NORBAR CASE STUDIES | NCS011-1

Mill Liner Bolting Services — NTS

ELIMINATION OF MILL LINER BOLT FAILURES

About Grinding Mills

Grinding mills are a key piece of equipment widely used in the mining industry for grinding crushed materials during the ore dressing stage. This process separates valuable minerals from their ore.

As the process is very arduous, mills are lined with steel or rubber liners, these are re-lined regularly to prevent damage to the main shell.

As part of the mill re-lining process, the mill liner bolts are normally retorqued 24 to 48 hours after going back on line. Due to the large number of bolts, the re-torquing process is time consuming and costs of lost production are extremely high. However if re-torquing is not done, there is an increased chance of unplanned down-time due to bolt failure.

The Norbar Technical Services Approach — Know Your Problem

At Norbar Technical Services, we champion doing this job once, and eliminating the need to do a re-torque.
We have applied our experience and knowledge to develop a mill liner re-torquing process that is accurate and efficient. The key to developing our trusted service has been in identifying and understanding the root causes of bolt failures.

The Root Cause of Bolt Failures

Liner bolts fail (break or loosen off) for several reasons, but our extensive experience demonstrates that these can be eliminated if the pre-load is correct. Fatigue failure is the most common failure; this is almost invariably due to pre-load that is too low. The reasons for this can be divided into three groups: inadequate original tension, inconsistent tension and high relaxation.

INADEQUATE ORIGINAL TENSION (PRE-LOAD TOO LOW)

The interfaces between the bolt, liner and shell are rarely smooth or in machined condition. Consequently the friction is greater than standard calculations predict, which results in low average bolt tension.

INCONSISTENT TENSION

The relationship between torque tightening and bolt tension in good conditions is generally ± 25%. Add rough surfaces, interaction and short clamp length to diameter ratios and this becomes significantly higher. Our experience is that the variation can be +25% to –100%; it is rare when we measure all bolts that we don't find at least one that is completely loose.

HIGH RELAXATION

The relaxation on liners is particularly high. The mating surfaces between the liners and bolts are rough due to being cast and forged during manufacturing. Added to this, the tapered engagement multiplies any relaxation. Any small embedment of raised surfaces will be multiplied by the slope angle. For example if 0.1 mm embedment occurs on a 1:4 taper, the result is 0.4 mm in lost elongation.

Image: The Boltstress G6. The G6 uses ultrasonic technology to measure the exact torque applied to each mill liner bolt during the relining process.

Our Solution

With our understanding of why mill liner bolts fail, Norbar Technical Services has developed a non-retorquing method that gives accurate, trackable and reliable bolting data to completely eliminate bolt failure.

The key to the method is measuring each individual bolt and then adjusting it to the precise required bolt pre-load. Many of our clients express concern that this process will slow down the relining process, however this concern has been disproved time and again. Our experienced NTS technicians complete the operation accurately and efficiently, ultimately saving not only the reline time, but also reducing down-time in the long run by eliminating liner bolt failure. Typically, the process takes approximately the same time to complete as other lesser methods.

In combination, Boltstress and Norbar torque tools form a comprehensive bolting solution with unbeatable accuracy. Our experienced technicians are fully trained in both ultrasonic measurement, and hydraulic or pneumatic bolt torquing. We offer these additional benefits:

- Elimination of bolt failures
- Removal of damaged seized fitted stud bolts
- Trustworthy technical advice
- Early detection of relaxation and defects

The Tools

Boltstress G5 or G6 — Ultrasonic technology in the Boltstress G5 and G6 measure the exact tension applied to a bolt. The interrogation of waveforms and internal calculation firmware uses the change-of-flight method, but also takes into consideration change in velocity due to stress, change in velocity due to temperature, thermal expansion and change in length. Most other systems only consider change in length.

Norbar pneumatic/hydraulic torque tools — Norbar torque tools provide the bolting grunt-work, completing bolting tasks with speed and precision.

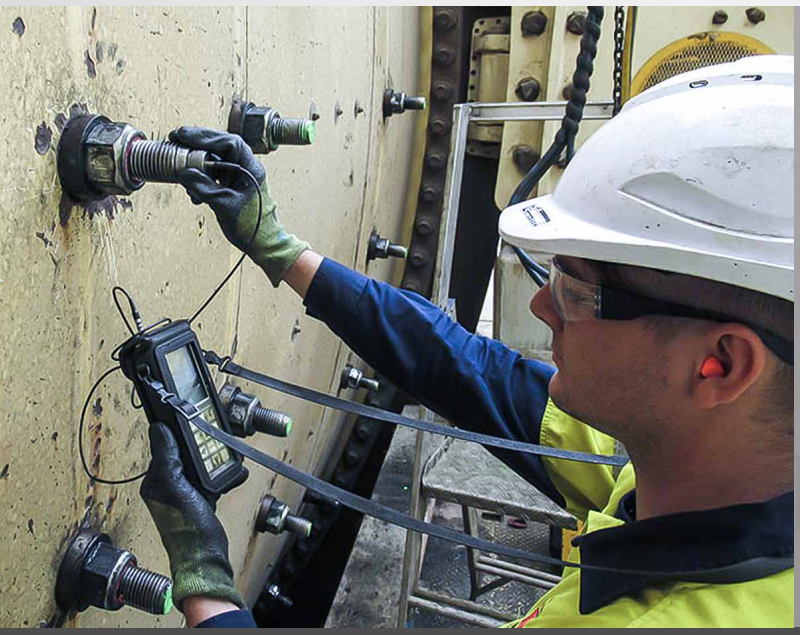
The Method

Prior to the relining process, the allowable tension for the bolts is calculated to determine the allowable stresses for mating parts. The ultrasonic data files are also set up at this time to begin capturing the bolting data for accurate tightening and for future tracking of bolt health.

