OMICRON Academy

Circuit breaker testing with CIBANO 500

Methods of measurement

Enter Trainer Name

9 June 2020

Typical test on Circuit breaker?

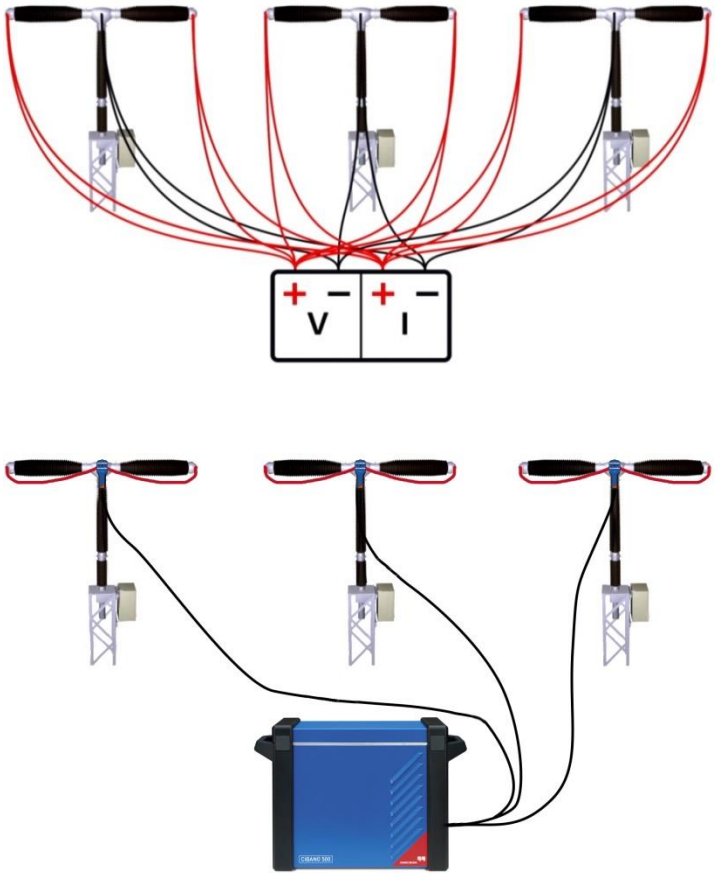
Which parts of the circuit breaker have to be tested?

1. Static/contact resistance (μΩ)
2. Timing of main and auxiliary contacts
   - > Different operation (O, C, O-C, CO, O-CO, CO-CO, O-CO-CO,...)
   - > Undervoltage test
   - > Coil currents
3. Minimum pick-up test
4. Motor current
5. Contact travel (motion) of main contacts
6. Dynamic contact resistance (DRM)

Contact wear and tear of main contacts

1. Static/contact resistance test (μΩ)

- Principle of measurement is to use μΩ-meter
- Can be used for circuit breakers, bus bar joints, etc.
- Conventional procedure
  - Inject a high current
  - Measure small voltage in a noisy environment
  - Use 4-wire technique for connection



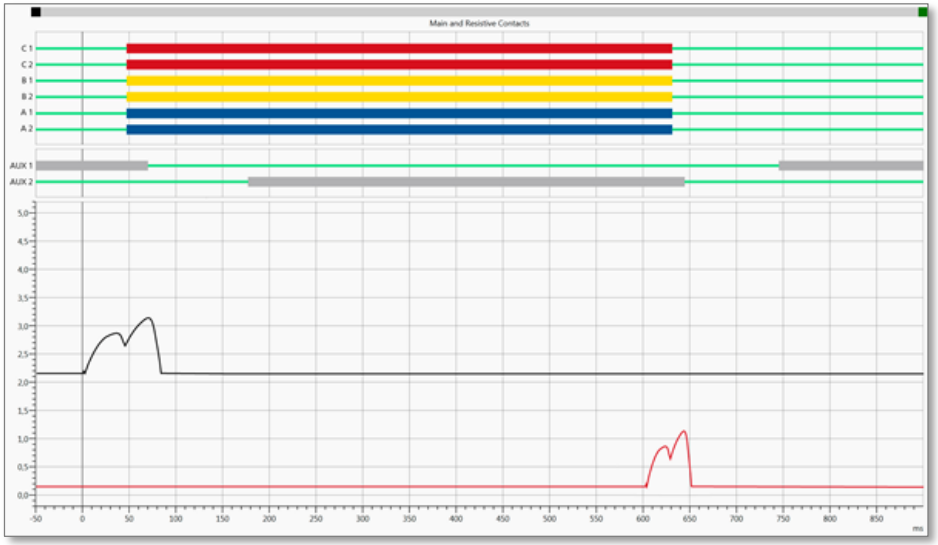
Performance of trip and close components

2a. Timing test

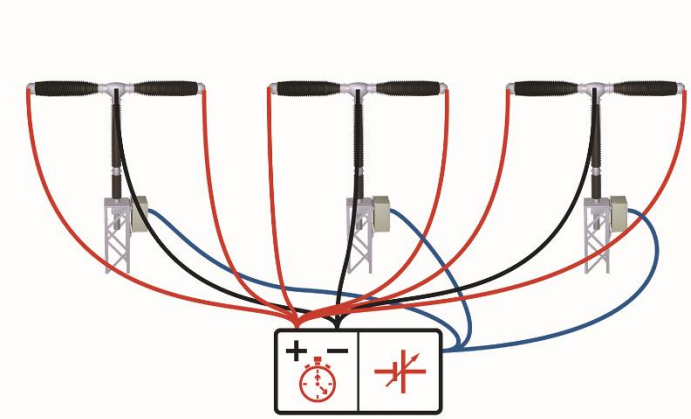
> Connect to all main contacts

> Connect to trip & close coil

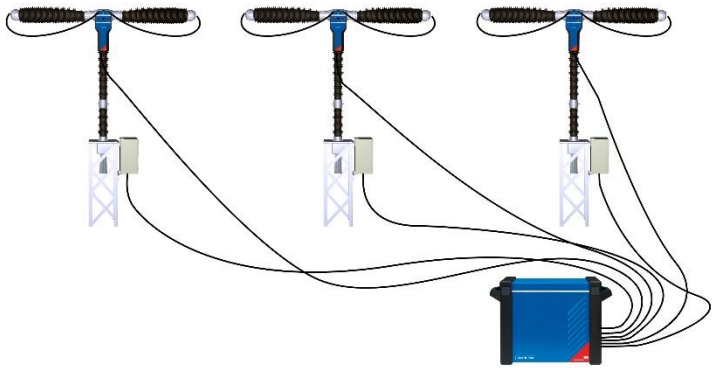
> Connect auxiliary contacts



Measured values: open time, close time, contact spread, phase spread, trip-free time, reclose time



