

Smiths-Heimann
Im Herzen 4

65205 Wiesbaden

Kompetenz.
Sicherheit.
Qualität.

A. TECHNICAL REPORT abridged version

Influence on films by X-ray inspection units and accelerators
for object detection

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Supervising specialist: Dipl.-Phys. Dr. J. Schrauf
Dipl. Ing. A. Kling

B. General information

Name and address of
client: Smiths-Heimann
Im Herzen 4
65205 Wiesbaden

Address of inspection place: site of client in:
1) Wiesbaden-Nordenstadt, Siemensstraße
2) Wiesbaden-Erbenheim, Borsigstraße

Details on the tests given by: Mrs. Freischlader,
Messrs. Geus, Hager, Kirsten, Studer

On-site inspections: 04/23, 07/07, 08/24, 09/7, 09/23, 10/14,
11/08 2004

C. Description of task setting

Various films are to be checked for visible modifications after being exposed to X-rays in an X-ray inspection unit or accelerator.

Irradiation shall take place under realistic conditions (films together with scattering body pass through a unit under standard operating conditions).

Commercial slide films of high sensitivity from various manufacturers as well as medical and technical X-ray films are to be examined.

The examination of negative films (prints) will not be carried out, because the use of slide films includes their testing. Also the influence of print making on the interpretation of the results shall be avoided.

D. Description of the X-ray inspection units

The test series were carried out with five different X-ray inspection units which are being used at airports for baggage inspections and with an accelerator unit used at border controls.

E. Description of the films

Very sensitive or commercial films, respectively, were applied.

(1) Slide films:

- Fuji Provia 100 und 400
- Kodak Elite 400 und Kodak 1600

(2) Medical X-ray films (used in human medicine and dentistry):

- Valmex VA 990 G-T
- TIAG EMO 200x (equals Typon)
- Kodak Dental Tubus Filme Insight und Ultraspeed

(3) Industrial X-ray film (films for material detection):

- Fujifilm Envelopak, Ix 80 + Pb(0,027mm), 6x10cm, 2005-4, EmNr. 82213E
- Fujifilm Ix Industrial, Envelopak 80, 6x47,5cm (without Pb)

F. Description of test set-up installation and testing method

(1) In X-ray inspection units:

The slide films (film rolls) and films for material detection (single packed) were marked and, placed in random order in a cardboard box together with a sample scattering body, then conveyed one, five and twenty times respectively through an X-ray inspection unit. For the purpose of comparison, one film each of the same type was not irradiated.

The test series paid attention to considering the following real-life scenarios:

- A "tourist" travels with unexposed films, exposes them at his resort and is inspected during his return (the films are X-rayed after exposure).
- A tourist is inspected before his journey and exposes his films afterwards (the films are X-rayed at first and then exposed).

The medical films were single packed, positioned in the centre of the respective scattering body and irradiated as the rest of the films.

Hence, the irradiation meets the conditions of a standard scanning process in a baggage or freight control as applied in reality and differs from a static irradiation.

To determine the optically perceptible modifications a film undergoes in an X-ray inspection unit as of what number of passes an influence is perceptible with the naked eye, an additional measurement series was established. For that reason, slide films (Fuji 400 ASA) were irradiated 20, 30, 40, 50, 75 and 150 times together with a hard-top case (including three layers of soft synthetics) in the EDtS unit mentioned above (140 kV, 5 mA; highest internal dose of the applied X-ray inspection units).

G. Description of film development and evaluation

All films were developed where it is usually done in reality (specialized laboratory, hospital, dentist, material detection institute) to have a realistic reference.

The slide films were evenly exposed by a professional photographer by means of a grey chart and a chromatic diagram. After development the films were measured by a transmitted light densitometer (X-Rite 820). For the colour slides the red, green and blue values were determined separately. For the black-and-white films and the negative films respectively the grey scale values were determined.

In order to exclude the influence on the position of the slide on the film roll, takings were made in the front end, in the middle and as well in the end of the film.

The black-and-white films were developed within four passes with five films each in one single capsule to create very constant influences on the films.

The colour films were developed in two different laboratories in order to detect differences caused by the development.

Besides the density measure values a contrast and black measurement was carried out which is to show the influence of radiation on unexposed film material and a possible contrast shift respectively.

The medical large X-ray films were developed in a radiological department of a hospital nearby and the dental films at a dentist's surgery by means of devices being in use there. Evaluation was carried out by means of a densitometer which is usually employed at expert tests.

The films for material detection were single packed by the manufactureres. They were developed and densitometrically measured by a service provider who has experience with such kind of films.

H. Conclusion

Standard slide films:

There is no significant influence on the film quality even at 20 X-ray inspections. The influence on the film material being observed at 50 X-ray inspections is within the usual tolerance and correction values of the development machines so that an irradiation with one of the mentioned units can be classified as completely uncritical.

It can be assumed that the number of X-ray inspections on average travels will not exceed five to ten X-ray inspections.

Medical X-ray films:

No influence can be observed so that an irradiation with one of the mentioned units is totally uncritical.

X-ray films for material detection:

An irradiation not exceeding five times is uncritical. A pre-exposure can only be observed within the test of 20 passes which seems unlikely in reality.

Eschborn, 05/13/2005

Supervising specialist:



Dr. J. Schrauf