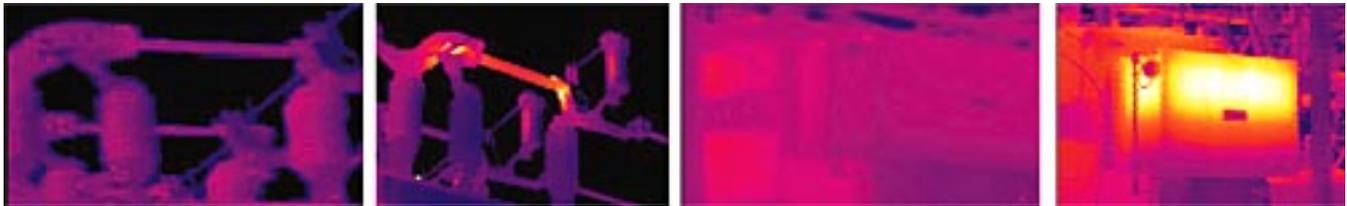


## Portable Infrared Imaging

Written by Ron Newport, Academy of Infrared Thermography  
Saturday, 01 May 1999 18:56

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### An overview of cameras, the industry, technological improvements, where to use them, and suppliers.



The use of infrared thermography to evaluate the operating condition of electrical, mechanical, and process equipment for early warning signs of impending failure has increased dramatically over the past few years. The industry is forecast to continue growing at unprecedented rates, driven by:

- Market awareness and acceptance. More information and articles are being published on this technology than ever before.
- Application diversity. Infrared thermography is used to inspect electrical and mechanical equipment, detect leaks in underground pipes, and check for subsurface metal corrosion, insulation deficiencies, building energy loss, and roof moisture intrusion. It also is used for monitoring and control of a wide range of processes. New applications are being developed continually.
- Equipment. The equipment is compact, easy to use, provides high-quality imagery and fast analysis, and uses software that allows reports to be written easily. Prices continue to drop.
- Standards. Standards for thermography are beginning to be developed (ASNT, ASTM, ISO), which means that it is gaining recognition and credibility. For example, in Canada, the United States, and Norway, most companies are requesting that thermographers have a Level I status to perform infrared thermography inspections.
- Training. Training, educational programs, and seminars are now available at locations throughout the world.

### The industry

Market evaluation companies such as Frost & Sullivan, Maxtech International, and Thomas Marketing Information Centre have prepared market studies and surveys that look at infrared thermography. The results are similar and show that infrared thermography is an emerging technology that is coming into its own. According to strategic research conducted by Frost & Sullivan, the total market is projected to experience a compound annual growth rate of 31 percent from 1996 to 2003.

Infrared equipment manufacturers are very aware of this growth potential and are

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positioning themselves to achieve greater market share. Raytheon purchased Texas Instrument IR Technology Divisions, Amber Infrared, and Santa Barbara Research Center. Last year FLIR Systems Inc. acquired Agema Infrared Systems. Most recently, FSI announced the purchase of Inframetrics, Inc., a privately owned infrared imaging company based in Billerica, MA.

### Technology advances

Infrared camera technology has advanced significantly since the early 1960s when the Swedish company AGA introduced the first commercially available infrared imaging instrument. Early instruments were heavy and bulky, required liquid nitrogen to operate, provided black and white fuzzy images, and offered only relative temperature measurement that required the use of long and complex formulae. Infrared imagers fall into three categories. Electromechanically Scanned instruments collect and direct the incoming infrared radiation onto a single detector element, or linear array, by means of rotating or oscillating prisms or mirrors. The Pyroelectric Videcon imager uses a pyroelectric surface detector, which after being aimed at the target, develops a charge distribution that is proportional to the target's radiant energy. The infrared focal plane array (FPA) camera makes use of a high-density mosaic of small detector elements, which are aimed at the target. Each element sees a single infrared pixel of the target, and no mechanically scanned optics are required. The size of the array ranges from a matrix of 128 horizontal elements x 128 vertical elements to one that contains 512 x 512 elements. These instruments are classified as staring systems in contrast to opto-mechanical scanning infrared devices.

