maku ag, Flurhofstrasse 13, CH-6374 Buochs

maku-DieTool®

operation manual

Project name:

Product name: maku-DieTool®
Serial number:

Manufacturer: maku ag
Flurhofstrasse 13
CH-6374 Buochs
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Revision date: 2023/03

Content

1 About these operating instruction 5
1.1 General information 5
1.2 Icons and symbols used 5
1.3 Structure of the warning notes 5
2 General safety provisions 7
2.1 Principles 7
2.2 Guidelines 7
2.3 Safety regulations 7
2.4 Proper use 8
2.5 Foreseeable incorrect use 8
2.6 Selection and qualification of personnel 9
2.7 Work stations for the operating personnel 9
2.8 Safety equipment 9
2.9 Protective measures 10
2.10 Residual risks 13
3 Product contents 13
4 Technical description 13
4.1 Overview funtional description 13
4.2 Module 1 14
4.3 Module 2 14
4.4 Module 3 14
4.5 Interfaces 14
4.6 Nameplate 14
4.7 Transport 14
4.8 Storage 14
5 Installation and start-up 15
5.1 Installation 15
5.2 Start-up 15
5.3 Mechanical installation 15
5.4 Angle adjustment 15
6 Control and display elements 16
6.1 Main switch 16
6.2 Emergency off 16

6.3 Safety barriers ... 16
6.4 Key switch bypassing the safety barrier ... 16
6.5 Control unit ON illuminated button ... 17
6.6 Start illuminated button ... 17
6.7 Stop button ... 17
6.8 Fault lamp ... 17
6.9 Start-up warning lamp ... 17
7 Control software ... 17
7.1 Control concept and screen layout ... 17
7.2 Entering a variable ... 17
7.3 Password ... 17
8 Screen masks ... 18
8.1 Referencing servo axes ... 18
8.2 Determine cross beam limits and home position of the carriage ... 19
8.3 Referencing the pneumatic piston stroke ... 19
8.4 Referencing of the actual profile ... 19
8.5 Determine engagement depth ... 20
8.6 Determine engagement time ... 20
8.7 Pneumatic box ... 21
9 Die data ... 21
9.1 Setting up the die parameters ... 21
9.2 Die bolt positions cross beam [position table] ... 22
9.3 Determining the reference die bolt ... 22
9.4 Thermal expansion ... 22
9.5 Blocking die bolts ... 23
9.6 Absolute die bolt limitation ... 23
9.7 Maximum difference to neighboring die bolt ... 23
10 Manual mode ... 23
10.1 Activating manual mode ... 23
10.2 Manually adjusting die bolts ... 24
11 Home screen maku-DieTool® ... 24
12 Process data ... 24
13 Control algorithm ... 25
13.1 Measurements ... 25

13.2 Control algorithm ... 26
13.3 Die bolt assignment ... 27
13.4 Product list ... 28
13.5 Copying the data record ... 28
14 Profile data ... 28
14.1 Profile list ... 28
14.2 Creating a target profile ... 29
14.3 Save the current actual profile as the target profile ... 29
14.4 Copying the target profile ... 29
14.5 Preset profile ... 29
15 Machine data ... 29
16 Machine operating modes ... 30
16.1 Manual mode ... 30
16.2 Automatic mode ... 30
16.3 Mode 1, measured values, maku-DieTool® in control ... 30
16.4 Mode 2, gauging system in control ... 30
16.5 Mode 3, gauging system profile task ... 31
17 Switching the machine on ... 31
17.1 Switching the machine off ... 31

1 About these operating instruction

Before operating the ***maku-DieTool®*** for the first time, these operating instructions must be read. Chapter 2 "general safety provisions" must be in particular observed.

1.1 General information

These operating instructions serve to familiarize the personnel with the ***maku-DieTool®*** to use it for certain applications. The operating instructions contain important notes on how to operate the ***maku-DieTool®*** in a safe and proper manner. Observing these instructions helps:

- to avoid hazards
- keep repair costs and downtimes to a minimum
- increase the reliability and life cycle of the product

These instructions must be read and used by every person assigned with working with ***the maku-DieTool®***. In addition to these operating instructions, the guidelines on accident prevention and protecting the environment must also be observed in the country and place of use.

1.2 Icons and symbols used

The following icons and symbols are used in these instructions:

➔ Activity symbol: The text following this symbol describes steps that must be followed in the described order, from top to bottom.

➔ Result symbol: The text after this icon describes the result of a particular action

1.3 Structure of the warning notes

Warning levels

Signal word	**Use with …**	**Possible consequences if the safety notice is not observed:**
DANGER	Injury to persons (imminent danger)	Death or severe injury!
WARNING	Injury to persons (potentially dangerous situation)	Death or severe injury!
CAUTION	Injury to persons Injury to property	Slight or minor injury! Equipment could be damaged, which can disrupt processes

Table 1: warning levels

The warning notes are structured as follows:

- Pictogram with a signal word corresponding to the warning level
- Description of the risk (type of risk)
- Description of the consequences of the hazard (consequences of the hazard)
- Measures (actions) for preventing the hazard

Hazard!
Type of hazard (text)
Consequences of the hazard (text)
Averting the hazard (text)

Warning symbols

Special safety notes will be provided at the respectively relevant passages. They are marked with the following symbols.

General source of danger
This symbol warns of tasks where there is a risk of injury to persons and extensive damage to property.

If there is a clear source of danger, one of the following symbols will be used.

Heavy current
This symbol indicates activities where there is an electrocution hazard with potentially fatal consequences.

Risk of crushing
This symbol refers to actions where there is a crushing hazard.

Suspended loads
This symbol advises of tasks where suspended loads could fall and injure people as a result.

Hand injury
This symbol advises of tasks where there is a risk of hand injury.

Hot surfaces
This symbol advises of tasks where there is a risk of injury posed by hot surfaces.

