LucasMilhaupt®
A Handy & Harman Company
Global Brazing Solutions®

Technical Data Sheet

CONSIL® 995

NOMINAL COMPOSITION

Silver	99.40 % Min
Magnesium	0.15% - 0.25%
Nickel	0.15% - 0.25%
Impurities	0.1% Max Lead
	0.01% Max Cadmium
Other Elements (Total)	0.10% Max

PHYSICAL PROPERTIES

Density (Troy oz/in^3)	5.52
Electrical Conductivity (%IACS) [(1)]	72 Max after oxidation hardening (conductivity will vary with temperature)

[(1)] IACS = International Annealed Copper Standard

Table 1. Typical mechanical properties of un-oxidized 0.012" strip at room temperature

Approx. Reduction (% in area)	Ultimate Tensile Strength (1000 psi)	2% Offset Yield Strength (1000 psi)	Minimum Elongation (% in 2")
00*	30	17	30
21	47	46	4
29	47	46	3
37	48	47	2

*Annealed

Table 2. Mechanical properties after oxidation hardening*(Longitudinal direction)

	(Room temperature minimum values)			
Strip Thickness (inches)	Up to 0.006	0.007 to 0.011	0.012 to 0.018	0.019 to 0.024
Tensile Strength (1000 psi)	62	60	58	56
Yield Strength (1000 psi/ 0.2% offset)	55	52	49	47
Elongation (% in 2")**	9	12	13	14
Elastic Modulus (1000000 psi)	12	12	12	12

* These values apply to material that prior to oxidation hardening was in either the soft or hard-as-rolled temper condition. Refer to section on METALURGICAL INFORMATION.

** Values at a strain rate of 0.5 in./in./min.

Table 3. The effect of temperature on the ductility of oxidized strip*

Temperature	Strain Rate (in./in./min.) (Est.)	Elongation (% in 2") 0.014"	0.005"
Room	0.1	18	16
100ºF (37.8ºC)	0.1	12	7
300ºF (148.9ºC)	0.1	4	2
400ºF (204.4ºC)	0.1	3	2
600ºF (315.6ºC)	0.1	2	1
900ºF (482.2ºC)	0.1	2	1

* At temperature above room temperature, the ductility of oxidized Consil 995 decreases sharply as the temperature increases.

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PHYSICAL PROPERTIES(CONT.)

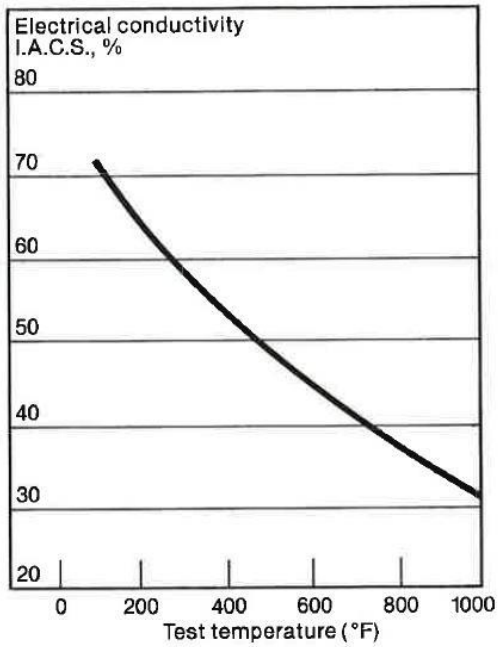

Figure 1. Electrical conductivity (typical values after oxidation hardening)

PRODUCT USES

Consil 995 is the Handy & Harman/Lucas-Milhaupt, Inc. designation for an alloy of 99.4% silver, 0.25% magnesium and 0.25% nickel. Consil 995 is a silver contact material which when oxidized may be brazed and still retain high strength. Its high conductivity and excellent mechanical properties offer advantages to spring members in various electrical devices, even at moderately elevated service temperatures.

