Hall Control Systems

Complete Automation Solutions

Date: 2/5/2018

Proposal for Litton Lathe Control System Upgrade

This proposal is for automating a manual or upgrading an automated Litton lathe to produce quartz or boriscillicate glass products. Proposed new control system for lathe could provide the following:

1. A control system to automatically form a quartz blank to given specifications. An operator interface (human to machine interface panel – HMI) for adjusting the heat time, move distance, cooling time, flame setting, move velocity, etc. parameters in the form of a touch screen data input panel. The HMI interface will allow the operator to choose from saved programs, edit saved programs via parameters, create new programs, and delete programs from the controller's memory. The programs will be saved on a remove-able micro-SD card that can be backed up to a PC for safe storage.
2. A set of 4 manually set control valves will allow automated control of the on /off of the flame settings for two (2) propane (or hydrogen) / oxygen burners. Burners could be of surface mix, and / or pre-mix type. Alternately, full automatic control of the flame settings from the PLC could be done with proportional control valves allowing multiple flame settings.
3. Automated adjustment of the quartz blank forming parameters based on operator parameter input.
4. Automated control of on / off valves for air thru headstock and tailstock rotary unions.
5. Digital control of all pneumatic valves for tooling, chucks, etc.
6. Automated digital control of headstock / tailstock chuck pneumatic pressure.

The HMI operator panel will allow operations personnel to adjust the machine parameters as needed based on current blank forming parameters for the product.

A diagram of the gas delivery system is shown in Figure 1. This system will turn on / off a set of valves via a PLC. Control of the flame setting will be via a set of manual needle valves on each burner, or thru analog 4-20 mA proportional control valves.

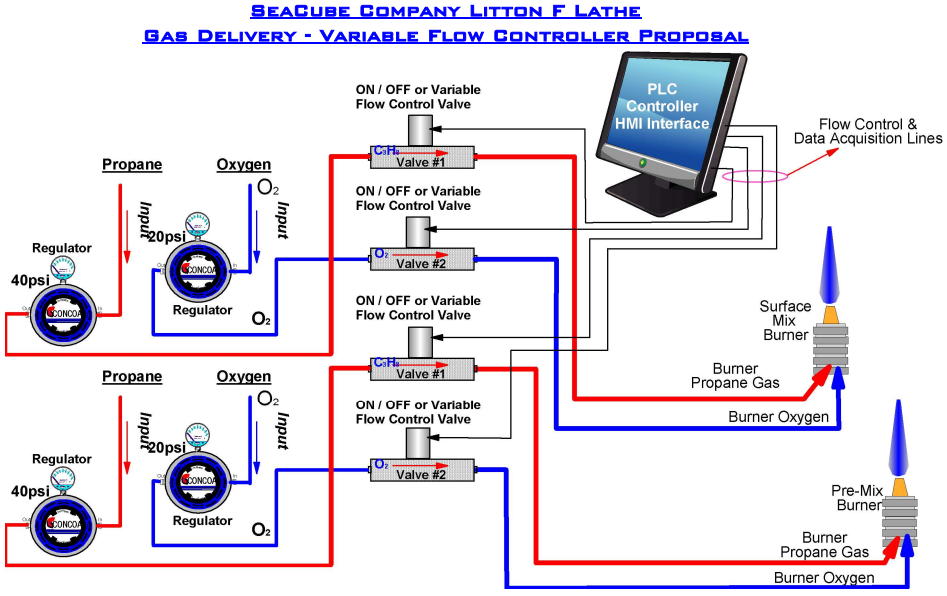

Figure 1. Gas Delivery System Overview Diagram

The lathe being modified could be a manual lathe that needs a control system, or an automated lathe that needs a replacement for an out dated Litton's "Glassmaker" system. The following controls are possible with new control system:

1. Motorized fire carriage (motor #1)
2. Motorized tailstock (motor #2)
3. Motorized spindle (motor #3)
4. Motorized tool carriage (motor #4) with the following possible attached controls:
    a. Tool #1 – pneumatic control of up / down motion
    b. Tool #2 – Motorized move to end point positioning (motor #5), motorized up /down positioning (motor #6), pneumatic control of tool
    c. Tool #3 - Motorized move to end point positioning (motor #7), motorized up /down positioning (motor #8), pneumatic control of tool
    d. Tool #4 - Motorized end point motion (motor #9) with automated pneumatic pressure controller.

The current concept of the new automation controls for the lathe is shown in Figure 2. This lathe will still require the operator to load the glass blank before starting the machine.

