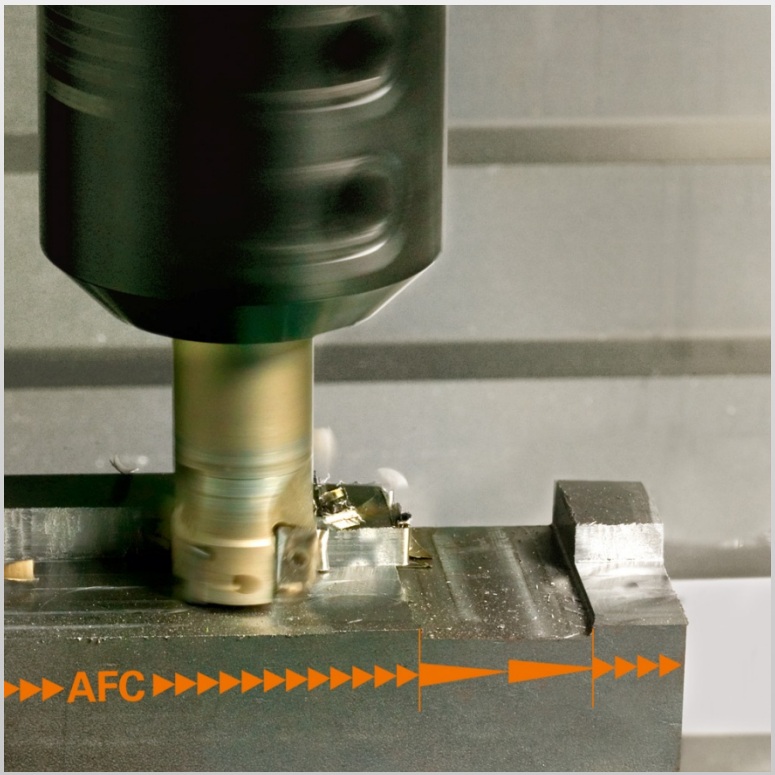
AFC

Adaptive Feed Control (Software Option 45)



HEIDENHAIN

iTNC 530
As of software 340 49x-03
As of software 606 42x-01

TNC 640
As of software 340 59x-02

dynamic + efficiency

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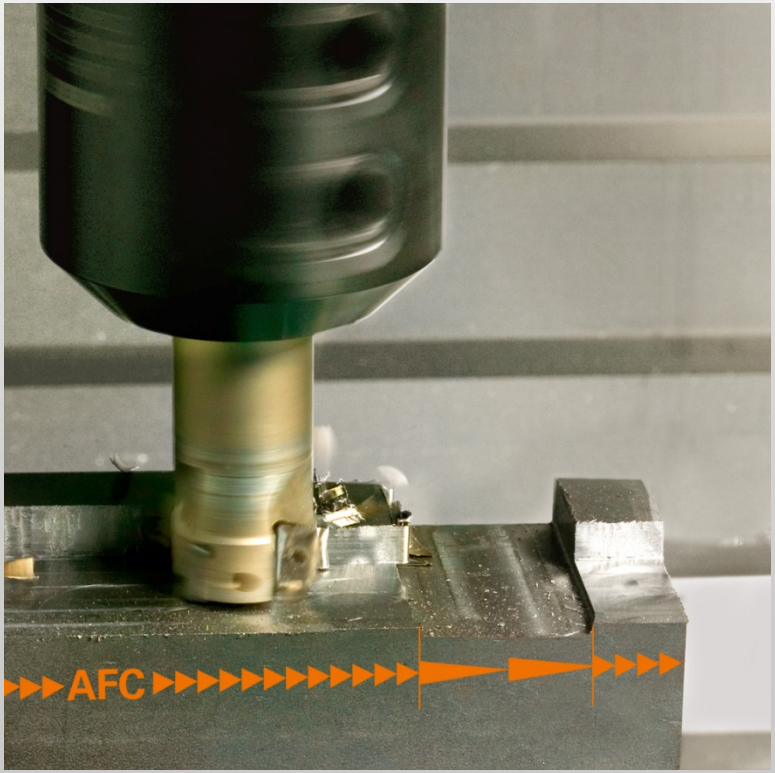
Application



Adaptive Feed Control

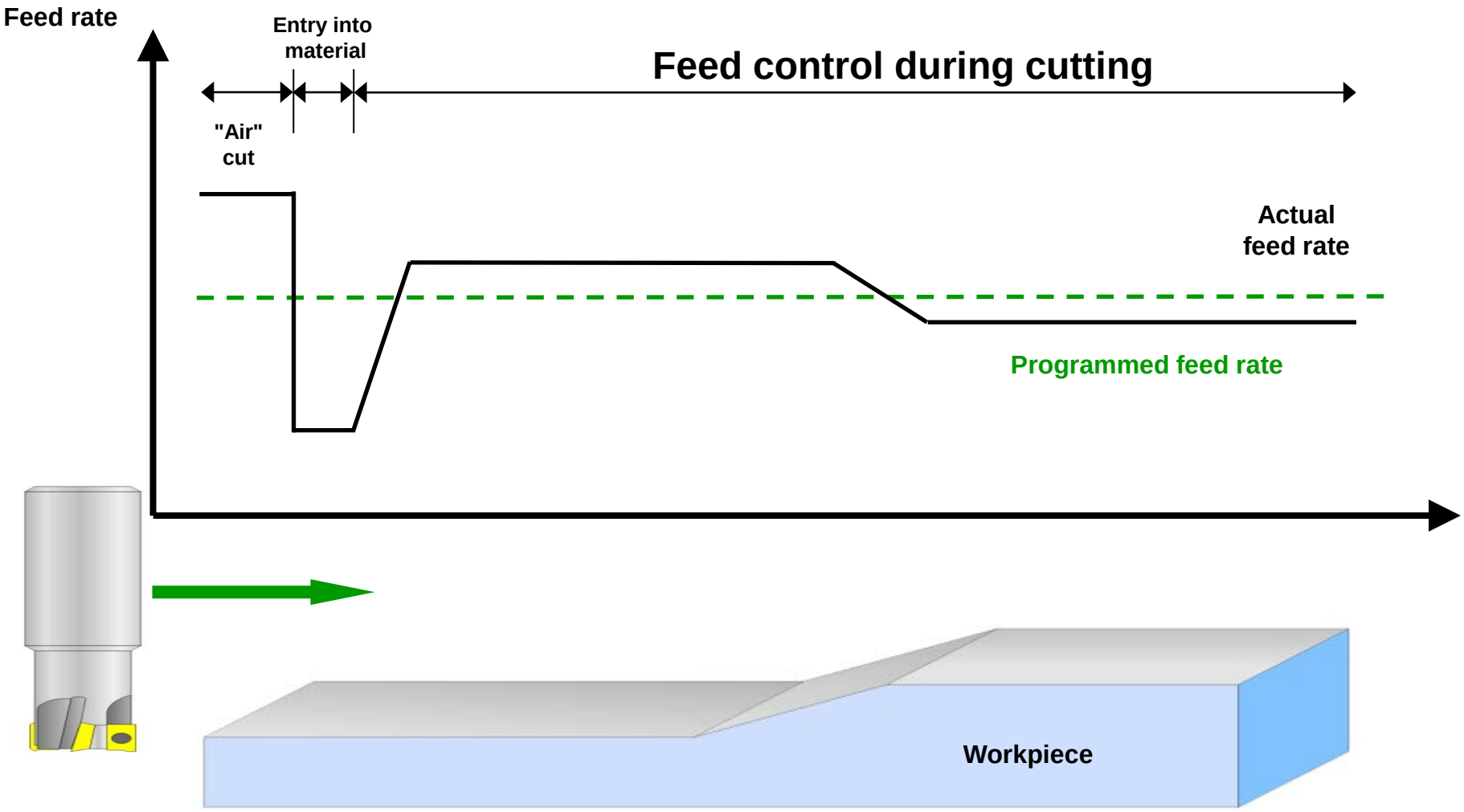
Application

- Extension of tool life
- Optimization of machining time
- Avoidance of tool breakage
- Protection of machine kinematics

