
DC Gaging LVDTs Monitor Stability of Mt. Rushmore

Mount Rushmore is located in the Black Hills, near Keystone, SD. It is composed of granite characterized by bands of large crystals cutting through the mountain. In addition, numerous joints and fractures also intersect the mountain. Like most rock masses, Mount Rushmore can be viewed as a group of interconnected rock blocks.

In 1989, a series of studies was conducted to assess the stability of the sculpture. Key block analyses revealed three “critical” rock blocks, meaning those portions of the rock mass more prone to movement. Although this sculpture has been stable for nearly 60 years, the National Park Service prudently hired an engineering services company in South Dakota to determine if any long-term movement of these three critical rock blocks (plus a 4th one not considered critical) could be detected.

For this application, the engineering firm developed a sophisticated rock block monitoring system, which includes the Model 0351-0000 DC Gaging LVDT, modified to have a higher spring force, a shorter overall length and added protection against moisture. The four

rock blocks that are continuously monitored are located on the depictions of Washington (two areas), Roosevelt and Lincoln. The monitoring program, designed to capture three-dimensional motion, takes measurements of a moving block relative to an adjacent, noncritical rock block.



The monitoring instruments are mounted on two separate pins set into the rock on either side of discontinuities defining the blocks. The modified Gaging LVDTs are an important part of this monitoring system, detecting any relative motion between the two pins. To offset

the large temperature variations in the Black Hills, instrument components most affected by temperature are made of Invar 36.

To further enhance this setup, four “dummy gages” were installed, consisting of identical Gaging LVDTs mounted in a machined Invar 36 fixture. Because of Invar’s low coefficient of thermal expansion, the dummy gages are used to track the typical response of the LVDTs to changes in temperature. The dummy gages facilitate diagnostics of the rock block monitoring system.