Initial

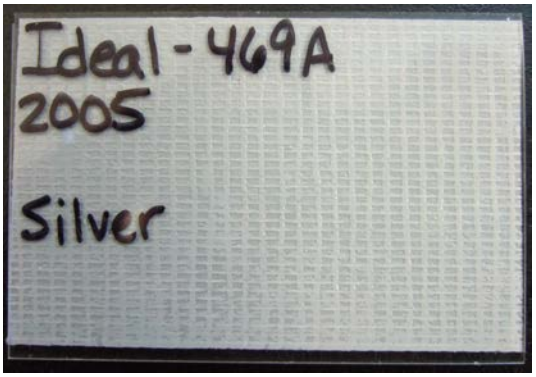
When you receive a new roll of duct tape, you will first need to label each roll. Do not assume that the outer wrapping will remain with the roll at all times.

- Remove the wrapping (if any) from the top facing side of the roll by cutting along the side at the top. Leave the sides covered with plastic as this will allow for easier storage.
- Peel back the wrapping enough to write on the inner cardboard. Label the roll with the manufacturer/year/model# and any other identifier that may be helpful. In situations where multiple rolls are submitted with the same model #, label them with a distinction (A, B, C or 1, 2, 3).
- Add the manufacturer, year, and model numbers of the new tapes into the most current Excel spreadsheet. Record the "Application" from any information that arrived with the tape.

MANUFACTURER	YEAR	APPLICATION	PRODUCT #	Munsell Book of Colors	Nominal WIDTH	Width MM
Cantech Industries	2002	Gen. Purpose	94-21(1)	N/ 9	2"	48
Cantech Industries	2002	Gen. Purpose	94-21(2)	N/ 9	2"	48.5
Cantech Industries	2002	Premium Grade	99-21	10Y / 8.5 /2	2"	48
Cantech Industries	2005		96-21			
Cantech Industries	2005		99-21			

Mounting

Mount each duct tape on a 2"x 3" slide. Label each slide with the manufacturer's name, model #, and year in permanent marker. When mounting tape, be sure to keep the warp yarns running lengthwise on the slide (see page 3).

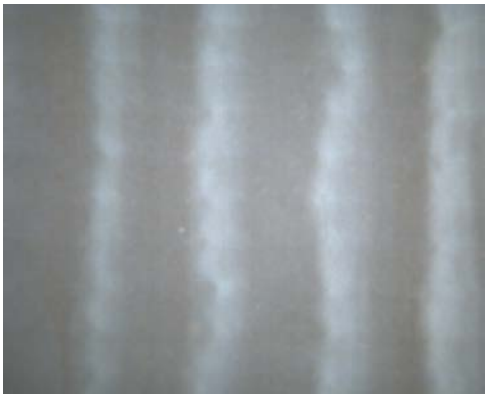


Record the following information:

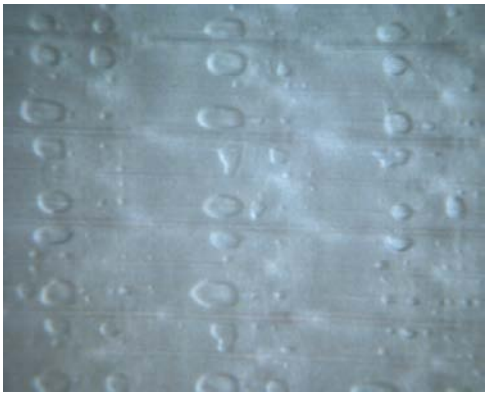
- nominal width in inches
- actual width in millimeters
- backing and adhesive colors

Determine whether the tape was manufactured by a blown or co-extruded (calendared) approach. You can accomplish this by looking at the backing side under a stereoscope.

The blown tapes will have a smooth surface that will only show bumps near the yarns:



Calendared tapes have irregular bumps on the surface of the backing due to bubbles forming and then popping:



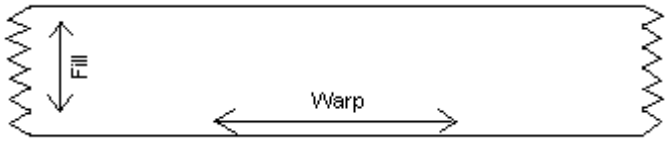
Removing Backing

A substantial amount of information can be gathered by removing the backing from duct tape and viewing the yarns and yarn structure.