Consil 995 is easily fabricated in an as-rolled temper and subsequently hardened by an internal oxidation treatment that converts the magnesium, which is in solid solution in silver, into sub-microscopic particles of magnesium oxide. These particles which strengthen the alloy do not coalesce appreciably except after very long exposure to high temperatures.

BRAZING CHARACTERISTICS

If oxidized Consil 995 is to be brazed to other materials, such as fine silver, it is recommended that furnace brazing be utilized with Silvaloy 603 and Handy Flux in order to obtain the highest peel strength.

When brazing is done in air, Handy Flux should be used in all cases to prevent oxidation of the joint. If furnace brazing with Easy Flo 45 in dry hydrogen is employed, no f lux is necessary. However, in hydrogen brazing it should be noted that the Oxidized Consil 995 itself may suffer a loss in tensile strength of about 40%.

The relative strength of furnace brazed joints made with Silvaloy 603, Easy-Flo 45 and Sil-Fos 15 brazing filler metals can be gauged by the data in **Table 4**. For more complete information on the brazing filler metals, refer to the Technical Data Sheets for Silvaloy 603, Easy-Flo 45 and Sil-Fos 15 respectively.

BRAZING CHARACTERISTICS (CONT.)

Table 4. Peel strength* of furnace brazed joints/oxidized Consil 995 brazed to fine silver

Filler Metal Used	Silvaloy 603	Easy-Flo 45		Sil-Fos 15
Flux Used	Handy Flux	Handy Flux	Hydrogen**	Handy Flux
Peel Strength*	4.82	1.60	0.50	2.28

* Inch-Pounds per inch of joint width.
Specimens 0.500 in. wide x 0.010 in. thick x 5.5 in. long brazed to ¼ in. O.D..fine silver tubing.
**Furnace brazed 5 minutes (-50 ºF dew point).

METALURGICAL CHARACTERISTICS

Hardening Property: The time required for oxidation harden Consil 995 is a function of the thickness of the section and temperature used for oxidation. These relationships are shown graphically in **Figure 2** and **Figure 3**. If hardening is done in an oxygen atmosphere, the time required is 0.6 (60%) of that shown on the graph. Tensile strength of strip hardened in an oxygen atmosphere will average 5% higher than that of strip hardened in air. (Note: Curves show minimum time for complete hardening in air containing no reducing gases under conditions of free convection. Longer times are recommended to assure complete oxidation. Oxygen is consumed in the process; be sure to provide for its replenishment.)

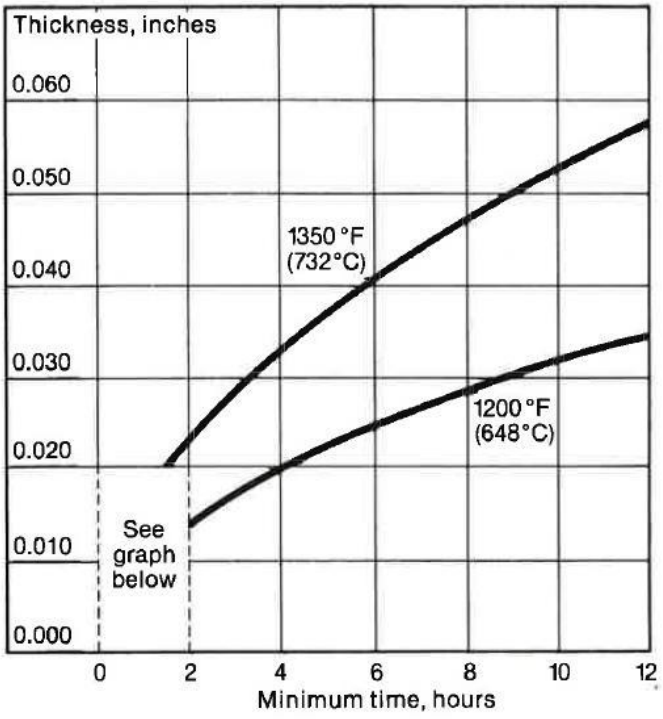

Figure 2. Minimum time for oxidation harden Consil 995 at different thickness of the section (a)

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METALURGICAL CHRACTERISTICS (CONT.)