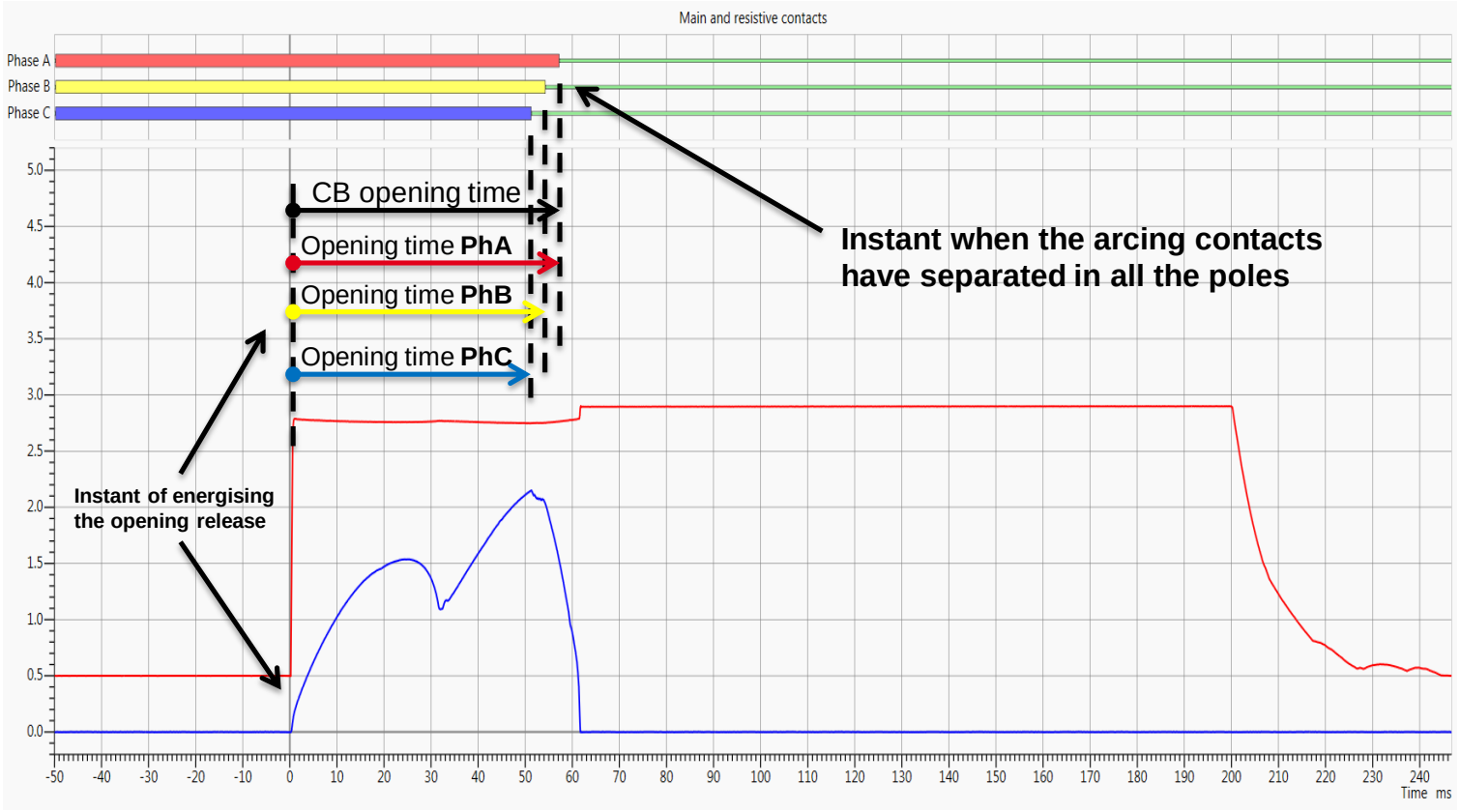
Conventional setup:
time-consuming and error-prone



CIBANO 500 setup:
same wiring as resistance test

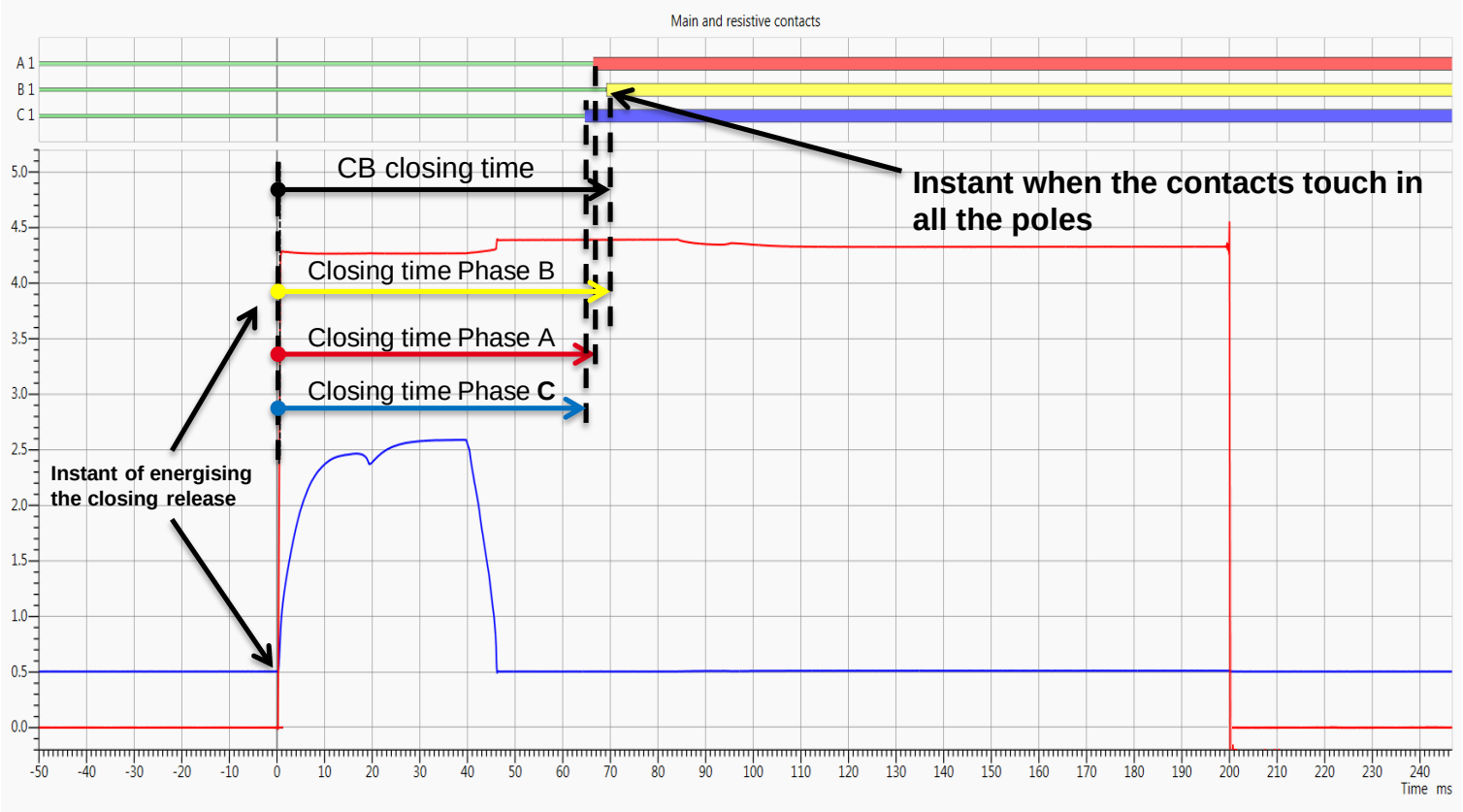
Performance of trip and close components

