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New equipment for body repair, MIDI-MIG (brazing) MIDIspot (spot welding)

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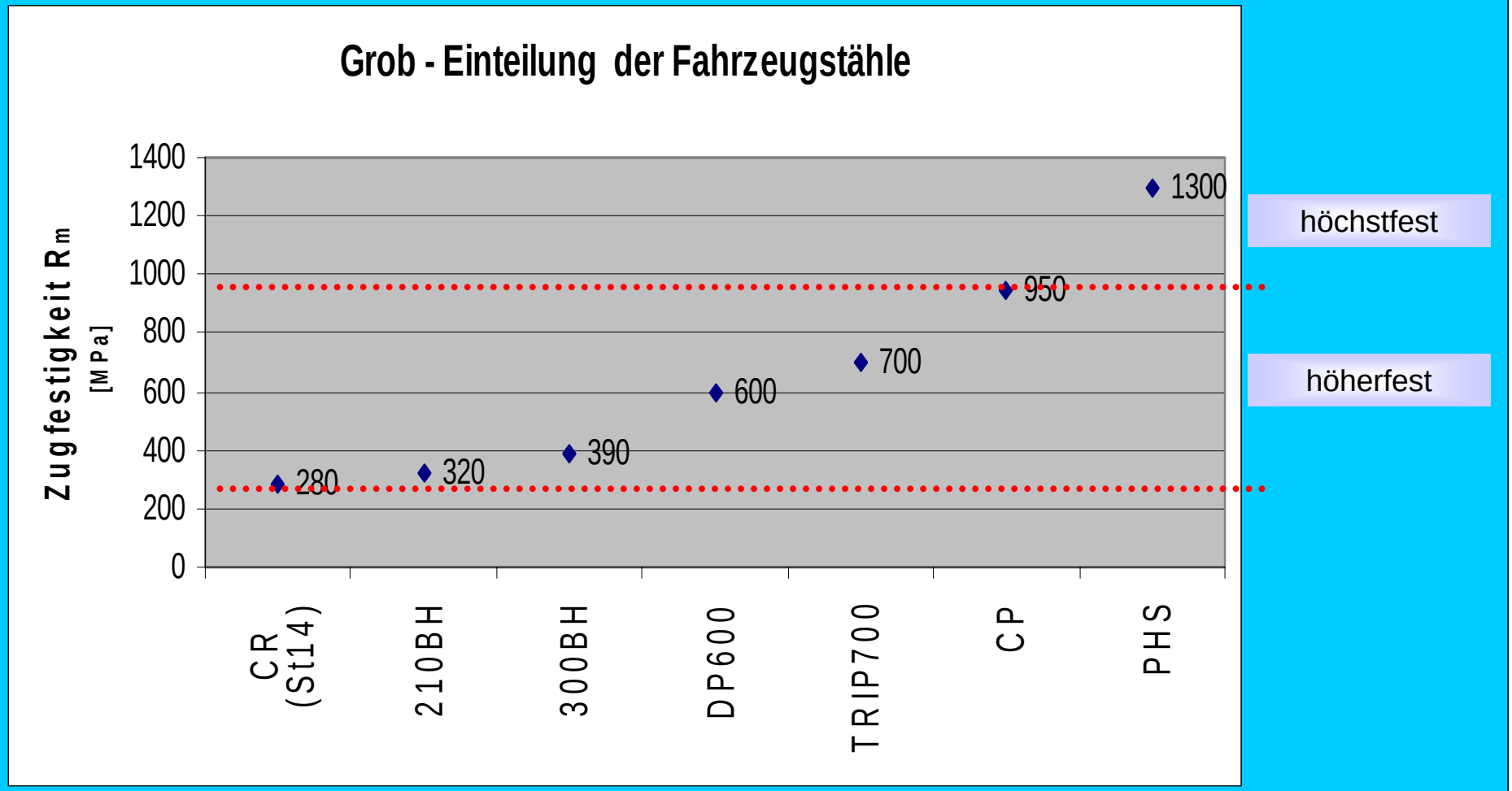
New demands for body repair -

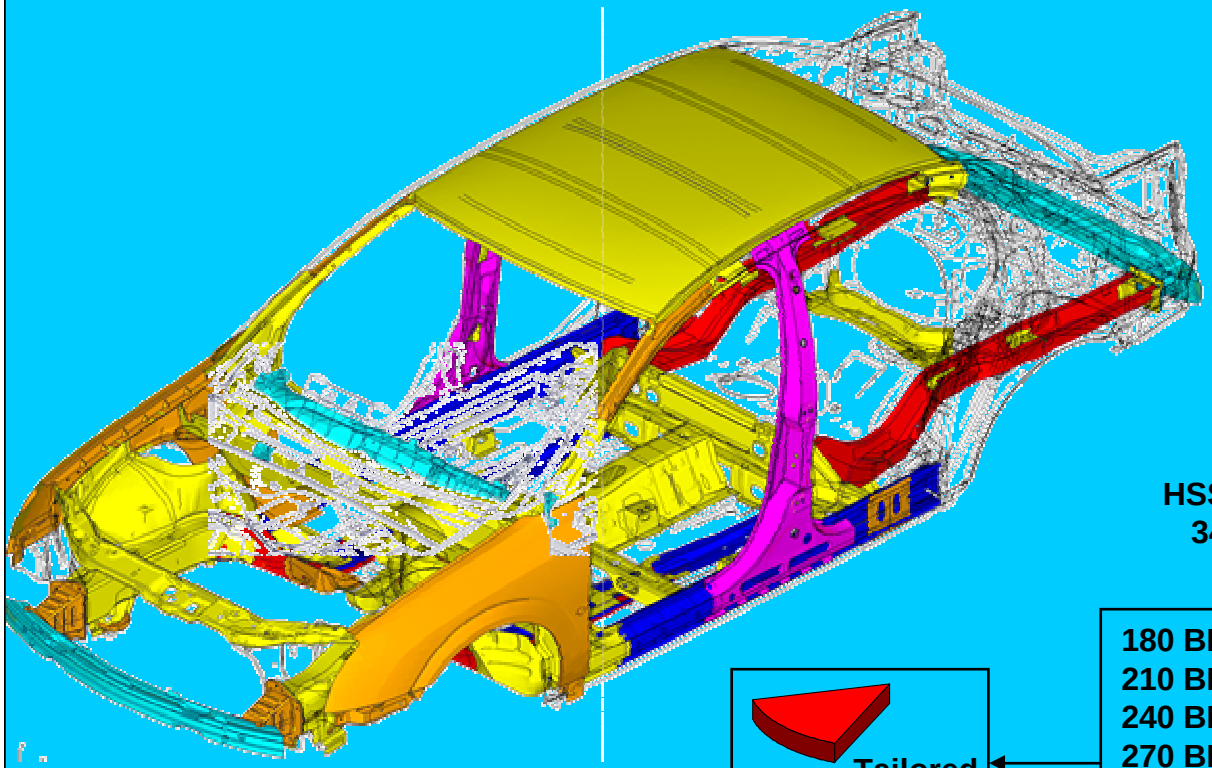
- Why?

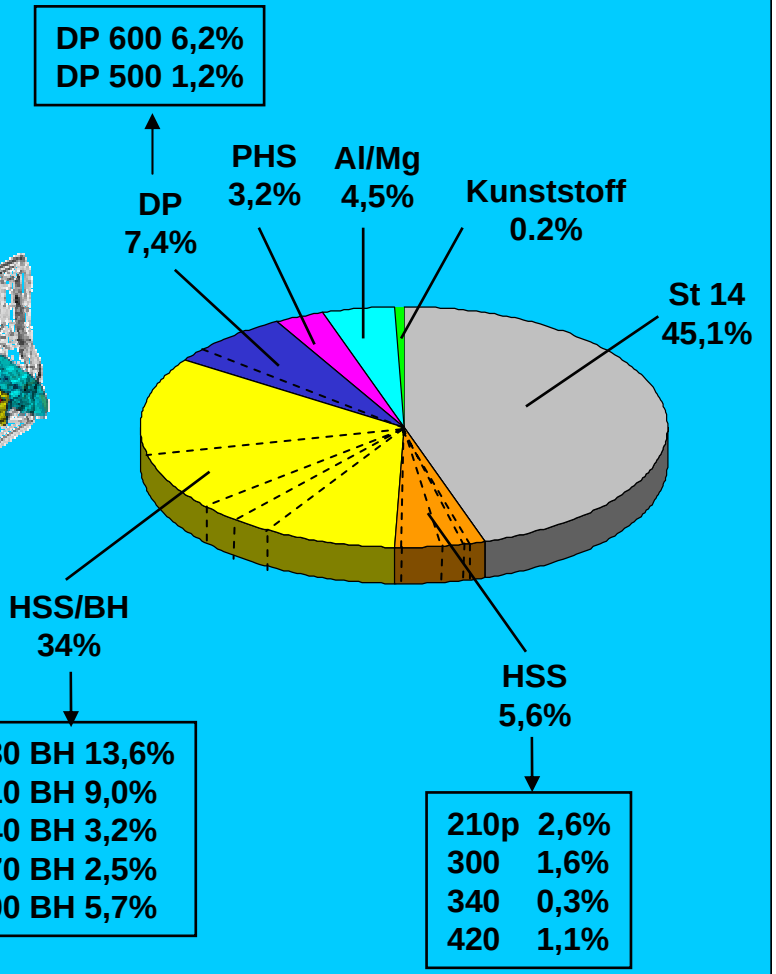
New Materials – New Demands



New Materials – New Demands

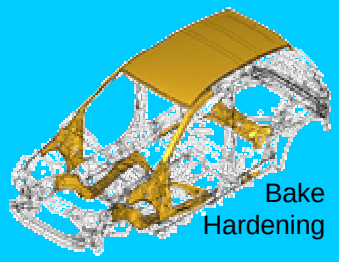
Opel Vectra C MY2002

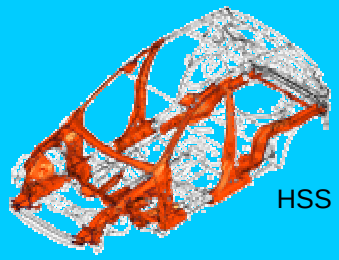


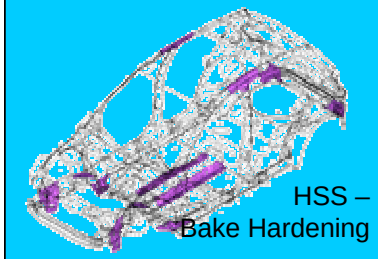


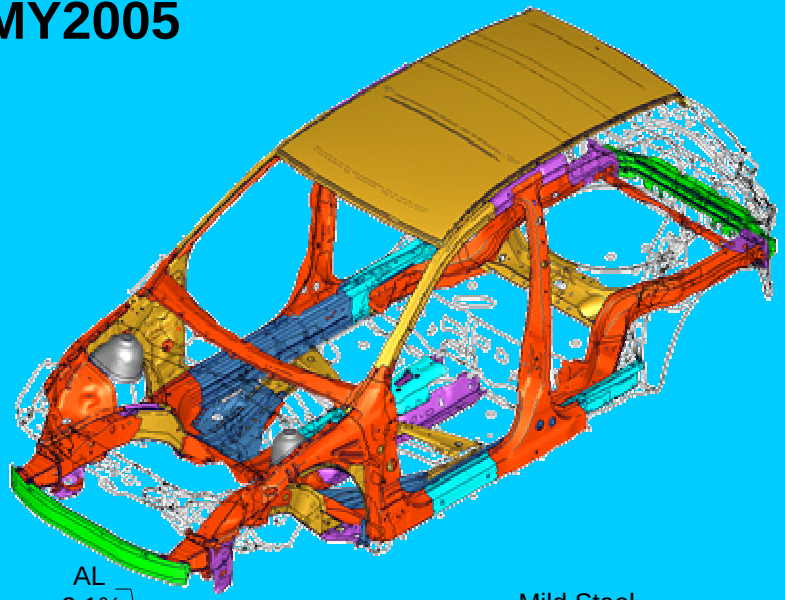
New Materials – New Demands

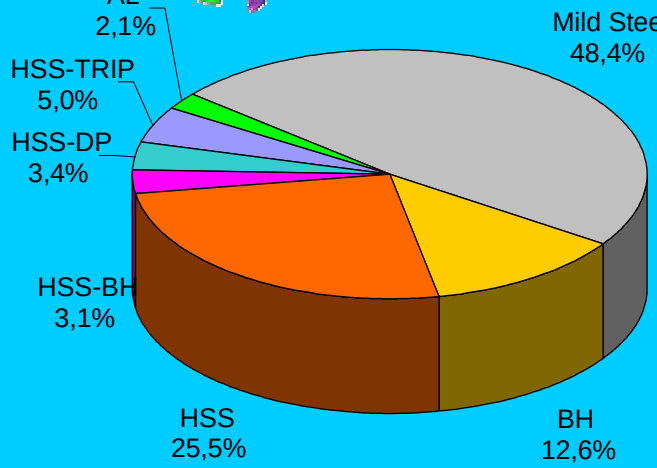
Opel Astra H MY2005

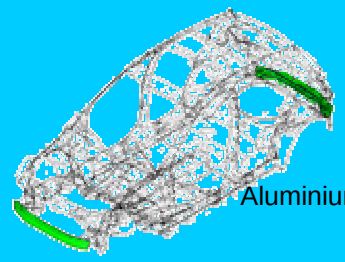


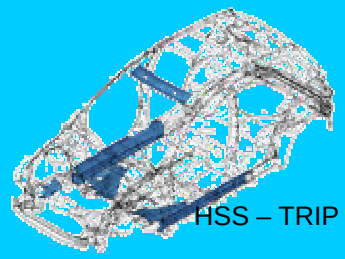


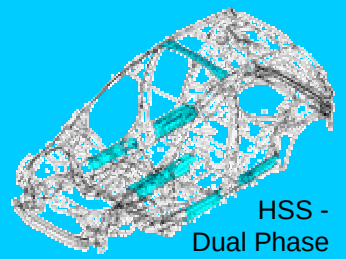












New Materials – New Demands

New structures with new materials:

- High strengthen steel
  - B – Column: **P**ress**H**arden**S**teel ($R_m \geq 1300$ MPa)
  - Front part: **D**ual**P**hase**S**teel ($R_m \geq 600$ MPa)
  - Bottom: **D**ual**P**hase**S**teel ($R_m \geq 600$ MPa)
  - Bottom **Trip**Steel ($R_m \geq 700$ MPa)

- **Increase of thickness / Combination of different materials:**
  - Astra H (A-Column / B-Column)
    - Combination A – Column, upper part: **4,25mm** (0,8 / 2,0 / 1,45)
      CR / 210B0 / 210P
    - Combination A – Säule lower part: **3,90mm** (0,8 / 1,5 / 1,6)
      CR / DP600 / TRIP700

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State of the Art

Current / time control,
partwise adaption of
current and time according
to trials

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New:

Innovative process control by a so called Virtual Machine, conditioning the parts before welding and calculating bypasses