While the part is being formed, the green stack light will be flashing to indicate machine is running. Any error will be indicated with a red stack light, and a finished part will be indicated by a solid green stack light. Also, the machine status will be shown on a display on the lower portion of the HMI screen.

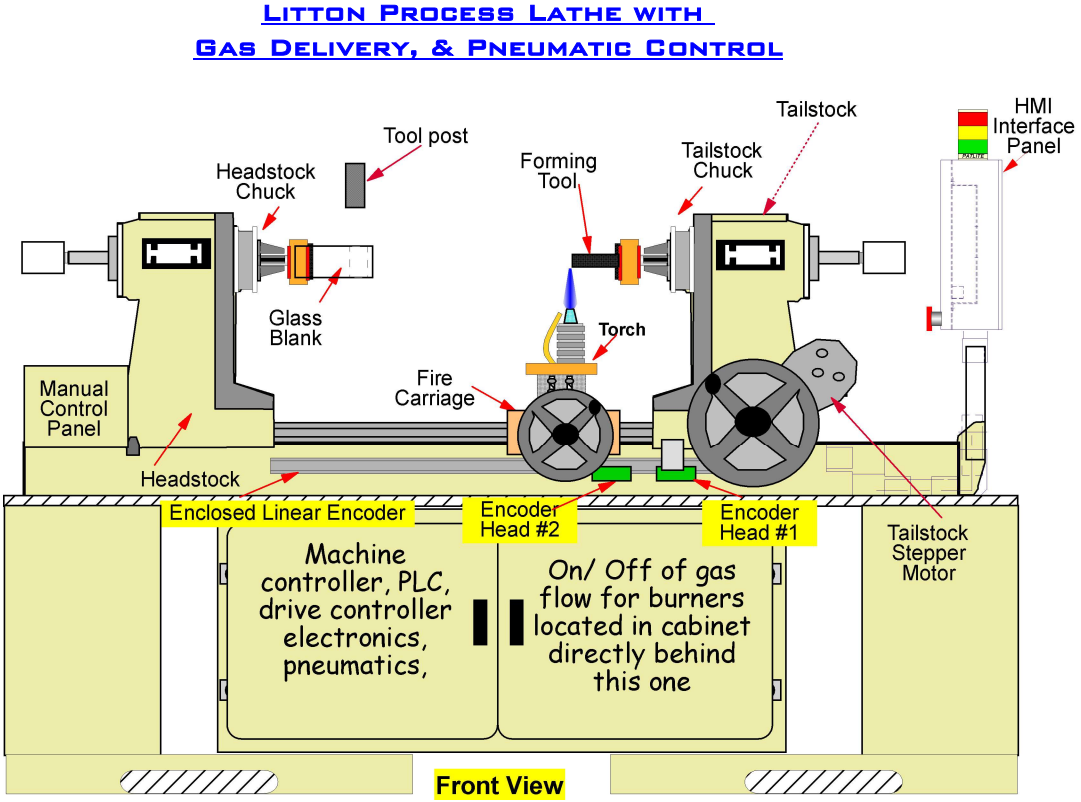

Figure 2. Front View of Upgraded Litton Lathe

The layout of the table for the machine is such that it will allow for location of tool carriage on top and electronics cabinet below. Also, the bottom section of the table is designed to allow easy access for a pallet jack to facilitate easy movement of the lathe (table design may be different than shown).

The machine main menu will display the information shown in Figure 3 and allow the operator to select the product to run, change parameters, add new designs, and access the maintenance menu functions.

