Lighting

Magnetic particle inspection predominately relies on visual inspection to detect any indications that form. Therefore, lighting is a very important element of the inspection process. Obviously, the lighting requirements are different for an inspection conducted using visible particles than they are for an inspection conducted using fluorescent particles. The lighting requirements for each of these techniques, as well as how light measurements are made, is discussed below.

Light Requirements When Using Visible Particles

Magnetic particle inspections that use visible particles can be conducted using natural or artificial lighting. When using natural lighting, it is important to keep in mind that daylight varies from hour to hour. Inspector must constantly stay aware of the lighting conditions and make adjustments when needed. To improve the uniformity of lighting from one inspection to the next, the use of artificial lighting is recommended. Artificial lighting should be white whenever possible and white flood or halogen lamps are most commonly used. The light intensity is required to be 100 foot-candles at the surface being inspected. It is advisable to choose a white light wattage that will provide sufficient light, but avoid excessive reflected light that could distract from the inspection.

Light Requirements When Using Fluorescent Particles

Ultraviolet Lighting

When performing a magnetic particle inspection using fluorescent particles, the condition of the ultraviolet light and the ambient white light must be monitored. Standards and procedures require verification of lens condition and light intensity. Black lights should never be used with a cracked filter as the output of white light and harmful black light will be increased. The cleanliness of the filter should also be checked regularly since a coating of solvent carrier, oil, or other foreign material can reduce the intensity or light by as much as 50%. The filter should be checked visually and cleaned as necessary before warming-up the light.

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For UV lights used in component evaluations, the normally accepted intensity is 1000mwatts/cm^2 when measured at 15 inches from the filter face (requirements can vary from 800 to 1200mwatts/cm^2). The required check should be performed when a new bulb is installed, at startup of the inspection cycle, if a change in intensity is noticed, or every eight hours if in continuous use. Regularly checking the intensity of UV lights is very important because bulbs lose intensity over time. In fact, a bulb that is near the end of its operating life will often have an intensity of only 25% of its original output. Black light intensity will also be affected by voltage variations, so it is important to provide constant voltage to the light. A bulb that produces acceptable intensity at 120 volts will produce significantly less at 110 volts.

Ambient White Lighting
When performing a fluorescent magnetic particle inspection, it is important to keep white light to a minimum as it will significantly reduce the inspectors ability to detect fluorescent indications. Light levels of less than 2fc are required by most procedures and some procedures require it to be less than 0.5fc at the inspection surface. Some specifications require that a white light intensity measurement be made at 15 inches from a UV light source to verify that the white light is being removed by the filter.

White Light for Indication Confirmation
While white light is held to a minimum in fluorescent inspections, procedures may require that indications be evaluated under white light. The white light requirements for this evaluation are the same as when performing an inspection with visible particles. The minimum light intensity at the surface being inspected must be 100fc.

Light Measurement

Light intensity measurements are made using a radiometer. A radiometer is an instrument that translates light energy into an electrical current. Light striking a silicon photodiode detector causes a charge to build up between internal layers. When an external circuit is
connected to the cell, an electrical current is produced. This current is linear with respect to incident light. Some radiometers have the ability to measure both white and UV light, while others require a separate sensor for each measurement. The sensing area should always be kept clean and free of materials that could reduce or obstruct light reaching the sensor.

Radiometers are relatively unstable instruments and readings often change considerably over time. Therefore, they must be calibrated regularly. They should be calibrated at least every six months. A unit should be checked to make sure its calibration is current before taking any light readings.

Ultraviolet light measurements should be taken using a fixture to maintain a minimum distance of 15 inches from the filter face to the sensor. The sensor should be centered in the light field to obtain the peak reading. UV spot lights are often focused which causes intensity readings to vary considerable over a small area. White lights are seldom focused and, depending on the wattage, will often produce in excess of the 100fc at 15 inches.

Back Next