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Principle of the Control

1. Checking starting conditions
   (Surfaces at optimum status,
   coated surfaces, insulating surfaces,
   current bypass by another spot)
2. Preparation segment for reproducable starting conditions
3. Running the spot weld
4. Balance of energie input, quality approval
5. Adding energy depending on bypass losses, setting QS-result

Worker's support

1. Spot counter => Check electrode
2. Reset-demand if QS-output is negativ
3. Showing programm branches
4. Checking the use of the right tongs (tongs code)
5. Start inhibit for fuse protection
6. Databank parameters for all occuring types of joints
7. Update possibility by MMC
8. Analog output for i(t), z(t), e(t)

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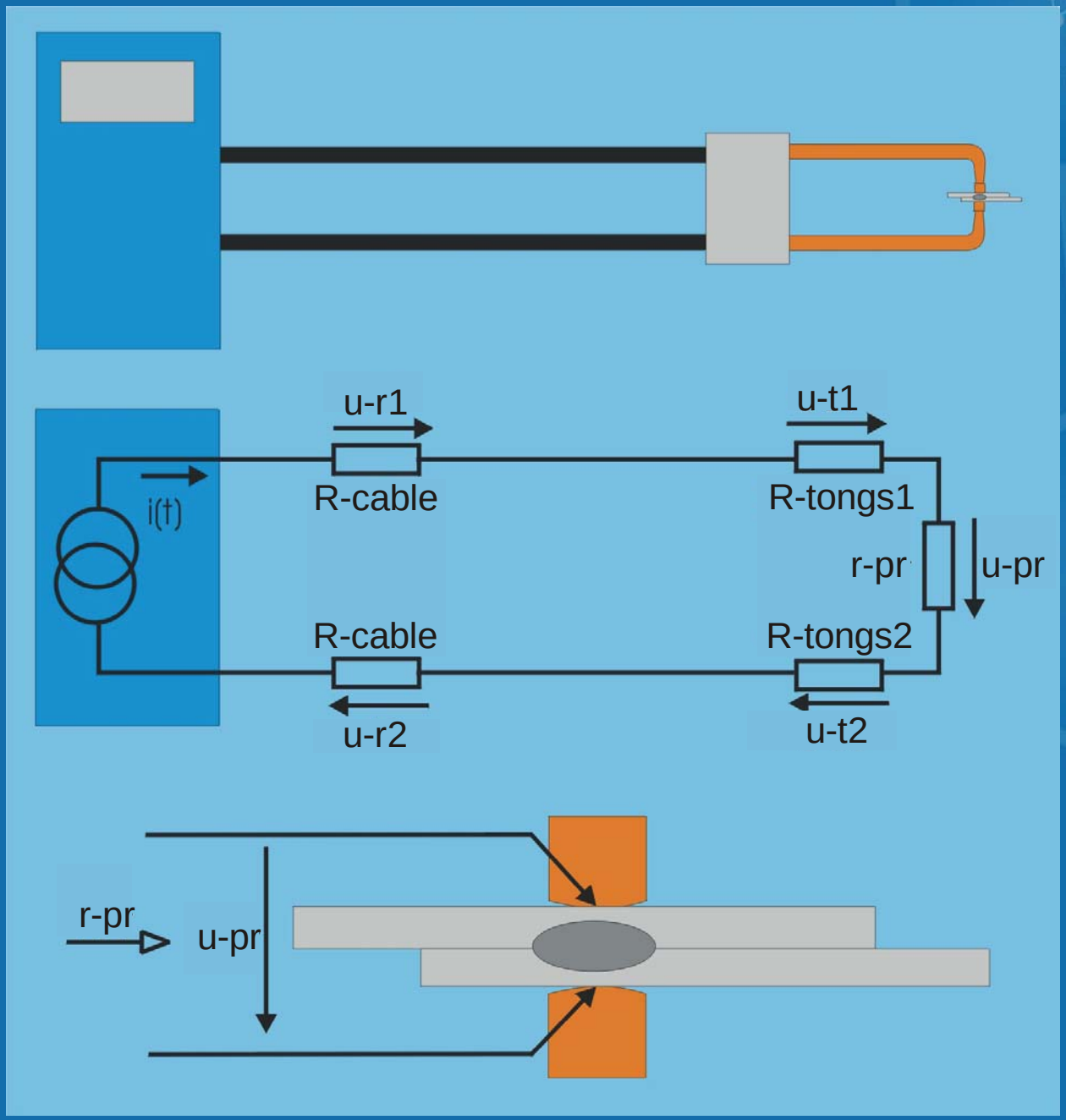

System Source - Welding-Tongs

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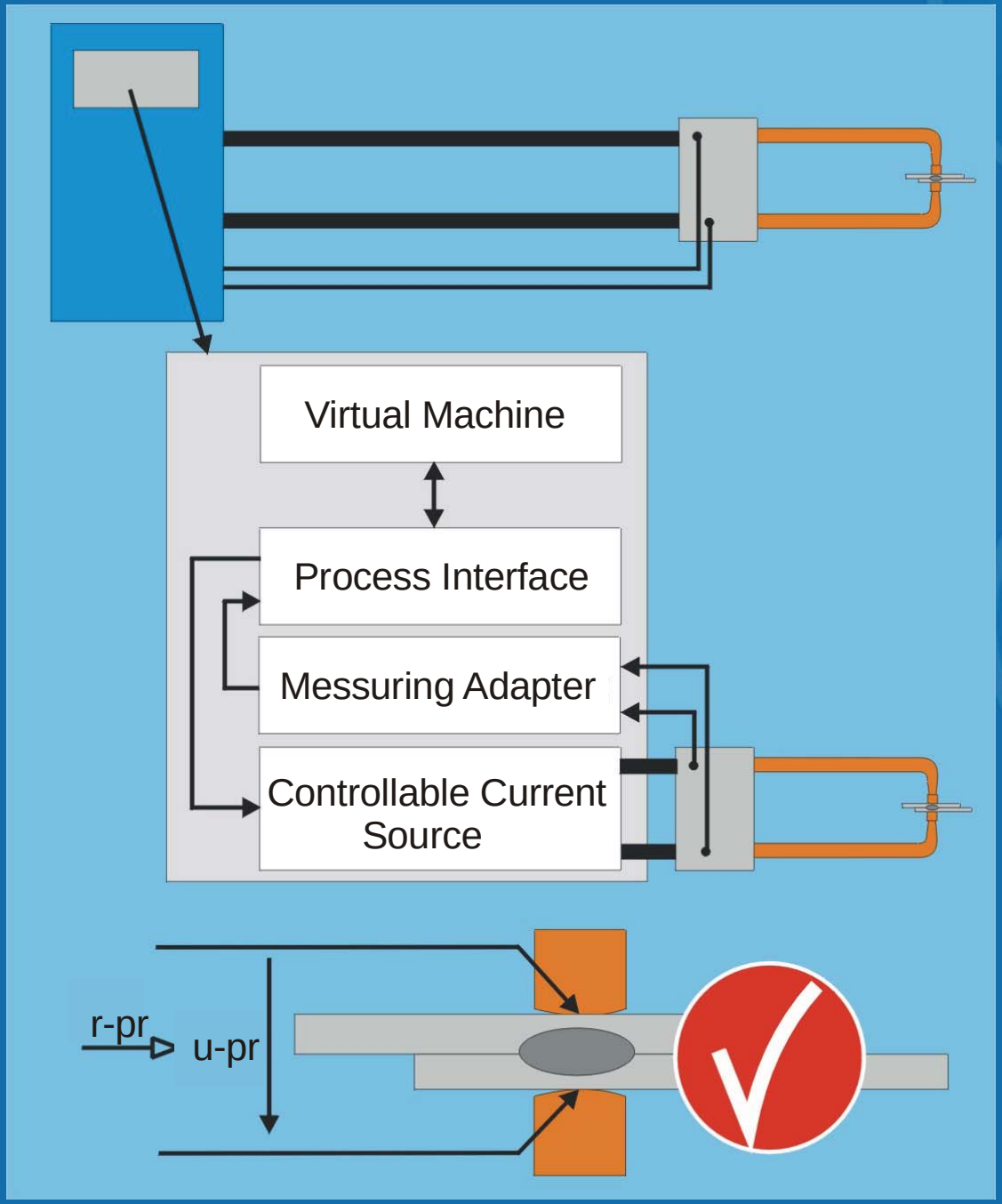

System Source - Welding-Tongs, Virtual Machine

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Midfrequency Spot Welder with QS-Traffic Light -Control by the Virtual Machine- C-Tongs

Prof. Dr.-Ing. P. Puschner

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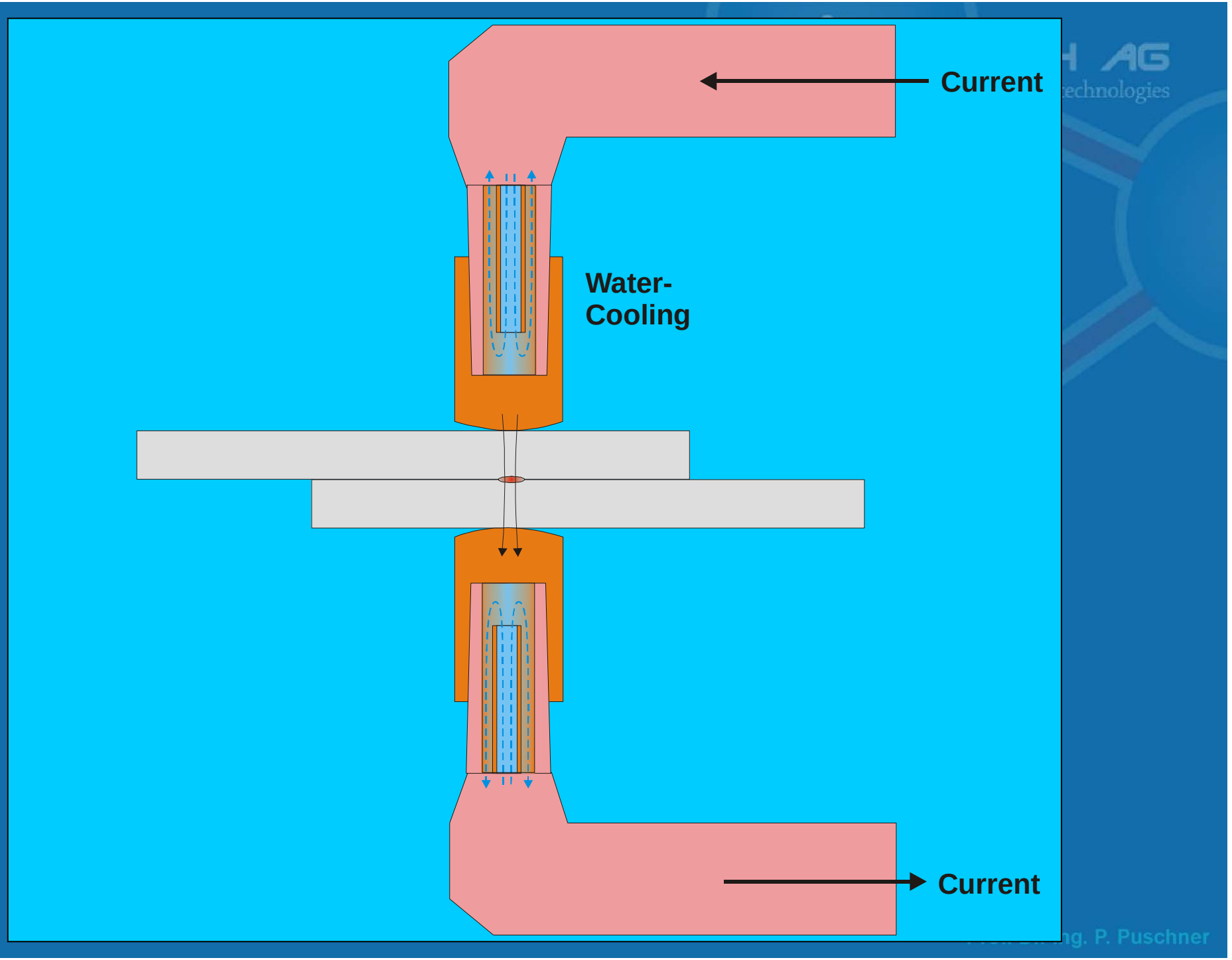
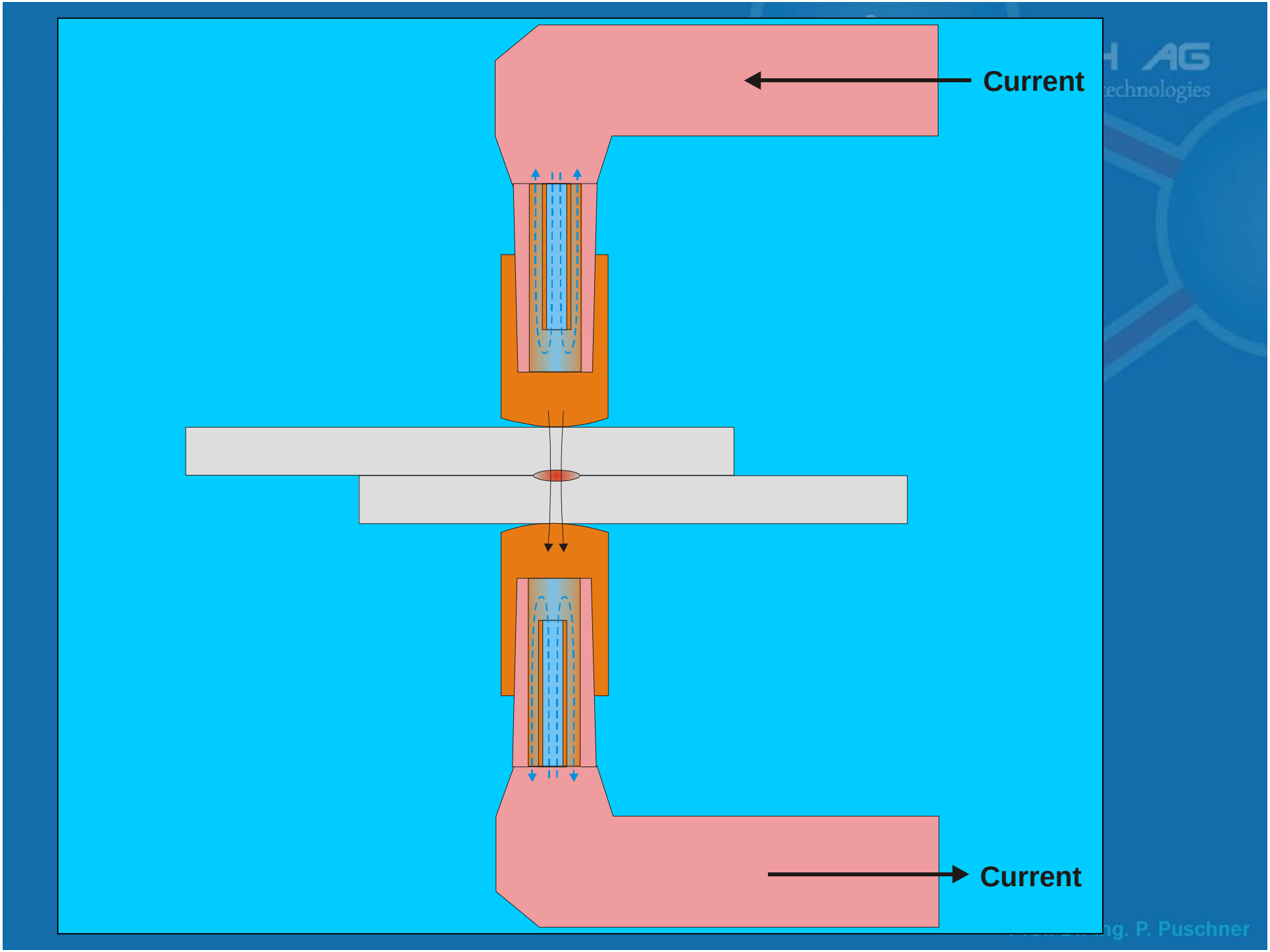
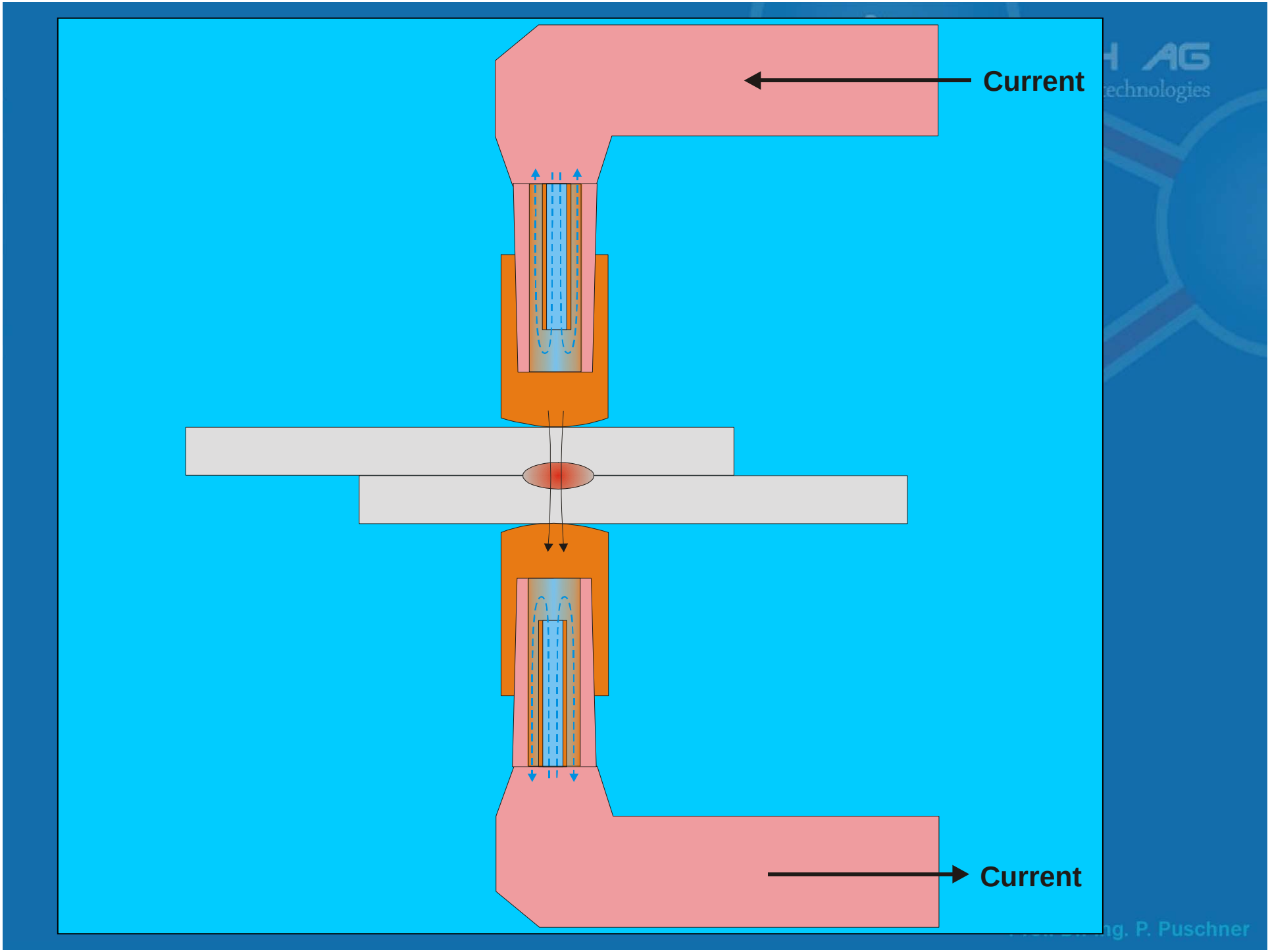
Virtual Machine

