CHAMPIONX
ARTIFICIAL LIFT

HARBISON-FISCHER | QUADPRO™ Plungers

# QUADPRO™ Plunger

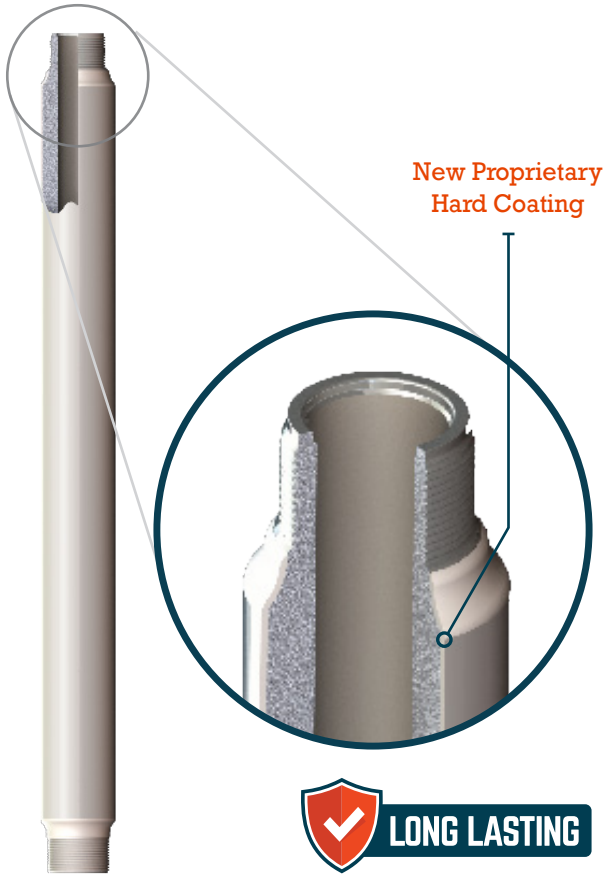
## Resists wear by downhole sand and other abrasive, corrosive particles

### Applications

- Conventional and unconventional wells
- Solid-rich environments that can compromise traditional spray-metal plungers

### Benefits

- Unique new proprietary hard coating
  - Features multi-sized ultra-hard particles
  - Applied with newest cutting-edge technology
- Coating is 50% harder than sand particles
- Wear resistance is vastly superior to common competitive technologies
- Resists abrasion in solid-rich pumping environments
- Corrosion resistance exceeds most stainless steels in




**To get the most from your plunger in challenging downhole environments, you need a plunger that can resist the effects of sand and other abrasive and corrosive particles.**

Most plungers fail in solid-rich environments when sand and other abrasive and corrosive particles invade the interface space between the plunger and the barrel. As the particles enter the interface space, the plunger and barrel surfaces wear down, which increases slippage, resulting in reduced efficiency and lower return on investment for operators.

In response to the market need, Harbison-Fischer has developed the QUADPRO™ Plunger, which offers significant improvement over traditional hard coated plungers in four main areas: sand tolerance, wear reduction, abrasion resistance and corrosion resistance. The innovation behind the improved performance of QUADPRO™ Plungers, is a unique coating formulation and application, which are proprietary to Harbison-Fischer. QUADPRO™ Plungers feature a new hard coating that contains multi-sized ultra-hard particles, which is applied via cutting-edge technology. The result is a plunger that has proven in the field to increase well run times significantly when compared to competing hard coated plungers.

