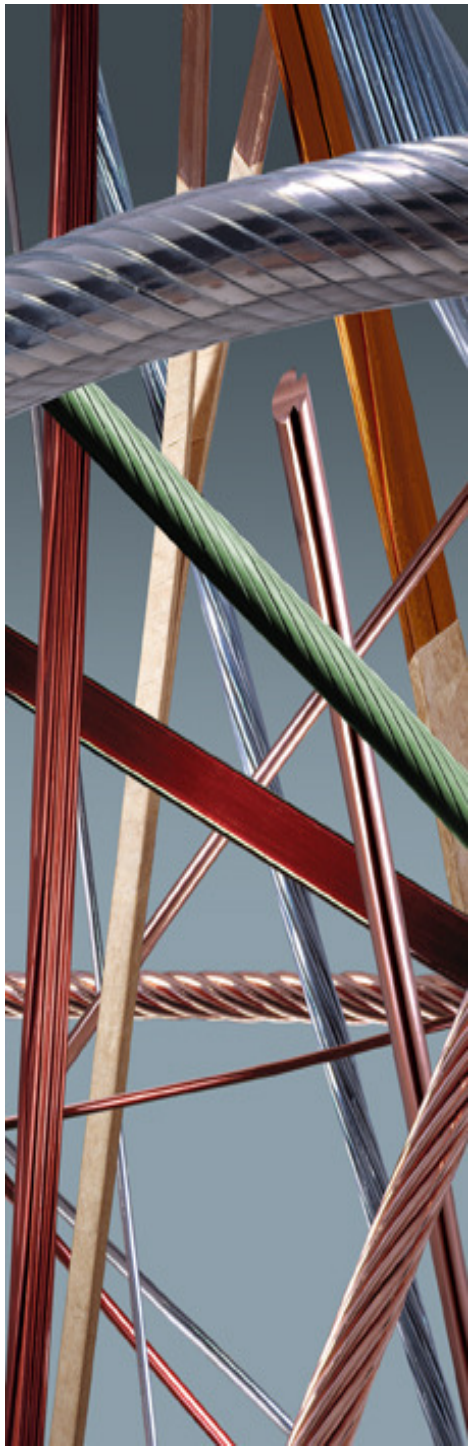

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DE ANGELI PRODOTTI
Every wire, everywhere.

New Technologies for Environmental Friendly Conductors

Giacomo Sarti

Research & Development Department

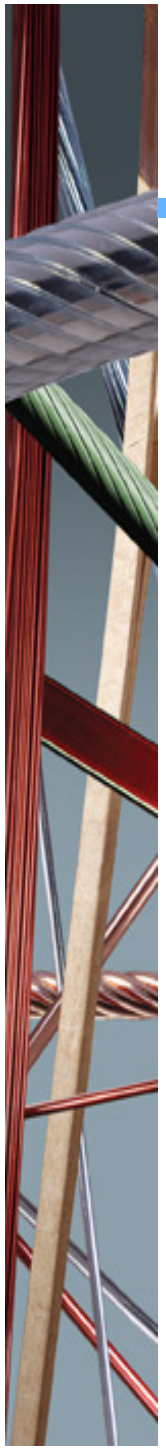
De Angeli Prodotti S.r.l.

2015

Introduction:

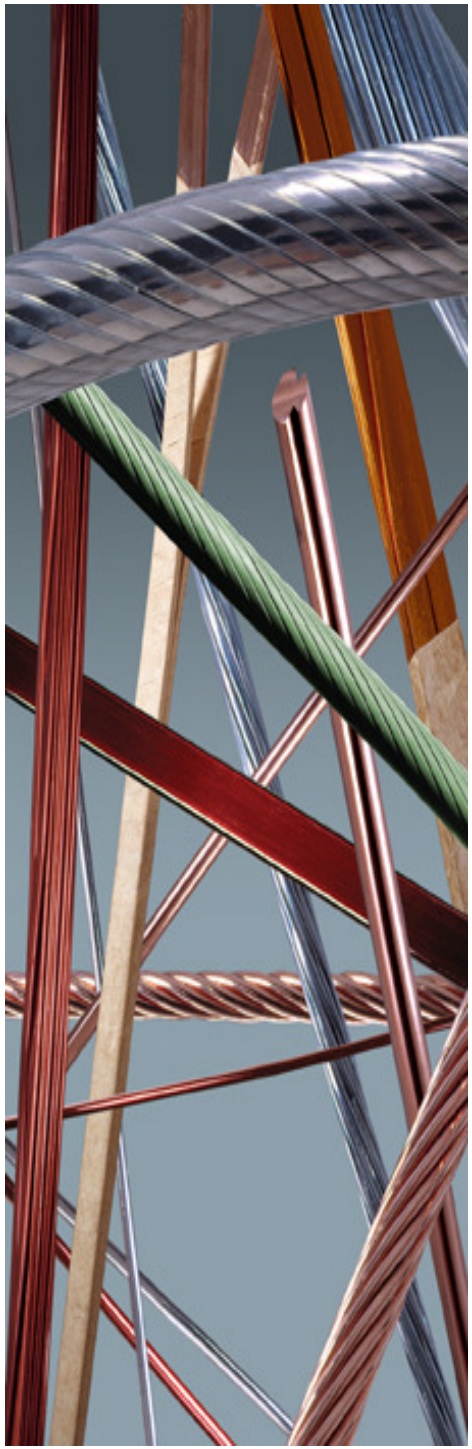
The **goals** of the modern electric power transmission are:

- Reduction of Line Losses
- Acceptability of the Lines
- Power Grid Safety



Summary:

- Low CO_2 Emissions Conductors
- Low Noise Conductors
- Low Visual Impact Conductors