Contol panel with
QS-traffic light, Alarm signals,
display with keys and settings,
MMC-slot


Current
Water-
Cooling
Current


Current
Current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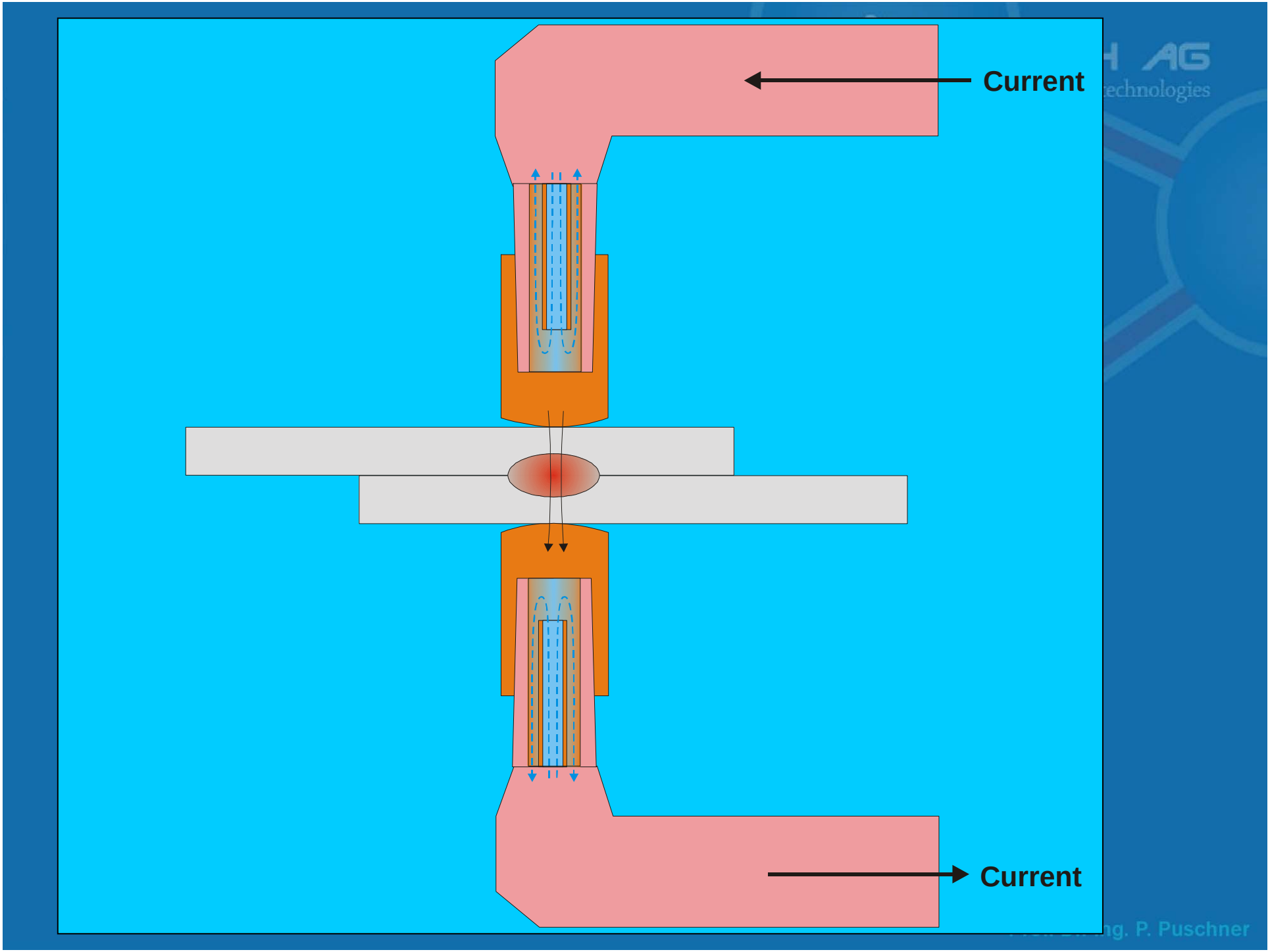