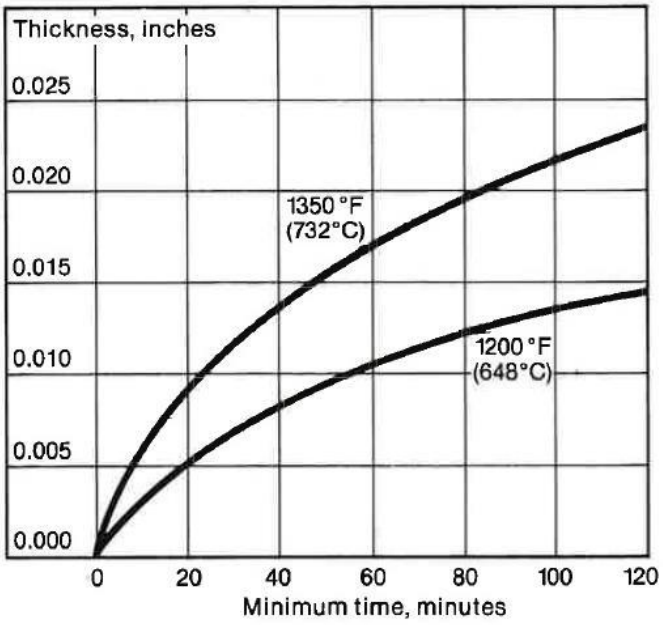

Figure 3. Minimum time for oxidation harden Consil 995 at different thickness of the section (b)

Formability: Before oxidation hardening, the ability of Consil 995 to be formed depends on temper. Minimum recommended bending radius for 180º bends perpendicular to rolling direction made prior to oxidation hardening (where T is the thickness of stock): Annealed-1T and Hard Rolled-2T.

Choice of Temper: In choosing temper, it is important to be aware of the effect of prior plastic deformation on recrystallized grain size after oxidation, since internal oxidation hardening takes place above the recrystallization temperature. Hard-as-rolled material will develop a fine uniform grain size after oxidation hardening whether oxidized in the as-rolled condition or after forming. Annealed material will develop a fine uniform grain size after internal oxidation if oxidized in the as-annealed condition. If annealed material is subjected to a small amount of plastic deformation prior to oxidation, an exaggerated and non-uniform recrystallized grain size will be induced in the region of deformation. Cracking and fatigue failure is possible in thin sections where a few such exaggerated grains develop across the entire section. These facts are illustrated in the photomicrographs on the following two pages. To avoid premature cracking or fatigue failure, a minimum 21% reduction (by cold rolling) is desirable prior to forming. (For the majority of applications hard-as-rolled temper should be specified.)