[O] Open time



Performance of trip and close components

[C] Close time



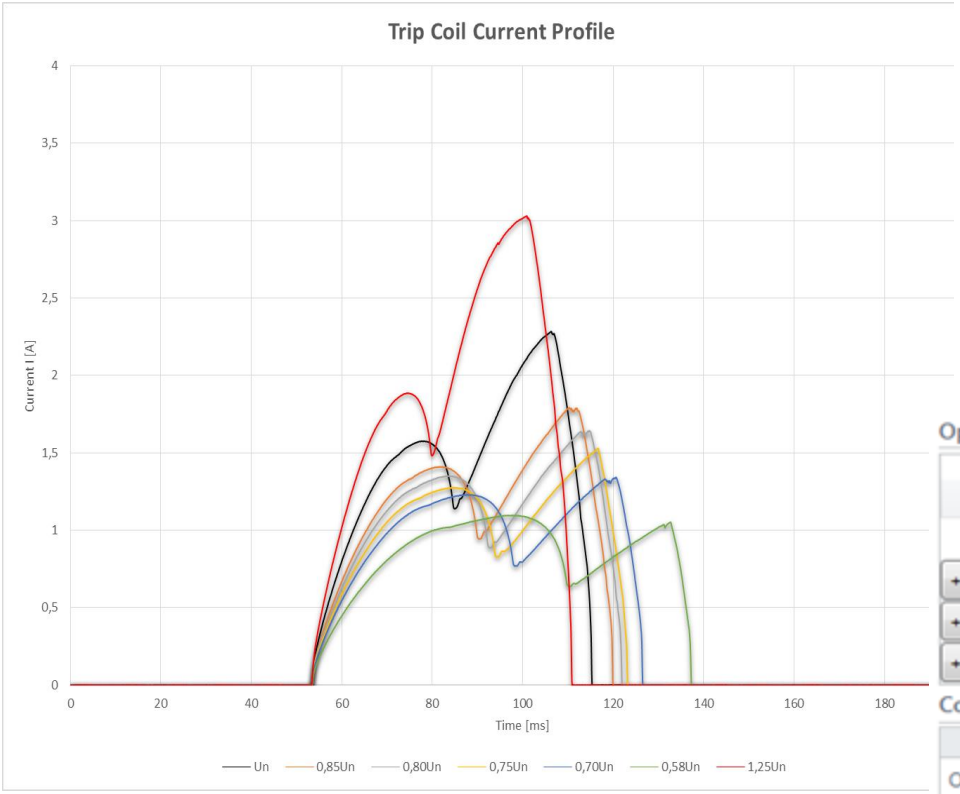
Performance of trip and close components

2b. Undervoltage test

- Coils are usually powered through station battery
  - Condition of the station battery?
- Checks behavior of coils in case of undervoltage supply
  - Perform test with reduced supply voltage (e.g. 80%)
  - Do the coils work at all?
  - Are there any delays compared to nominal voltage?
- Before: impact of undervoltage supply on close and trip operation was a rough simulation
- CIBANO 500: set exact undervoltage of nominal value and check behavior of the coils

Performance of trip and close components

2b. Undervoltage test



Operating times for breaker

	U_n	Open time
	Breaker	52,10 ms
+	R	50,90 ms
+	S	52,10 ms
+	T	51,80 ms

Coil characteristics

	Peak current
Open 1	2,29 A

Operating times for breaker

	$1{,}25U_n$	Open time
	Breaker	46,70 ms
+	R	45,50 ms
+	S	46,70 ms
+	T	46,40 ms

Coil characteristics

	Peak current
Open 1	3,03 A

Operating times for breaker

	$0{,}75U_n$	Open time
	Breaker	61,60 ms
+	R	60,40 ms
+	S	61,60 ms
+	T	61,30 ms

Coil characteristics

	Peak current
Open 1	1,53 A

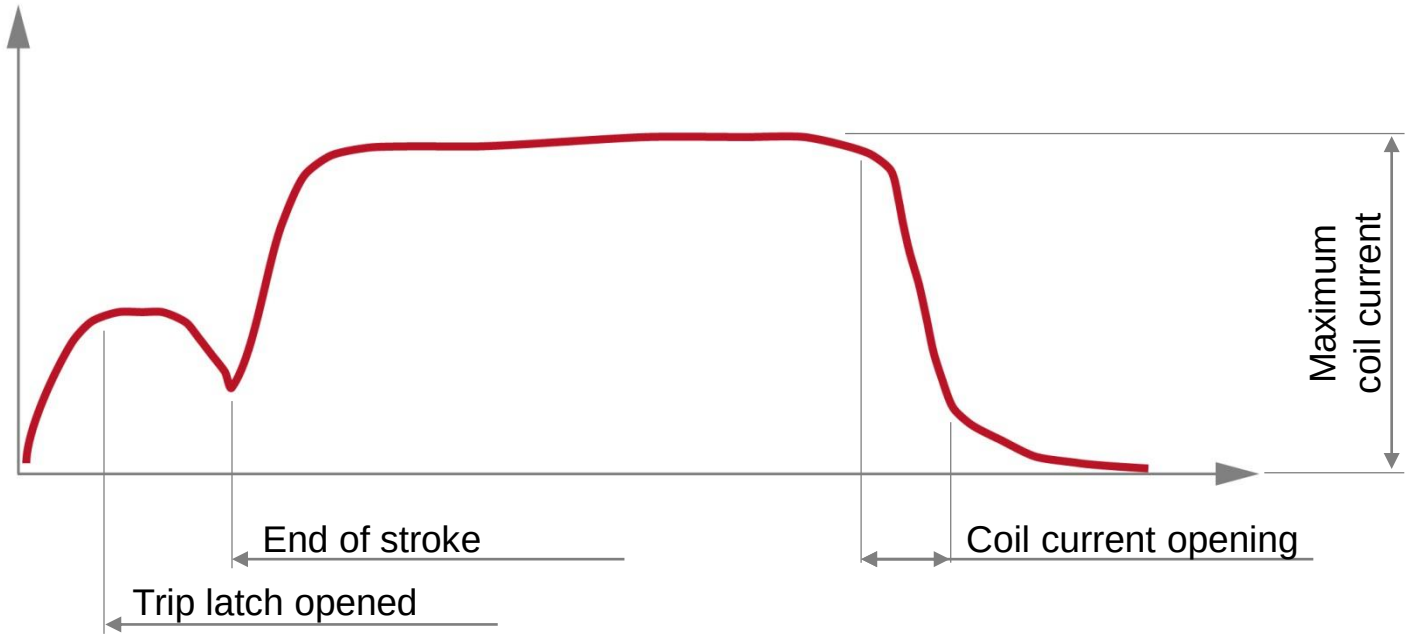
Performance of trip and close components

2c. Coil currents

> Detection of potential problems in actuating coils

> Reveals information on power supply

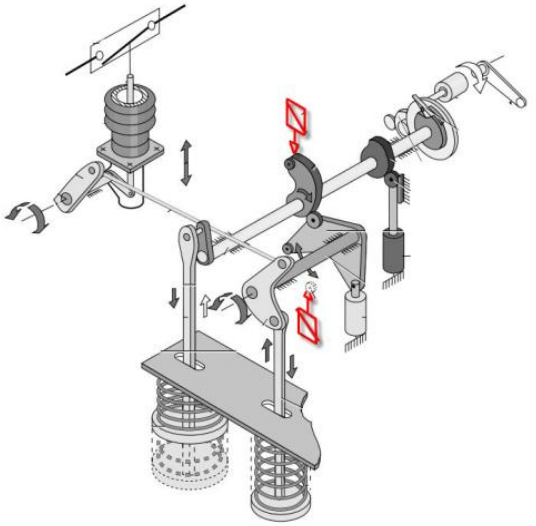
> Comparison is the best method of analysis

