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**Testing of used cableway components before re-installing these railways**

**Abstract:** The article concerns the the problem of research and evaluation of the results of these tests components and mechanical assemblies used ropeway imported into Polish. The requirements regarding research and evaluation and general technical requirements in relation to the selected assemblies ropeway. As an example, we presented research carried out at the Department of Rope Transport University of Science and Technology in Cracow and also carried out repair and regeneration assemblies ropeway by Mostostal Zabrze Realizations Industrial S. A. Department of Silesia in Katowice Factory in Czechowice (formerly Department Assembly - Production "Czechowice").

**Keywords:** diagnostics, visual testing, non destructive testing (NDT), drives testing, grips.

**Introduction**

Private owners of small ski-tour operators continue to be interested in purchasing previously used cableways for re-installation. This applies mainly to cableways with four-seater unchecked chairs previously operated in Austria, Italy or Switzerland, normally produced before the entry into force of Directive 2000/9 / EC of the European Parliament and of the Council of 20 March 2000 relating to cableway installations intended for carriage people.

Having determined that these installations are generally in good technical condition and that the financial conditions correspond to the potential investor, they should be subjected to a rigorous testing, renewal, repair or modernization procedure after they have been brought to Poland.

In many cases, the dismantling of these trains at large ski stations was due to their too low capacity and the need to replace them with the new generation of vehicles with towed vehicles.

These modern trains meet the high demands of driving comfort, passenger safety, and high transport capacity.

The main factor determining the profitability of using the cableway used is its cost constituting about 40-50% of the value of the new railway. Under Polish conditions for many investors, this is decisive.

### **Formal requirements**

The Transport Technical Supervision (TDT) sets detailed technical conditions for the re-assembly of a particular railway in Poland. Mostostal Zabrze Industrial Repossessions S.A. Silesian Branch in Katowice The Czechowice-Dziedzice Plant (formerly the Czechowice-Czech Republic Assembly Plant) performs this type of work on the basis of its TDT mandate. For cableways currently installed in Poland, the Regulation of the Minister of Transport of 1 June 2006 on the technical conditions for technical supervision in the field of design, manufacture, operation, repair and modernization of rope transport equipment (Journal of Laws 2006, No. 106 , p. 717), hereinafter referred to as the Regulation [8].

In addition, for all the subsystems and safety components manufactured after May 1, 2004 and forming part of the cableway installations that were installed and put into service after that date in Poland, the Ordinance of the Minister of Infrastructure of 11 December 2003 essential requirements for cableways intended for the carriage of persons (Journal of Laws 2004 No. 15, item 130) [7], introducing into Polish law Directive 2000/9 / EC of the European Parliament and of the Council of 20 March 2000 relating to for rope cable installations intended for the carriage of persons [1].

The cableways to be built in a new location may include elements from the dismantled cableway from the previous railway site, provided that the elements used in the new site are subjected to a non-destructive test (NDT) by a TDT-certified laboratory.

At present, there are no clear criteria for the transmission of cableways established at the level of European Community law.

On the other hand, electrical equipment for steering and control of the main and emergency drive, hydraulic devices in the rope tensioning system, hydraulic devices in the main and motor brake systems should meet the current requirements as for newly built equipment and must meet the essential requirements referred to in Annex II of Directive 2000/9 /IN. The requirements to be met are not less than those laid down in the harmonized standards of Directive 2000/9 / EC. Hydraulic systems in the rope tensioning system should be new and have the appropriate CE declaration.

The re-assembled technical documentation of the cableway should be agreed by the TDT and must include the following parts:

- rules of carriage of persons,
- technical regulations of the cableway,
- updated or new operating and maintenance instructions for changes due to new railway construction,
- newly prepared evacuation instructions,
- new route calculations,
- a trial and test program for the performance of the cableway test involving the TDT inspector,
- inspection certificates and non-destructive test results for railways,

- original drawings of the main rail components;
- current electrical and hydraulic diagrams used in hydraulic systems, rail traffic control and monitoring,
- technical parameters of the railway, as well as original and current calculations of the rope route,
- security analysis [1].

The security analysis should identify the occurring or predictable types of threats and provide technical means for eliminating or reducing them to acceptable levels. The stated acceptable level of risk should not be higher than would result from the use of solutions described and currently used in overhead cableways built in the EU. The installation of all elements including other equipment or equipment associated with the construction of the cableway shall be in accordance with the technical documentation approved by TDT and certified in writing by the authorized technician performing the work.

