

## Thickness Gauges Automatic Systems for Extrusion-Dies



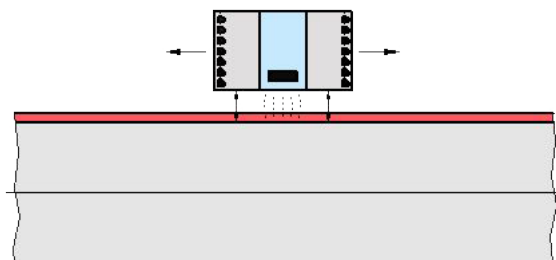
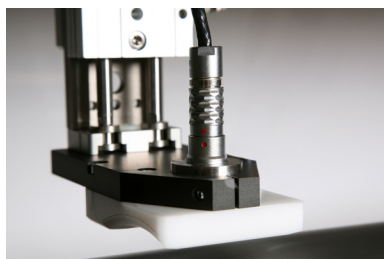
# Thickness gauges



## Kapa I & Kapa II

### MEASURING WITH CAPACITIVE/EDDY CURRENT

Non-contact thickness measuring device for sheet/films up to 3 mm thickness (Kapa II for flexible plates up to 6mm) and a maximum width of 4 m. It creates a thickness profile of the produced sheet/films with an accuracy of  $\leq 0.1 \mu\text{m}$ .



### MEASURING PRINCIPLE

The capacitance between the sensor and the roller is measured and the thickness is calculated (according to calibration). The capacitance depends also on the distance of the sensor to the roller, therefore this distance is measured constantly with an eddy current sensor (located together with the capacitive sensor in the same casing). According to the result of the eddy current measurement, the output is corrected.

Technical Data	Kapa I	Kapa II
Measuring system	capacitive/eddy current	
Max. measuring thickness	3000 $\mu\text{m}$	6000 $\mu\text{m}$
Measuring gap	4,5 mm	9,5 mm
Diameter of the sensor	30 mm	45 mm
Measuring spot diameter	12 mm	12 mm
Sensor resolution	0,05 $\mu\text{m}$	0,5 $\mu\text{m}$
Accuracy	$\leq 0,1 \mu\text{m}$	$\leq 1 \mu\text{m}$
Measuring speed	10 – 300 mm/s adjustable	
Movement speed	10 – 500 mm/s adjustable	
Calibration	necessary for each material	
Diameter of the reference roller	200 mm	
Guiding roll (optional)	120 mm	
Dimension WxHxD	(Measuring width+633) x 720 x 400 mm	
Dimension Control cabinet WxHxD	600 x 1960 x 600 mm	
Colour	RAL 7035/7022	

# Thickness gauges

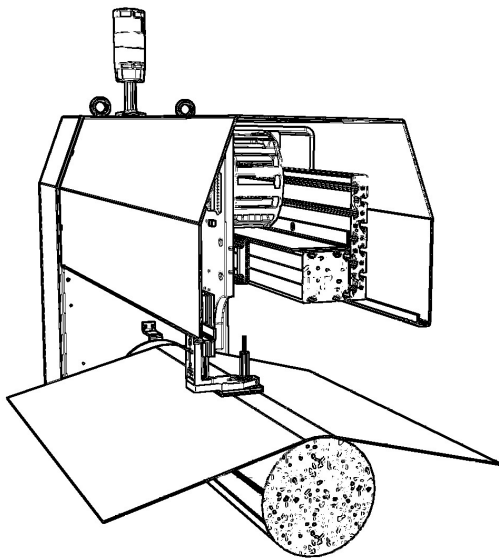


Kapa I & Kapa II

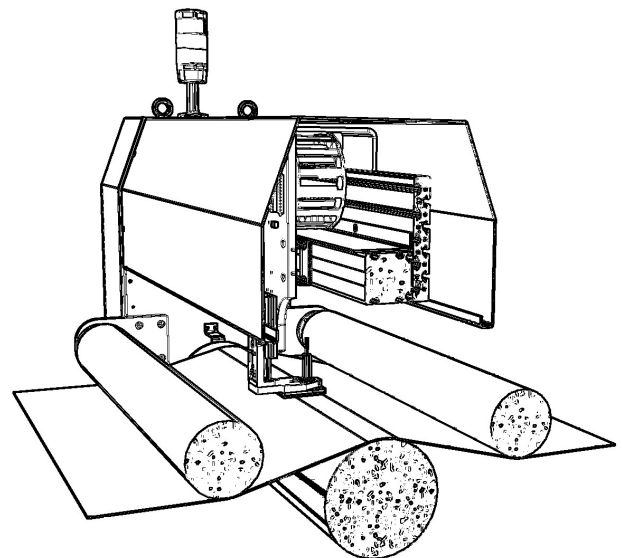


## CALIBRATION

In the calibration mode, the sensor is placed in a fixed position (traversing stopped) during production. Measurement happens along a line of the sheet/films in the extrusion direction. A piece of sheet/films needs to be cut out along this line and measured manually. This manually measured value needs to be keyed in the software as a calibration value. Calibration is only required once per material or formulation and can be stored in the recipe.