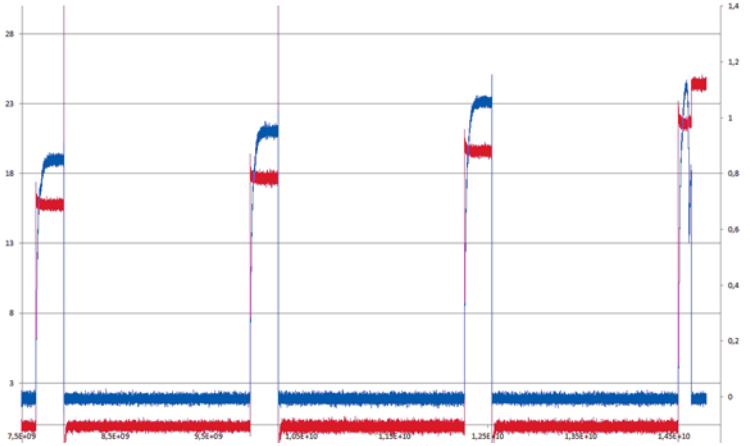


Performance of trip and close components

3. Minimum pick-up test

- Indicates the lowest voltage to operate the trip or close coil
- Conventional procedure
  - Start at a certain voltage level
  - Try to operate
  - If not working, increase voltage and try again
  - Ramp the voltage pulse until minimum voltage is reached with which the circuit breaker switches
- Everybody has a „self-made“ solution for this test
- CIBANO 500: automatic testing after setting pass/fail level to certain percentage of nominal value





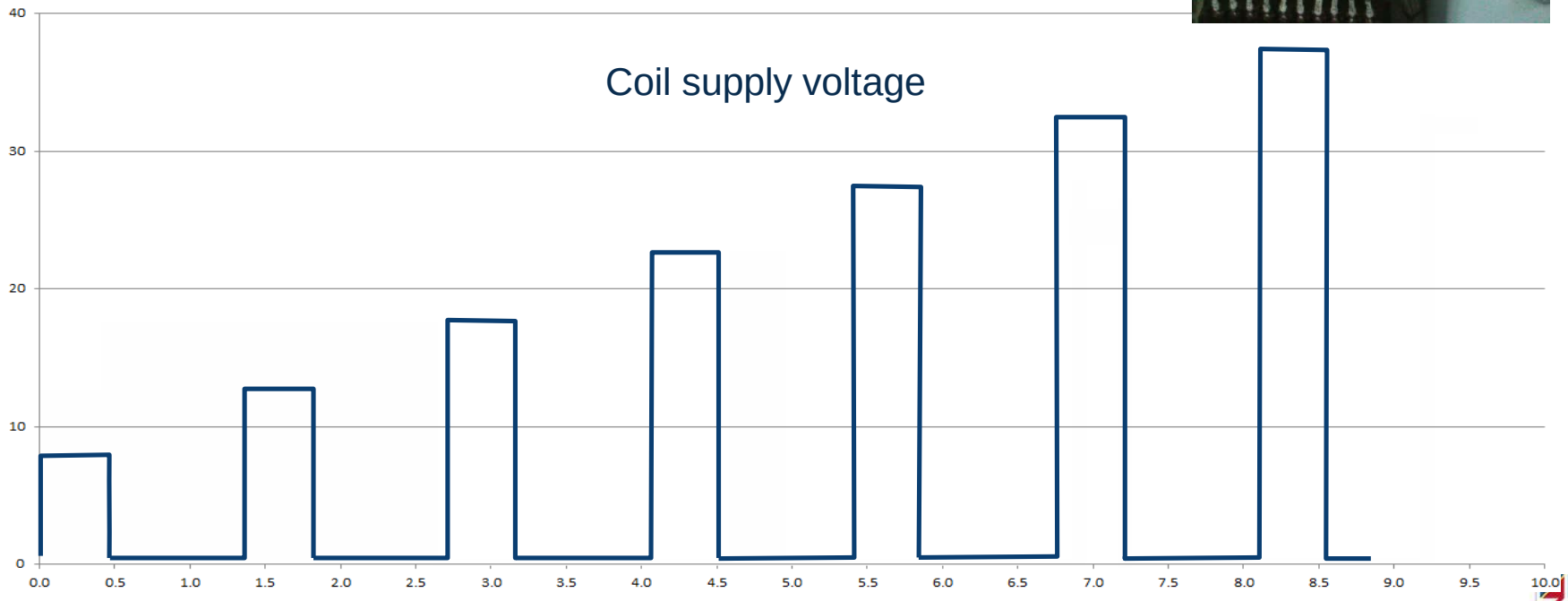
Performance of trip and close components

