

## BREAKING SYSTEM INNOVATION OF HOISTING MACHINE IN CZECH REPUBLIC

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**ABSTRACT.** Underground mining of minerals and the consecutive vertical transport are high level Czech Republic. The up-to-date pieces of knowledge of the science and research for technical innovations including the operation use are utilized.

### ИНОВАЦИЯ НА СПИРАЧНАТА СИСТЕМА НА ПОДЕМНА МАШИНА В РЕПУБЛИКА ЧЕХИЯ

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**РЕЗЮМЕ:** Подземният добив на минерални суровини и свързания с него вертикален транспорт са на високо равнище в Република Чехия. Научно-техническият прогрес изисква прилагане на иновационни решения в установената практика от дейности.

## 1. Introduction

On OKD, a.s., mine Darkov, plant No. 3 (formerly the plant 9. mai) is operating the hoisting machine, marked Su-Sto III (formerly PG III). This installation is working under the following parameters:

- a) double-acting cage
- b) mining depth ... 783 m  
(9th floor)
- c) hoisting machine type ... 2B4516
- d) drive ... power  
thyristors
- e) power ... 1000 kW
- f) loading mining = 5t 40 passengers from 40  
to 87.5 kg = 3.5 t
- g) speed of mining and of transport 6 m/s
- h) mining cables ... 2x ø40mm  
PN 22-286.57
- i) 2x shoe brakes and 2x braking machines BV48  
(ŠKODA Plzeň)

## 2. Innovation requirements

2.1. The hoisting machine has passed the former modernization, i. e. the exchange of asynchronous drive (ŠKODA Plzeň). The present innovation has been carried out by INCO engineering, Ltd., i.e. double drum hoisting engine with drum of 4.5 m diameter and of width 1.6 m, which is driven by electric engine of 1MW power, supplied by the

2.2 With regards to the necessity to preserve the safe operation of hoisting machine for next 20 years, it has been decided to modernize the breaking system. In addition to that on the jaw's breaks (the delivery of Škoda Plzeň) the fatigue crack has been revealed (on the front jaw), which has been immediately repaired by stiffening of the jaw (the repair has been done by company Hudeczek, Ltd.) Leadership of Darkov mine has organized the selection treatment (draft) for the innovation of break system, and this project has been won by the company BASTRO, J. S. C. In the year 2006 has been signed the agreement. The modernization consisted of following points (from the drawing No. 8209 0360.00)

- a) Manufacture of 4 pcs jaw's – Drowing No. 8209 0361.00
- b) Manufacture of the wooden brake lining – Dr. No. 8209 0369.00
- c) Manufacture of 18 pcs pins
- d) Manufacture of 10 pcs of casings
- e) Delivery of 4 pcs of Teflon casings for the lower pins
- f) Delivery of brake lining – Dr. No. 8209 370.00
- g) Transregulation of stands and pull rods
- h) Dismounting the present brake jaws
  - i) Mounting the wooden brake lining
  - j) Finishing the flanges
  - k) Mounting the jaws
  - l) Fitting the wooden brake lining
  - m) Mounting the brake lining and brakes
  - n) Adjustment, the partial tests with the graphical storage, the pilot operation

For all the new pins, casings and the pull rods of jaws we have used the steel 14220.3 (55SiCr6.4) and in final state

tyristor transducer with the controller ČKD 2300.

The continuous operation of hoisting machine was agreed by the director of mine on the 20 May 1991, the permanent operation of container for long products on the 20. 11. 1992. Passenger transport has started on 28. 5. 1991 by the decision OBU No.3253/1991. Further, three-years revisions of hoisting machines have been organized according to ČBÚ No.12/1982.

and the brake has to show at the highest static strength the 7 section (16). It is valid that the safety measures are strong times higher tensile strength value.

