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STOCHASTIC METHOD FOR EXTRAPOLATION OF DIAGRAMS OF LONG-TERM STRENGTH OF STRUCTURAL MATERIALS

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The research objective is to develop a stochastic method of basic diagrams for extrapolation of a long-term strength of structural materials to the lives exceeded the experiment duration by several orders. This method takes into account a random character of a long-term strength of materials and considers a hypothetic stress value as a totally analogue random quantity for a chosen life. Physically, it results in a gross correctness in comparison with the known deterministic methods, and the research novelty. Based on stochastic processing the long-term strength diagrams and methods of a regression analysis, the technique for identifying the unknown parameters of the method is developed. It was concluded that the theoretical results, obtained with this method, are in a good agreement with the long-strength experiments with samples made from the 18Cr-8Ni stainless steel. The above method can be used to predict the failure time of several structural materials that are widely employed for machine-building, nuclear engineering and rocket technology, as well as in the development of standards, methodic recommendations for evaluating the structural materials lives in creep.

Keywords: *failure, long-term strength, method of basic diagrams, time to failure, probability distribution.*

1. *Rabotnov Yu.* N. Creep of Structural Elements. M.: Nauka, 1966. 756 p. *(in Russian)*
2. *Poshivalov V. P.* On the approach to determination of time to failure in creep. Problemy Mashinostroenia i Nadezhnosti Mashin. 1993. No 3. P. 56 – 60. *(in Russian)*
3. *Doyar I., Poshyvalov V.* Development of a stochastic model of failure of structural materials in creep at hardening stage. Vostochno-Evropeyskiy Zhurnal Peredovykh Tekhnologiy. 2016. No 3 (5). P. 25 – 31. *(in Russian)*
4. *Manson S. S., Haferd A. M.* A linear time-temperature relation for extrapolation of creep and stress rupture data. NASA TN 2890. 1953.
5. *Larson F. R., Miller J.* Time-temperature relationship for rupture and creep stresses. Trans. ASME. 1952. V.74. P. 765 – 775.
6. *Orr R. L., Sherby O. D., Dorn J. E.* Correlation of rupture data for metals at elevated temperatures. Trans. ASM. 1954. Vol.46. P. 113 – 128.
7. *Kucher N. K., Prikhodko R. P.* Method of extrapolation of long strength diagrams for heat-resistant materials. Visnyk TNTU. 2013. No 2. P. 84 – 93. *(in Ukrainian)*
8. *Krivenyuk V. V., Avramenko D. S., Prokhodko R. P.* Correlation and extrapolation of results of long strength tests for chrome-nickel and chrome-molybdenum steels. Life, reliability and safety of heat-power equipment for power stations: Collected Papers / Edited by Ye. A. Grin. M., 2011. P. 127 – 134. *(in Russian)*
9. *Krivenyuk V. V.* Prediction of High-Temperature Creep and Long-Term Strength. Strength of Materials and Structures: Book Series /Edited by V. T. Troshchenko. Kiev: Pisarenko Institute for Problems of Strength, NASU, 2012. Vol. 5. 752 p. *(in Russian)*
10. Data sheets on the elevated-temperature properties of 18Cr-8Ni steel. NRIM Creep Data Sheet. 1986. 4B. 32 p.