Carestream

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INDUSTREX Film Processing and Exposure Instructions

To achieve optimal radiographic image quality with INDUSTREX films, it is important to follow recommended processing conditions for development time and temperature and then determine proper exposure (dose) for the selected film type and object being examined.

- **Follow Recommended Processing Conditions** – Will deliver the film's designed speed and contrast and ensure that performance matches requirements for system class per EN ISO11699-1 and ASTM E1815-08. It is important to set processing conditions first before establishing exposure.
- **Determine Proper Exposure (Dose)** – Sufficient dose is essential to achieving high-quality radiographs. During exposure, image detail is recorded in the film's emulsion layer. Under-exposure will limit image quality, increase grain (noise) and reduce signal to noise ratio.

Set Recommended Processing Conditions

Processing Recommendations: Optical density and overall radiographic image quality depend on adhering to the film manufacturer recommendations for processing conditions. Carestream processing recommendations have been set to optimize film speed, film contrast and base + fog density in particular.

Highly recommended:

Do not over process: Increased contrast can be exaggerated when developing time and temperature are longer or higher than recommended. This can create the effect of "**Dark Radiographs.**" Further, over-processing can lead to increased graininess and a decrease in contrast latitude with any high-contrast film. Avoid over-processing by following the recommendations described in the tables to the right.

Do not intermix photo chemicals: Different brands or types of photo chemicals may be incompatible in the same process. Intermixing can create unintended results.

Clean film processor and fill with fresh chemicals: When converting to a new film, best practice is to perform a preventative maintenance check on your automatic film processor and fill with fresh chemicals.

Avoid cross-contamination of fixer in developer: Small amounts of fixer will quickly degrade the performance of the developer solution, leading to increases in gross fog, and undesirable changes in film speed, contrast and image tone.

Automatic Processing:

	Floor-standing INDUSTREX M43ic Processor	**Table-top INDUSTREX M37 Plus Processor**
Developer Immersion Time	**100 seconds** (8-minute cycle)	**110 seconds**
Developer Temperature	**26 °C (79 °F)**	**28 °C (82.5 °F)**

Manual Processing:

Developer Temperature	**Development Time (Minutes)**
20 °C (68 °F)	5
22 °C (72 °F)*	**4***
24 °C (75 °F)	3
26 °C (79 °F)	2

***Recommended starting point**

Use INDUSTREX Photo chemicals for best results. INDUSTREX films are designed to produce optimum results when processed in INDUSTREX chemicals.

INDUSTREX SP Developer and LO Fixer (Automatic or Manual Processing)

INDUSTREX Manual Developer and Manual Fixer

Carestream works diligently to constantly improve the performance of INDUSTREX films for the best imaging quality and overall robustness. When used following Carestream recommendations for proper storage, mixing and replenishment, INDUSTREX chemicals provide improved process stability and longevity.

Establish Exposure (Dose)

Sufficient dose is critical to achieving image quality

For a given film, the relation between the optical density (a measure of the degree of film darkening) in the processed radiograph and exposure is commonly expressed in the form of a characteristic curve. Film characteristic curves can be used to adjust the exposure used to produce a radiograph with a certain optical density to an exposure that will produce a second radiograph of higher optical density. Film characteristic curves can also be used to relate the exposure produced with one film to exposure needed to produce a radiograph of the same density with another radiographic film.

Film characteristic curves are included in our INDUSTREX Radiographic Films Technical Information, available on our website: (http://www.carestream.com/ndt-resources.html).

Optical density and overall radiographic image quality depend on adhering to the manufacturer's recommendations for processing conditions. **Carestream's processing recommendations have been set to optimize film speed, film contrast and base + fog density in particular.**

For a given film, another starting point for determining the amount of exposure (R) to produce a desired optical density is the film's factor (R). **R-factors** for current INDUSTREX films are shown in the tables to the right.

NOTE: The R-factor values shown below are based on manually processing in INDUSTREX chemicals with a 4-minute developer immersion time at 22 °C (72 °F).

		R-Factors			
	Desired Densities:	**2**	**2.5**	**3**	**3.5**
Selenium	M100	3.6	4.6	5.5	6.5
	MX125	2.2	2.9	3.6	4.4
	T200	1.4	1.8	2.2	2.6
	AA400	0.8	1.2	1.6	2
	HS800	0.3	0.6	0.8	1
Iridium	M100	3.2	4.3	5.5	6.6
	MX125	2.3	3.1	3.9	4.7
	T200	1.1	1.5	2	2.4
	AA400	0.8	1.1	1.5	1.9
	HS800	0.2	0.5	0.7	0.9
Cobalt	M100	7.3	9.3	11.4	13.4
	MX125	3.9	5.3	6.7	7.9
	T200	2.3	3.1	3.9	4.7
	AA400	1.2	1.8	2.4	2.9
	HS800	0.1	0.6	1	1.4

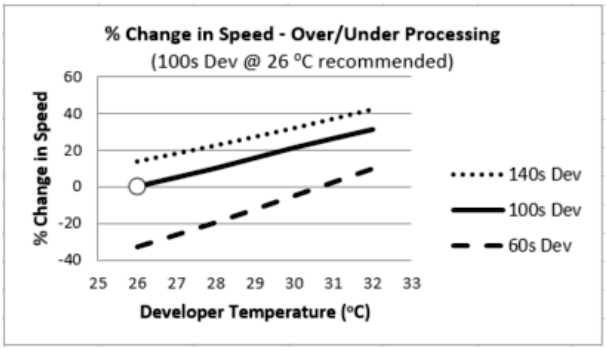
Adverse effects of over/under processing on film speed and contrast

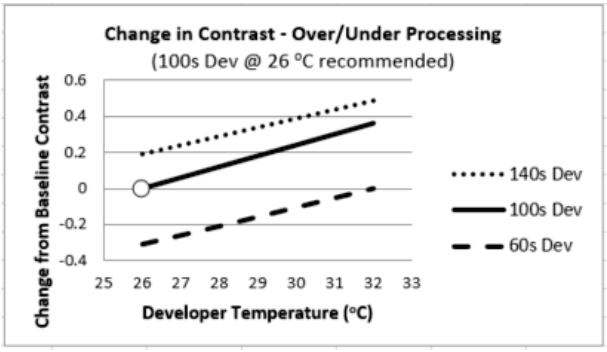
In general, the contrast of industrial radiography films increases continuously with optical density in the usable optical density range. For this reason, exposing an industrial X-ray film to produce higher optical densities will increase the contrast in the radiograph. It is generally accepted that **higher radiographic contrast should improve radiographic sensitivity** (the ease with which the images of small details can be detected). Achieving adequate radiographic contrast is thus one rationale for avoiding under-exposure.

While film speed may increase with **over-processing** (longer development time/higher developer temperature), this increase does not fully compensate for **under-exposing** the film and may be accompanied by an undesirable increase in base + fog density, an increase in film contrast and perceived graininess and **a decrease in contrast latitude.** The graphs to the right illustrate how speed and contrast change with over- and under-processing (higher processing temperatures and shorter and longer development times).

The most important goal in radiography should be to produce radiographs with the highest possible radiographic contrast. In the long run, the key to cost-effective radiography is to achieve the highest image quality and thus to use appropriate exposures and recommended processing conditions. Under-exposing followed by over-processing the film should be avoided in order to consistently obtain adequate radiographic contrast and radiographic sensitivity.

Graphs showing the undesirable effects of over- and under-processing on film speed and contrast:





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