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Low Losses

Conductors

EXPO
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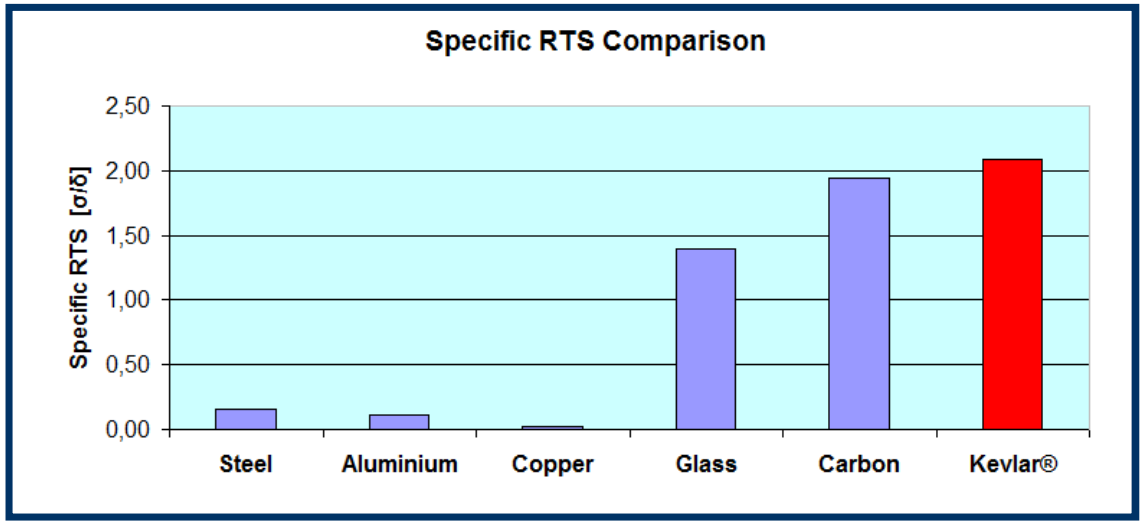
Low Losses Conductors

In the current scenario of the innovative conductors for low CO_2 emissions there is the born of a new type of Aluminium Conductor Fiber Reinforced (ACFR) with the following properties compared to a traditional ACSR:

- Low **weight** per unit length (-8%)
- Low **sag** (-15%)
- Increase of the **Breaking Strength** (+7%)
- Operating **Temperature** of 120°C
- Reduction of **Line Losses** (-14%)

Low Losses Conductors

	Density [kg/m³]	Elastic Modulus [GPa]	RTS [MPa]	Thermal Expansion Coefficient [x10⁻⁶ °C⁻¹]
Steel	7800	200	1200	11,5
Aluminium	2700	70	300	23
Copper	8920	122	216	17
Glass	2500	75	3400	5
Carbon	1800	230	3500	-1.5
Kevlar®	1440	130	3000	-2



Low Losses Conductors

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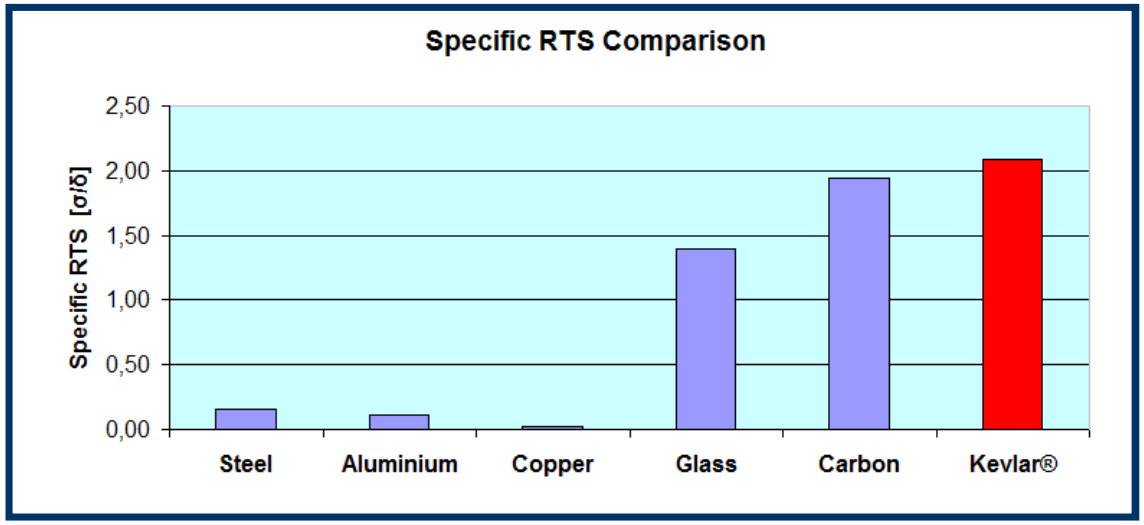


Low Losses Conductors

ACSR

Ø 31.50 mm

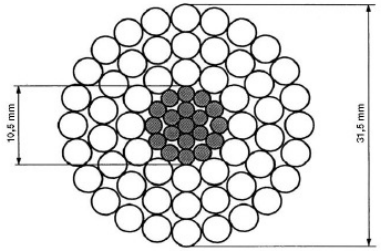
Terna Rete Italia

Specifica di componente

CONDUTTORE A CORDA DI ALLUMINIO-ACCIAIO ø 31,5 mm

Codifica LIN_000000C2

Rev. 00 del 02/07/2012 | Pag. 1 di 2



TIPO CONDUTTORE		2/1	2/2 (*)
		NORMALE	INGRASSATO
FORMAZIONE	Alluminio	54 x 3,50	54 x 3,50
	Acciaio	19 x 2,10	19 x 2,10
SEZIONI TEORICHE (mm^2)	Alluminio	519,5	519,5
	Acciaio	65,80	65,80
	Totale	585,30	585,30
TIPO DI ZINCATURA DELL'ACCIAIO		Normale	Maggiorata
MASSA TEORICA (Kg/m)		1,953	2,071(**)
RESISTENZA ELETTR. TEORICA A 20°C (Ω/km)		0,05564	0,05564
CARICO DI ROTTURA (daN)		16852	16516
MODULO ELASTICO FINALE (daN/mm^2)		6800	6800
COEFFICIENTE DI DILATAZIONE (K^{-1})		$19,4 \times 10^{-6}$	$19,4 \times 10^{-6}$

(*) Per zone ad alto inquinamento salino
(**) Compresa massa grasso pari a 103,39 gr/m.

