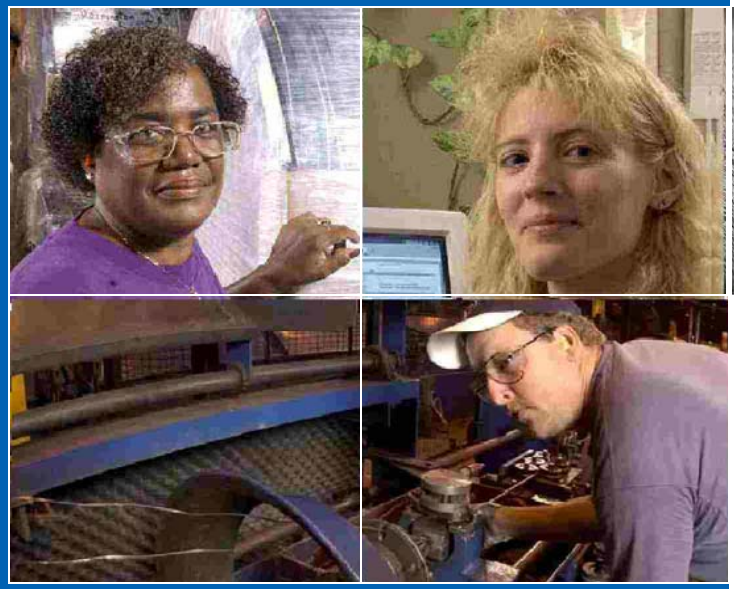
Alcan Cable



grounded in service
wired to innovateSM

Stabiloy, Aluminum or copper?

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Applications Engineer, North West
Oct 8, 2008

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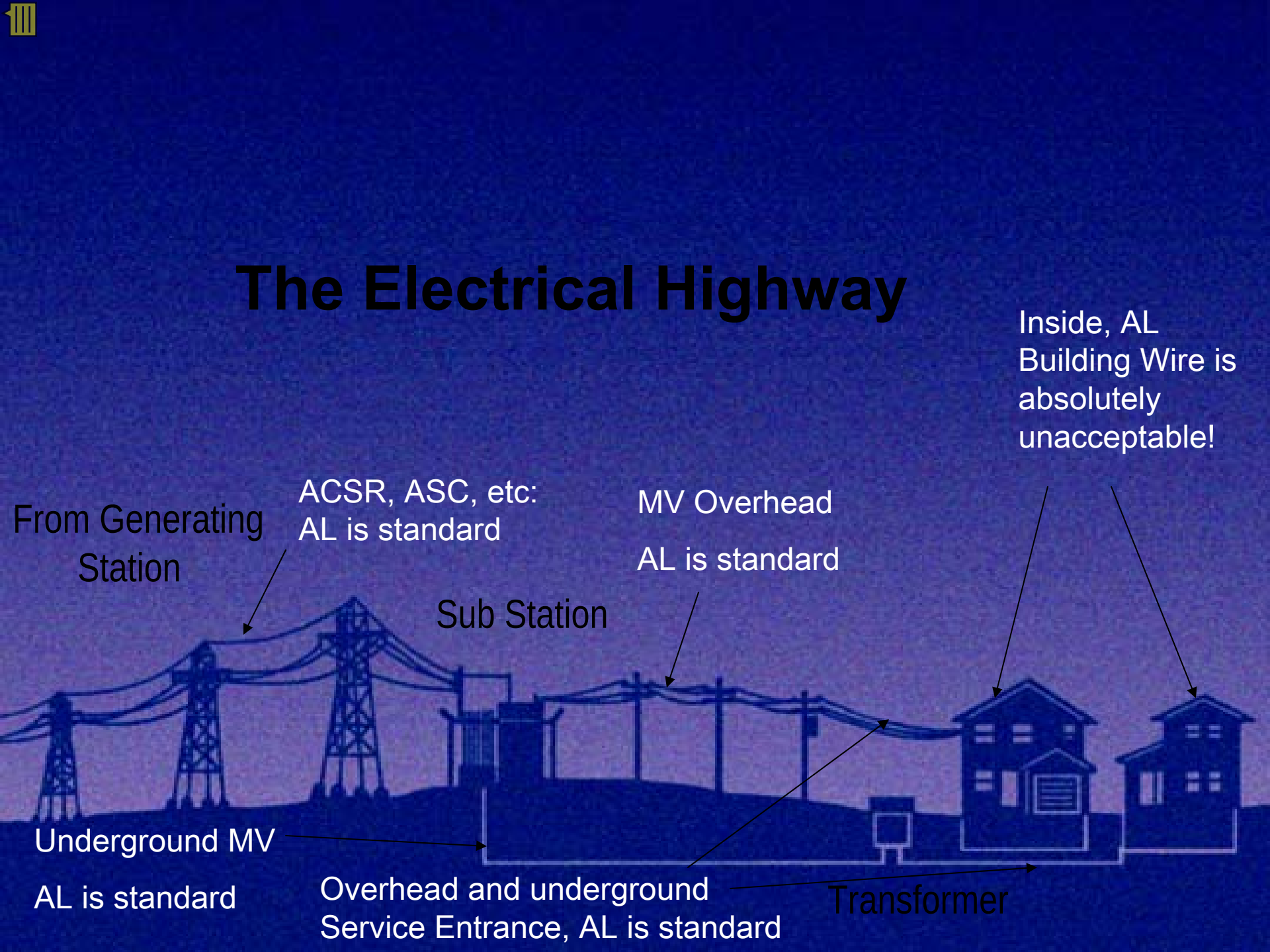
The Electrical Highway



Aluminum Wiring had a tainted past!

Branch Circuit Wiring History

How the Wire and Cable industry took a product designed for Overhead Transmission Wire application and tried to use it in branch circuit wiring applications

Imagine building an airplane out of copper!

