www.foma.eu



elongated/worm
hole porosity


shrinkage
mark CD4

## FOMA NDT SYSTEM

- **X-Ray films for industrial radiography INDUX and FOMADUX**
- **Processing chemicals**

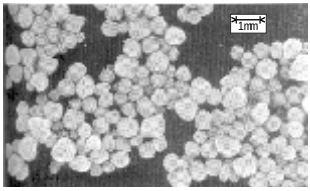
## FILMS FOR INDUSTRIAL RADIOGRAPHY

### Tradition and present

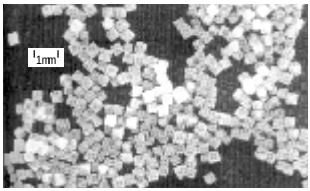
In 1986, FOMA BOHEMIA spol. s r.o. (Ltd.) began manufacturing of new generation films for non-destructive material testing (NDT) - INDUX and FOMADUX. The manufacturing of film in two speed classes, R4 and R7, began by implementing changes in the production formula of the original NDT film, which had been manufactured since the sixties.

In 1995, a radical modification of the technological process took place. The utilization of controlled precipitation resulted in uniform cubic crystals (grains) of silver halides with a narrow distribution of sizes. The composition of emulsion microcrystals and their narrow size-distribution curve has become prerequisite for high speed and contrast of the film, its high resolving power and low graininess.

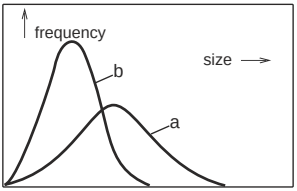
Simultaneously the processing of the industrial X-ray films has been speeded up. The controlled precipitation has become the basic precondition for the stable quality of INDUX line films.
Originally manufactured films R4 and R7 speed class were completed by R2, R3, R5 and R8 speed classes to become an integral line.




a) silver halide microcrystals in the previous emulsion




b) silver halide microcrystals in the new-type emulsion




c) comparison of size-distribution of microcrystals frequency size

### Programme of industrial radiography (FOMA NDT SYSTEM)

The FOMA NDT SYSTEM includes complete speed series of X-ray films INDUX and FOMADUX. Processing chemicals FOMADUX for manual and automatic processing and additional accessories. The wide range of speed classes enables the user to find a film suitable for practically any type of radiographic work, using X-ray appliances and radionuclides.

### Specification and use of INDUX and FOMADUX

| | | |
|---|---|---|
| **INDUX R2** | Extremely fine-grain, high-contrast, low-speed film with excellent sharpness. Designed for the detection of critical small-sized defects. | Application: Thin-walled steel parts/products, light metal parts, plastics and composite materials in machine, electrical and aircraft industries, etc. |
| **INDUX R3** | Extremely fine-grain, high-contrast, a low-speed film with excellent sharpness suitable for radiography with or without lead screens. | Components, ceramical particles, castings, nuclear components, in cosmic research, aircraft and shipping industry. |
| **INDUX R4** | A very fine-grain, high-contrast, medium-speed film designed for the detection of small critical defects. | Light metal and steel castings, aircraft industry, nuclear energetics. |
| **INDUX R5** | A fine-grain, high-contrast, standard-speed film. A standard film for most applications. | Inspection of welds and castings, general engineering, shipbuilding industry. |
| **INDUX R7** | A fine-grain, high-contrast, high-speed film for most standard applications. | Inspection of welds and castings, general engineering, building industry. |
| **INDUX R8** | A medium-grain, high-contrast, very high-speed film, designed for general use. | Inspection of thick-walled castings, building industry, inspection of concrete and heavy structures. |
| **INDUX RX8** | An extremely high X-ray sensitivity and medium contrast with a high sensitivity in the blue spectral region, primarily intended for use in combination with intensifying screens. | Useful for radiographing thick-walled products, building structures or in situations requiring a very short exposure |

**Image quality and classification of film system**

NDT films suitable for a specific type of application/work are subdivided by the EN ISO 11699-1 Standard according to minimally guaranteed parameters into six groups, denominated C1 to C6. To include a film into a group, four parameters specifying ability of the film to differenciate details in the radiograph are relevant:

– local gradient at optical density $D_{min}$ +2
– local gradient at optical density $D_{min}$ +4
– film granularity at optical density $D_{min}$ +2
– system parameter G/s, which is defined as the ratio of gradient and granularity at optical density $D_{min}$ +2, and represents the useful-to-disturbing ratio.

**Requirements of the EN 11699-1 Standard on a radiographic film system**

| Class according to EN 11699-1 | G $D_{min.}$+2 | G $D_{min.}$+4 | s | G/s |
|---|---|---|---|---|
| C1 | ‡ 4,5 | ‡ 7,5 | £ 0,018 | ‡ 300 |
| C2 | ‡ 4,3 | ‡ 7,4 | £ 0,020 | ‡ 230 |
| C3 | ‡ 4,1 | ‡ 6,8 | £ 0,023 | ‡ 180 |
| C4 | ‡ 4,1 | ‡ 6,8 | £ 0,028 | ‡ 150 |
| C5 | ‡ 3,8 | ‡ 6,4 | £ 0,032 | ‡ 120 |
| C6 | ‡ 3,5 | ‡ 5,0 | £ 0,039 | ‡ 100 |

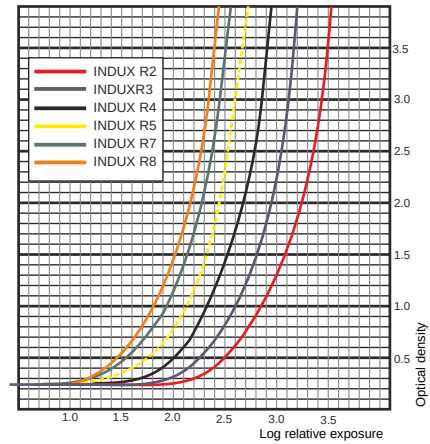
**Guaranteed parameters of INDUX line films according to EN 11699-1 and other corresponding Standards**

| Film type / Characteristic | INDUX R2 | INDUX R3 | INDUX R4 | INDUX R5 | INDUX R7 | INDUX R8 |
|---|---|---|---|---|---|---|
| EN ISO 11699-1 class | C1 | C2 | C3 | C4 | C5 | C6 |
| ASTM E1815 class | special | I. | I. | I. | II. | III. |
| JIS K 7627 | T1 | T1 | T2 | T2 | T3 | T4 |

**Characteristics curves of INDUX line films**

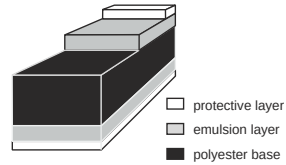
Exposure parameters
X-rays 200 kV
Cu 8 mm
Pb screens 0,025 mm

Processing parameters
FOMADUX LP-D developer
developer immersion time 2 minutes at 28°C
VSF 350 Processors



## Film composition

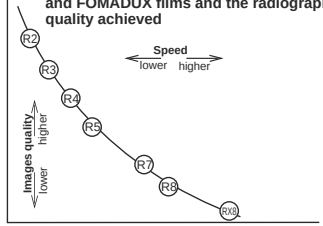
INDUX and FOMADUX films are manufactured by coating of a light-sensitive silver bromo-iodide emulsion on both sides of a bluish polyester base, that is 0,175 mm thick. The emulsion layers are protected against mechanical impacts by effective protective gelatine layers featuring anti-static properties. The sensitivity of film to visible light is reduced by means of a desensitization dye being added to the emulsion layers.




## Optimum image quality

As it is applicable to photographic materials, the same applies to films for industrial radiography, the lower the film speed, the lower granularity, and the higher the resolving power. Therefore, the correct choice of film is important in view of exposure time, size of the inspected part , and required resolution of presented defects.

**Relation between the speed of INDUX and FOMADUX films and the radiograph quality achieved**




## Packaging forms of INDUX and FOMADUX industrial X-ray films

- Daylight packaging (FOMAPAK) – one-sheet vacuum-sealed packaging with lead screens of 0,025 or 0,1 mm thickness; sizes: 6x10, 6x12, 6x16, 6x20, 6x24, 6x30, 6x40, 6x48, 10x10, 10x12, 10x16, 10x20, 10x24, 10x30, 10x40, 10x48, 18x24 and 30x40 cm. The vacuum-sealed packaging FOMAPAK ensures optimum contact of film surface with lead screens, simple handling, and is light-tight, air-tight and waterproof.
- Darkroom packaging (KB) – sizes: 6x24, 6x40, 6x48, 10x12, 10x20, 10x24, 10x40, 10x48, 10x72, 18x24, 24x30, 30x40 and 35x43 cm interleaved (IF, FW) or not interleaved (NIF).
- FOMADUX ROLLFILM – a daylight roll film packaging sized 60, 70 or 100 mm x 90 m with lead screens 0,025 mm thick or without lead screens (DW) and bare rollfilm (BLR) of length of 150 m, wound on a paper core and packed in a cardboard dispenser box.
- Packaging forms with lead screens are suitable for use with voltages above 100 kV.
- Packaging forms without lead screens are suitable for use with voltages below 100 kV.

## Sensitivity to safelight illumination

General sensitivity to visible light has been reduced in INDUX and FOMADUX films by adding a filter dye into the emulsion layers. The reduction of sensitivity to visible light does not influence the sensitivity to ionizing radiation. Therefore INDUX and FOMADUX films may be processed under brighter safelight illumination in darkroom. The danger of unwanted film fog is lower and the operator´s fatigue is limited. FOMA industrial X-ray films can be processed under indirect safelighting with a wavelength higher than 590 nm, as rendered by a dark-red or olive-green safelight filter. A diode illumination with a wavelength over 590 nm is a convenient alternative. It is advisable to test real working conditions in advance.

## Processing chemicals

INDUX and FOMADUX films are designed for manual and automatic processing with using FOMA chemicals. The liquid concentrates Fomadux LP-T developer and Fomadux Fix fixer or the powder baths Foma DP-I developer and Fomafix P-I fixer are intended for manual processing. The chemicals intended for automatic processing are supplied as liquid concentrates Fomadux LP-D developer and the fixer Fomadux Fix set including Fomafix H Hardener. The pre-exposed test film Fomatest SC 981 enables to monitor the stability of processing procedure as rendered by EN 11699. This test discovers any deviation in the quality of processing in comparison with the standard conditions and helps to determine the replacement time for the baths and make the processing procedure more cost-effective.