Storia delle revisioni

Rev. 00	del 02/07/2012	Il documento, redatto in prima emissione, aggiorna e sostituisce il documento Terna RQUT0000C2 rev. 01 del 25/07/2002 (C.D'Ambrosa, A.Posati, R.Rendina)

ISC – Uso INTERNO

Elaborato			Verificato			Approvato
ITI s.r.l.			A. Piccinin SRI-SVT-LAE	A. Guameri SRI-SVT-LAE		**A. Posati SRI-SVT-LAE**

ACFR

Ø 31.50 mm

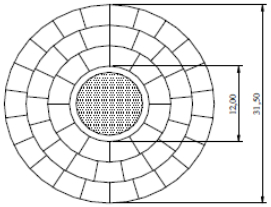
DE ANGELI PRODOTTI

Aluminium Conductor Fiber Reinforced

ACFR Ø31,5mm

Rinforzi fibrosi + AT1 aluminium alloy (TAL)

SPECIFICATION: In accordance with: DAP
In case the numerical value in this specifications and the international standard value are different, the numerical value in this specification has priority.



CONDUCTOR PROPERTIES				
DIAMETER			[mm]	31,50
FORMATION	Core wires		No. x Ø[mm]	1 x 12,00
	Gap		No. x Thick [mm]	- x -
	AT1 formed wires		No. x Thick [mm]	51 x 3,25
SECTION	Core		[mm^2]	113,1
	AT1 formed wires		[mm^2]	612,9
	Total		[mm^2]	726,0
MASS	Core		[kg/km]	115
	Grease		[kg/km]	
	AT1 formed wires		[kg/km]	1696
	Total		[kg/km]	1811
DC RESISTANCE AT 20°C			[Ω/km]	0,0480
RATED TENSILE STRENGTH		Core	[kN]	67,86
		Total	[kN]	165,31
MODULUS OF ELASTICITY		Core	[GPa]	60
		Total	[GPa]	56
COEFF. OF LINEAR EXPANSION		Core	[10^{-6}/°C]	-1,8
		Total	[10^{-6}/°C]	18,8
AMPACITY (IEC 61597)		(120 °C) *	[A]	1484

* Ambient temperature 30 °C - Wind speed 0,55 m/s - Emissivity ε 0,50 - Absorptivity α 0,50 - Solar radiation 1000 W/m²

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Low Losses Conductors

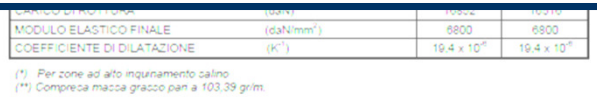
ACSR

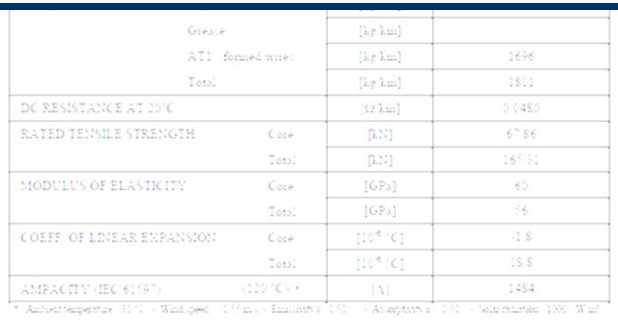
Ø 31.50 mm

ACFR

Ø 31.50 mm

	Conductor ACSR Ø 31.50mm	Conductor ACFR Ø 31.50 mm	Difference
Diameter [mm]	31.50	31.50	–
RTS [kN]	169.6	181.4	+7%
Weight [kg/km]	1953	1803	–8%
Operating Temperature [°C]	75	120	+60%
Ampacity [A]	999.6	1456.5	+46%
Electrical Resistance @20°C [Ohm/km]	0.0557	0.0479	–14%





EXPO MILANO 2015

Low Losses Conductors

ACSR

Ø 31.50 mm

Specifica di componente
CONDUTTORE A CORDA
DI ALLUMINIO-ACCIAIO Ø 31,5 mm

Codice LIN_000000C2
Rev. 00 del 02/07/2012 Pag. 1 di 2

ACFR

Ø 31.50 mm

DE ANGELI PRODOTTI

Aluminum Conductor Fiber Reinforced
ACFR Ø31.5mm
Reinforcing fibers + AT1 aluminum alloy (TAL)

	Conductor ACSR Ø 31.50mm	Conductor ACFR Ø 31.50 mm	Difference
Diameter [mm]	31.50	31.50	–
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Electrical Resistance @20°C [Ohm/km]	0.0557	0.0479	–14%

MODULO ELASTICO FINALE	(daN/mm²)	6800	6800
COEFFICIENTE DI DILATAZIONE	(K^{-1})	19.4×10^{-6}	19.4×10^{-6}

(*) Per zone ad alto inquinamento salino
(**) Compresa massa grasso pari a 103,39 gr/m.