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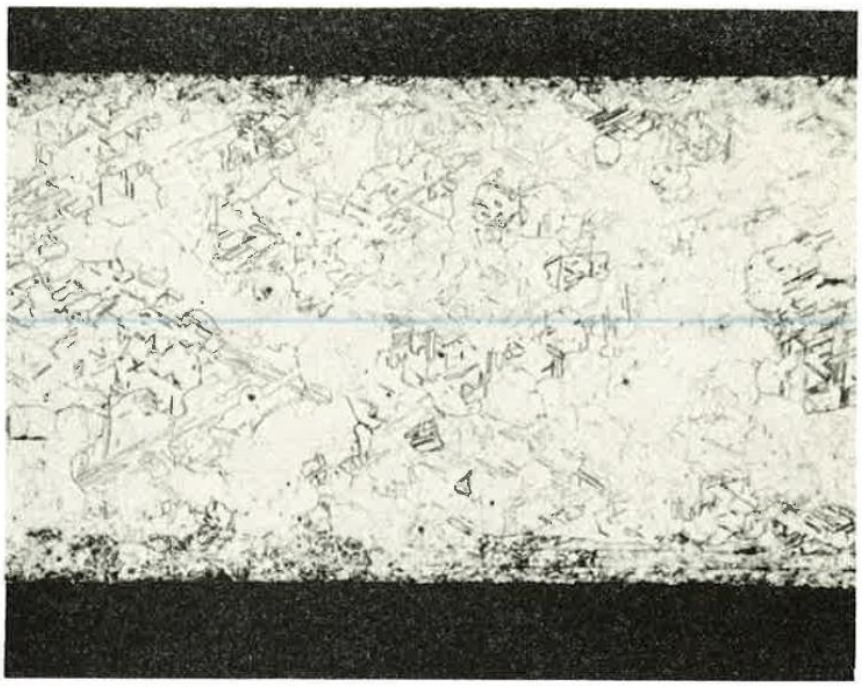
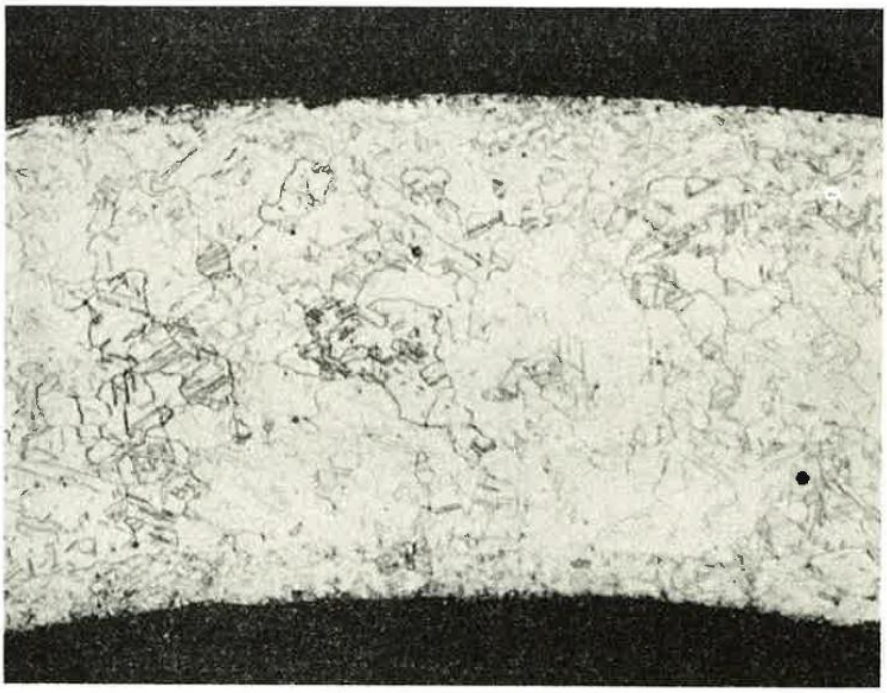
METALURGICAL CHRACTERISTICS (CONT.)



.012″ sheet oxidation hardened 215 X

Figure 4. Recrystallized microstructure of Consil 995 after oxidation hardening (starting temper-soft)



.012″ sheet oxidation hardened after bending 180° on a 1/8″ radius 215 X

Figure 5. Recrystallized microstructure of Consil 995 after oxidation hardening (starting temper-soft)