Function

- Trigger overload reaction depending on the reference values
- Transfer the spindle reference load
- Adapt the machining feed rate depending on the spindle current consumption

Adaptive Feed Control



Adaptive Feed Control

Name of the control setting for the tool table

Maximum feed rate in % in the material

Feed rate in % upon entry in / exit from the material

Sensitivity of the feed control

Consecutive line number

Feed rate in % as of which there is an overload reaction

Maximum feed rate in % in the air

Spindle performance in % of the ref. load as of which the tool exit is output

Value to be transferred to the PLC

Datei: AFC.TAB

NR	AFC	FMIN	FMAX	FIDL	FENT	OVLD	POUT	SENS	PLC
0	Standard	75	130	140	90	M	8	100	0
1	Test	80	200	300	70	S	6	100	0
2	Versuch	85	180	200	80	F	7	100	0
3	Wert	90	135	160	92	E	10	100	0

[END]

Desired reaction of the TNC to overload:

M: Run a special AFC macro. (defined by the OEM)

F: Output NC stop when the tool has been retracted

-: Do not perform overload reaction

S: Immediately perform NC stop

E: Only error message on the screen

Adaptive Feed Control

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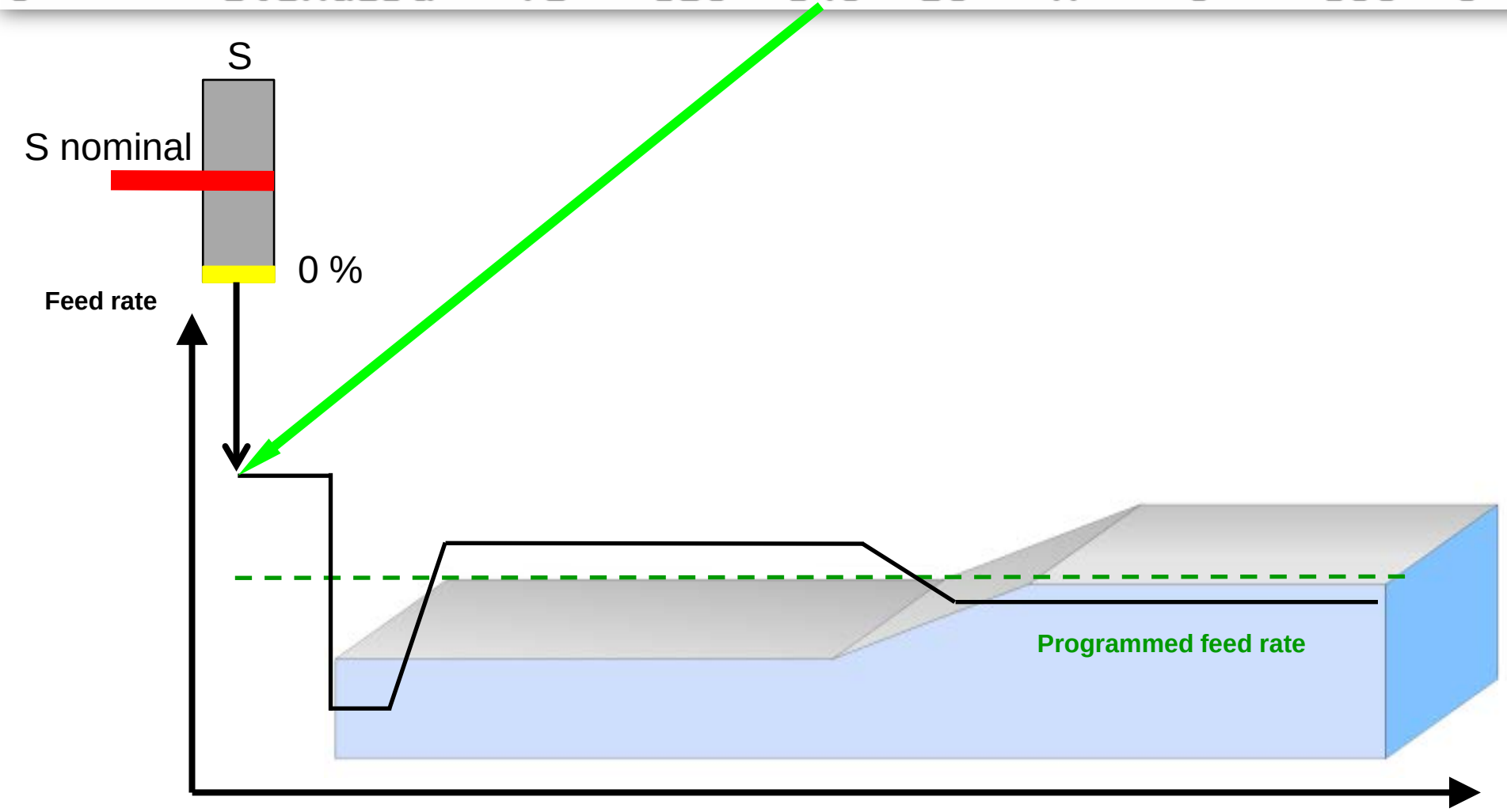
NR	AFC	FMIN	FMAX	FIDL	FENT	OVLD	POUT	SENS	PLC
0	Standard	75	130	140	90	M	8	100	0