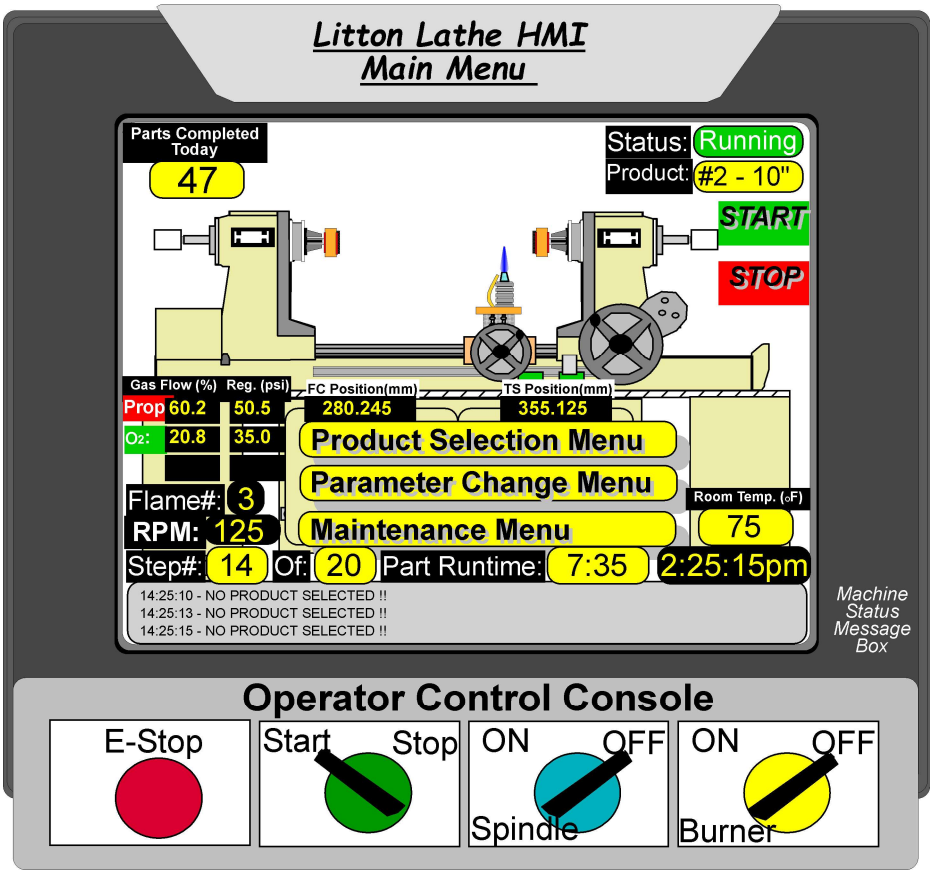

Figure 3. – HMI Panel Main Screen

The operator's main console will consist of a simple 4 button console shown in Figure 3 for starting / stopping the machine and turning on / off the spindle and burner as necessary. All other controls and this control will be accessible thru HMI touchscreen panel.

The operator will first have to select the "Product Selection Menu" to select the product to be run. Once the product has been selected and operator has loaded the part, the "Start" button is pressed to run the blank. All parameters for the product selected will be automatically set, including the gas flow for the torch. Currently selected parameters will be displayed on the main operator screen as shown in Figure 4.

From the "Product Selection Menu" screen, new products can be added and current products can be modified by the supervisor / operator. All the current products are shown and can be selected from the 1st screen and new product will be available from the "Next" screen.

The "Parameter Change Screen" shown in Figure 4 will allow process changes to the blank to be made.

