H

Inkjet Business Division (formerly Integrated Circuits Business Division), Corvallis, OR
Project Manager – Daryl Meekins, (541) 715-5363

Final Quarterly Report – HBTU Heater Core Hoist Project

Last quarter success criteria:

1. Assess success of the project based on observation and performance of the system from the perspective of the design engineer.
   As stated in the application for the grant, the goal of the project is to allow technicians to change heater cores easily and quickly without the need to manually lift the cores at any point in the change process.

   Since the delivery of the heater core hoist, the following is the procedure for changing out the cores. It is evident from the description that the goals of the project have been met:

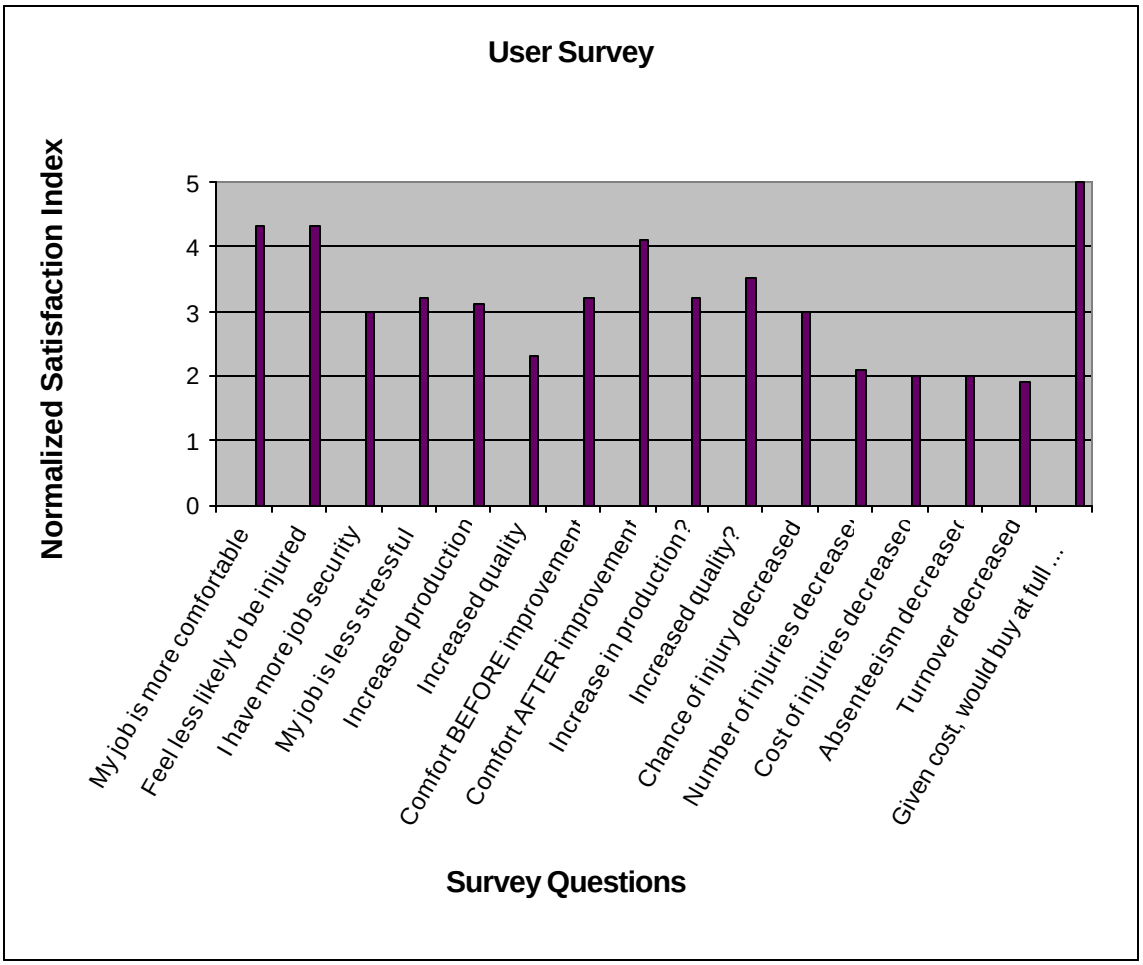
   In the staging/cleaning area ("preclean" room) of the cleanroom (fab), the new core is removed from its shipping crate with a crane (a non OR-OSHA funded improvement added as part of the project) and placed on one of the heater core carts. The core is moved via the cart to the area of the furnace being serviced. The old core is removed from the furnace with the hoist and placed on the other heater core cart for removal from the fab. The new core is then lifted off its cart with the hoist and placed into the furnace. The spent core is taken to the "preclean" area where a crane lifts it off the cart and places it on a pallet for disposal.

