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Cobalt Base Superalloy Has Outstanding Properties Up to 1478 K (2200°F)

NASA alloy VM-103 (cobalt-25W-3Cr-1Ti-0.5Zr-0.5C) can be produced in wrought form and has outstanding properties up to 1478 K (2200°F). Working schedules and specifications have been developed. This alloy is especially promising for use in applications requiring short time exposure to very high temperatures. Its properties over a broad range of temperatures are superior to those of comparable commercial wrought cobalt-base superalloys, L-605 and HS-188.

Alloy VM-103 was originally developed as a high strength cobalt-base cast superalloy (U.S. Patent No. 3,276,865). It has been demonstrated that its ductility allows it to be processed by hot and cold rolling. Ingots have been produced by induction plus vacuum arc remelting and by induction plus electroslag remelting. The ingots have been forged and hot rolled, typically at 1463 K (2174°F). Adding up to 10 percent nickel to the base composition is beneficial and further enhances alloy workability without adversely affecting other mechanical properties. The alloy can be rolled with reductions up to 25 percent per pass with intermediate anneals at 1478 K (2200°F).

Cold rolled sheet alloy in the solution heat-treated (1478 K (2200°F), one-half hour, water quench) condition has average tensile properties as follows:

TEMPERATURE		ULTIMATE Tensile Strength		YIELD STRENGTH		ELONGATION
ĸ	٥F	MN/m ²	PSI (x 1000)	Mil/m ²	PS1 (x 1000)	I
298 923	75 1200	1095 780	159 113	705 540	102 78	17 12
1143 1238 1368	1600 1770 2000	565 415 150	82 60 22	400 295	58 43	32

At high strain rates (5 per minute), the tensile properties are higher:

TEMPERATURE		ULTIMATE TENSILE STRENGTH		YIELD STRENGTH		ELONGATION
К	٥F	MN/m2	PSI (x 1000)	MN/m ²	PSI (x 1000)	1
298 923 1143 1253 1368 1478	75 1200 1600 1800 2000 2200	1140 820 725 470 275 180	165 119 105 68 40 26	850 515 485 395 270 180	123 75 70 57 39 26	22 26 12 19 19 20

This document was prepared under the sponsorship of the National Aeronautics and Space Administration. Neither the United States Government nor any person acting on behalf of the United States Comparatively, for L-605, the corresponding values are:

TEMPERATURE		ULTIMATE TENSILE STRENGTH		YIELD STRENGTH		ELONGATION
ĸ	°F	mn/m²	PSI (x 1000)	mn/h²	PSI (x 1000)	I
1368 1478	2000 2200	217 123	31.5 17.8	192 123	27.8 17.8	25 25

Notes:

- 1. Potential applications for high temperature cobalt-base superalloy include high firing rate small caliber gun barrels and gun barrel liners, gas valve and hydraulic power system components for missiles, various static parts on jet engines, ramjets and rocket engines, where high temperature strength is required up to 1478 K (2200°F).
- 2. Further information is available in the following reports:

NASA CR-121189 (N73-21457), Further Development and Characterization of VM-103, A NASA Wrought Cobalt-Base Alloy

NASA CR-72726 (N70-37090), Development and Metallurgy Study of a NASA Cobalt-Base Superalloy

Copies may be obtained at cost from: Aerospace Research Applications Center Indiana University 400 East Seventh Street Bloomington, Indiana 47401 Telephone: 812-337-7833 Reference: B74-10081

3. Specific technical questions may be directed to: Technology Utilization Officer Lewis Research Center 21000 Brookpark Road Cleveland, Ohio 44135 Reference: B74-10081

(continued overleaf)

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Patent Status:

NASA has decided not to apply for a patent.

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