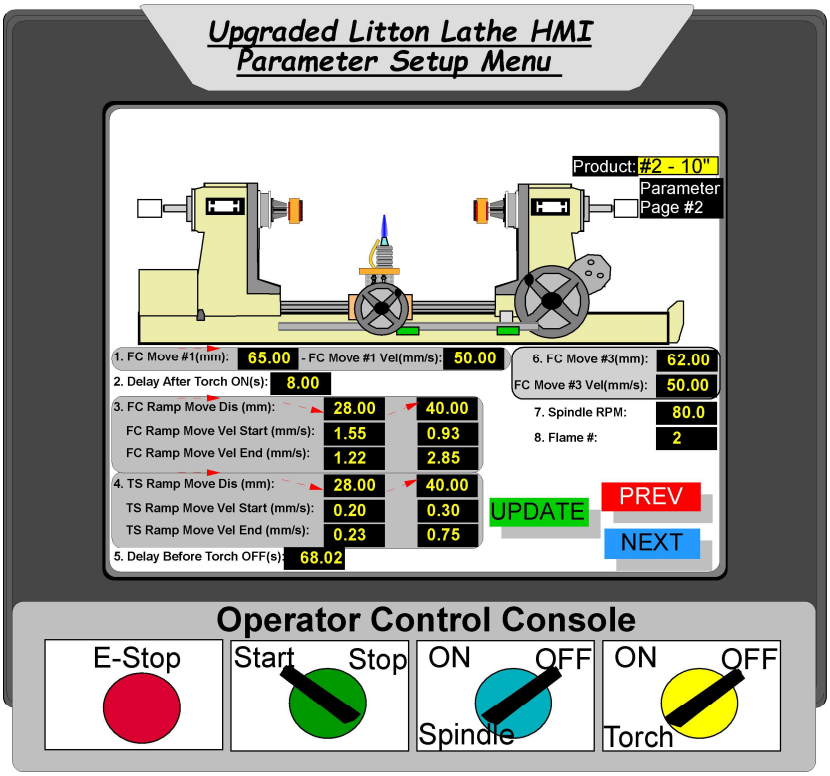

Figure 5. Parameter Change Menu – For Process Changes

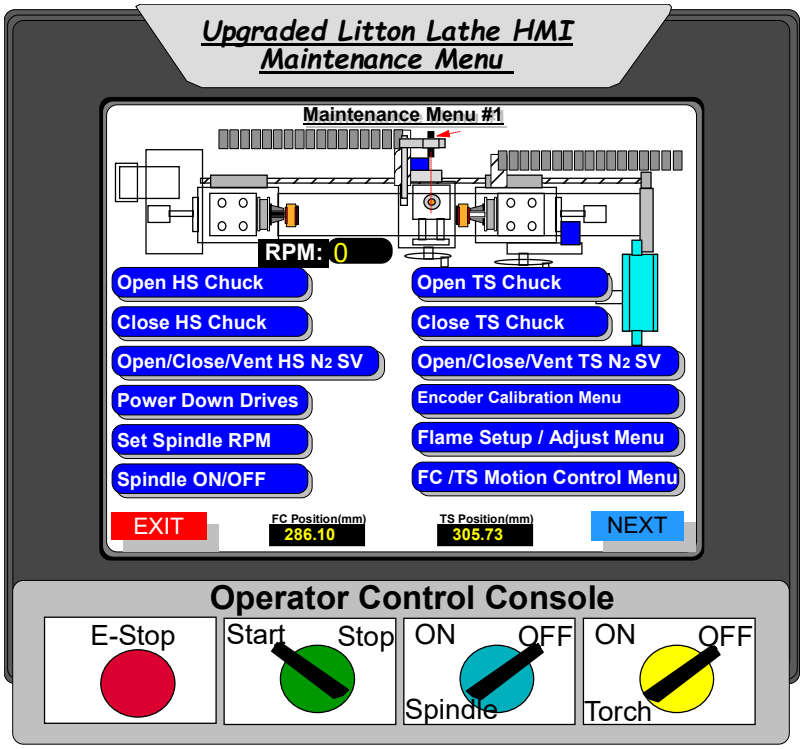

Figure 6. Maintenance Menu #1

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The maintenance menu will allow the operator to open / close valve, turn on/ off the burners, turn on/ off the spindle, reset the system, etc. Additional maintenance menus can be accessed from the main maintenance page.

Adjustments to the burner flames settings will be made through the needle valves on the burners for the correct propane to oxygen mixture.

An example of the screen used for conversion of a prior Litton lathe conversion is shown in Figure 7. An example control panel is shown in Figure 8.

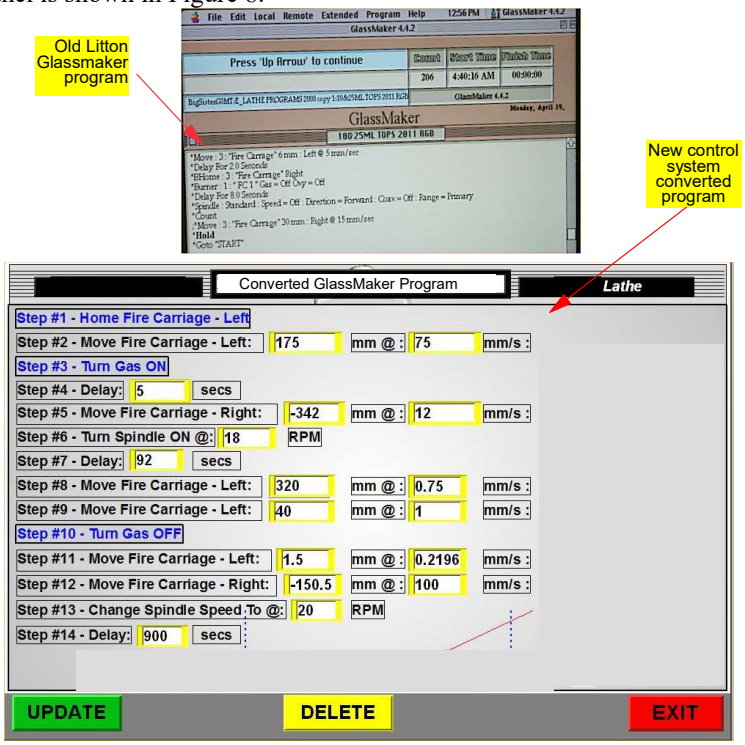

Figure 7. Example of program parameter input screen.

