# Research on profile aging from the supporting structure of ERC 1400 excavators from coal pits

**M. Truşculescu[1], D. R. Pascu[2], R. A. Roşu[2], I. Cireş[3]**

[1]Politehnica University of Timişoara, [2]National R&D Institute for Welding and Material Testing - ISIM Timişoara, [3]PROATLAS Timişoara, Romania
*E-mail: rpascu@isim.ro*

## Keywords

Structural examinations, mechanical tests, supporting structure, excavator, aging tendency, fragile breakings

## 1. Introduction

There are made analysis and testing of the supporting structure profiles of ERC 1400-3313 excavators from Jilț Sud mining career, ERL 1400 – 3017 excavators from Berbeşti and ERC 1400-30 from Roşia [1].

There are established the steel grades used, the structure and mechanical characteristics, tendency to embrittlement of the material used in profiles manufacture. For each excavator in part there are established the possibilities to rehabilitate the bearing structure that the excavators to meet the technical parameters.

## 2. Operating data of the expertised excavators [2]

1. ERC 1400 3017-3 excavator manufactured by CIUMMR Timisoara was commissioned in August 1989 and worked 51,621 hours in Jilț career stall.

2. ERC 1400/03 excavator manufactured by Krupp firm was commissioned in February 1982 and worked 66,200 hours at Roşia career.

3. TRC IWO-30/11 excavator was manufactured by CIUMMR Timisoara, and was commissioned in November 1981 and worked 53,435 hours Berbeşti career. The excavators worked in sterile and coal.

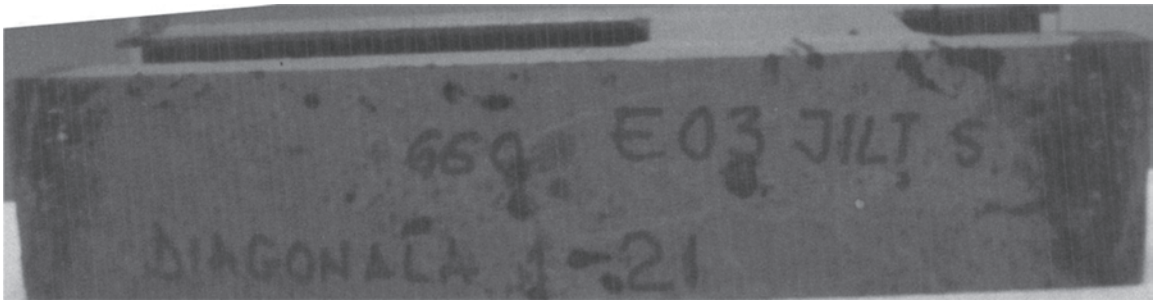


Figure 1. U140 profile, Jilț


Figure 2. L profile, (60x8mm), Roşia


Figure 3. L profile (60x8mm) Berbeşti

From the critical areas of the bearing structure of excavators were taken profiles shown in Figures 1, 2, and 3.

## 3. Analysis examinations and tests

### 3.1. Analysis of chemical composition

Compositional state was determined by spectral analysis and the results are shown in Table 1.

Table 1. Chemical compositions of steels

| Profile | Chemical compositions | | | | | |
|---|---|---|---|---|---|---|
| | C | Mn | Si | P | S | Residual |
| U 140 Jilț | 0.567 | 0.40 | 0.01 | 0.021 | 0.010 | Cr, Ni, Mo, Cu, Al |
| L60x8 Roşia | 0.049 | 0.35 | 0.09 | 0.010 | 0.010 | Cr, Ni, Cu, Al |
| L60x8 Berbeşti | 0.124 | 0.49 | 0.24 | 0.010 | 0.02 | Cr, Ni, Cu, Al |

U-140 profile was made from OLC10 STAS 880-80 steel (C10 W 10301), L60x8 profile from Roşia from OLC10 (C10W10301) steel and L6x8 profile from Berbeşti was made from OL37-3K steel STAS 500/2-88.

### 3.2. Microscopic examination

The microstructure of samples taken from the profiles was determined according to SR EN 5000-97 and SR 693:2003 (Nital 2%) and are presented in Table 2.

Table 2. Structural characteristics of profile

| Profile | Structural characteristic and symbols | | | | No. figure |
|---|---|---|---|---|---|
| | Ferrite | Pearlite | Structural defects | Grain size | |
| U 140 Jilț | X | X | No cracks | ~ 7 | 4 |
| L60x8 Roşia | X | X | No cracks | ~ 7 | 4 |
| L60x8 Berbeşti | X | X | No cracks | 6 ... 7 | 5 |

