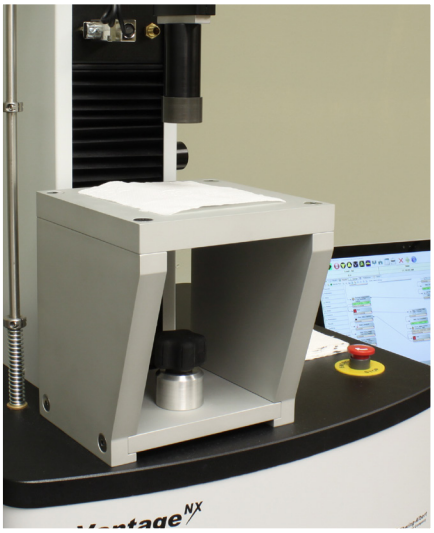
Measuring Compression/Softness of Nonwovens

Using the Vantage^{NX} and MAP4



Several factors should be taken into consideration to calculate an objective measurement of material softness. A compression/softness test can be run with a Vantage^{NX} Universal Testing Machine. The machine is paired with MAP4 software to evaluate the sample loft, thickness, compressibility, and structural softness. This test is applicable to sheeted materials including paper, tissue, toweling, nonwovens and textiles.

To run the test, a sample is placed in the test area on an adjustable lower anvil. When the test is started, the pressure foot comes down and makes contact with the sample. After contact, force and position data is collected. Unlike a micrometer, the test is set to measure at a specific force, and the test can capture information throughout the test from compression through the bounce back of the material.

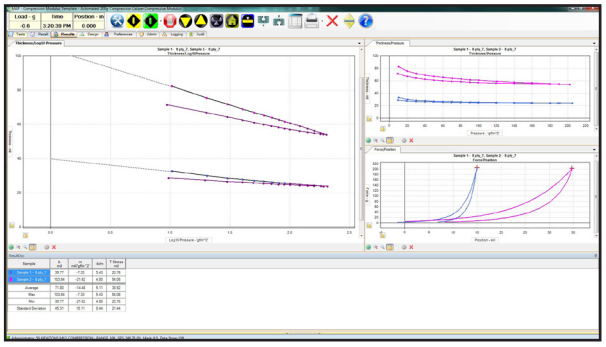
Key Details:

- Evaluate the sample throughout the test
- Calculate thickness or pressure at any data point
- Report multiple thickness values at various corresponding pressures
- Ideal for high loft materials
- Pressure controlled by force
- Review data at any point of the test
- End result = a value for objective softness
- Graphically view the slope to compare a decrease in thickness vs increase in pressure
- The larger or steeper the slope, the more compressible the material