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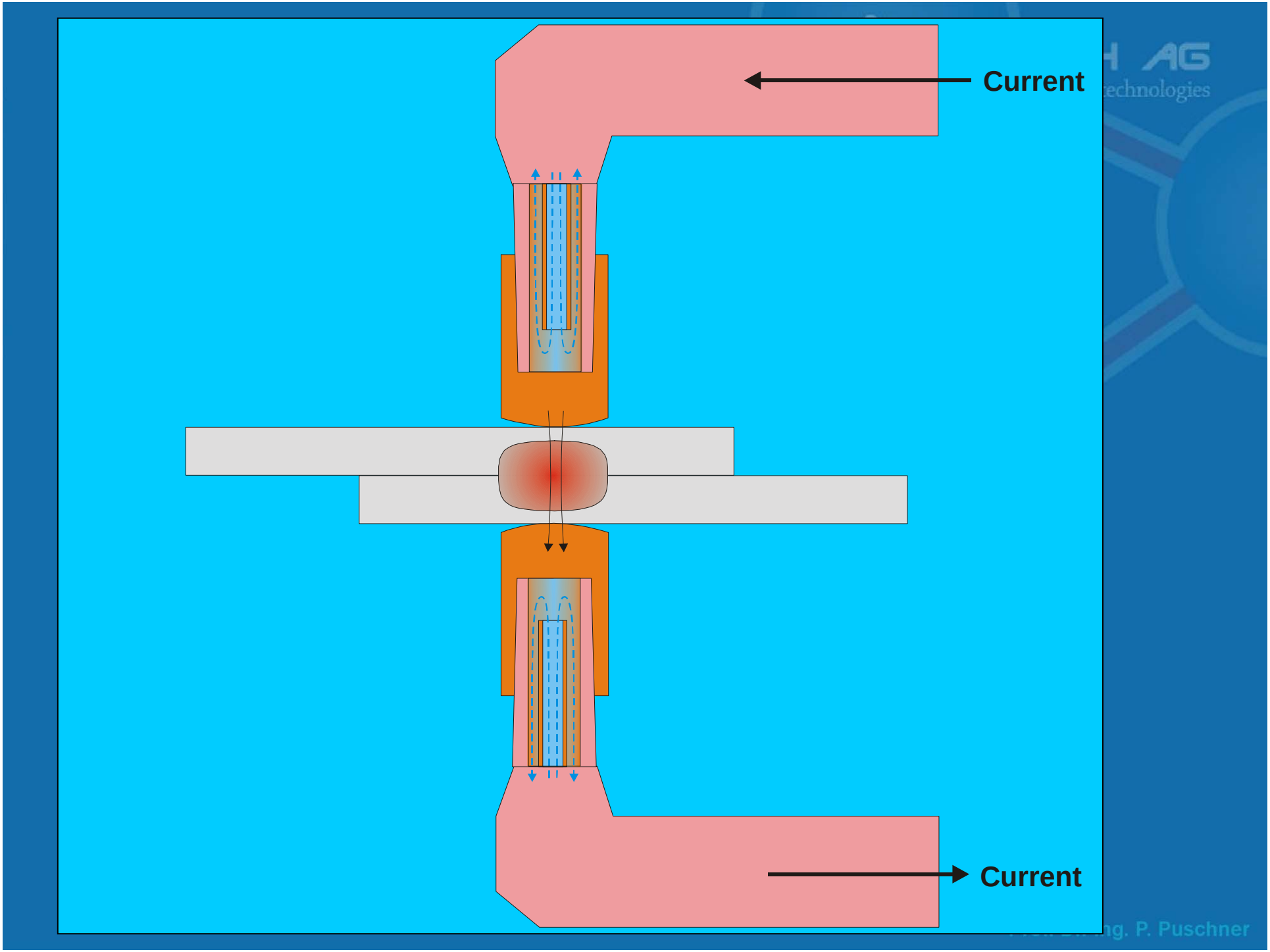
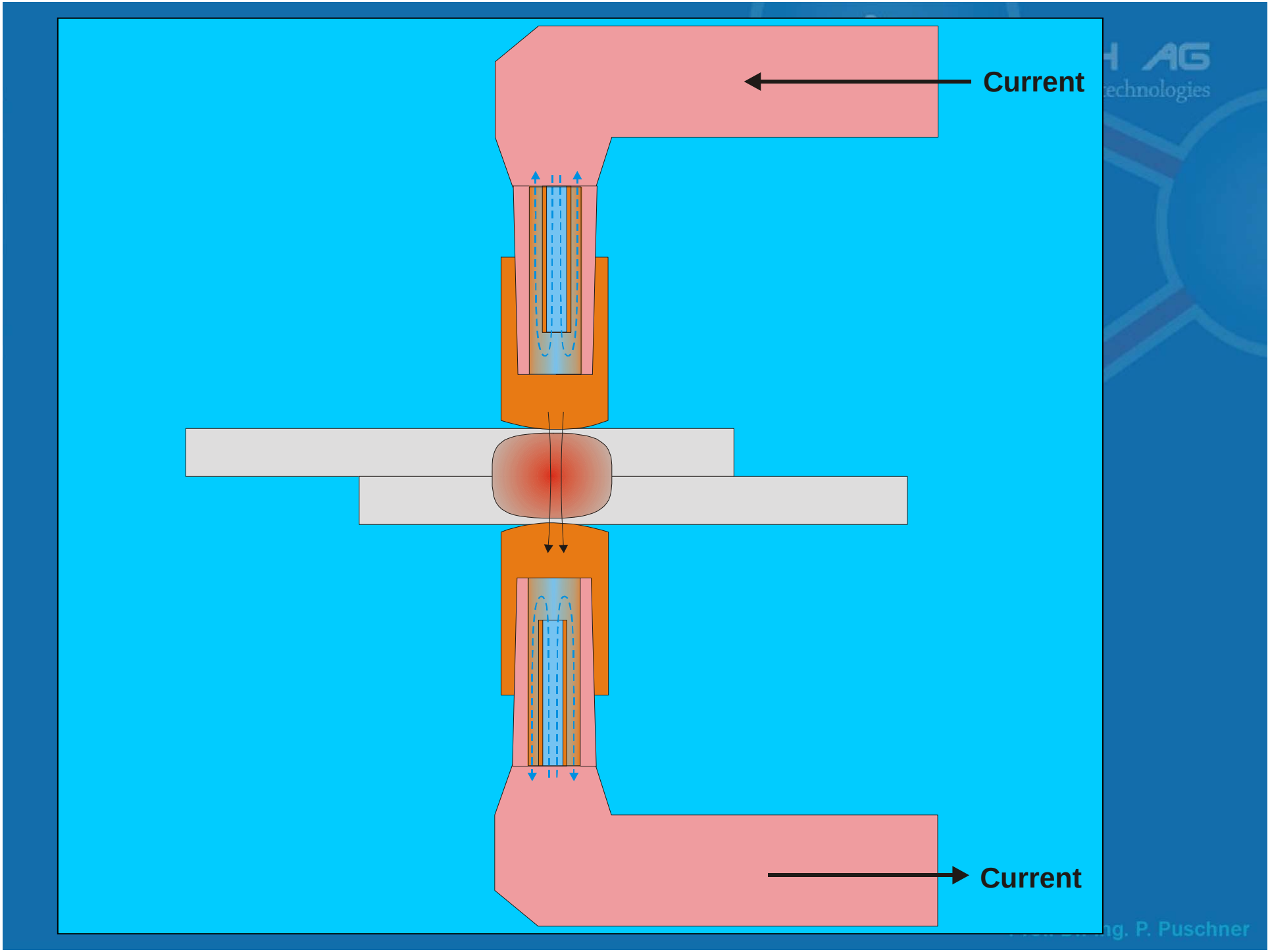
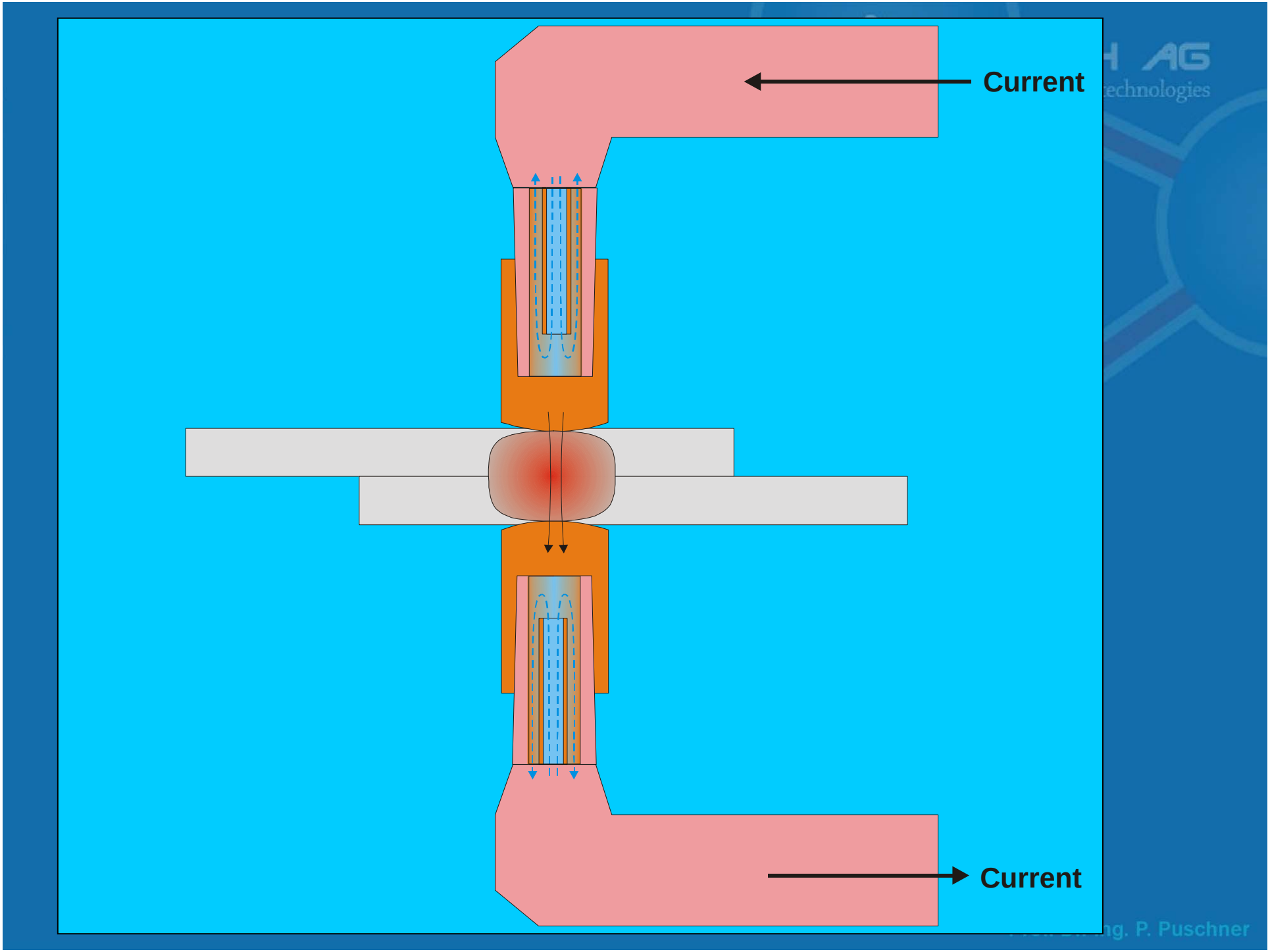
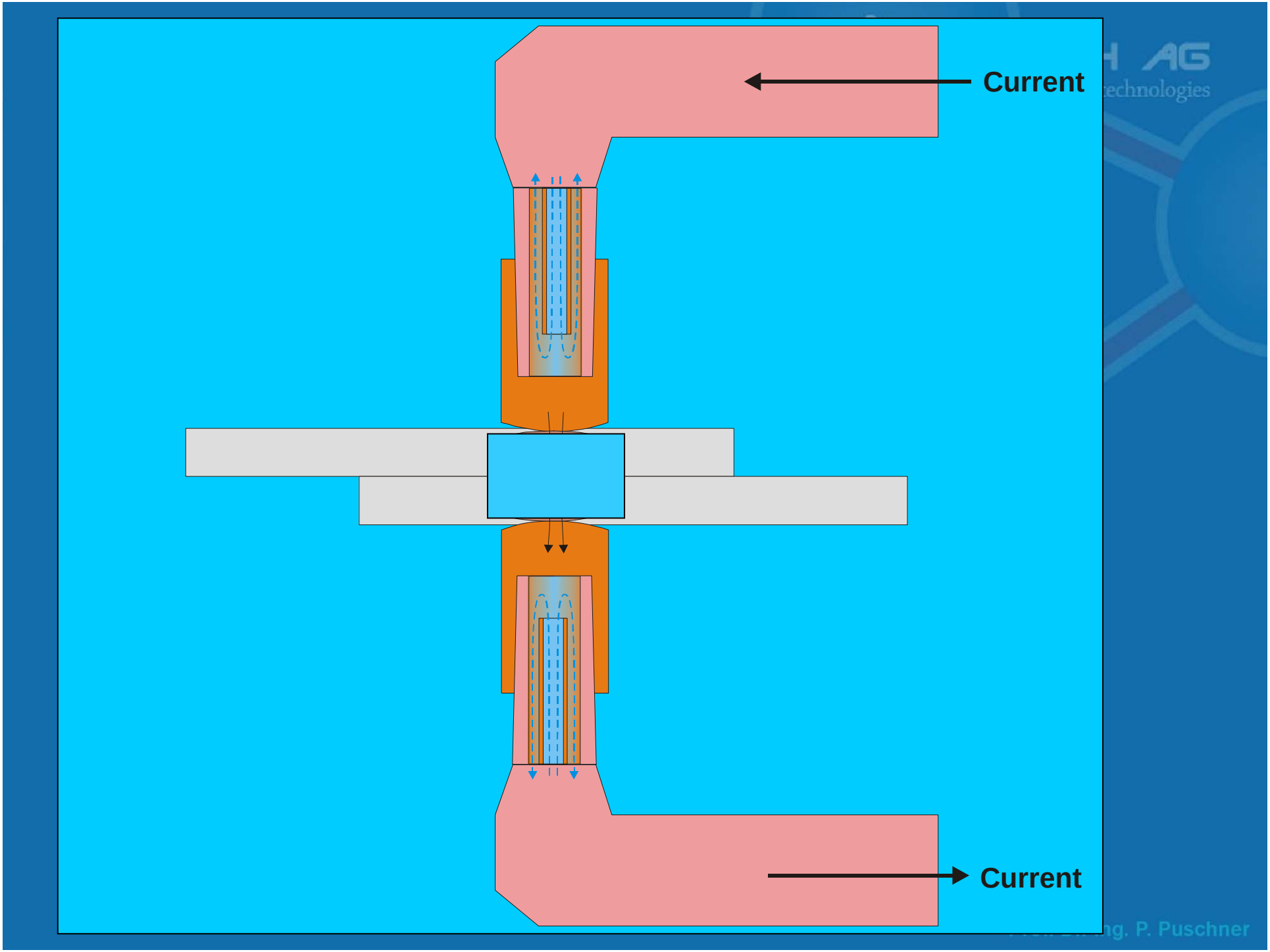
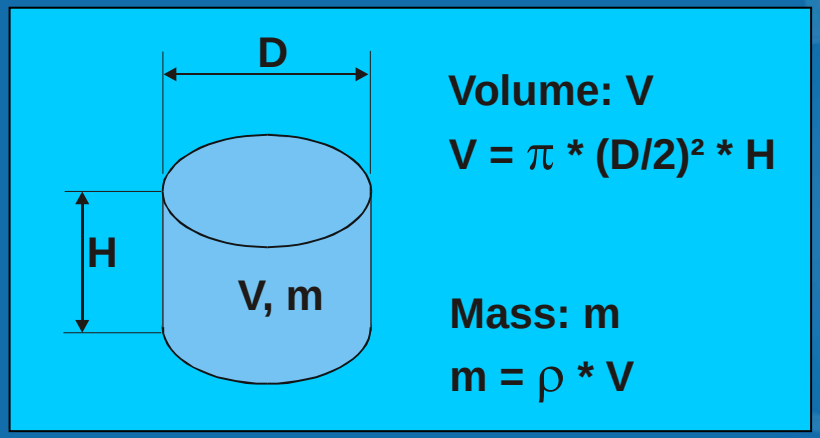
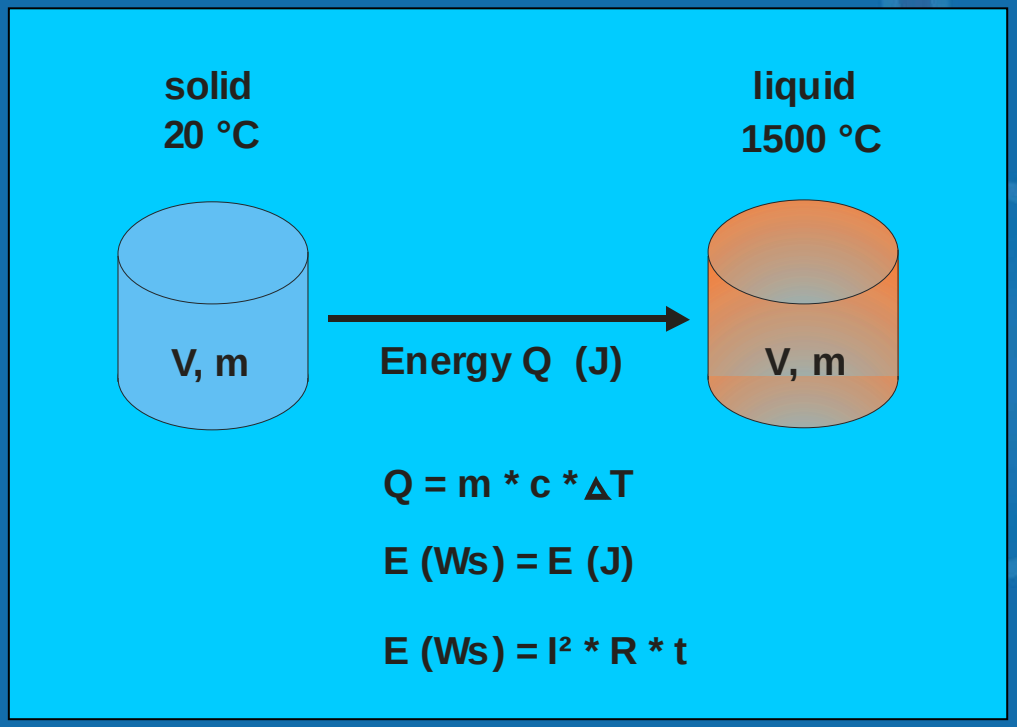