necessary sheet guiding

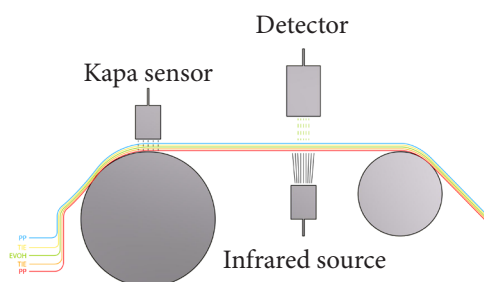


optional with guiding roll

## KAPA - IR

### NON-CONTACT THICKNESS MEASURING DEVICE FOR BARRIER SHEET/FILMS

This non-contact thickness measuring device is for sheet/films sheet up to a total thickness of 3 mm and a maximum width of 4 m. It is equipped with 2 different sensor systems. A capacitive sensor (KAPA) measures the total thickness and an infrared sensor (IR) determines the EVOH layer thickness.



Technical Data	KAPA	IR
Measuring system	capacitive/eddy current	infrared
Thickness range	up to 3000 $\mu\text{m}$	>10 $\mu\text{m}$
Measuring gap	4,5 mm	35 mm
Sensor dimension	circularly $\varnothing$ 30 mm	rectangular 50x60 mm
Measuring spot diameter	12 mm	10 mm
Sensor resolution	0,05 $\mu\text{m}$	1 $\mu\text{m}$
Accuracy	$\leq 0,1 \mu\text{m}$	$\leq 5 \mu\text{m}$
Measurement speed	10 – 300 mm/s adjustable	
Calibration	necessary for each material	

### MEASURING PRINCIPLE AND CALIBRATION:

KAPA (for total thickness):

According to capacitive system as mentioned in page 2 and 3.

IR (for the EVOH layer):

It is based on a non-contact, transmission measurement principle. For the determination of the EVOH layer thickness, a wide infrared spectrum of the plastic is recorded and the resulting absorption of the EVOH polymer molecules is evaluated by using our modern analytic methods.

During calibration, the sensor is moved to a sample holder. In this holder, there must be a sample placed from the same material recipe which has to be measured with the EVOH gauging system. The EVOH layer thickness of this calibration sample needs to be previously determined by a microtome cut and to be keyed in the software as a calibration value. It is only necessary once per material and can be stored as a recipe.

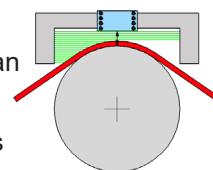
## Shadow

### MEASURING WITH LASER SHADOWING

This non-contact thickness measuring device for sheet/films up to 3.5 mm thickness, maximum width of 4 m and offers an accuracy of  $\leq 3.0 \mu\text{m}$ . It is equipped with a dual sensor system – a laser scanner and an eddy current sensor.

### MEASURING PRINCIPLE

A laser light curtain is guided over the measurement roller and the sheet. The receiver (line scan camera) measure beams or shadows due to the thickness of the sheet. An eddy current sensor measures the distance between laser sensor and roller. With the result of both measurements (shadowing and eddy current) the thickness of the sheet is calculated.



### CALIBRATION

No calibration with an external calibre is needed; the measurement is independent from other sheet properties!

Technical Data	Shadow
Measuring system	Laser/eddy current
Max. measuring thickness	3,5 mm
Measuring gap	5,5 mm
Diameter of the sensor	30 mm
Measuring spot diameter	0,5 mm
Sensor resolution	0,5 $\mu\text{m}$
Accuracy	$\leq 3,0 \mu\text{m}$
Measuring speed	10 – 300 mm/s adjustable
Movement speed	10 – 500 mm/s adjustable
Calibration	not essential
Diameter of the reference roller	200 mm



# Thickness gauges



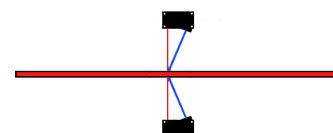
## STG

### MEASURING WITH LASER DISPLACEMENT

Equipped with a laser displacement sensor, the STG is designed for sheets up to 40 mm thickness, a maximum width of 3 m and with an accuracy of  $\leq 20 \mu\text{m}$ .

### MEASURING PRINCIPLE

Non-contact indirect thickness measurement. On the top and bottom side of the extruded sheet, there are two laser displacement sensors scanning from a constant distance to the sheet. These laser-triangulation sensors (with high resolution and excellent linearity), are designed for precise measurements in industrial applications.