3. Minimum pick-up test

> Under voltage test of trip & close coil

> continuously increase of coil supply voltage

> ramp of voltage pulse to avoid overheating of coils

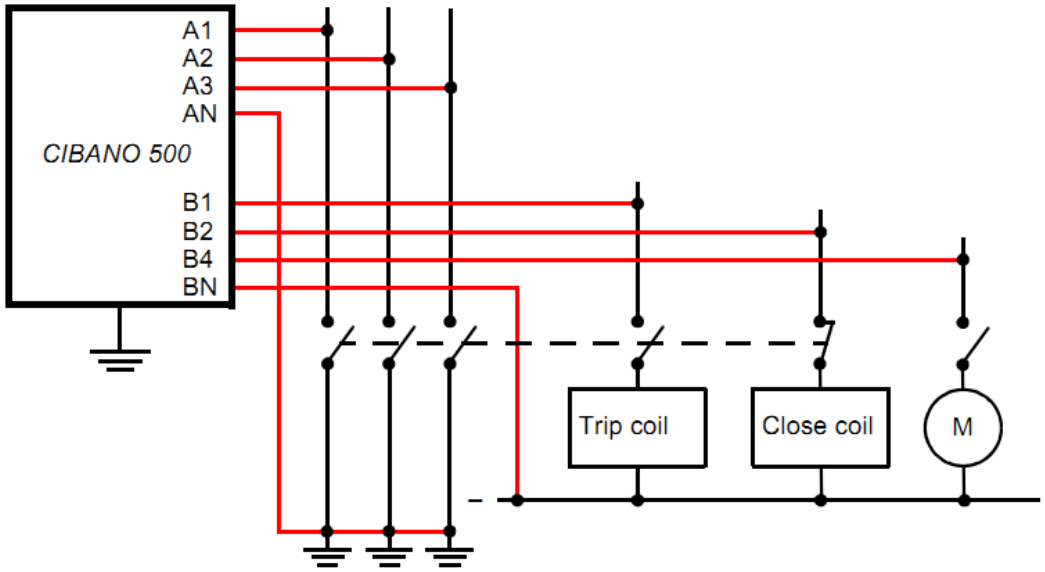


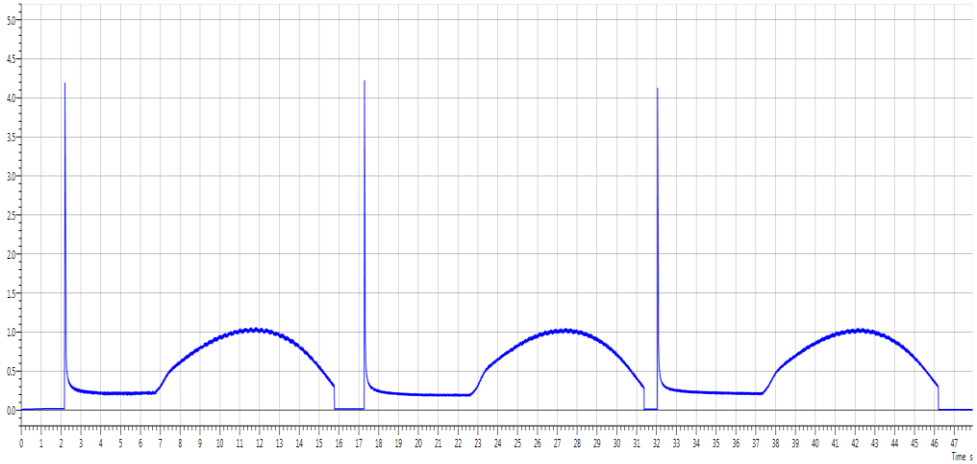
Performance of charging motor

4. Motor current

> Trend of motor current shows you the power needed by the motor

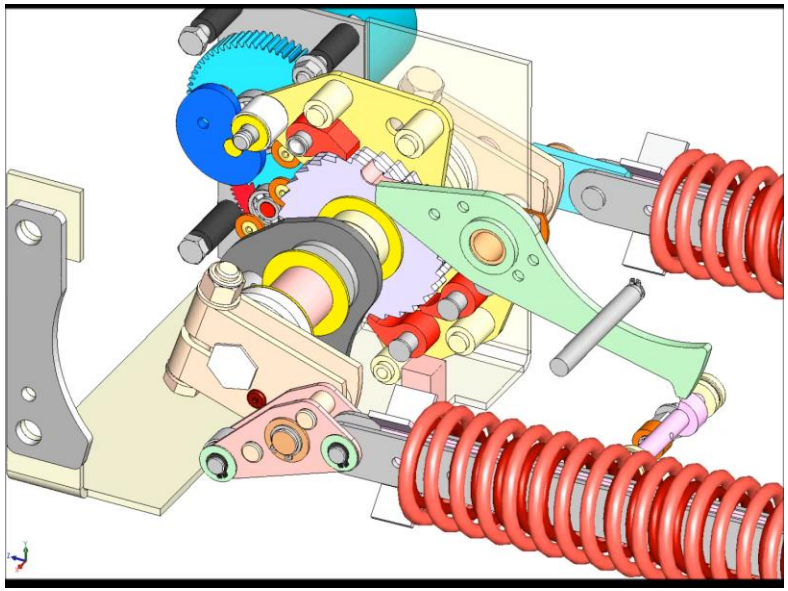
> Procedure
  > Connect source to charging motor or use current clamp
  > Check charging times and charging currents
  > Compare with previous measurements
  > Analyze undervoltage conditions



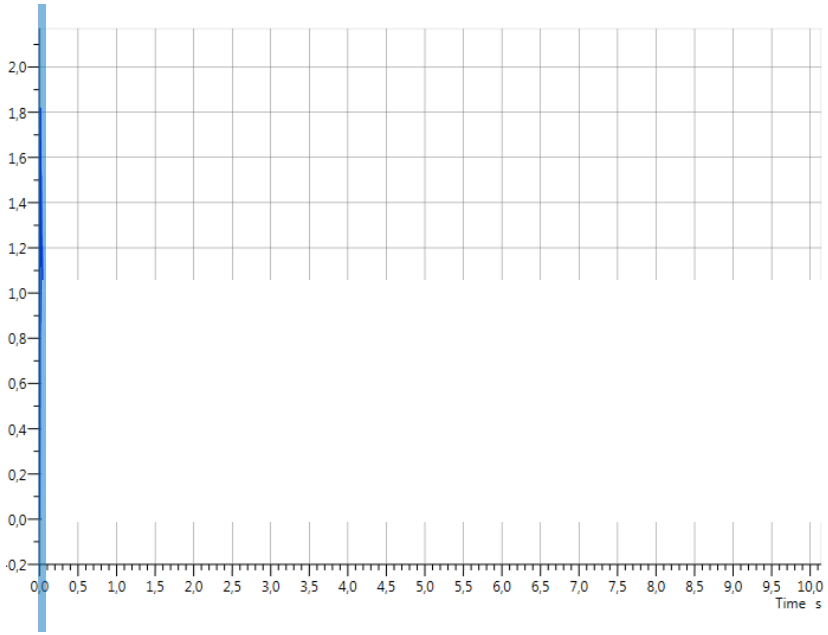


Performance of charging motor

4. Motor current



Source: Schneider Electric

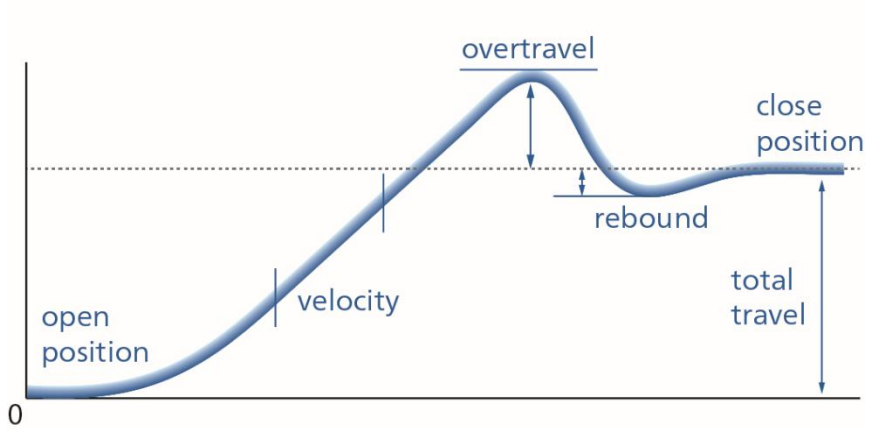


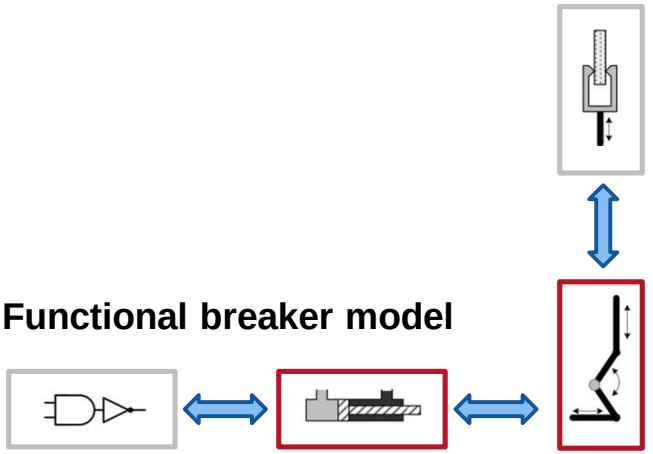
Performance of kinematic chain

5. Contact travel (motion) of main contacts

> Reveals mechanical defects of the cinematic chain
  > Overall mechanical performance
  > Slow operation due to jammed mechanism
  > Deterioration of mechanical damping (dashpots)

> Contact wear
  > Arcing contact length (combined with DRM)

