G-Force® System Enables Perforating in any Direction, Regardless of Gun/Casing Positioning

Halliburton’s G-Force® system comprises an internal orienting charge tube assembly and gun carrier that allows perforating in any direction irrespective of the gun’s position relative to the casing.

With an orientation accuracy range of ± 5°, the G-Force system overcomes adverse factors that can significantly decrease the ability to orient the guns in a desired direction.

Unlike externally oriented systems, which use devices and weights external to the gun and exposed to the casing environment, the G-Force orienting mechanism is contained within the gun carrier. This eliminates added friction created by external guns moving axially down the casing wall and minimizes doglegs and other discontinuities during the deployment that can cause loss of orientation.

In addition, because the G-Force rotating orienting device is contained inside the protective environment of the carrier, the fundamental orienting design is unaffected by potential restrictions in the completion string.
G-Force Gun Systems

<table>
<thead>
<tr>
<th>Gun OD</th>
<th>2-7/8 in. (73.025 mm)</th>
<th>3-3/8 in. (85.725 mm)</th>
<th>4-5/8 (117.475 mm)</th>
<th>7 (177.80 mm)</th>
<th>4-5/8 (117.475 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shot Density</td>
<td>4 spf (13 spm)</td>
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<td>6 spf (20 spm)</td>
<td>4 spf (13 spm)</td>
</tr>
<tr>
<td>Phasing</td>
<td>0-180° and 10-350°</td>
<td>0, 0-180° and 10-350°</td>
<td>0, 0-180° and 10-350°</td>
<td>0°, 0-180°</td>
<td>0°, 0-180° and 10-350°</td>
</tr>
<tr>
<td>Tensile Rating</td>
<td>141,000 lb (63,957 kg)</td>
<td>228,000 lb (107,946 kg)</td>
<td>358,000 lb (162,388 kg)</td>
<td>643,000 lb (292,068 kg)</td>
<td>358,000 lb (162,388 kg)</td>
</tr>
<tr>
<td>Collapse Pressure</td>
<td>22,000 psi (1,517 bar)</td>
<td>25,000 psi (1,724 bar)</td>
<td>20,000 psi (1,379 bar)</td>
<td>15,000 psi (1,034 bar)</td>
<td>20,000 psi (1,379 bar)</td>
</tr>
</tbody>
</table>

Benefits
- Increased orientation accuracy range of ± 5° in wells of 25° deviation and greater
- Can be loaded as a KleenZone® system for low debris applications
- Compatible with live well intervention systems such as the AutoLatch™ Connector, Ratchet Connector, and the Modular Gun System
- Can be deployed on coiled tubing, wireline, slickline or jointed pipe

Features
- Orienting mechanism is contained within the gun carrier, and is unaffected by potential restrictions in the completion string
- Can be run through tubing to orient in casing
- No need for fin tandems, eccentric tandems, or swivel subs
- Gun assemblies can be centralized in the casing
- No external weight bars required, eliminating gaps between loaded sections and lost shots
- Gun orientation can be verified after gun retrieval

Case History
North Sea
This job required accurate orientation of the perforation planes in the direction of the maximum principle stress to ensure stable perforation tunnels, overcoming a sand production problem that previously limited production from the completion. The result was a safe and flawless onsite job execution, that guaranteed flow assurance with an initial sand-free oil production rate of 6,000 standard cubic meters per day (37,600 BOPD)—a 20 percent increase in the overall Norne Field production potential.

West Africa
Customer objective: Manage sand flow into the wellbore
The challenges to overcome: Loss of perforations in the productive zone due to the use of eccentric weighted hollow steel carriers and loss of orientation accuracy due to excessive torque and drag associated with conventional orienting techniques such as external fins and swivel. Halliburton recommended the 7-in. OD oriented gun system to perforate a 9 5/8-in. casing in the direction of maximum principle stress. In addition to performance improvement, the new 7-in. OD G-Force system reduced operating time during makeup, deployment and positioning of the gun assemblies, saving the customer over 50 hours of rig time.

For more information, contact your local Halliburton Wireline and Perforating representative or visit us on the web at halliburton.com