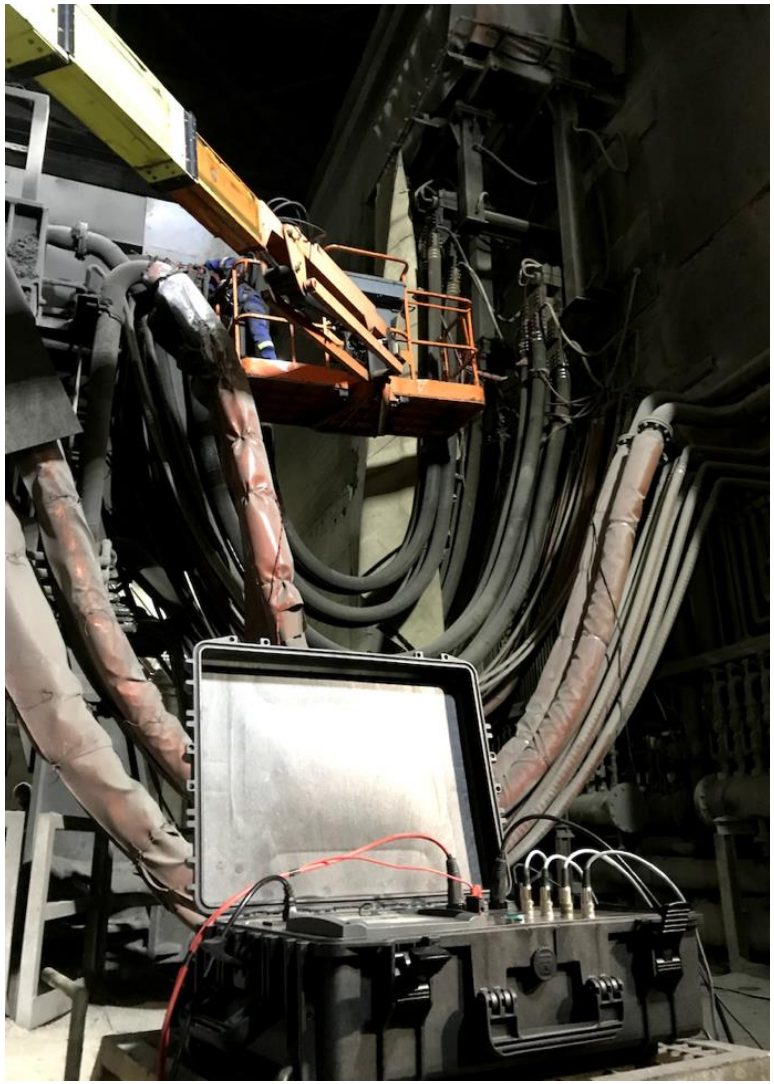
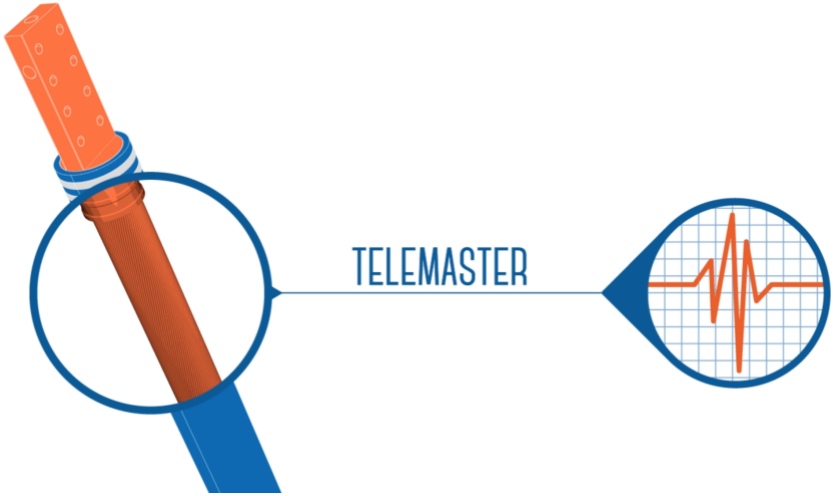


TELEMASTER

On- line Preventive Maintenance System for Water Cooled Cables



INTRODUCTION

During the last years EAF productivity has significantly increased shortening the power-off and power-on times, thanks to new systems to monitor parameters and performances of the furnace.
With regards to the maintenance of electrical equipment and components of the furnace, *main problem still to be solved is to predict the water cooled cables failure in advance*.