**Stability of the processed radiographs**
The stability of processed radiographs depends on perfect fixing and washing of film. On following prescribed processing conditions, a minimum archiving time of 10 years is quaranteed. To ensure even a longer archiving time, it is recommended to check the processing using the FOMATEST THIO test kit. Correctly processed films have a theoretical life expectancy of up to 500 years.

**Storage**
Unexposed INDUX and FOMADUX films should be stored in original intact light-tight packagings, in a dry environment, out of reach of aggressive vapours and gases, at the lowest temperature possible. An ideal storage temperature should be between 10 to 25°C and relative humidity from 40 to 60%. Long time storage at higher temperatures accelerates unwanted physical and chemical changes in the emulsion layers. Films should be stored out of reach of ionizing radiation with an intensity exceeding 100 nGy per hour.

Films stored in a refrigerator and a freezer should be acclimatized to room temperature for approx. 2 and approx. 6 hours respectively.

Exposed films should be processed as soon as possible.

**Services, consultancy, additional assortment**
FOMA BOHEMIA spol. s r.o. (Ltd.) provides its partners with a wide range of technical assistance regarding applying and correct processing of INDUX and FOMADUX NDT films.The manufacturer also offers additional accessories for the NDT sphere, such as gauges, film viewers, darkroom safelightning, densitometers, and others.

**Quality assurance programme**
INDUX and FOMADUX industrial X-ray films have been subject to continuous improvements. The objective quality checking is quaranteed by an automatic laser checking and grouping inspection equipment. Film speed parameters are tested by a special X-ray equipment and evaluated by an automatic apparatus.


ELEKTROTECHNICKÝ ZKUŠEBNÍ ÚSTAV

CERTIFICATE

EN ISO 9001:2008

FOMA BOHEMIA spol. s r.o.

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# INDUX R2

INDUSTRIAL X-RAY FILM

## General information

INDUX R2 is an industrial radiographic film intended for non-destructive material testing using X- or gamma radiation.

INDUX R2 is a low-speed, high-contrast, extremely fine-grain film with excellent sharpness suitable for radiography with or without lead screens.

INDUX R2 corresponds with the class C1 classification according to EN ISO 11699-1 standard and according to ASTME 1815 standard with class special.

## Applications

INDUX R2 is suitable for applications where extraordinary demands on the quality of radiographs are made, e.g. for the detection of critical small-sized defects in thin-walled steel parts/products, for the radiography of light metal parts/products of usual thickness, plastics and composite materials in machine, electrical and aircraft industries, etc. For the radiography of thick-walled parts/products, exposures should be prolonged accordingly.

## Packaging forms

daylight packaging (FOMAPAK) – one-sheet vacuum-sealed packaging with lead screens of 0,025 or 0,1 mm thickness

Sizes: 6x10, 6x12, 6x16, 6x20, 6x24, 6x30, 6x40, 6x48, 10x10, 10x12, 10x16, 10x20, 10x24, 10x30, 10x40, 10x48, 18x24, 30x40 cm in boxes and other sizes according to an agreement with manufacturer.

The vacuum-sealed packaging FOMAPAK ensures optimum contact of film surface with lead screens, simple handling, and is light-tight, air-tight and waterproof.

darkroom packaging (KB)

Sizes: 6x24, 6x40, 6x48, 10x12, 10x20, 10x24, 10x40, 10x48, 10x72, 18x24, 30x40 cm in boxes and other sizes according to an agreement with manufacturer.

## Film base

INDUX R2 is manufactured on a dimensionally stable bluish polyester base of 0,175 mm thickness.

## Screens

Screens-packed kinds (FOMAPAK) content lead screens 0,025 or 0,1 mm thick, backed by a paper of 70 - 90 g/sq. m of basis weight, on both film sides.

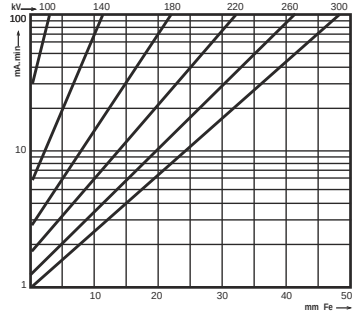
## Darkroom illumination

The film is processed at yellow safety illumination with wavelength of 590 nm and higher. Length of exposure and a distance of the processed material from the illumination source should be tested.

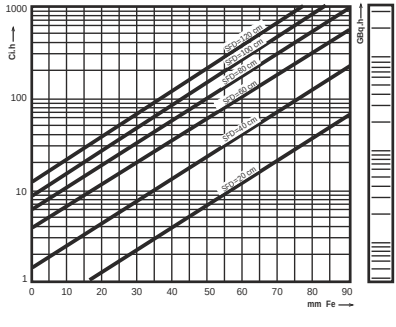
## Exposure charts for steel

For optical density D=2, front and back lead screens 0,025 mm thick, FOMADUX LP-T Developer 5 minutes at 20 °C.

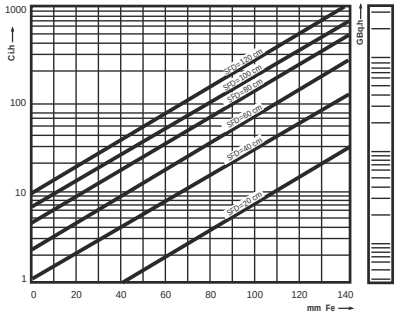
**X-rays** (FFD = 100 cm)




**Gamma rays** (Iridium 192)




**Gamma rays** (Kobalt 60)



## Processing

INDUX R2 is intended both for the manual and automatic processing.

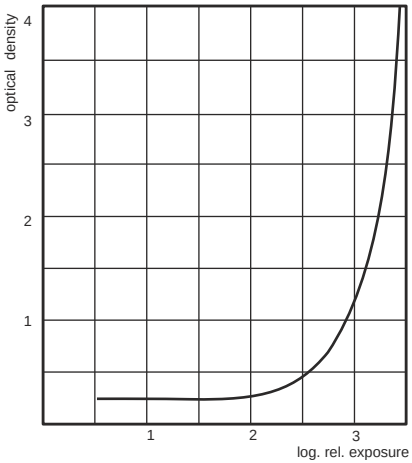
Recommended chemicals for the manual processing:
FOMADUX LP-T Developer and Developer-Replenisher
(5 minutes of developing time at 20 °C, 1 + 3)
FOMAFIX Rapid Fixer

Recommended chemicals for the automatic processing:
FOMADUX LP-D Developer-Replenisher
(120 seconds of developer immersion time at 28 °C)
FOMA LP-DS Developer Starter
FOMADUX FIX-Set Hardening Fixer – part A (fixer) + part B (hardener)

INDUX R2 can also be processed in corresponding processing chemicals of other manufacturers, for example developer Agfa G135 for automatic processing 100 seconds of developer immersion time at 28 °C or for manual processing 5 minutes of developing time at 20 °C.

## Sensitometric characterist

220 kV/10 mA/8 mm Cu, automatic processing, FOMADUX LP-D Developer, 8 minutes of processing time at 28 °C (corresponds with 120 seconds developer immersion time)




## Archiving of processed films

The manufacturer guarantees the archival permanence of minimum 50 years when complying with conditions following:
– films must be perfectly fixed and washed
– films must be stored at a relative humidity of 30 to 60% out of reach of harmful gases.

## Storage of unexposed films

Unexposed films should be stored in the vertical position in the original packaging in a dry and cool place at a temperature of 10 to 25 °C and at a relative humidity of 40 to 60 %, out of reach of harmful gases and any ionizing radiation.

After opening the film bag, you must re-close it with two folds to secure it against opening. This prevents air moisture from entering the film bag. Exposed films should be processed as soon as possible.

# INDUX R3

INDUSTRIAL X-RAY FILM

## General information

INDUX R3 is an industrial radiographic film intended for non-destructive material testing using X- or gamma radiation.

INDUX R3 is a low-speed, high-contrast, extremely fine-grain film with excellent sharpness suitable for radiography with or without lead screens.

Dimensions and speeds of inserted films according to customer's individual requirements.

Film INDUX R3 corresponds with the class C2 classification according to EN ISO 11699-1 standard and according to ASTME 1815 standard with class I.

## Applications

INDUX R3 is suitable for applications requiring exact resolution in details like inspection electronical components, ceramical particles, castings, nuclear components, in cosmic research, aircraft and shipping industry.

## Packaging forms

daylight packaging (FOMAPAK) – one-sheet vacuum-sealed packaging with lead screens of 0,025 or 0,1 mm thickness

Sizes: 6x10, 6x12, 6x16, 6x20, 6x24, 6x30, 6x40, 6x48, 10x10, 10x12, 10x16, 10x20, 10x24, 10x30, 10x40, 10x48, 18x24, 30x40 cm in boxes and other sizes according to an agreement with manufacturer.

The vacuum-sealed packaging FOMAPAK ensures optimum contact of film surface with lead screens, simple handling, and is light-tight, air-tight and waterproof.

darkroom packaging (KB)

Sizes: 6x24, 6x40, 6x48, 10x12, 10x20, 10x24, 10x40, 10x48, 10x72, 18x24, 30x40 cm in boxes and other sizes according to an agreement with manufacturer.

MultiPack – daily package containing 2 films INDUX with various speeds.

Dimensions and speeds of inserted films according to customer's individual requirements.

## Film base

INDUX R3 is manufactured on a dimensionally stable bluish polyester base of 0,175 mm thickness.

## Screens

Screens-packed kinds (FOMAPAK) content lead screens 0,025 or 0,1 mm thick, backed by a paper of 70– 90 g/sq. m of basis weight, on both film sides.

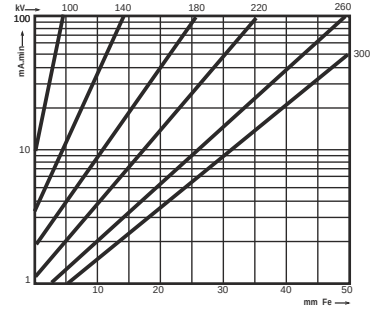
## Darkroom illumination

The film is processed at yellow safety illumination with wavelength of 590 nm and higher. Length of exposure and a distance of the processed material from the illumination source should be tested.

