



# YASKAWA

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## *Tram Line in Mining Operation*

Many thought Yaskawa's distributor stepped off the deep end when they accepted the challenge to smooth out the operation of a tram line carrying gypsum rock.

The tram line, in operation at an Alabaster, Mich. quarry, moves three-ton buckets of gypsum over Lake Huron shallows to a deep-water bin for loading onto deep draft cargo carriers.

Utilizing three cables, including one with a length of more than 13,000 feet in a continuous loop, the tram line resembles a giant ski lift as it carries the buckets over a series of nine towers spaced 750 feet apart.

The tram was powered by a vintage 1920's, one-of-a-kind wound-rotor AC motor. Repairs were difficult and spare parts were virtually impossible to find.

In its present configuration, the tram could run at only four operator-selected speeds, and the combined characteristics of the tram line and motor made even those limited speed changes extremely rough and hard on mechanical components. Across-the-line starting also produced variations in speed and rpm levels that were beyond the operators control.

Working with the Distributor and Yaskawa, the engineers studied their options for replacing the aging wound-motor setup and eliminating its drawbacks. Selection quickly narrowed to a Yaskawa flux vector variable speed drive and matched motor. It was a choice based on a combination of drive/motor capabilities, including:

- A "stepless" speed range of 1,000 to 1 - a vast improvement over the previous 4-step arrangement.
- Continuous speed regulation of 0.01 %, compared to 5 to 7 % in the old system.
- The ability to provide 100 % torque at zero rpm and full-torque soft starting capabilities.

- Torque-limiting to protect vintage tram machinery.
- The modern design of the flux vector drive, assured availability of parts and service for many years.

"Installation of the 150 HP drive/motor combination has vastly improved line performance and increased production". Tram operators noted immediate improvements, including:

- Smooth starts and stops from preselected ramp speeds.
- Easy speed adjustments through the drive's digital keypad.
- During line stops, the drive's "zero servo lock" activates as a backup, easing stress on the line's mechanical braking system.
- Built-in dynamic braking dissipates motor regeneration energy when a loaded bucket travels downhill.
- Stepless control permits better control in high winds, frequent to the Great Lakes.

Control is so precise, in fact, that even in high wind conditions, the tram can be adjusted to a speed lower than that of the former first setting and continue to operate. Previously, high wind conditions had required that the tram be shut down entirely. Additionally, the high slip ratio of the old motor created variations in traction cable speed as the buckets traveled up and down sags between towers. Speed regulation from the flux vector drive, however, maintains precise tension in the cable.

These factors have combined to increase production per shift to 230 tons per hour from 210 tons per hour. That's an impressive increase of 160 tons per shift, which keeps production sailing along.