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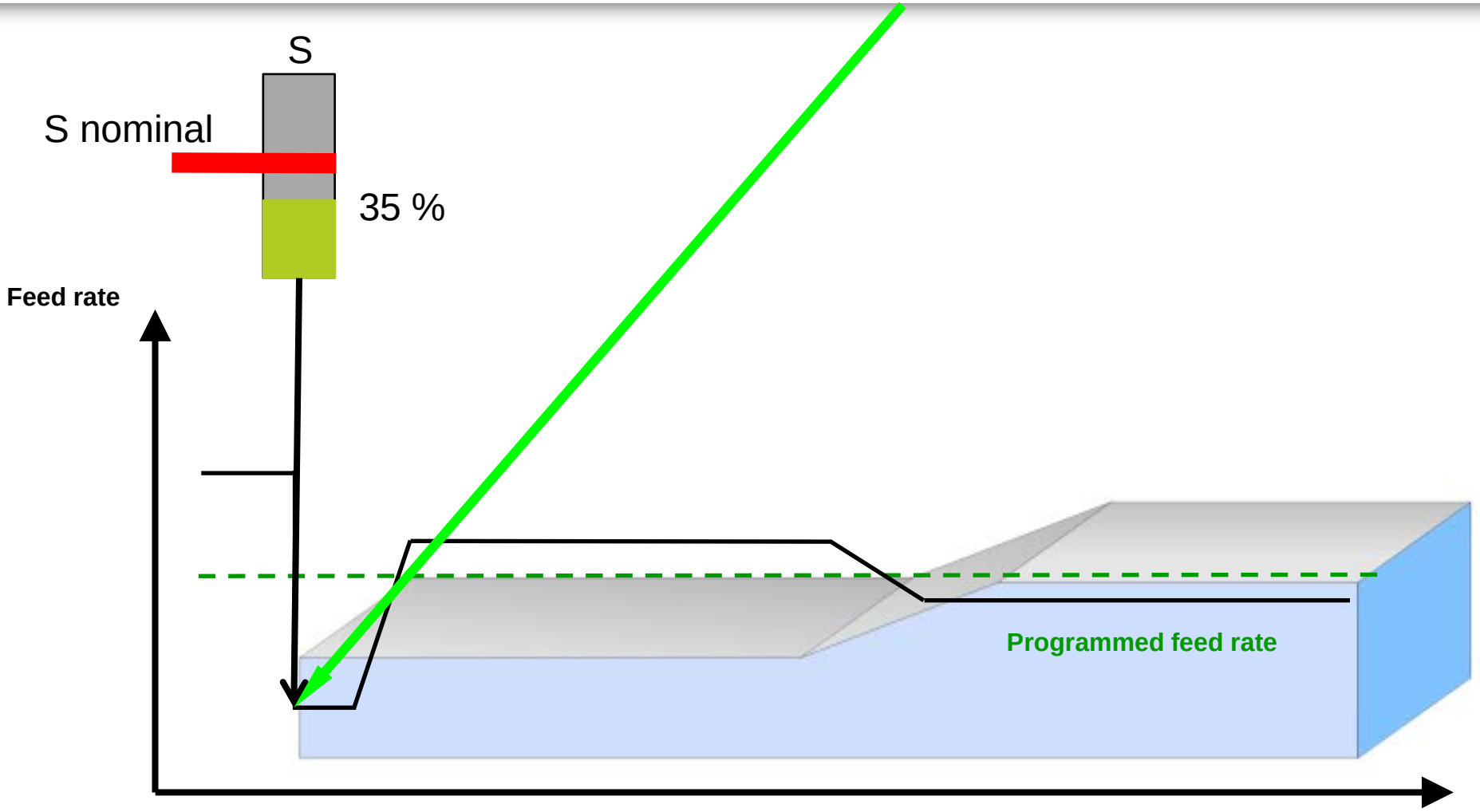

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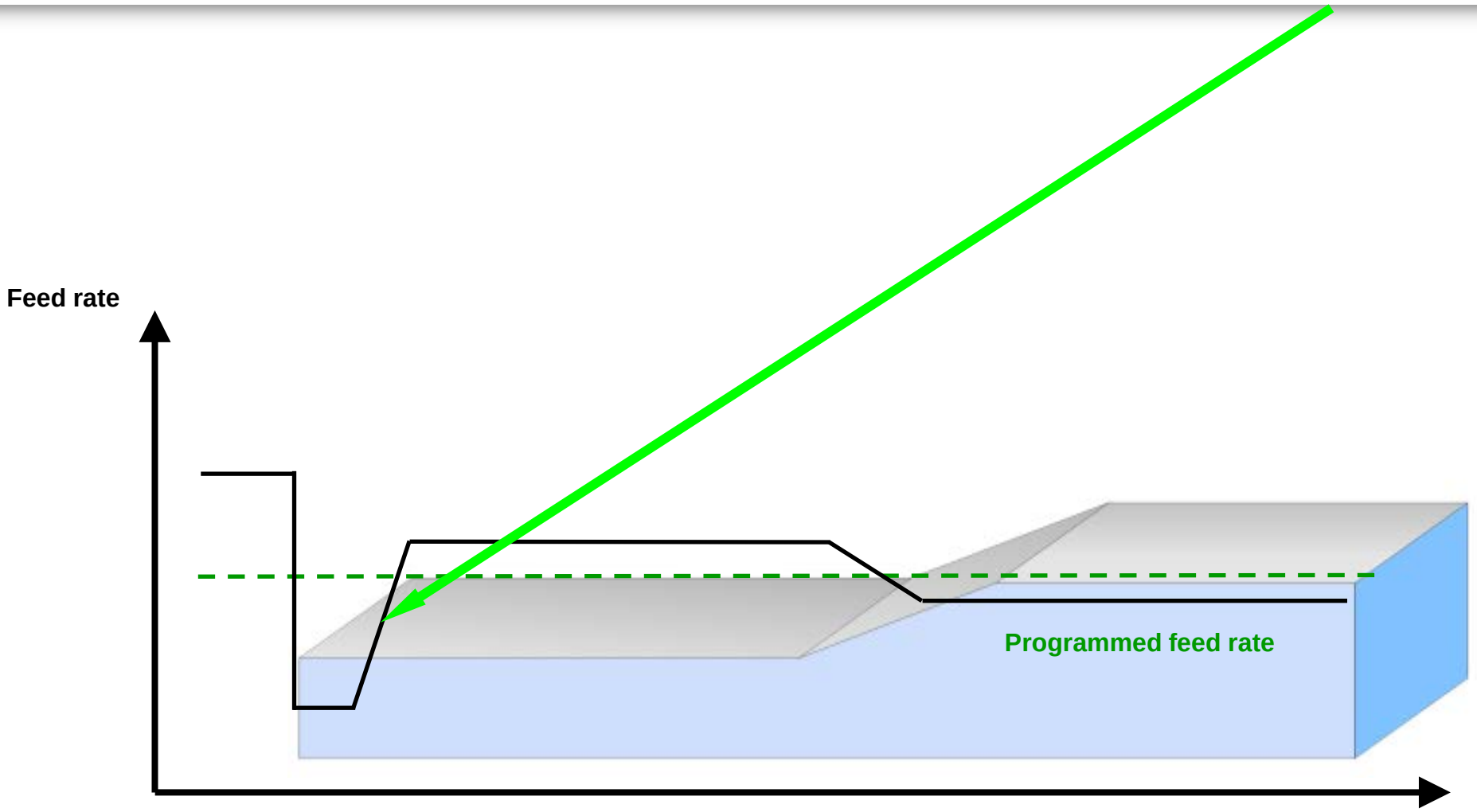