Current
Current


Current
Current


Current
Current


Current
Current


D
H
V, m
Volume: V
V = π * (D/2)² * H
Mass: m
m = ρ * V



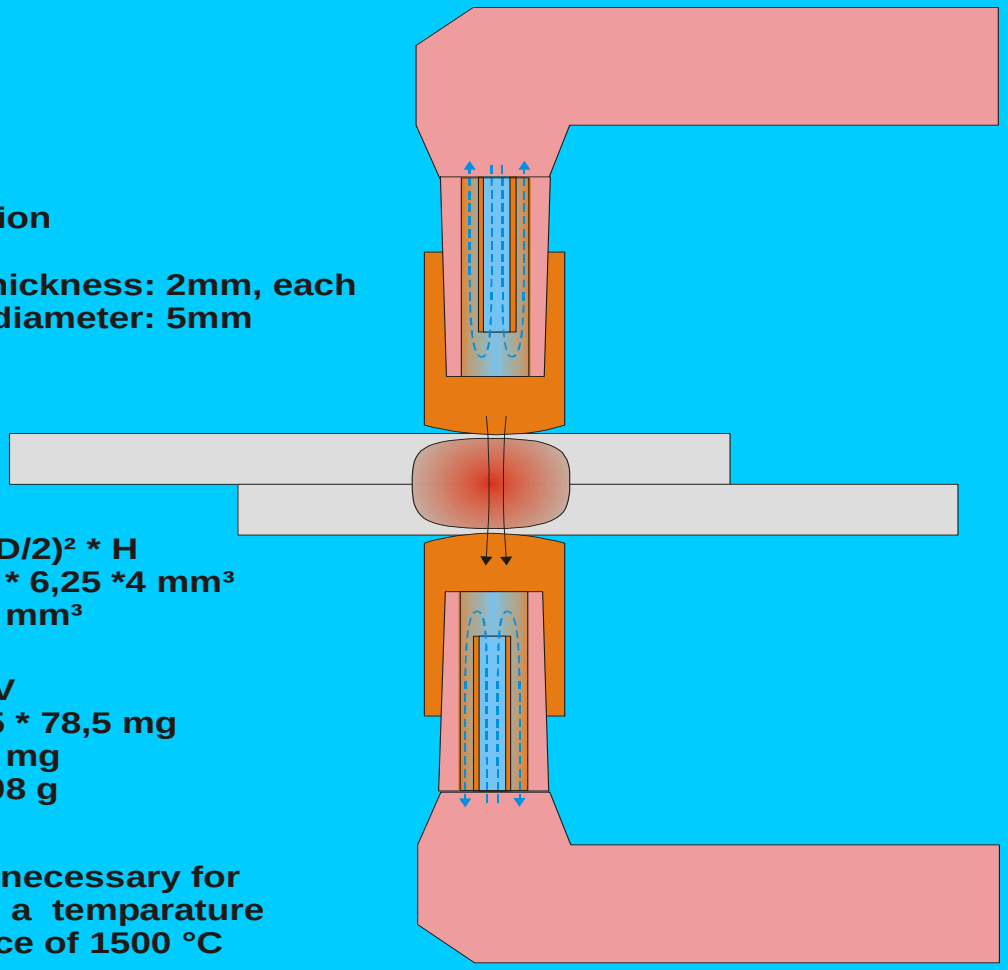
$$Q = m * c * \Delta T$$

$$E\,(Ws) = E\,(J)$$

$$E\,(Ws) = I^2 * R * t$$

Calculation

Sheet thickness: 2mm, each
Nugget diameter: 5mm



$V = \pi * (D/2)^2 * H$
$= 3{,}14 * 6{,}25 * 4\ mm^3$
$= 78{,}5\ mm^3$

$m = \rho * V$
$= 7{,}85 * 78{,}5\ mg$
$= 608\ mg$
$= 0{,}608\ g$

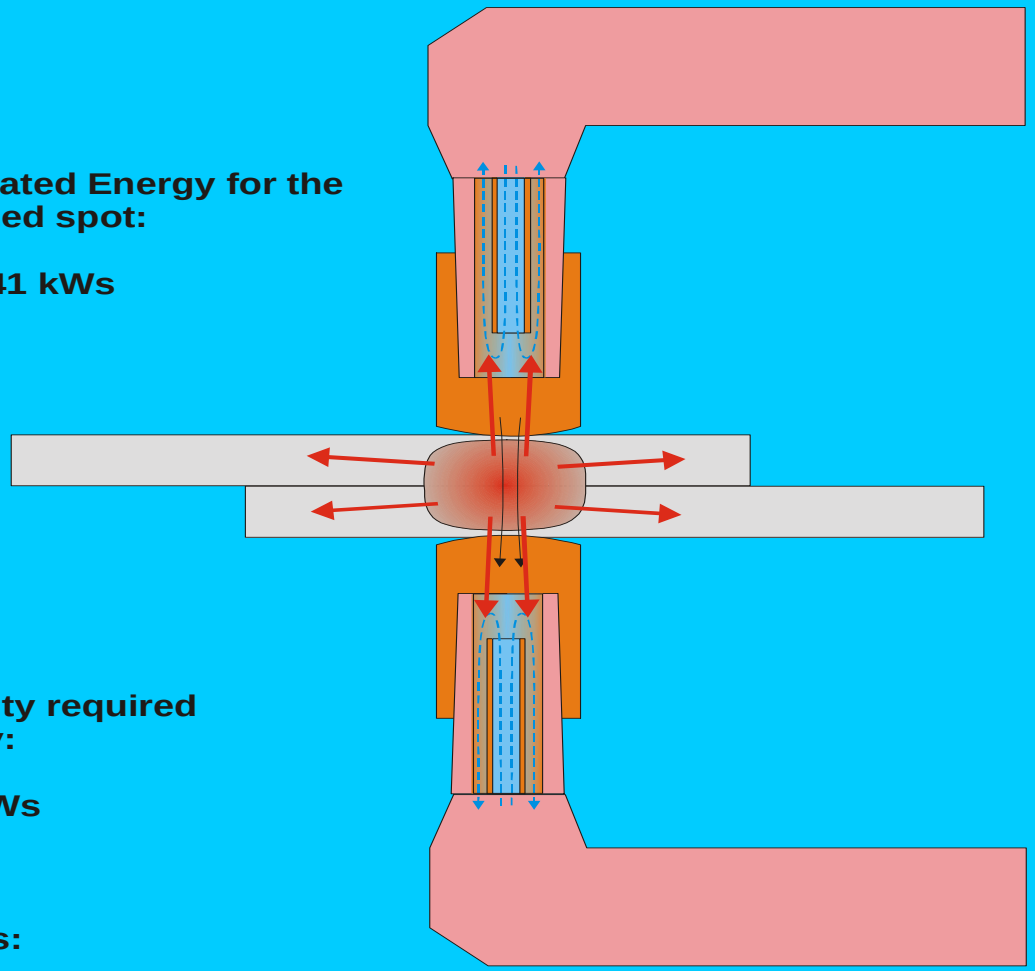
Energy, necessary for creating a temparature difference of 1500 °C

$Q = m * c * \Delta T$
$Q = 0{,}608 * 0{,}45 * 1500\ J$
$= 410\ J$

$E = 0{,}41\ kWs$

Calculated Energy for the idealized spot:

E = 0,41 kWs



In reality required energy:

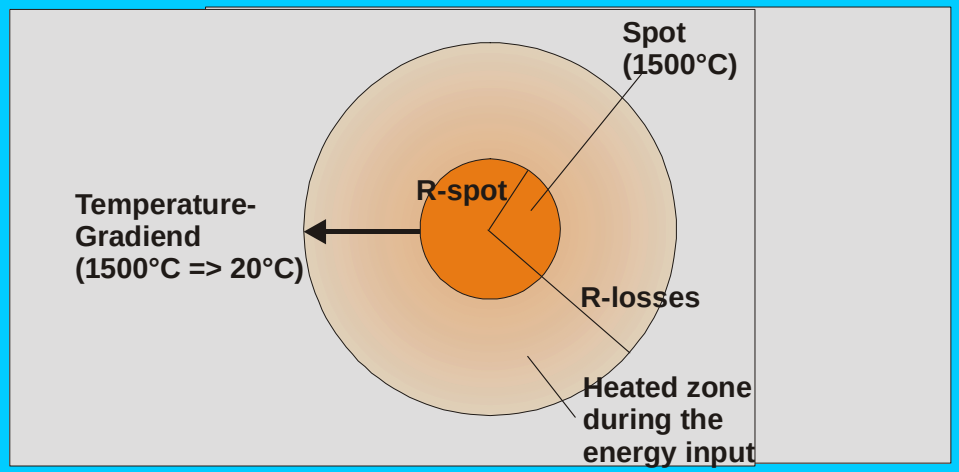
4,32 kWs

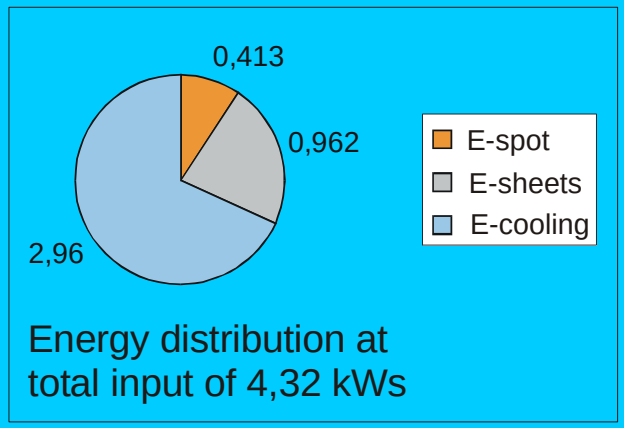
Losses:

1. Heat conduction into the neighborhood of the sheets, radial direction from the center of the spot
2. Heat conduction into the water cooled copper electrodes

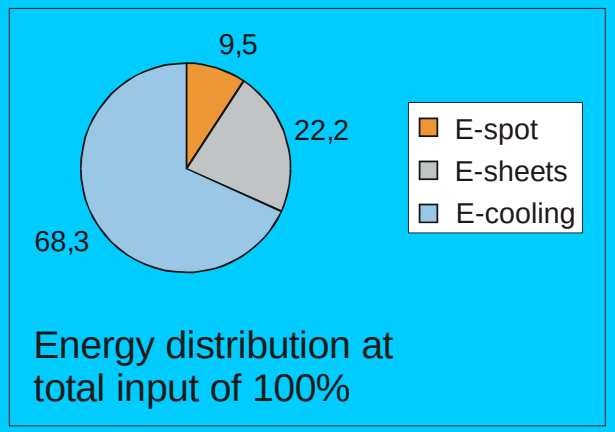
Total losses: 3,91 kWs => nearly. 90%of the electrical input!

Estimated losses, 2-sheet spot weld



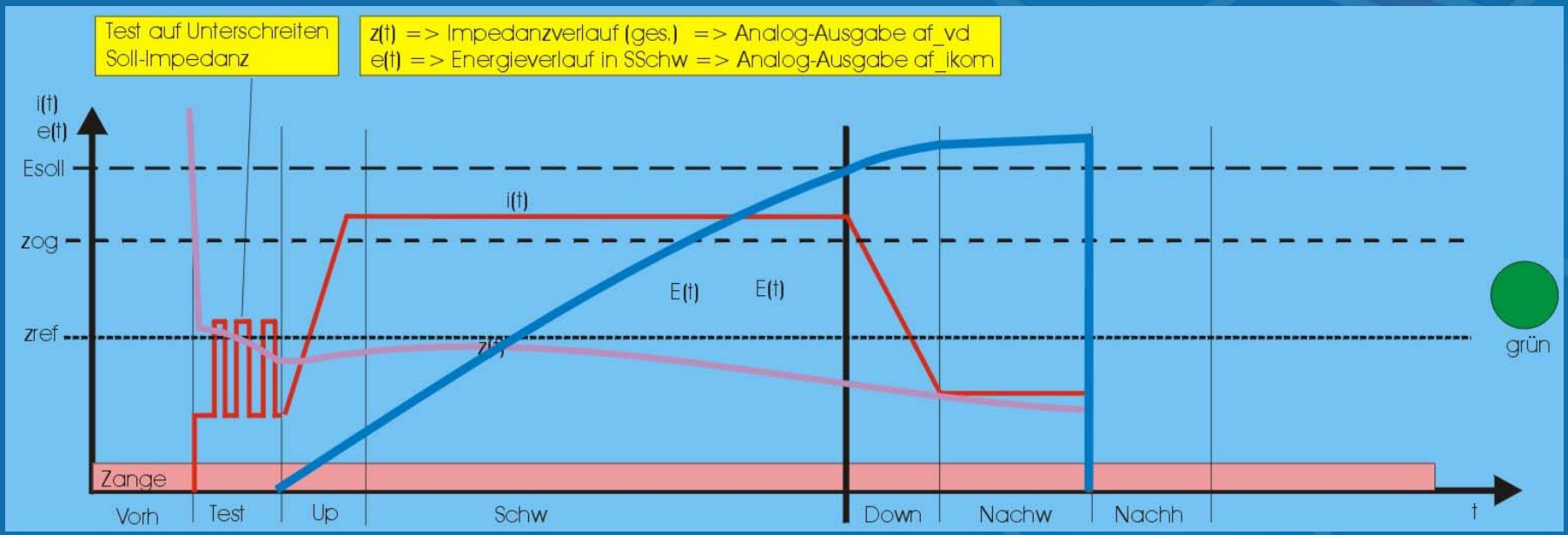


Energy distribution at
total input of 4,32 kWs

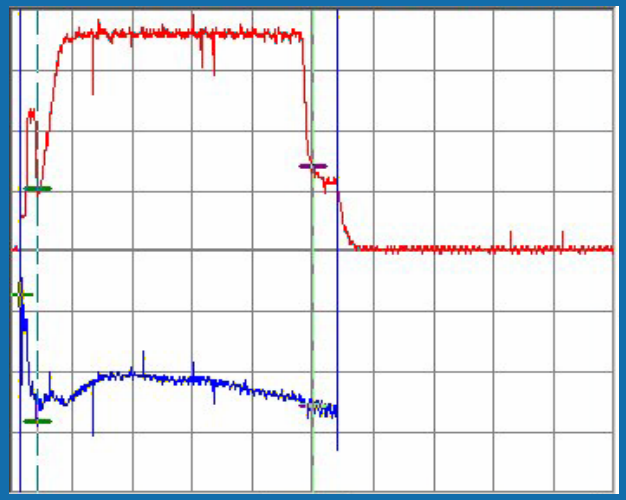


Energy distribution at
total input of 100%

Example No. 1



Starting conditions at its optimum



Example No. 2

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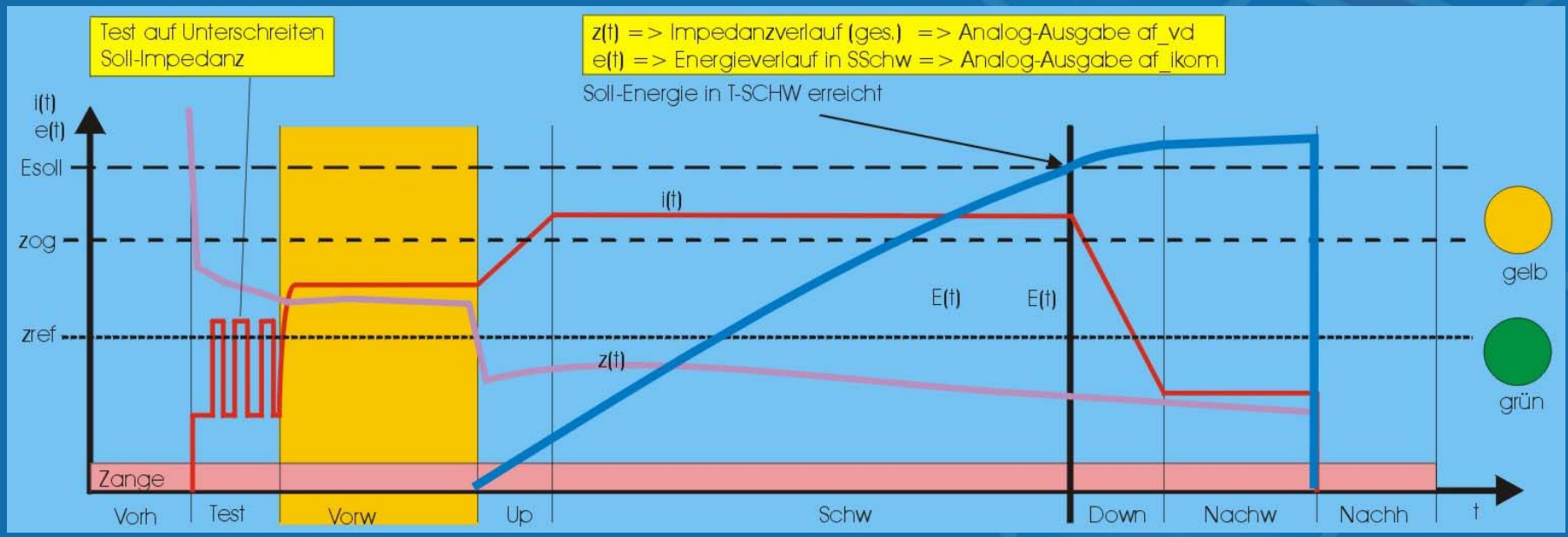
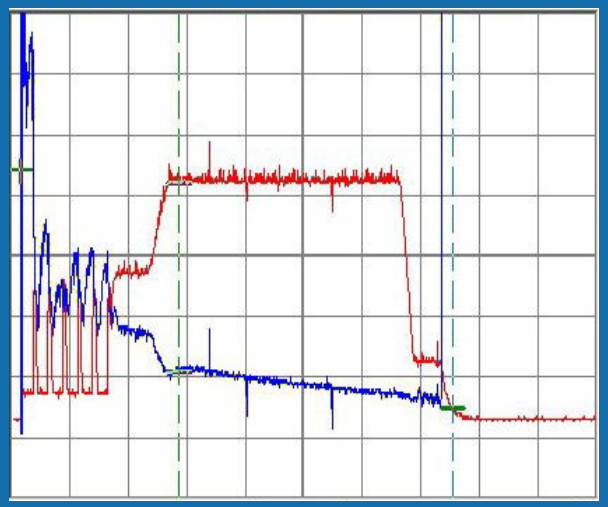
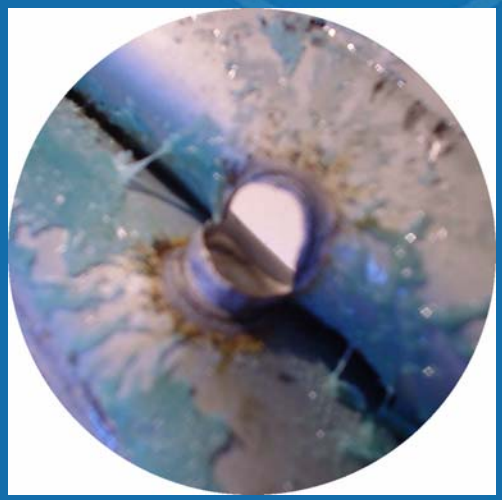