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2 General safety provisions

2.1 Principles

The ***maku-DieTool®*** may only be operated if:

- all safety systems are working properly
- trained personnel are present
- the device is in proper technical condition

2.2 Guidelines

This machine was built in consideration of the following guidelines:

2006/42/EC	*Directive 2006/42/EC of the European Parliament and Council of 17 May 2006 on machinery and amending directive 95/16/EC (new version) (1)*
2014/35/EU	*Directive 2014/35/EU of the European Parliament and Council dated 26 February 2014 on harmonizing legal guidelines of the member states on the provision of electrical equipment used within certain voltage limits on the market*
2014/30/EU	*Directive 2014/30/EU of the European Parliament and Council dated 26 February 2014 on harmonizing legal guidelines of the member states on electromagnetic compatibility (new version)*

2.3 Safety regulations

EN 953:1997+A1:2009	*Safety of machines - separating safety devices - general requirements for the design and construction of fixed and moveable guards*
EN 894-1:1997+A1:2008	*Safety of machines - ergonomic requirements for the design of displays and control actuators - part 1: General guidelines for user interaction with displays and control actuators*
EN 894-4+A1:2010	*Safety of machines - ergonomic requirements for the design of displays and control actuators - part 4: Location and arrangement of displays and*
EN 842:1996+A1:2008	*Safety of machines - visual danger signals - general requirements, design and testing*
EN 62061:2005/A2:2015	*Safety of machines — functional safety of safety-related electrical, electronic and programmable electronic control systems*

EN 60204-1:2006/AC:2010	*Safety of machines - electrical equipment of machines - part 1: General requirements*
EN 547-1:1996+A1:2008	*Safety of machines - human body measurements - part 1: Principles for determining the dimensions required for openings for whole body access into machinery*
EN 349:1993+A1:2008	*Safety of machinery - Minimum gaps to avoid crushing of parts of the human body*
EN 1037:1995+A1:2008	*Safety of machines - prevention of unexpected startup*
EN 62061:2005/A1:2013	*Safety of machines — functional safety of safety-related electrical, electronic and programmable electronic control systems*
EN ISO 13857:2008	*Safety of machines - Safety distance to prevent danger zones being reached by the upper and lower limbs (ISO 13857:2008)*
EN ISO 12100:2010-11	*Safety of machines - general principles for design - risk assessment and risk reduction (ISO 12100:2010)*
EN 1005-2:2003+A1:2008	*Safety of machines - human physical performance - part 2: Manual handling of objects in connection with machines and machine parts*
EN 1005-4:2005+A1:2008	*Safety of machines - human physical performance - part 4: Evaluation of working postures and movements in relation to machinery*
EN 1005-3:2002+A1:2008	*Safety of machines - human physical performance - part 3: Recommended force limits for machinery operation*

2.4 Proper use

The ***maku-DieTool®*** adjusts die bolts based on measurements performed by a gauging system or manual entree. If new measurements are sent to the ***maku-DieTool®*** by a gauging system, an adjustment cycle will be initiated in accordance to the selected algorithm in order to align the flat trajectory with the desired target value.

2.5 Foreseeable incorrect use

Deployment of staff that has not been instructed and is not sufficiently qualified.

2.6 Selection and qualification of personnel

The system is only operated by qualified and trained personnel. Training and familiarization of the equipment are required when the machine is running and when it is stopped.

2.7 Work stations for the operating personnel

The ***maku-DieTool®*** is installed primarily on the flat die. The operating/touch panel is located close to the flat die. The machine is operated using the touch panel within the view of the ***maku-DieTool®***.

2.8 Safety equipment

The ***maku-DieTool®*** is turned off when the emergency stop is pushed. If this has to be integrated in the entire machine, it must be done by the customer.

Position of the safety equipment (if applied)

Figure 1: position of the safety equipment at the side ends

Function of safety equipment

The safety equipment serves to ensure a safe environment when a person is working on or operating the machine.

Emergency stop button

If an emergency stop button is pushed, the carriage and the actuator are brought to a stop and turned off.

Safety barriers

Safety devices such as safety light curtains or similar safety protection equipment prevent people from coming close to the ***maku-DieTool®*** during operation. As soon as one of the protective devices opens or is interrupted, the carriage and the actuator will be halted and turned off.

Key switch bypassing the safety barrier

The key switch can be used to bypass the safety devices for the purpose of maintenance. A message is shown on the panel. If the safety device is bypassed, the machine can only be operated in manual mode. It is no longer possible to automatically adjust multiple die bolts or use the preset profile function. The speed of the carriage is also limited. If the key switch is used during automatic operation or preset profile function, the ***maku-DieTool®*** will be halted.

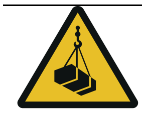
2.9 Protective measures

Personal safety equipment

To reduce the risk of accident:

- Do not wear any watches/chain/rings.
- Do not leave any objects in the pockets of your clothing.
- Wear tight-fitting gloves/clothing.
- Wear a hair net (particularly if you have long hair).
- In the extrusion area, wear heat-resistant protective clothing and eye protection.
- Wear safety gloves

During assembly



Hazard!
Lifting when loading and unloading
Severe injury due to falling loads
Barriers in the lifting area, including those of the invisible

During startup

Hazard!
Sled moves to the starting and final position
Crushing of fingers and hand
Safety barrier in the form of a protective grate, safety light curtains or similar protective equipment
Limit the forward thrust to 150N (0.6Nm on the motor)

Hazard!
Screwdriving process
Laceration of fingers
Safety barrier in the form of a protective grate, safety light curtains or similar protective equipment
Limit the forward thrust to 150N (0.6Nm on the motor)

Hazard!
Sled unexpectedly moves to a new position
Injury to the hands and arms
Safety barrier in the form of a protective grate, safety light curtains or similar protective equipment
Limit the forward thrust to 150N (0.6Nm on the motor)

During manual operation

The supervisory person will visually inspect the components of the ***maku-DieTool®*** (actuator, carriage, tracks, die bolts, energy chain, cable). He will check the starting and final position of the carriage.