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ISC – Uso INTERNO

Elaborato			Verificato			Approvato
ITI s.r.l.			A. Piccinin SRI-SVT-LAE	A. Guamen SRI-SVT-LAE		A. Posati SRI-SVT-LAE

MASS	Core	[kg/km]	115
	Grease	[kg/km]	
	AT1 formed wires	[kg/km]	1696
	Total	[kg/km]	1811
DC RESISTANCE AT 20°C		[Ω/km]	0.0480
RATED TENSILE STRENGTH	Core	[kN]	67.86
	Total	[kN]	169.31
MODULUS OF ELASTICITY	Core	[GPa]	60
	Total	[GPa]	56
COEFF. OF LINEAR EXPANSION	Core	[10^{-6} °C]	21.8
	Total	[10^{-6} °C]	18.8
AMPACITY (IEC 61597)	(120 °C) *	[A]	1484

* Ambient temperature: 30 °C - Wind speed: 2.56 m/s - Emissivity: 0.9 - Absorptivity: 0.9 - Solar intensity: 1000 W/m²

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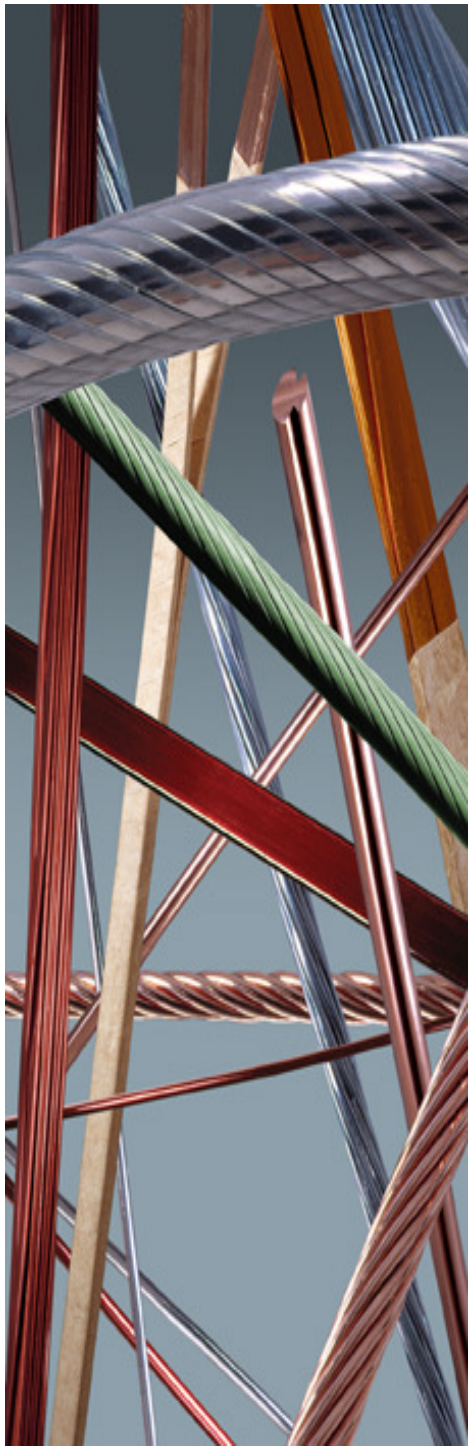
Low Losses Conductors

