# POSSIBILITIES OF RADIOGRAPHIC IMAGE DIGITALIZATION IN BELLOWS PRODUCTION

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## ABSTRACT

*Bellow is one of the most sensitive parts of pipelines since its parts are much thinner than pipelines which are built in (but bellow has to endure the same temperature and pressure as the pipeline). The topic of this paper is the analysis of defects of welded joints in the production of bellows using digitalization of radiographic films for better analysis and archivation. In this paper test of quality of digitalized radiographic films with the help of digital camera and scanner is shown.*

## KEYWORDS

non-destructive testing, radiography, digitalization

## INTRODUCTION

Bellow is a part of pipelines which has one or more metal waves, which are used for compensation of dimensional changes in pipelines caused by temperature or pressure (Figure 1). [1]

Figure 1. Bellow production in ĐĐ Kompenzatori d.o.o. factory

Radiography is used to detect defects in welded piece. The advantage of this method is that there is no destruction of welded piece, and it can be used during exploitation. The principle of this testing method is based on changing the intensity of ionizing radiation through the material. The results of these changes are visible on radiographic films. If there is a volume defect on the radiographic film, the difference will be visible. [2,3,4]

## PROCEDURE OF RADIOGRAPHY CONTROL IN BELLOW PRODUCTION

In bellow production radiography control has the big role. The purpose of radiographic testing is to determine the quality of welded piece.

The quality of welded piece is defined in the request of contract between producer and customer. Radiography is applied on all longitudinal butt welded joint of 0,13 – 1,6 mm thickness (stainless steel), and carbon steels. Radiography tests of longitudinal welds in bellow production are performed before its deformation.

In factory ĐĐ "Kompenzatori d.o.o." radiographic records are kept for 5 years, and annual production now demands 2000 records which are archived and used in this period. Digitalization of these records would be easier to save the recordings and the reuse of it.

The high criteria of welded pieces acceptability (i.e. dimensions of acceptable inclusions is less then 10% of base metal thickness), and very small dimensions of welded piece and thickness of basic material makes the demands for detection of weld defects very high. So, digitalization of films would help the analysis and detection of weld defects as it would enable the enlarged representation of welded piece radiographic film.

In practical part of the paper two methods of digitalization of radiographic films will be compared (digital camera and scanner) in two types of characteristic weld defects (weld porosity and incomplete penetration).

## DIGITALIZATION OF RADIOGRAPHIC FILMS WITH DIGITAL CAMERA

For digitalization of radiographic films with digital camera, CANON digital camera EOS 400D, 10,1 megapixel, EF – S 18 – 55 KIT, with a flashlight CANON 430 FX was used. In figure 2 and 3 the records of radiographic films with porosity and incomplete penetration by this method are shown.

Figure 2. Radiographic film of welded joint with porosity (recorded by digital camera)


Figure 3. Radiographic film of welded joint with incomplete penetration (recorded by digital camera)

## DIGITALIZATION OF RADIOGRAPHIC FILMS WITH SCANNERS

Two scanners are used for digitalization of radiographic films:

- MICROTEC SCANMACKER 9600 XL
- HP SCANJET 5500c.

## SCANNING WITH MICROTEC SCANMAKER 9600 XL SCANNER

First, for scanning radiographic films MICROTEC SCANMAKER 9600 XL scanner is used. Characteristic of that scanner is that it can scan an A3 paper size.

Parameters of scanning:

- resolution 5100×7014,
- image type JPG ,
- the size of file is 1,3 MB (figure 4) and 1,5 MB (figure 5).

In figures 4 and 5 radiographic films with porosity and incomplete penetration scanned with MICROTEC SCANMAKER 9600 XL scanner are shown.

Figure 4. Example of scanned radiographic film with weld porosity (MICROTEC SCANMAKER 9600 XL)

Figure 5. Example of scanned radiographic film with incomplete penetration of weld joint (MICROTEC SCANMAKER 9600 XL)

## SCANNING WITH HP SCANJET 5500 C SCANNER

Selected films are digitalized using HP SCANJET 5500 c scanner with transparent materials adapter (TMA) [5]. Parameters of scanning:

- resolution 2400 dpi,
- image type JPG,
- the size of file is 1,5 MB (figure 6), the size of picture is 1,6 MB (figure 7).

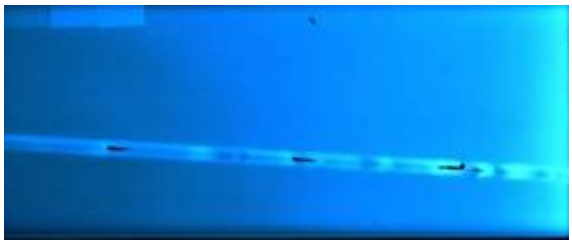


Figure 6. Example of scanned radiographic film with weld porosity (HP SCANJET 5500c)

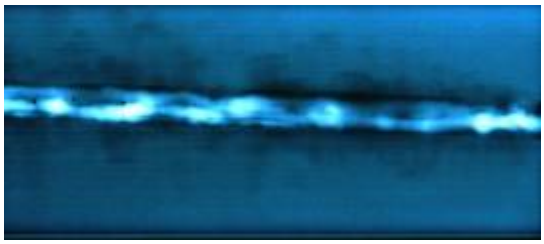


Figure 7. Example of scanned radiographic film with incomplete penetration of weld joint (HP SCANJET 5500 c)

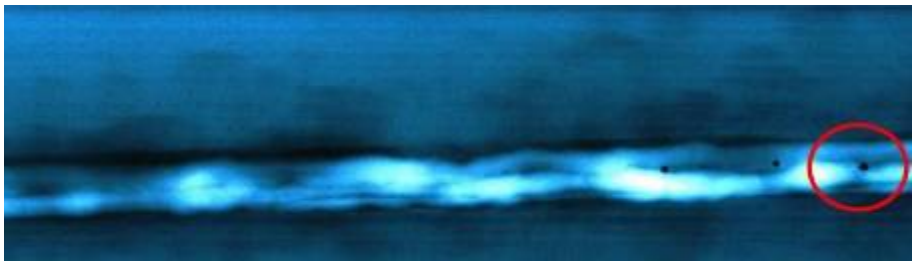
## ANALYSIS OF RESULTS

The comparison of these two methods of radiographic films digitalization shows that necessary time for digitalization is much shorter when digital camera is used. For scanning of films more time is necessary, because HP SCANJET 5500 c has to use transparent materials adapter (TMA) [5], which limits the size of the scanning area of radiographic film to 153×44 mm so it is not able to scan the whole radiogram at once.

On figure 8 the comparison of digitalization results for zoomed detail of welded piece with defect (porosity in weld joint) are shown. It is noticeable that the quality of picture is the best when the digital camera CANON EOS 400 D, with resolution 3888×2592 pixels is used.

CANON EOS 400 D

MICROTEC SCANMAKER 9000 XL



HP SCANJET 5500 c

Figure 8. Comparison of radiographic films digitalization results for weld joint with porosity in weld metal

## CONCLUSION

In practice, the highest speed and quality of digitalization of radiographic films with useable size of the file is demanded, and the best method for now, is by digital camera with the tripod and good lightning. The use of scanner is much slower, but with high resolution, this method also insures a good quality of digitalized shooting.

In further investigation, the development of system for archiving and automatically detection of weld defects on radiographic films during the control of quality is planned. The main purpose of this system will be to assist in the detection and classification of errors on welded pieces.

## LITERATURE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