In the previous Digest No. 12/1982 the safety has been quoted as at least 5. To hold the specific strength and weight parameters, it has been necessary to use the imported steel material StE 690V (according to DIN) or S690QL (according to EU Standards).

**Table I Mechanical properties of the steel materials**

Plate thickness (mm)	Yield stress (MPa)	Tensile strength (MPa)	Ductility A5 (%)
<63	>690	760 – 940	>15
>63	>620	690 – 900	>14

The delivered 20 and 40 mm plates were always provided by the atest of the producer. At the manufacture we have verified the strength values by measuring the hardness by the Equotip 2 device (measuring the hardness and calculation of tensile strength).

the steel 14220.4 (Q+T) with the resulting values  $Re = 600$  MPa and  $Rm = (750 - 900)$  MPa).

To keep the values of static and dynamic friction parameters on the same level we have designed the change from up to now used lining YU555 to the lining COSID C190 (see Table II).

The welding has been carried out in the workshop OKD BASTRO, a.s. in the protection atmosphere at the accuracy according to EN ISO 13920 using the welding rod material OK AUTROD 13 – 19 (12 – 64). After the welding the whole steel structure was stress relieved. The list in the Table III summarizes the disassembly and assembly works.

- o) Transport of deliveries
- p) Technical documentation

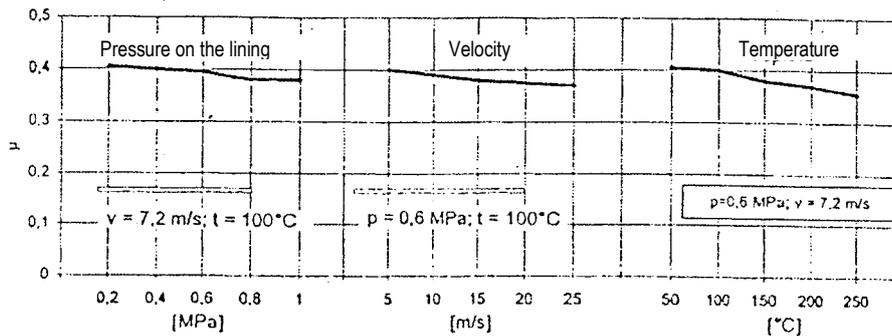
In the cooperation with OKD BASTRO, a.s. we have worked out the complete technical documentation, respecting already the Czech Law (Public notice No. 415/2003 of the Digest). From this title it has been necessary to accept the new measures in the production of new jaws (4 pcs).

For the construction and the production of new brake jaws we were not able to use the material 11523 (St52) and 11453 (St45) regarding the new Digest § 22 – brakes,

**Table II + Material list**

Product	No asbest brake lining
Material	Special textile of fibrous character, resisting the see water
Use	At the ship construction, in the logistic, also in underground mining
Properties	Material with the flexibility useable with no regards to radius and angle of lining

Dependence of the coefficient of friction on the pressure on the lining, velocity and temperature



**Table III – The exchange of breaking jaws in the Unit No. 3, Mine Darkov**

Activity	1.day,		2.day		3.day		4.day		5.day	
Disassembly of the present breaking system	X	X								
Assembly of the new break jaws		X	X							
Tuning of breaking mechanism			X	X						
Welding the rasps on the left and the right breaking ring to rasp the back jaws				X						
Rasping the left back jaws				X	X					
Grinding down the rasps					X					
Welding the rasps on the left and the right breaking ring rings to rasp the front jaws					X					
Rasping the left front faws				X	X					
Disassembly of jaws					X	X				
Grinding down the rasps					X					
Co-drilling the ferrodo and the wooden lining						X	X			
Sticking the ferrodo and screwing it by screws							X	X		
Assembly of the jaws and the breaking mechanism, bringing the system to broken state								X	X	
Age hardening of the epoxy resin								X	X	X
Cleaning the breaking ring of the sticking stuff										X
Adjustment of the breaking mechanism										X
Proof testing of breaks										X

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