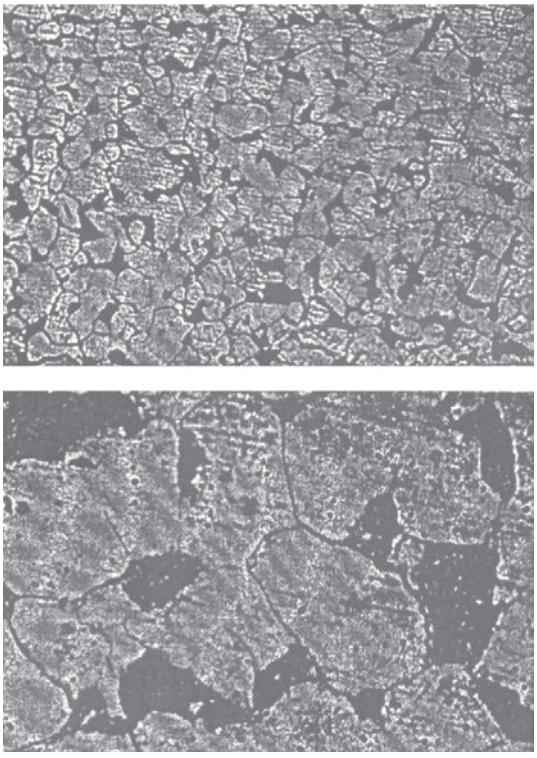

Figure 4. Jilț and Roşia profiles microstructures

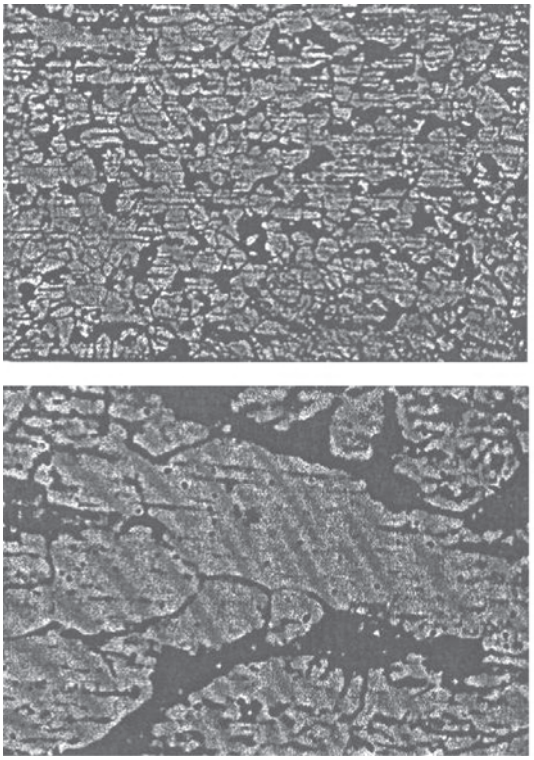

Figure 5. Berbeşti profile microstructure

### 3.3. Tensile tests

Mechanical characteristics of resistance ($Rp_{0,2}$, Rm) and deformability (A and Z) determined according to EN 895:1997 and EN 10002-1:2002 are indicated in Table 3.

Table 3. Mechanical characteristics of steels

| Profile | | Mechanical characteristic | | | |
|---|---|---|---|---|---|
| | | $Rp_{0,2}$ [N/mm²] | Rm [N/mm²] | A5 [%] | Z [%] |
| U140 Jilț | L | 279 | 402 | 39 | 65 |
| | T | 250 | 425 | 32 | 54 |
| L60x8 Roşia | L | 290 | 418 | 36 | 66 |
| | T | 277 | 411 | 31 | 62 |
| L60x8 Berbeşti | L | 321 | 456 | 39 | 64 |
| | T | 317 | 448 | 37 | 56 |

Mechanical characteristics values determined are specific to the non-alloyed steel from the excavators profiles construction investigated (OLC10 and OL373K)

3.4. Toughness and sensitivity to aging of the examined profiles [4, 5]

Toughness profiles expressed by breaking energy was determined by bending test using prismatic specimens at the testing temperatures of 20°C and -20°C. The experimental results are given in Table 4.

The tendency to aging of the examined steels, $\Delta KV_{îmb}$ is calculated with the relationship:

$$\Delta KV_{imb} = \frac{KV_i - KV_j}{KV_i} \bullet 100\ [\%] \quad (1)$$

where: - $KV_i$ is the breaking energy in actual state
- $KV_j$ is the breaking energy aged state ( plastically deformed with 7% and heat treated at 250°C, one hour)

Table 4. Breacking energy KV of profiles

| Profiles | | $KV_i$ [J] native | | $KV_i$ [J] aged | |
|---|---|---|---|---|---|
| | | +20°C | -20°C | +20 | -20 |
| U140 Jilț | L | 44 | 14 | 6 | 4 |
| | T | 21 | 8 | 3 | 3 |
| L60x8 Roşia | L | 59 | 27 | 38 | 3 |
| | T | 49 | 15 | 3 | 3 |
| L60x8 Berbeşti | L | 61 | 20 | 28 | 6 |
| | T | 58 | 14 | 23 | 4 |

The experimental results are presented in table 5.

Table 5. Embrittlement tendency of profiles

| Profile | $\Delta KV_{imb}$ [%] | | Limit ($\Delta KV_{imb} \geq 50\%$) |
|---|---|---|---|
| | + 20 | - 20 | |
| UMP Jilț L | 86 | 71 | Embrittlement tendency to negative and positive temperatures |
| L60x80 Roşia L | 64 | 80 | Embrittlement tendency to positive and negative temperatures |
| L60x80 Berbeşti L | 55 | 70 | Embrittlement tendency to negative and positive temperatures |

## 4. Conclusions

4.1 Profiles excavators expertise from Jilt, Roşia and Berbeşti careers stall, are made of OLC10 STAS 880-80 and OL37-3K STAS 500/2-88 steels.

4.2 The characteristic structures of the construction steel profiles are ferrite-pearlite and no manufacturing defects were observed (cracks, etc.).

4.3 The mechanical characteristics of strength and deformability determined by specific tests are specific to non alloy steels OLC10 and OL37-3k.

4.4 The trend of steels aging of the examined steels is high both at positive temperatures (+20°C) and the negative (-20°C).

4.5 Finally, it is considered that the operation of the profile investigated excavators is strongly influenced by the working conditions and may occur fragile breaking of the bearing structure. It is recommended the restoration of the steel bearing structure from new OLC10 and OL37-3K steels.

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