Common Beliefs relating to Aluminum Wiring

1. Aluminum Wiring is brittle and difficult to install
2. Aluminum Wiring is susceptible to thermal expansion issues and creates loose terminations
3. Excessive Creep of aluminum wiring causes terminations to loosen over time
4. Aluminum conductors need to be much larger than copper conductors for equivalent ampacity
5. Aluminum wiring oxidation creates high resistance termination
6. Aluminum wiring corrodes and can not stand up in atmospheric conditions.

Common Belief #1:
Aluminum Wiring is brittle and difficult to install

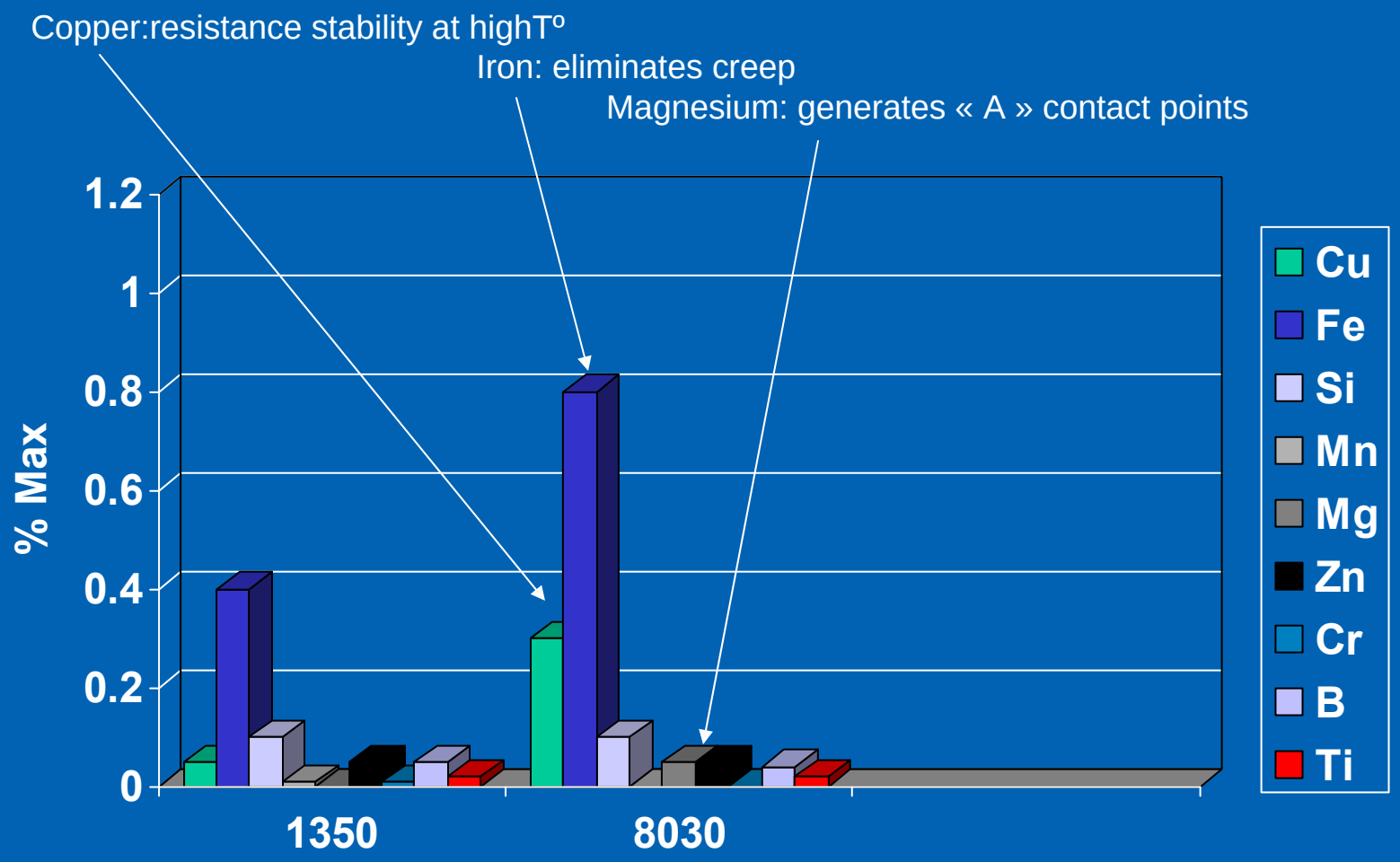
1960's and 1970's Copper Shortage

High Purity Aluminum Alloy AA 1350 (H19) designed for Transmission Wire applications was introduced for 8/10/12 AWG

WHAT IS 8030 Alloy / STABILOY?

To Combat Mechanical Deficiencies, Alcan specifically developed AA8030, known as Stabiloy for building wire applications

PERFORMANCE CHARACTERISTICS



Common Belief #1

The Addition of Fe allowed AA8030 (Stabiloy):