   For the upper two cores in the stack of furnaces, elevated work platforms, also designed as part of the project, are attached to the frame of the furnace at the start of the procedure. They are positioned on either side of the hoist when it is in position to place a core in the furnace. The platforms allow the techs to stand close to the cores to attach the hoist and do other connecting and disconnecting tasks associated with core removal and replacement. The platforms are equipped with wheels,

counterweights and handles which allow them to be easily moved to the furnace at the start of the procedure and to their storage area afterward.

There is no point during the process at which the technicians have to manually lift the cores. Forces required to move the manipulator when loaded with the heater core are approximately 5 pounds. Moving the loaded hoist requires a maximum static/overcome force of about 20 pounds to start it moving and about 10 pounds to keep it moving. Techniques have been developed to align the wheels prior to and during movement to minimize forces.

2. Survey end users and develop a representation of their responses to determine success from their perspective.
   The survey provided by OR-OSHA WRP was used in its original form and the results are shown below with a commentary that may be useful for interpreting the data. All data was normalized to 5 and oriented so that on the chart, 5 represents the most positive reaction to the question, and 0 the least positive response.



Reaction of the technicians to the survey, unfortunately, was that it really didn't capture the total improvement of the project and that many of the questions did not pertain to them or knowledge that they have. Areas of the survey that indicate a low score are typically those questions that the techs felt were outside their area of knowledge. Examples are increased production and quality, and cost of injuries. Because HP generally doesn't lay off workers (most of the technicians in the area were recently "redeployed" from other areas) questions about turnover and job security are difficult to answer. The project engineer (who conducted the survey) was unaware that the survey provided by the WRP is a guideline and not a "verbatim" requirement of the final report and so it was not customized to be specific to the project. Nevertheless, the scores of questions concerning comfort, likelihood to be injured (at this task), comfort before and after the project, and willingness to purchase the hoist without the program if necessary indicate a high level of satisfaction.

In the experience of the project engineer, overall response to the hoist has been very positive. Most telling are the written comments of the technicians: (Note: editorial comments and clarifications are in brackets [ ].)

"I can complete my job without having to hunt for big strong technicians to help me. It [the WRP] helped to provide a much needed tool for our job."

"[The hoist makes the task] safer, more convenient, easier, ergonomically more sound, vucanish!" [not sure what this means, but the context appears positive]

"Acquiring the hoist did not impact my job security because the job still requires my involvement. What the hoist did was greatly reduce my chance of being injured because I don't have to lift this heavy object and move it. [same respondent, different question->] Having the lift [crane?] and hoist reduces physical effort needed to move around the 150 lb. [actual weight 210 lb.] heater cores. We no longer have to physically pick them up and carry them ourselves thus greatly reducing our chance of injury."

"Improves [the] worker's job"

"It provided me a safer way to perform one of the infrequent tasks of my job."

3. Identify persisting shortcomings of the system.
   There are no persisting shortcomings to the system at the time of this report. A lot of follow-up work has been invested in the identification and fixing of deficiencies. Some of the "bugs" that were repaired are:
   - Replaced the jackscrew brakes that came with the hoist with foot actuated retracting brakes.
   - Replacement of the original drawer slide manipulator with a double articulated arm that requires much less force.
   - Design of a plastic dedicated strap hook to aid technicians in securing winch straps to the heater cores and a plastic hanger to hold the hook in a convenient location.
   - Replacement of the original ten bolt manipulator attachment system with a quick-change system of two alignment pins and four bolts. This increases the utility of the hoist base (hoist minus the manipulator) in addressing other lifting issues in the fab, but also makes it faster to reattach the heater core manipulator.
   - A cover plate was added to the manipulator latching mechanism to prevent manually overriding the electrical interlock system and to prevent a technician getting fingers pinched.
   - Manipulator handholds were remounted in a different (than the way they were originally designed) orientation so that they were easier to use and so technicians could apply more force without using a partial pinch grip.