Hazard!
Carriage moves to the starting and final position
Crushing of fingers and hands
Safety barrier in the form of a protective grate, safety light curtains or similar protective equipment
Limit the forward thrust to 150N (0.6Nm on the motor)

Hazard!
Actuator process
Laceration of fingers
Safety barrier in the form of a protective grate, safety light curtains or similar protective equipment
Limit the forward thrust to 150N (0.6Nm on the motor)

Automatic mode

The supervisory personnel will inspect the function of the ***maku-DieTool®*** during operation. They monitor and evaluate the function of the ***maku-DieTool®*** purely by watching it and recognize any malfunctions that occur.

Hazard!
Carriage moves to the starting and final position
Crushing of fingers and hand
Safety barrier in the form of a protective grate, safety light curtains or similar protective equipment
Limit the forward thrust to 150N (0.6Nm on the motor)

Hazard!
Actuator process
Laceration of fingers
Safety barrier in the form of a protective grate, safety light curtains or similar protective equipment
Limit the forward thrust to 150N (0.6Nm on the motor)

Hazard!
Carriage unexpectedly moves to a new position
Injury to the hands and arms
Safety barrier in the form of a protective grate, safety light curtains or similar protective equipment
Limit the forward thrust to 150N (0.6Nm on the motor)

Care and control work

Hazard!
Carriage moves to the starting and final position
Crushing of fingers and hand
Safety barrier in the form of a protective grate, safety light curtains or similar protective equipment
Limit the forward thrust to 150N (0.6Nm on the motor)

Hazard!
Actuator process
Laceration of fingers
Safety barrier in the form of a protective grate, safety light curtains or similar protective equipment
Limit the forward thrust to 150N (0.6Nm on the motor)

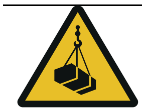
Maintenance and repair work

Hazard!
Carriage moves to the starting and final position
Crushing of fingers and hand
Safety barrier in the form of a protective grate, safety light curtains or similar protective equipment
Limit the forward thrust to 150N (0.6Nm on the motor)

Hazard!
Actuator process
Laceration of fingers
Safety barrier in the form of a protective grate, safety light curtains or similar protective equipment
Limit the forward thrust to 150N (0.6Nm on the motor)

Hazard!
Carriage unexpectedly moves to a new position
Injury to the hands and arms
Safety barrier in the form of a protective grate, safety light curtains or similar protective equipment
Limit the forward thrust to 150N (0.6Nm on the motor)

During disassembly



Hazard!
Lifting when loading and unloading
Severe injury due to falling loads
Barriers in the lifting area, including those of the?? invisible

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2.10 Residual risks

The risk of the ***maku-DieTool®*** without special measures already falls under the scope of the accepted risk. Under certain circumstances, this could result in treatable injuries, which incapacitate staff. The probability of reaching into the running machine is classified as improbable based on the temperature of the surrounding machine in the amount of 200 – 300 °C.

However, the risk of injury can be further minimized by reducing the forward thrust or mounting a protective hood on the ***maku-DieTool®***, which is electrically monitored. (total mass approx. 22 Kg). A preliminary visual and acoustic warning in manual operation will only result in a subjective improvement of safety as the risk of reaching into the machine, which is nonetheless minimal, is not rendered impossible.

Safety barriers such as protective grates, safety light curtains or similar safety protection equipment prevent persons from coming close to the ***maku-DieTool®*** during operation. As soon as one of the protective devices opens or is stepped through, the carriage and the actuator will be halted and switched off due to the emergency.

3 Product contents

The ***maku-DieTool®*** consists of the following modules:

- Adjustment system
- Cable according to the cable plan
- Power/control cabinet

4 Technical description

4.1 Overview funtional description

The ***maku-DieTool®*** adjusts die bolts based on the measurements performed by a gauging system or manual entree. If new measurements are sent to the ***maku-DieTool®*** by a gauging system, an adjustment cycle will be initiated in accordance to the selected algorithm in order to align the flat trajectory with the desired target value.

4.2 Module 1

Cross beam, carriage, actuator unit and mounting brackets

Figure 2: machine layout

maku-DieTool® adjustment system

4.3 Module 2

Cables between Power/control panel and the ***maku-DieTool®***

4.4 Module 3

Power/control panel, touch panel and control elements

4.5 Interfaces

The maku-DieTool® communicates with a gauging system via a network connection (path IP address: machine data → network)

4.6 Nameplate

The nameplate is located on the pneumatic box (drive side)
maku-DieTool®
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www.maku-ag.ch
Tel.: +41 41 620 11 14

4.7 Transport

The ***maku-DieTool®*** must be transported with the transport device provided (crate or support rack)

4.8 Storage

The following guidelines apply when storing the ***maku-DieTool®:***

- dry and protected room
- 10°C and 30°C ambient temperature

5 Installation and start-up

5.1 Installation

The ***maku-DieTool®*** will only be installed by employees of the company maku ag during the first installation.

5.2 Start-up

At the first installation, the ***maku-DieTool®*** will only be commissioned by employees of the company maku ag

5.3 Mechanical installation

First and foremost, the ***maku-DieTool®*** or in particular the cross beam needs to be aligned properly with the die bolts. In order to do that, 2 sets of adjustment bolts are located on the side plates (Fig. 3). One set for the height and the other set for the cross alignment. If the adjustment bolt is being turned clockwise, the cross beam moves towards the adjustment bolt head, if the adjustment bolt is being turned counterclockwise, the cross beam is being moved away from the adjustment bolt head. The alignment needs to be done as such, that the actuator travels along the center of the die bolt with approximately the same distance from the die body. A good alignment ensures proper engagement between the actuator and the die bolts.