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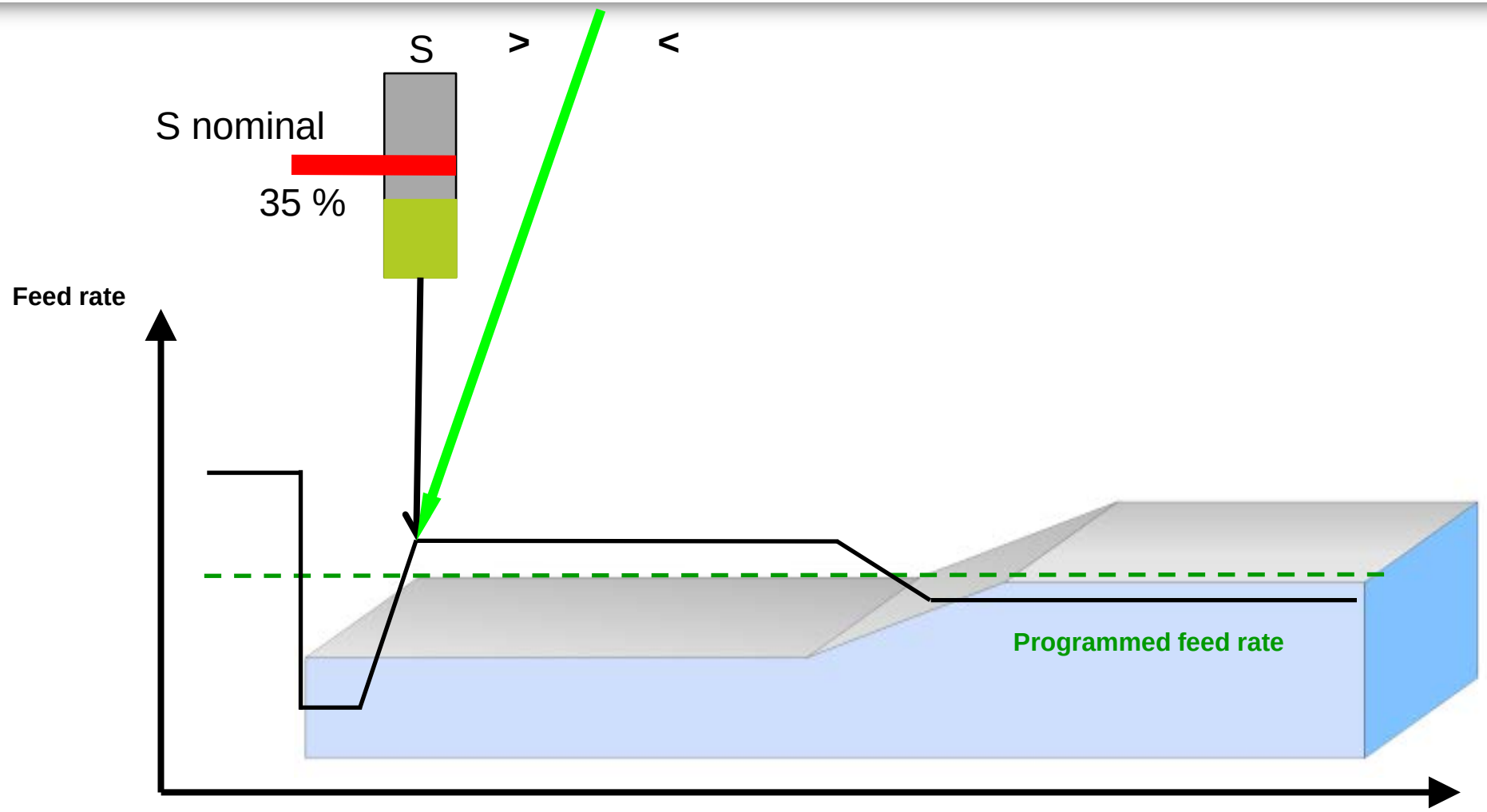

Adaptive Feed Control

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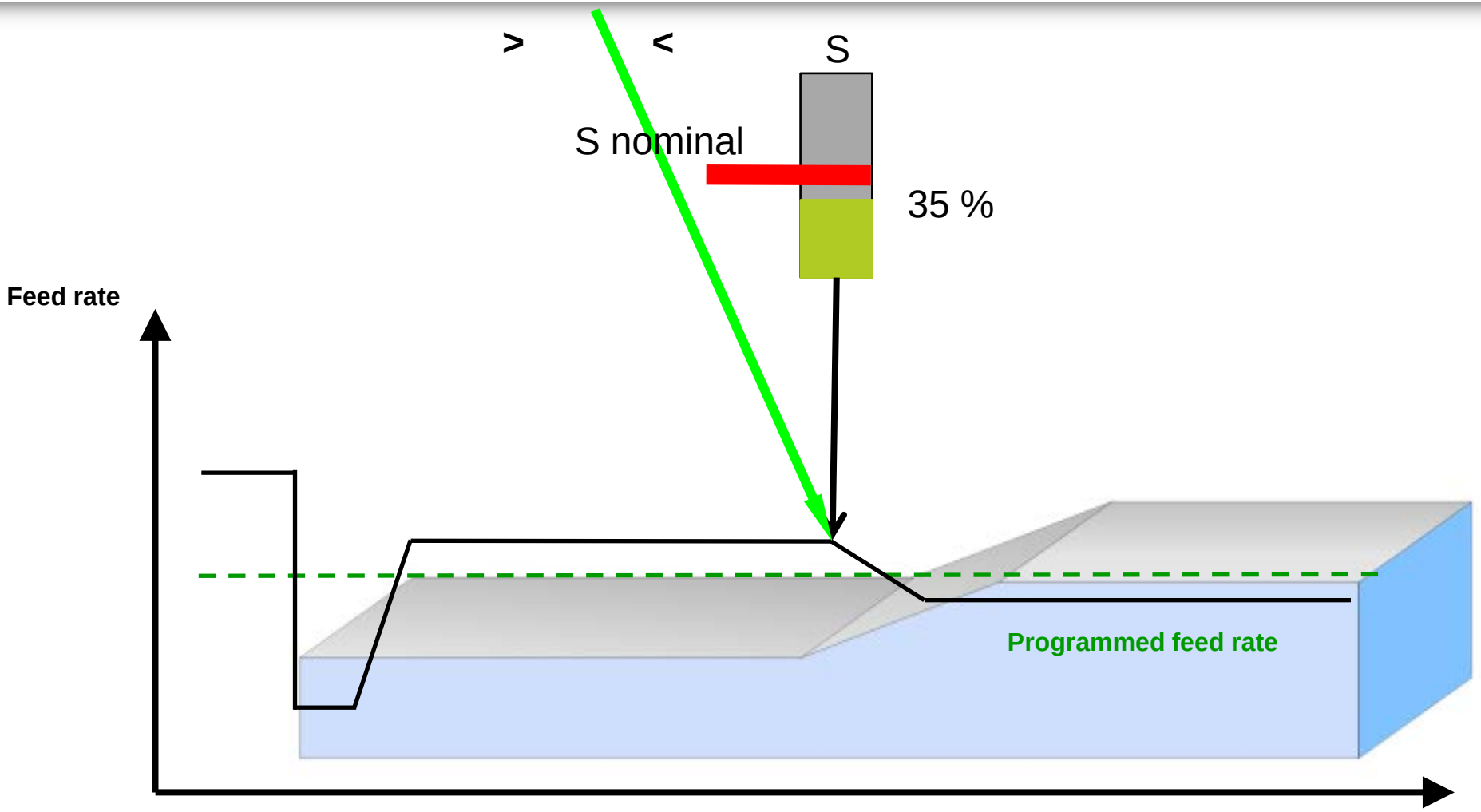

