NONDESTRUCTIVE TESTING FOR THE BRAKE SYSTEMS OF MINING HOISTS

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Abstract: According to the new instructions in safety of work in Romania, all mine hoists with outdated life span will undergo technical expertise under which the active and dynamic components for the braking components components or assemblies will be checked by nondestructive testing.

Key words: brake, nondestructive, testing.

1. INTRODUCTION

Nondestructive testing does inspection, testing and evaluation of materials, components or assemblies for discontinuities or differences between the characteristics without destroying the part or system operation. The most frequently used test methods are [8]:

- Magnetic particle testing
- Liquid penetrant testing
- Radiographic testing
- Ultrasonic testing
- Electromagnetic testing
- Visual testing.

The diagnosis of cracks in placed on the first place within the nondestructive control process. This problem is solved for the geometrically simple devices: shaft, pipes, bolts etc. by the ultrasonic testing and for the devices with more complicated geometry by ferro-magnetic materials with electromagnetic testing.

The nondestructive control will be performed having all the components the

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brake components of mining hoists decomposed and cleaned. The control is performed on all possible surfaces, except the threaded areas, with key channels, splines, passing holes and another unacceptable area.

The nondestructive testing is not to be performed with the tensed devices.

2. THE INTERPRETATION OF THE RESULTS OBTAINED BY THE NONDESTRUCTIVE TESTING

The interpretation of the nondestructive tests is realizing following the next phases:

a) setting of the areas that are to be analyzed;
b) classifying the faults will be performed by the technical operator with the following mentions:
   - structural defects that represent a real danger for the considered section,
   - structural defects that do not represent a real danger for the considered section.

When interpreting the results of the nondestructive testing, based on defects maps will proceed as follows [1] [2] [6]:

- For round sections :
  a) Core structural defects 0.25 D, no matter their nature are not to be taken into consideration;
  b) Structural defects, from the 0.25-0.5 area, having a real degree of danger, are considered applying a coefficient of 0.5 as to their real dimension transposed at the periphery of the section;
  c) Structural defects, from the 0.5-0.75 area, having a real degree of danger, are considered applying a coefficient of 0.75 as to their real dimension transposed at the periphery of the section;
  d) Structural defects, from the 0.75-1.0 area, having a real degree of danger, are considered at their real value (as surface);
- For square sections three areas are to be considered:
  a) The core area, in which the rectangle line is between the limits (0.25 - 0.6) of the real rectangle;
  b) The external area in which the rectangle line is between the limits (0.6 – 1.0) of real rectangle;
  c) The surface of structural defects is transposed to the periphery of the external area with the following calculus coefficients: 0.4; 0.7; 1.0.

On the basis of the results of the nondestructive testing and their interpretation, the active sections will be determined, after which the effective calculus efforts will be determined under the new interpreting conditions by determining the fatigue safety coefficients.

The normative duration for the brake of mining drum hoists is established according to the construction form and the number of the existing brakes on the existing drum hoist as follows:

- The brake of mining drum hoists which have only one braking group and which with the support of a rod actions the brake shoes on both braking rims, will have the normative exploiting period of maximum 15 years on condition that in 10 years of exploitation the main rod is yearly checked for defects. This measure has been imposed due to the fact that there is no second braking element to ensure the security of the mining drum hoist if is brake damage;
- The brake of mining drum hoists with two independent braking systems, with separate action on each rim of the drum has the normative exploitation time of 18 years on condition that after 15 years the main rod is nondestructively checked with the ultrasonic fault detector yearly. [1];
- The brake of mining drum hoists with brake between the engine and the reducer; the normative exploitation time is established at 20 years and the main rod will be checked yearly with the help of the ultrasonic fault detector after 12 years of continuous functioning. [1].

3. ULTRASONIC TESTING EXAMPLE

Figure1 represents the brake of the drum hoist 2T3000X1500 and figure 2 its components. This is a brake shoes with two pneumatically operated.