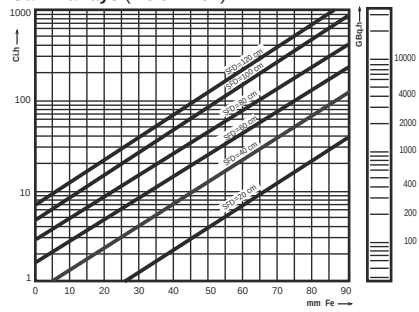
## Exposure charts for steel

For optical density D=2, front and back lead screens 0,025 mm thick, FOMADUX LP-T Developer 5 minutes at 20 °C.

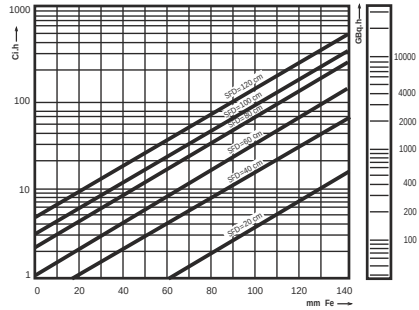
**X-rays** (FFD = 100 cm)




**Gamma rays** (Iridium 192)




**Gamma rays** (Kobalt 60)



## Processing

INDUX R3 is intended both for the manual and automatic processing.

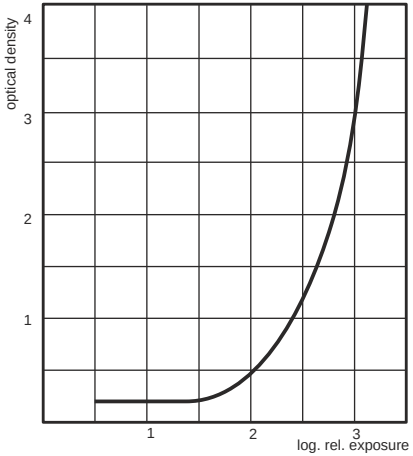
Recommended chemicals for the manual processing:
FOMADUX LP-T Developer and Developer-Replenisher
(5 minutes of developing time at 20 °C, 1 + 3)
FOMAFIX Rapid Fixer

Recommended chemicals for the automatic processing:
FOMADUX LP-D Developer-Replenisher
(120 seconds of developer immersion time at 28 °C)
FOMA LP-DS Developer Starter
FOMADUX FIX-Set Hardening Fixer – part A (fixer) + part B (hardener)

INDUX R3 can also be processed in corresponding processing chemicals of other manufacturers, for example developer Agfa G135 for automatic processing 100 seconds of developer immersion time at 28 °C or for manual processing 5 minutes of developing time at 20 °C.

## Sensitometric characterist

220 kV/10 mA/8 mm Cu, automatic processing, FOMADUX LP-D Developer, 8 minutes of processing time at 28 °C (corresponds with 120 seconds developer immersion time)




## Archiving of processed films

The manufacturer guarantees the archival permanence of minimum 50 years when complying with conditions following:
– films must be perfectly fixed and washed
– films must be stored at a relative humidity of 30 to 60% out of reach of harmful gases.

## Storage of unexposed films

Unexposed films should be stored in the vertical position in the original packaging in a dry and cool place at a temperature of 10 to 25 °C and at a relative humidity of 40 to 60 %, out of reach of harmful gases and any ionizing radiation..

After opening the film bag, you must re-close it with two folds to secure it against opening. This prevents air moisture from entering the film bag. Exposed films should be processed as soon as possible.

# INDUX R4

INDUSTRIAL X-RAY FILM

## General information

INDUX R4 is an industrial radiographic film intended for non-destructive material testing using X- or gamma radiation.

INDUX R4 is a medium-speed, high-contrast, extremely fine-grain film suitable for radiography with or without lead screens. It is an ideal film for most standard applications.

INDUX R4 corresponds with the class C3 classification according to EN ISO 11699-1 standard and according to ASTME 1815 standard with class I.

The quality of INDUX R4 films meets the requirements of BAM certification.

## Applications

INDUX R4 should be used at low voltages for the radiography of thin-to-medium thick-walled light metal parts/ products. At higher voltages the film is suitable for the testing of thick-walled light metal or thin-walled steel parts/products. With high-energy gamma rays the film is suitable for the radiography of thick-walled dense metal parts/products.

## Packaging forms

daylight packaging (FOMAPAK) – one-sheet vacuum-sealed packaging with lead screens of 0,025 or 0,1 mm thickness

Sizes: 6x10, 6x12, 6x16, 6x20, 6x24, 6x30, 6x40, 6x48, 10x10, 10x12, 10x16, 10x20, 10x24, 10x30, 10x40, 10x48, 18x24, 30x40 cm in boxes and other sizes according to an agreement with manufacturer.

The vacuum-sealed packaging FOMAPAK ensures optimum contact of film surface with lead screens, simple handling, and is light-tight, air-tight and waterproof.

darkroom packaging (KB)

Sizes: 6x24, 6x40, 6x48, 10x12, 10x20, 10x24, 10x40, 10x48, 10x72, 18x24, 30x40 cm in boxes and other sizes according to an agreement with manufacturer.

Rollfilm packaging

– rollfilm with lead screen
– rollfilm without lead screen (DW)
– bare rollfilm (BLR)

for more details see the technical data sheet of ROLLFILM

Other sizes are subject to be agreed with the manufacturer.

MultiPack – daily package containing 2 films INDUX with various speeds.

Dimensions and speeds of inserted films according to customer's individual requirements.

## Film base

INDUX R4 is manufactured on a dimensionally stable bluish polyester base of 0,175 mm thickness.

## Screens

Screens-packed kinds (FOMAPAK) content lead screens 0,025 or 0,1 mm thick, backed by a paper of 70 - 90 g/sq. m of basis weight, on both film sides.

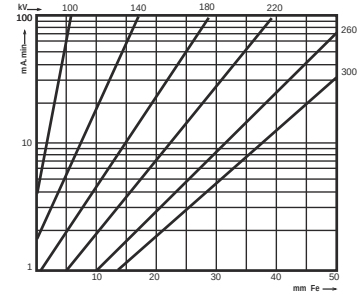
## Darkroom illumination

The film is processed at yellow safety illumination with wavelength of 590 nm and higher. Length of exposure and a distance of the processed material from the illumination source should be tested.

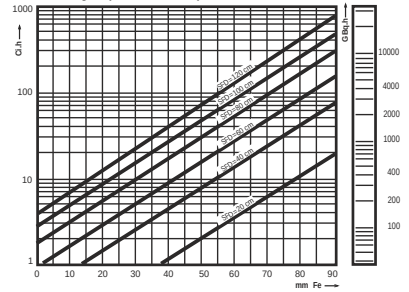
## Exposure charts for steel

For optical density D=2, front and back lead screens 0,025 mm thick, FOMADUX LP-T Developer 5 minutes at 20 °C.

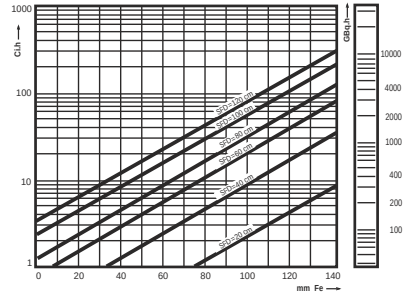
**X-rays** (FFD = 100 cm)




**Gamma rays** (Iridium 192)




**Gamma rays** (Kobalt 60)



## Processing

INDUX R4 is intended both for the manual and automatic processing.

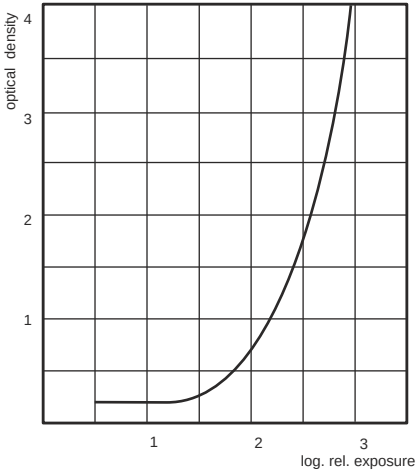
Recommended chemicals for the manual processing:
FOMADUX LP-T Developer and Developer-Replenisher
(5 minutes of developing time at 20 °C, 1 + 3)
FOMAFIX Rapid Fixer

Recommended chemicals for the automatic processing:
FOMADUX LP-D Developer-Replenisher
(120 seconds of developer immersion time at 28 °C)
FOMA LP-DS Developer Starter
FOMADUX FIX-Set Hardening Fixer – part A (fixer) + part B (hardener)

INDUX R4 can also be processed in corresponding processing chemicals of other manufacturers, for example developer Agfa G135 for automatic processing 100 seconds of developer immersion time at 28 °C or for manual processing 5 minutes of developing time at 20 °C.

## Sensitometric characterist

220 kV/10 mA/8 mm Cu, automatic processing, FOMADUX LP-D Developer, 8 minutes of processing time at 28 °C (corresponds with 120 seconds developer immersion time)




## Archiving of processed films

The manufacturer guarantees the archival permanence of minimum 50 years when complying with conditions following:
– films must be perfectly fixed and washed
– films must be stored at a relative humidity of 30 to 60% out of reach of harmful gases.

## Storage of unexposed films

Unexposed films should be stored in the vertical position in the original packaging in a dry and cool place at a temperature of 10 to 25 °C and at a relative humidity of 40 to 60 %, out of reach of harmful gases and any ionizing radiation.

After opening the film bag, you must re-close it with two folds to secure it against opening. This prevents air moisture from entering the film bag. Exposed films should be processed as soon as possible.

# INDUX R5

INDUSTRIAL X-RAY FILM

## General information

INDUX R5 is an industrial radiographic film intended for non-destructive material testing using X- or gamma radiation.

INDUX R5 is a standard-speed, high-contrast, very fine-grain film suitable for radiography with or without lead screens. It is an ideal film for most standard applications.

INDUX R5 corresponds with the class C4 classification according to EN ISO 11699-1 standard and according to ASTME 1815 standard with class I.

The quality of INDUX R5 films meets the requirements of BAM certification.

## Applications

INDUX R5 is suitable for the radiography of welds and medium-walled steel or thick-walled light metal parts/ products.

## Packaging forms

daylight packaging (FOMAPAK) – one-sheet vacuum-sealed packaging with lead screens of 0,025 or 0,1 mm thickness

Sizes: 6x10, 6x12, 6x16, 6x20, 6x24, 6x30, 6x40, 6x48, 10x10, 10x12, 10x16, 10x20, 10x24, 10x30, 10x40, 10x48, 18x24, 30x40 cm in boxes and other sizes according to an agreement with manufacturer.