ACFR conductor

Kevlar® Fibres Core



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Low Noise

Conductors

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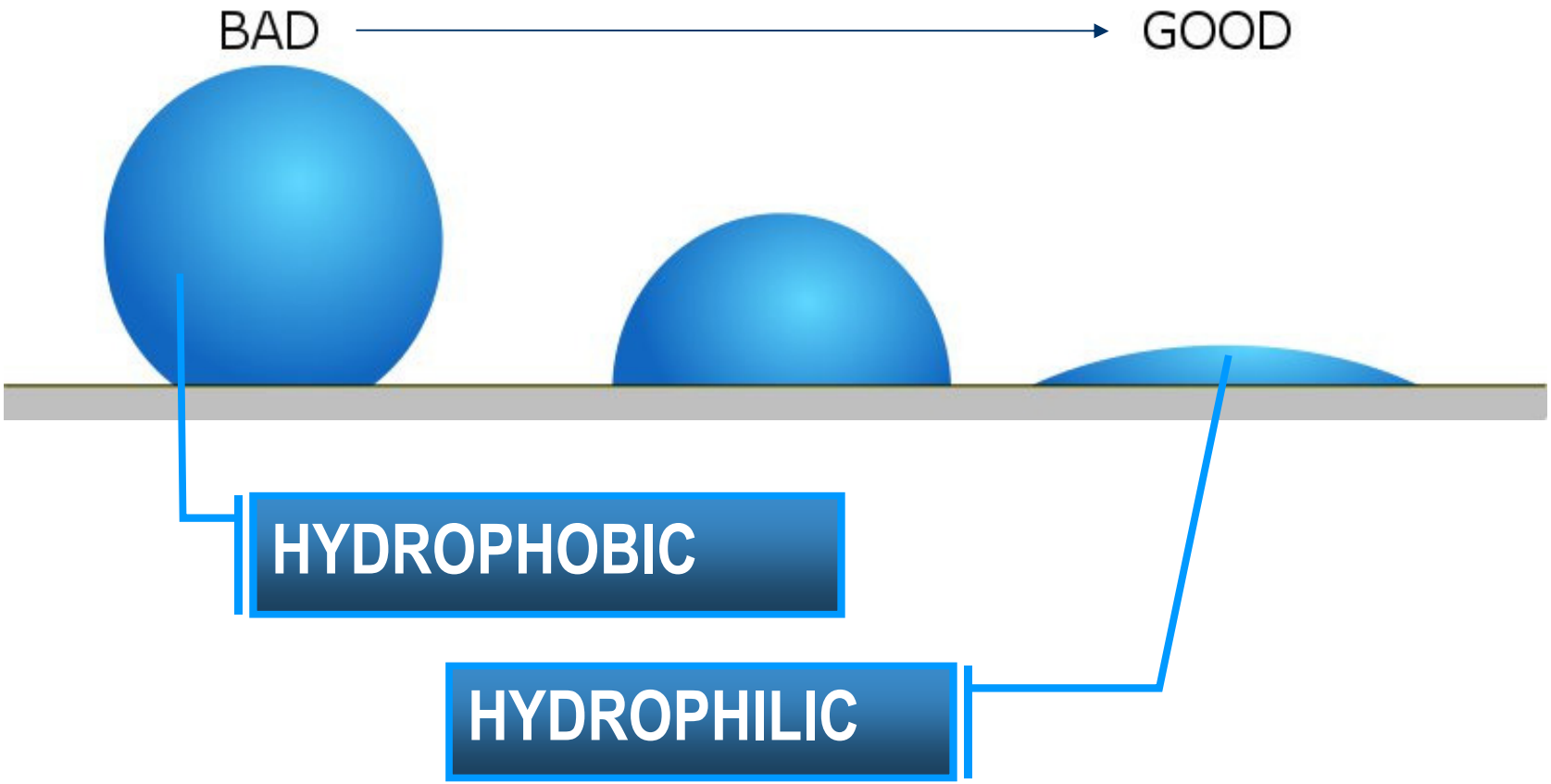
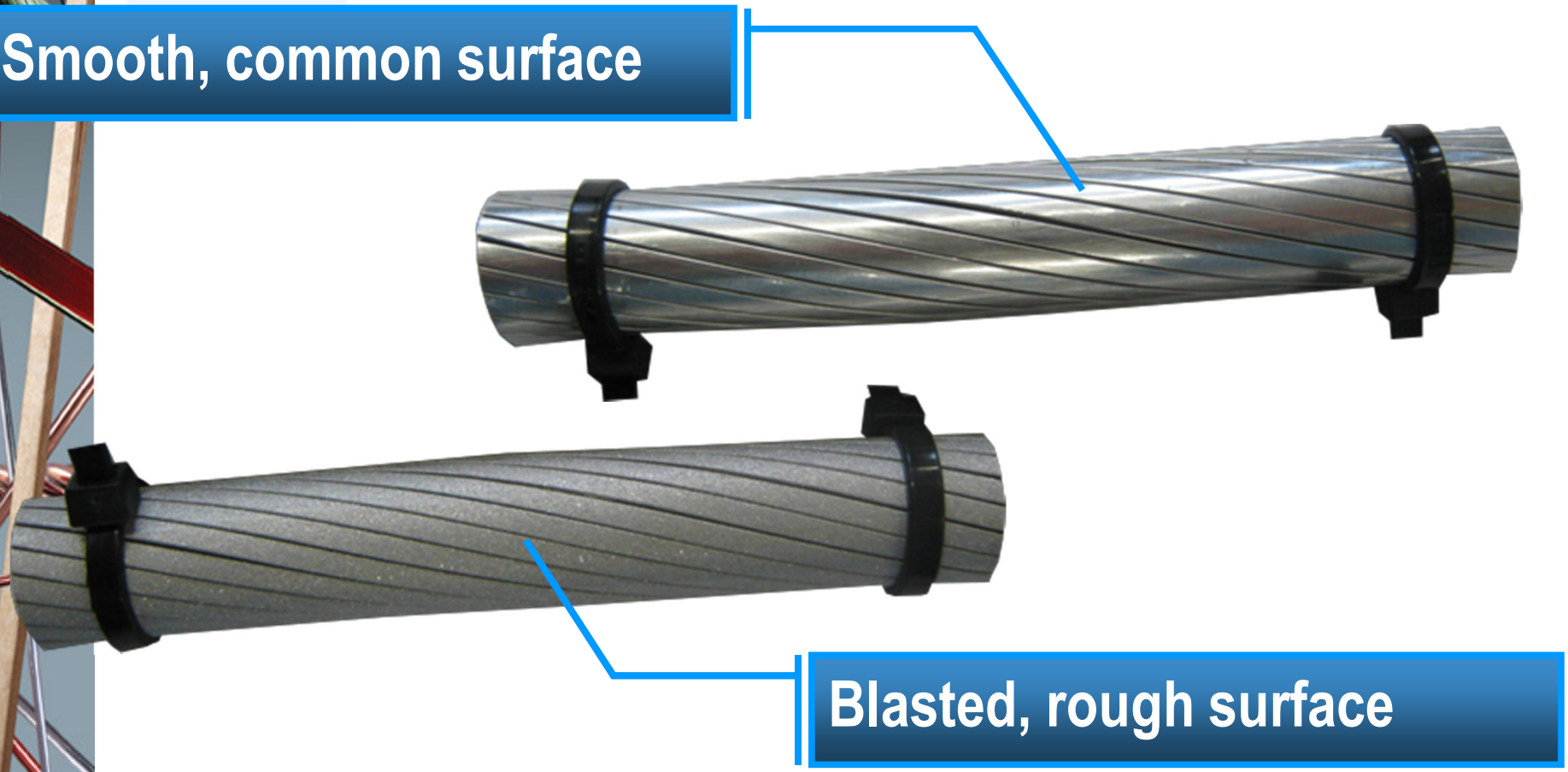
SURFACE TREATMENTS: SANDBLASTING