Conditioning surfaces by process controlled preheating





Example No. 3

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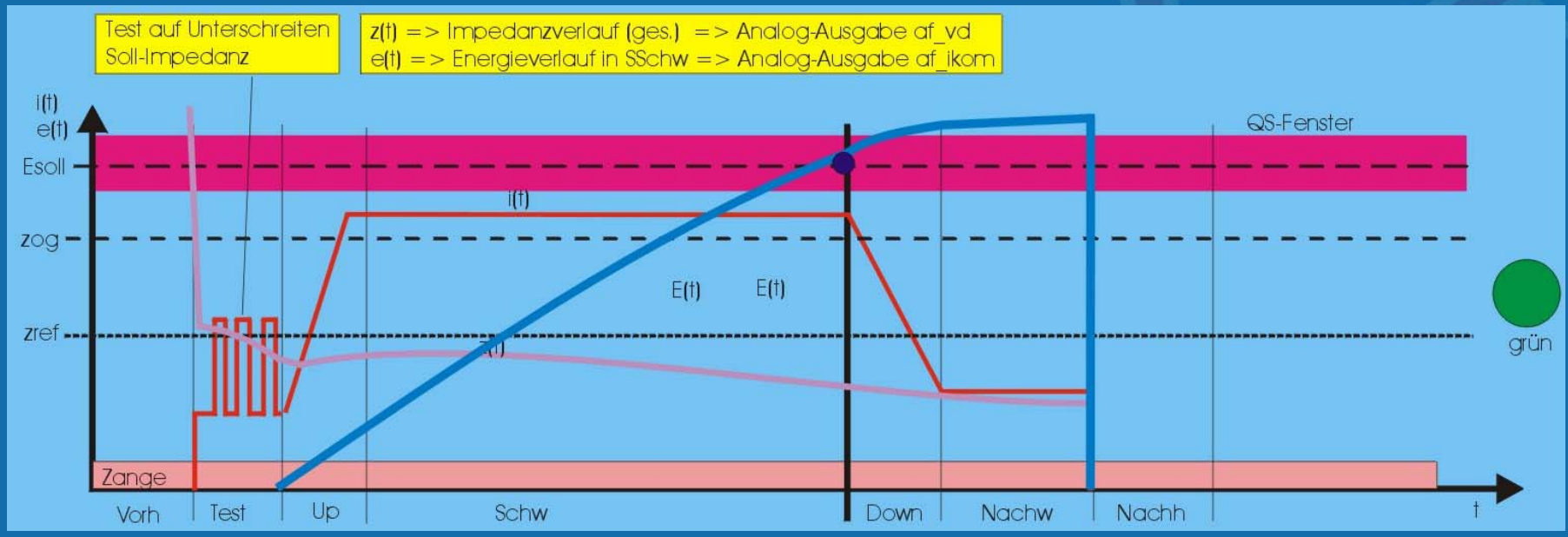
Process control with current over time
QS-result OK if energy
input is in a preset energy window
when reaching ref. time



Conditions at its optimum,
QS-window for total energy input

Example No. 4

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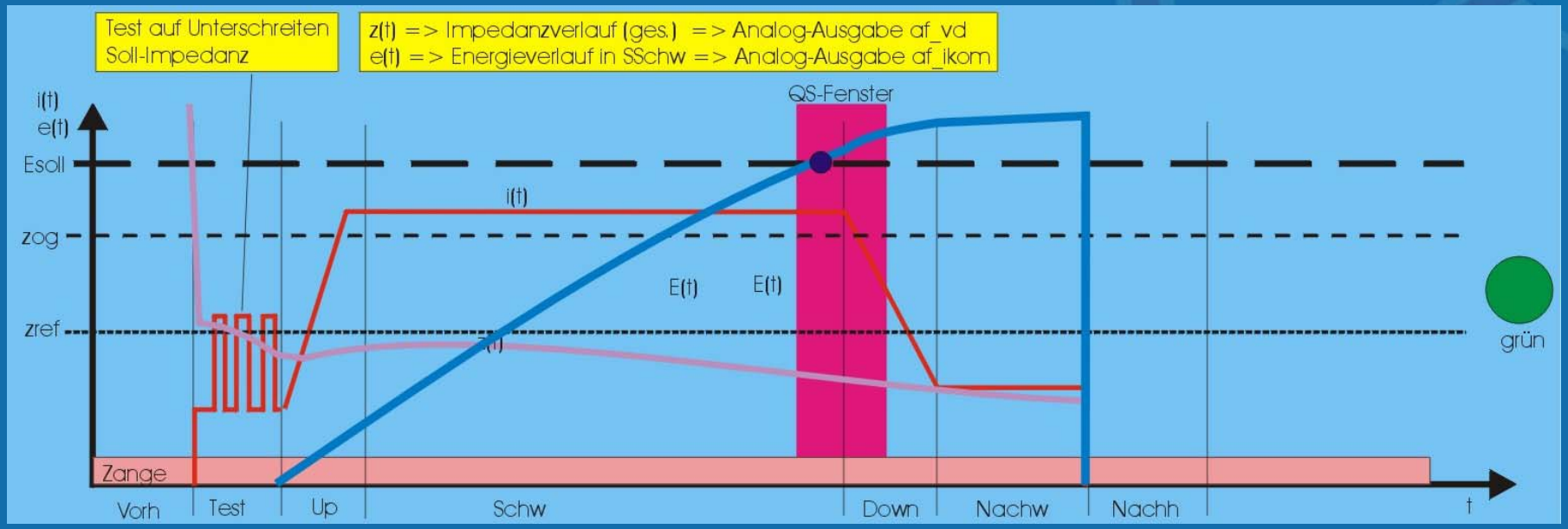
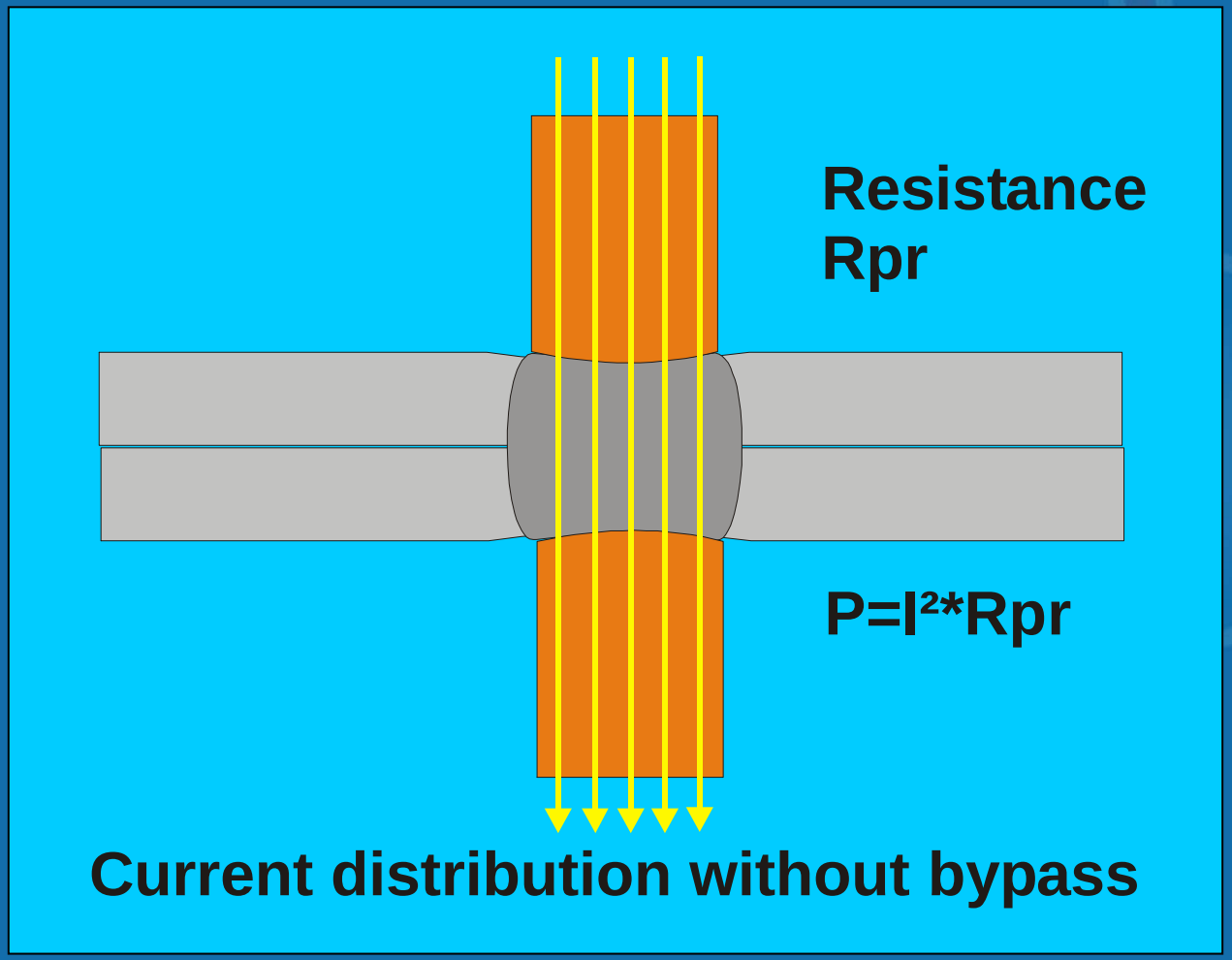
Process control with current and energy over time
QS-result OK when reaching ref. energy
input in a preset time window

