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RESEARCHES ABOUT CRITICAL TRANSITION TEMPERATURE FROM ELASTIC FIELD TO PLASTIC FIELD FOR PEARLITIC-FERRITE NODULAR CAST IRON

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ABSTRACT
In this paper are presents the results of some experimental researches for stretching stress executed from pearlitic-ferrite nodular cast iron test. The tests are realized from different temperatures. Using the experiments, we are presented the variation curves depending by temperature of breaking strain and elastic modulus for this cast iron. Also, using the same determinations, it was established the elastic deformation field from plastic deformation field of transition temperature. In the final of this paper are presented the conclusions, which result following these experiments.

1.INTRODUCTION

In casting pieces obtaining process are created a temperature gradient for pieces stress, made by elastic and plastic stress, which, in different phases of processing have a dynamic character and, in the final, born the remanent stress.
The appearing of stress in casting pieces are affected by a multitude of factors, which are depended by the alloy, constructive form and the dimensions and the applied, casting technologies.
The casting pieces alloy have a influence over the stress by: elastic and plastic properties, critical transition temperature from elastic to plastic field during the cooling process; the dilatation/contraction thermal linear coefficient with temperature variation; the existence or absence of transformation phases during the cooling process; the chemical composition – the presence of some chemical elements with plastering effect or the hardening of alloy from basis crystal.
In this paper, from all of this factors, we are boarded the elasticity modulus, the stretching stress and the critical transition temperature from elastic to plastic field.
In case of stress distribution study in the different types of casting pieces joint, the cooling temperature field influences the indirect stress during the cooling, after the solidification and the alloy properties.

Starting from this dates, using the made researches, we trying to limit the accidental factors, results a maximum constancy of conditions for each analyzed element.
For researches we are using nodular cast iron with same chemical composition, molded in the same conditions for every test pieces.
We are trying, using our experiments, to determining with high accuracy the stretching stress and elastic modulus values for different temperatures for a ferrite-pearlitic nodular cast iron.
First group of tests was made for elastic modulus determination for environmental temperature.
A second series of tests was made for elastic modulus variation establish with temperature.
A third series of tests was made for critical transition temperature from plastic to elastic field establish.
The test conditions were made for environmental temperature for first series of determinations and controlled temperature for the other two series.
The deformation speed: 0,05 m/min.
The nodular cast iron type: Fgn 600-3 SR ISO 1083-93; C = 4.0%; Si = 2.2%; Mn = 0.4%; Mg = 0.8%; P<0.03%.

2.EXPERIMENTAL ANALYSIS

2.1. Equipment and instrumentations

The test was made using a pull test machine, fitted with measuring-recording curves system $\varepsilon=f(F)$;

ε - Extension function of force F.

For determinations by a different temperatures over the same machine are adjusted a tubular electric furnance, fitted with a control and setting up temperature system.

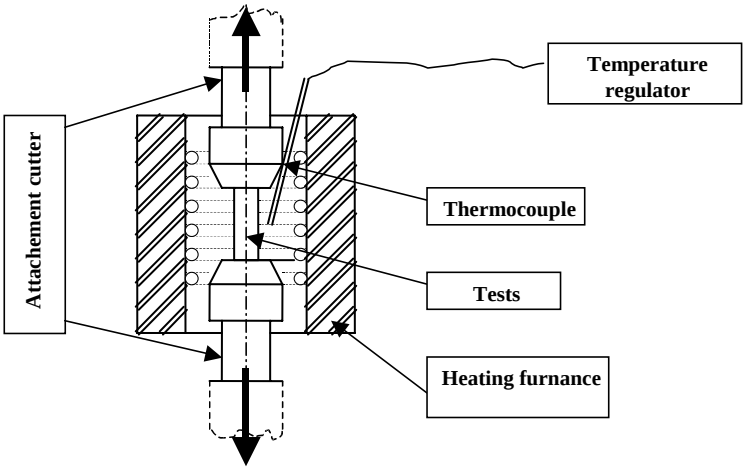

FIGURE 1. THE SYSTEM TEST SCHEME

2.2. The Test execution

The test pieces for traction tests were made like in figure no. 2. The tooling of tests was made from casting test “U” type (SR ISO 6071/1993) realized by casting in core moulding.

