

Hoist Repowering Project for 4100A Shovels

Project Developed
In the
Powder River Basin



11/18/2001

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Introduction

- ≪ **M22 Motor installation on 4100A shovel**
 - **Mark Townsend – Flanders Electric Motor Service**
- ≪ **Motor Field Control**
 - **Gary Sorenson – Drives and Controls Services**

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P&H 4100A Hoist Repowering Project

- ≪ **Original goal: Find an economical solution to the unacceptably short hoist motor life, primarily due to thermal degradation, on 4100A shovels.**
- ≪ **Solution must not compromise performance.**
- ≪ **Solution must not adversely effect machine. Electrically or Mechanically.**

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Solutions Explored

- ≪ **Modifying the Cooling Capacity of existing Motors.**
- ≪ **Replacing Existing Motors with Motors that have more Thermal Capacity.**

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Solution Agreed Upon

- ⚡ Investigation revealed that the existing Hoist Motors on the 4100A's are thermally inadequate for the duty to which they are being subjected.
- ⚡ Therefore, it was mutually decided to repower the Hoist on a test Shovel with new, more thermally robust, Motors.
- ⚡ This Motor is the M22.

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Additional Objectives

- ⚡ Provide a Motor, in which we have enough confidence, to offer it with a four year Warranty.
- ⚡ Provide a Motor with enough reserve thermal capacity to allow for an increase in hoist performance through motor field control.
- ⚡ The M22 has met all aforementioned criteria.

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Project Development Timeline

- ⚡ June, 2000. Project discussions begin with customer. Potential solutions explored. Historical data examined.

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Project Development Timeline

- ⚡ June-Aug, 2000. Investigation conducted to determine underlying causes of problem. Viable solutions explored. Research and development conducted for the design of possible replacement motor.

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Project Development Timeline

⌚ **Aug-Dec, 2000.** Research indicated that existing motors are thermally insufficient, even if modifications were implemented (some airflow modifications had already been effected) . Mutually decided upon to try a different motor.

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Project Development Timeline

⌚ **Sept. 2000** Discussing options available for drive upgrades and motor field control.

⌚ **Dec, 2000.** Tentative dates set for retrofitting a machine. Date set for test run (dyno) of proposed motor.

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Project Development Timeline

⌚ **Jan, 2001.** "M22" Motors are test run (dyno tests). Speed Torque comparisons double checked. Customer Maintenance Personnel in attendance. Tests went well. Plans finalized to implement the retrofit.

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M22's on Test Stand



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Project Development Timeline

Feb 15th, 2001. Motors on Unit #108, 4100A shovel retrofitted with FE M22 motors. Installation went well (less than 12 hours). Final control adjustments made and machine returned to production following morning.

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M22 Installed



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Project Development Timeline

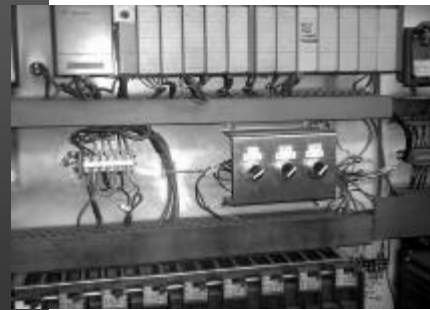
Feb 27th, 2001. Stand alone field control for the Hoist and Swing Motors tested and commissioned. Hoisting, lowering and swing speeds checked and set. Machine operated well. Significant improvement in performance achieved (see recordings).

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Field Control Installed



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Project Development Timeline

≈ **March-May. Small adjustments made on a couple of occasions to fine tune the machine. Machine has run well to date. Cycle times improved by approximately 10%.**

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Project Development Timeline

≈ **July 17th, 2001. M22's removed from unit 108 to allow for the installation of the Digital Drive and K-1690's. This was the only machine scheduled for enough down time to allow for this installation. M22's met all the requirements set forth by customer and two new units ordered. New M22's go into full scale production.**

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Project Development Timeline

≈ **August 22nd, 2001. M22 test motors and DCS field control installed on Unit 107 shovel. Installation completed in less than 12hrs and machine returned to production, with active hoist field control, that evening. Final commissioning performed the following morning. Virtually no loss in production.**

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Project Development Timeline

≈ **August 23rd, 2001 to Date. Unit 107 performing very well. Machine has proved to be very reliable with no nuisance problems whatsoever. Operators and management delighted with machine performance.**
≈ **Maintenance Dept. reports that to date there has been no increase in maintenance attributable to this retrofit.**