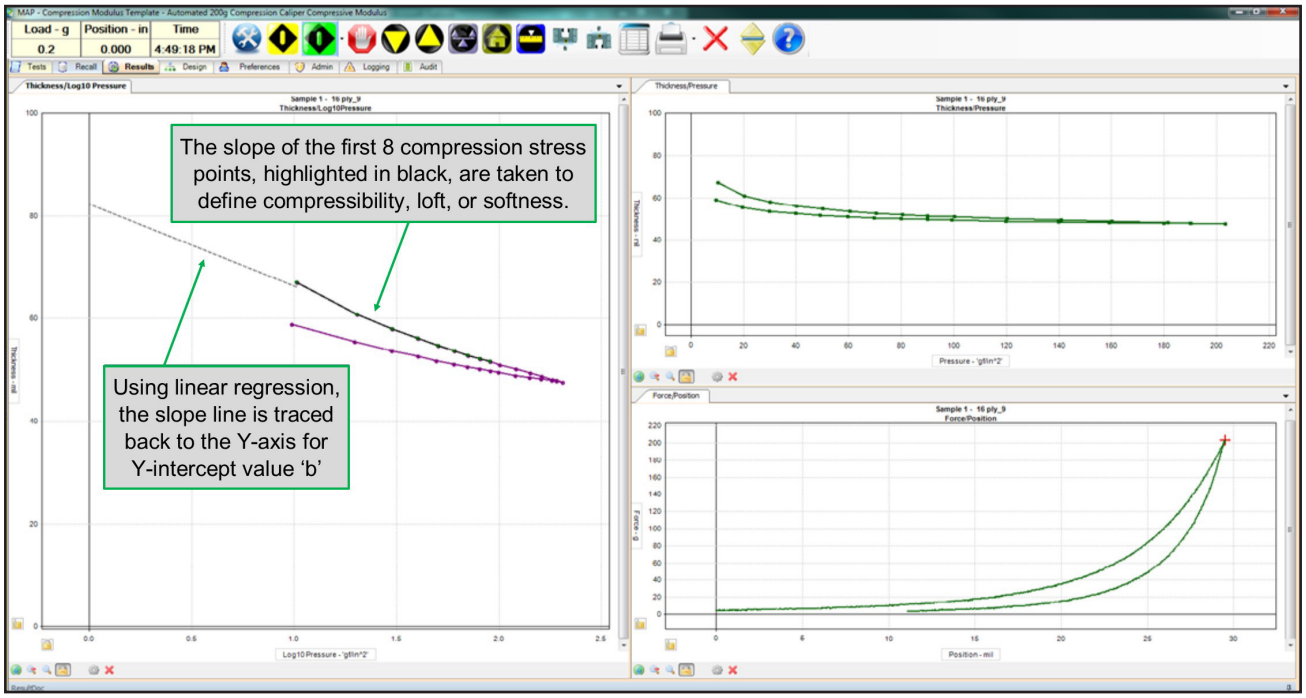
Calculated Softness?
Several measurements of a sheeted material are used in combination to evaluate an objective softness value:

- ⇨ Sample Loft
- ⇨ Thickness
- ⇨ Compressibility
- ⇨ Structural Softness

= Overall Softness



▲ MAP4 Software Results for Compression/Softness



Test Details:

A pre-test is run to establish the opening distance between the anvil and the measuring foot. All parameters for the test are set to default, but can be edited with allowed user permissions.

A sample is placed in the test area (lower anvil). When the test is started, the pressure foot will come down and make contact with the sample. After contact, force and position data is collected.

MAP4 software knows the pressure foot position relative to where the lower anvil sits. Thickness and corresponding force readings are taken throughout the compression and return cycle. The foot will slowly compress the sample to specified force and then return to the home position while continuing to record force and position.

Once the test is finished, the data points are displayed on three different graphs:

1. Force/Position
2. Thickness/Pressure
3. Thickness/Log10 Pressure

Since the force, position, and surface area of the foot are known at every point during the test, the pressure and thickness can be calculated at any data point. The pressure data is converted to Log10 Pressure to show a better representation of the compressive slope (decrease in thickness vs. increase in pressure).

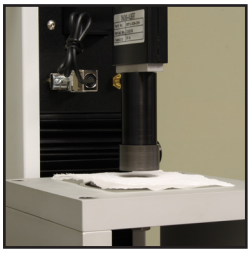
These changes in thickness vs. pressure allow the slope of the data points to be calculated. The slope value tells us the compressibility of the sample. The larger or steeper the slope, the more compressible the material is.

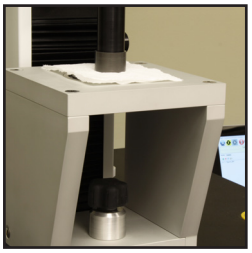
Test Results:

The data can also be used to calculate other results like thickness at specific pressures and the comparison between the original compression curve and return curve. This can tell us the energy lost or the resilience of a material to spring back to its original thickness.