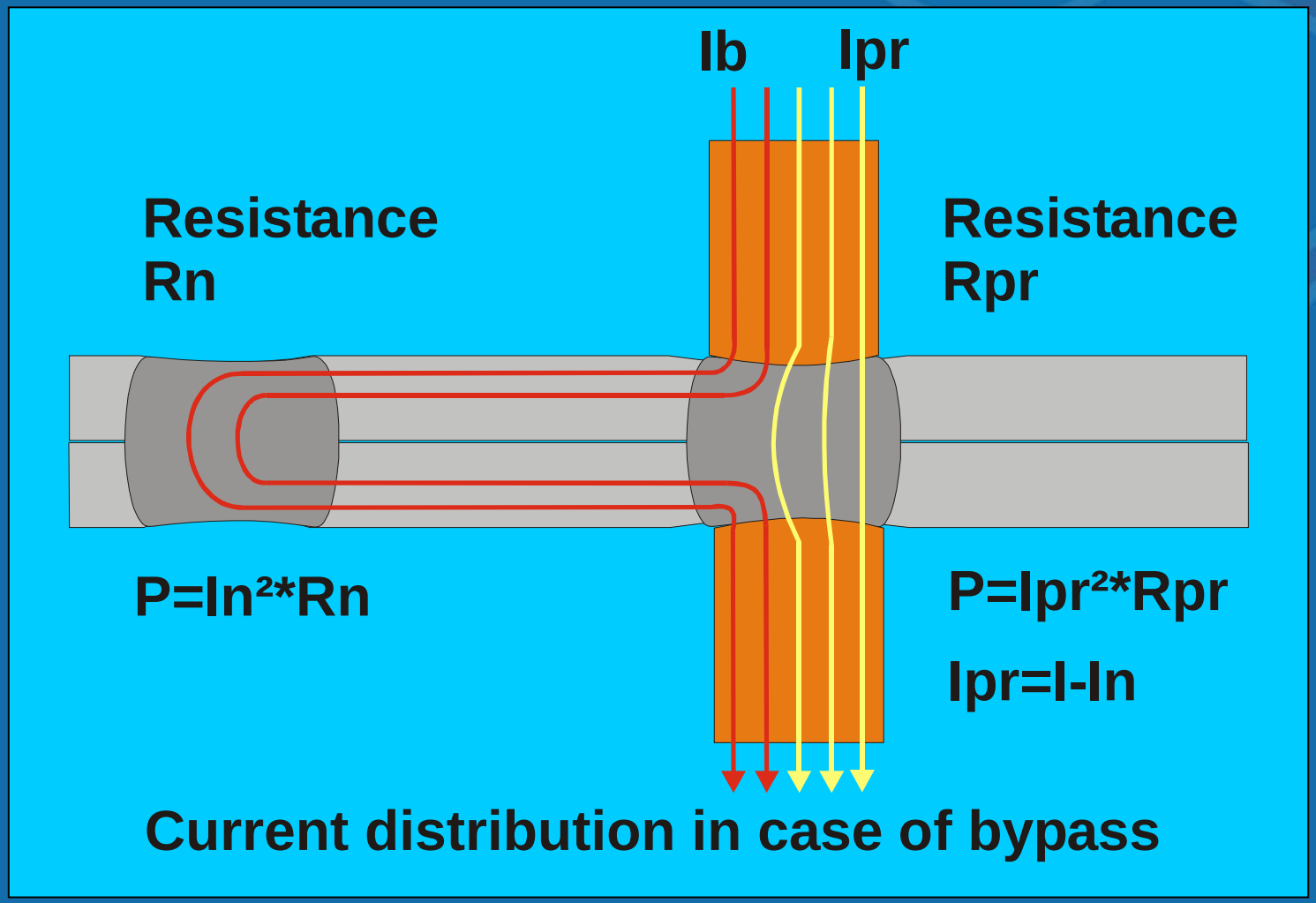


Starting conditions at its optimum
QS-window for welding time

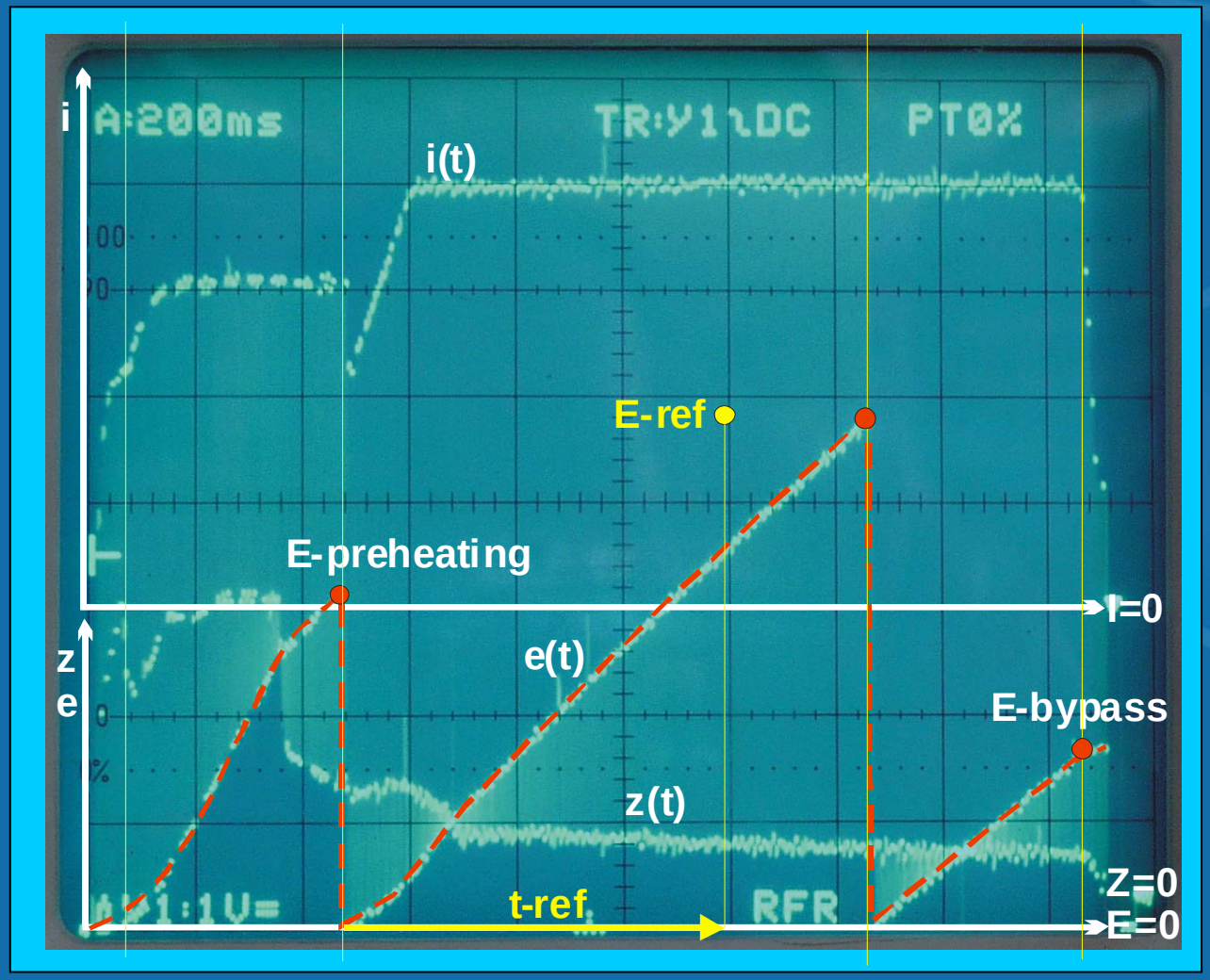
Starting conditions at optimum



Bypass case


Ib
Ipr
Resistance
Rn
Resistance
Rpr
P=In²*Rn
P=Ipr²*Rpr
Ipr=I-In
Current distribution in case of bypass

ELMAspot 9000 QSVM



Parameters in case of bypass, welding operation started after breakthrough of a partwise insulation

Controlled energy input by the Virtual Machine

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Probe done under heavy circumstances with partwise insulation by corrosion and bypass after evaporation of zinc
- Example No. 1 -

Probe done under heavy circumstances with partwise insulation by corrosion and bypass after evaporation of zinc
- Example No. 2
-

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Probe done under heavy circumstances with partwise insulation by adhesives
- Example No. 3 -

Aim and Result

Spot Welder with fast reacting
Power Part

+

Virtual Machine

=

Reproducible Process Result

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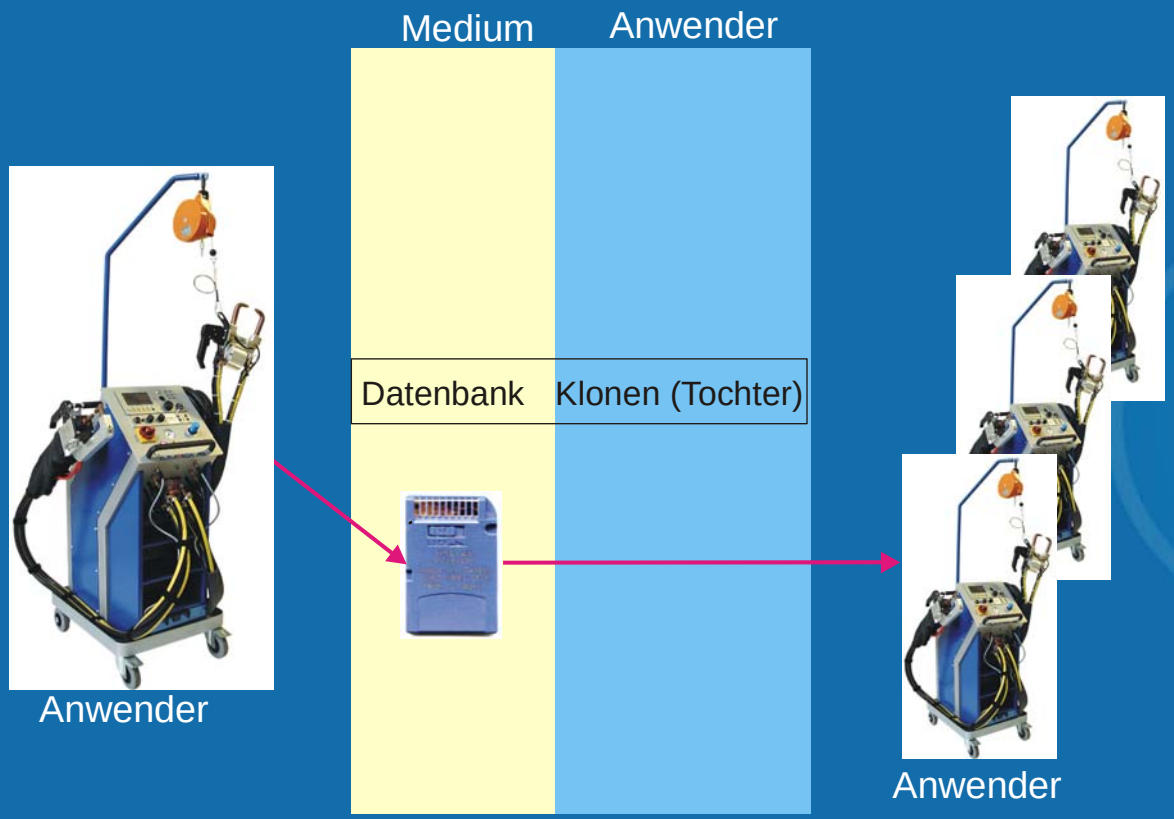
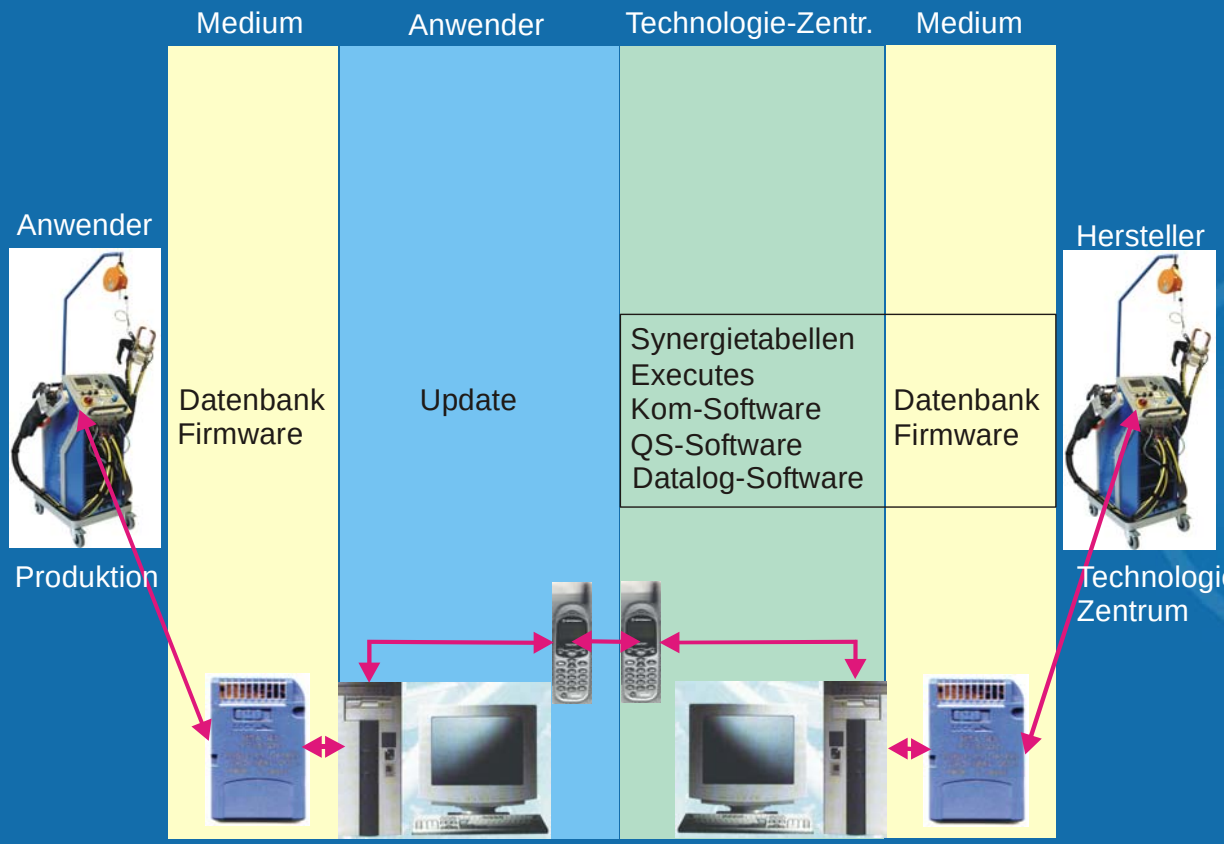
Clones of Spot Welders





MMC

Firmware
Databank
Processdata
QS-Data

Machine-Update managed by Telecommunication

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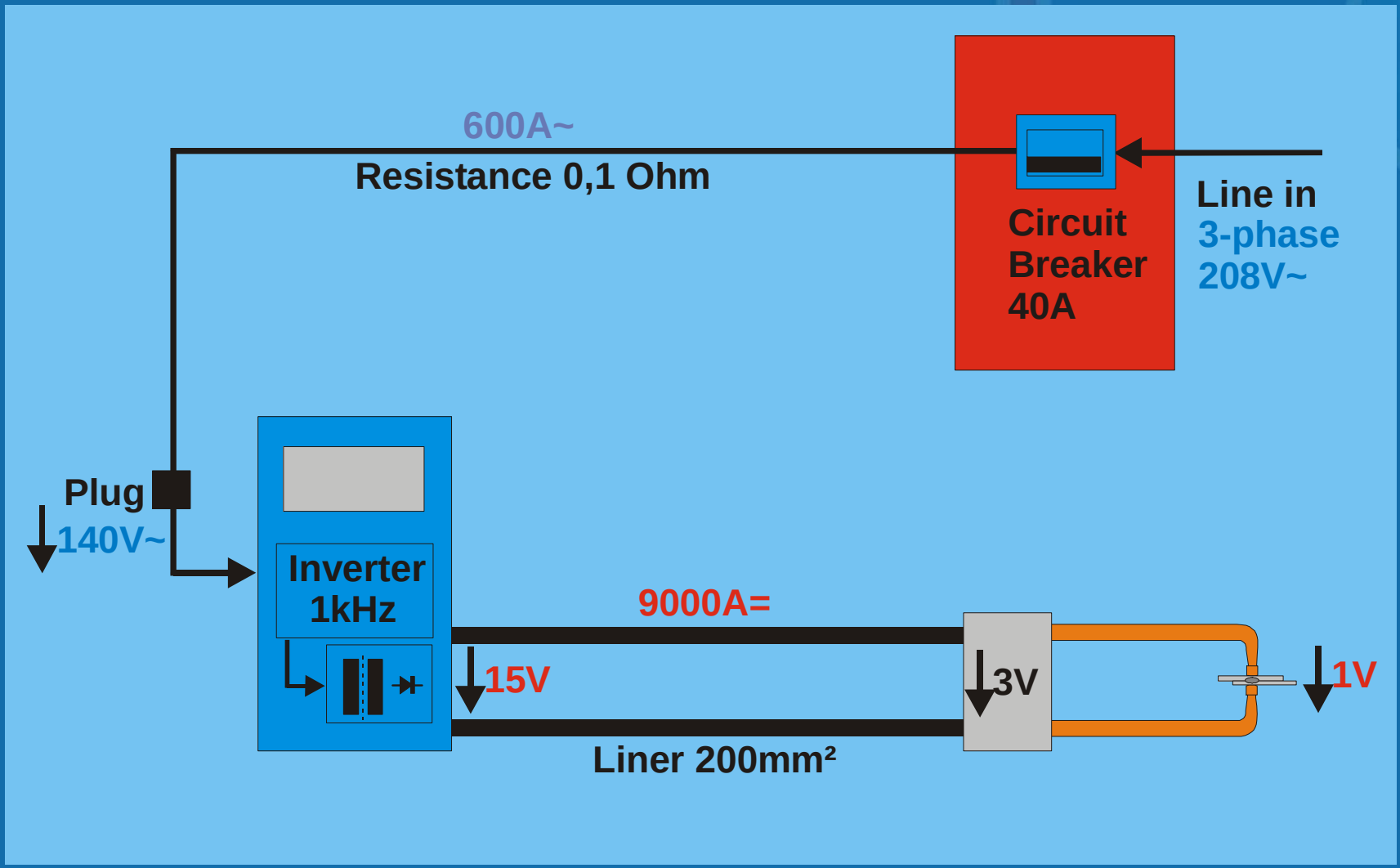
Today's Situation