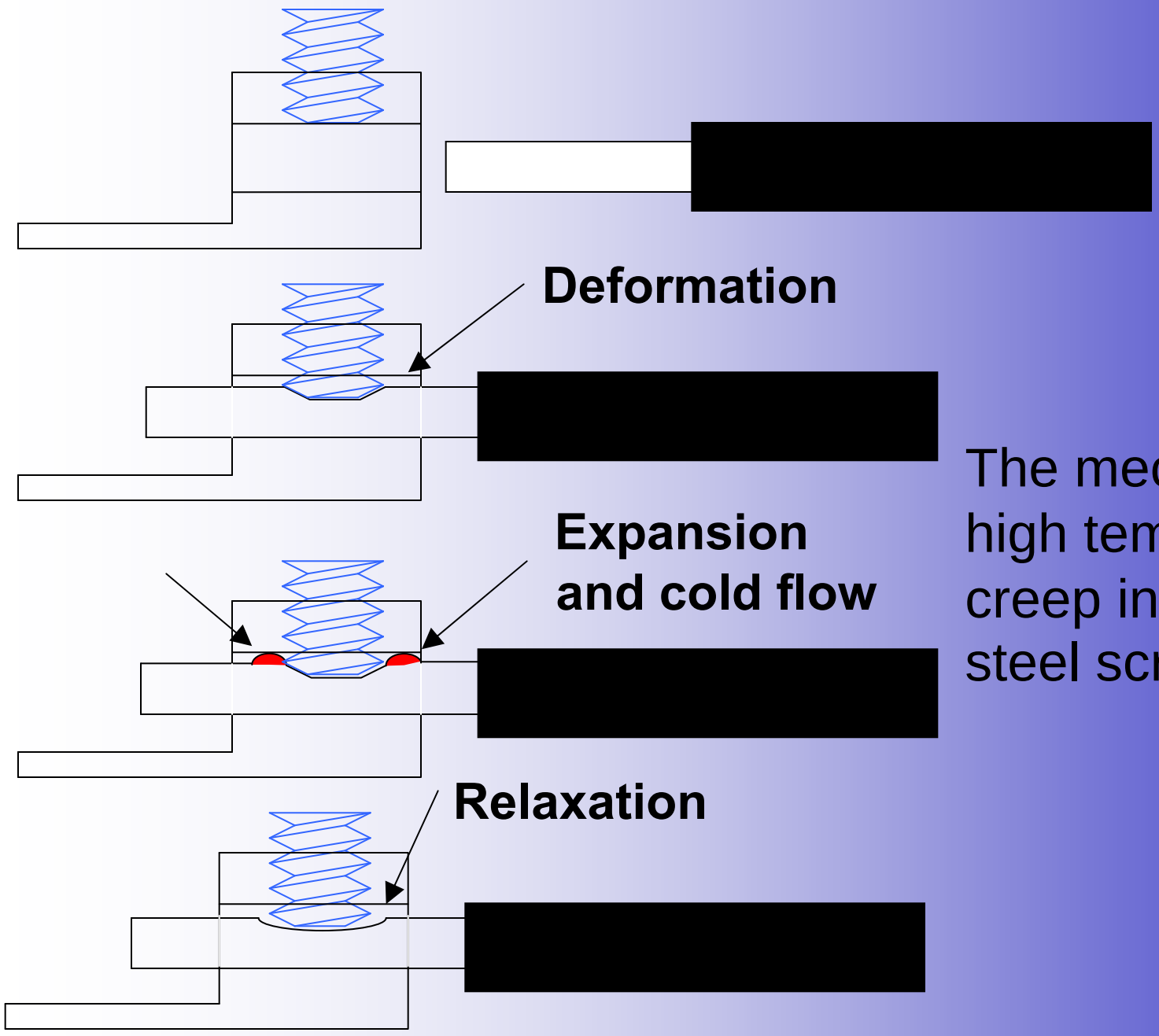
1. **To be annealed to a softer state**
2. **Retain high tensile strength**
3. **Eliminate Creep**

Common Belief #2

Aluminum Wiring is susceptible to thermal expansion issues and creates loose terminations

1960's and 1970's aluminum branch circuit wire was terminated in receptacles and devices designed for copper and made of copper and steel.

Aluminum's thermal expansion is 30% greater than Copper.



The mechanics of high temperature creep in EC1350 with steel screws

Solving the problems:

Connector manufacturers developed AL-CU lugs suitable for both Copper and Aluminum Wiring.

A short history of AL-CU lugs

1960’ CO/ALR receptacles and switches (12 & 14 AWG)

1974: AL/CU connectors first introduced (tin or zinc plated aluminum)

1982: Connector manufacturers recertify their products to meet stricter UL standard

1985: All connectors UL approved

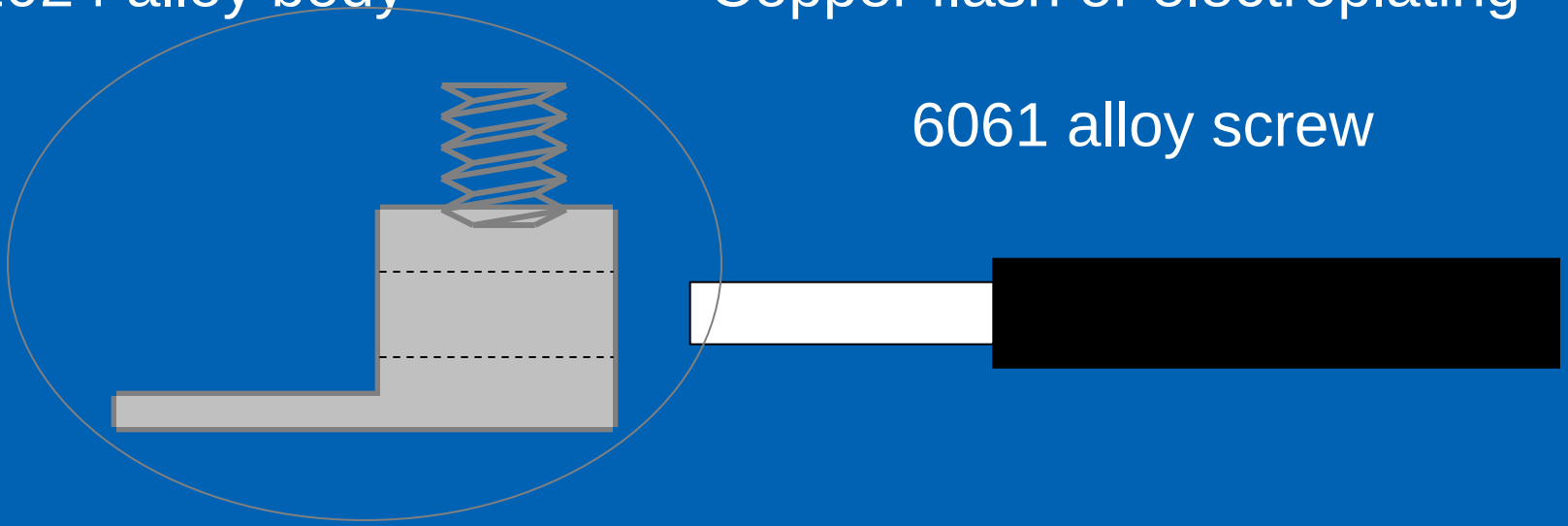
UL 486B requires connectors is an intense heat cycling test that uses EC1350 for testing.