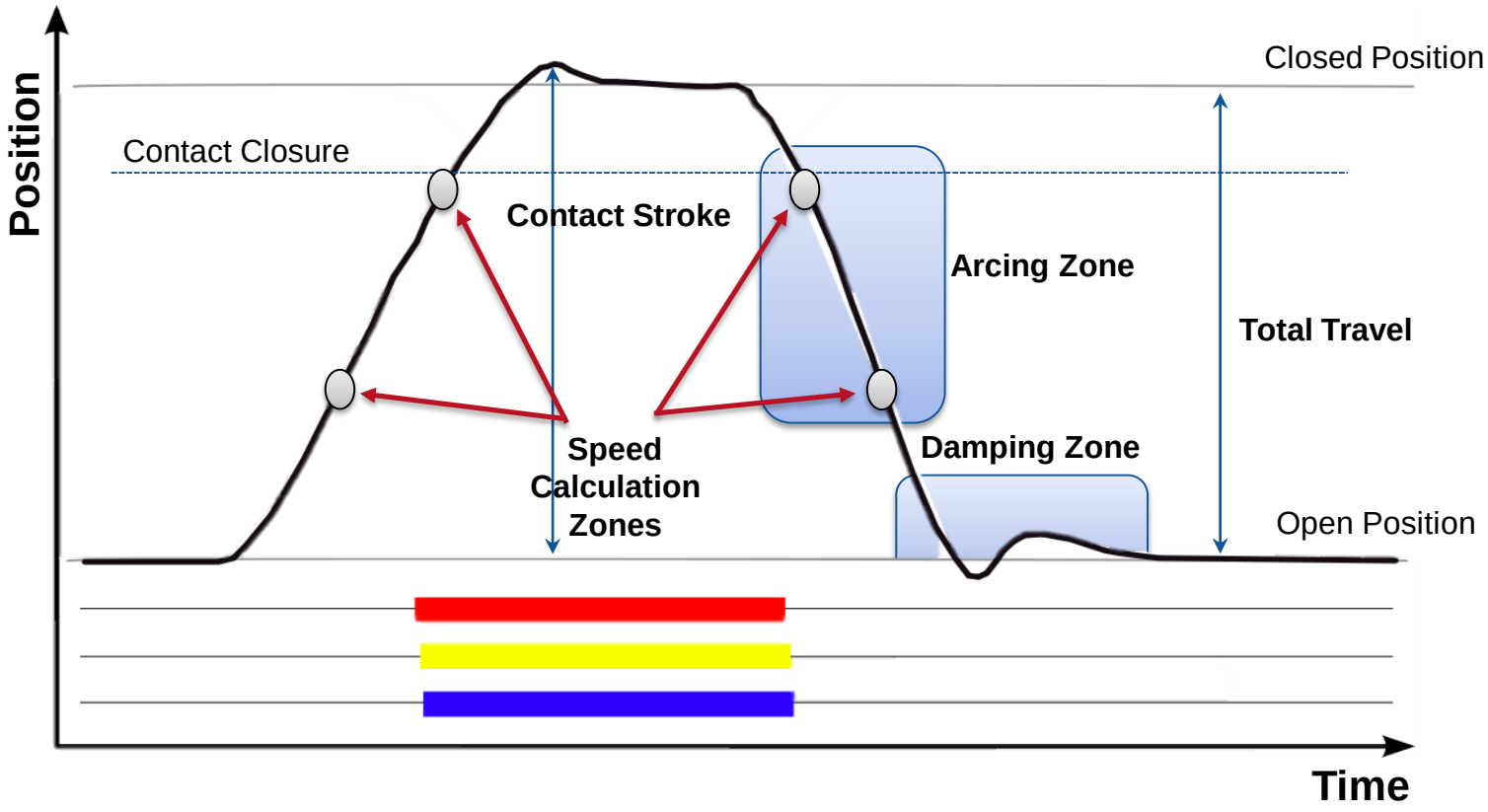




Performance of kinematic chain

5. Contact travel (motion) of main contacts

> What information do we get? e.g. during Close-Open [CO]