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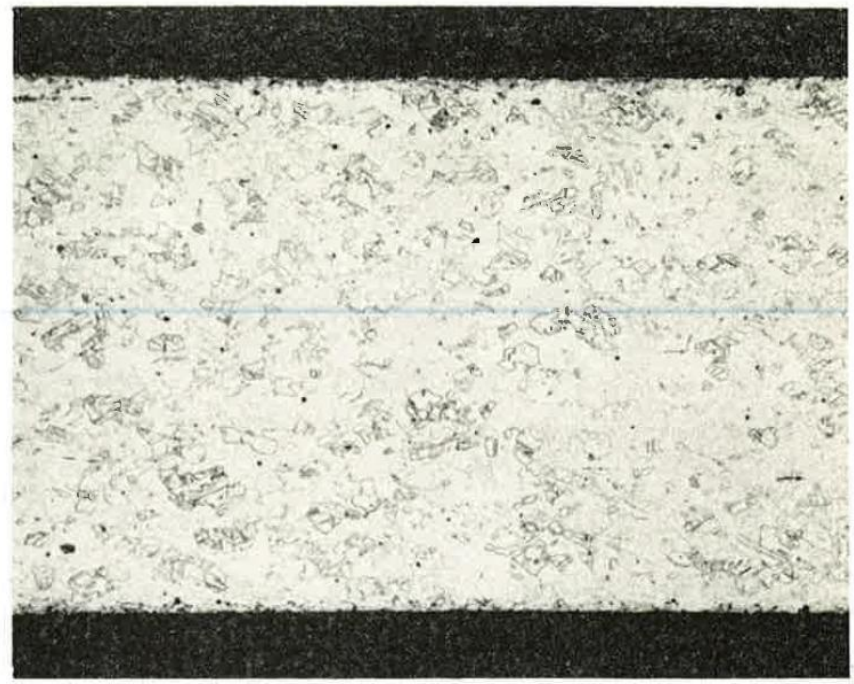
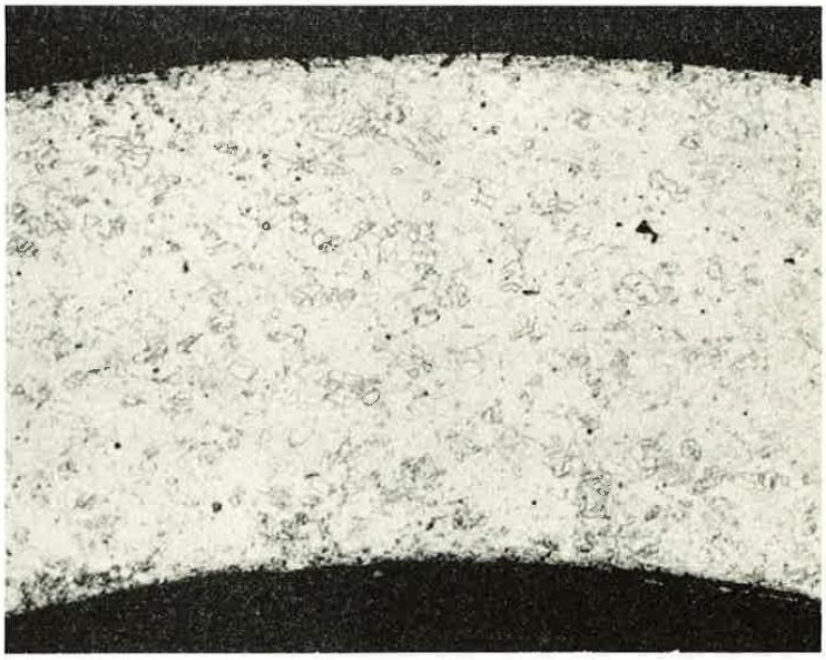
METALURGICAL CHRACTERISTICS (CONT.)



.012″ sheet oxidation hardened 215 X

Figure 6. Recrystallized microstructure of Consil 995 after oxidation hardening (starting temper-hard-as-rolled)



.012″ sheet oxidation hardened after bending 180° on a 1/8″ radius 215 X

Figure 7. Recrystallized microstructure of Consil 995 after oxidation hardening (starting temper-hard-as-rolled)

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METALURGICAL CHARACTERISTICS (CONT.)

The Effect of Temperature on the Notch Sensitivity of Oxidized Strip: Elevated temperature tensile tests on notched and un-notched oxidized Consil 995 samples show an increasing tendency to notch sensitivity as the temperature is increased. This sensitivity is greater for thin sections. Consequently, care must be exercised in the design of parts to be stressed at elevated temperatures. Stress concentration should be avoided.

