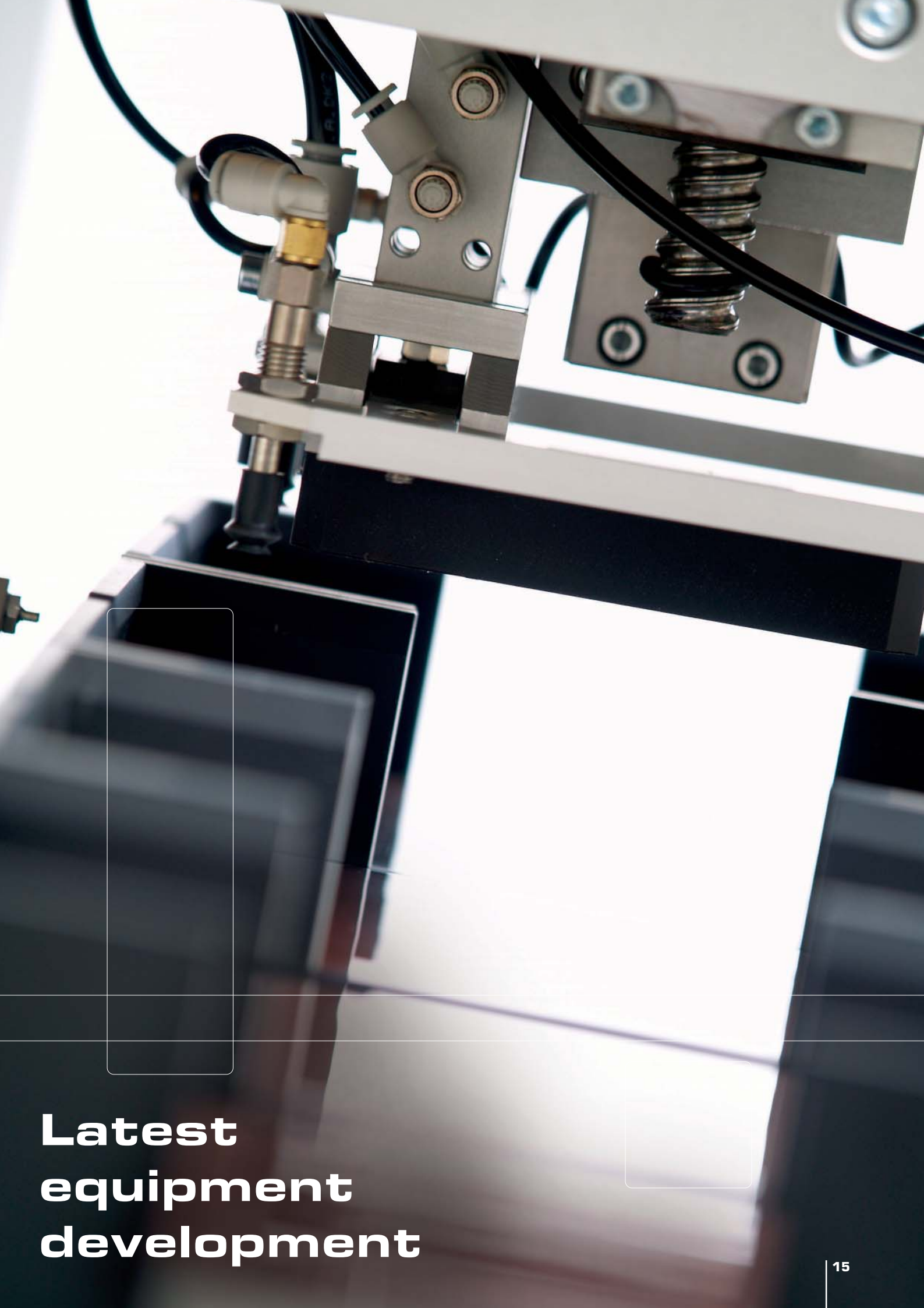
Automatic screen printer FCP-2IR

Tape caster model CAM-MH250

The tape is heated from the bottom using heating plates and from the top with heated air in counter flow; this method provides maximum drying efficiency. The number of drying zones is defined depending on many parameters, e.g. slurry properties. Side inspection windows on the drying section allow constant monitoring of the cast tape.

All casting parameters, i.e. tape thickness, drying temperatures, speeds, etc are set through a touch screen and controlled by a PLC. Optionally, a connection and software to remotely monitor the casting process on a PC is available. Another option is to use EX proof dryer components for solvent based slurry systems.