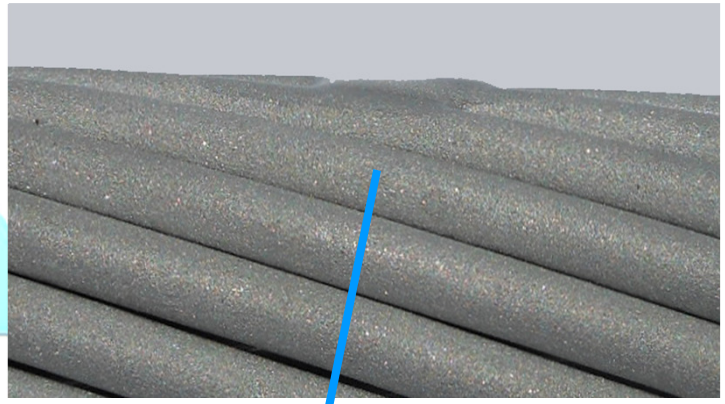


SURFACE TREATMENTS: SANDBLASTING



SURFACE TREATMENTS: SANDBLASTING

BAD → GOOD



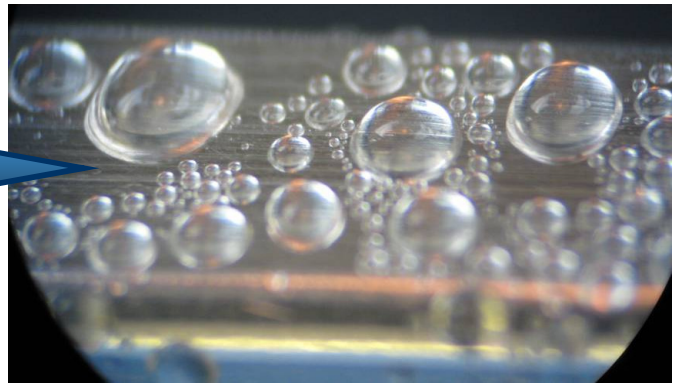
HYDROPHOBIC

HYDROPHILIC

Low Noise Conductors

SURFACE TREATMENTS: SANDBLASTING

Common Al surface: HYDROPHOBIC

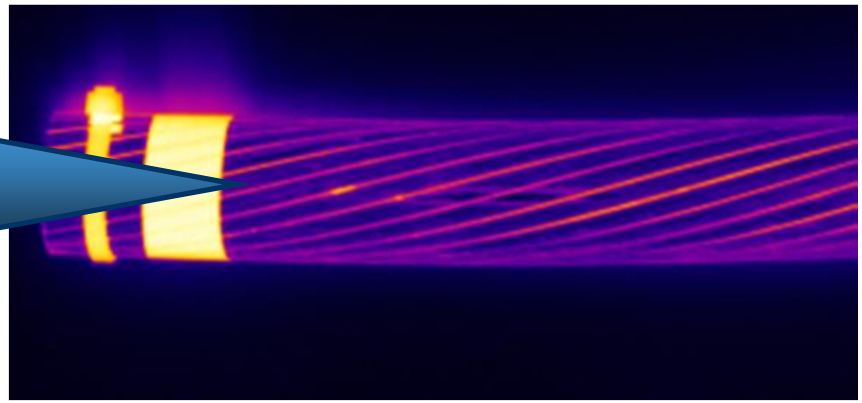


Treated surface: HYDROPHILIC

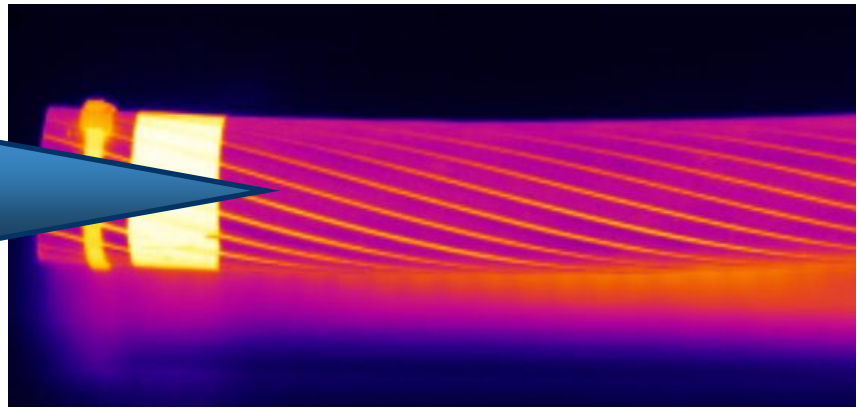
Low Noise Conductors

SURFACE TREATMENTS: SANDBLASTING

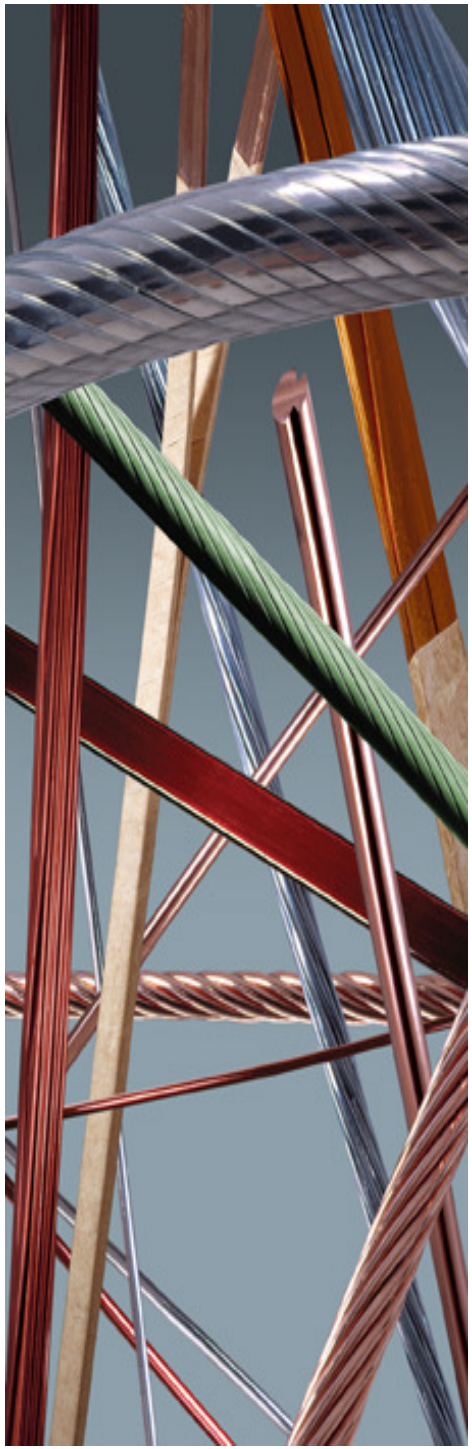
Smooth surface, low emissivity



Rough surface, higher emissivity