DESIGN OF MECHANICAL AL-CU LUGS

2024 alloy body

Copper flash or electroplating

6061 alloy screw

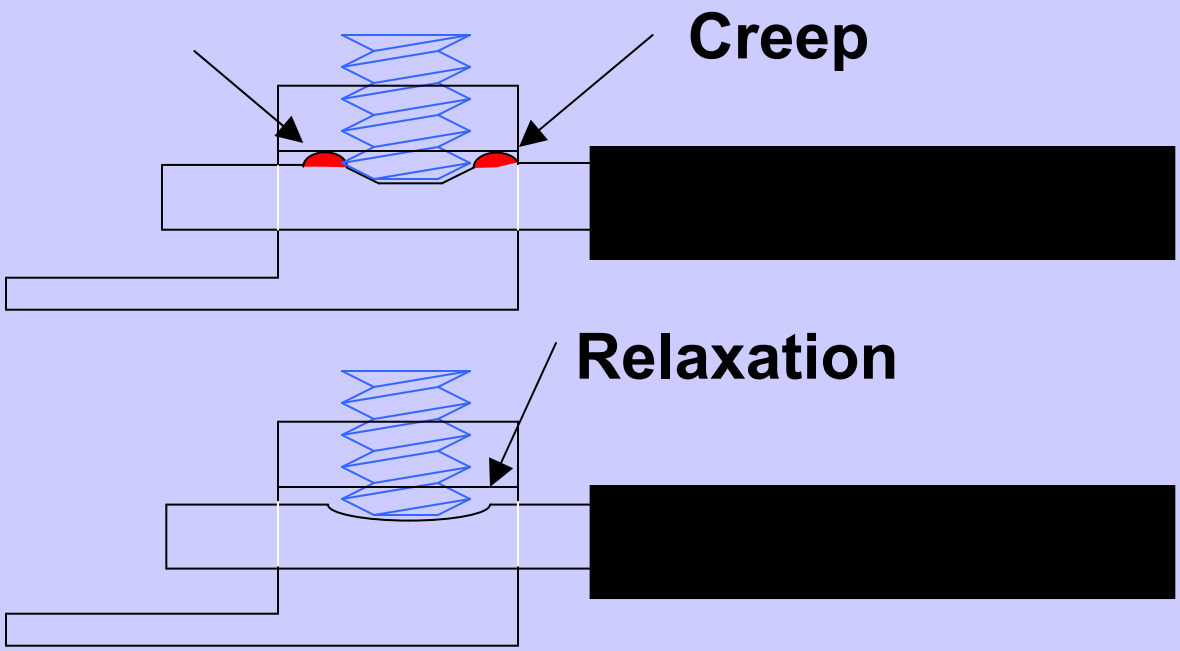


Tin plating

Thermal expansions are identical – no flow

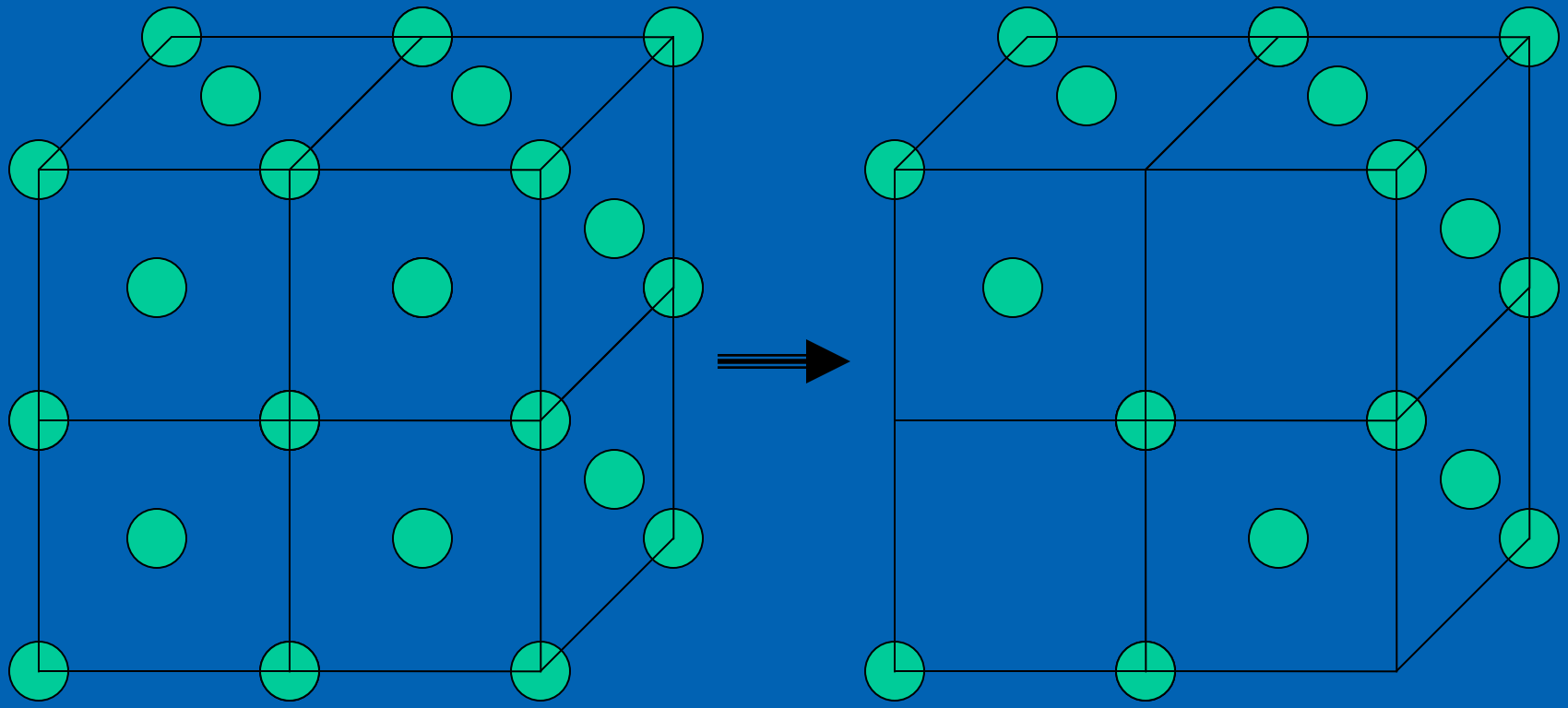
Common Belief #3