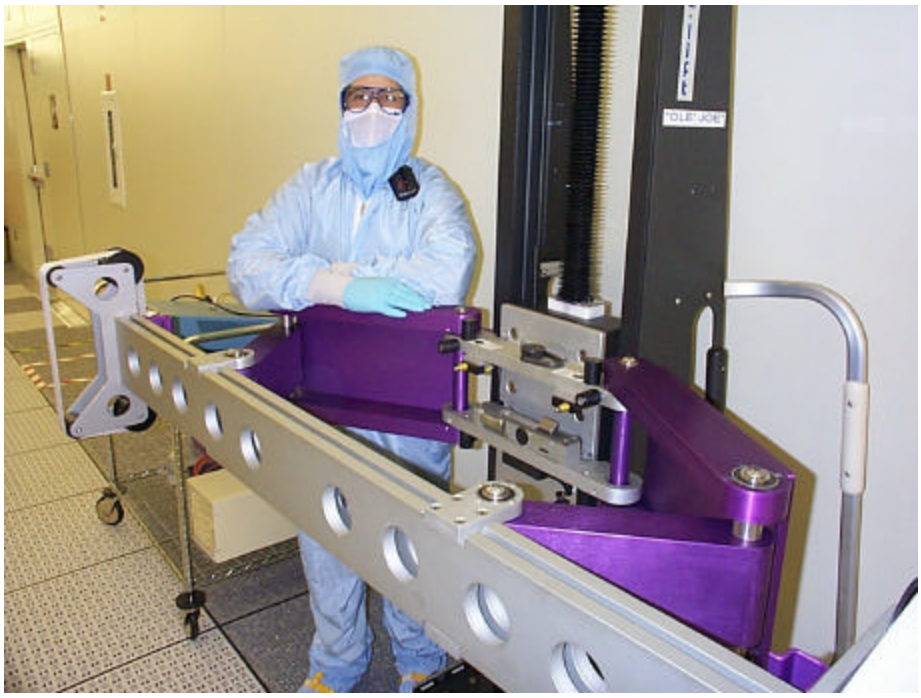
4. Dissemination of project results.
   In an effort to share the results of the project, I have called the following companies: Hyundai-Eugene, Tektronix-Portland, Intel-Portland, Mitsubishi-Salem, and other HP sites that I know may use the horizontal furnaces. I passed along specifics of the project and details of the WRP grant program. Fort Collins, Colorado HP site has need of a version of the hoist, but has much more difficult constraints than our project and so would require a complete project to adapt our design. Our work has moved their project significantly closer to a solution, but the ball is in their court, so to speak. The Oregon based manufacturers mentioned above

showed limited interest in the project for reasons ranging from not having many horizontal furnaces to what appeared to be suspicion concerning my intentions.

An article is in progress at this writing to submit to several professional ergonomic and engineering organizations and a presentation is over 50% complete to present at the Applied Ergonomics Conference for the year 2000. An application with abstract has been submitted to the Institute of Industrial Engineers for that conference.

We are presently developing a website for in-HP use which should disseminate the information about this project to the HP culture. There may be other HP facilities which have need of similar technology, although it is doubtful that any such need within HP exists for Oregon sites.