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Advantages of M22 Motor

- ⚡ **A very cost effective solution to the Hoist Motor problem.**
- ⚡ **Four year warranty on Motor.**
- ⚡ **Simplicity of installation and operation. Can be installed on a down day with virtually no loss in production. No major changes to control scheme.**

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Advantages of M22 Motor

- ⚡ **The M22 is exhibiting very good commutation characteristics with extraordinary brush life (5,000 hrs to date with no re-brushing). Has developed a good film with no commutator grooving to date. Is exhibiting less flashover potential, with the few flashovers being effectively dissipated without damage.**

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Advantages of Motor Field Control

- ⚡ **Installed during 12 hour PM**
- ⚡ **Takes advantage of superior thermal characteristics of M22 by weakening field when torque demands are low resulting in higher motor speed**
- ⚡ **Proven design**
- ⚡ **Simplified Troubleshooting**

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Advantages of Field Control

- ⚡ **With motor field control, provides a significant increase in performance and a corresponding increase in production**
- ⚡ **Meets or exceeds performance of P&H digital drive for less than 10% of cost**
- ⚡ **Cost effective for 2800 and 2300 machines**
- ⚡ **Cycle times indicated approximately 10% improvement in performance**

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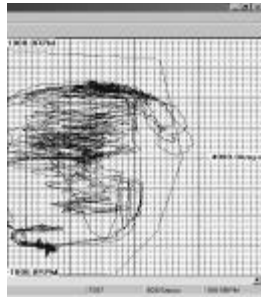
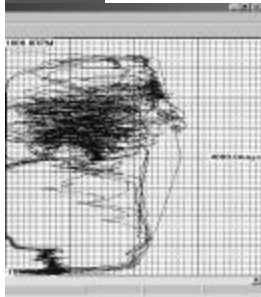
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Original Hoist vs. M22 W/FC

M22 W/DCS Field Control

K-1250 Standard



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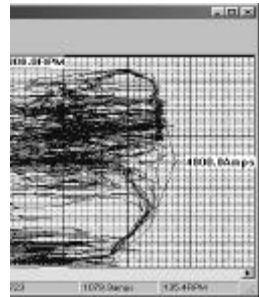
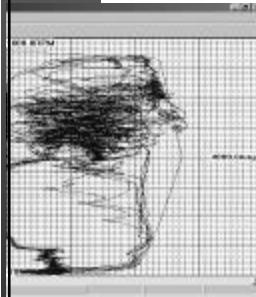
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Comparison

M22 W/DCS Field Control

Digital Drive Upgrade



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Summary of Performance Enhancements

Motor	Lower Speed	Hoist Speed <small>*load dependent</small>	Peak Power Amps
K-1250	812	632	2250
K-1690	975?	975*	2500
M22	1000	860*	2473

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Prospective Applications

- ≠ Any 4100A hoist application
- ≠ K-925 Replacement / Upgrade on 2800 or 2300 Hoist (potentially higher gains possible than with 4100)
- ≠ K-1010 Replacement
- ≠ Upgrade to Motor Field Control and run P&H motors at M22 levels for a short evaluation period
- ≠ K-700 Replacement?
- ≠ Utilize DCS production monitor to evaluate performance improvements

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Project Summary

- ⚡ **K-1250's removed and M22's installed. Approximately 12 hrs. install time.**
- ⚡ **Adjustments made and Machine returned to production following morning.**
- ⚡ **Motors caused no compromise in performance.**

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Project Summary, cont.

- ⚡ **Field Control commissioned 2-weeks later, 2001 in 12 Hours. Virtually no loss in production.**
- ⚡ **Substantially increased the performance of the machine.**
- ⚡ **Retrofit successful. All project goals met or exceeded. Customer delighted with all aspects of this project.**

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Contact Information

Flanders Electric Motor Service

- ⚡ **Dave Patterson, Co-Owner and Operations Manager. (812) 867-7421.**
- ⚡ **Steve Pfettscher, Western Division Manager. (970) 416-6332**
- ⚡ **Mark Townsend, Field Services Tech. (970) 870-6397**

Drives & Controls Services:

- ⚡ **Don Patterson, President & C.E.O. (903) 509-9595.**
- ⚡ **Gary Sorenson, P.E., Project Engineer. (903) 520-5276.**

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