Significant Noise Reduction



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Low Visual Impact

Conductors

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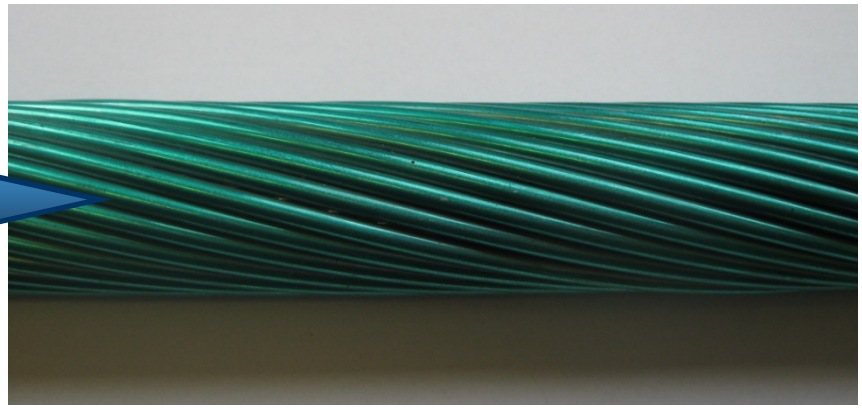
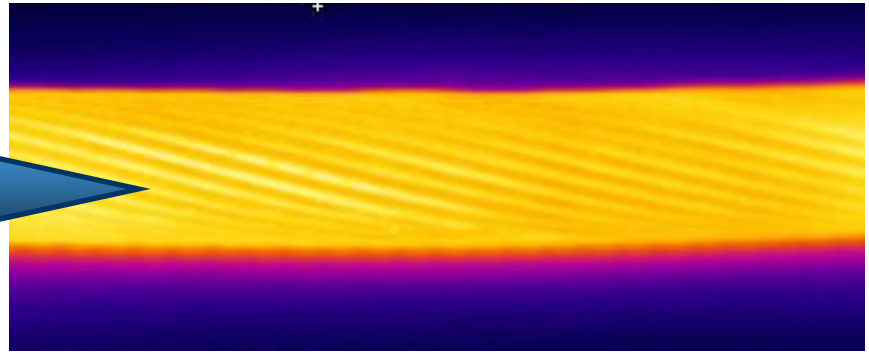
SURFACE TREATMENTS: COLOURING

Visible light picture



Infrared light picture



SURFACE TREATMENTS: COLOURING

FEATURES

- Emissivity: >0.75
- Dimensions: up to 50 mm diameter
- Continuous operating temperature: 180°C
- Emergency temperature: 200°C
- Eco-friendly technology!