The vacuum-sealed packaging FOMAPAK ensures optimum contact of film surface with lead screens, simple handling, and is light-tight, air-tight and waterproof.

darkroom packaging (KB)

Sizes: 6x24, 6x40, 6x48, 10x12, 10x20, 10x24, 10x40, 10x48, 10x72, 18x24, 30x40 cm in boxes and other sizes according to an agreement with manufacturer.

Rollfilm packaging

– rollfilm with lead screen
– rollfilm without lead screen (DW)
– bare rollfilm (BLR)

for more details see the technical data sheet of ROLLFILM

Other sizes are subject to be agreed with the manufacturer.

MultiPack – daily package containing 2 films INDUX with various speeds. Dimensions and speeds of inserted films according to customer's individual requirements.

## Film base

INDUX R5 is manufactured on a dimensionally stable bluish polyester base of 0,175 mm thickness.

## Screens

Screens-packed kinds (FOMAPAK) content lead screens 0,025 or 0,1 mm thick, backed by a paper of 70 - 90 g/sq. m of basis weight, on both film sides.

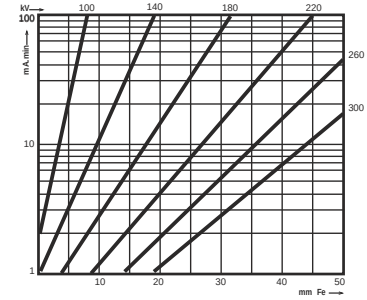
## Darkroom illumination

The film is processed at yellow safety illumination with wavelength of 590 nm and higher. Length of exposure and a distance of the processed material from the illumination source should be tested.

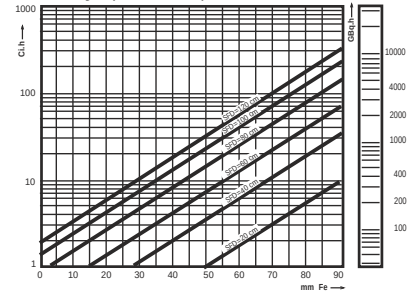
## Exposure charts for steel

For optical density D=2, front and back lead screens 0,025 mm thick, FOMADUX LP-T Developer 5 minutes at 20 °C.

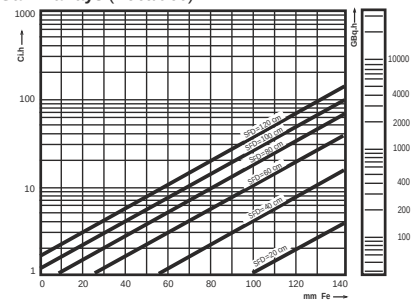
**X-rays** (FFD = 100 cm)




**Gamma rays** (Iridium 192)




**Gamma rays** (Kobalt 60)



## Processing

INDUX R5 is intended both for the manual and automatic processing.

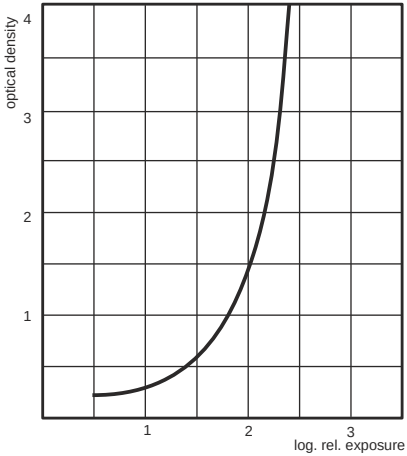
Recommended chemicals for the manual processing:
FOMADUX LP-T Developer and Developer-Replenisher
(5 minutes of developing time at 20 °C, 1 + 3)
FOMAFIX Rapid Fixer

Recommended chemicals for the automatic processing:
FOMADUX LP-D Developer-Replenisher
(120 seconds of developer immersion time at 28 °C)
FOMA LP-DS Developer Starter
FOMADUX FIX-Set Hardening Fixer – part A (fixer) + part B (hardener)

INDUX R5 can also be processed in corresponding processing chemicals of other manufacturers, for example developer Agfa G135 for automatic processing 100 seconds of developer immersion time at 28 °C or for manual processing 5 minutes of developing time at 20 °C.

## Sensitometric characteristic

220 kV/10 mA/8 mm Cu, automatic processing, FOMADUX LP-D Developer, 8 minutes of processing time at 28 °C (corresponds with 120 seconds developer immersion time)




## Archiving of processed films

The manufacturer guarantees the archival permanence of minimum 50 years when complying with conditions following:
– films must be perfectly fixed and washed
– films must be stored at a relative humidity of 30 to 60% out of reach of harmful gases.

## Storage of unexposed films

Unexposed films should be stored in the vertical position in the original packaging in a dry and cool place at a temperature of 10 to 25 °C and at a relative humidity of 40 to 60 %, out of reach of harmful gases and any ionizing radiation..

After opening the film bag, you must re-close it with two folds to secure it against opening. This prevents air moisture from entering the film bag. Exposed films should be processed as soon as possible.

# INDUX R7

INDUSTRIAL X-RAY FILM

## General information

INDUX R7 is an industrial radiographic film intended for non-destructive material testing using X- or gamma radiation.

INDUX R7 is a high-speed, high-contrast, fine-grain film suitable for radiography with or without lead screens.

INDUX R7 corresponds with the class C5 classification according to EN ISO 11699-1 standard and according to ASTM E1815 standard with class II.

The quality of INDUX R7 films meets the requirements of BAM certification.

## Applications

INDUX R7 should be used at low voltages for the radiography of medium-walled light metal or thin-walled steel parts/products. At higher voltages the film is suitable for the testing of thick-walled light metal or medium-walled steel parts/products. With high-energy gamma rays the film is suitable for the radiography of thicker-to-thickest dense metal parts/products.

## Packaging forms

daylight packaging (FOMAPAK) – one-sheet vacuum-sealed packaging with lead screens of 0,025 or 0,1 mm thickness

Sizes: 6x10, 6x12, 6x16, 6x20, 6x24, 6x30, 6x40, 6x48, 10x10, 10x12, 10x16, 10x20, 10x24, 10x30, 10x40, 10x48, 18x24, 30x40 cm in boxes and other sizes according to an agreement with manufacturer.

The vacuum-sealed packaging FOMAPAK ensures optimum contact of film surface with lead screens, simple handling, and is light-tight, air-tight and waterproof.

darkroom packaging (KB)

Sizes: 6x24, 6x40, 6x48, 10x12, 10x20, 10x24, 10x40, 10x48, 10x72, 18x24, 30x40 cm in boxes and other sizes according to an agreement with manufacturer.

Rollfilm packaging

– rollfilm with lead screen
– rollfilm without lead screen (DW)
– bare rollfilm (BLR)

for more details see the technical data sheet of ROLLFILM.

Other sizes are subject to be agreed with the manufacturer.

MultiPack – daily package containing 2 films INDUX with various speeds. Dimensions and speeds of inserted films according to customer's individual requirements.

## Film base

INDUX R7 is manufactured on a dimensionally stable bluish polyester base of 0,175 mm thickness.

## Screens

Screens-packed kinds (FOMAPAK) content lead screens 0,025 or 0,1 mm thick, backed by a paper of 70 - 90 g/sq. m of basis weight, on both film sides.

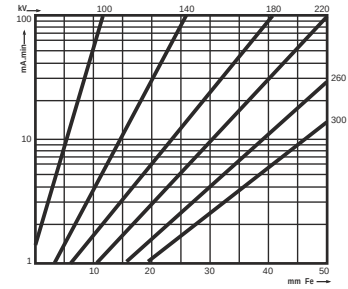
## Darkroom illumination

The film is processed at yellow safety illumination with wavelength of 590 nm and higher. Length of exposure and a distance of the processed material from the illumination source should be tested.

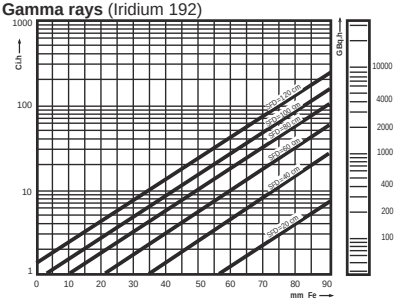
## Exposure charts for steel

For optical density D=2, front and back lead screens 0,025 mm thick, FOMADUX LP-T Developer 5 minutes at 20 °C.

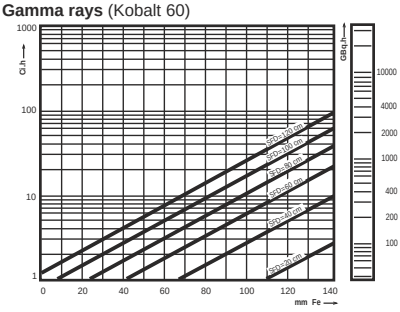
**X-rays** (FFD = 100 cm)




**Gamma rays** (Iridium 192)




**Gamma rays** (Kobalt 60)



## Processing

INDUX R7 is intended both for the manual and automatic processing.

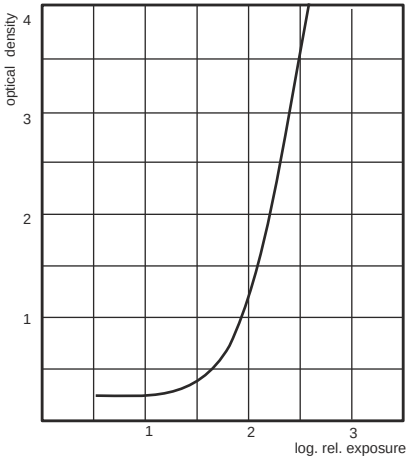
Recommended chemicals for the manual processing:
FOMADUX LP-T Developer and Developer-Replenisher
(5 minutes of developing time at 20 °C, 1 + 3)
FOMAFIX Rapid Fixer

Recommended chemicals for the automatic processing:
FOMADUX LP-D Developer-Replenisher
(120 seconds of developer immersion time at 28 °C)
FOMA LP-DS Developer Starter
FOMADUX FIX-Set Hardening Fixer – part A (fixer) + part B (hardener)

INDUX R7 can also be processed in corresponding processing chemicals of other manufacturers, for example developer Agfa G135 for automatic processing 100 seconds of developer immersion time at 28 °C or for manual processing 5 minutes of developing time at 20 °C.