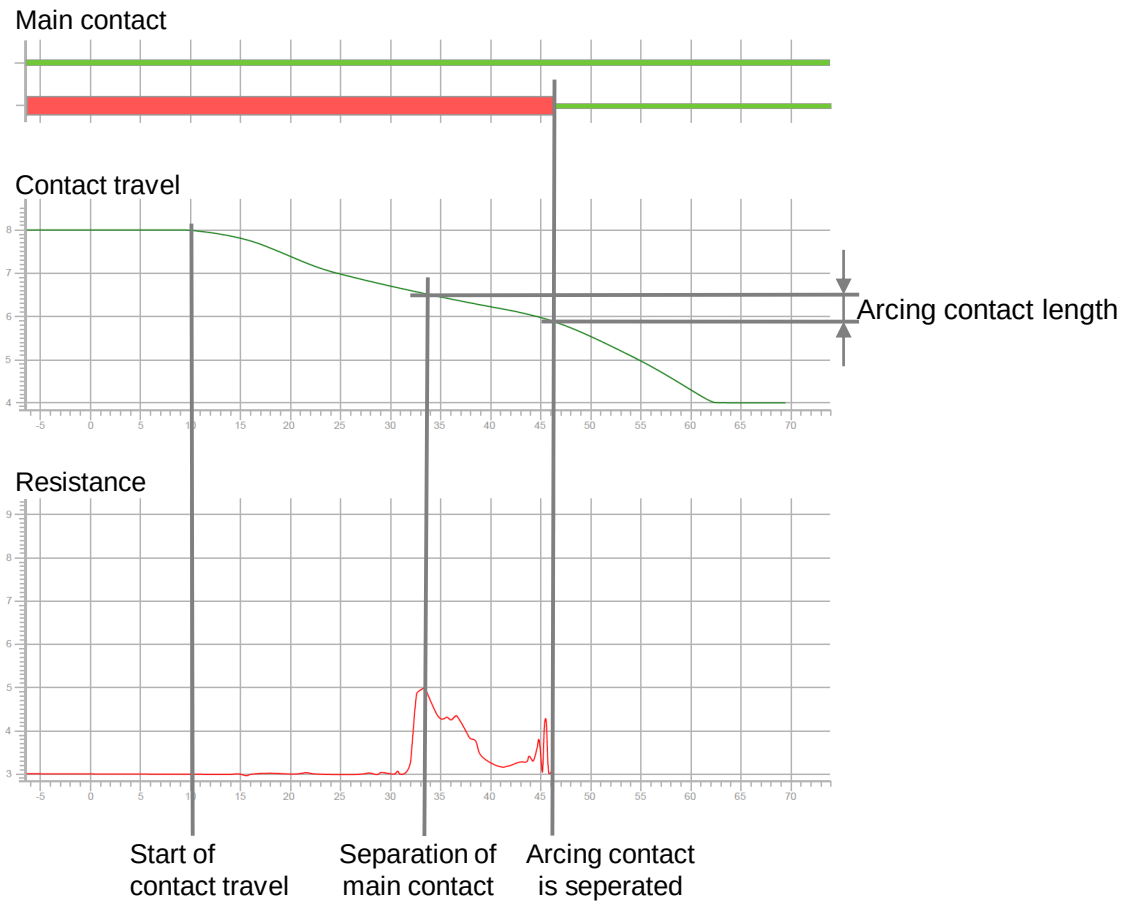
Performance of kinematic chain

5. Contact travel (motion) of main contacts

Contact wear and tear of main contacts

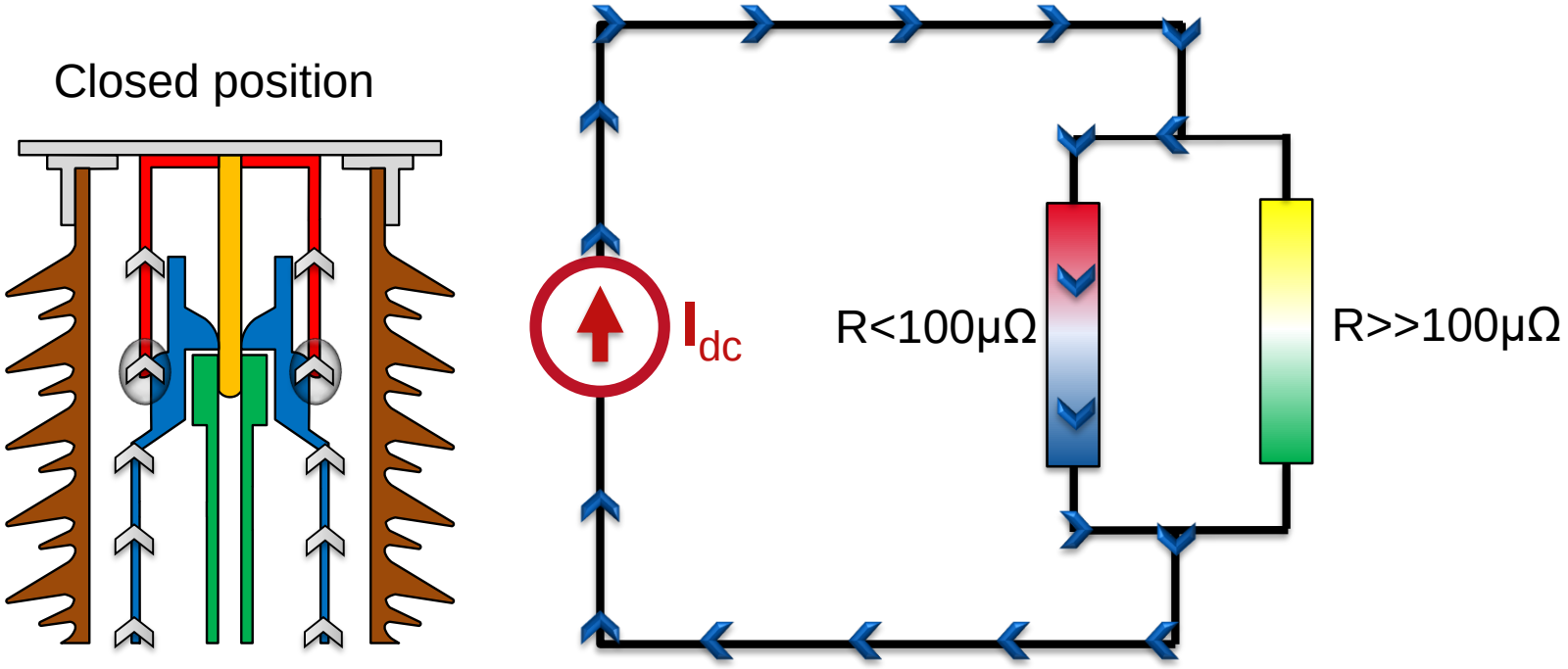
6. Dynamic contact resistance (DRM)

- Records contact resistance during breaker operation (resistance over time)
- Combination of contact resistance, timing and travel measurements
- Use DRM to find out
  - The arcing contact length
  - Contact finger problems
  - Lubrication problems
- Procedure
  - Inject high current
  - Start recording current and voltage
  - Operate circuit breaker
  - Calculate resistance



