4.2.33. QUALITY AND RELIABILITY ASSURANCE OF AEROSPACE EQUIPMENT AT OJSC "PERM ENGINE CO." BY MEANS OF NON-DESTRUCTIVE TESTING (NDT)

Bashkatov I.G., Kalinin N.P., OJSC "Perm Engine Co.", Perm, Russia

The origins of Non-Destructive Testing (NDT). The rapid development of industry and mechanical engineering in the 1st half of the 20th century made it necessary to create a totally new approach to a product quality control. Thanks to X-ray discovery and the development of magnetic powder technique there has been a quick growth of Non-Destructive Testing (NDT), especially evident in the aviation companies.

Before the Second World War, despite the lack of well-directed and integrated state policy concerning Non-Destructive Testing (NDT), OJSC "Perm Engine Co." managed to set the necessary material, organizational and technical basis for the development of Non-Destructive Testing (NDT), which met the requirements of aero-engines reliability.

Development of non-destructive X-ray diffraction method. The development of non-destructive X-ray diffraction method has been meant to achieve the following:

1. The increase in the control productivity.
2. The re-equipment of the inspection cells with the home-manufactured equipment.
3. The improvement of inspection techniques.
4. The application of modern X-ray diffraction techniques.

It was the time when the negatoscopes with the variable screen brightness were first tested and used, which allowed to view X-ray images with 1,0 – 3,5 film fogging. That gave an opportunity to reduce the number of images, necessary for the inspection of goods with a variable X-ray thickness, and to increase the defects detection.

Since 1993 there has been done a huge work on automation of X-ray images photo-processing and drying. Currently two NDT machines by AGFA have been implemented. A digital densitometer and some new models of negatoscopes made by Research Institute of Introscopy of MSIA "SPECTRUM" and ASK Rentgen have been introduced to increase the quality and productivity of X-ray control. Nowadays there's a new stage of re-equipment of X-ray cells in series production shops, that involves the replacement of old X-ray equipment for the new one (RUSLAN, EXTRAVOLT).

A very important step in NDT improvement was made in 2007 when an X-ray computing tomograph BT500 was developed by OJSC "Perm Engine Co.".

The specialists of the company believe that the most perspective tasks in the computer X-ray imaging should be the development of filmless X-ray imaging with application of phosphorus plates as well as the development of X-ray images archiving systems.

Development of magnetic powder technique. The first magnetic equipment appeared at OJSC "Perm Engine Co." in 1934. That was the vertical battery supply flaw detector (defectoscope) by "MAGNAFLUX". In 1942 the designers of OJSC "Perm Engine Co." developed the vertical defectoscope, which received DC power supply from generators. In 1945 the vertical defectoscopes began to use power from AC network by means of step-down transformers. In 1953 the specialists of the company designed a combined defectoscope ЭМ-186. It was especially useful during the inspection of small parts.

In 1958 there were introduced the machines for the magnetic control of bars and pipes up to 2 m long, when by means of a lever mechanism the parts were immersed into

a narrow long bath. In 1960 a new machine was developed equipped with changeover switches for the inspection of big circular-type parts.

In 1970 a special thyristor adapter was added to magnetic defectoscopes, which provided stability of switching off phase of the magnetizing current.

Before 1989 black magnetic powder was used with the concentration of 25 – 30 gr. per 1 l of dispersed water. Nowadays the luminescent powder is mainly used. The parts are inspected under the ultraviolet lamp.

Development of dye penetrant inspection. In 1933 a method of kerosine-chalk sampling (adopted by N.P. Bazilev from "WRIGHT" during his business trip to the USA) was already used for cast parts inspection (piston rings, etc.). Later LUM 17 (1951) was introduced as another method of cast parts control. In 1955 K-P4 and B-P4 sets of radiographic materials, used during dye penetrant method (DPM), were prepared by V.A. Yachlakov, specialist of OJSC "Perm Engine Co." The control method with the usage of the digital divider (CD 1) was introduced in 1963. In 1969 LUM 1-OB method was developed as a means of net shape casting control. It was introduced by the initiative of the Design Bureau specialists and Chief- designer P.A. Solovyev in person. LUM-BA method, used for threaded defects detection, was developed in 1977. The standard set of CM 15-B method began to be used in 1980. In 1993 FPI control by "P & W" was implemented with the use of water-washable radiographic materials.

Development, production and application of various NDT equipment. The detection of residual stresses by means of Barkhausen noise detection method.

To control the wall thickness of hollow turbine blades there has been used a special thickness meter A1212 T manufactured by Research Institute of Introscopy of MSIA "SPECTRUM".

In 1991 there was introduced a device similar to VE-37NC with a digital indication of inspection results and an independent power supply.

The widespread usage of eddy-current method in its various applications (flaw detection, structurescopy, wall thickness measuring, etc.) was mainly due to the cooperation of the company's specialists with such research institutes as Research Institute of Introscopy of MSIA "SPECTRUM", All-Russian Scientific Research Institute of Aviation Materials "VIAM", State Scientific Research Institute of Civil Aviation"GOSNIIGA", Central Institute of Aviation Motors "CIAM", etc.

A.L. Dorofeev, Russian scientist, popularizer and organizer of scientific work, has made an especially significant contribution to the development of eddy-current method.

In 1987 the first time in the history of this industry a dynamic eddy-current method was introduced with the application of a foreign defectoscope D2.831. It is used to detect fatigue cracks in the attachment holes of HPC titanium discs.

Thus, a wide and effective application of NDT during the manufacture and the operation of the aviation equipment at OJSC "Aviadvigatel" and OJSC "Perm Engine Co." ensures its high reliability and competitive ability. It is also possible thanks to an effective system of specialists' preparation and certification.

Certification of NDT specialists. According to the requirements of the branch standard OST 1.02765-96 at OJSC "Perm Engine Co." there has been introduced a certification of the NDT personnel by means of 3-level qualification system. In 2001 OJSC "Perm Engine Co." built a special examination center "AVIATEST" which was certified to carry out exams in eddy-current, magnetic, capillary, radiation and ultrasonic methods of control.

The possibility to have exams at OJSC "Perm Engine Co." has made a certification process closer to the actual working technologies. The management of OJSC "Perm Engine

Co." pays a special attention to the preparation and certification of the company's personnel. Thus, for instance, the certified specialists may have up to 16% salary increments.