Computed radiography (CR)

Computed radiography (CR) is a digital imaging technique widely used for medical, and veterinary diagnostics. Instead of a conventional X-ray film, CR uses a special X-ray sensitive, photo-stimulable phosphor plate also known as an imaging plate (IP). CR reader or IP reader machines are typically designed to process and digitize X-ray images in a short time with high image quality.

When X-rays are irradiated onto the imaging plate, electrons are released within the storage phosphor material and stored in higher energy states. A laser beam then scans the plate creating an image from the blue fluorescent light emitted by the plate in proportion to the input amount of X-ray exposure. A high sensitivity, wide dynamic range photomultiplier tube (PMT) is then used to convert the emitted weak visible light into electronic signals. These signals are then digitally processed to reconstruct a high contrast image of the original object that was exposed to X-rays.

For medical and veterinary imaging applications large format imaging plates are often used, such as 8”x10” up to 17”x17” size. For such large format plates, CR reader machine designers often employ either a large format lens to collect emitted light from the entire plate to one PMT, or a group of smaller lenses coupled to an array of PMTs.

PMTs employed in CR reader machines should have a large active area, high sensitivity to blue light, excellent linearity over a wide operating range, and good uniformity in order to produce the highest quality images. Our PMTs incorporate all of these features.

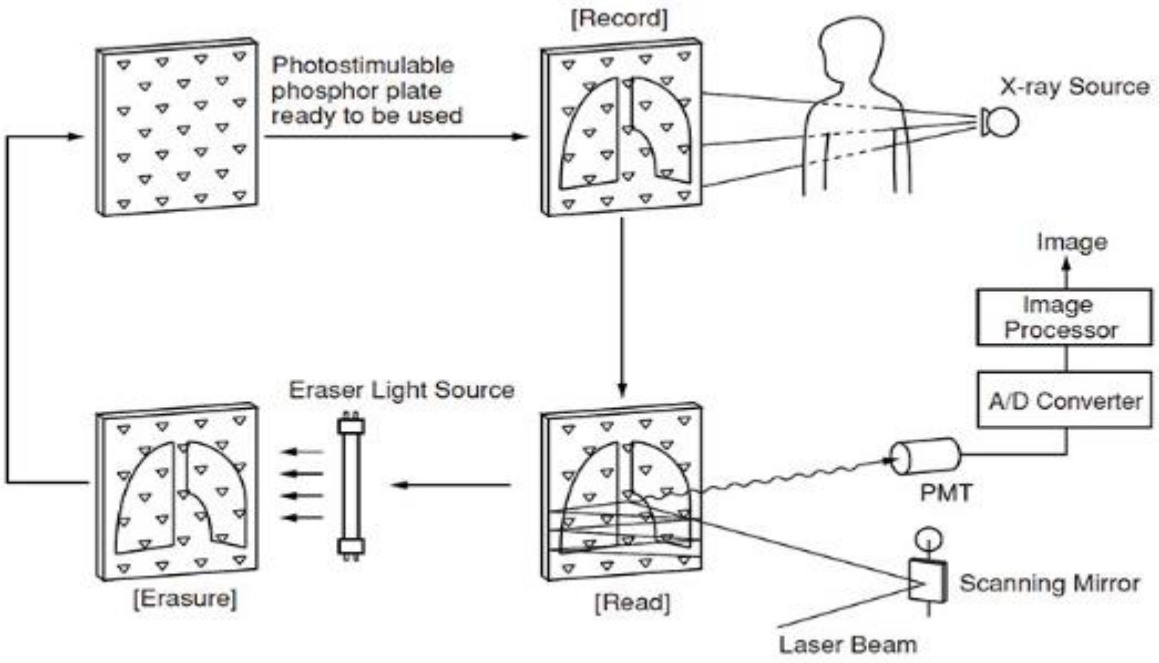

Figure 1

computed radiography (CR) cassettes use photo-stimulated Sparkling screens to capture the X-ray image, instead of traditional X-ray film. The CR cassette goes into a reader to convert the data into a digital image .

the Components of Computed Radiography

Computed radiography systems comprise several hardware and software components that perform each part of the imaging process.

These are the five main parts of a CR system:

1. **Imaging plates:** CR systems use cassette containing reusable phosphor plates rather than film. You can erase and reuse these plates thousands of times, significantly reducing the need for consumables.
2. **Image reader:** The reader replaces the darkroom of conventional X-ray testing. Rather than applying chemical solutions to an exposure to reveal the image, CR readers scan the phosphor plate and digitize the image. They then transfer the image to the workstation.
3. **Workstation:** Most CR radiography systems use a standard PC to view, evaluate and send digitized images.
4. **Software:** Diagnostic imaging software provides a consolidated platform for storing, analyzing, and managing test images. This software streamlines file management and optimizes analysis processes.
5. **Printer**

Proper system maintenance is critical for ensuring high-quality test images. For example, you must erase imaging plates after each use because residual energy can create ghost images in later exposures. It's also important to regularly erase unused plates, which can capture faint images even while not in use.

Figure 2

How Does Computed Radiography Work?

The name “computed radiography” can be misleading because the actual imaging process includes minimal computations. In reality, it is more similar to traditional X-ray imaging than most computer processes.

Here’s a brief step-by-step explanation of how the process works.

1. Exposure

First, you expose the imaging plate and test object to radiation to capture a latent image. This radiation may be X-rays or gamma rays, depending on your application. The energy from the radiation remains trapped in the plate’s phosphor layer.

