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Thermal Treatment and Mechanical Properties of Aluminum-2021

Mechanical properties, after various thermal treatments, are reported (see documentation) for sheet and plate of copper-rich, high-strength, heat-treatable aluminum-2021 (refs. 1–4). The alloy shows great promise for lightweight structures of great strength; in many applications it may replace alloys 2014 and 2219 (see Table). In strength and cryogenic toughness it is equivalent to aluminum-2014-T6, but its weldability and resistance to stress corrosion are better. In weldability it resembles aluminum-2219, but has greater weld strength.

Alloy, Temper	Tensile Strength, 100 lb/in^2 Ultimate	Yield	Elongation, %
	70°F		
2219-T87	69	57	10
2014-T651	70	60	13
2021-T81	73	63	9
	-320°F		
2219-T87	83[a]	61	15
2014-T651	80	53	28
2021-T81	91	75	10
	400°F		
2219-T87	34	25	20
2014-T651	16	13	35
2021-T81	32	28	23

[a]Originally T81

Tensile Properties of Three Aluminum Alloys at Three Temperatures

Tensile tests were run between 400° and -423°F on samples of 0.063-in. sheet and 0.50-in. plate either as supplied (tempers 0 and T81) or after various further thermal treatments that might be applied by a fabricator. The results are reported graphically and in tabular form.

The material is so quench sensitive (especially the plate) and so responsive to thermal and mechanical conditions of processing and handling that procedures must be closely specified for consistent production of strength and other properties. The quench rate is expected to affect its corrosion behavior, the supplier's recommendation of "rapid quenching in cold water" appears to be sound. An earlier suspicion is confirmed that cold working, introduced by flattening of the warpage after quenching, may adversely affect elongation.

Artificial aging from 16 to 24 hr at 325° ± 10°F produces little variation in strength of either sheet or plate. Sheet is generally higher than plate in both ultimate tensile strength and elongation; in yield strength the two gages may be comparable. Although strengths may be relatively unaffected, corrosion behavior may be readily affected by variations in aging. It is generally recognized that overaging improves the corrosion behavior of aluminum alloys; thus the recommended thermal treatment is usually a compromise for a useful combination of strengths, corrosion behavior, and other desired characteristics.

More comprehensive testing, covering all aspects of fabrication, is required for establishment of realistic data governing all potential uses of the material.

References:

1. Aluminum Company of America, Inc.: Aluminum Alloy 2021. Alcoa Green Letter, April 1968.
2. Anon.: Alloy 2021: Another Step Ahead? Iron Age, June 27, 1968, p. 72.

(continued overleaf)

3. Anon.: Alcoa Develops Alloy for Rocket Structure. Metalworking News, Dec. 23, 1968, p. 10.
4. Anon.: Two New Cryogenic Alloys Look Promising in Tests. Metal Progress, April 1969, pp. 7–8.

Note:

The following documentation may be obtained from:

Clearinghouse for Federal Scientific
and Technical Information
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.65)

Reference:
NASA-TM-X-53847 (N69-34671), Thermal Treating Studies on New Aluminum Alloy 2021

Patent status:

No patent action is contemplated by NASA.

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