Excessive Creep of aluminum wiring causes terminations to loosen over time and requires aluminum terminations to be re-torqued annually.



Mechanisms of Creep

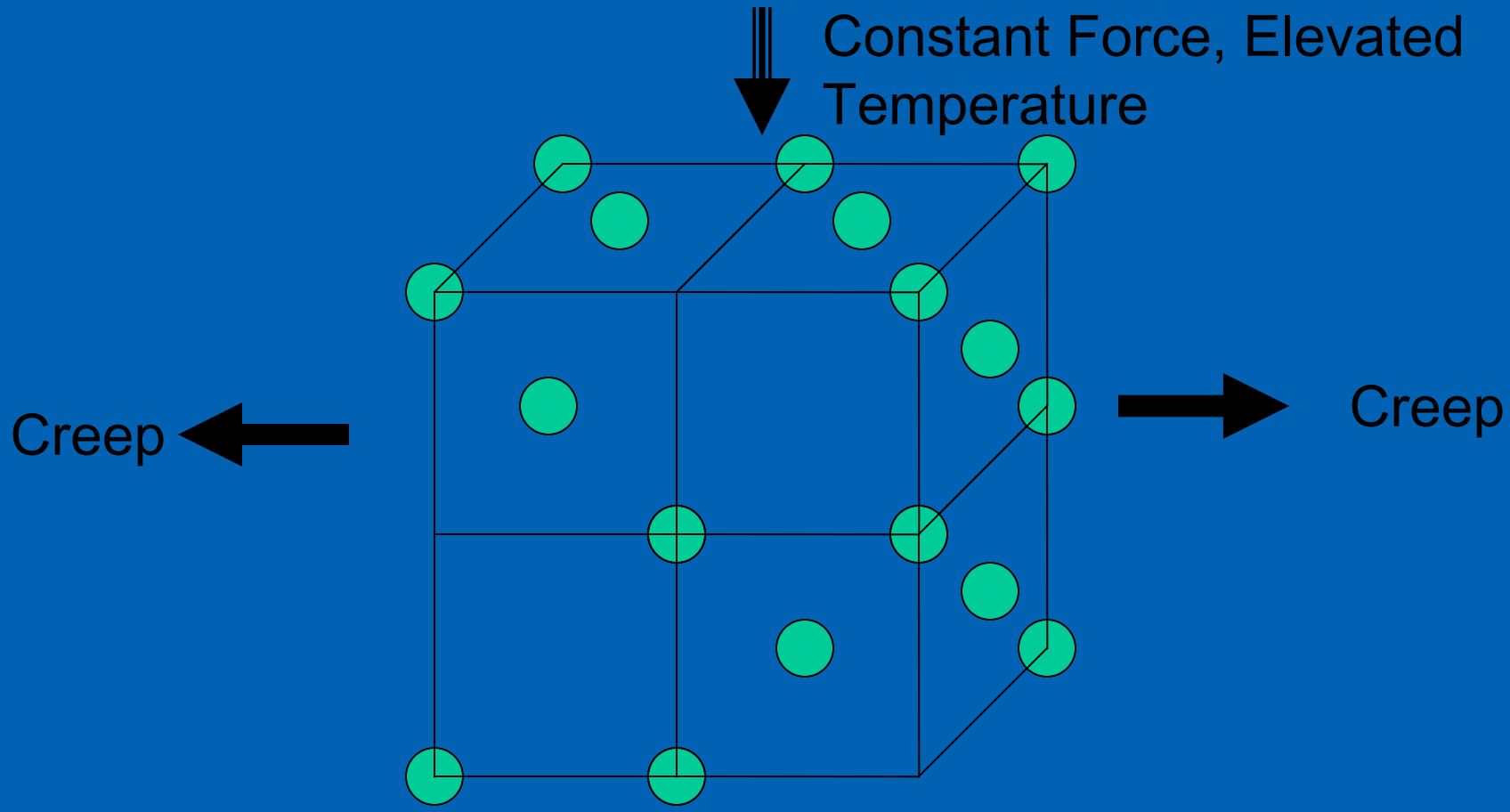
Face Center Cubic Crystal Structure of Cu, Al and Fe