### **Scope of necessary works and activities on specific subsystems**

#### *Selection of testing elements*

Based on previous experience of the authors of the article, obtained during the construction of a dozen or so reestablished jointly with the company Mostostal Zabrze Industrial Realization S.A. Silesian Branch, Plant in Czechowice cableway. The following is an example of this type of work. The most important elements with railways having direct influence on the safety of its operation are:

- clutch and bearing elements of chairs,
- motor and main brake systems together with power supply and control unit,
- battery axles of support discs,
- ropes,
- tensioning systems for the load-bearing rope,
- support structures - support shafts, guide supports, mounting harnesses, etc.

#### *Clutches*

Clutches are one of the most responsible and relatively expensive elements of the cableway. The safety of the passengers depends on the proper operation. Therefore, they should be subject to a thorough review before being allowed to be re-used in the transferred rail. All the tests should be carried out after complete dismantling [3]. Fig. 1 shows an example of coupling with visible bends from the rope.



**1. Clutch with visible bends from the rope**

Non-destructive research of clutches and evaluation of their results shall be strictly performed according to the recommendations of the manufacturer of the railways, and if such are not according to TDT's Technical Terms. In addition to these studies, the amount of bite from the rope wires on the jaw should be determined and compare the results with the permissible values [2]. Then check the clutch force of the clutch to the rope. Figure 2 shows a study of the shear force applied to the lines.



2. Testing the clutch force on the load-bearing line

Positive evaluation of the results of the mentioned tests for slope conditions of the slope of the re-built cableway [5].

### **Hydraulic components of brakes and rope tensioning system**

Due to the physical and moral aging of the hydraulic components of power supply and control units, it is necessary to consider the complete renewal of these units using the currently manufactured components. Existing in the country, the "Brydex" company, which has been recognized by TDT, successfully performs such redevelopment, issuing this Declaration of Conformity. Figure 3 shows the cable tensioning system after reconstruction.



3. Hydraulic cable tensioning device "Słotwiny TAB" in Krynica Zdrój [6]

The use of new hydraulic components (manifolds, valves, pressure transducers, hydro-cyclones, pumps, elastic hoses, etc.) produce the units with a full guarantee of operation. Figure 4 shows the test stand for the brakes in the AGH-KTL laboratory.



4. Laboratory for testing braking systems

In each case, it is necessary to analyze the activities of these units in the context of ensuring safe operation in terms of meeting current standards.

#### **Railway propulsion power and control units**

Technological advances in electronics and electrical power make rail-delivered teams generally obsolete and may continue to work, but in the event of a failure, their repair, if technically feasible, costs disproportionately to the currently offered units.

At present, it is possible to obtain certification in the country of new components of the power supply and rail control. The authors' experience shows that, in many cases, leaving (usually still in good condition) power supply units led to failure at the least expected by the Investor.

Electric motors imported from abroad are obliged to be inspected and inspected by a professional company dealing with DC machines. Also, in this case, an external company like "Damel" was used, which properly performed the work. An example of damage to the DC motor during the inspection is shown in the figure 5.



5. View of the broken ring fixing the arms of the brush device

### **Propulsion switch**

The technical condition of the main switches of the previously operated railway depends on the number of hours that these switches worked. Specialist gearbox manufacturers use different operating times after which the gear unit must be serviced..

For example, it can be stated that the number of service hours is typically  $35,000 \div 45,000$ . Due to the provision of professional service methods (replacement of bearings, sealing, tooth wear assessment, etc.), these operations must be carried out by the manufacturer or by a specialist company dealing with switches. Any field repairs are unacceptable because of the lack of technical ability to properly repair this precision unit.

### **Ropes**

It was generally accepted that the transferred cableways would be equipped with a new load-bearing rope delivered during the construction in Poland, accompanied by a Declaration of Conformity by a manufacturer having the competence of the Transport Technical Inspection. The requirements and periods between the magnetic tests shall be adopted in accordance with the rules applicable to cableways [4].

Only in special cases, a carryinghauling rope is used for further operation. This situation can occur when the rope has been operating for a relatively short time (several years), has a well-documented history of work (manufacturer's certificates, periodic inspections) which shows that the rope is in good condition and has successfully passed the test immediately prior to reinstallation in Poland (magnetic tests, strength tests of wires unraveled from a piece of rope).

### **Summary**

The issues in the article on research, restoration, repairs, etc. chairlifts results are the authors of teenage experience in carrying out this type of work scope. The article focuses only on selected issues, as the overall scope of work leading to the re-start and safe operation of the previously used rail is much greater. After the assembly of the railroad, it should pass the pre-flood test (before TDT) according to the "Attempt and Research Program".

The decision to build a previously operated railway may be profitable for the prospective Investor only in the case of professional performance of activities which, inter alia, present this article.

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