- Label a slide in permanent marker with the manufacturer/year/model #.
- Temporarily mount tape with adhesive side up on previously labeled slide.
- In a well ventilated area, place several drops of xylene onto the center of the adhesive. Wait approximately 30-60 seconds and then remove adhesive using cotton tipped applicators. Work carefully as to not destroy or pull out any yarns. Repeat as necessary until at least a 1" square area is exposed.
- Allow ample time to dry. Permanently mount sample tape to the slide using clear tape to cover all remaining duct tape adhesive. Remember to always mount tape so that the warp yarns are running lengthwise on the slide.

Yarn Information

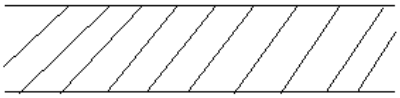
Cloth reinforced duct tape is made by weaving yarns in an up/down direction (fill) with yarns in an across direction (warp).



- You will first need to record the number of yarns running in each direction for a 1" square. Feel free to use the below as a guide. On some tapes it is helpful to use a stereoscope. Record the number of warp and fill yarns on the spreadsheet.

- Next, you will want to determine if the yarns are twisted, textured, or other. View tape under the stereoscope and record warp and fill yarn types on the spreadsheet.

  A twisted yarn is one that resembles a rope:

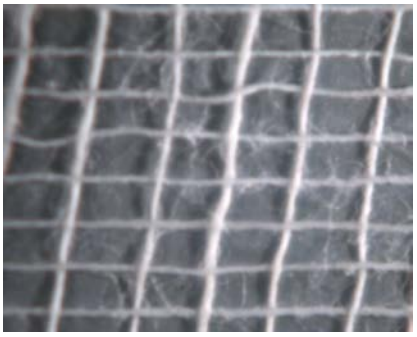


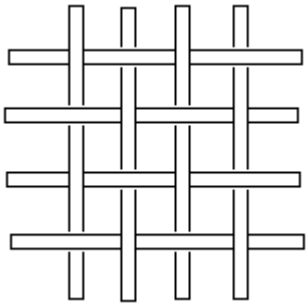
  A textured yarn is one that appears bumpy:

  Other types of yarn may appear flat, straight, but not twisted together:

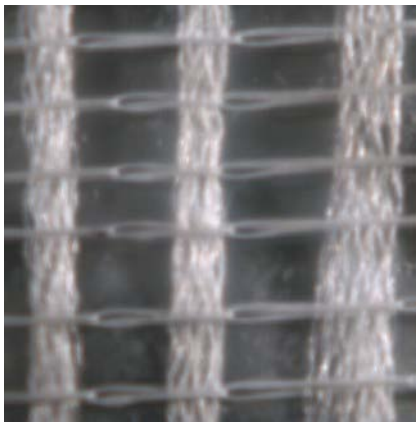
- You will also need to record the weave type. The two basic types seen in duct tape are the weave (basket weave) and the knit (weft insertion).

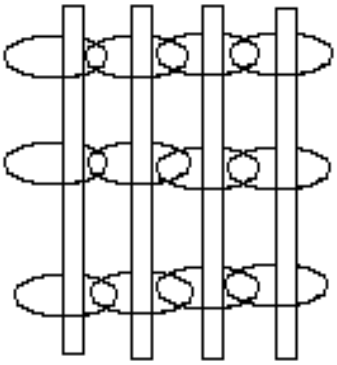
  The plain weave is made by an under-over approach:



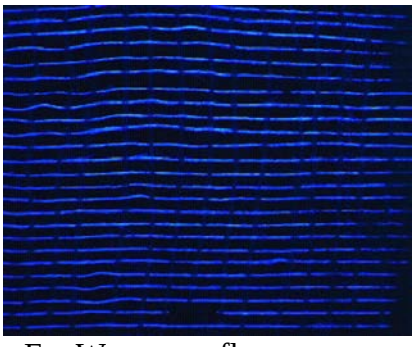


  In contrast, the knit is made by a looping around of yarns:

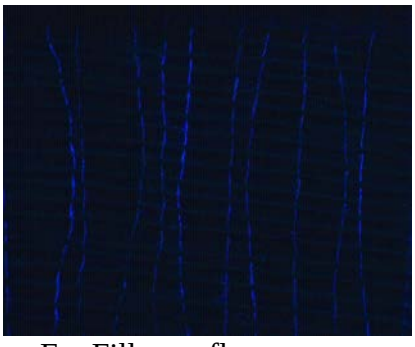




- Fluorescence is a discriminating factor in fibers. Many fibers will omit a glow when in the presence of an ultraviolet light while others will not. There are two ultraviolet lights in the scope room, one using short (256nm) and one using long (366nm) wavelengths. In low lighting, use the long wavelength ultraviolet light to illuminate the exposed yarns on the slide. Record whether or not the warp or fill yarns fluoresce.