The TELEMASTER is the new innovative system to monitor the water cooled cables electrical electric performances, predict the failure in advance and reduce power losses.

BASIC CONSIDERATIONS

Water-cooled cables are the most sensitive part of an arc furnace secondary circuit and typically subject to two kinds of accidents:

- Hose failures
- Copper conductors failures

Until today the only way to have an idea of the water cooled cable electrical situation, is to disassemble the cable from the furnace and measure the ohmic resistance***. In fact the estimation of the current intensity distribution with Rogowski coils is not enough, because gives only a distribution of the currents in a parallel of cables with no relation to the cable's resistance***.

During operation, water-cooled cables copper ropes are subject to:

- Chemical corrosion/erosion caused by the cooling water
- Mechanical stress caused by:
  - Vibration induced from the furnace
  - ELECTRO-MAGNETIC FORCES generated by the very high current intensity. Cables are bumping hardly.

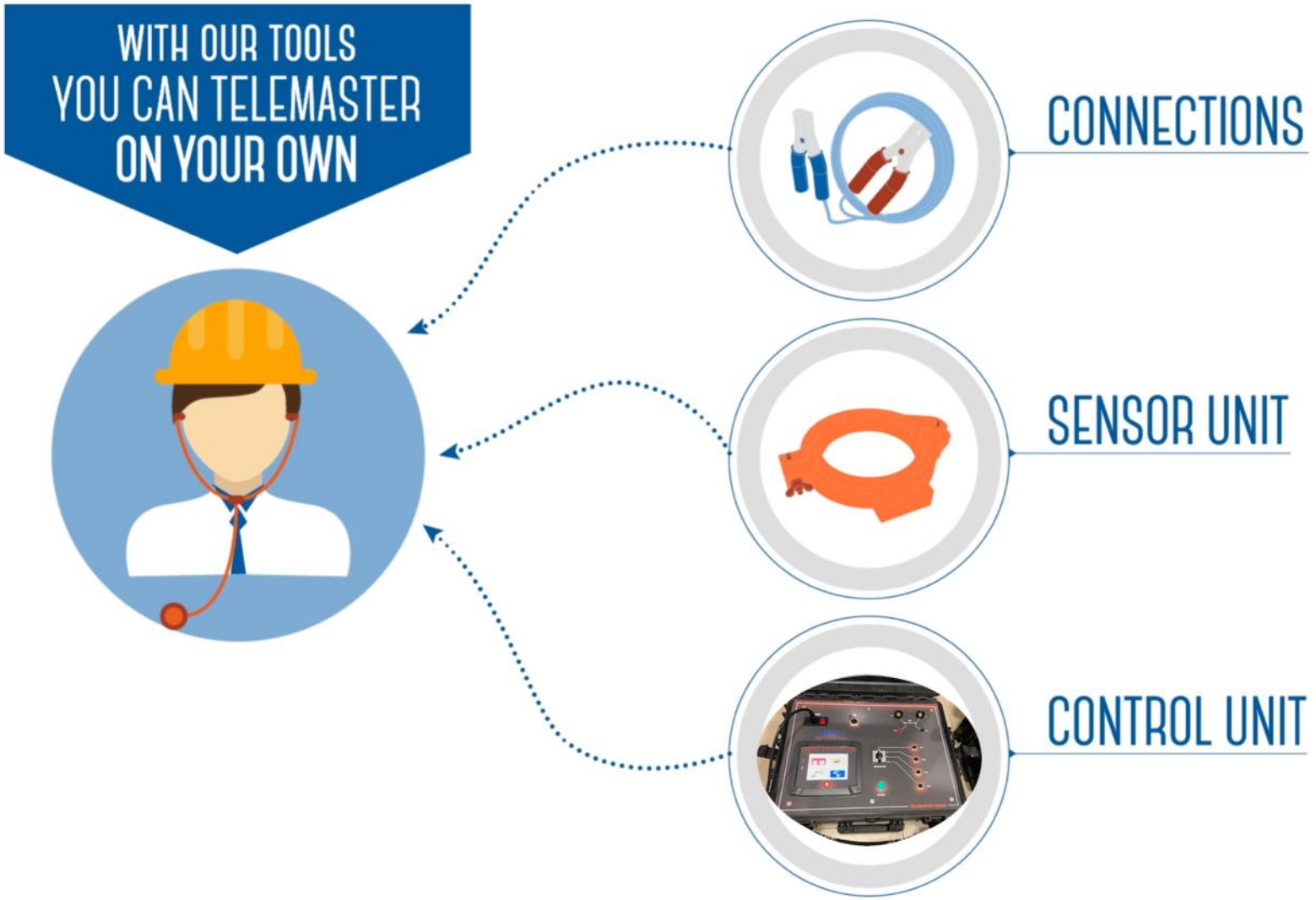
As the cable resistance increase, power losses ($I^2 R$) in the cables increases, which in turn increases the temperature rise of the cable, leading to rapid and un-expectable cable failure.