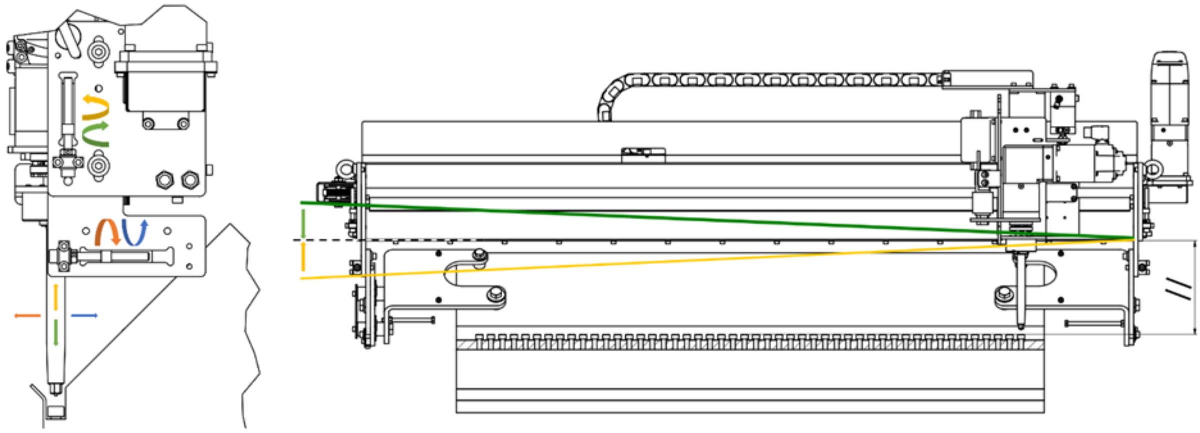

Figure 3: adjustment bolts on side plates

5.4 Angle adjustment

The actuator needs to match the angle of the die lip bolts. To measure the angle of the actuator, angle measurement devices should be used. With the angle adjustment bolt(s), located on the side plates(s), the angle of the actuator can be adjusted to the correct value.

6 Control and display elements

Figure 4: position of the control and display elements

6.1 Main switch

Turning the main switch will connect the machine to feeding power.

6.2 Emergency off

If an emergency stop button is pushed, the lateral axis and the actuators are brought to a stop and switched off in connection with the emergency.

6.3 Safety barriers

Safety barriers such as protective grates, safety light curtains or similar safety protection equipment prevent persons from coming close to the ***maku-DieTool®*** during operation. As soon as one of the protective devices opens or is stepped through, the lateral axis and the actuators will be halted and switched off due to the emergency.

6.4 Key switch bypassing the safety barrier

The bypass safety barrier key switch can be used to bypass the safety barrier for the purpose of maintenance. A message is shown on the panel. If the safety barrier is bypassed, the ***maku-DieTool®*** can only be operated in manual mode and only one adjustment at the time can be made. The speed of the lateral axis is also limited. If the key switch is used during automatic operation or processing of multiple die bolts, the ***maku-DieTool®*** will be halted.

6.5 Control ON illuminated button

Pushing the control unit ON button will activate the emergency off relay and energizes the motor control units. The button illuminates to indicate this. If the button doesn't light up, the emergency off circuit has been interrupted. If the emergency off relay cannot be switched with the control unit button ON, not all switching elements are in the standard position.

6.6 Start illuminated button

Pushing the illuminated start button activates the ***maku-DieTool®***.

6.7 Stop button

The stop button switches the machine off. In the process, the carriage will move to the home position. In addition, if the button is pushed for longer than two seconds, the remaining die bolt orders will be deleted.

6.8 Fault lamp

The fault lamp will light up if the machine has a fault.

6.9 Start-up warning lamp

The start-up warning lamp indicates that the ***maku-DieTool®*** is moving. The lamp warns shortly before the maku-DieTool® moves.

7 Control software

7.1 Control concept and screen layout

Using the touch panel

General information

WARNING!
Pushing the touch panel with a hard, pointy or sharp object as well as forcefully pushing the touch panel will significantly reduce its service life and could even break the touch panel. Only touch the touch panel with your finger or a soft touch pen.

7.2 Entering a variable

The corresponding variable field is touched in order to enter or change a variable. If it is possible to enter or change a value for this variable, a numerical or alphanumerical input keyboard will appear on the screen. The [Return/Enter] button must be pushed to confirm the new variable. If the variable is too large or too small, the upper and lower limits will be shown with a variable field. The entry will be interrupted with the [ESC] button.

7.3 Password

The entry of a password is required to adjust a variable or open a certain screen.

8 Screen masks

8.1 Referencing servo axes

The servo axes can only be operated if they have been referenced. As the axes have an absolute encoder system, the axes do not have to be referenced after a power cutoff.

Important: If the power and absolute encoder cables are disconnected from the maku-DieTool, the device must first be turned off by pushing the main switch (OFF). Otherwise there is the risk that the absolute encoder loses its position and has to be referenced.

Figure 5: reference die lip actuator and cross beam

If a servo regulator has been replaced, the axis must be referenced. This can be done under [menu] → [reference] →[axes].

Before referencing the carriage, the carriage must first be moved to the reference point with the encoder, the reference point is 300 mm away from the side of the cross beam where the encoder counts negative:

1. Move carriage back and forth to determine the negative count
2. Move carriage all the way to the side plate where the encoder counts negative until it touches the side plate.
3. Refence the carriage by pushing the button <reference cross beam>, push it twice to confirm it. The reference point is set at 300 mm (but in reality, it is not, so continue with point 4)
4. Push the button <reference cross beam> again, move the carriage 300 mm from the side plate where the encoder counts positive until it reaches 600 mm
5. Refence the carriage by pushing the button <reference cross beam>, push it twice to confirm it. The reference point is set at 300 mm for good now.
6. The button <reference die lip actuator> just needs to be referenced without turning

orange	carriage is not referenced
green	carriage is referenced

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8.2 Determine cross beam limits and home position of the carriage

To determine the limits (high and low) the cross beam can travel go to [menu] → [die data] → [die data] →[cross beam].

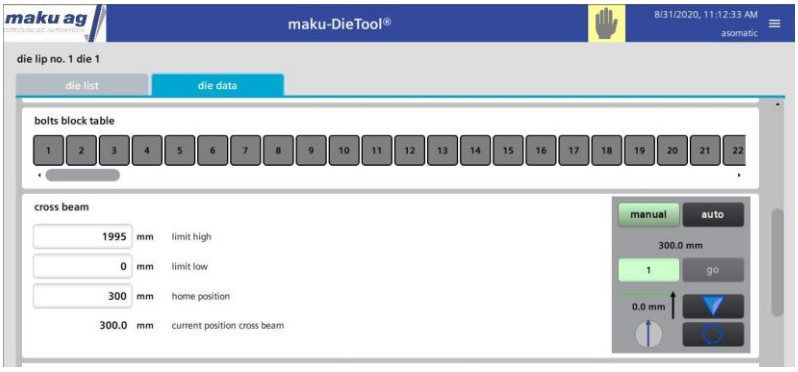

Figure 6: determine the limits

The home position can be set anywhere between the two limits [menu] → [die data] → [die data] → [page 3 of 3].