Ex. Warp yarn fluorescence

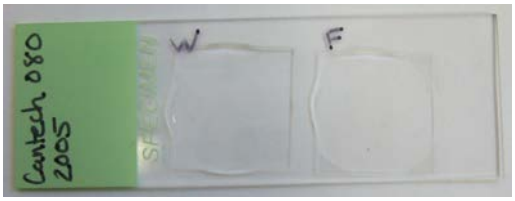


Ex. Fill yarn fluorescence

Yarn Composition

Yarn composition can be determined by using a Polarized Light Microscope. The vast majority of yarns found in duct tape are cotton, polyester, or a combination of the two. It is possible that you may encounter another type of fiber not discussed here. Please seek the advice of SCLA Ryland for clarification if such a situation arises.

- Mounting fibers: Clean your work area diligently to prevent contamination from fibers in the environment. Label the slide appropriately. Remove a small amount of warp yarns from duct tape. Place a drop of xylene on the removed yarn and agitate to remove any remaining adhesive. Lightly pull apart the yarn so that the fibers are not bunched together. Allow yarn to dry. Place a drop of Norland's Optical Adhesive on the yarns and cover with a cover slip. Label this area "W" for warp. Repeat for fill yarns. Use the below picture as a guide.

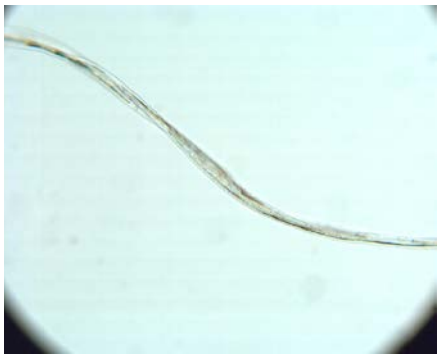


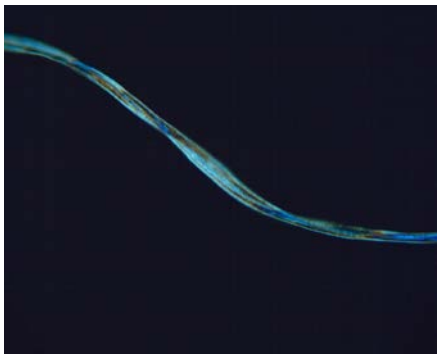
Polarized Light Microscope

Note: The following is general information on using a Polarizing Light Scope. If this is the first time that you have encountered this scope, please ask SCLA Ryland for a demonstration.

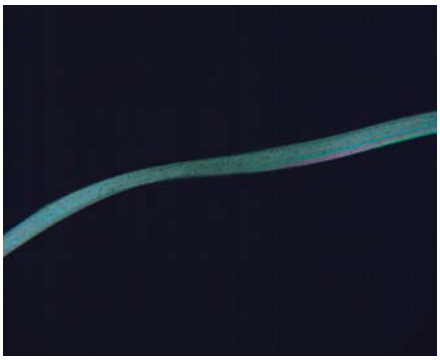
Turn "ON". Use side slide near bottom to adjust light brightness (start around 7). Put slide on stage and move stage using the two knobs. Focus using the black knobs near the back arm. Push in the Analyzer ("A") at the top of the scope to cross poles.

Cotton: Closely resembles a twirling ribbon. Surface of fiber has dislocations or X marks. When the poles are crossed, cotton fibers appear to be brilliant blues and reds. A cotton fiber will never go to extinction (disappear) when the stage is rotated.

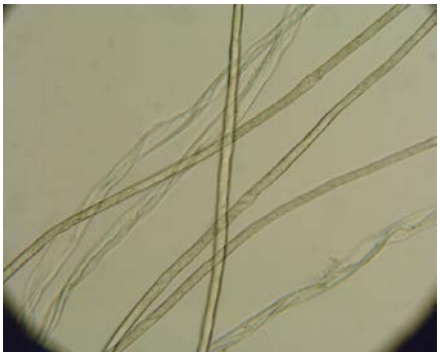


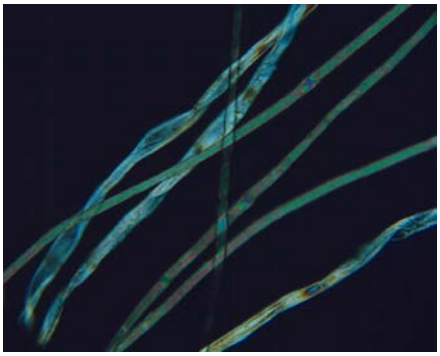


Polyester: Appears to be smooth and has an even diameter. Polyester fibers often have a titanium delusterant that looks like small specs throughout. When the poles are crossed, these fibers have bands of pastel colors which are an indication of the thickness of the fiber itself. An extinction position can be found when the stage is rotated to a 45° angle. The fiber will disappear and then reappear as the stage is rotated.