The greatest single benefit of an FPA is its ability to generate high-quality images. In mechanically scanned single-element detectors, 14,000 to 26,000 picture elements make up the field of view. An FPA covering the same field of view will comprise 65,000 to 262,000 pixels. This means the FPA will have 3-10 times more image detail. An image with higher resolution allows problems to be identified without the camera operator having to change lenses, enhances analysis procedures, and provides an image that is easier to read and understand.

The FPA detector may be a significant breakthrough in technology but without advancements in the optics, electronics, and microprocessor technologies it would not have been possible to develop these cameras. The interaction between these components determines the diversity and quality of the instruments available today.

Clearly, uncooled infrared FPAs represent a revolution in infrared instrumentation. It is

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expected that the technology will continue to develop, particularly in the area of improved detector performance and reduced noise equivalent temperature difference and electronics.

As costs continue to decrease and production volumes rise, the price of solid state uncooled, lightweight systems should drop significantly. Expect to see larger arrays (640 x 480) and smaller, lightweight instruments using less power.

There is a movement now into a new semiconductor-based FPA detector technology, Quantum Well Infrared Photodetector. The interest in this technology is that it promises major advances for infrared focal plane arrays. It:

- Provides excellent pixel uniformity, imaging, and sensitivity performance.
- Offers large pixel format capability, up to 640 x 480.
- Is tunable and can be made responsive from about 3 to 25 microns, for broad band and dual band applications.
- Can be produced at relatively low cost and in large quantities.

The simplicity, flexibility, high performance, and low cost will guarantee the development of this technology.

**Camera Evaluation** Once the plant's requirements are understood, a plan established, applications identified, and a training course completed, then consider purchasing equipment. Do not purchase a camera and then try to work out what to do with it. That approach has caused many programs to fail. These points should be considered when choosing an instrument:

- Portability
- Rugged, compact design
- Weight
- Temperature range (both measurement and operating range)
- Image resolution
- Accurate, repeatable temperature measurements, under your specific conditions
- Lenses (Will you require additional lenses for close-up or long-distance inspections?)
- Viewer (Is the eyepiece adequate or is a viewer required for certain applications?)
- Image storage and retrieval capabilities

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- Camera and peripheral accessories
- Image analysis and report software (simple to use, exportable programs, etc.) to other
- Warranty
- Service, service, service (Get references, find out how long it takes to have equipment repairs, will a loaner instrument be provided?)
- Technical support (Phone their technical support line with some questions and see how efficient, knowledgeable, and friendly they are.)
- Training
- Price (This is the last thing to consider. Do not buy on price; you will regret it. Purchase the instrument that works for your program.)

### Establishing a program

In order to profit from the benefits of infrared thermography, regardless of the technology chosen, a company must give much consideration to establishing an infrared inspection program. One that is properly initiated is guaranteed to provide users with a quick return on investment. Typically this will occur within 3 months of purchasing and using the equipment, but many companies claim receiving a payback the very first day on which they performed an infrared inspection.

The first step in setting up a successful thermography program is education. Find out about the products and technology that are available and how they can be used:

- Go to introductory seminars and conferences.
- Request product data sheets and application literature from equipment vendors (see the accompanying chart).
- Browse the Internet. This is a little time consuming, but there is a wealth of information on the Web.
- Contact specialist groups and associations. They publish newsletters regularly and sponsor conferences and meetings each year.
- Contract an independent consultant to assist in the assessment and education process.
- Hire an experienced infrared service company and learn from their employees while they are performing an inspection in the field.
- Take a training course before you purchase your instrument. This will provide you with an understanding of the infrared industry and technology, equipment, and application knowledge, and allow you to gain valuable experience from the instructors and other students. You will then be prepared to deal with and negotiate efficiently with the instrument sales representatives.

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### Selecting a camera

Although the methodology used to implement and purchase equipment, and the program requirements, vary from plant to plant or from person to person, the following observations should be helpful.

- Select an instrument that will make inspections successful now and in the future. An infrared camera is a diverse tool. When deciding on a particular type, also take into account your future requirements.
  - Plan the implementation phase carefully. Decisions on how to collect and manage data should be made at the outset, and should focus on the desired output of the program. This planning will both simplify implementation and maximize the value of the program.
  - Provide good training for the personnel involved. Set aside sufficient time for the equipment operators to become proficient at their jobs. Strive for continual improvement and remember that each challenge that is successfully completed is followed by additional new and exciting opportunities. **MT**
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