8.3 Referencing the pneumatic piston stroke

The signal from the position sensor must be aligned with the stroke of the pneumatic piston. This needs to be done after the sensor has been remounted or moved to a new position.

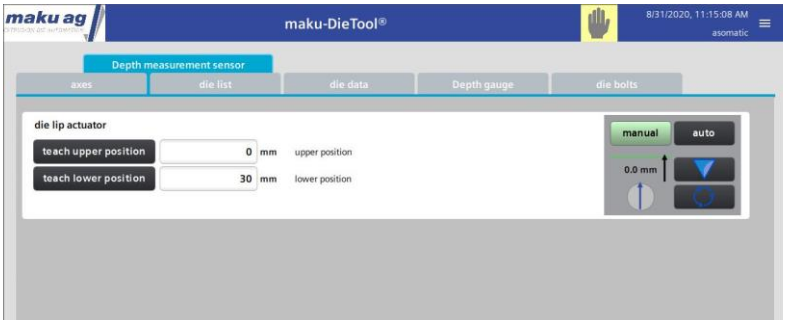

Figure 7: teach upper and lower position

8.4 Referencing of the actual profile

The actual profile or lip opening must be entered in the PLC. In order to do this, all die bolts are adjusted manually to the same reference value with the feeler gauge. The reference value is then entered in the menu [maku-DieTool]. When the [reference] button is pushed and confirmed, all values in the actual profile are set accordingly.

8.5 Determine engagement depth

The engagement depth is determined when the actuator is indeed engaged with the die bolt. This can be done by moving the actuator to a die bolt position and lowering the actuator (the button “control on” must be illuminated in order to do that). If the actuator is not engaged, it needs to be raised and slightly rotated and lowered again. This procedure needs to be repeated until the actuator is firmly engaged with the die bolt. When the actuator is firmly engaged, the engagement depth can be stored with the button “record die bolt engagement”. This depth applies for all other die bolts as well.

Or, with the button [start measurement], the actuator taps every single die bolt on top calculating the engagement depth with preset parameter under [referencing] → [depth measurement sensor]. Note, after every adjustment, the new engagement depth is updated automatically.

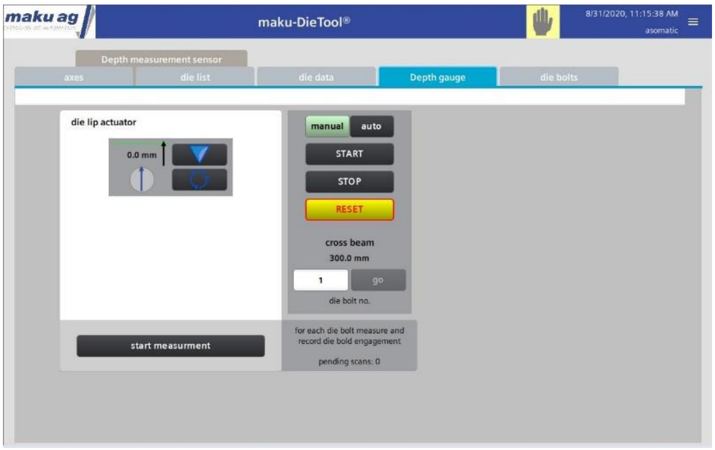

Figure 8: measure engagement depth

8.6 Determine engagement time

The engagement time is defined as the time it takes to engage the actuator with the die bolt. There are 2 different settings which can be used:

A. The actual time to engage from the 0 position to the engagement depth. A shorter time can also be chosen for the searching motion or

B. The time in seconds per millimeter (e.g. 1.2 sec. per 80 mm would result in 0.015 sec/mm). This is a more dynamic and suitable setting for larger differences of the die bolt heights (push/pull).

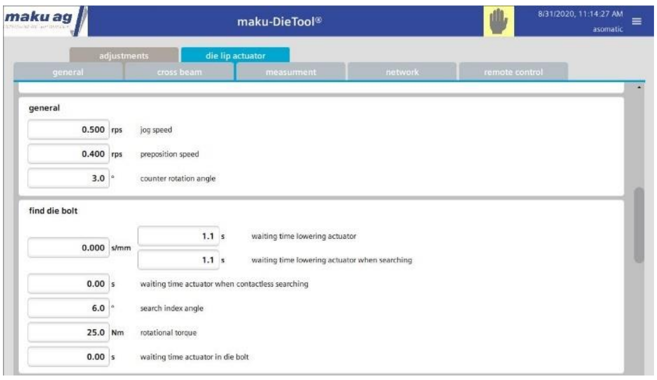

Figure 9: engagement time

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8.7 Pneumatic box

The pneumatic piston requires 1-3 bars to lower the piston. A pneumatic piston with the locking mechanism, it requires a minimum of 3 bars to lower the piston. With the reducer valve (silver knob), the pressure can be adjusted (clockwise it increases, counterclockwise it decreases the pressure).

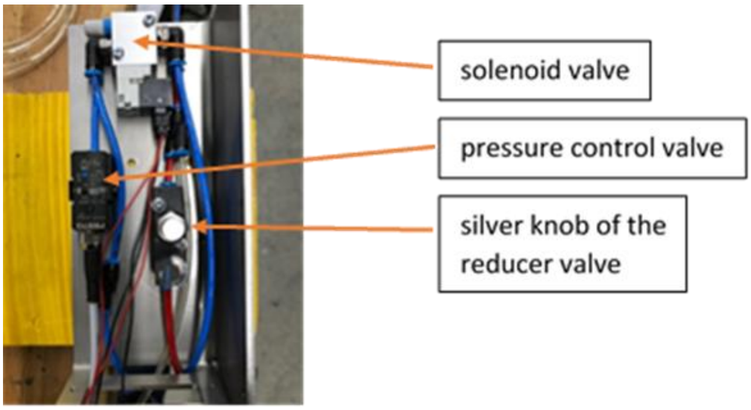

Figure 10: pneumatic box

9 Die data

The die list can be accessed with the buttons [die data] → [die list]. A die can be selected or reparametrized in this case.