Each sensor is guided on two linear bearings across the sheet and are driven by stepper motor. Based on a calibration curve of the measuring frame (detected on a calibration scan without sheet), the measured values of the laser sensors determine the thickness profile and it is displayed on the screen.

Technical Data	STG
Measuring system	Laser triangulation/reflection
Max. measuring thickness	40 mm
Clear height	250 mm
Measuring spot diameter	0,2 mm
Sensor resolution	1 $\mu\text{m}$
Accuracy	$\leq 20 \mu\text{m}$
Measuring speed	10 – 100 mm/s adjustable
Movement speed	10 – 200 mm/s adjustable
Diameter roller	80 mm



# Thickness gauges



## General Data

### COMPOSED OF

- Measuring frame with integrated control cabinet
- Traversing unit with electrical drive
- Measuring sensor mounted on a pneumatic lift-off-device on the traversing unit
- Control cabinet with industrial PC, 17" touch monitor, keyboard drawer with track ball
- Uninterrupted power supply (UPS)
- Connection cable PC-measuring frame, 10m length

### VISUALISATION

- Cross profile diagram as bolt and line chart
- Trend and SPC analysis
- Roll protocol
- Recipe storage
- Alarm and history



#### Electrical Supply

Supply voltage	115/230 VAC $\pm$ 10 %
Supply frequency	50/60 Hz $\pm$ 1 %
Max. power consumption	700 W
Max. current consumption	5 A
Electrical equipment to EN 60204	

#### Ambience

Max. ambient temperature	40°C
Max. air humidity	95%, without condensation
Max. film temperature	90°C

#### General Data

Dimension of the control cabinet	600 x 600 x 1960 mm
Color	RAL 7035/7022
Documentation	EU Language
Operating pressure	6 bar



# Thickness gauges



## Software Thickness control

### FUNCTIONS

- Production parameter (opening frame: production parameter)
- Calibration
- Analysis (opening frame: analysis)
- Alarms (displays alarm in readable text)
- Print
- Roll changing (reset parameters of frame production parameters, running meter e.g.)
- Roll protocol (report of every roll can be displayed, stored and printed)

### PRODUCTION PARAMETER

Frame for setting production parameter

- Data of order: order no., customers name, article no., ....
- Production parameter: thickness set value, +/- tolerances, resolution of displays, net width, etc.

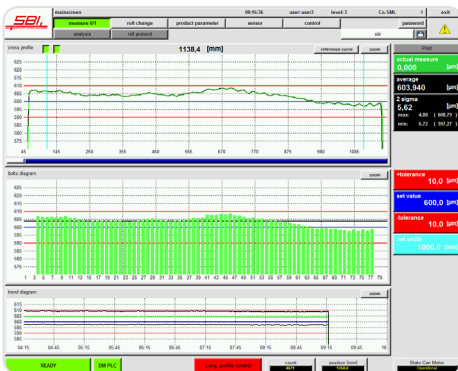
### ANALYSIS

This frame displays production data and trends

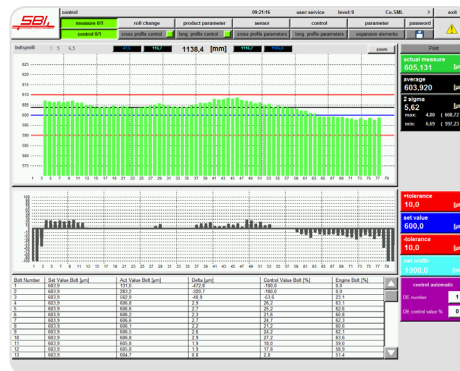
- Production data: time of start, time since start or roll changing, running meter since roll changing, speed, etc.
- Trend: Displays trend graphics of previous 24 hours, older trends are stored and can be loaded for viewing and printing. Trend graphics shows thickness average, set value and tolerances

### THICKNESS CONTROL

Frames for thickness control (optional) with automatically adjustable extrusion dies.



Thickness/bolts/trend diagram



Control



## Features

### DESCRIPTION OF MOST IMPORTANT SCREEN SHOTS

#### LINE CHART/BOLT DIAGRAM

- Actual thickness profile displayed over measuring width
- Actual thickness via bolt number
- Average profile of last 3 scans
- Reference curve: freeze actual profile to compare with future profiles – reference curve can be stored
- Net width
- Zoom in graphics (thickness profile and bolt diagram) for close inspection



Bolt diagram

#### TREND DIAGRAM

- The trend diagram shows the processing of the film for 24 hours
- The most important values like set value, actual/average thickness according to the cross profile
- Minimum, Maximum, 2 sigma and tolerances are displayed in a bar chart graphics

#### NUMERIC DISPLAYS

- Actual thickness (µm) according to the displayed sensor position
- Average thickness according to the cross profile, 2 Sigma value, min. and max. thickness
- Tolerance set values
- Thickness set value
- Net width set value