Low Visual Impact Conductors

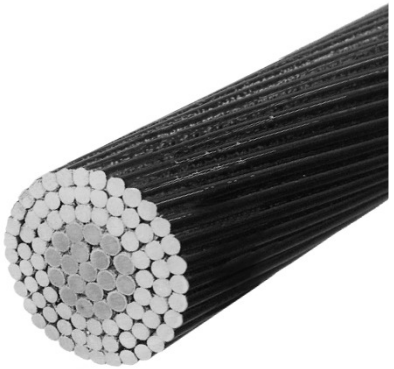
Standard Conductor

Coloured Conductor

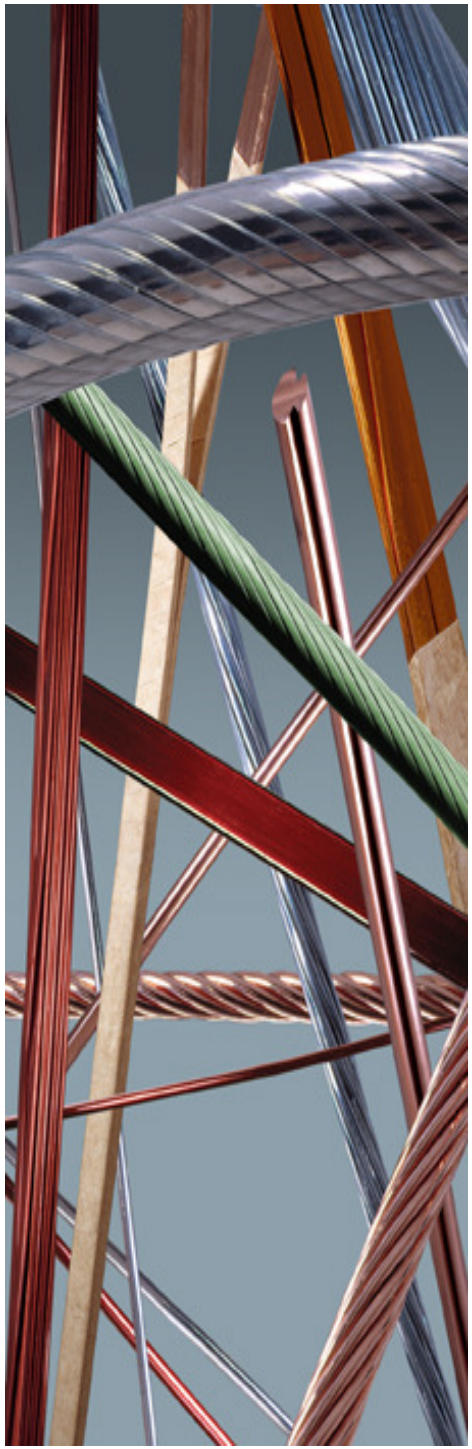
Low Visual Impact Conductors

Before

Low Visual Impact Conductors



After



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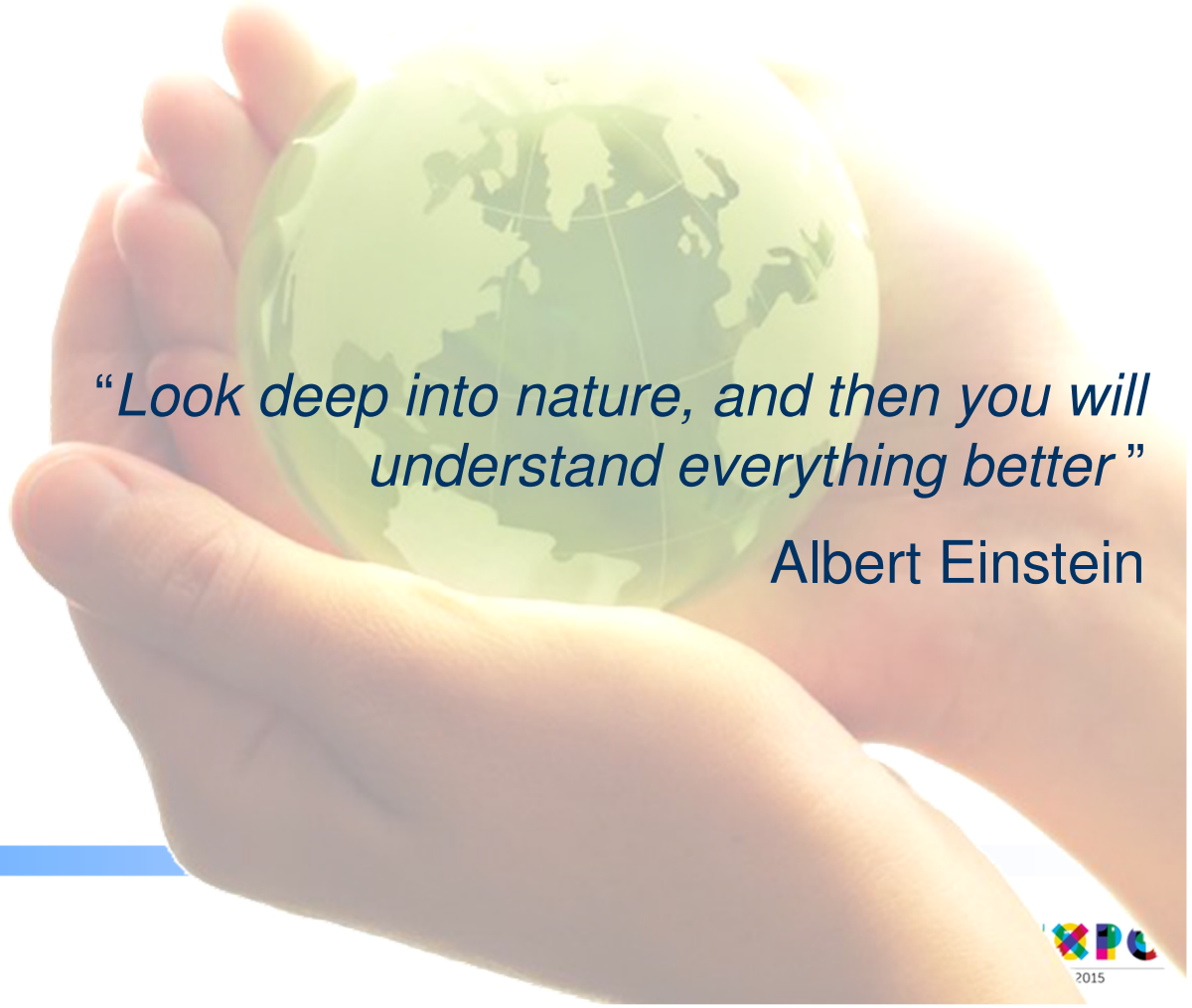
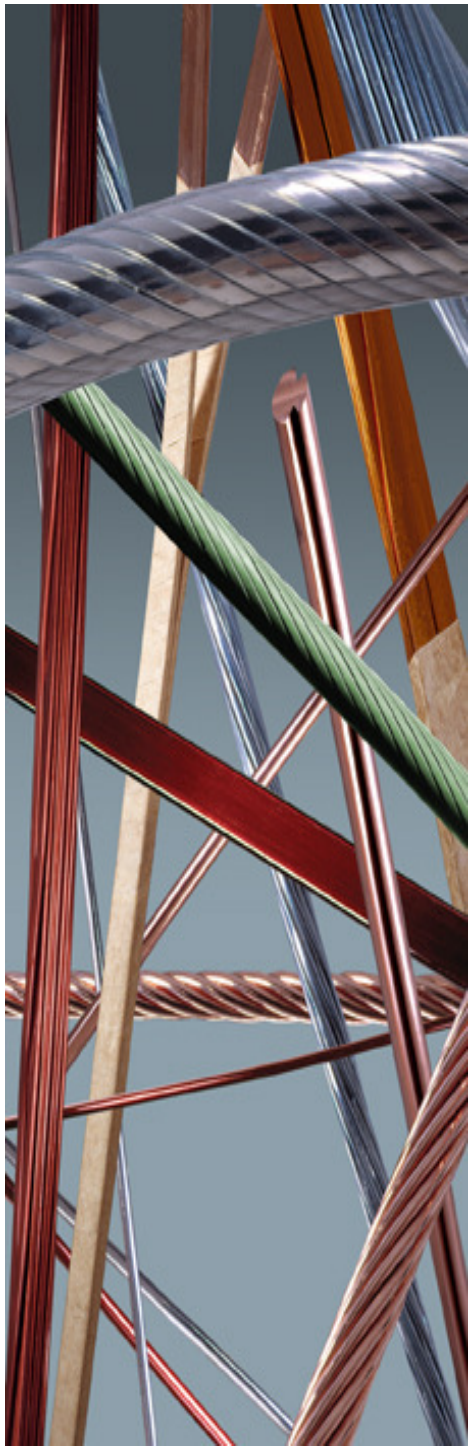


"Look deep into nature, and then you will understand everything better"

Albert Einstein



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Thanks for your attention

For any questions please contact us at
info@deangeliprodotti.com

www.deangeliprodotti.com

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