Engineered to Perform Under Pressure

When drilling across highly depleted zones and weaker formations, low density systems are required to prevent/minimize problems associated with excessive overbalance conditions including fluid loss/lost circulation, differential sticking, minimal penetration rates, formation damage, and reduced well productivity.

3M™ Glass Bubbles in drilling/completion/work-over fluids:
- Successfully and predictably reduce the fluid density
- More homogeneous and incompressible fluid properties compared to aerated systems
- Eliminate the need for specialized equipment used in foamed or aerated systems
- More economical and allow a greater density reduction window than synthetic oils
- Compatible with both water based and oil based systems
- Resistant to harsh downhole conditions

![Graph showing GB Effective Density vs. Pressure for different HGS Series products.](image-url)
**3M™ Glass Bubbles**

**Typical Physical Properties**

<table>
<thead>
<tr>
<th>Nominal Density (g/cc)</th>
<th>D&lt;sub&gt;50&lt;/sub&gt; (Microns)</th>
<th>Minimum Fractional Survival</th>
<th>Test Pressure (psi)</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.28</td>
<td>30</td>
<td>80%</td>
<td>4,000</td>
<td>HGS4K28</td>
</tr>
<tr>
<td>0.38</td>
<td>40</td>
<td>80%</td>
<td>4,000</td>
<td>HGS4000</td>
</tr>
<tr>
<td>0.38</td>
<td>40</td>
<td>80%</td>
<td>5,500</td>
<td>HGS5000</td>
</tr>
<tr>
<td>0.42</td>
<td>26</td>
<td>90%</td>
<td>8,000</td>
<td>HGS8000X</td>
</tr>
<tr>
<td>0.46</td>
<td>20</td>
<td>80%</td>
<td>19,000</td>
<td>HGS19K46</td>
</tr>
</tbody>
</table>

**3M™ Glass Bubbles achieve and maintain the target density throughout the operation:**

- **Light** – When synthetic oils are used as base fluid, densities as low as 5.5 lb/gal (0.66 kg/l).
- **Tiny** – HGS8000X and HGS19K46 remain in the fluid when circulating through solids control equipment, including shale shakers, hydrocyclones and centrifuges.
- **Tough** – HGS8000X and HGS19K46 are resistant to shear and impact forces when circulating through bit nozzles and impacting formation walls.

**3M™ Glass Bubbles help reduce your cost through reconditioning and reuse of the lightweight fluid.**

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