2.3. The elastic modulus determination

For the elastic modulus determination we are using 8 tests like in figure no.2. this determination was made using the deformation diagram by the tangent method.

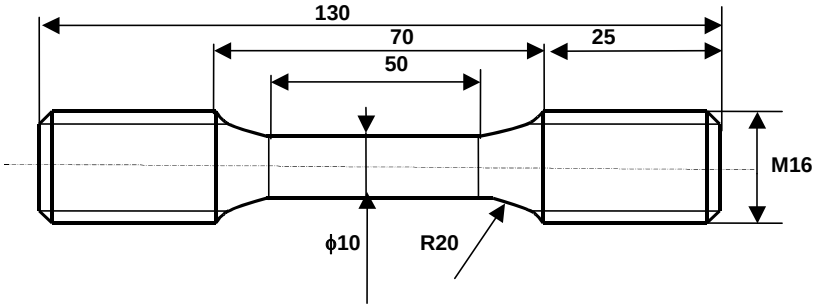

FIGURE 2. THE TEST DIMENSIONS USING
BY STRETCHING STRESS

Stress conditions:

-Variable force;

-Deformation speed: 0.05 m/min;

-Constant temperature (≈20°C).

TABLE 1

No. of test	Traction force for breaking **F** [N]	Breaking strain $\mathbf{R_t}$ [10^3·N/m^2]	Breaking elongation **A** [%]	Ductility limit$\mathbf{R_{0,2}}$ [10^3·N/m^2]	Elastic modulus **E** [10^9·N/m^2]
1	48300	615	2,6	510	179
2	46500	592	3,6	480	176
3	46300	589	3,8	470	172
4	47900	609	3,2	505	178
5	43500	554	4,2	380	168
6	47200	601	3,4	490	175

If we analyse the results for elastic modulus, the medium value value is E = 174,66·10^9 N/m^2.

2.4. The elastic modulus variation with temperature

This determination was made with monitoring purpose, for temperature field determination where are placed, probably, the transition temperature from plastic to elastic field.
Stress conditions: variable force; the temperature deformation diagram: 293 K; 473 K; 673 K; 723 K; 873 K; 923 K;

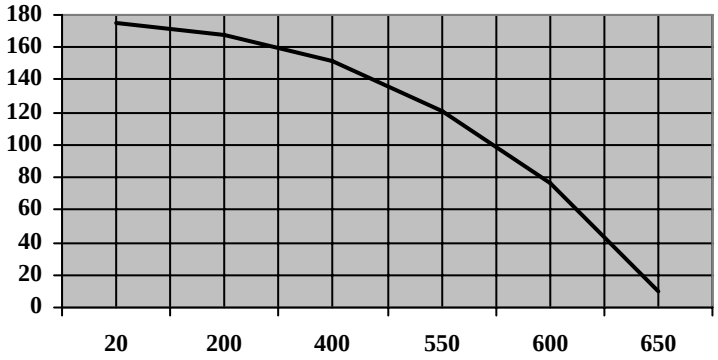

FIGURE 3. ELSASTIC MODULUS VARIATION WITH TEMPERATURE

3. CONCLUSIONS

From values determination analyses, results: the medium transition temperature from plastic to elastic field for nodular cast iron 600-3 are around 580°C (575 - 585°C). So, this value can be used for remanent stress calculation in casting pieces.
The medium critical transition temperature from plastic to elastic field can be determined most precisely with this method, but for every cast iron separately.
The obtaining value is included in a thin interval. The technical literature interval is 500-660°C, for nodular cast iron in a large acceptation.
Elastic modulus is reduced with growth of temperature, being almost zero close to transition temperature from elastic to plastic field.
All of this values can be used with success for every type of analytical and practical determinations, for casting pieces from nodular cast iron.

4. REFERENCES

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