HARD ROCK MINING

RESIN BOLT COMPARATIVE TESTING

R27 SECURA BOLT

INTRODUCTION

A variety of four (4) different rock-bolts with fitted nuts used extensively in hard rock mining were tested by a NATA accredited laboratory MTS\(^1\). The rock-bolts and nuts were tested for various strength and mechanical properties.

The samples were delivered to the testing facility differentiated only by a painted colour marker. All testing of the bolts referenced the following colour code I.D.

The orange colour I.D. refers to the Minova R27 Secura Bolt.

Minova R27 Secura Bolt

The Secura Bolt\(^6\) is a specifically designed solid reinforcing bar for use in strata reinforcement. The bolts include a unique paddle system to improve resin mixing and 27mm diameter deforms which provides higher bond strength in larger diameter boreholes. Secura paddles are formed using a unique shearing process which results in a more consistent resin mixing along the column length.

Advantages

- Proven historical performance
- Extensive quality-controlled manufacture
- Permanent primary support
- Multiple lengths, diameters, paddle configurations
- Consistent pin nut torque drive system
- High strength thread
- Proven resin mixing performance
- High load transfer

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\(^1\) All the testing and results reported, were undertaken (independently) by a NATA accredited testing service, Melbourne Testing Services Pty. Ltd. (MTS) in collaboration with the Deakin University.

\(^2\) While the report does not provide any specific conclusion, this flyer identifies the Minova R27 Secura Bolt and offers a performance comparison, based on our own interpretation of the tested data.

\(^3\) Complete Report No. MT-19/0101-B, “Testing of Steel Rock-Bolt Bars and Retaining Nuts” is included in the pages following this bulletin.
**TENSILE STRENGTH TESTING**

Five repeat test pieces for each variant bar type were accurately weighed and measured to determine the specific mass per metre and actual diameter. Five repeat test pieces for each variant bar type were loaded in tension until rupture of the bar occurred. Testing was conducted in accordance with AS 1391-2007.

*Bolt Tensile Response*

<table>
<thead>
<tr>
<th>Bolt by Colour I.D.</th>
<th>Tensile Strength (MPa)</th>
<th>Maximum Force (KN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orange Bolt (Minova Secura)</td>
<td>833</td>
<td>351</td>
</tr>
<tr>
<td>Red Bolt</td>
<td>691</td>
<td>303</td>
</tr>
<tr>
<td>Blue Bolt</td>
<td>744</td>
<td>324</td>
</tr>
<tr>
<td>Yellow Bolt</td>
<td>646</td>
<td>212</td>
</tr>
</tbody>
</table>

**SHEAR STRENGTH TESTING**

Five repeat test pieces for each variant bar type was prepared and then fitted to a hardened steel, double shear plain loading tool. Shear force was then applied to the tool's plate until the peak force was attained and shear failure of the test pieces occurred.

*Bolt Shear Response*

<table>
<thead>
<tr>
<th>Bolt by Colour I.D.</th>
<th>Single Shear Strength (MPa)</th>
<th>Single Shear Force (KN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orange Bolt (Minova Secura)</td>
<td>624</td>
<td>263</td>
</tr>
<tr>
<td>Red Bolt</td>
<td>487</td>
<td>214</td>
</tr>
<tr>
<td>Blue Bolt</td>
<td>536</td>
<td>233</td>
</tr>
<tr>
<td>Yellow Bolt</td>
<td>504</td>
<td>166</td>
</tr>
</tbody>
</table>

**TORSIONAL RESPONSE TESTING**

*Shear Pin*

One single test bar for each variant type / colour was tested. A length of bar incorporation the threaded end and nut was secured to a fixed torque plate assemble. Rotational torque was applied in an anti-clockwise direction until the peak torque was achieved and failure of the shear pin or end cap had occurred.

After completion of the shear pin tests the nuts were welded to the rock-bolts to facilitate testing of the bar for torsional strength. Rotational torque was applied in an anti-clockwise direction until the peak torque was achieved and torsional rupture of the bar occurred.

*Torsional Bar Strength*

<table>
<thead>
<tr>
<th>Bolt by Colour I.D.</th>
<th>Mode of Failure</th>
<th>Torsional Strength (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orange Bolt (Minova Secura)</td>
<td>Torsional rupture of bar</td>
<td>1755</td>
</tr>
<tr>
<td>Red Bolt</td>
<td>Torsional rupture of bar</td>
<td>1534</td>
</tr>
<tr>
<td>Blue Bolt</td>
<td>Torsional rupture of bar</td>
<td>1534</td>
</tr>
<tr>
<td>Yellow Bolt</td>
<td>Torsional rupture of bar</td>
<td>975</td>
</tr>
</tbody>
</table>

**TENSILE STRENGTH THREADED SECTION & NUT PULL-OFF TESTS**

Repeat tests were conducted for each variant bar and nut type. Sample lengths of bar were cut with nuts threaded onto the end of the bar in the as delivered condition. Special loading washers were fitted over the bar to provide a secure reaction against the loading nose of the nut. The test pieces were then fitted into the tensile testing machine and loaded in tension until the peak load and failure of the bar or threaded connection occurred.

*Nut / Thread Tensile Response*

<table>
<thead>
<tr>
<th>Bolt by Colour I.D.</th>
<th>Mode of Failure</th>
<th>Maximum Force (kN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orange Bolt (Minova Secura)</td>
<td>Tensile rupture of bar</td>
<td>352</td>
</tr>
<tr>
<td>Red Bolt</td>
<td>Tensile rupture of bar</td>
<td>302</td>
</tr>
<tr>
<td>Blue Bolt</td>
<td>Thread stripped</td>
<td>308</td>
</tr>
<tr>
<td>Yellow Bolt</td>
<td>Thread stripped</td>
<td>201</td>
</tr>
</tbody>
</table>
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- Water stop grouts
- Ventilation formwork systems including: Meshblock and Tecmesh
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- Flexible membranes for strata support and waterproofing applications

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