In many tapes, the yarns consist of a combination of both cotton and polyester fibers as pictured below. Be careful when identifying a yarn as a cotton/poly blend. It is possible that a stray fiber could have made it onto your slide. The ratio of cotton to polyester should be close to 50:50.





Micro X-Ray Fluorescence

This step of the project will produce quantitative elemental spectra of the duct tape adhesive. Please ask for a demonstration if this is the first time you will be using the Eagle II.

- Mount the duct tapes adhesive side up onto a designated case. Be careful not to touch the surfaces of the tape that will be examined.

Run Duct Tape on Eagle II

Turn on Phoenix first (switch in back), computer, then the “Power” button on the instrument.

Calibrate using logbook

- Open Vision32 on desktop
- Wait until vacuum indicator is at least ½ the way down
- Find Al/Cu disk on upper right corner and focus
- Click on red "magnification" icon to increase magnification
- Set kV: 40 and uA: 740
- Click on "Setup" on top bar and select "Edam Calibration"
- Click "Auto" and wait for the calibration to run
- Click "OK" and a table will appear to the right of the screen
- Record selected values into the logbook and click on "OK"

Running samples

- Bring x-rays down to minimum
- Lower Z axis down half way
- Place mounted duct tape to stage and close door. Wait for vacuum.
- Change "Peak ID" to only the ones needed
- Focus on sample
- Adjust kV: 20 and uA: 1000
- Setup for AutoRun
    - Check print settings
    - Click on "Preset"
        - Change Live field to "300"
        - Display Memory should have "A" selected
        - Select "Vacuum" at the bottom of the window
    - Click on "Setup"
        - Check the following: "save .spec", "intensity calc", "auto print spectra", "auto print quant %", "Live x-ray", and "Minimize x-ray"
        - In Live field enter "300".
        - Change file name and folder name as needed.
    - Click on "Stage"
        - Use or to move stage to desired location (try to keep between yarns)
        - Find location and click on "Save Point"
        - Select "Label" column and enter desired text (ex. Cantech 99-21). Press <enter>
        - Select next row and continue to save points. You will want three areas on each sample of tape.
        - Press "OK" when complete
    - Click on "AutoRun"
- Make sure that there is ample paper in the printer

Once the AutoRun is complete, go back and rename all spectra and save in appropriate folders. All printed spectra will be three-hole punched and put into a binder. Use the "Ten point scale" transparence to determine values from one spectrum of each tape. Record these values on the spreadsheet.

Click on “Programs” from Start menu. Select “Edax Genesis” and then “Spectral Utilities.” Click on “File” -> “Open” and select one run for each tape to convert. Open spectra and click on “SPC>MSA” from top menu. Save to floppy or burn to CD.

Photography

With a digital camera, take a picture of the roll of duct tape. Using the Pax-It Cam or HIROX system, take a picture of the scrim and backing of the tape with approximately a 1cm field of view (include a scale). Save all three pictures to disk.

Enter Data into SLICE

- Load the disk or floppy onto a computer with the SLICE database loaded.
- Open SLICE.
- Right click on the screen and select “Open Database.” Select “FDLEtape1.mdb”
- The database maybe write protected. To disable this feature, right click on the screen and choose “Write Protect.” Enter the password “12345” and press <ENTER>.
- Right click again & select “Import with Template.” A new window will pop up.
- Change any information in this window to correspond with the tape you wish to import.
- Click “Continue”
- Select file from disk/floppy. Click “Open”
- Click on “Material” and select the “Attributes” tab. Change all information to correspond with current spreadsheet.
- Under the “Manufacturer” tab, enter 1/1/YY for Date manufactured field
- Under the “Elements” tab, right click on the spectra and select “Peak ID.” Make sure that Rh is listed as an element. Right click on the spectra again and select “Quant”
- Under the “Instruments” tab
    - Select “Acquisition” and add “Rh” in the Tube field.
    - Select “Geometry” and change the X-Ray Emergence Angle to 60
    - Select “Detector” and change Window thickness to 10 microns & dead layer to 0.085 microns.
- Add any additional comments under the “Notes” tab.