Illuminating and Viewing Coded Wire Tags

Application Note APC16

Introduction

Decimal Coded Wire Tags™ (DCWT™) should be illuminated properly for good contrast between the background and the code marks in order to ensure easiest reading. Good viewing conditions are especially important for Decimal CWT TM, since the dots making up the decimal characters are smaller than the marks used on binary CWT.

The most important idea to keep in mind when setting up a microscope and light for viewing CWT is that the unmarked surface of the wire acts approximately like a smooth, curved mirror, while the marked dots act approximately like small dimples or pits. The goal insetting up good lighting conditions is to make the smooth, mirror-like background look black, and the dimples or pits look white.

NMT recommends and sells a light source, the Illuminator, which has been engineered to provide convenient, optimal lighting for easy reading of Decimal CWTs. However, you may choose to design your own lighting system. The remainder of this note provides suggestions for such design.

How to make a mirror look black and pits look white

A mirror looks black if whatever is being reflected in the mirror is black. For example, you can be in a well-lit room and look in a mirror at the reflection of a black wall, and the mirror will look black even though the rest of the room is light. Even if someone shines a flashlight at the mirror from the side, as long as you can't see an image of the flashlight in the mirror, the mirror will continue to look as dark as the black wall.

On the other hand, any imperfection in the surface of the mirror, such as a speck of dust or dirt or a scratch or small pit --- including a laser-marked pit --- will scatter light that strikes it in all directions, and will look white no matter what direction light is coming from.

So if a mirror with a scratch on it is oriented so that you are looking at a reflection of a black wall in the mirror, but someone is shining a flashlight from the side onto the mirror, the scratch will be light and prominent and easily visible on the dark mirror. In contrast, if you look at the same scratch on the same mirror but with the mirror reflecting a white wall or light surface to your eye, the scratch will be much less visible, because both the scratch and the background (as seen by your eye) are white.

This is the basic idea used to optimize lighting for viewing CWT: Light up the laser-marked pits with light coming from the side, while orienting the mirror-like, smooth background of the tag so that you see the reflection of a black or dark surface in it.

The only complicating factor is that the "mirror" --- the surface of the CWT --- is curved. But a solution is simple: Have the illuminating light coming from the side, with the light source positioned over the axis of the wire and directed so that it illuminates the wire at about 45 degrees, and have black or dark surfaces surrounding the CWT in all other directions. See the figure below.

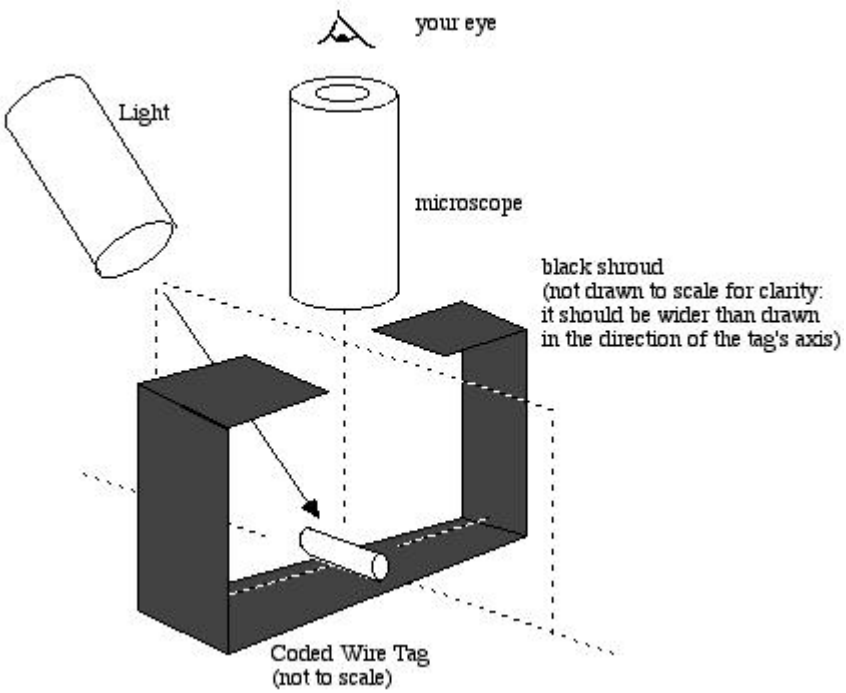

Figure 1

Figure 2 - Sketch of recommended viewing and lighting geometry.