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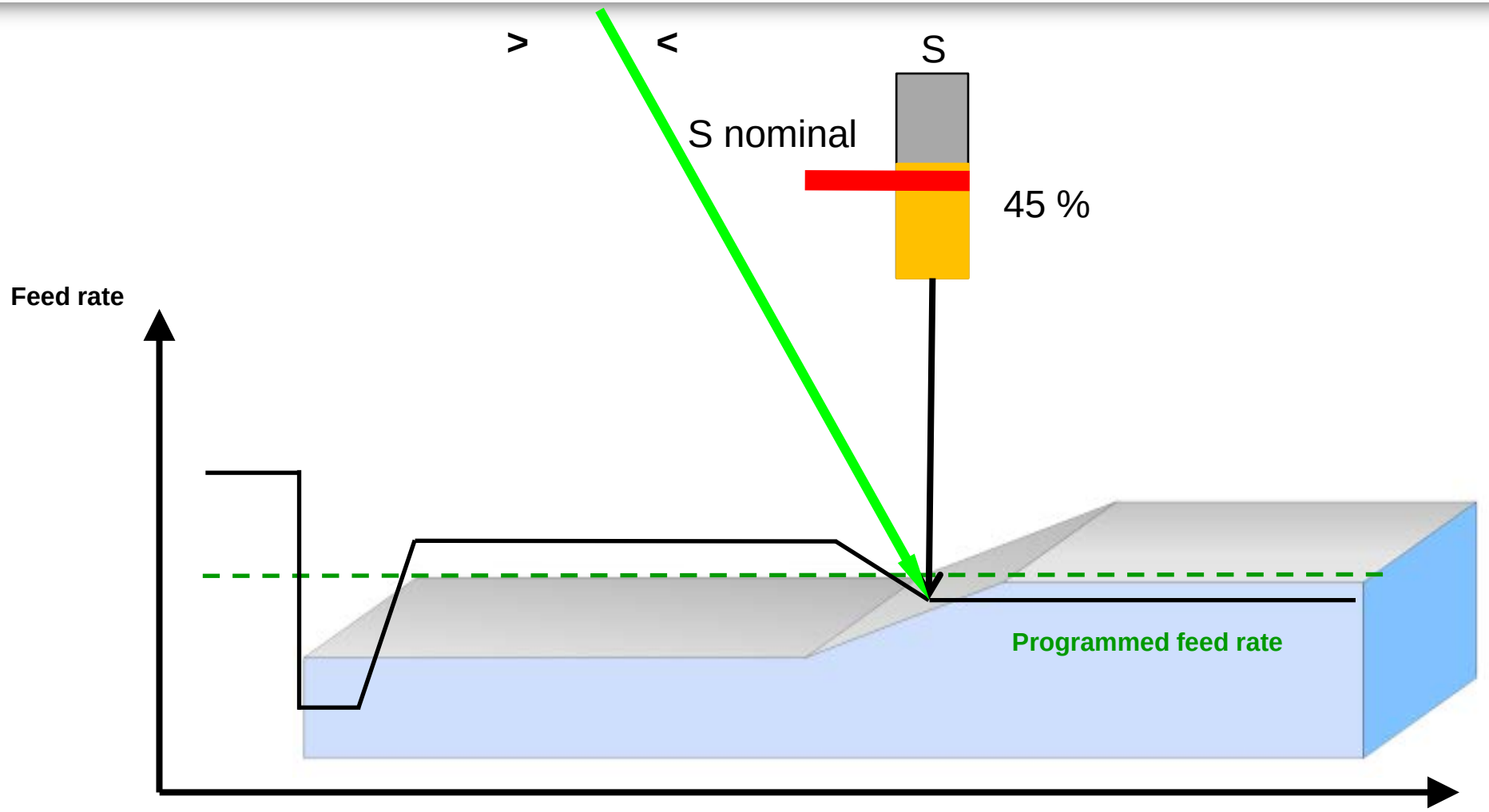

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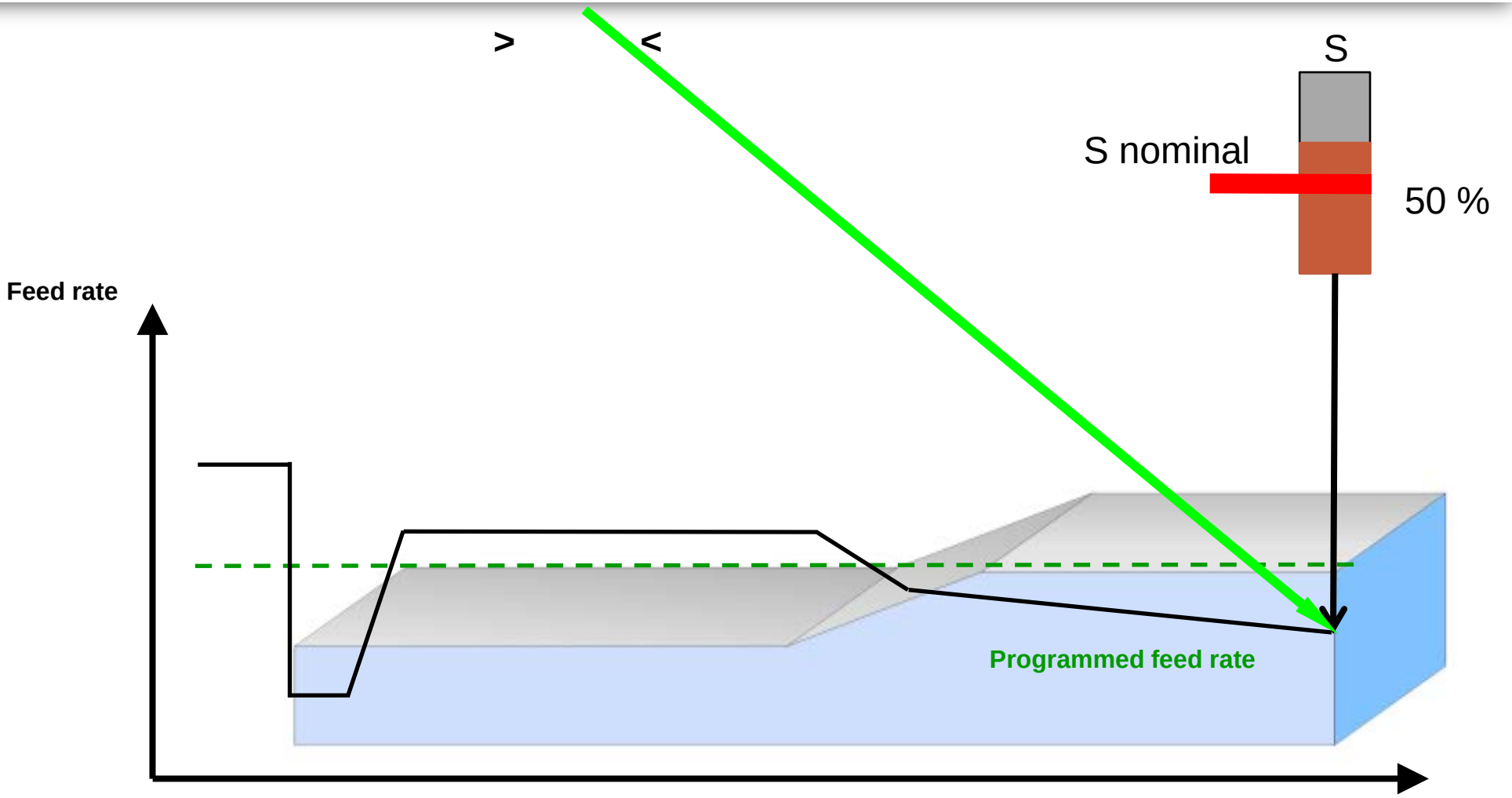