HOW IT'S MADE

Practical resistance measurement it is done while the furnace is OFF

- injecting a current in each phase
- measuring the voltage drop across the cables
- measuring the current in each cable by a special sensor.

The resistance value is than calculated using Ohms Law and thanks to this value is possible to understand if the cable is still in good condition or not. *This measurement does not require individual cables to be disconnected from the furnace*.


WITH OUR TOOLS
YOU CAN TELEMASTER
ON YOUR OWN
CONNECTIONS
SENSOR UNIT
CONTROL UNIT

CU control unit includes all equipment and control devices to permits the measurement.
Another portable box includes all cable connections and sensors.

N°2 trolley

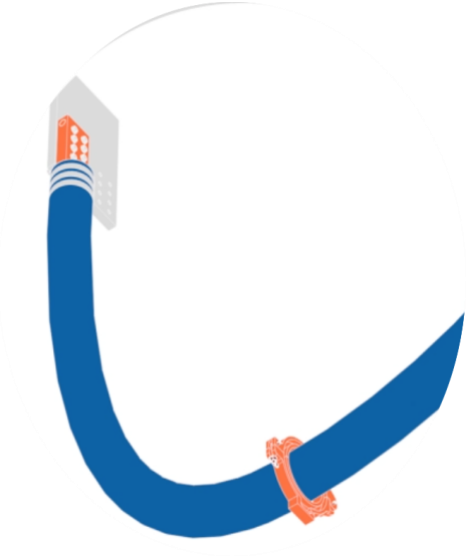
Controll unit box

Accessories box

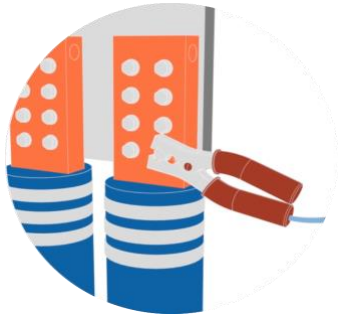
Dimensions: 2 trolleys 60x40x25cm, **Net Weight**: 25kg+18kg=43kg

S Sensors (very high precision and accuracy).
Sensor clamps have to be assembled around cable.





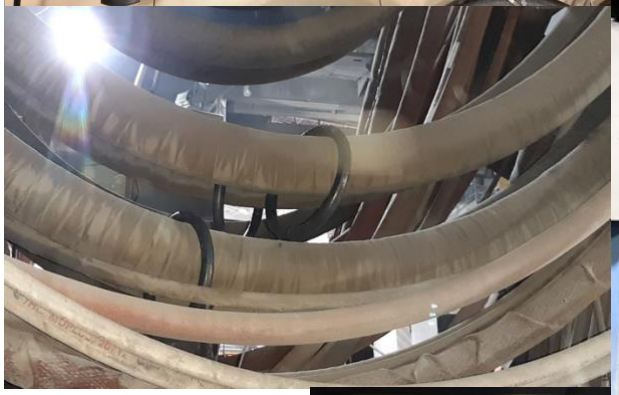
CO Connetions clamps and wiring
(2 sets for current injection and 2 sets for voltage measure)