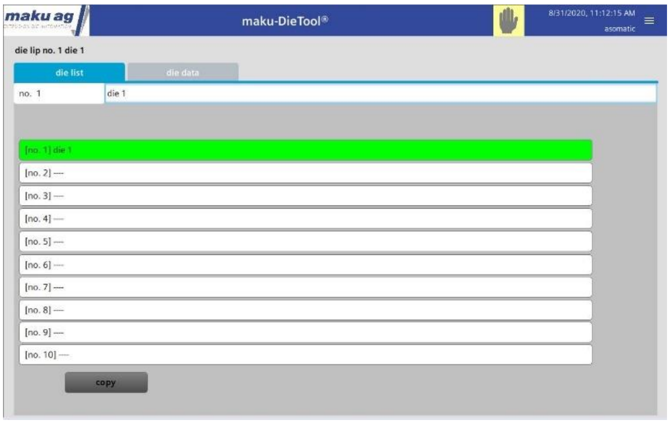

Figure 11: select die

9.1 Setting up the die parameters

The parameters for every individual die (up to 10 recipes) is stored under [die data] → [die data].

Figure 12: die lip data

9.2 Die bolt positions cross beam [position table]

Depending on the reference point of the carriage (300mm), the smallest die bolt number can be located on any side of the die. The home position of the carriage can be anywhere along the cross beam. The numbering of the die bolts can be reserved in the machine data

0.0mm______________carriage____________x mm

300 mm reference point
1 die bolt number or
n die bolt number 1
die middle with die bolt number x

9.3 Determining the reference die bolt

In order for the carriage to engage with any die bolt, the exact position of each die bolt is stored in a table. Any die bolt can be selected as the refence die bolt. The calculation of the positioning table is under [die data] → [die data] → [positioning table] → [calculate]. If the reference die bolt and the distance to the reference die bolt has been entered, the actuator can be lowered with the ▼ button to see how it is aligned against the die bolt.

If the actuator is too far left or right, move the actuator by using the offset button.

9.4 Thermal expansion

As thermal expansion cannot be neglected with respect to the die bolt spacing. It must be determined in the product parameters. The expansion is described as µm/m. This value can be best obtained by measuring the distance between the first and last die bolt in a cold and hot die condition.

9.5 Blocking die bolts

Under [die data] → [die data] die bolts can be blocked. Blocked means that these die bolts can neither be approached/adjusted in manual nor automatic mode.

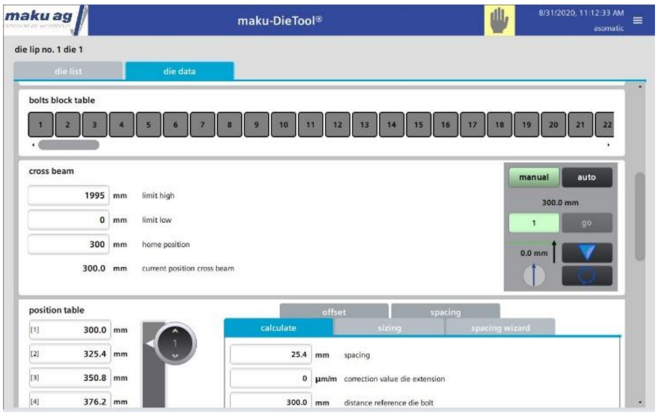

Figure 13: block die bolts

9.6 Absolute die bolt limitation

The die bolts can be limited to an absolute opening or closing value. This means the die bolts are moved no further than up to these limits. A message indicates if a die bolt is limited.
Absolute limitation only works properly if the die bolt profile was referenced and corresponds with the actual positions.

9.7 Maximum difference to neighboring die bolt

This limits the difference in adjusted values from die bolt to die bolt. A message indicates if a die bolt is limited. The differential limitation only works correctly if the die bolt profile was referenced and corresponds with the actual lip opening.

10 Manual mode

Manual mode is for adjusting single, multiple or all die bolts. The screens <manual operation> is accessed on the main screen with the button [manual mode].

10.1 Activating manual mode

The manual mode function is activated when the button [manual mode] is green and deactivated when its grey. In order to turn it on and off, the machine has to be stopped.

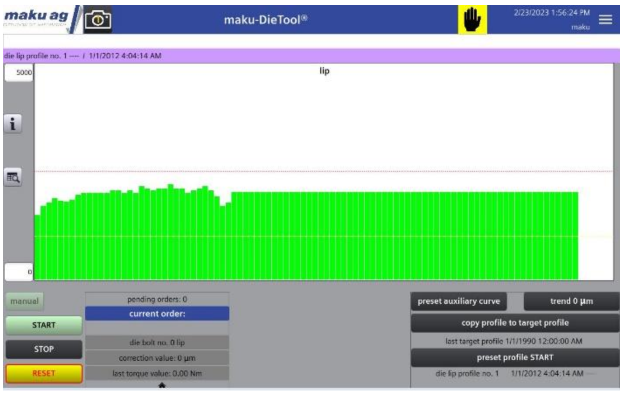

Figure 14: manual mode

10.2 Manually adjusting die bolts

In manual mode, single, partial or all die bolts can be adjusted for a certain value. The machine must be started in manual mode for this. The adjustment value is determined in the [manual mode] screen as well as the [close/open] button. The maximum difference to the neighboring die bolt is considered as well in the manual mode.
The die bolt order can be entered reversely by entering the higher die bolt number on the left and the lower one on the right. The die bolt number refers either to the lip or the restrictor bar.