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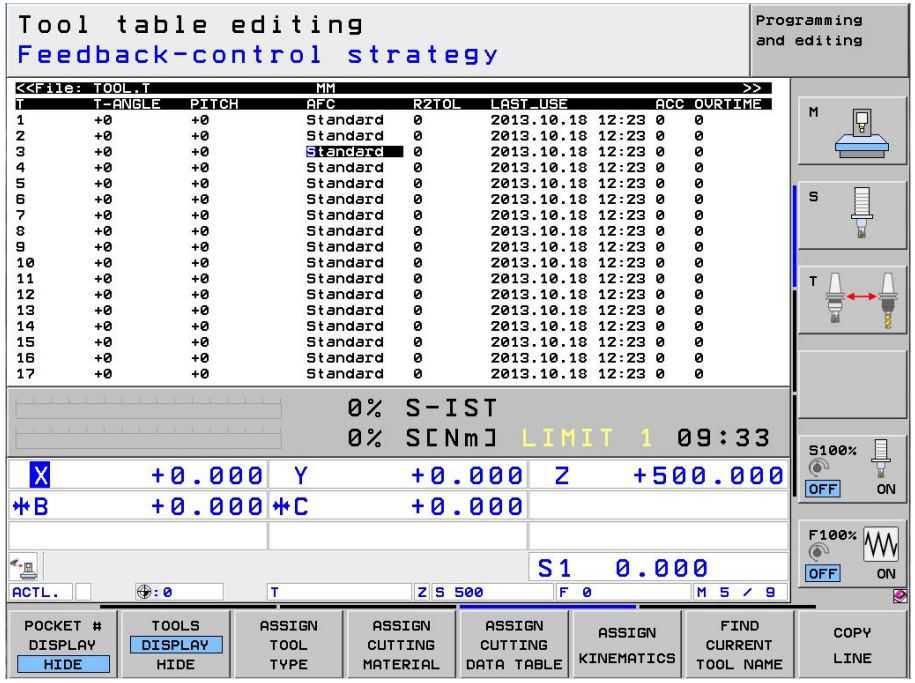
Programming

Preparation:

- **AFC table** (AFC.TAB in the TNC directory)
  - Name of the control strategy
  - FMIN, FMAX, FIDL, etc.
- **TOOL.T**
  - Entry of AFC strategy



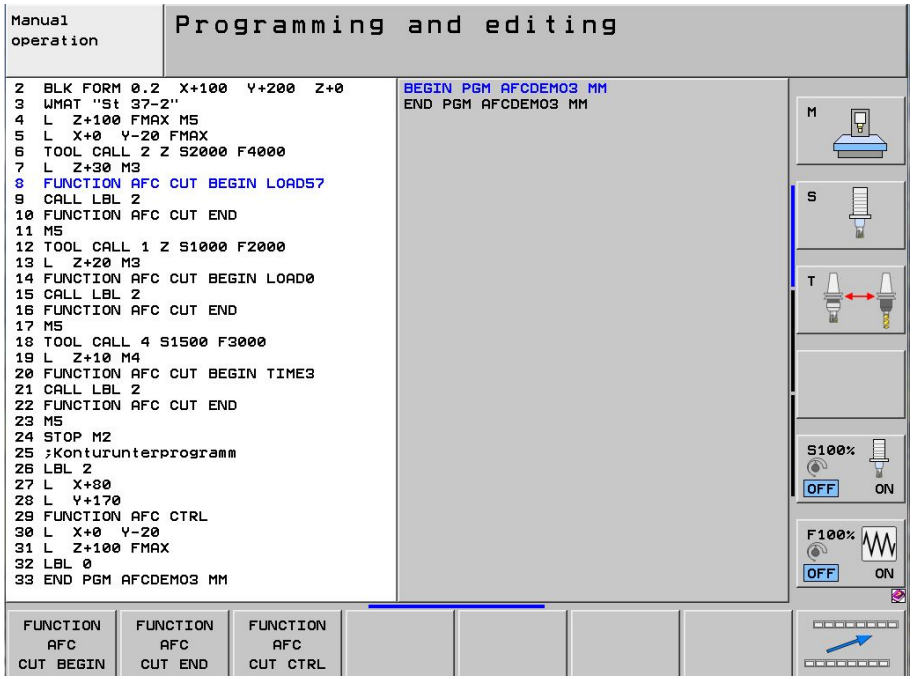
AFC operating statuses:

- **During teach-in:**
  The maximum spindle load during machining is determined.
  The teach-in phase can extend over the entire machining operation or be terminated manually after the maximum spindle load has been reached.

- **During controlling:**
  As soon as the control or the operator switches to controlling, the AFC controls the feed rate so that the learned spindle load is maintained.
  For this purpose, AFC varies the feed rate between **FMIN** and **FMAX**. If no spindle load is detected (<2%), AFC switches to **FIDL**.

Preparation:

- **NC program**
  - Tool change
  - Spindle ON
  - AFC ON via
    - HEIDENHAIN function
    - M function (OEM)
    - Cycle (OEM)
  - Machining
  - AFC OFF
    - HEIDENHAIN function
    - M function (OEM)
    - Cycle (OEM)



AFC ON/OFF

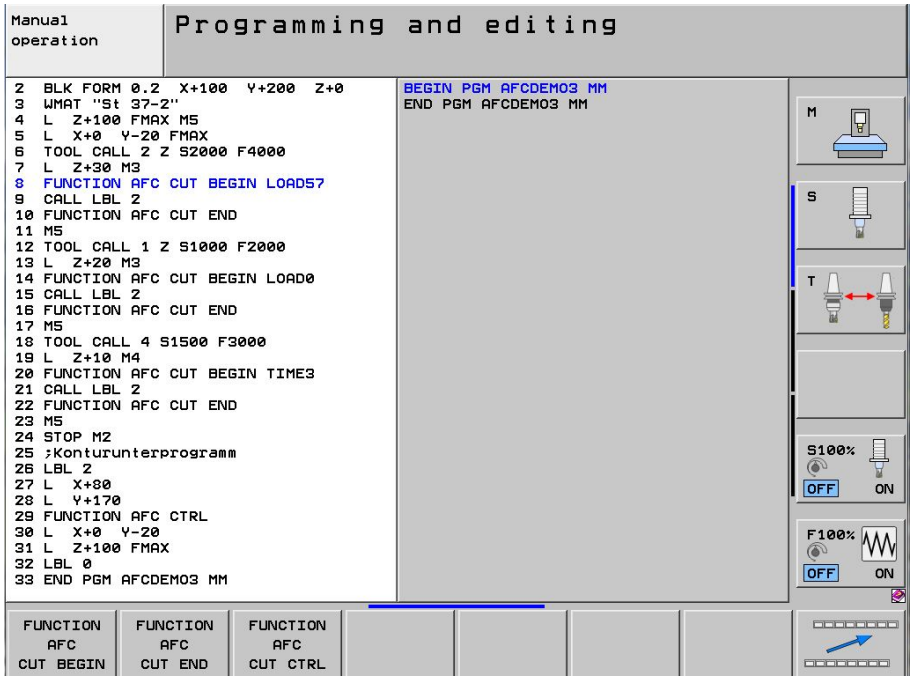
FUNCTION AFC CUT

- **SPEC FCT** key
- **PROGRAM FUNCTIONS** soft key
- **AFC FUNCTIONS** soft key

- **FUNCTION AFC CUT BEGIN:** Start teach-in cut (teach-in can be stopped manually)
- **FUNCTION AFC CUT BEGIN TIME10:** Start teach-in cut
  Teach-in for 10 seconds, then switchover to controlling