ResultDoc

Sample	Y-Intercept 'b' mil	Slope 'm' mil/psi	-b/m	C10 mil	C20 mil	C30 mil	C40 mil	C50 mil	R10 mil	R20 mil	R30 mil	R40 mil	R50 mil	Calibration Date
Sample 1 - 4 ply_4	19.32	-1462.0	6.00	16.2	15.0	14.4	14.1	13.8	14.7	14.0	13.6	13.4	13.2	11/3/2015 2:17:46 PM
Sample 2 - 4 ply_4	57.18	-5633.5	4.60	44.8	40.9	38.7	37.2	36.0	38.4	36.0	34.4	33.4	32.6	11/3/2015 2:17:46 PM
Sample 3 - 4 ply_4	29.50	-3109.3	4.30	23.0	20.3	19.0	18.2	17.7	19.5	18.0	17.3	16.8	16.5	11/3/2015 2:17:46 PM
Sample 4 - 4 ply_4	25.09	-2235.5	5.09	20.4	18.5	17.6	17.0	16.6	17.6	16.7	16.2	15.9	15.7	11/3/2015 2:17:46 PM
Sample 7 - 4 ply_4	63.85	-8095.4	3.58	46.8	39.9	36.9	34.8	33.2	36.0	32.1	30.2	29.0	28.1	11/3/2015 2:17:46 PM
Sample 5 - 4 ply_4	23.39	-2104.8	5.04	19.1	17.1	16.3	15.8	15.4	16.7	15.6	15.1	14.8	14.6	11/3/2015 2:17:46 PM
Sample 6 - 4 ply_4	25.94	-1941.9	6.06	21.8	20.2	19.5	19.0	18.6	19.5	18.6	18.2	17.9	17.6	11/3/2015 2:17:46 PM



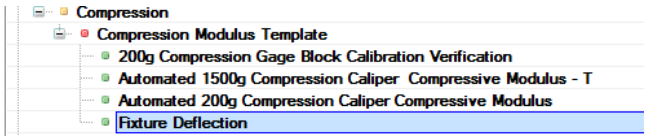


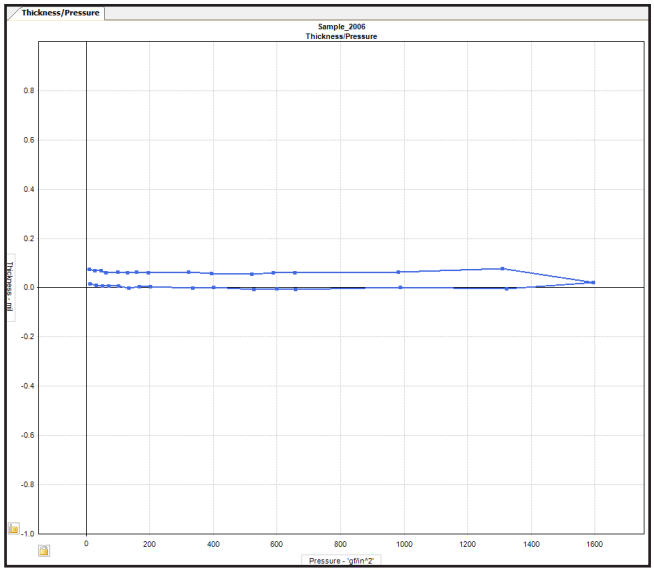
▲ The figure displayed above shows some of the possible results options including the Y-Intercept (b), Slope (m). The C10-C50 values are thickness values at certain traps (stress points). These are some of the points that make up the slope calculation. This test uses C10-C80 for the compression phase, but this can also be adjusted depending on the material. The R10-R50 are the same traps, but captured during the relaxation phase as the measuring foot is decreasing pressure from the sample.

Note that the compressibility is the slope (y = mx+b) of the stress points (C10-C80) in the compression phase. It is a negative result because as the pressure increases the thickness decreases. The larger the negative slope 'm' value, the softer or more compressible the sample is said to be in this test. This softness is the compressibility or loft of the material.

Before testing is started, an initial calibration is run. This calibration procedure is done completely through the MAP4 Software. It adjusts out the internal deflection of the system to give the most accurate position readings possible.

► The graph to the right displays the fixture deflection test. Y-Axis is deflection, X-Axis is pressure applied. The MAP4 software compensates for this greatly increasing accuracy. The corrected line runs back along the X-Axis to zero.





ResultDoc

Sample	Fixture Deflection mil	Compression Slope g/mil	Compression Intercept g	Relaxation Slope g/mil	Relaxation Intercept g
Sample_2006	3.36	534.13	-210.21	534.10	-175.08