## Sensitometric characteristic

220 kV/10 mA/8 mm Cu, automatic processing, FOMADUX LP-D Developer, 8 minutes of processing time at 28 °C (corresponds with 120 seconds developer immersion time)




## Archiving of processed films

The manufacturer guarantees the archival permanence of minimum 50 years when complying with conditions following:
– films must be perfectly fixed and washed
– films must be stored at a relative humidity of 30 to 60% out of reach of harmful gases.

## Storage of unexposed films

Unexposed films should be stored in the vertical position in the original packaging in a dry and cool place at a temperature of 10 to 25 °C and at a relative humidity of 40 to 60 %, out of reach of harmful gases and any ionizing radiation.

After opening the film bag, you must re-close it with two folds to secure it against opening. This prevents air moisture from entering the film bag. Exposed films should be processed as soon as possible.

# INDUX R8

INDUSTRIAL X-RAY FILM

## General information

INDUX R8 is an industrial radiographic film intended for non-destructive material testing using X- or gamma radiation.
INDUX R8 is a very high-speed, high-contrast, medium-grain film suitable for radiography with or without lead screens.
INDUX R8 corresponds with the class C6 classification according to EN ISO 11699-1 standard and according to ASTM E1815 standard with class III.

## Applications

INDUX R8 should be used for applications where the high film speed is an advantage, e.g. in the radiography of thick-walled parts/products and materials, engineering structures, etc. or when exposure times should be minimized. The usage of film in combination with fluorometalic screens results in further shortening of exposure times.

## Packaging forms

daylight packaging (FOMAPAK) – one-sheet vacuum-sealed packaging with lead screens of 0,025 or 0,1 mm thickness
Sizes: 6x10, 6x12, 6x16, 6x20, 6x24, 6x30, 6x40, 6x48, 10x10, 10x12, 10x16, 10x20, 10x24, 10x30, 10x40, 10x48, 18x24, 30x40 cm in boxes and other sizes according to an agreement with manufacturer.
The vacuum-sealed packaging FOMAPAK ensures optimum contact of film surface with lead screens, simple handling, and is light-tight, air-tight and waterproof.
darkroom packaging (KB)
Sizes: 6x24, 6x40, 6x48, 10x12, 10x20, 10x24, 10x40, 10x48, 10x72, 18x24, 30x40 cm in boxes and other sizes according to an agreement with manufacturer.
Rollfilm packaging
– rollfilm with lead screen
– rollfilm without lead screen (DW)
– bare rollfilm (BLR)
for more details see the technical data sheet of ROLLFILM.
Other sizes are subject to be agreed with the manufacturer.

## Film base

INDUX R8 is manufactured on a dimensionally stable bluish polyester base of 0,175 mm thickness.

## Screens

Screens-packed kinds (FOMAPAK) content lead screens 0,025 or 0,1 mm thick, backed by a paper of 70 - 90 g/sq. m of basis weight, on both film sides.

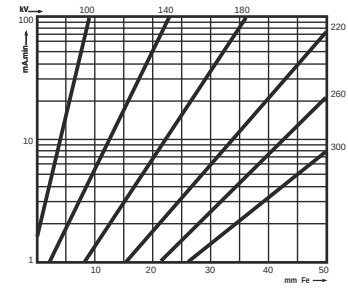
## Darkroom illumination

The film is processed at yellow safety illumination with wavelength of 590 nm and higher. Length of exposure and a distance of the processed material from the illumination source should be tested.

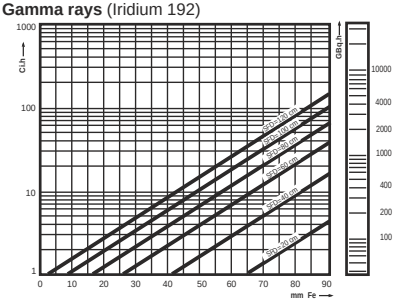
## Exposure charts for steel

For optical density D=2, front and back lead screens 0,025 mm thick, FOMADUX LP-T Developer 5 minutes at 20 °C.

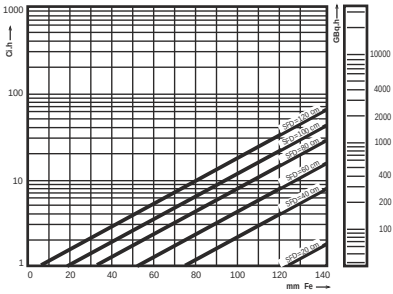
**X-rays** (FFD = 100 cm)




**Gamma rays** (Iridium 192)




**Gamma rays** (Kobalt 60)



## Processing

INDUX R8 is intended both for the manual and automatic processing.

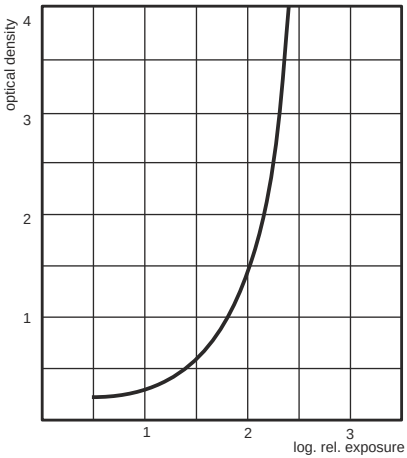
Recommended chemicals for the manual processing:
FOMADUX LP-T Developer and Developer-Replenisher
(5 minutes of developing time at 20 °C, 1 + 3)
FOMAFIX Rapid Fixer

Recommended chemicals for the automatic processing:
FOMADUX LP-D Developer-Replenisher
(120 seconds of developer immersion time at 28 °C)
FOMA LP-DS Developer Starter
FOMADUX FIX-Set Hardening Fixer – part A (fixer) + part B (hardener)

INDUX R8 can also be processed in corresponding processing chemicals of other manufacturers, for example developer Agfa G135 for automatic processing 100 seconds of developer immersion time at 28 °C or for manual processing 5 minutes of developing time at 20 °C.

## Sensitometric characteristic

220 kV/10 mA/8 mm Cu, automatic processing, FOMADUX LP-D Developer, 8 minutes of processing time at 28 °C (corresponds with 120 seconds developer immersion time)




## Archiving of processed films

The manufacturer guarantees the archival permanence of minimum 50 years when complying with conditions following:
– films must be perfectly fixed and washed
– films must be stored at a relative humidity of 30 to 60% out of reach of harmful gases.

## Storage of unexposed films

Unexposed films should be stored in the vertical position in the original packaging in a dry and cool place at a temperature of 10 to 25 °C and at a relative humidity of 40 to 60 %, out of reach of harmful gases and any ionizing radiation.

After opening the film bag, you must re-close it with two folds to secure it against opening. This prevents air moisture from entering the film bag. Exposed films should be processed as soon as possible.

# FOMADUX RX-8

SPECIAL INDUSTRIAL X-RAY FILM

## General information

FOMADUX RX-8 is an industrial radiographic film designed for non-destructive X-rays or gamma rays testing.

FOMADUX RX-8 possesses an extremely high X-ray sensitivity and medium contrast. In addition, FOMADUX RX-8 has a high sensitivity in the blue spectral region, and as such it is primarily intended for use in combination with intensifying screens.

## Application

FOMADUX RX-8 is particularly useful in circumstances where its high sensitivity is beneficial, e.g. when radiographing thick-walled products and materials, building structures, and the like, or in situations where a very short exposure is a critical requirement. Its assets include the possibility of using it in combination with blue emitting tungsten intensifying screens and, in particular, with fluorometallic screens. Its use with lead screens is feasible as well.

## Intensifying screens

The following fluorometallic screens are recommended for use with FOMADUX RX-8:

– Rennex UPW – 1,UPW – 2
– Agfa Structurix RCF
– Kyokko SMP 308
– Kodak Lanex Fast Screens

The use of fluorescent intensifying screens (CaWO4) emitting in a region with a peak at approx. 420 nm is also possible.

## Exposure with intensifying screens

The inverse relation (mA/time or time/distance), which is applicable to exposure to direct X-rays or behind lead screens, does not apply here. Therefore no universal intensifying factor valid in all exposure conditions can be identified.

## Packaging forms

Darkroom packaging (KB)
Size: 30x40 cm in boxes of 50 sheets .

Rollfilm packaging
– rollfilm with Pb, 60, 70 mm or 100 mm wide, 90 m long
– rollfilm BLR (Bulk Road Roll)

Other specific sizes or rolls can be obtained subject to agreement with the manufacturer.

## Film base

FOMADUX RX-8 is coated on a dimensionally stable bluish polyester backing 0.175 mm thick. The two film surfaces are provided with protective layers against mechanical damage and electrostatic discharge

## Darkroom illumination

FOMADUX RX-8 should be handled and processed under indirect safe yellow light (wavelengths 590 nm and higher). In view of the high film sensitivity it is recommended that the exposure time and the film-light source distance be tested in advance.

## Processing

FOMADUX RX-8 is well suited to both manual and automatic processing.

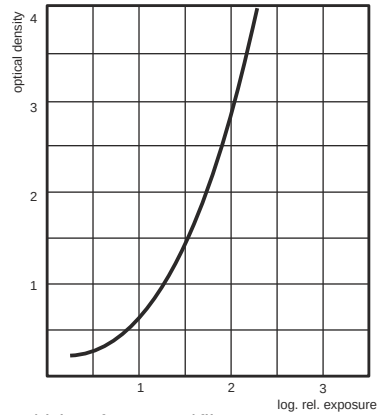
Recommended baths for manual processing:
FOMADUX LP-T developer and developer-replenisher
(developing time 5 min/20°C, dilution 1 + 3)
FOMAFIX rapid fixer
FOTONAL wetting agent

FOMADUX RX-8 can also be processed in baths designed for processing industrial radiographic films from other manufacturers.

Adhere to the developing time of 100 seconds and temperature of 28°C when using Agfa baths for automatic processing (Agfa G135 developer), and the developing time of 5 minutes and temperature of 20°C when using Agfa baths for manual processing (Agfa G128 developer).

## Sensitometric characteristic

220 kV/10 mA/8 mm Cu, automatic processing, FOMADUX LP-D developer, cycle 8 min/28°C, developing time 120 sec




## Archiving of processed films

The manufacturer guarantees stability of the processed films for 50 years or longer provided that the following conditions are met:
- The films have been properly fixed and washed
- The films are stored at 10°C to 25°C, RH 30% to 50%, out of the reach of harmful gases.

## Storage of unexposed films

Unexposed films should be stored in the vertical position in the original packaging in a dry and cold place at 10°C to 25°C and relative humidity 40% to 60%, out of the reach of any ionising radiation.

