11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25
ICAM2009

Tensile properties of MAR-M247 superalloy

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Abstract – In this work tensile properties at 25 and 760°C of MAR-M247 superalloy were measured. The results are in accordance with literature, except the result of ultimate tensile strength at 25°C.

MAR-M-247 is a nickel-base casting alloy (microstructure in Figure 1a) for applications requiring high strength at elevated temperatures up to about 1000°C. Its balanced composition (10 wt% Co, 10W, 8.25Cr, 5.5Al, 3Ta, 1.5Hf, 1.0Ti, 0.7Mo, 0.15C, 0.05Zr, 0.015B, Ni balance) provides an excellent combination of tensile and creep-rupture properties as a result of γ' strengthening enhanced by solid solution and grain-boundary strengthening [1,2,3]. The aim of this work is to evaluate the values of elastic modulus (E), yield strength (σ_y) and ultimate tensile strength (σ_R) of MAR-M247 superalloy at 25 and 760°C.

The alloy was produced via vacuum induction melting furnace (VIM) and investment casted in the form of rotors for turbocharger application. Samples from the central part of the rotors (Figure 1b) were taken via electro-discharge machining. Tensile tests at 25°C were carried out in a MTS 810M with capacity of 250kN with a strain gauge 634 model MTS 12F-21. Tensile tests at 760°C were carried out in a EMIC model DL 10000 with capacity of 100kN. Nine bars were used in each test and all the tests were carried out with velocity of deformation of 0.5mm/min.

The value of hardness is 413±12 HV, in accordance of 408HV found in literature [3]. Table 1 shows the results of tensile tests at 25°C. The σ_y and E values are near the values found in literature [1,2] and the σ_R is below the value of 965 MPa cited in literature [2]. Table 2 shows the results of tensile tests at 760°C. The σ_R value is in accordance with the literature [2].

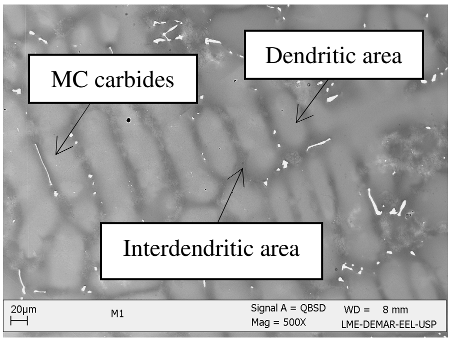

Figure 1a: Microstructure of MAR-M247 superalloy.

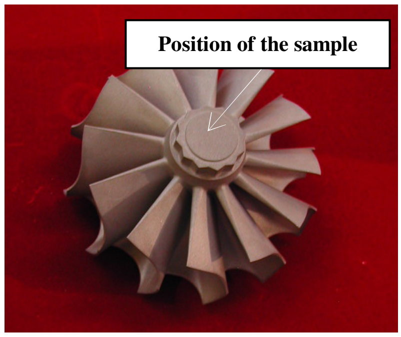

Figure 1b: Position of the sample on rotor.

Table 1: Results of tensile tests at 25°C for MAR-M247 superalloy.

Material	E (GPa)	σ_y (MPa)	σ_R (MPa)
Test Bar (MAR-M247)	185±14	814±12	859±38
Literature	170<E<210 [1]	827 [2]	965 [2]

Table 2: Results of tensile tests at 760°C for MAR-M247 superalloy.

Material	σ_R (MPa)
Test bar (MAR-M247)	816±54
Literature	786 [1]

References

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[3] BHAUMIK, S. K. et al. Failure of turbine rotor blisk of an aircraft engine. **Engineering Failure Analysis**, v. 9, p. 287-301, 2002.