



## From Mexico to Canada with a Stop in Detroit; A Case Study in Recapitalization

Problem: Relocate three late vintage automotive production grinding machines from Mexico to Canada and retool the machines to process different components, reduce cost and provide faster return on investment.

Keep in mind, the machines will be stripped of some key components and will also be partially disassembled. Also included is a complete automation system which is also in pieces. Even though the machines are now four years old, they must meet the same statistical capability requirements as new machines. Oh and by the way, the machines from Mexico must adhere to Canada Electrical and Safety Specifications prior to entry into that country.

Sounds complicated and expensive! Worse yet it sounds like there is only one place to send the machine for this work; back to the OEM. This in and of itself is a problem because most Machine Tool OEMs would much rather sell new equipment than rebuild or retool. In most cases, they do not have the culture or mentality for retooling, and for this reason customers often pay much more than they need to.

Where do you turn? The best solution is to find an independent company, who has been in business for over 30 years with the talent base to retool, retrofit, rebuild, remanufacture, and even re-engineer your machine at a competitive price.

Enter, C & B Machinery of Livonia, MI. In business since 1980, C & B Machinery started out as a small machine tool remanufacturing company whose primary focus was (and still is) production grinding machines. Though C & B's business has also evolved into new production double disc grinders as well, major retooling for their customer base is still a large portion of their business. Industries and customers include Automotive (the Big-3) and tier-1 suppliers (GKN, Metaldyne; connecting rods, American Axle; u-joints), Aircraft (Honeywell; brake pads), Bearings (MRC, NTN), Recreational Vehicles (Harley Davidson; connecting rods), Commercial Truck (Navistar; bearing caps, Allison; transmission gears) and more.

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In addition to retooling their own grinding machines, they also retool their competitor's machines.

Machine tool repair / rebuilding is not a new industry. Many companies sprung up in the 1960's and 70's and more continue to emerge. In retrospect many companies have gone under in recent years due to economic conditions, competitiveness, and an inability to keep up with the latest trends in technology.

There is no doubt that the introduction of the disposable or commodity machine has also hurt the machine tool rebuilding market over the years. Those who have survived are companies rebuilding / remanufacturing larger production and specialty machine tools. Production grinding machines and large multi-axis boring mills are examples of machines that lend themselves well to rebuilding, retrofitting and retooling.

In order to determine whether an existing piece of equipment can be re-utilized, the intended process must first be analyzed in depth. This is the same sequence as determining the design parameters for new machines. What are the components to be processed? What are the critical tolerances, stock removal(s) and what is the production requirement; per year, per hour. How many shifts per day will the equipment be required to run? What is the material and hardness?

Once the process is analyzed, then attention can be turned to the machine. Will the envelope of the machine work for the components to be produced? Is it capable of producing the tolerances? Is it designed to run 24/7? If not, then what is the extent of rework and/or redesign involved in making the equipment suitable for the process? Age and hours of use are also determining factors. What is the condition of the guide-ways? Are the cutting tool spindles still salvageable? Are OEM parts still available? Are the machine controls still supported?

In the world of machine tool refurbishment there are many levels:

- Repair: Replace only what is broken and get the machine working again.
- Recondition: Repair or recycle existing machine components.
- Rebuild: Restore the machine back to the original OEM specs.
- Retool: Arrange the machine to run a different component by designing new tooling and part programming.

- Retrofit: Install new control system while leaving the existing mechanical systems intact.
- Remanufacture / Re-Engineer: Rework the machine to the customer's specifications and beyond. Replace all commercial components; re-design the machine to accept the latest feed systems, guarding and automation.

Getting back to the case study at hand, it is a story worth reading, and might even save your own company some capital investment in the future.

An RFQ was received from a domestic automobile producer to retool, re-qualify and relocate three production double disc grinding machines from Silao, Mexico to St. Catharines, Ontario Canada. The machines are equipped with complex automation systems which include gantry style load / unload system, eddy current system, error proofing system and post process gaging system. The production requirement is 600 parts per hour based upon the grinders processing three components simultaneously in 18 seconds. This is also assuming all of the aforementioned systems function properly. Each machine must be capable of running five part configurations with minimal changeover. This means changing over the automation as well. Maximum changeover time is expected to be within 30 minutes. The machines must conform to Canada CSA and PSR electrical and safety standards as well.

After considerable research on the part of C & B Machinery's estimating and engineering departments, a comprehensive bid package was constructed and submitted. It was decided that the machines were suitable for the proposed components and of a vintage that only retooling and moderate machine repair would be required to ensure a capable process and long lasting machine. The bid process alone consumed dozens of man hours. The automotive producer agreed and awarded C & B the contract for the three machines from Mexico and one from Michigan. The fact that C & B supplied this customer with multiple NEW double disc grinding machines processing like components was also a contributing factor in their decision.

The grinding cells were disassembled at the plant in Mexico. All of the subsystems had to be removed and the grinders had to be partially disassembled in order to ship the machines to C & B. This also included disconnecting the machine's main electrical panel and the operator console. The cells were received basically in pieces with damage to several areas due to the long journey. Upon receipt of the

machine(s), every component was inspected, photographed and logged. An internal review meeting was conducted involving all relative departments. From this review, detailed work instructions were developed and then reviewed again.

To successfully expedite this program required a good deal of synergy between C & B and several suppliers. For example the automation and automatic gaging systems were delivered back to the original suppliers for evaluation, retooling and testing. To oversee the activities of these suppliers as well as the entire project, a Project Manager was assigned to the program.