After opening the film bag, you must re-close it with two folds to secure it against opening. This prevents air moisture from entering the film bag.

Exposed films should be processed as soon as possible.

# FOMADUX NDT ROLLFILM

INDUSTRIAL X-RAY FILM

## General information

FOMADUX NDT ROLLFILM is a special confectioning form of technical radiographic film with designed for non-destructive material testing with use of X- or gamma radiation. The special form of the packaging ensures the film´s resistance to light, humidity and greasy impurities.

The film is placed between two lead screens (thickness 0,025 mm) of the same dimensions; the screens are in perfect contact with the film; the film is packed in a light- and moisture-proof package – using the "edge to edge" system.

## Usage

This kind of film is ideal solution for testing of long welds, e.g. welds of pipelines, pressure vessels or large parts in the aerospace industry, as the length can be chosen so that all the radiogram can be exposed to a single piece of film.

Packed film is wound onto a cardboard core and inserted in a transport box from which required length can be simply wound out. There is a print in the package axis on the side with folded edges; the print helps determine the film center and the film length. Contact of the film with a wet or impure object has no effect on the quality of the final radiograph.

How to remove the film from the package before processing: In a dark room hold the non-printed part of the package together with lead screen and the film with one hand and strip off the printed part of the package and the second lead screen with the other hand. Thus the film will be easily and quickly removed from the package.

## Advantages of the rollfilm

The full length of the weld can be radiographed onto a single piece of film, i.e. we avoid using several film sheets for one weld. Required film length is determined according to the weld length. Further advantages:

– Using without cassettes
– Lightproof package is resistant to humidity and greasy impurities
– By single – usage films we avoid faults caused by their repeated usage
– Perfect contact between the film, lead screens and checked object ensures optimal quality of the image
– The "edge to edge" packing system allows optimal use of the film surface where there is not sufficient space for placing the film

## Processing

FOMADUX is intended both for the manual and automatic processing.

Processing technology

Long films must be processed carefully. Generally it is possible to split the film after marking it and then to process it in the ordinary way or to fully exploit the advantages of the ROLLFILM package and to process it in full length.

a) When machine processing it is necessary to ensure precise leading (by a suitable jig) of the film into the axis of the developing machine.
b) In manual processing of ROLLFILM, prior to processing it is necessary to wind the film into a special wire coil that facilitates contact of the film with baths. It is also possible to split the film and to process it in parts in ordinary frames used for cell processing.

Recommended chemicals for the manual processing:
FOMADUX LP-T Developer and Developer-Replenisher
(5 minutes of developing time at 20 °C, 1 + 3)
FOMAFIX Rapid Fixer.
Recommended chemicals for the automatic processing:
FOMADUX LP-D Developer-Replenisher
(2 minutes of developer immersion time at 28 °C)
FOMA LP-DS Developer Starter
FOMADUX FIX-Set Hardening Fixer – part A (fixer) + part B (hardener)
FOMADUX NDT ROLLFILM can also be processed in corresponding processing chemicals of other manufacturers, for example developer Agfa G135 for automatic processing 2 minutes of developer immersion time at 28 °C or for manual processing 5 minutes of developing time at 20 °C.

Archiving of processed films

The manufacturer guarantees the archival permanence of minimum 50 years when complying with conditions following:
– films must be perfectly fixed and washed
– films must be stored at a relative humidity of 30 to 60% out of reach of harmful gases.

## Storage of unexposed films

The product has been produced and marketed in conformity with a quality system according to the international standard EN ISO 9001:2000.Unexposed films should be stored in the original packaging in a cool, dry place (temperature ranging from 10 to 25 °C, relative humidity from 40 to 60 %), out of reach of harmful vapours, gases and ionizing radiations.

Exposed films should be processed as soon as possible.

## Packaging

Rollfilm with Pb
– lightproof, humidity and greasy resistant
– sandwiched between two lead screens(thickness 0,025 mm)
– ·width 60, 70 or 100 mm in length up to 90 m.

Rollfilm DW
– greasy resistant
– without lead screens lightproof, humidity and
– especially intended for works using low to very low radiation (<100 kV)
– width 60, 70 mm or 100 mm in length up to 90 m.

Rollfilm BLR
– bare rollfilm
– intended for using in cassettes
– width 60, 70 mm or 100 mm in length up to 150 m.

*By using and processing of the product Indux R arise wastes, which is necessary to environmentally liquidate according to valid legislation.*

*Wastes:*
*– packaging foil : PET / AL / PE or PAPER / PE / PAPER*
*– Pb foil*
*– waste developers*
*– waste fixers*
– width 70 mm or 100 mm in length up to 150 m.

# FOMATEST SC 981

## General information

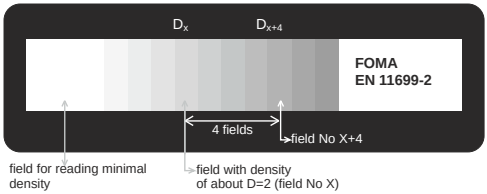
FOMATEST SC 981 is a pre-exposed test film strip designed for monitoring the quality of processing of INDUX radiogra-phic films, in accordance with the requirements for classified film systems to EN 11699-2 standard. It helps to monitor and optimize the processing system, to indicate the proper time for baths exchange or processor adjustment.

## Packaging

Boxes of 25 sheets of daylight packaging: test strips are exposed on INDUX R4 or INDUX R5 or INDUX R7 film, size 6 x 24cm, and supplied as one-sheet, vacuum – sealed, lead screen containing FOMAPAK packages.

## Test film exposure

To make a FOMATEST SC 981 test strips, a control pattern is X-ray exposed at INDUX R4 or INDUX R5 or INDUX R7 film. The test pattern consists of 10 fields with stepwise increasing exposure, completed by an area for minimum density reading and a space for sample identification data.




## Application

1. Proof of standard processing according to EN 11699-2

   Classification of a film system into C1–C6 classes according to EN 11699-1 anticipates a standard processing quality. If a proof should be presented to a customer that a given film series has been classified correctly according to EN 11699-1 by an NDT workstation, it is necessary to check the processing quality by Fomatest SC 981 before and after the series. This test allows for measuring and evaluation of minimum density $D_{min}$, speed index $S_X$ and contrast index $C_X$. If these sensitometric characteristics before and after processing of the series keep within the tolerated limits, the whole series is considered as satisfactory.

2. Control and diagnostics of processing .

FOMATEST SC 981 test strips are processed in regular intervals in a given processing system. Values of minimum density, speed index and gradient index are evaluated from the test strip by means of a densitometer. As reference data, the test results are used that were measured and recorded at the beginning of the whole series, usually in fresh processing solutions. During regular monitoring of the process, the measured test strip speed and contrast index should not exceed the tolerable deviations from the reference data. In a chart, monitored values are plotted against time. If all parameters are within the tolerated limits, the process is considered satisfactory. More detailed instructions for use are attached.

## Darkroom illumination

SC 981 test strips are handled and processed in the same way as other films of INDUX series, i.e. under indirect safelighting with a wavelength over 520 nm. Agfa R1safelight filter (dark red) or Agfa G7 (olive green) should be used with 25W bulb or LED sources (590 or 660 nm), at a minimum distance of 75 cm.

## Processing

Test strips are designed for monitoring and control of any process used by a customer. Processing parameters are those commonly used by a customer, usually as recommended by the processing baths manufacturer. Processing based on other than FOMADUX baths may be also monitored by SC 981 test strips.

## Storage

Unprocessed tests should be stored in the original packaging at the temperature not exceeding 20 °C, out of reach of harmful fumes and ionizing radiation.

Life time of unprocessed tests is 6 months.

# FOMATEST THIO

THE KIT FOR CHECKING STABILITY OF PROCESSED INDUSTRIAL X-RAY FILMS

## General information

FOMATEST THIO is a kit for a simple check of stability of processed X-ray films INDUX in terms of their ability to be archived. By means of the test kit inadequate fixing and washing processing of the film, whick makes the stability of the exposed image and the service life of the film shorter may be determined immediately.
The FOMATEST THIO kit is supplied in a box containing a small bottle with 30 ml of FOMATEST THIO, a dropper, an etalon strip, application instructions, and a package of paper filters.

## Testing

### Selection of the test area

The test is done on a completely processed and dry radiogram, where an absolutely clear and unexposed spot of about 1 square cm is selected (which is not part of the image, because the chemicals leave yellowish coloration). If there is no such spot on the film, the test may be performed on an unexposed film that was processed under identical conditions as the tested radiogram.

### The basic test

The dropper is held about 1 to 2 cm above the tested zone of the film and one drop of FOMATEST THIO is released without the dropper touching the surface. The chemical reacts within 2 minutes plus minus 15 sec. Using a small piece of the filter paper the drop is absorbed carefully, again without touching the tested area of the film at all. The remaining fluid is removed by pressing finger lightly on the filter paper. The emulsion must not be damaged by the filter paper. The tested zone is dried by airflow. The described procedure is repeated on the reverse side of the film on the same place.

## Test evaluation

The film must be protected against the effects of direct sunlight or other intense light sources. The film must be evaluated as soon as possible, not later than 30 minutes after the test. Delay in evaluation may result in incorrect evaluation, because the yellow spot on the tested area darkens gradually. The tested area is placed over a standard white background and compared visually with the enclosed etalon strip positioned next to the test spot. The etalon colour that is closest to the colour of the spot identifies the expected life of the radiograph.

Colour grades of the etalon correspond to values in the following table:

| Color grade | Content of thio-sulphate ($S_2O_3$)$^2$total – on both sides of the film (g/m$^2$) | Archivability in years Life expectancy (LE)[1/] |
|---|---|---|
| 1. darkest | more than 0.35 | not capable of being archived, find and correct error,requires additional processing[2/] |
| 2. dark | max. 0.20 | up to 10 years, average archivability LE = 10 |
| 3. light | max. 0.10 | up to 100 years, long-term archivability, LE = 100 |
| 4. lightest | max. 0.04 | permanent, archivability film, LE = 500 |

1/ LE according to ISO 18901:2010, for permanent archives LE is 500 years
2/ If the color of the test spot is more saturated than the darkest grade of the etalon, the quality of the fixer (pH and silver content) and the rinse water (amount of through-flow) must be checked and corrected for the application. Thereafter, the film must be fixed again in the fresh solution and rinsed again in running water. Older processed films may be fixed and rinsed again. For automatic processing the films may be placed in the fixing cell and drawn through the fixer and rinse, and dried. In manual processing the films are fixed for 2 minutes in a fresh fixer and rinsed for 10 to 15 minutes in running water. Finally, the FOMATEST THIO test is repeated.