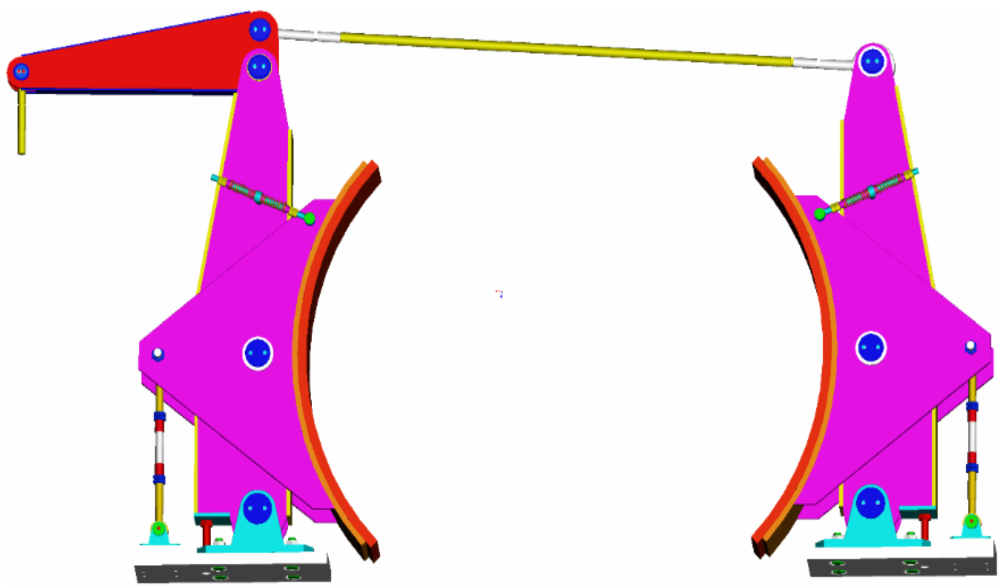

Fig. 1. The brake of the drum hoist 2T3000X1500 [5]

The mining drum hoist 2T3000X1500 is equipped with two independent braking devices, with parallel alignment.

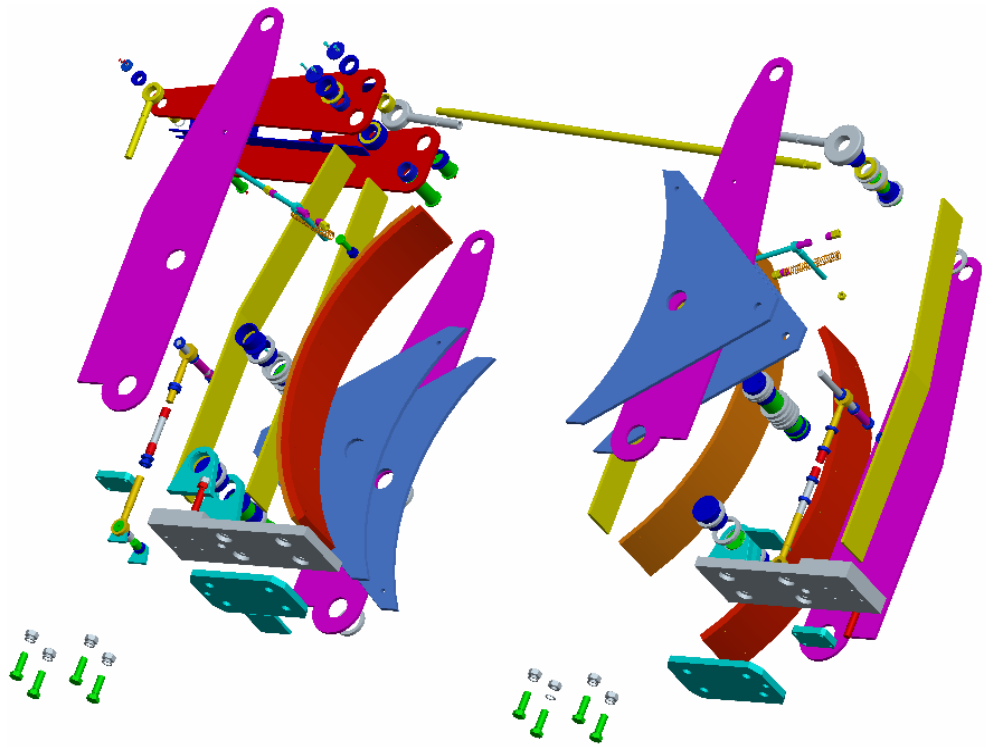

Fig. 2. The components of the braking system for the drum hoist 2T3000X1500 [3]

All brake components components or assemblies are dismounted according to drawing in Figure 3 and cleaned.