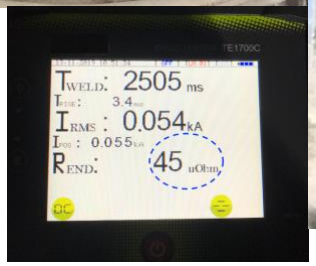


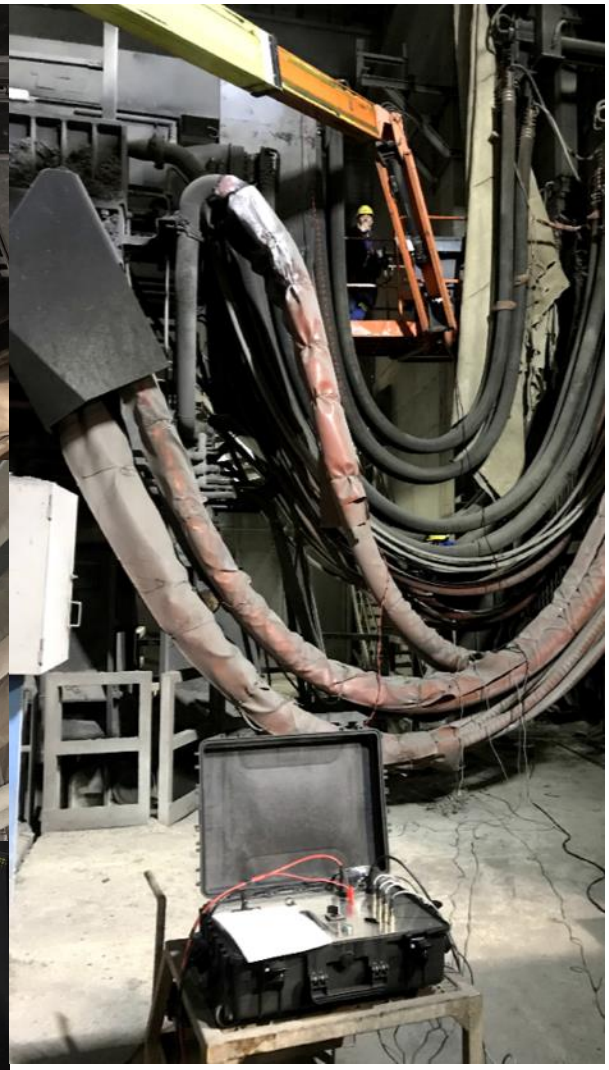
HOW TO MEASURE

1) Take care furnace is OFF and **safety circuit breakers open** ⚠
2) Carry the CU Control Unit closeby the
3) Assemble the **S** Sensor clamps around cables
4) Connect the current and voltage clamps (on both secondary circuit side and furnace side) of the selected phase
5) Switch ON the CU Controll Unit
6) Start the software acquisition program
7) Measurement report is completed in few minutes
8) Repeat the measure (steps 3,4,5 and 6) on other phases


Power connection
On/Off
USB
Current
Voltage
Monitor
Selector
Sensor connection from 1 to 4
Start measure




TWELD: 2505 ms
IRMS : 0.054kA
REND: 45 uOhm



RESULT OF THE MEASURES

The measured resistance of a water cooled (R_{Meas}) has to be compared with the nominal resistance of the brand new cable (R_{Nom}).
The maximum acceptable value of the measure is $R_{Max} = 1{,}5\ R_{Nom}$

If $R_{Meas} > R_{Max}$ → the cable need to be replaced.

Example

Water cooled cables	4000 mm^2 x10.000mm
Resistance R_{Nom}	44 μΩ1)
Resistance R_{Max}	66 μΩ

1) Resistance of a conductor is: $\mathbf{R_{Nom} = \rho * L / S \ [\Omega]}$
ρ = 0,0176 Ω mm^2/m (Copper resistivity at 20°C)
L = length of the water cooled cable in meter (m)
S = Copper section of the water cooled cable in sqmm (mm^2)

Final considerations/advantages

- Measuring the water cooled cables resistance in very short time
- Keeping records for each water cooled cables with all installation details and measures
- Scheduling water cooled cables replacements well in advance
- Avoiding furnace stop, increasing productivity
- Prevent overload of other cables in the parallel
- Energy savings

Note:.

Standard AC current measurement by Rogowsky coils gives only a distribution of the currents but has no relation to the cables resistance.

MEASURES ON SITE BY BRAR WITH TELEMASTER

	CUSTOMER	COUNTRY
1	ALFA ACCIAI SPA	ITALY
2	ACCIAIERIE VENETE	ITALY
3	INDUSTRIE RIUNITE ODOLESI	ITALY
4	OLIFER-ACP SPA	ITALY
5	ACCIAIERIE DI CALVISANO	ITALY
6	RIVA ACCIAIO SP	ITALY
7	ACCIAIERIA ARVEDI	ITALY
8	NLMK	ITALY
9	FERALPI SIDERUR	ITALY
10	METALCAM SPA	ITALY
11	TRAVI E PROFILA	ITALY
12	SAFAS SPA	ITALY
13	LAMINES MARCHAN	FRANCE
14	FAREM FONDERIE	ITALY
15	PITTINI VERONA	ITALY
16	ACCIAIERIA COGNE	ITALY
17	VALSABBIA	ITALY
18	BHUSAN	INDIA
19	JSW	INDIA
20	Vallourec St-Saulve	FRANCE
21	Riva SAM Nueves-Maison	FRANCE
22	Riva Thy-Marcinelle	BELGIUM
23	Aperam Carinox	BELGIUM