## Storage

The solution must be stored in a dry and cool, preferably dark place. The bottle must be closed tight after use. The color chips should be protected against contact with chemical solutions (alcohol, acetone, ethers, etc.).

## Safety precautions

Avoid contact of FOMATEST THIO solution with the skin, clothing, and photographic materials. Should the skin or eyes come into contact with FOMATEST THIO, the affected spot should be rinsed with clear water immediately. The solution stains and the spots are difficult to remove.

# FOMASTEP E-09

ETALON OF OPTICAL DENSITIES WITH THE PROTOCOL OF CALIBRATION

## General information

FOMASTEP E-09 is etalon of optical densities for calibration of densitometers, intended for evaluating of processed NDT x-ray films. There are 9 fields of 10x15mm size with graduated optical densities on the etalon, which fully cover the range of optical densities D = 0 ~ 4,0.

## Calibration and protocol of calibration

The parts of the etalon are practically measured data of optical density, which have been measured with the calibrated densitometer of proved connection to state etalon ČMI. These data are mentioned in the attached protocol of calibration, which confirms the connection of calibrating measuring instrument, the practically measured data and measurement uncertainty.

## Application

FOMASTEP E-09 is being used for checking and calibration of working measuring instruments operating densitometers.

## Packaging form

FOMASTEP E-09 is made out from polyester base and exposed using the light method. Etalon is in covering envelope from polyester and together with relevant protocol of calibration is inserted in labelled envelope (name of the producer, product name, and date of production).

## Storage

Both opened and unopened product must be stored in a dry and air place at the temperature of 5 to 20°C and at a relative humidity of 30 to 50 %.

## Warranty

Recommended usable life of etalon is 12 month from the date of measurement.

# FOMADUX LP-D, FOMA LP-DS, FOMADUX FIX Set

LIQUID CHEMICALS FOR AUTOMATIC PROCESSING OF INDUSTRIAL X-RAY FILMS

## General

The liquid concentrate of chemicals are intended for automatic processing of industrial X-ray films in processing machines using 8 – 12 minutes cycle. The processing solutions are prepared by diluting concentrated chemicals with water. The liquid chemistry is especially suitable for processing of FOMA X-ray INDUX films as well as for comparable materials of other producers.

The chemicals are labeled as follows:

FOMADUX LP-D Developer-Replenisher

FOMA LP-DS Starter

FOMADUX FIX-Set Hardening Fixer

## Features

FOMADUX LP-D Developer-Replenisher provides high image quality with particularly fine grain and well balanced contrast, making full use of the film speed.

Its formula quarantees the product long-lasting stability, prevents deposits formation even with hard water.

FOMADUX FIX-Set

Part A – Rapid Fixer provides high fixing and buffering action, strong hardening power and long-term stability.

Part B – Hardener increases hardening power of the fixer, resulting in high mechanical resistance of the film and short processing time.

## Packing

FOMADUX LP-D

liquid concentrate for the final volume of 20 litres:

Part A– 1 container of 5 litres

Part B – 1 bottle of 0.25 litre

Part C – 1 bottle of 0.5 litre

FOMA LP-DS

1 bottle of 0.5 litre

FOMADUX FIX-Set

set for 21 l of solution:

Part A – 1 container of 5 litres (fixer)

Part B – 1 bottle of 1 liter (hardener)

## Preparation of working solutions

The developer solution is made using FOMADUX LP-D Developer-Replenisher and FOMA LP-DS Starter (25 ml of starter per 1 litre of developer). As replenisher the solution of FOMADUX LP-D Developer-Replenisher without starter is used. The product has been produced and marketed in conformity with a quality system according to the international standard EN ISO 9001.

For preparation of working solution of replenisher 5 litres of liquid concentrate FOMADUX LP-D part A is mixed with 10 litres of water. Continuosly mixing this solution the FOMADUX LP-D part B and FOMADUX LP-D part C is succesively added. After that water is filled up to the final volume of 20 litres. The reservoir with the working solution of replenisher must be safely closed by a cover. Using one packing 20 litres of replenisher can be made.

For preparation of 21 liters working solution of FOMADUX FIX Set is part A (5 liters of fixer) diluted with 15 liters of water and afterwards is added successively part B (1 liter of hardener) to the solution under continuously mixing. Basic and regeneration bath is the same.

## Processing

Recommended development conditions:

| temperature | developing time | processing time |
|---|---|---|
| 28°C | 2 min. | 8 min. |

Recommended replenishment doses are 600 to 800 ml/m$^2$.

Recommended standard fixing conditions:

| temperature | time |
|---|---|
| 28°C | 2 min. |

Minimum fixing time = 100 sec.

Recommended replenishment doses of ready-made fixing bath (i.c. with hardener) are 1000 to 1200 ml/m$^2$.

Replenishment values being for reference, the exact values are to be determined by trial processing involving the processing machine and film used, the daily processing capacity and processing time.

In case of any need do not hesitate to ask special technical help of FOMA service.

## Storage

The chemicals should be stored in the original packing in a dry place at temperatures +5 to +25 °C, for a period not exceeding 24 months.

A possible crystalline fraction in parts A and C is not a defect, it will dissolve again after heating to 40 °C and agitation the solution.

# FOMADUX LP-T, FOMAFIX KIT

LIQUID CHEMICALS FOR MANUAL PROCESSING OF INDUSTRIAL X-RAY FILMS

## General information

The concentrates for the preparation of baths for manual processing of technical radiographic films. The baths are suitable especially for technical radiographic films INDUX, but could be used also for comparable materials from other manufacturers.

Designation of developing baths:
Developer FOMADUX LP-T
FOMAFIX KIT

## Features

Developer FOMADUX LP-T is a single-component concentrate for the preparation of developer for manual processing of technical radiographic films. The developer ensures a high quality of picture and is distinguished especially with a fine grain and a well balanced contras. It uses fully the film sensitivity. Composition of the developer assures its long-term stability, eliminates creation of sediments, if hard water is used.

Rapid fixer FOMADUX FIX

Is a concentrate of fixing bath on the base of ammonium thiosulphate with a high fixing rate and efficiency, a strong buffer action and long-term stability.

Wetting agent FOTONAL

A liquid concentrate of wetting agent containing surface active substances and additives which enhance the stability of the developed picture. The use of wetting agent ensures an even off-take of water from the surface of the processed film, speeds up the process of drying and eliminates the occurrence of stains.

## Adjusting

Concentrated developer FOMADUX LP-T
Container with volume 5 litres

Set FOMAFIX KIT
2x 5 litres of rapid fixer FOMADUX FIX
2x 1 litre of wetting agent FOTONAL

## Preparation of baths

Concentrated developer FOMADUX LP-T should be diluted with water in proportion 1 + 3 (up to 1 + 4), from one packing of 5 l you can get 20 to 25 litres of the processing solution. It is appropriate to close the tank with the developer by a cover.

Recommended standard developing conditions:

| temperature | processing cycle |
|---|---|
| 20°C | 5 min. |

For the regeneration, a bath prepared from the concentrate FOMADUX LP-T is used which is diluted by water in proportion 1:2(3).

The recommended dosing of the regeneration bath is for the technical X-ray films 800 ml/m$^2$. Optimum conditions of regeneration are dependant on the method of processing, size of the developing tank, daily processing capacity etc.

Concentrate of quick fixer FOMADUX FIX is determined for the preparation of 20 to 25 litres of fixing bath.

Recommended standard fixing conditions:

| temperature | time |
|---|---|
| 20°C | 3 min. |

The same bath is used for the regeneration.

The recommended regeneration doses of 1000 to 1200 ml/m$^2$ should be elaborated by a practical test.

The wetting agent Fotonal should be applied in the last water washing bath, just before drying.

You may prepare the solution by adding of 10 to 40 ml of concentrate in 1 litre of water.

In case when necessary, ask for a professional advice from the service engineers of the firm FOMA.

## Storage

The concentrates should be stored in the original packing on a dry place at temperatures from 5 to 25°C.

The respective crystallised portion does not affect the function and may be dissolved again by warming up to 40 °C and stirring.

The time of usability is 24 months from the date of manufacture. The usability time for one application of processing solutions, if regeneration is applied continuously, is 4 –to 8 weeks.

# FOMA DP-I, FOMAFIX P-I

POWDER CHEMICALS FOR MANUAL PROCESSING OF INDUSTRIAL X-RAY FILMS

## General information

Powder processing baths are used for the preparation of baths for the manual processing of FOMA X-ray films.

FOMA DP-I is a powder form n-hydroquinone developer for the manual processing of technical X-ray films at temperatures between 20°C and 30°C.

FOMAFIX P-I is a powder form rapid fixer suitable for the manual processing of technical X-ray films.

## Pack Volumes

Powder form baths for the technical X-ray films are delivered with the following pack volumes:

FOMA DP-I – component parts A + B for the preparation of 20 litres of the working-strength developer solution.

FOMAFIX P-I – component parts A + B + C for the preparation of 20 litres of the working-strength rapid fixer solution.

## Bath Preparation

FOMA DP-I – Dissolve the content of 2 bags A in 15L of water heated up to 40°C. Allow them fully dissolve and then add the content of 2 bags B. The solution shall be made up to a 20-litre volume of the working strength.

FOMAFIX P-I – Dissolve gradually the content of 4 bags A, 2 bags B and 2 bags C in 15L of water heated up to 40°C. Bags B and C should be added only after the previous bag content has been fully dissolved. Once all of the component parts are fully dissolved, the solution should be made up to a 20-litre volume.

## Processing

Recommended standard consitions for the development process

| temperature | time (min.) |
|---|---|
| 28°C | 5 |
| 28°C | 3.5 |
| 28°C | 2 |

It is recommended for the development process that a stop bath is used for a period of 30s.

One litre of the FOMA DP-I developer allows to process 1m$^2$ of the technical X-ray films.

Fixation takes 5 minutes at a temperature of 20°C.

It is possible to process 1m$^2$ of X-ray films in one litre of the FOMAFIX P-I rapid fixer.

