What Type of Cover Should I Use to Optimize my Process?

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Process Determines What is Needed

The Needs of the WEB Control Everything!

- Releases From the Web
- Holds Up to Process Heat
- Holds Up to Process Pressures
- Resistance to Process Chemistries
- Has Proper Finish  \((\text{Rough or Smooth})\)
- Has Proper Geometry
Roller Cover Operational Questionnaire

• What Type of Operation Does This Roller Perform?
• What Temperature Does the Roll Face See During Operation?
• Is the Roll Body Chilled or Heated?
• What Chemicals are Present On or Near the Roll Cover?
• Is the Roller in a Nip? If So What Pressure Does the Cover Experience in PLI (Pounds per Linear Inch)?
• What Durometer is Desired?
• What Type of Surface Finish or $R_a$ is Desired?
• What Geometries (TIR, Taper, Steps) Are Required for Your Cover?
What Rubber Compound Should I Use?

Why Isn’t There One Type of Rubber That Works For Everything?

• There Are Over 20 Major Rubber Families

• There Are Elastomeric Alloys (Blends) EPDM/SI

• Two Types of Rubber Structures
  - Crystalline
  - Amorphous

• Molecular Structure of Compound Determines Physical Properties
What Properties Should be Optimized?

The Properties of a Rubber Cover Are Controlled by the Formula or Compound. Compounding is the Method that a Particular Formula is Mixed.

- Chemists Choose Physical Properties to Optimize When Formulating
- Compounding Will Vary the Performance Between Formulas Made with the Same Base Polymers
  - A 50 Duro Compound From One Supplier ≠ A 50 Duro Compound From a Different Supplier
- Choose Wisely Which Property to Optimize
  - Covers Don’t Fail Due to Tensile Strength
Imagine a Small Square Table with a Round Tablecloth that is Just a Little Too Small.

- If You Cover 3 Corners of the Table, The Fourth Corner is Exposed.

- Each Corner Represents a Physical Property That is Desired for the Application.

- As the “Tablecloth” is Moved Around to Optimize Coverage, Other Edges and Corners (Physical Properties) Are Exposed or Given Up.
Hot Melt Example

• Hot Melt Adhesive Working Temperature is 360° F

• 360° F Eliminates Most Rubber Compounds Except the Silicones and Fluoroelastomers (Viton™ type)

• Silicone Works Great With Heat But Wears Out Easily, Fluoroelastomers Are Very Expensive and Easily Damaged

• Does the Roll Cover Really See 360° F? NO!

• Process Web and Chilled Core Carries Off Heat

• Surface Cool Enough to Utilize Many Different Rubber Compounds
What About Hypalon?

Hypalon Softens With Heat and Pressure

All Compounds Soften In Use and with Increased Temperature!

Hypalon Looses 40% - 60% of Its Properties at 300° F.

Hypalon is Chlorosulfonated Polyethylene

Works Great Under the Right Conditions
What About Nitrile?

Nitrile Comes in 3 Different Forms

- Each Form Has Differing Properties
  - Nitrile (NBR)
  - Hydrogenated Nitrile (HNBR)
  - Carboxililated Nitrile (XNBR)

- Molecular Structure Determines Physical Properties
What About Urethane?

Castable & Millable

• Great Abrasion Resistance & Elasticity
  - Relatively Low Operating Temperature (< 150° F)
  - Can Revert @ Temperature (Sticky)
  - Not Optimum for Water Resistance
  - Difficult to Machine
  - Expensive
What Durometer Should I Use?

What Does Durometer Measure?

• Durometer is an *Indicator* of a Compound’s Modulus

• Durometer is Measured While the Rubber Is In a Non-Stressed Condition (Static)

• Rubber Covers Are Used In a Stressed Condition (Dynamic)
What Is Modulus?

Modulus, Or Stress, Is Used To Express The Amount of Pull Needed to Stretch A Test Piece to a Given Elongation.

- Modulus Expresses the Stiffness of the Compound
- Modulus Indicates How Much a Rubber Cover Will Move in a Nip
- Modulus is a Dynamic Measurement
Modulus Curves

![Graph showing stress-strain relationship for Amorphous and Crystalline materials.](image-url)
Which Is Stiffer: A 95 Durometer HNBR Or a 95 Durometer Urethane?

HNBR Is Stiffer Because of Its Higher Modulus Number!
Can Modulus Be Modified In a Compound?

Yes!

• EPDM Cover Needed Due to UV Cure Chemistry

• Existing EPDM Compound is “Too Soft”

• Different Binding Agents & Cure System Change Modulus and Make it “Harder”
Why Is My Cover Cracking?

- 75 Durometer Silicone Cover on Heated Embossing Line

- Cover Starts to Crack Along Web Edge
Solution to Cracking

- Step Cut Cover Just Wider Than Web

- Stress Along Web Edge Drastically Reduced

- Cover Stopped Cracking
Conclusion

• Process Dictates The Type of Cover Needed

• Durometer Widely Used to Specify Covers But Unfortunately Doesn’t Tell the Whole Story

• Modulus Describes a Compound’s Behavior Dynamically

• Modulus Can Be Altered Through Mixing

• End User Must Understand Process Needs in Order to Properly Specify a Roller Cover
Questions?