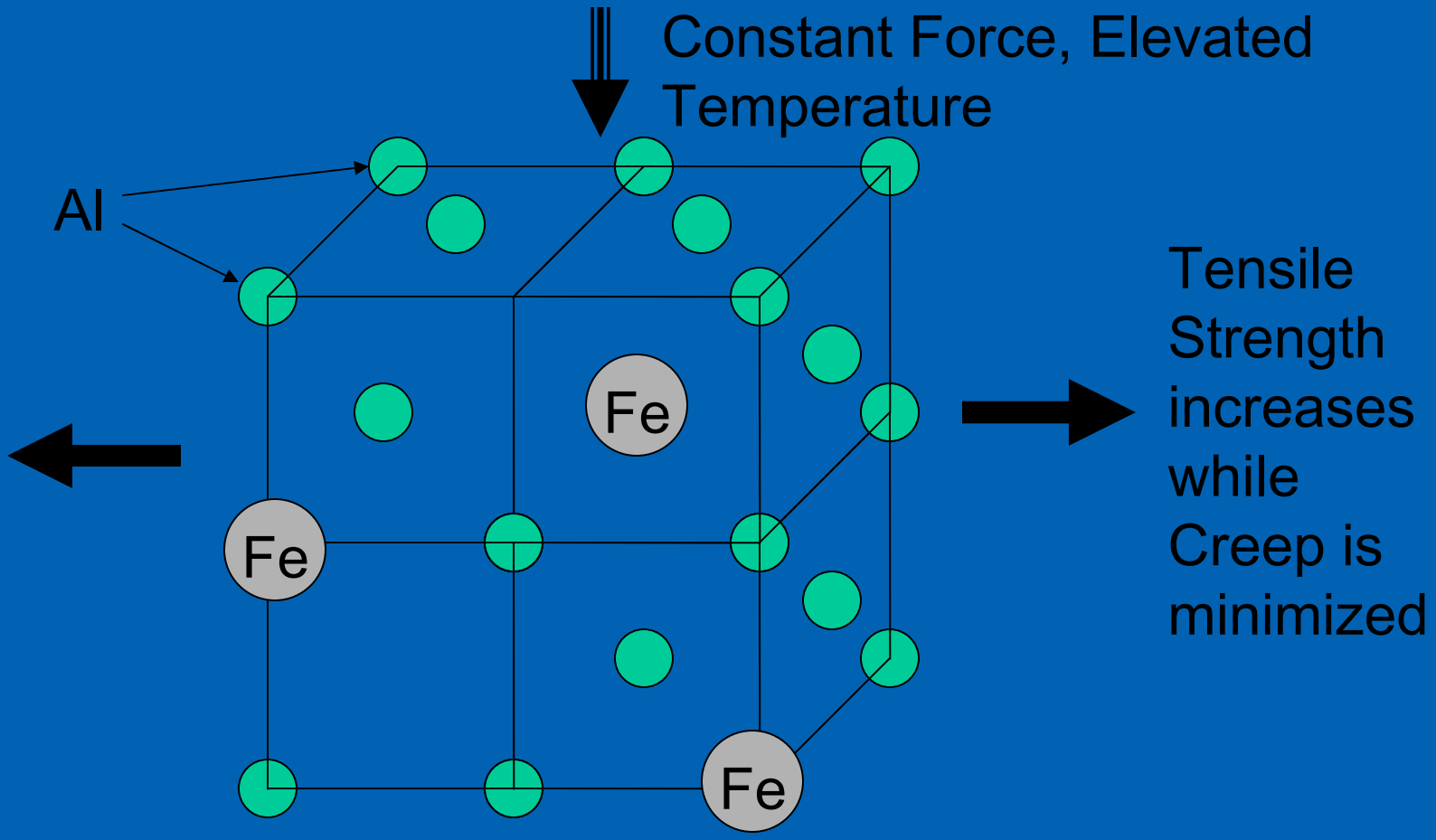
Theoretical

Actual

Mechanisms of Creep



Solving the Creep Problem with the addition of Iron in Stabiloy

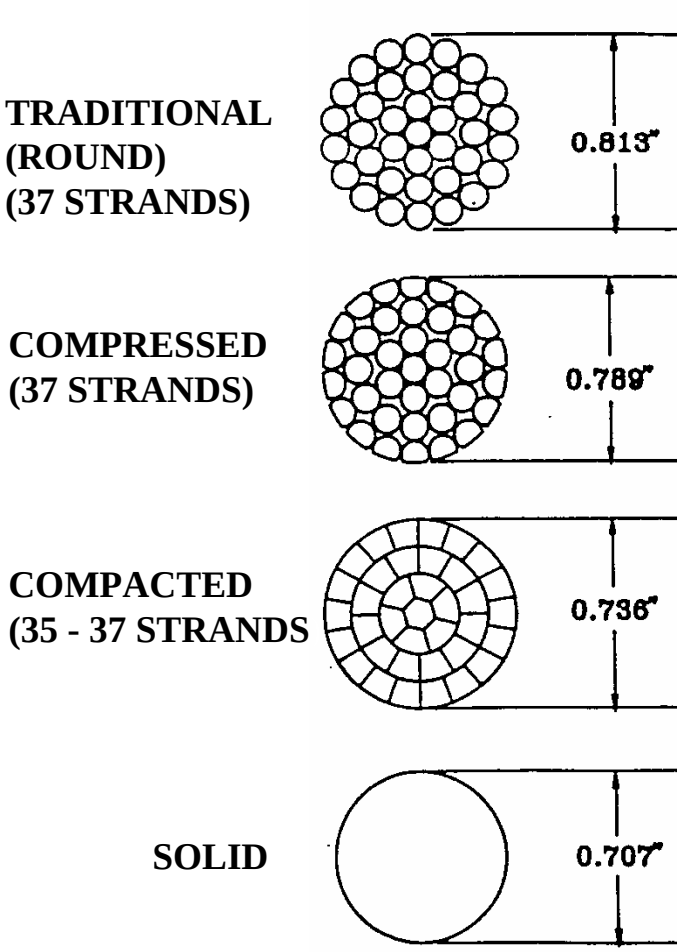


Common Belief #4

Aluminum conductors need to be much larger than copper conductors for equivalent ampacity

