

A Lemke Industrial Machine LLC White Paper



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Gate Hoist Testing Methodology

Lake Darling Dam Project Stage 2

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INTRODUCTION

Lake Darling Dam was constructed in order to provide water in times of extreme drought. The U.S. Fish and Wildlife Service owns and operates the dam, but the U.S. Army Corps of Engineers takes over the dam's management during periods of flood risk.

Constructed in 1936, it has a normal surface area of 18 square miles.

Lake Darling, also known as Dam No. 83, is of earthen construction. The core is earth and the foundation is soil. Its height is 39 feet with a length of 3,300 feet. Maximum discharge is 22,400 cubic feet per second. Its capacity is 227,400 acre-feet. Normal storage is 121,600 acre-feet. It drains an area of 9,160 square miles.

PROBLEM STATEMENT

To accommodate the outflows from the Lake Darling Dam, the Army Corps of Engineers designed tainter dam gates that were substantial in size. The gates were 42' wide X 19.5' high.

Due to the critical nature of the operation, the Corps wanted to ensure that the gate hoist design could accommodate the worst case loading conditions. It was decided all five of the gate hoists would be tested as final assemblies before being shipped to the job site. This meant that the contractor who built the gate hoists would need to have testing capabilities.

PREVIOUS OPTIONS

Test methods in practice typically consist of a frame structure that supports sheaves. Cables run in the sheaves connecting a fixed load to the gate hoist. Accurately adjusting the desired load is difficult and time consuming.

Since the structure is fixed, the width of the gate hoist is typically limited. Additionally, the physical limits of the available load make testing for the desired reserved lift capacity impractical.

PRAXIS SOLUTION

Lemke Industrial Machine LLC designed, engineered, and built a fixture specifically for the testing of gate hoists. The fixture was originally built to test the pocket wheel drum concept developed by the U.S. Army Corps of Engineers.

The fixture can apply both static and dynamic loads of up to 400,000#.

Mounted on a track system that allows for width adjustment, the test fixture will accommodate all types of gate hoists from as narrow as 4' up to 50' wide.



Benefit 1: Static Lift Load Test

The test fixture can subject the gate hoist to the intended operating lift load. The full system realizes the static load as the test fixture exerts the required pull force on the hoist cables. This test validates that the gate hoist will properly operate under the intended lift load.

Benefit 2: Dynamic Lift Load Test

The test fixture can subject the gate hoist to the intended operating lift load while monitoring the hoist operating speed. This test validates the gate will operate at the design speed with the intended dynamic lift load.

Benefit 3: Reserve Lift Capacity Test

The test fixture can accurately subject the gate hoist to a multiple (1.25X, 1.5X, 2X etc.) of the design lift load to insure a desired reserve lifting capacity. This reserve lifting capacity test can be run both statically and dynamically.

IMPLEMENTATION

Lemke Industrial Machine built the five Lake Darling Dam gate hoists to the specifications as provided by the U.S. Army Corps of Engineers. The 43' wide gate hoists were individually mounted on the test fixture. Once mounted, each gate hoist was subjected to 80,000# of force, first statically and then dynamically as the gate hoists were operated. The hoist was operated and stopped at various predetermined points. The load was held for one hour at each point before moving on to the next point.

Operating speeds, while under lift loads were recorded. Additionally, each gate hoist was subjected to a reserve lift capacity load of 140,000#. This designed reserve lift capacity was 1.75 times the rated load or 75% over the lift load.

The torque limiting switch feature of the drive units was then adjusted to “trip out” the drive. This safety feature was, and is, included to protect the equipment, both gate and hoist, from damage should any unusual and/or extreme overload condition occur during field service operation.

Without incident, all five of the gate hoists performed as required by the specifications.

SUMMARY

The ability to test a gate hoist before it is put into service results in a number of advantages. The overall assembly can be tested to determine if the design meets all service requirements. Additionally, testing can validate the reserve lift capacity designed into the gate hoist. All designs have a theoretical reserve lift capacity, but only physical testing can validate and accurately set the reserve lift capacity.

During spring, the Lake Darling Dam gate hoists are mission critical to controlling the floodwaters of the Souris River. Statically and dynamically testing the gate hoist gave the U.S. Army Corps of Engineers the assurance that the product performed as designed. Additionally, the U.S. Fish and Wildlife Service, as owners, were given confidence in the installed product.