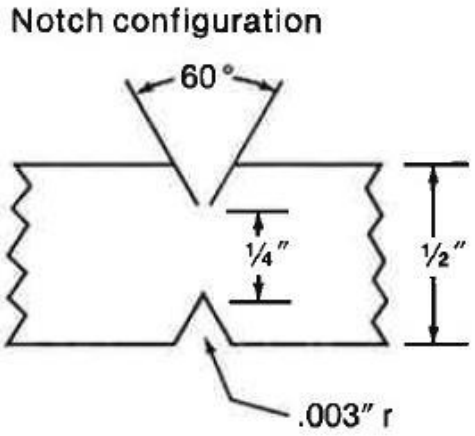

Figure 8. Notch configuration

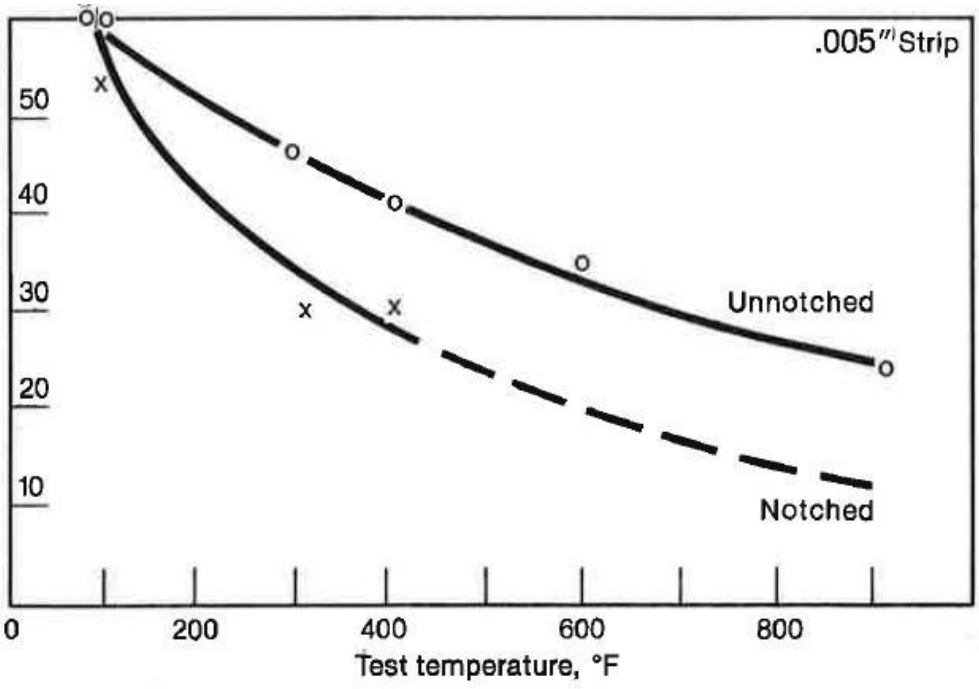

Figure 9. Ultimate tensile strength at different temperature for 0.05" strip

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METALURGICAL CHARACTERISTICS (CONT.)