11 Home screen maku-DieTool®

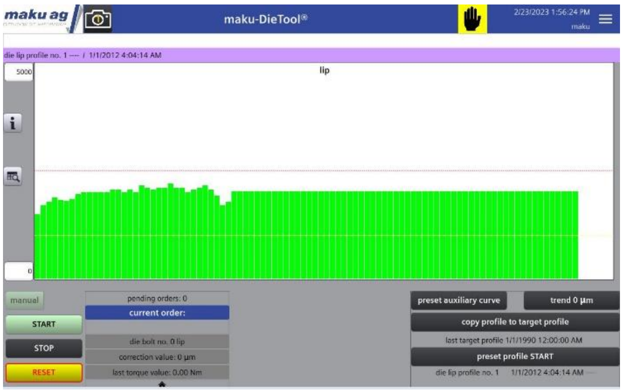

Figure 15: home screen maku-DieTool®

12 Process data

Under [maku-DieTool®] → [process data] different information regarding the workflow is shown. The target value can be either taken from the gauging system by activating the button under [home] → [control algorithm] → [measurements] or a desired target value can be entered manually under [nominal value product thickness]. The flatting mode is activated if all measurements of the die bolts considered for the automatic mode are either above or below the nominal value product thickness. If the nominal value product thickness is set to 1 µm, the mode will remain in the flatting mode.

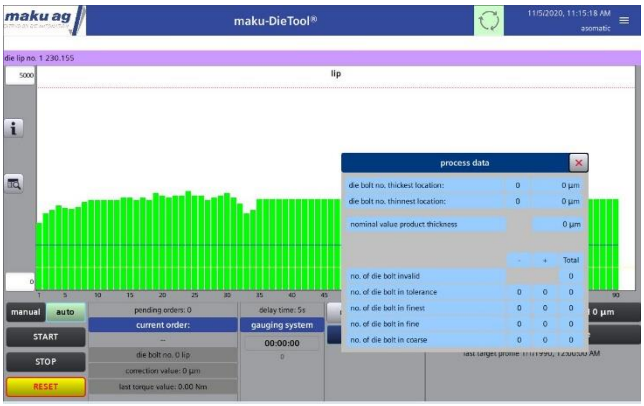

Figure 16: process data

13 Control algorithm

13.1 Measurements

The target value as well as the line speed can be taken from the gauging system (if available). Otherwise the target value can be entered manually under [home] → [process data]. If the target value is not taken from the gauging system, it will be calculated based on the average of the number of scans and measurements.

Figure 17: process data

The maximum adjustment value for each zone can be limited to prevent the ***maku-DieTool®*** from overreacting to extreme deviations.

Figure 18: max. adjustment value

The number of the scans for averaging proposes for the different zones can be determined separately. The collection of scans starts after the delay time has passed.

Figure 19: delay time gage measuring system

13.2 Control algorithm

The difference between die gap and the measured product thickness by the gauging system is described as the drawdown ration. It determines the intensity of the reaction on the die gap.

The order of adjustments depends on the selection of control algorithm. The following algorithms can be selected:
1. high and low spots within the same adjustment cycles
1.1 high and low spots within separate adjustment cycles (alternating)
2.1 coherent high and low spots within the same adjustment cycle
2.2 coherent high and low spots within separate adjustment cycle (alternating)

The minimal no. of die bolts in zone only applies for the algorithms with coherent adjustments.

Figure 22: product data control algorithm

The measurements are categorized by zones depending upon the deviation in regards to the target value. The zones are called coarse, fine, finest and dead zone. The zone limits are determined by high (positive) and low values (negative). Measurements located in the dead zone are not taking into consideration for the next adjustment cycle. The other zones and their limits are determined by higher limits.
The adjustment cycles start from the highest to the lowest deviation in regards to the target value unless it's changed under [menu] → [die data] → [control algorithm] to the numeric order [adjust profile in the order of the die bolt number].

The number of adjustments for each adjustment cycle can be limited if needed. The number of adjustments gets doubled if high and low spots are adjusted within the same adjustment cycle. The relative correction value in regards to the deviation to the target value is also zone depended.

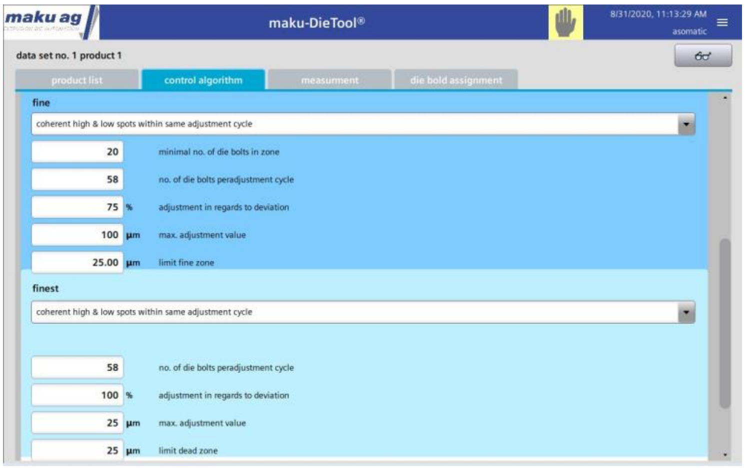

Figure 23: product data control algorithm

13.3 Die bolt assignment

Die bolts can be dismissed. They are not considered in automatic mode, only in manual mode. These parameters are stored under [main screen] → [control algorithm] → [die bolt assignment].

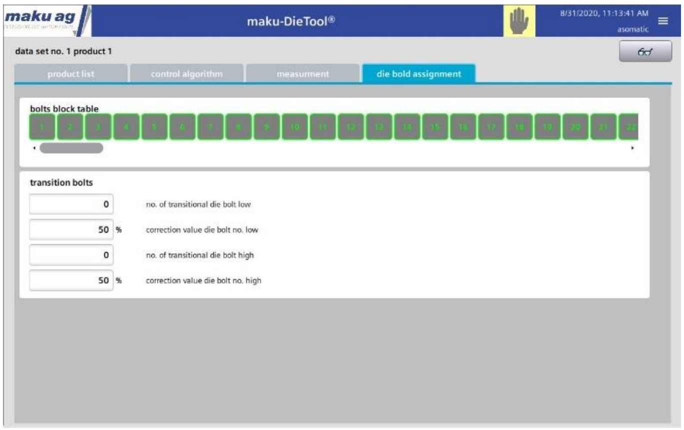

Figure 24: product data die

13.4 Product list

In order to select a product, the product list can be accessed under [main screen] → [control algorithm] → [product list].