Cu	Aluminum
8	6
6	4
4	2
3	1
2	0
1	00
0	000
00	0000
000	250
0000	300
250	350
300	400
350	500
400	600
500	750
750	1000
1000	1500

STRANDING PATTERNS
e.g. 500 kcmil conductor
Stabiloy uses Compact stranding



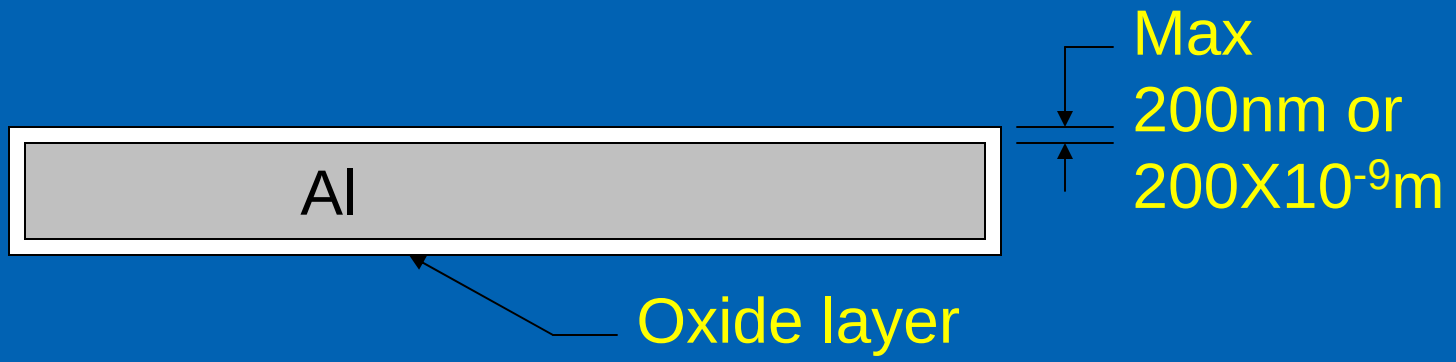
Common Beliefs #5

Aluminum wiring oxidation creates high resistance termination

A thin film of corrosion products does form on an aluminu`m's surface spontaneously, acting as a barrier to further oxidation. This film is self limiting and is typically between 5nm to 200nm thick.

Aluminum Oxide is a perfect insulator! The Dielectric Strength is 16.5kV per mm!

At the limiting thickness of 200nm, it will take 3.3V to breakdown this oxide film.



Common Beliefs #6

Aluminum wiring corrodes and can not stand up in atmospheric conditions.

The tightly bonded oxide layer serves as an indirect kinetic barrier.

Similar to Stainless Steel, this thin, protective layer of oxide on aluminum conductors contributes to the excellent corrosion resistance of aluminum.

GALVANIC CORROSION

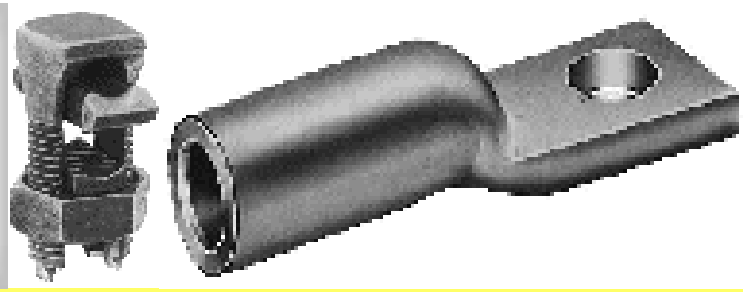
GALVANIC SERIES (why tin plating on AL/CU lugs?)

+ ANODIC
less noble

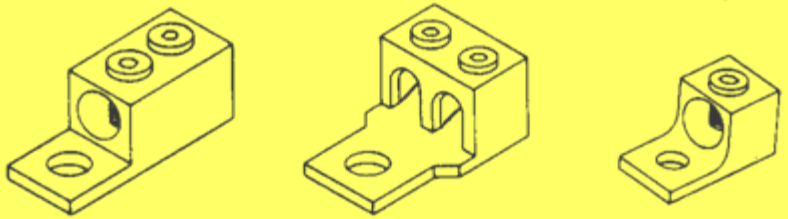
- CATHODIC
more noble

Metal	Eo (V)
Li	−3.05
Na	−2.71
Mg	−2.38
Al	−1.68
Mn	−1.18
Sn	−1.07
Zn	−0.76
Fe	−0.44
Ge	−0.29
Si	−0.14
Cu	0.34
Ag	0.8
Hg	0.85
Tl	1.25
Pb	1.69
Au	1.83
Ag	1.98

TYPES OF AL-CU LUGS



Mechanical



Compression

7 RULES TO PROPER CONNECTIONS

Summary

Seven basic rules help ensure simple, reliable connections with aluminum cables.

1. Connector must be aluminum-body.
2. Look for the AL7CU or AL9CU mark.
3. Size connector according to conductor size, not diameter or apparent diameter.
4. Do not ring conductor when stripping insulation.
5. Wire brush bare cable, apply compound (if not prefilled), insert.
6. Tighten set screw according to instructions.
7. Install compression connectors with the right die for the cable connector size.

PREVENTIVE MAINTENANCE

Visual inspection of insulation near lugs

Visual inspection of cable jackets, straps, and connectors

Thermal scanning

NO RE-TORQUING!