After firing the tape, the electrodes are deposited on the electrolyte sheet by screen printing. The P-200 screen printer is ideal for R&D / Lab applications. For high volume applications an automatic screen printer, the FCP-21R, is used with 3 seconds print to print cycle. Print lay-down is usually high, so an IR drier is used for faster drying.



Latest equipment development

Latest equipment development

Green ceramic tape stacker

The newly developed ST- 6 or ST-8 model stackers automatically stack individual (6 x 6 or 8 x 8 inches) sheets from cassettes to produce a monolithic ceramic block.

A vision assisted alignment system ensures a perfect layer alignment.

These types of stackers are universal and suitable to produce all types of multilayer components. They are particularly suitable for stacks with a high number of layers and LTCC stacks containing cavities. An innovative sticky tape assisted Mylar removing station can be (optionally) added to remove the carrier film from thin tapes, where Mylar removing is usually difficult.

Two versions of the stackers, either automatic or manual, are available. Up to 30 different sheet types can be automatically stacked from a cassette system.

Photo: Automatic stacker - model ST-6AV

Ferrite printer stacker

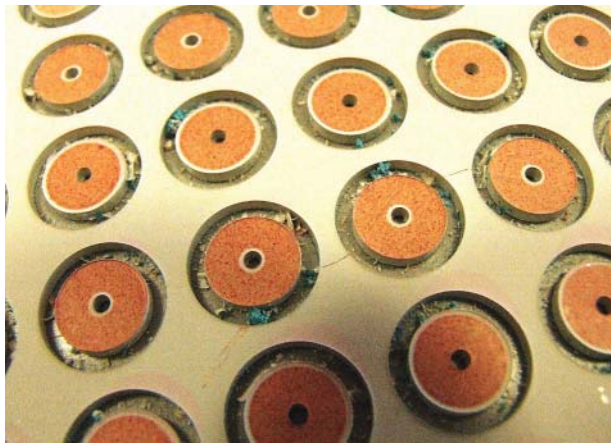
A giant leap in the high volume chip ferrite production was achieved with the development of the FSP-12 printer stacker. Its development was a real challenge to us. The FSP-12 has three screen printers, three IR driers, automatic sheet loading from five different cassettes, vision alignment of sheets and a lamination press. Eleven video cameras, four PC's and two PLC's are used to control all machine operations. The FSP-12 produces up to 2.4 million 0603 chips in one eight hour shift. Only one operator is needed.

A vision assisted CNC router

Oddly shaped multilayer components have to be cut out of green stacks using a router. Keko Equipment has designed a custom router, in which the ceramic stacks are fixed to the alignment table using vacuum, then automatic vision alignment of the stack is done against the fiducial marks printed on top of stack and the shape is cut out according to the program.

Two different tools can be used to cut with automatic tool change.

Vision alignment improves accuracy and efficiency of the router compared to manual alignment.



Keko Equipment production facilities in Žužemberk, Slovenia

Trade Fairs & Exhibitions

We were attending Hannover Fuel Cells Show, Korea Green Energy Expo 2006&2007, London Fuel Cell Show, NEPCON Shanghai 2007, Productronica Munich 2005, IMAPS 2005 Philadelphia, IMAPS 2006 San Diego, CARTS 2007 Albuquerque, Fuel Cell Seminar Honolulu and Fuel Cell Seminar Palm Springs...

Installed Keko Equipment machines worldwide

Company Profile

KEKO Equipment Ltd. is a leader in the manufacture of machines for the production of multilayer passive ceramic components but also many other products, based on a tape casting process.

Twenty-five years of experience have given us the vast knowledge that is now marketed under our own brand in the European, Asian, American and Australian markets.

Our roots stretch a long way back to when we were a unit of the Iskra consortium. Since 1995 the company is in private hands and its philosophy today is formulated by a team of highly motivated engineers and designers.

In addition to the extensive range of proven products, we focus our specialized know-how into custom manufacturing.

In the development of specialized technological solutions we take into account our customers requirements and the needs of each individual buyer, thus providing the basis for a successful long-term relationship.

This is aided by our widespread sales network that spans all continents, where we always cooperate closely with knowledgeable local agents. They have helped us to provide very successful post-sales services and ensure customer satisfaction.

Knowledge, flexibility and innovation are our company's key competitive advantages and our brand name's good reputation now reaches all over the world.

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