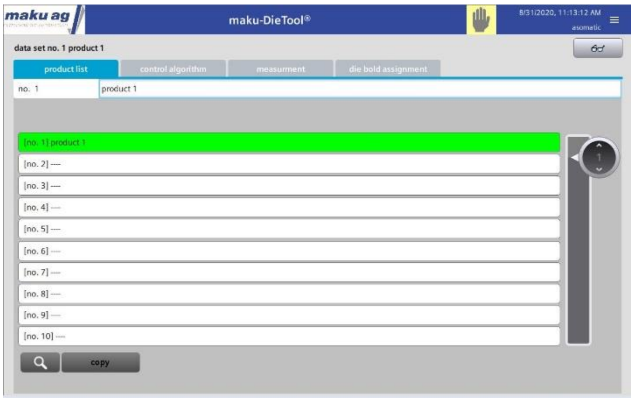

Figure 25: control algorithm data list

The following steps are taken to change products:
[stop] → [home] → [control algorithm] → [product list] → select product by pushing the product number button. The parameters of the previous product are automatically saved.

13.5 Copying the data record

Profiles can be copied to another profile number with the copy function.

14 Profile data

The profile data shows the profiles of die gap and restrictor bar. It shows the current (green bars) and target profiles (blue line). After every adjustment, the current profile is updated automatically.

The die bolt profile is shown under [profile data] with the button [actual profile] as a bar diagram. Manual die bolt adjustments without the ***maku-DieTool®*** results in a discrepancy between the die bolt profile which is displayed and the actual profile.

14.1 Profile list

The target profiles (die gap und restrictor bar) can be managed in der profile list [profile data] → [profile list]. Up to 30 profiles can be managed and saved thereunder.

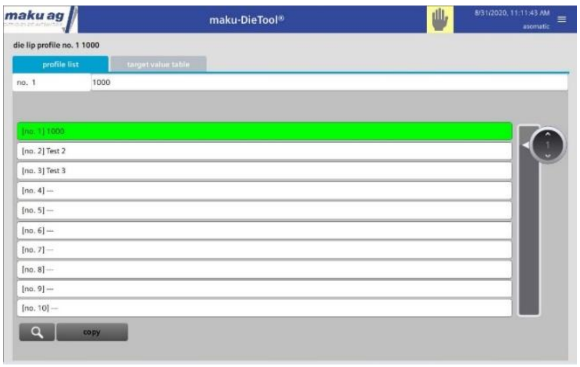

Figure 26: profile list lip

14.2 Creating a target profile

A target profile can be created by entering die gap or restrictor bar values for each bolt in the target value table. The table can be accessed under [menu] → [profile data] → [target value table].

Figure 27: die bolt profile actal value table lip

14.3 Save the current actual profile as the target profile

With the button [save profile in the target profile], the profile gets overwritten by the currently configured profile.

14.4 Copying the target profile

The current target profile can be copied to another profile number with the profile copy function.

14.5 Preset profile

Pushing the button [preset profile START], the die gap or restrictor bar profile is applied to the selected target profile. The parameters "maximum adjustment values" and "maximum difference between the position to the adjacent die bolt " are taken into consideration.
Under [main screen] → [system] → [machine data] → [adjustments], it can be determined how the target profile is to be established. Either in numeric order [adjust profile in the order of the die bolt number] or the die bolts are adjusted in order of the highest to the lowest deviation in regards to the target profile.

15 Machine data

The machine data parameters are not project related (global parameters) and applications specific. These settings are primarily established by maku employees during installation and start-up. If needed, the machine data can be accessed under [menu] → [machine data].

16 Machine operating modes

16.1 Manual mode

The manual mode is for adjusting an individual die bolt [one], a range of die bolts [part] or all die bolts [all].

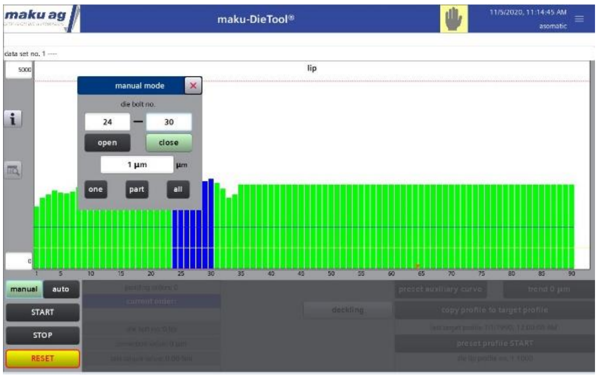

Figure 28: measured values

16.2 Automatic mode

There are different modes which can be operated in depending upon the gauging system and data protocol. The different modes can be selected under system [main screen] → [machine data] → [measurements].

16.3 Mode 1, measured values, maku-DieTool® in control

The measurements allocated to each bolt are sent by the gauging system and analyzed by the ***maku-DieTool®***. The ***maku-DieTool®***, based on its algorithms, generates the necessary adjustments (see chapter 8.7).

16.4 Mode 2, gauging system in control

The gauging system sends an array of deviations in regards to the target value for each bolt to the maku-DieTool®. The maku-DieTool® makes the adjustment in numeric order or from the highest to the lowest deviation in regards to the target profile.

16.5 Mode 3, gauging system profile task

The gauging system sends an array of the die gap for each bolt to the ***maku-DieTool®. The maku-DieTool®*** makes the adjustments in numeric order or from the highest to the lowest deviation in regards to the target profile. The maximum adjustment value is determined under [menu] → [die data] → [control algorithm].

Figure 29: max. adjustment value

17 Switching the machine on

The ***maku-DieTool®*** is switched on using the main switch on the switch cabinet.

17.1 Switching the machine off

The ***maku-DieTool®*** is switched off with the main switch on the switch cabinet.