ALCAN US Cable Products Available in Feeder Sizes Only!

XHHW2

MC Cable

Stabiloy Teck90 Cable

ACSR, AAC, etc

Multiplexed
Overhead Service

Feederplex XHHW-2

ECONOMICS OF Stabiloy (Structural cost advantage)

Trading prices as of Oct 2008

LONDON METAL EXCHANGE
THE WORLD CENTRE FOR NON-FERROUS METAL TRADING

Aluminum

US $1.01/lb

Copper

US $2.45/lb

General Pricing Comparison (US)

Conductor Material	OC	# Of runs	4 Cond.	Grnd	Min. EMT	Total Length Feet	Total Cost with EMT	Total Cost MC	Savings
Copper THHN	100	1	#3	#8	1 1/4"	100	$ 415.59		
Stabiloy XHHW	100	1	#1	#6	1 1/4"	100	$ 260.56		37%
Stabiloy MC	100	1	#1	#6		100		$ 264.77	36%
Copper THHN	150	1	1/0	#6	1 1/2"	100	$ 723.53		
Stabiloy XHHW	150	1	2/0	#4	2"	100	$ 374.16		48%
Stabiloy MC	150	1	2/0	#4		100		$ 346.58	52%
Copper THHN	200	1	3/0	#6	2"	100	$ 1,081.34		
Stabiloy XHHW	200	1	4/0	#4	2"	100	$ 461.13		57%
Stabiloy MC	200	1	4/0	#2		100		$ 481.66	55%
Copper THHN	400	1	500 kcmil	#3	3"	100	$ 3,031.75		
Stabiloy XHHW	400	1	750 kcmil	#1	3 1/2"	100	$ 1,434.57		53%
Stabiloy MC	400	1	750 kcmil	3/0		100		$ 1,389.86	54%
Copper THHN	600	2	350 kcmil	#1	2 1/2"	100	$ 4,465.05		
Stabiloy XHHW	600	2	500 kcmil	2/0	3"	100	$ 2,013.07		55%
Stabiloy MC	600	2	500 kcmil	2/0		100		$ 1,992.59	55%

General Pricing Comparison (US)

Conductor Material	OC Device (Amps)	# runs	3 Phase and 1 Neutral Conductors	Ground	Min. Size EMT	Total Length Feet	Total Cost with EMT	Total Cost MC	Savings over Copper THHN
Copper THHN	800	2	600 kcmil	1/0	3 1/2"	100	$ 7,511.60		
Stabiloy XHHW	800	2	900 kcmil	3/0	3 1/2"	100	$ 3,695.51		51%
Stabiloy MC	800	2	750 kcmil	3/0		100		$ 2,779.73	63%
Stabiloy MC	800	4	250 kcmil	3/0		100		$ 2,478.34	67%
Copper THHN	1000	3	400 kcmil	#3	3"	100	$ 7,499.79		
Stabiloy XHHW	1000	3	600 kcmil	4/0	3"	100	$ 3,640.65		51%
Stabiloy MC	1000	3	600 kcmil	400 kcmil		100		$ 4,254.85	43%
Copper THHN	1200	3	600 kcmil	3/0	3 1/2"	100	$ 11,518.55		
Stabiloy XHHW	1200	3	900 kcmil	250 kcmil	4"	100	$ 5,632.92		51%
Stabiloy MC	1200	4	500 kcmil	250 kcmil		100		$ 4,533.31	61%
Copper THHN	1600	4	600 kcmil	4/0	3 1/2"	100	$ 15,592.90		
Stabiloy XHHW	1600	4	900 kcmil	350 kcmil	4"	100	$ 7,666.26		51%
Stabiloy MC	1600	5	600 kcmil	400 kcmil		100		$ 7,091.42	55%

Project Profiles

NUAL IN INDUSTRY

- ACME Steel, Riverdale, IL.
- Fort Wayne Anodizingm Fort Wayne, IN.
- Beta Steel, Portage, IN.
- Carondelet Foundry, St. Louis, MO.
- Koons Steel, Parkesford, PA.
- Super Steel, Milwaukee, WI.

- Laurel Steel, Burlington, ON.
- McCoy Foundry, Troy, ON.
- Honda, Alliston, ON.
- UBE Automotive, Sarnia, ON.
- Formet Industries, St-Thomas, ON.
- Intier Automotive, Halton, ON.
- Péchiney, Norsk Hydro, Alcan Smelters, QC., BC.
- Louisiana Pacific, Domtar, Alliance Forest Products, QC, ON.
- Falconbridge Mining, Timmins, ON.
- Lavo Bleach, Montreal, QC.

COMMERCIAL AND INSTITUTIONAL

- Alaska Airport Authority
- Whistler / Blackcomb Mountain, 2010 Olympic Ski Runs
- Olympic Stadium, Atlanta GA, Georgia Dome, Atlanta GA
- Rose Garden, Portland OR, Portland Convention Center, Oregon
- Doernbecher Childrens Hospital, Oregon
- Columbia Tower, Seattle WA
- Safeco Stadium / Seahawks Stadium – Seattle
- Royal Jubilee Hospital – Victoria, Sacred Heart Hospital –

PETROCHEMICALS

- IMPERIAL OIL (pump jacks), Cold Lake, AB
- SUNCOR (compressor stations), Burnt Lake, AB
- CHEVRON OIL (gas plants, pump jacks)
- MORRISON PETROLEUM (hydrogen sulfide extraction)
- PETRO CANADA (pump jacks)
- SHELL OIL (Scottford refinery), AB
- PETRO CANADA (Montreal Refinery de-sulphurisation)
- HUSKY OIL (Lloydminster SK and Minedosa MB ethanol refineries)
- CNRL Primerose Facility (ACWU on LV Motors)

THANK YOU FOR YOUR ATTENTION