→ Available as of **606 42x – 04 (iTNC 530)**

→ Available as of **340 59x – 04 (TNC 640)**

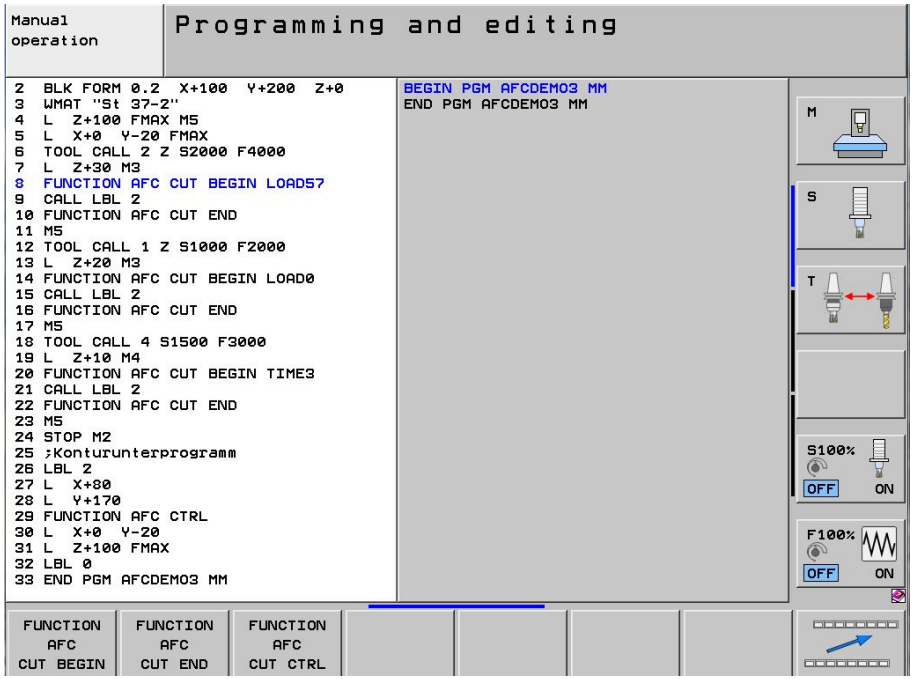


AFC ON/OFF

- **FUNCTION AFC CUT BEGIN DIST100:**
  Start teach-in cut
  Teach-in over 100 mm, then switchover to controlling
- **FUNCTION AFC CUT BEGIN LOAD45:** Start controlling with spindle reference load of 45 %
- **FUNCTION AFC CTRL:**
  Switchover from teach-in to controlling
- **FUNCTION AFC CUT END:**
  AFC OFF, end cut

→ Available as of **606 42x – 04 (iTNC 530)**

→ Available as of **340 59x – 04 (TNC 640)**



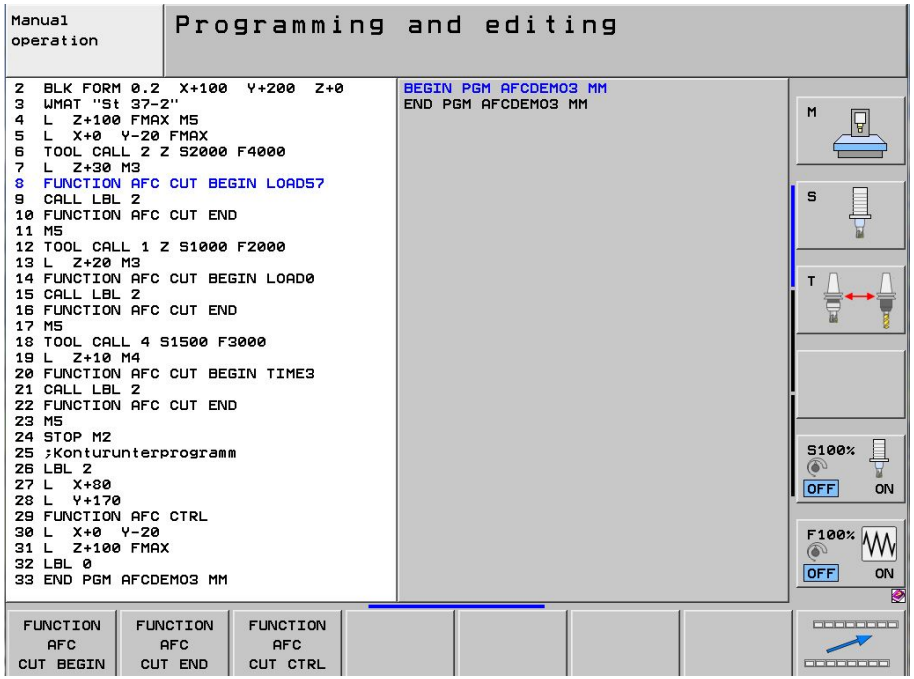
Assigning several teach-in steps to a tool

- **Call the tool**
- **M3**

- AFC ON
- **Machining 1**
- AFC OFF

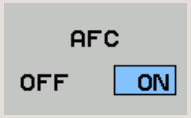
- AFC ON
- **Machining 2**
- AFC OFF

→ Thus you can save several reference spindle loads for a tool (e.g. for half-cut, trochoidal milling, full cut)



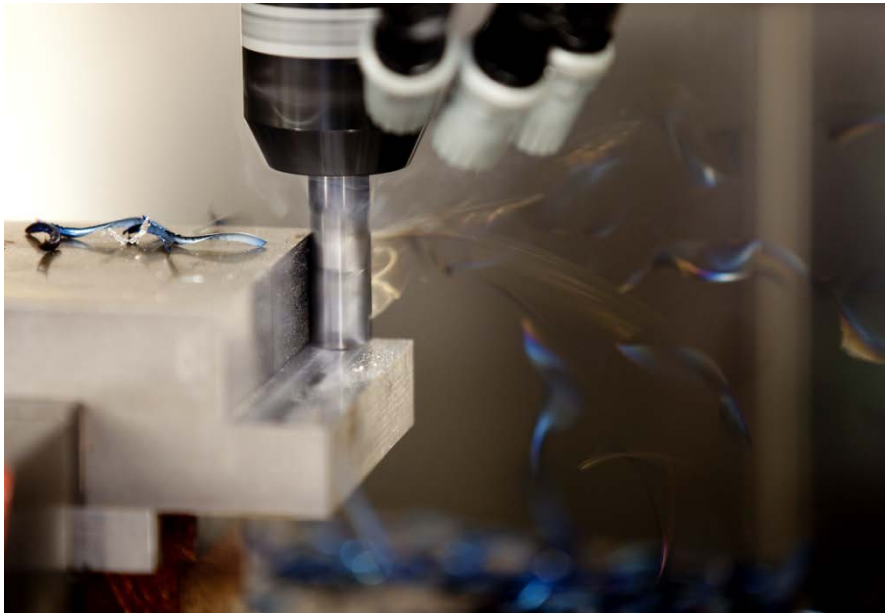
Possibility of intervention in controlling

- **Deactivate** or **activate** via soft key



- **Deactivate** if the value set for the potentiometer is changed manually **by more than 10 % in minus** direction.

- If the value of the **potentiometer is smaller than 50 %** and the AFC soft key is set to ON, **AFC is ineffective**. If the potentiometer setting is increased above 50 %, AFC automatically becomes active.