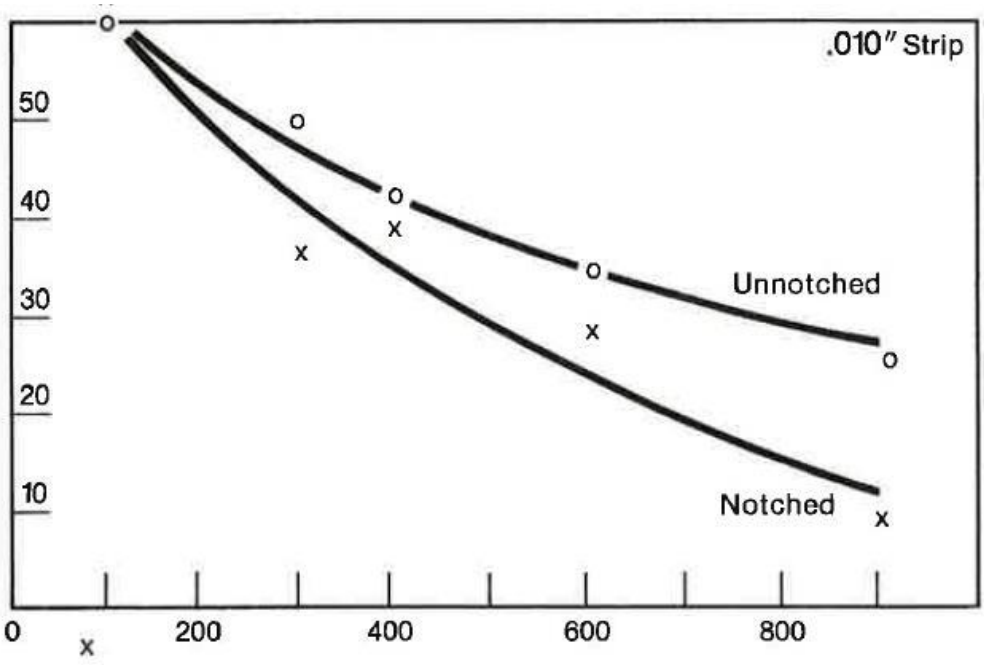

Figure 10. Ultimate tensile strength at different temperature for 0.010" strip

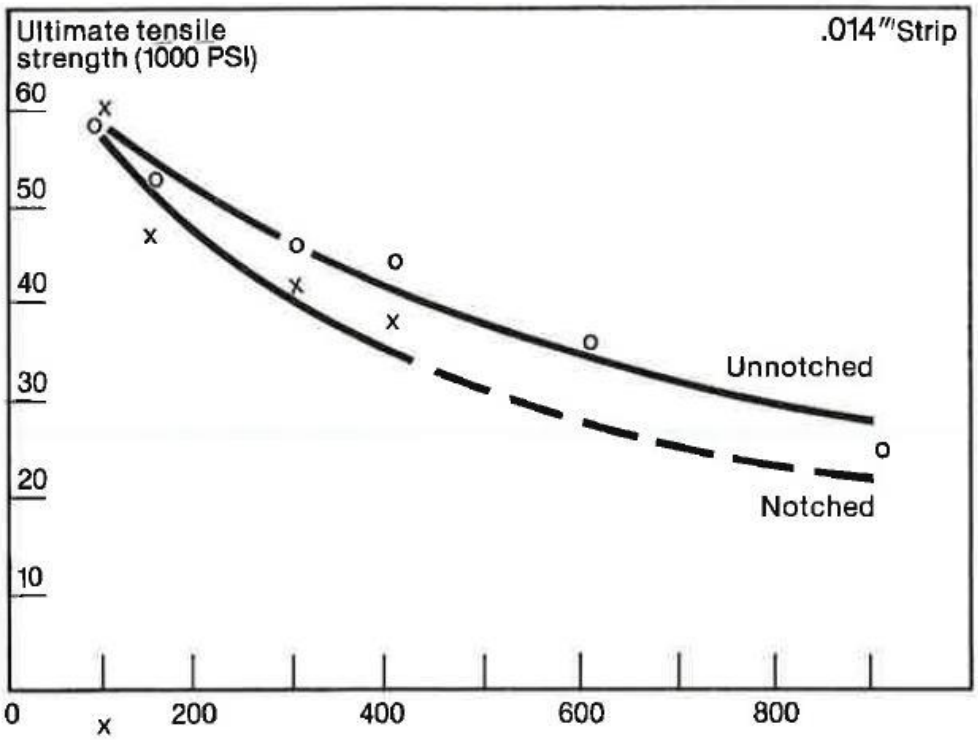

Figure 11. Ultimate tensile strength at different temperature for 0.014" strip

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METALURGICAL CHARACTERISTICS (CONT.)

Elevated temperature stress-to-rupture tests on oxidized strip: Stress-to-rupture test results are rather independent of strip thickness. The data points fall within a 4000 psi band. Design criteria should be based on the lower values.