# Thickness gauges



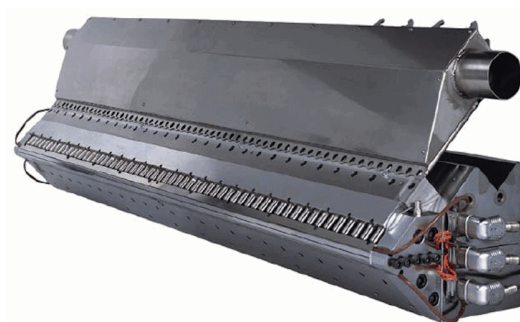
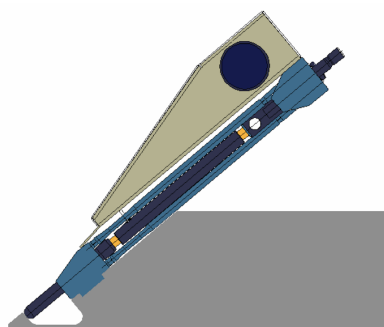
## Thermal bolts

Perfect system for automatic extrusion-die adjustment in order to get an even thickness profile, controlled by state-of-the-art thickness gauges which are enabled to control automatic dies.

Operating range of bolts: 300  $\mu\text{m}$  (+/- 150  $\mu\text{m}$ ).

Actuators are steel bolts with heating cartridges, operating range 300  $\mu\text{m}$  + manual adjustment.

Partition of actuators: 30, 28 or 25,4 mm (1").



Automatic flat die with thermal bolts

Thermal bolts utilizes thermal expansion of steel bolts

Bolts are heated with heating cartridges and chilled with air (external ventilation)

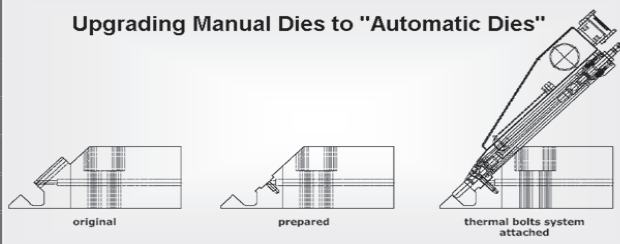
### COMPOSED OF

- Thermal bolts with heating cartridges
- Casing with connection for ventilation
- With and without blower (chilling with air or convection)



Technical data	Thermal bolt
Operating range	300 $\mu\text{m}$
Partition	30mm, 28 or 25.4 mm (1")
Heating cartridges, rated power	80 W
Mechanical fine tuning with fine thread (0,5 mm/rev.)	
Thermal separation to extrusion die (thermal brakes)	

### Upgrading Manual Dies to "Automatic Dies"



# Thickness gauges

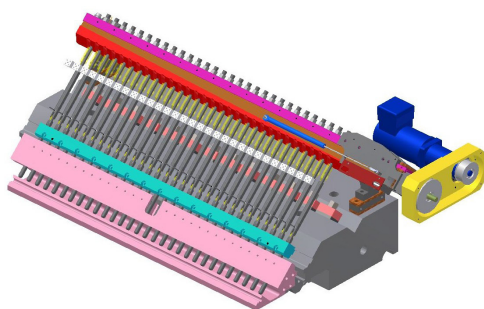


FRAD (Full Range Automatic Die) operating range: 2 mm

FRAD is an automatic extrusion-die adjustment system in combination with a gap changing device.

Actuators are “thermal bolts” which are actuated all together by a sliding wedge.

The wedge is driven by an electronic motor and controlled by software of thickness gauge.



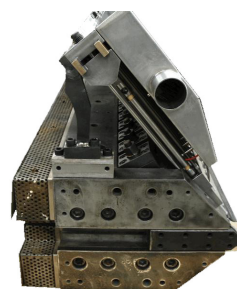
FRAD is a combination of two adjustment systems:

- Mechanical adjustment of all thermal bolts with a wedge system
- Thermal bolts utilizing thermal expansion of steel bolts

The bolts are heated with heating cartridges and chilled with air (external ventilation).

## CONSISTING OF

- Mechanical adjustment with a driven wedge system, driven with electric motor
- Thermal bolts with heating cartridges
- Casing with connection for ventilation
- With and without blower (chilling with air or convection)



Technical data	Wedge system
Operating range	2 mm
Drive	asynchronous motor with gearbox and position measuring
Push only elements	

Many existing extrusion-dies are upgradeable.

Technical data	Thermal bolt
Operating range	300 µm
Partition	30mm
Heating cartridges, rated power	80 W
Push only elements	
Mechanical fine tuning with fine thread (0,5 mm/rev.)	
Thermal separation to extrusion die (thermal brakes)	



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Subject to technical changes and mistakes!