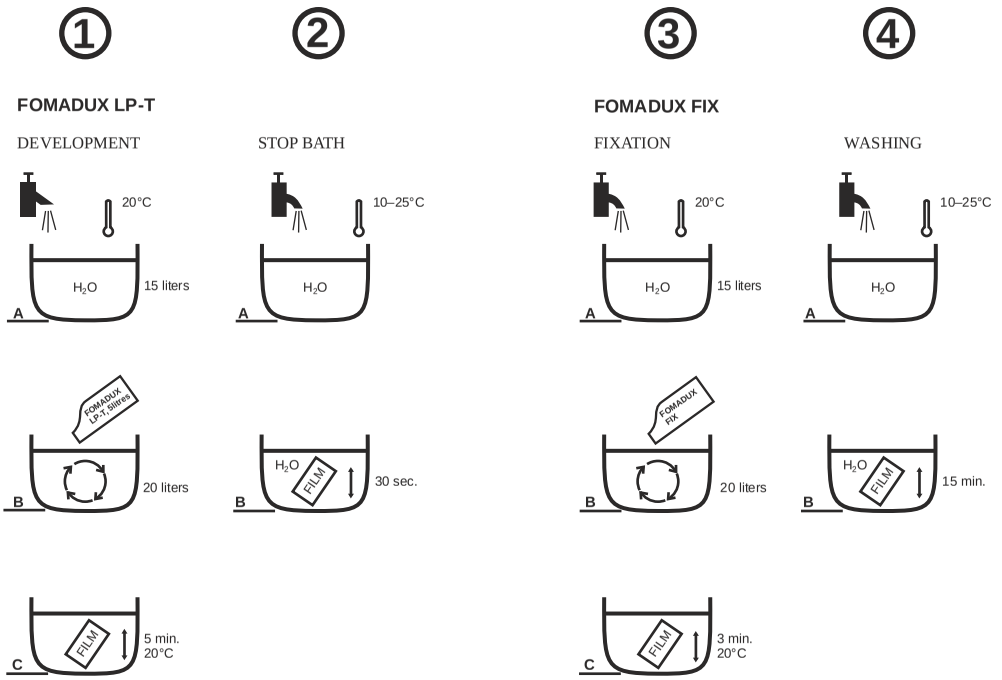
If you need assistance, please ask our FOMA customer service team.

## Storage

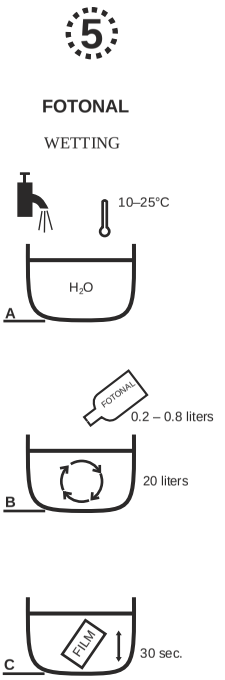
Store the powder form baths in the original packing in dry and well-ventilated rooms at temperatures between +5°C and +25°C and a relative humidity not exceeding 65%. Protect the baths from rapid temperature variations and keep them away from direct sunlight.

*Information about environmentally-sound disposal as well as the safety rules during the transport, storage and handling can be found in the Material Safety Data Sheet of the product.*

## MANUAL PROCESSING INSTRUCTIONS

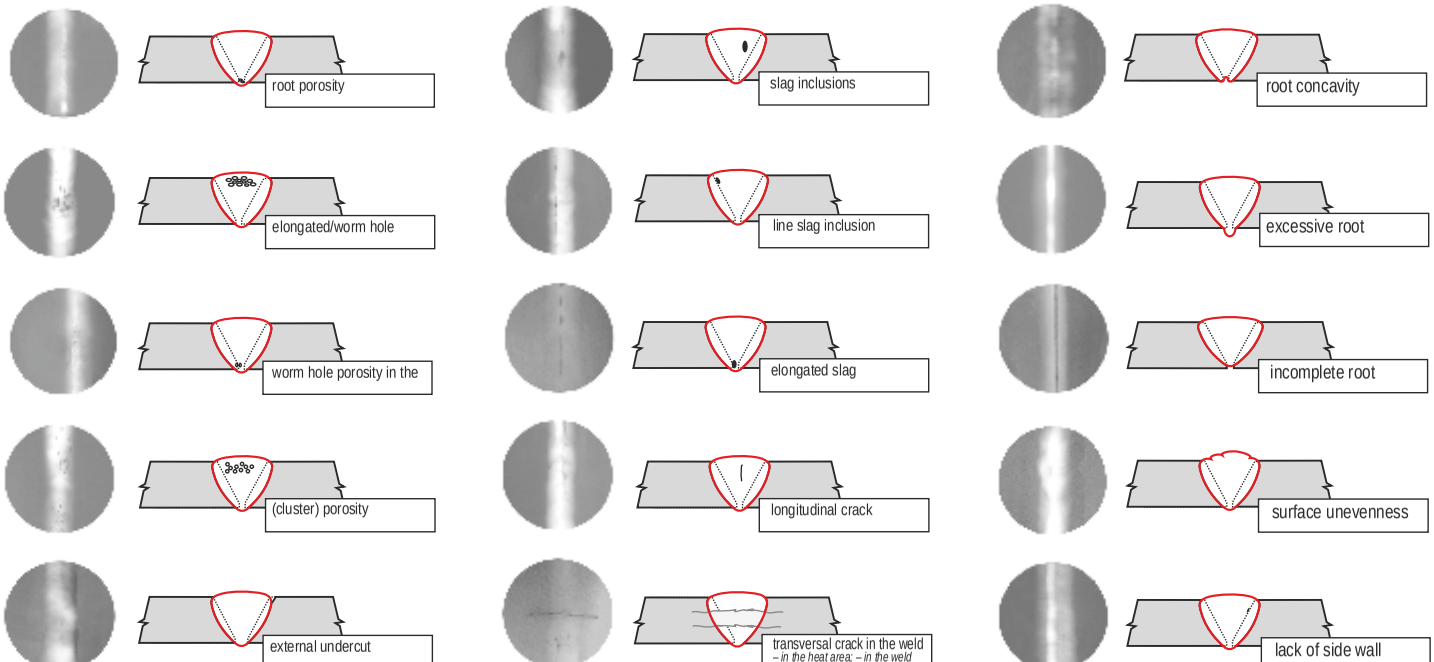



In case of dried water drops use.



# EXAMPLES OF SELECTED WELD DEFECTS

**PICTURES OF THE DEFECTS WERE MADE USING THE INDUX OR FOMADUX FILMS.**



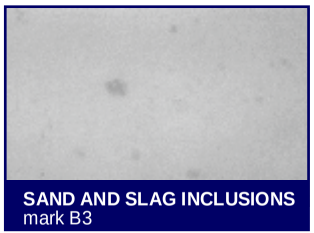

FOMA NDT SYSTEM – programme for industrial radiography

- a range of radiographic films: INDUX, FOMADUX ROLLFILM, FOMATEST THIO and FOMATEST SC 981 and also chemicals for both manual and automatic processing of these films
- automatic processors, viewers, densitometers, safelamps and other accessories

# EXAMPLES OF SELECTED DEFECTS

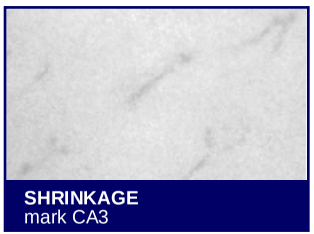
(ASTM E 446, volume II)

**PICTURES OF THE DEFECTS WERE MADE USING THE INDUX OR FOMADUX FILMS.**
**REFERENCE RADIOGRAPHS FOR STEEL CASTINGS UP TO 2 in (51 mm) IN THICKNESS 1 MV X-RAY TUBE OR IRIDIUM-192.**

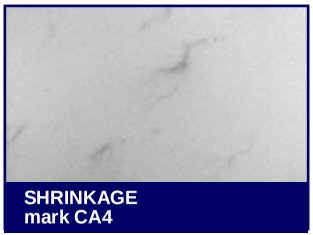


**SAND AND SLAG INCLUSIONS**
mark B3

**SAND AND SLAG INCLUSIONS**
mark B4

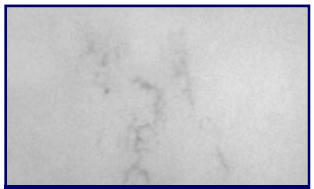


**SHRINKAGE**
mark CA3



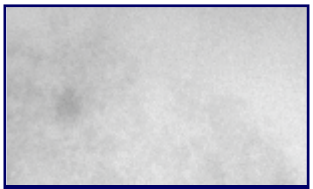
**SHRINKAGE**
**mark CA4**

**SHRINKAGE**
mark CB3



**SHRINKAGE**
mark CB4

**SHRINKAGE**
mark CC3



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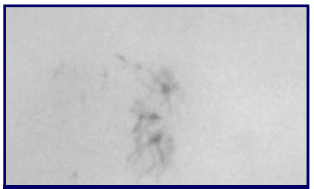
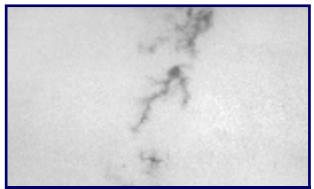


**SHRINKAGE**
mark CD3



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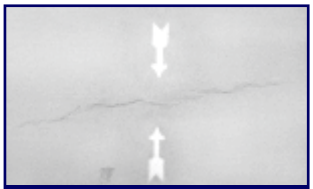
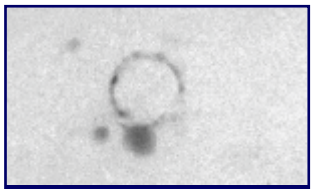


**HOT TEAR**
mark E



**INSERT**
mark F

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# EXAMPLES OF SELECTED PROCESSING ARTEFACTS

**PICTURES OF THE DEFECTS WERE MADE USING THE INDUX OR FOMADUX FILMS.**


Film sheets stucked together in the developer.


Unconsidered mechanical manipulation – Electrostatic discharges.


Film washed insufficiently – dry water drops.


Developing without film motion in bath.


Film manipulation with polluted fingers.


Dry water drops.


Pressure roller tension.


Unconsidered mechanical manipulation – mechanical pinch.

The examples A, B, C, D, E, F and H are characteristic of manual processing of industrial X-ray films.

The examples E, G and H are characteristic of automatic processing.

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since 1921


**EXPORT FOMA**

**FOMA BOHEMIA spol. s r.o. (Ltd.), Hradec Králové, Czech Republic**
**phone: +420 495 733 288, +420 495 733 111, fax: +420 495 733 376**
**ndt@foma.cz, www.foma.eu**

2017