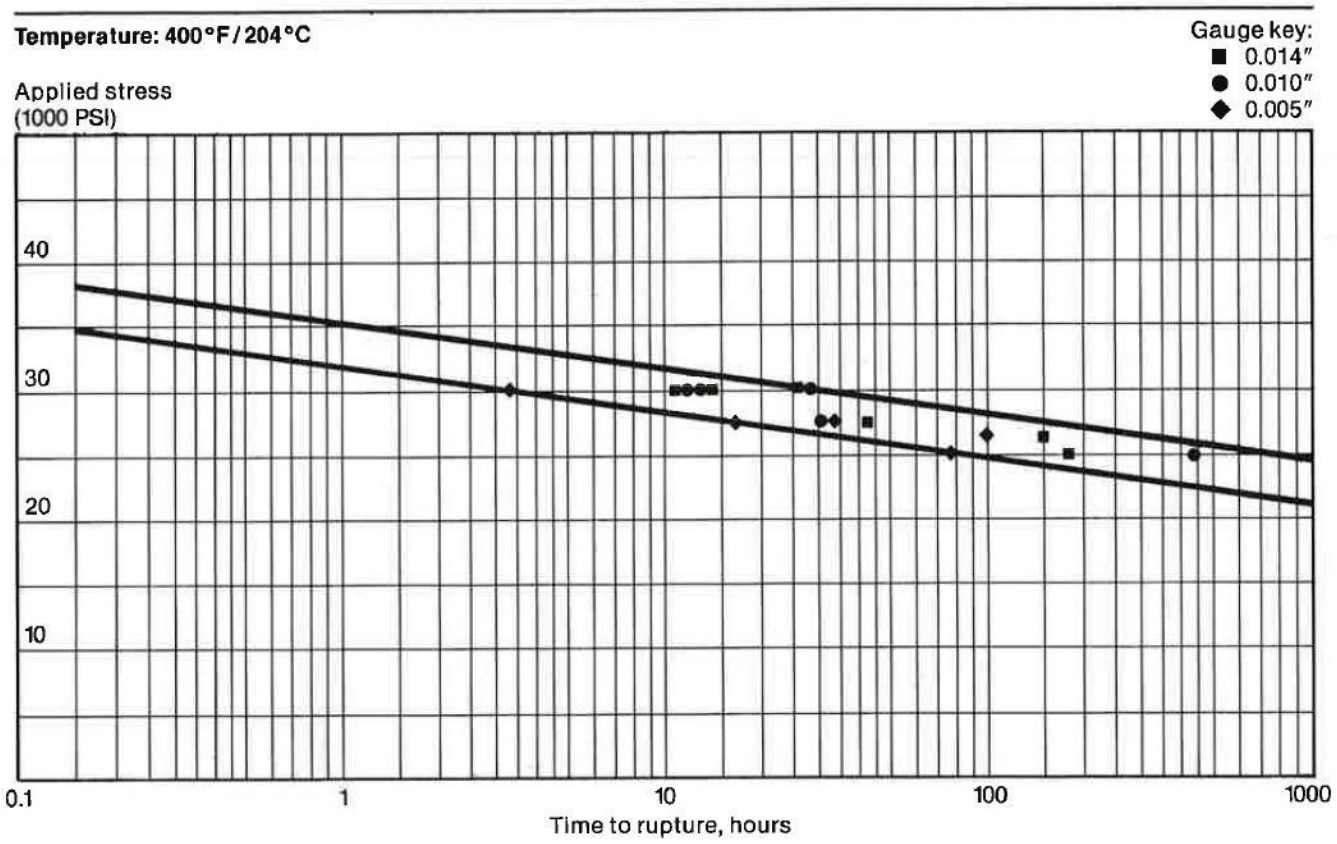

Figure 12. Elevated temperature stress-to-rupture tests on oxidized strip results

AVAILABLE FORMS

Wire, strip, engineered preforms, specialty preforms per customer specification.

SPECIFICATIONS

Consil 995 alloy conforms to the following specification: N/A

APPLICABLE PRODUCT CODE(S)

The applicable Lucas-Milhaupt product code(s) for this technical data sheet: 15-995.

SAFETY INFORMATION

For more complete information refer to the Material Safety Data Sheet for Consil 995.

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