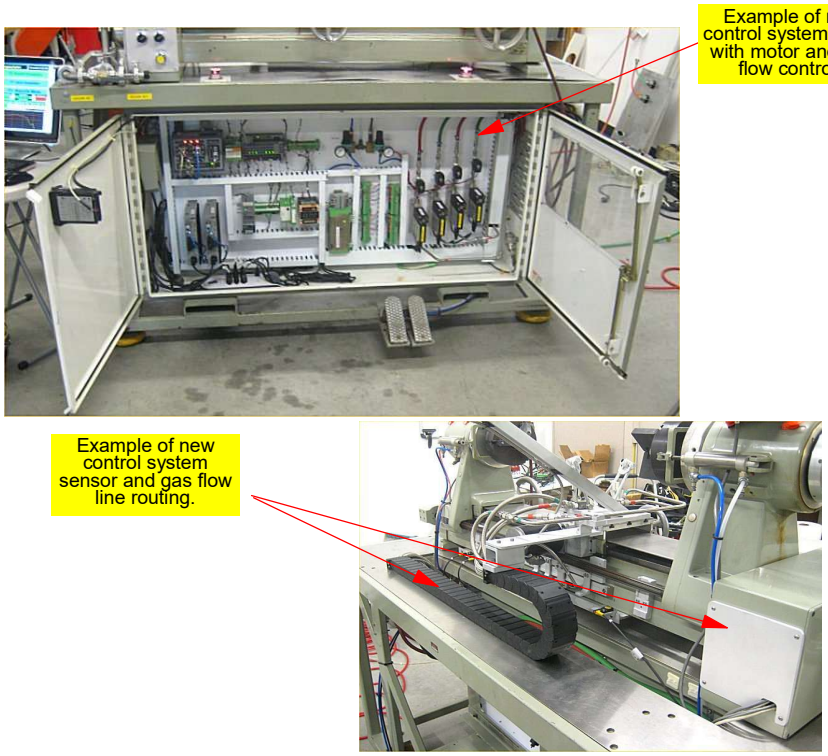

Figure 9. Example of Sensor / Cable Routing

For maintenance support, a laptop type pc loaded with the machine software for the HMI and the machine control programming software will be provided to allow for possible upgrades / changes to the machine operation. Base lathe control system design and PLC programming without integration is what is covered in this proposal. Optional components were broken out to allow customization based on each customer's requirements.

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Time estimate for engineering costs include time to make electrical panel, program PLC / HMI , program motor controllers, along with integration and qualification on site at HCS. Machine will need facility connection for 120VAC, 15amp wall plug, instrument compressed air supply (90psi), along with gas connections for propane, and oxygen. All facility hookup to be done by in plant personnel.

Electrical / Programming Engineering Cost Breakdown

Part #:	Description	Qty	Price (Ea)	Price (Tot)	
Base System Design	Programming:			$14,120.00	
	Electrical Engineering:			$5,400.00	
	Engineering Total:			$19,520.00	

Options / Parts Cost Breakdown

Part #:	Description	Qty	Price (Ea)	Price (Tot)	
Basic Control System	Lathe Basic Electrical Control System Components Total:			$19,575.00	
Basic Testing	System Integration:			$6480.00	
Optional Table	Mechanical Table for Lathe Components:			$2850.00	
Optional PLC Flame Burner / Torch Control	Proportional Control Valves Control Components for 2 Burner Control or 1 Torch with Center Fire (Pre-mix) and Outer Fire (Surface Mix) Components Total:			$11,290.00	
Optional Process Temperature Control	Pyrometer Temperature Control Components:			$4350.00	

Estimated time to complete design, integrate, and qualification onsite (HCS): 16.0 weeks. Estimated time to complete project on site setup :3 days. Estimated machine turn around time is 12 weeks after arrival of machine at HCS, Inc. Time estimated for turn-around assumes order is placed a minimum of 12 weeks prior to shipment of machine. This quote is provided with the expectation that XXX Company – USA, will be supplying the lathe with chucks, tool carriage, mounting table & glass for testing and qualification, and any specialty gauges used for part verification. All shipping charges to and from HCS to be paid by XXX Company. HCS, Inc will then add electronics hardware and software as stated above.