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The QUADPRO™ Plunger was laboratory tested alongside three types of traditional spray-coated plungers. The ASTM G174 abrasion test, which tests rigid engineering materials for abrasion resistance when rubbed against aluminum oxide finishing tape, was performed on each plunger in order to benchmark the wear resistance of the various plunger coatings under pure wear conditions. The test involved rubbing a loop of abrasive finishing tape against each plunger over a period of time with each tape loop replaced after every hour. As a groove develops in the plunger's surface the volume of material that is removed is measured for mass lost. The wear volume loss for the duration of the test measures the ability of the plunger's surface to resist wear from abrasive substances; the lower the volume loss, the better the abrasion resistance. (See Figure 1)

The test results showed that QUADPRO™ Plunger performed significantly better than the flame spray-coated plungers. In fact, the QUADPRO™ Plunger showed 8, 15 and 28 times more

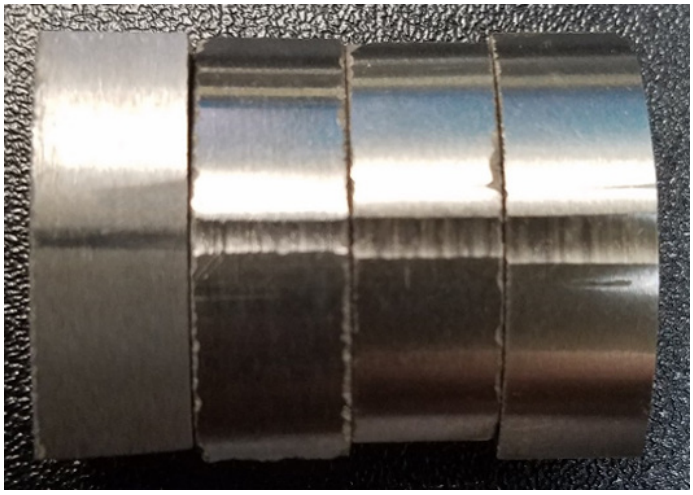

**Figure 1:** A batch of test samples is shown. Horizontal wear bands are clearly seen.

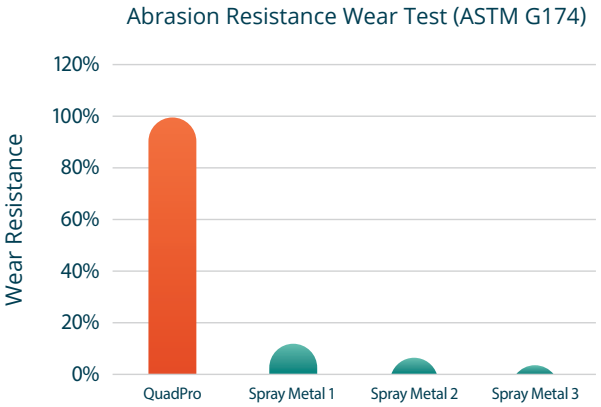


**Figure 2:** Results of ASTM G174 abrasion test.

resistance in head-to-head comparison with the three competing plungers. (See Figure 2)

The QUADPRO™ Plunger was also field-tested in several oil wells in California that had historically short run times due to sand and particle abrasion. The first test plunger was installed in February 2018 with a total of 28 plungers installed over the life of the test period. As of March 2020, 14 of the plungers are still running, with a largest single-well improvement in run time of 1,677% over historic run times, while there is currently an overall 51%

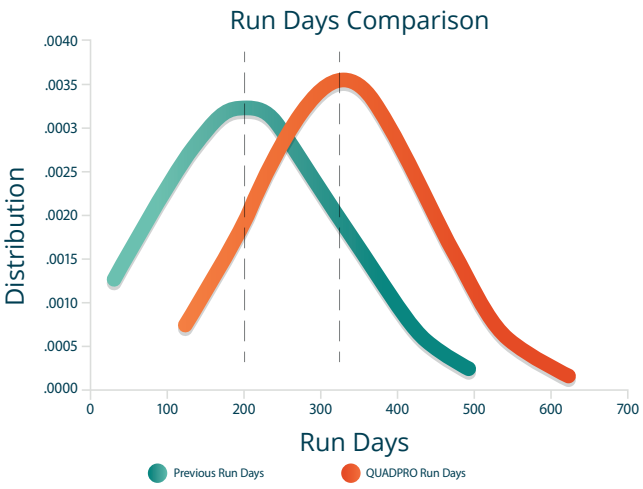


**Figure 3:** QUADPRO plungers are exceeding historical performance over a large sample size.

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