Specific illumination and viewing suggestions

Below are some rules of thumb for setting up good lighting for viewing Coded Wire Tags:

1. With the axis of the viewed CWT going from left to right and the CWT holder extending to the right, position the light source to the left of and above the CWT and direct the light so that the light strikes the CWT at about 45 degrees to the CWT's axis (that is, the light rays from the light to the tag, the tag axis, and the light rays reflecting off the tag and into your eye or microscope should all be in the same plane; see the sketch below). This will allow bright glints from the laser-marked dots, without significant lightening of the unmarked wire surface. Do not use uniform lighting, such as from a ring illuminator, since this will tend to light up parts of the tag other than the laser-marked pits.

2. The CWT should be cleaned --- at least rinsed with alcohol or acetone ---immediately prior to viewing. Dust is everywhere and unavoidable, and can significantly reduce the readability of a tag if not removed.

3. The background to the view of the CWT --- that is, whatever is seen in the background when the CWT is viewed through the microscope --- should be black. A piece of black electrical tape adhered to the surface behind the CWT works well. This helps your eye more easily see the light, laser-marked dots. For the same reason, the room lights near the CWT should be dimmed.

4. All surfaces that are visible from the CWT should be black or dark, except the light. That is, if you imagine yourself shrunk down to the size of a CWT and standing on the CWT, then as you look around in all directions you should see only black or dark surfaces, except for the light source. For example, a ceiling light, even at the other end of the room, can cause a significant glint on the CWT that reduces a person's ability to read the tag. One easy way to ensure this is to use a black shroud over the CWT holder (described below).

Various light sources can work well: a simple gooseneck desk lamp with a standard incandescent bulb, a special-purpose microscope illuminator that puts out more directed or collimated light, and a white LED flashlight have all been tested at NMT and all can work acceptably. Each has advantages and disadvantages.

An incandescent bulb works much better if a black shroud is used to prevent illumination of surfaces that should be dark. A shroud that works well consists simply of a piece of 2" diameter x 3" long black tubing with two opposing 2" long x 1" wide notches cut in it from one end. This can be made from black construction or poster board paper, or plastic or ABS tubing. It is placed over the center of the 1"x1" brass CWT cradle from NMT with its axis vertical and with the cradle in the notches, positioned so as to view the CWT through the open top end of the tube and to allow light to illuminate the CWT through the upper half of one of the notches. See figure 2.

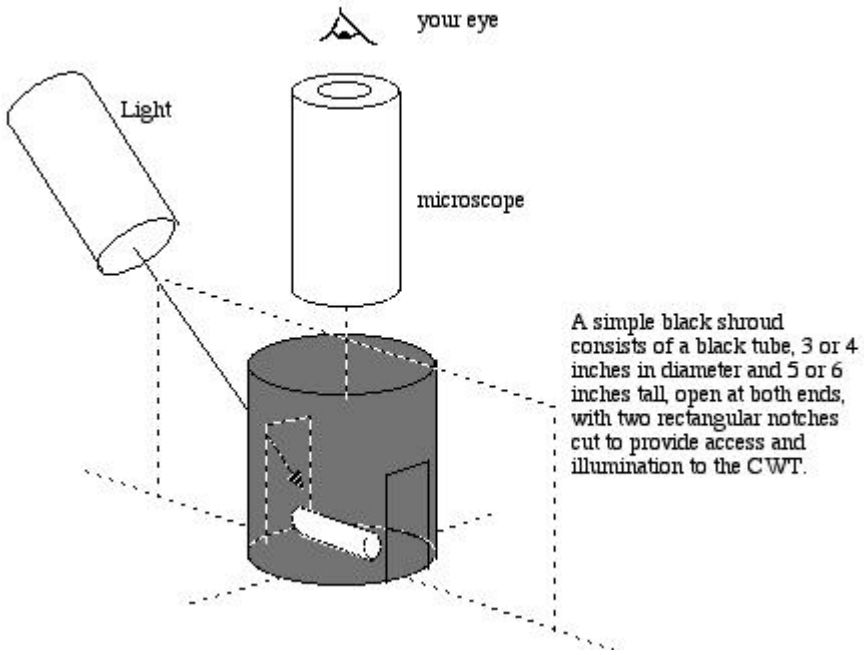

Figure 3

Figure 4 - Sketch of a setup with a simple tubular black shroud.

A collimated microscope illuminator has less or no need of a shroud, since it creates only a relatively small amount of stray light. But without a shroud, it is more important to have other lights in the room dimmed.