The HAPPY BALL is made of common neoprene. The UNHAPPY BALL is made of rubber called Norbornene polymer (brand name: Norsolex), which possesses excellent impact absorption properties. The rubber has great internal absorption of input energy and is able to dampen impact from a colliding object without giving the object a reaction force. It has the advantage whereby little resonance is caused by external vibrations. It can be processed in a manner similar to that of ordinary rubber, and sheets made of this material are utilized in many applications.

CHARACTERISTICS
1. Low restitution elasticity (less than 10%)
2. Excellent energy absorption under normal temperature ranges (10 ~ 30°C)
3. Absorption and insulation of high frequency vibrations are exceptional

RANGE OF USE
1. Damping Material
   - Protection of conveyor mechanism, stoppers for precise location of conveyed articles, and shock absorbers (in place of pneumatic and hydraulic devices)
2. Padding Materials
   - Protects dropped items from damage and reduces leg and join fatigue
3. Material for Minimizing unwanted Audio Equipment Resonance
   - Prevents speaker howl and insulates player units from external vibrations
4. Low Hardness Rubber Roll Material
   - Rolls for printing
5. Footwear Sole Material
   - Reduces heelstrike fatigue
6. Industrial Applications
   - Gaskets and Packing
7. Sporting Goods
   - Gloves, Mits, and Supporters
**COMPARISON OF MECHANICAL PROPERTIES**

<table>
<thead>
<tr>
<th>Item</th>
<th>Neoprene (Happy Ball)</th>
<th>Norsolex (Unhappy Ball)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength (kg f/cm²)</td>
<td>205</td>
<td>124</td>
</tr>
<tr>
<td>Stretch (%)</td>
<td>370</td>
<td>550</td>
</tr>
<tr>
<td>Hardness (JIS A)</td>
<td>63</td>
<td>32</td>
</tr>
<tr>
<td>Restitution Elasticity (%)</td>
<td>53</td>
<td>3</td>
</tr>
<tr>
<td>Compression Permanent Set</td>
<td>15</td>
<td>478</td>
</tr>
<tr>
<td>(70°C x 22H%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.39</td>
<td>1.25</td>
</tr>
</tbody>
</table>

**MANUFACTURING METHOD OF NORSOLEX**

As shown in Figure 1, Norsolex is obtained through the synthesis of Norbornene from Ethylene Cyclopentadiene by the Diels-Alder's reaction, then through ring opening polymerisation of the Norbornene monomer. Norsolex is a polymer which has a construction whereby double bonding and the five membered ring have been bonded alternately, which means that vulcanization can be done by utilizing this double bonding.

![Diels-Alder's Reaction](image1)

**Figure 1**

![Energy Absorption Rate of Norsolex according to Temperature (tan δ)](image2)

**Figure 2**