Contact wear and tear of main contacts

6. Dynamic contact resistance (DRM)



2 Stationary arcing contact

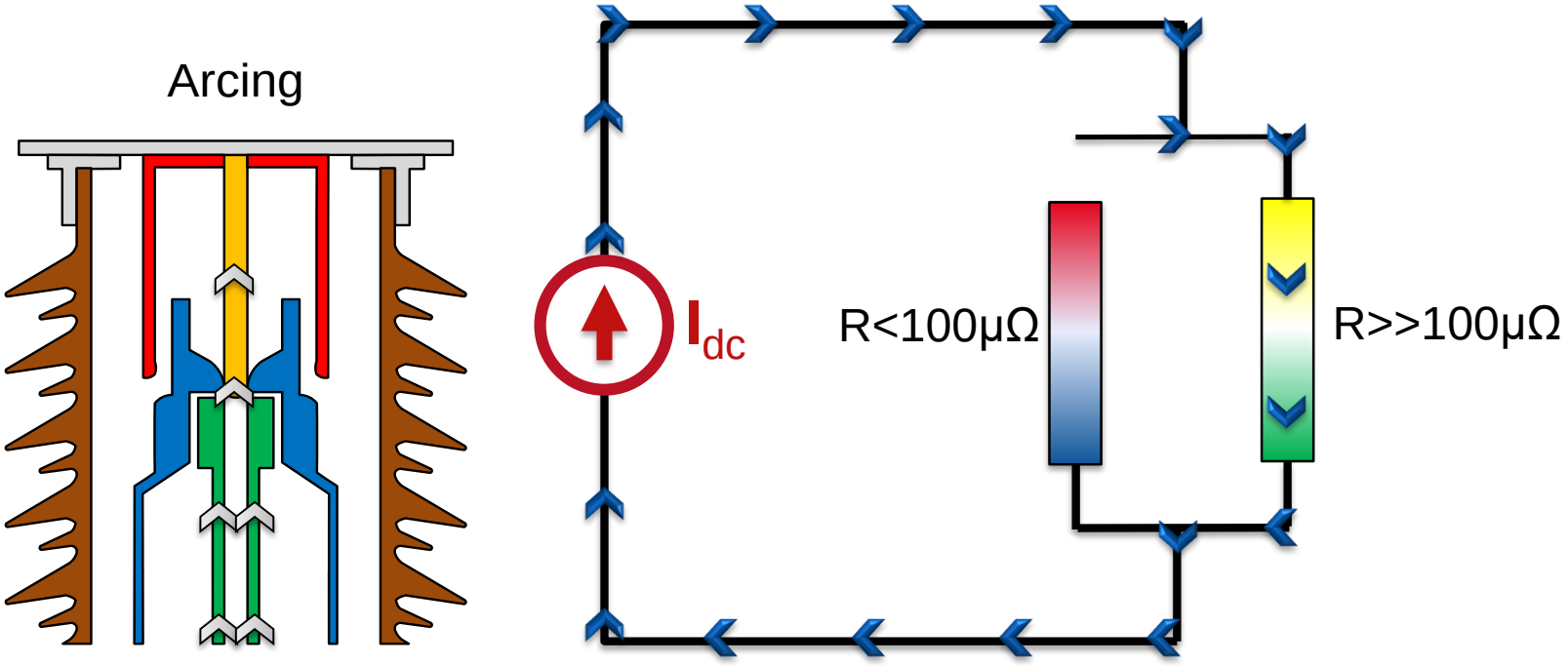
3 Moving arcing contact

7 Stationary main contact

8 Moving main contact

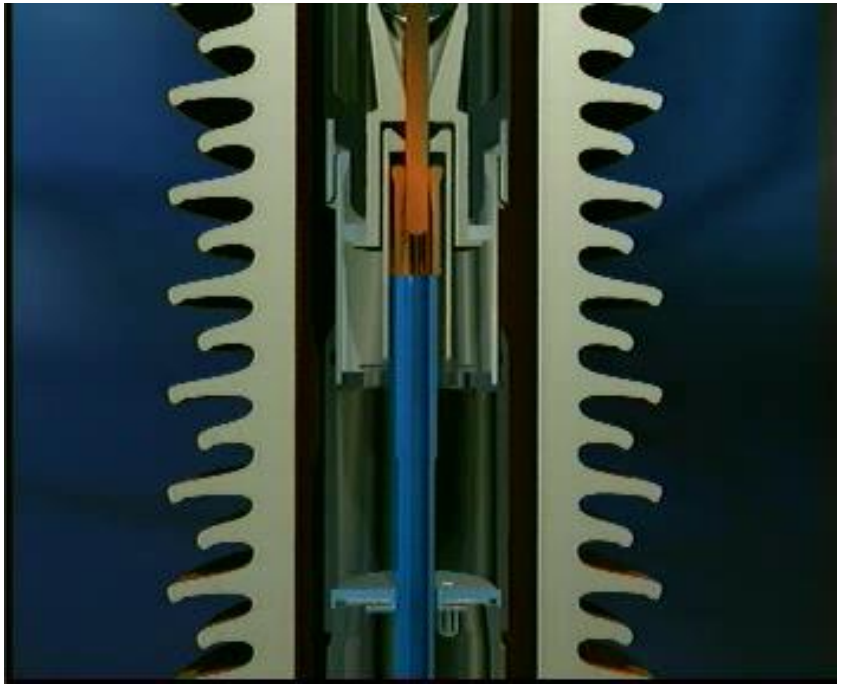
Contact wear and tear of main contacts

6. Dynamic contact resistance (DRM)

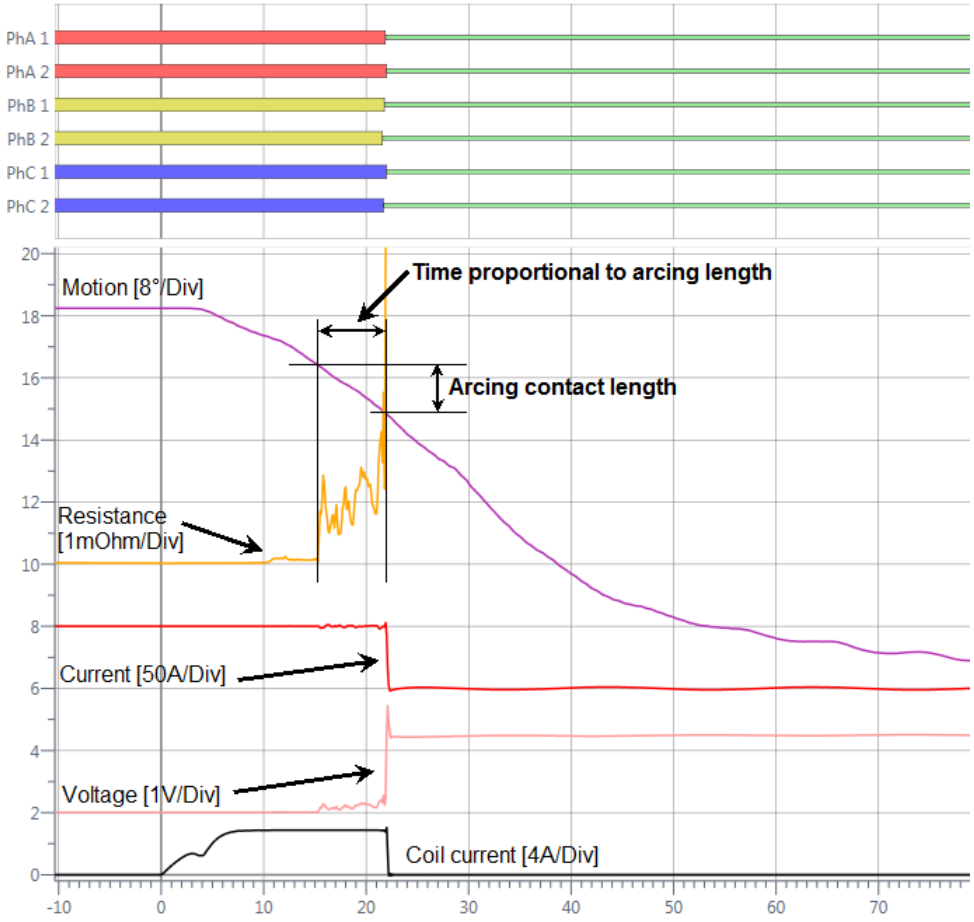


Contact wear and tear of main contacts

6. Dynamic contact resistance (DRM)



Source: SIEMENS



Contact wear and tear of main contacts

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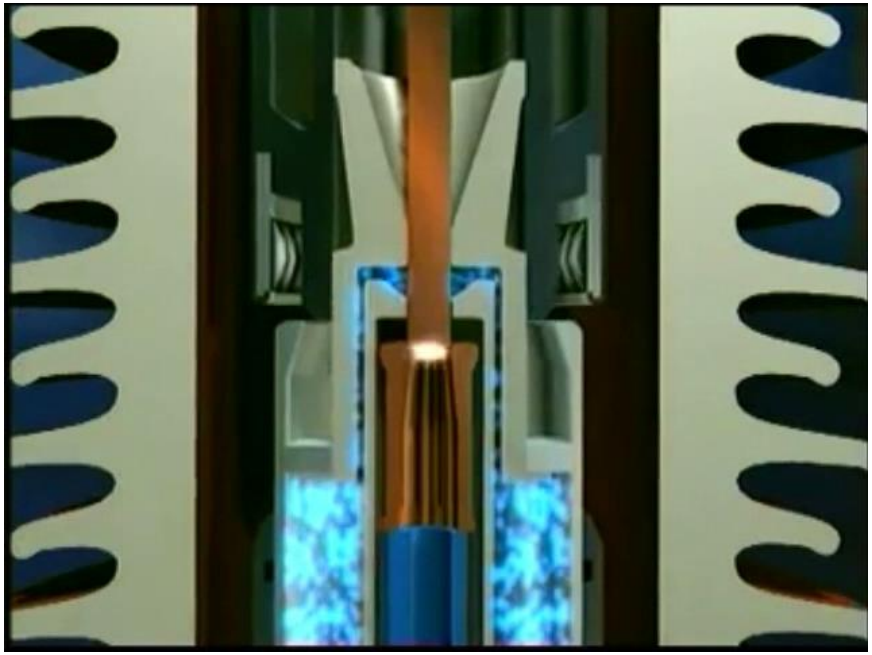

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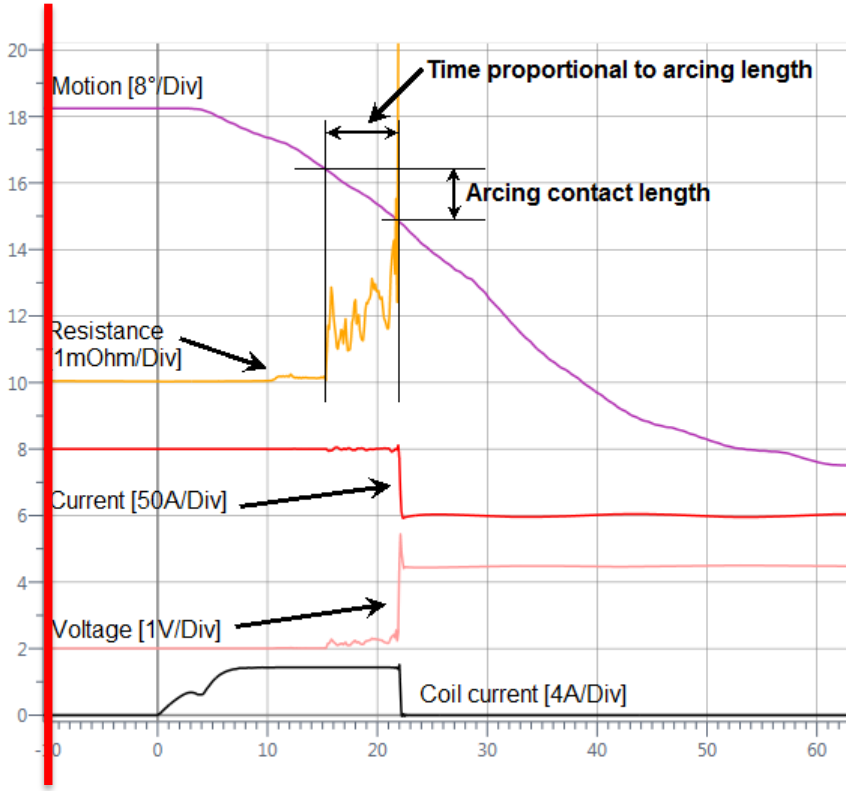

Contact wear and tear of main contacts

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