AFC settings memory file

- **<Program name>.h.AFC.DEP**
  Storage location for the individual settings and reference spindle loads

- **<Program name>.h.AFC2.DEP**
  AFC evaluation

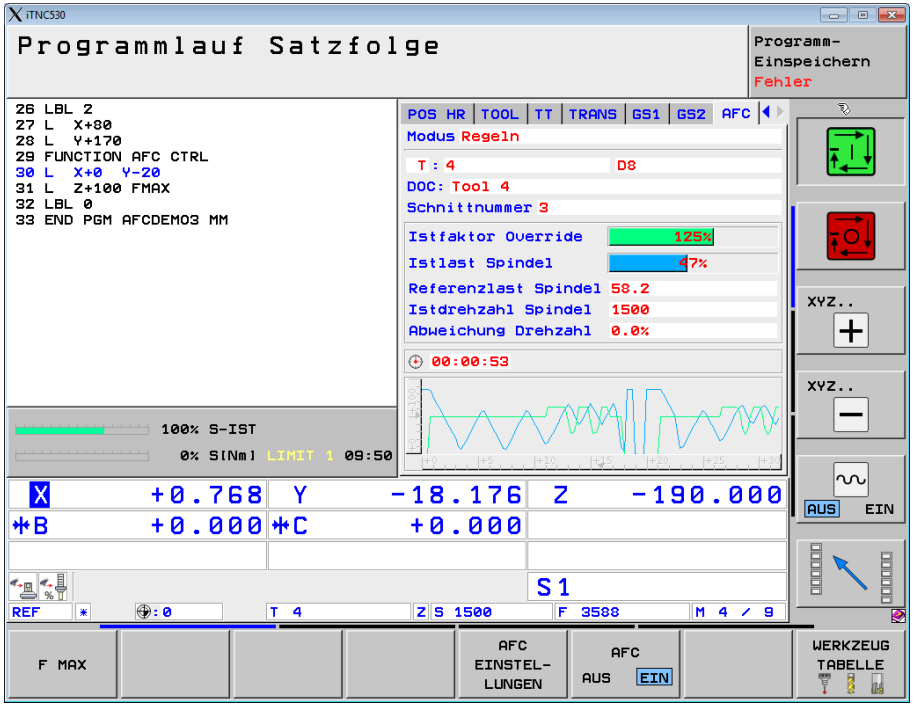
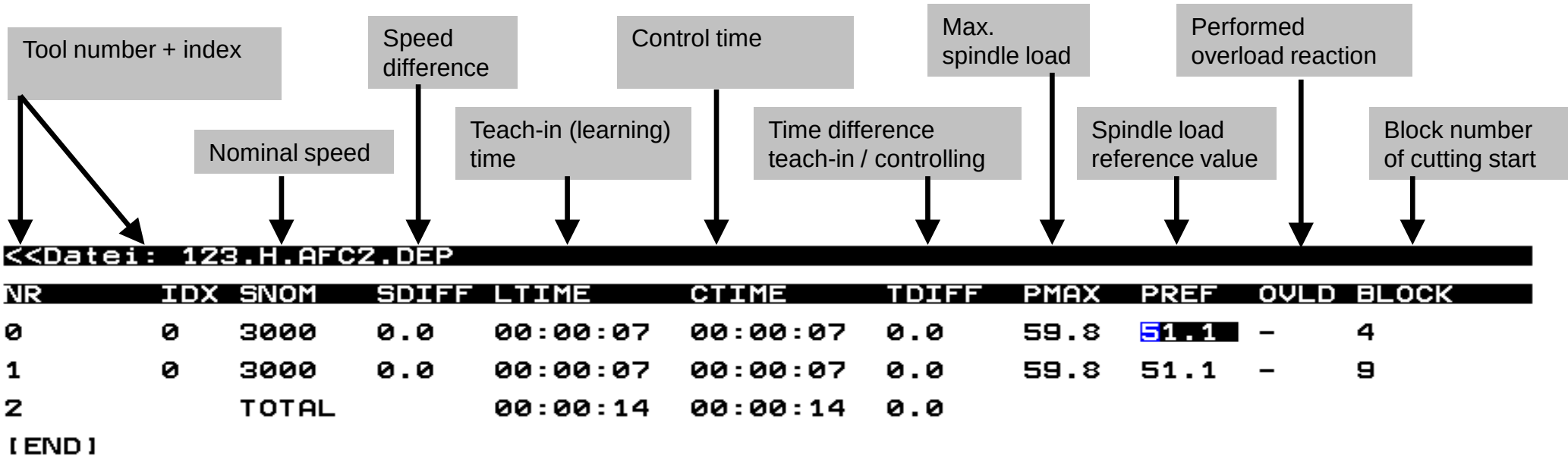


Table for the evaluation of AFC



Tasks of feedback control

- Detect entry into material
- Calculation of the optimal feed rate
- Monitoring for overload (switch-off reaction, if necessary)
- Saving the maximum value of the spindle power (for the evaluation)
- Detect exit from material
- Switchover to feed rate in air
- **AFC inactive during machining with FMAX**

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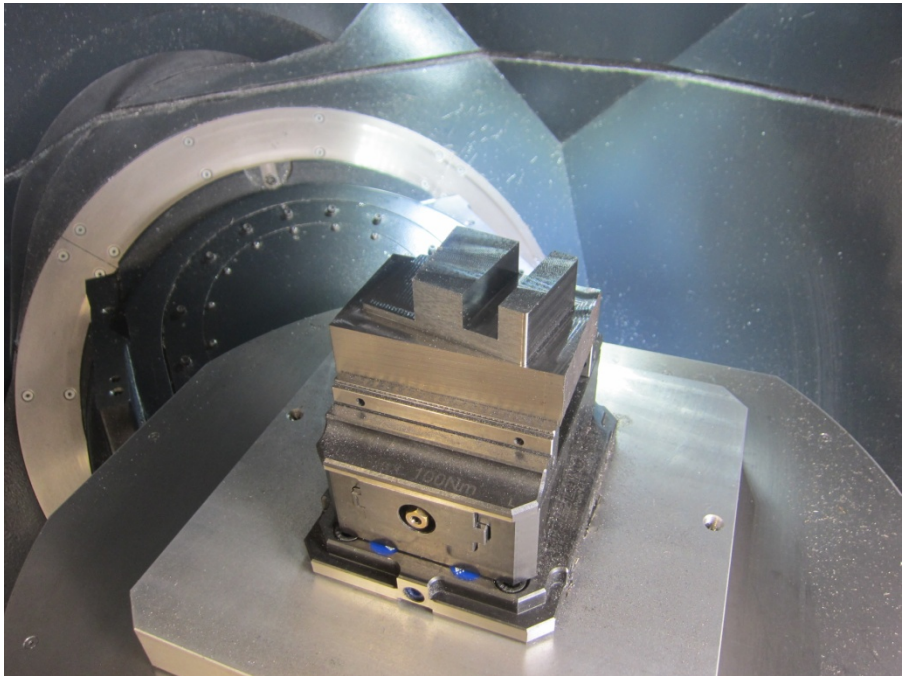
Machining example

Machining example

Example

- Face milling (without AFC)
- Rectangular stud milling (at 10 ° angle, with AFC)
  - T D16
  - ae 4 mm (cutting width)
  - ap 30 mm (cutting depth)
  - Fz 0.2
- Shoulder milling (with AFC)
  - T D16
  - ae 4 mm
  - ap 25 mm
  - Fz 0.15



Machining example

Example

- Trochoidal milling (with AFC)
  - T D12
  - Ae 2 mm
  - ap 20 mm
  - Fz 0.2

Program run time:

Without AFC	**05:20 min**
With AFC	**04:15 min**

→ Time saving of 21 %