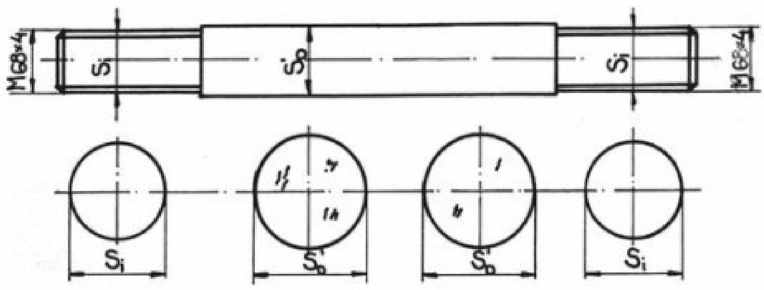

Fig. 3. Shaft

The brake components will be tested as follows:

- for components with simple geometry parts we using ultrasonic testing;
- for components with complex geometric we using electromagnetic testing.

The device used for testing:

- ultrasonic fault detector;
- normal and inclined feelers – ORION frequency 2,4 MHz;

- coupler vaseline, oil,

present a way for non-destructive testing results interpretation shaft shown in figure 3.

As a result of the control performed, small structural faults has been observed in the horizontal bar (pore groups) considered at about 10% of the total surface, faults that penetrate to the surface.

The test shaft has the diameter of d = 70 mm threaded endings M68×4, undergoing a tractive force of 1800 kgf.

The bellow are known:

- the material of the shaft is 1 C 45, for which σ_r = 5400 kgf/cm^2; after 15 years of functioning σ_{-1} = 3000 kgf/cm^2;
- the maximum force in the bar S_1 = 1800 kgf.

Under these conditions the effective effort and the safety under stress coefficient are to be determined for real conditions.

Resolution:

The transverse surface in section d=70 mm:

$$S_0 = 0{,}785 \cdot d^2 = 0{,}785 \cdot 7^2 = 38{,}465 \text{ cm}^2 \quad (1)$$

The transverse surface in section d=70 mm, considering the structural faults:

$$S_0^{'} = S - 0{,}1 \cdot S_0 = 34{,}615 \text{ cm}^2 \quad (2)$$

The minimal surface of the bar in the corresponding thread diameter section:

$$S_i = 0{,}785 \cdot d_i^2 = 30{,}66 \text{ cm}^2 \quad (3)$$

The effective tractive effort in the thread area considering the material stress:

$$\sigma_{-1tr.filet} \cong \frac{S_1}{S_i} \cong \frac{18000}{30{,}66} \cong 587 \text{ kgf/cm}^2 \quad (4)$$

The effective tractive effort in the central area containing structural faults:

$$\sigma_{-1tr.centr.} \cong \frac{S_1}{S_0^{'}} = \frac{18000}{34{,}615} \cong 520 \text{ kgf/cm}^2 \quad (5)$$

The safety coefficients under stress:

$$C_{sfilet} \cong \frac{\sigma_{-1}}{\sigma_{-1filet}} \cong \frac{3000}{587} \cong 5{,}11 \quad (6)$$

$$C_{scentr} \cong \frac{\sigma_{-1}}{\sigma_{-1tr.centr.}} \cong \frac{3000}{520} \cong 5{,}77 \quad (7)$$

4. CONCLUSIONS

As the mining drum hoist is equipped with two independent braking devices, with parallel alignment, one for each drum, we can consider that safety coefficients value for traction under stress are adequate as the minimum safety coefficient, under stress, in the mentioned case is minimum 4. In conclusion relating shaft checked for in paragraph 3, it can still be used.

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