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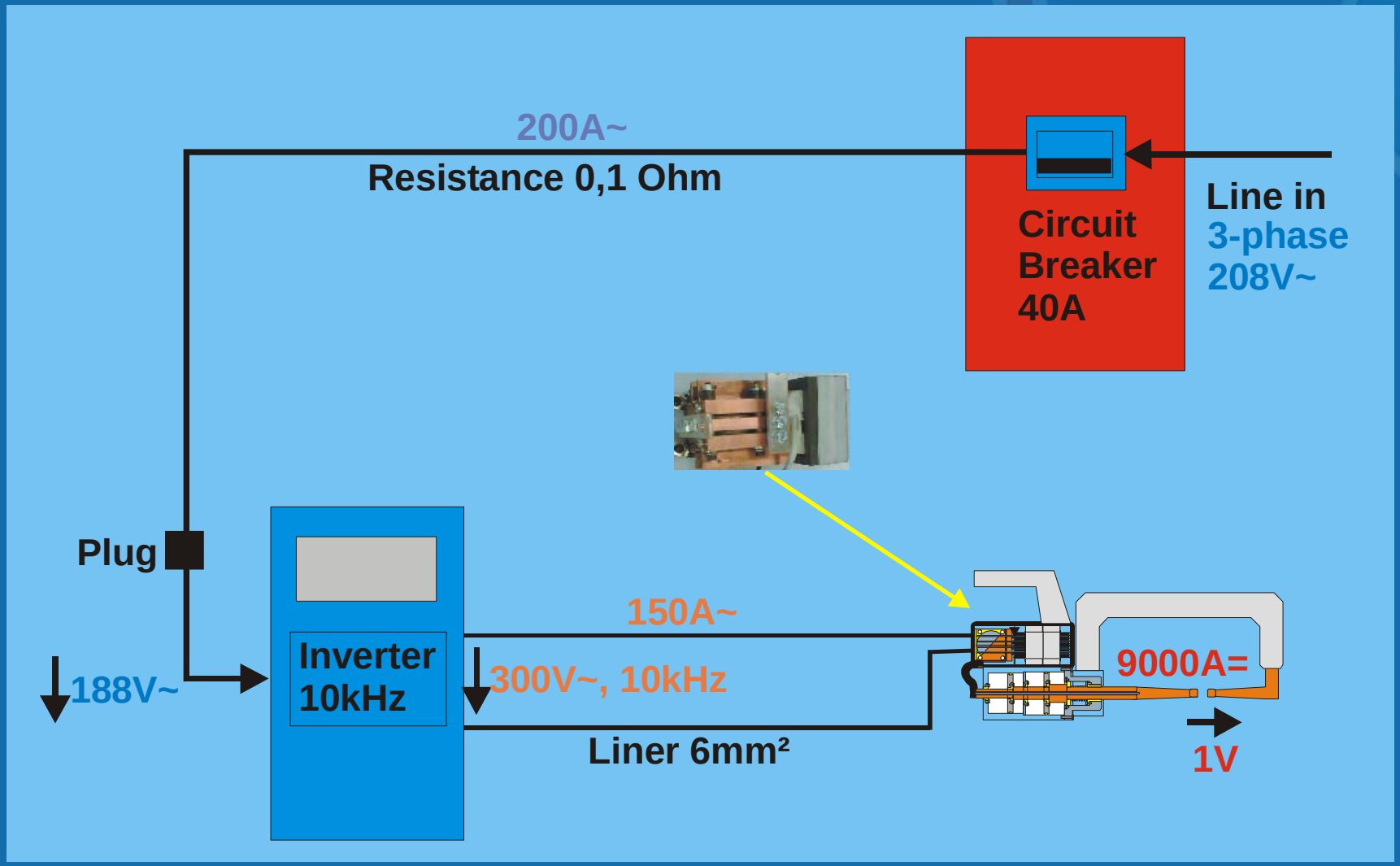
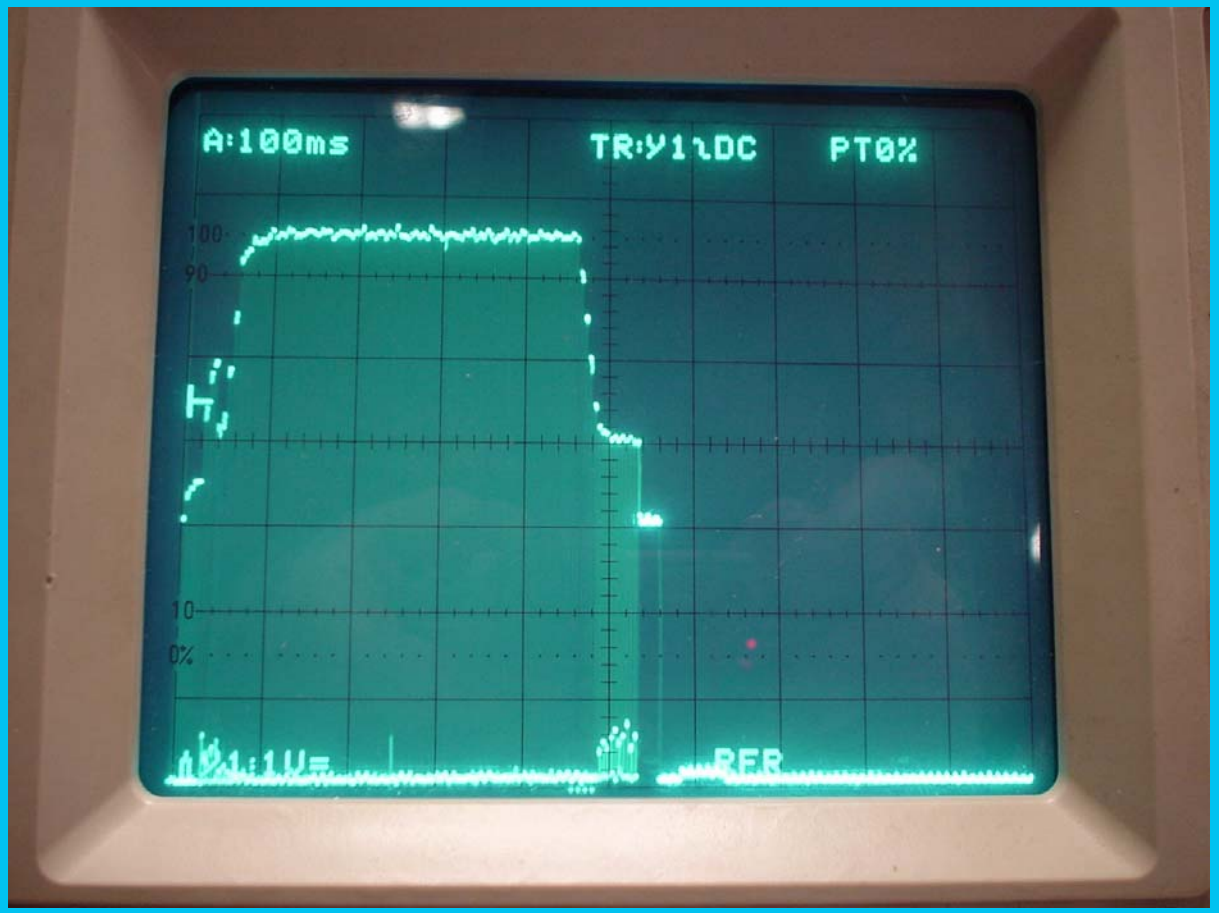
Future





Parameters with closed tong (copper to copper) without working parts

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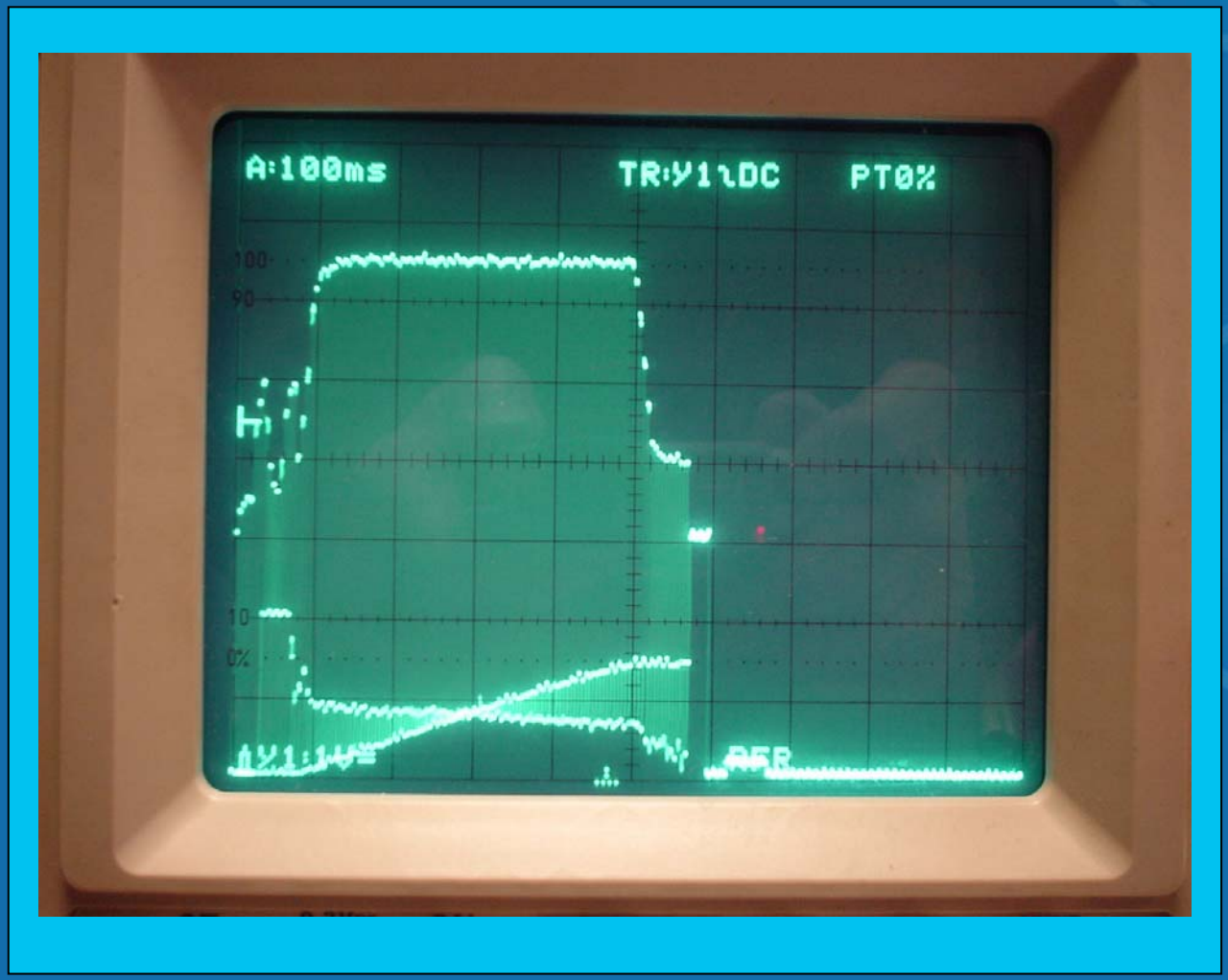
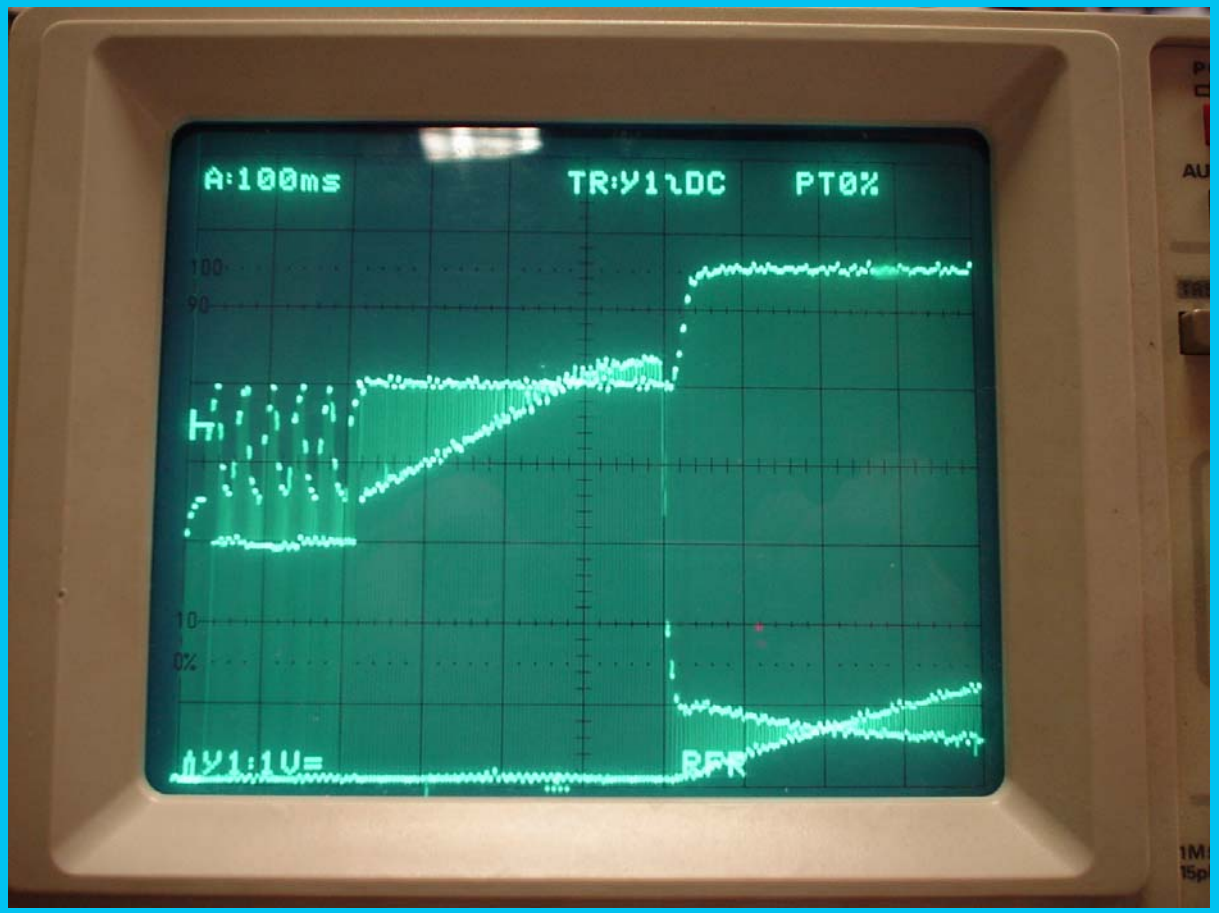


Parameters

2-Sheet-Weld Common Steel

Parameters

2-Sheet-Weld Stainless Steel



Parameters

2-Sheet-Weld
Commen Steel
Partwise Insulation