1. Each bolt is measured and stored into memory. Files are saved by joint (e.g. Head, Shell, Discharge etc.).

2. As the bolt is tightened it is measured 'live', the torque wrench is stopped when precisely the correct tension is achieved. This improves the tightening accuracy to ±1% (from ±25%). This is repeated for every bolt, stored in memory for future monitoring.

Our experienced NTS technicians complete the operation accurately and efficiently, ultimately saving not only servicing time, but also reducing down-time in the long run.

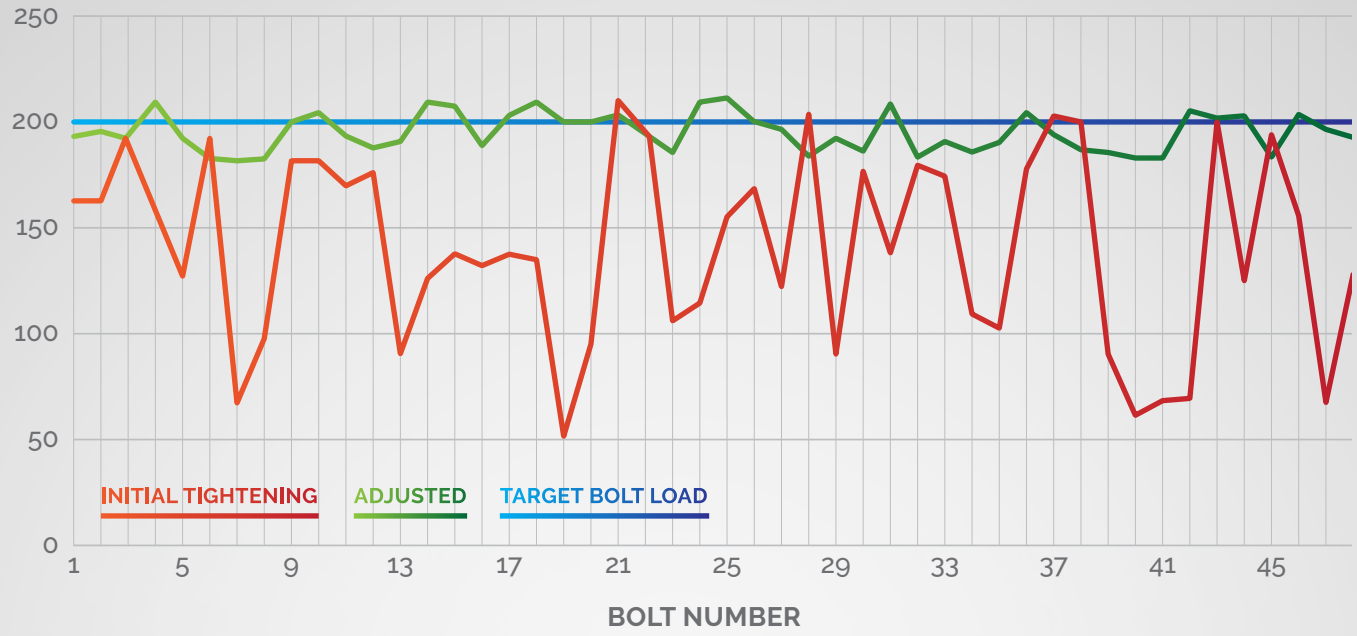


To eliminate instances of failure, each bolt is measured and adjusted to precise required bolt pre-load. Experienced NTS technicians complete the operation accurately and efficiently.

Image: A technician testing a mill liner bolt using the Boltstress G5.

Proven Results

The results below from a real case show the normal variation that torque tightening generates. The average is well below the required pre-load. The variation is +5% / –75%, the green line shows the final result after adjustment of each bolt. The outcome was total elimination of all bolt failures. Prior to this the failure rate was one per week, each causing an unplanned breakdown costing up to AUD$160,000 incident. Many other sites lose $50,000 to $150,000 per hour. They are often out of action for four to eight hours, costing between $200,000 to $1,200,000 per incident.



Global Client Portfolio — To date, we have installed, measured and torqued new mill structural bolting to over 50 mills in Australia, Egypt, Ghana, Laos, Sweden and Brazil.

Trusted Advice — More than 25 years of ultrasonic measurement experience and over 70 years of torque experience make us one of the most trusted in our field.

Proven Results — Our graphed results show the clear benefits of ultrasonic measurement and accurate torquing to achieve a reduction on equipment down-time.

Early detection of defects — By tracking torque data over time, defects can be detected and remedied before bolt failure occurs.

CLIENT PORTFOLIO

Altura | WA
Anglo Gold Ashanti | WA & Brazil, 3 mills
Barrick | WA & Saudi Arabia, 3 mills
BHP | WA
Citic Pacific | China, 12 mills
Evolution | NSW, 2 mills
Glencore | 4 sites, WA & QLD, 6 mills
Goldfields | 2 sites, WA, 3 mills
Metso Minerals | 4 sites, WA, NSW & Ghana, 9 mills
Newcrest Mining | 4 sites, WA, NSW & PNG, 19 mills
Newmont | 3 sites, WA & Ghana, 6 Mills
PanAust | Laos, 4 mills
Rio Tinto | NSW & QLD, 3 mills
Pilbara Minerals | WA
Sandfire Resources | WA
Sino Iron | WA, 12 mills
South 32 | 2 sites, WA & QLD, 4 mills
Weir Minerals | WA & NSW, 2 mills

Find out more about these products and services:

- **Services offered by NTS**
- **Boltstress ultrasonic measuring products**

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