Exposure time and image quality can vary depending on the type of plate you use. Other system components, like your scanner or display monitor, can also influence image quality.

2. Digitization

You then insert the cassette into the CR reader, which scans the plate by applying a focused laser beam to it. The plate emits a bright blue light in response, allowing the reader to pick up the image on the plate.

Using an analog-to-digital converter (ADC), the scanner turns the light into a digital signal, which it transfers to the computer. Then, it wipes the image from the plate using a high-intensity light source.

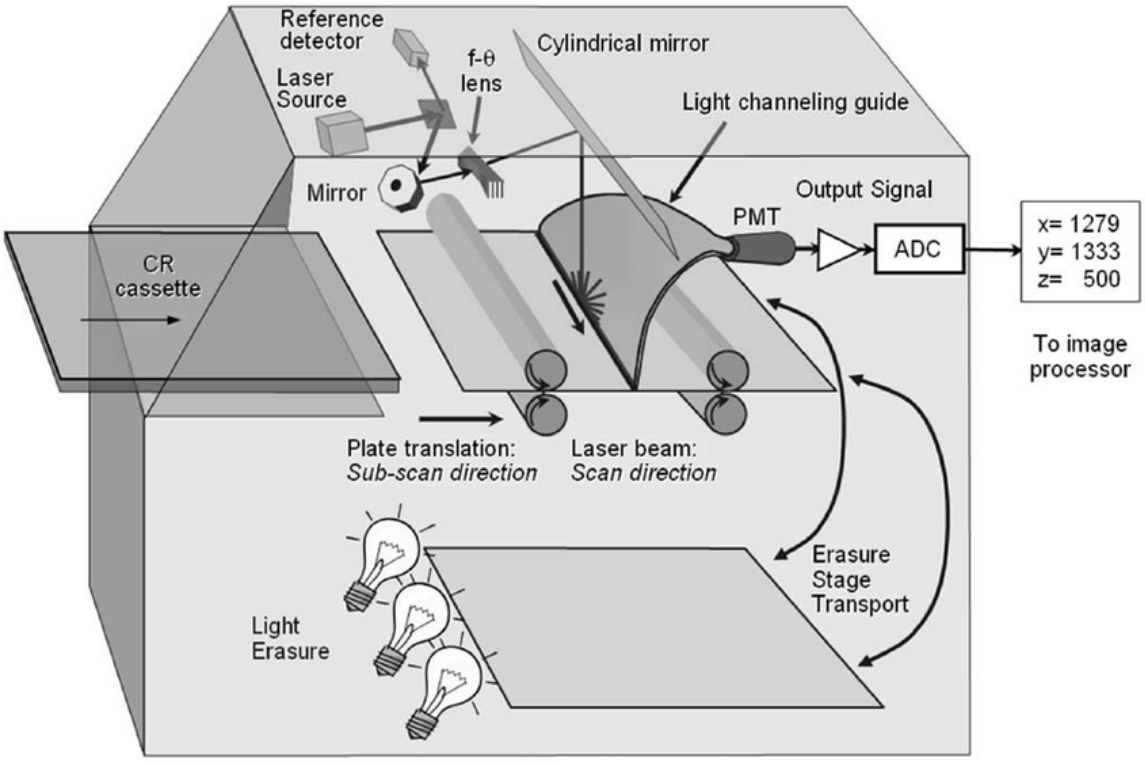

Figure 3

3. Analysis

Once the converter has transferred the image to your workstation, you can begin analysis. Your diagnostic software allows you to manipulate the image for more in-depth analysis. You can also reuse the plate immediately after erasure as needed. Depending on the brand of plates you use and your specific application, you may be able to reuse one plate more than a thousand times. Your analysis software allows you to alter the image and view it from different angles to get a clear, comprehensive view of the test object. Each software program has different features and capabilities, so it's important to choose the right one for your business. Some helpful features to look for include the following:

- Automatic measurement tools
- Digital contrast normalization

- Smooth transitions between screens
- Traceability and reliable image quality assessment
- Flexible network configuration

Ideally, your analysis software will fit seamlessly into your CR system. Choosing one manufacture and developer for all your system components is ideal for ensuring smooth integration.

How Is Computed Radiography Different From Traditional X-Ray Testing?

CR radiography effectively replaces X-ray testing by digitizing the darkroom process. Like X-ray testing, CR imaging uses cassette-based media and radiation to capture images — however, CR uses imaging plates instead of X-ray film.

Some other key differences between the two include the following:

- **Consumables:** Processing images using film requires darkroom chemicals, single-use film and other consumable materials. You can produce thousands or even tens of thousands of images through CR radiography with one set of plates, a computer and a CR reader.
- **Environment:** You need to keep X-ray images in a temperature- and humidity-controlled environment to prevent the film from warping or distortion. However, with CR imaging, you can store images on your workstation, eliminating the risk of image degradation resulting from environmental factors.

- **Location:** Film development must take place in a darkroom, which poses a challenge for many industrial facilities. As a result, many businesses using X-ray testing must process their images off-site, which adds to the processing time. Fujifilm's computed radiography systems can easily fit into narrow spaces, saving you valuable floor space and time.

While X-ray testing has been the standard in image-based NDT for decades, transitioning to a CR system can help bring businesses into the modern era. Faster processing times and easier analysis enable companies to increase testing throughput and meet deadlines quicker, which is essential for staying competitive in today's fast-paced world.