With limited engineering drawings, C & B design engineers developed new tooling layouts and part touching tooling details. This effort included analyzing existing tooling, confirmation of accuracy of the drawings and reverse engineering of components with no existing documentation. These new designs were developed in accordance to the customer's drawing standards. The customer receives a complete new set of Cad drawings to their specifications.

C & B controls technicians and engineers reconnected the machine(s) to the main electrical panel and the operator station in accordance to existing documentation. Likewise all pneumatic and lubrication lines were reconnected. Once the machine was reconnected, electrical power was applied. Prior to commencing any debug the main spindle drives and all motors were analyzed via Spectral Analysis to determine the condition of bearings and balance. The first machine analyzed showed premature failure of the spindle bearings due to extreme out of balance condition of the spindles, pulleys and motors. Consequently (with the customer's blessing) the grinding wheel heads were removed from the machine and completely rebuilt. The bearings were replaced with new and the bearing seats and spindle journals were meticulously inspected for signs of wear and to ensure size and roundness were within the bearing manufacturer's specifications. Once rebuilt, the spindles, pulleys and motors were independently balanced in accordance to industry standards. After being reinstalled on the machine, the units were rebalanced as an assembly.

The grinding wheel heads were rebuilt in parallel with tooling design & manufacturing and retooling of the automation and gaging systems. No timeline delays were caused by this additional work.

The automation and gaging systems were received after retooling and spotted in correct (rough) position relative to the grinder. After the new tooling was installed, necessary new (CSA compliant) control components installed and the system checklist was completed, the cell underwent a very lengthy debug process with engineers and skilled machine builders working in unison.

- All utility settings adjusted.
- Motor rotations verified.
- Communications from the HMI to all other intelligent devices checked and verified.
- All machine functions tested and verified in manual mode.
- Part and dress programs verified.
- Re-referencing of all axes of motion.
- Sensor and switches checked for proper operation and sequencing.
- Peripheral system functionality tests (gage, gantry system, error proofing system, eddy current tester and conveyor systems)
- Finally auto cycle verified at fractional rates.

Once auto cycle was debugged, final alignments of the automation system were performed. The machine cycle was slowly sped up and tested repeatedly. Once eight hours of continuous trouble free operation was met, the grinding wheels were installed, dressed and optimization of the actual grinding cycle commenced. All in all, the debug and testing phase lasted almost one month, which is not unusual for such complex machining cells.

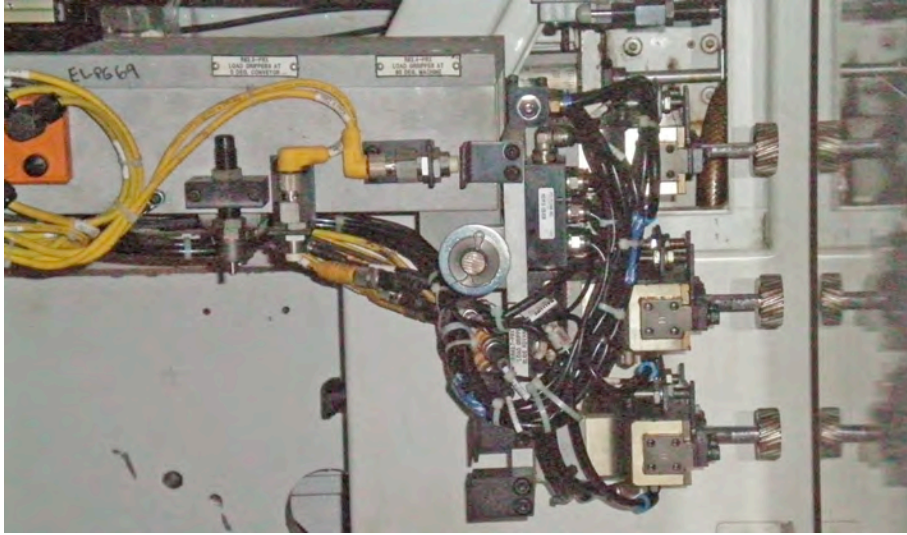
What is unusual is that this highly complicated grinding cell was delivered to the end user at approximately 30% of the cost of a new machine.



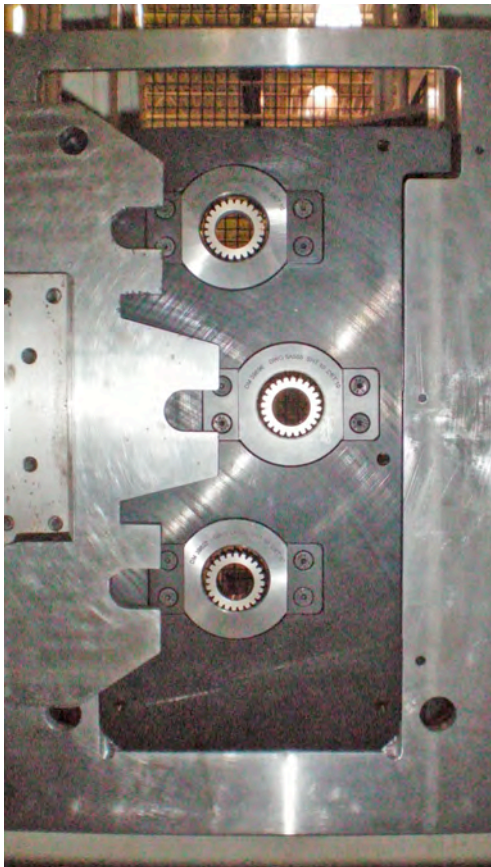
Grinding Cell as Received at C & B



Reassembled Complete Cell



Gears ready to enter grinder



Gears in workholding fixture