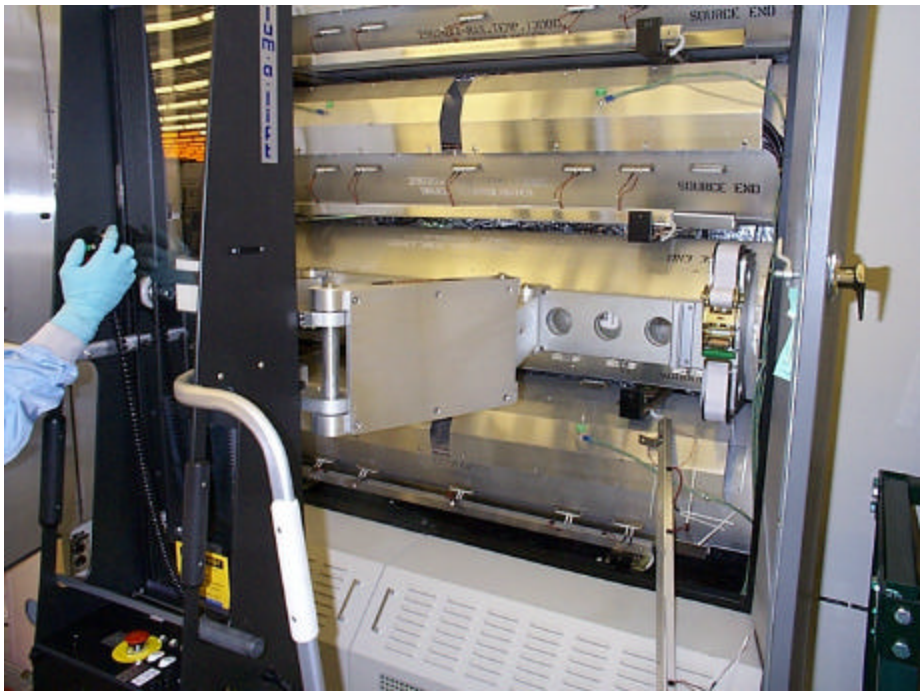
Pictures of the hoist and related equipment follow:



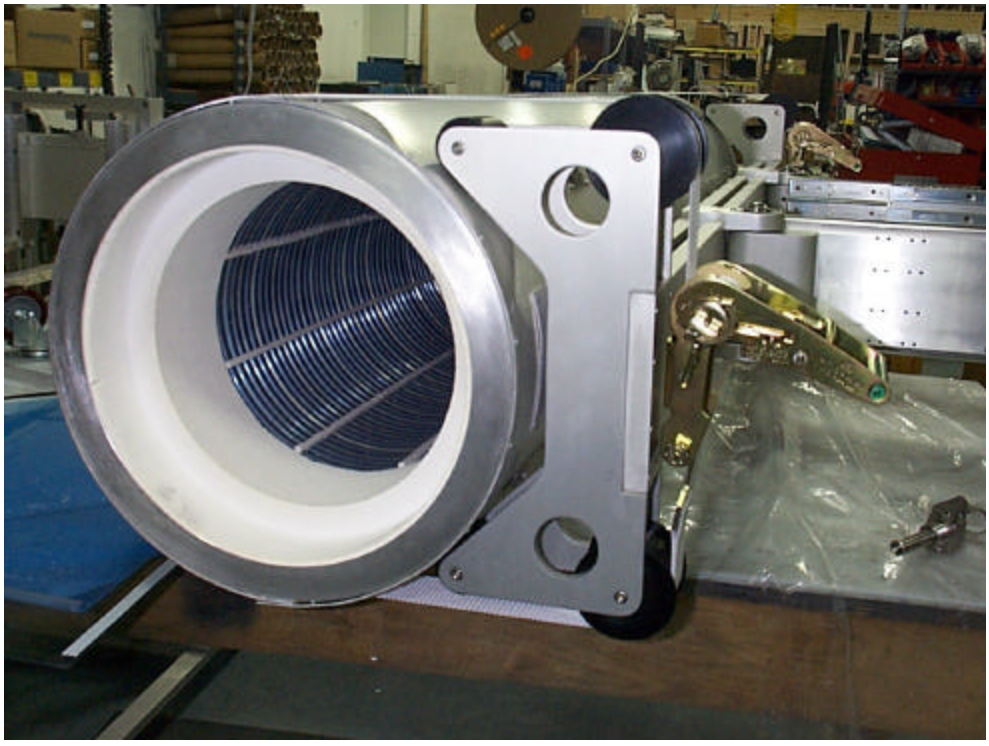
Technician with the HBTU Heater Core Hoist, shown with the manipulator unlatched and partially extended

Elevated work platforms dedicated to the core change process. Note the space between the platforms for the hoist

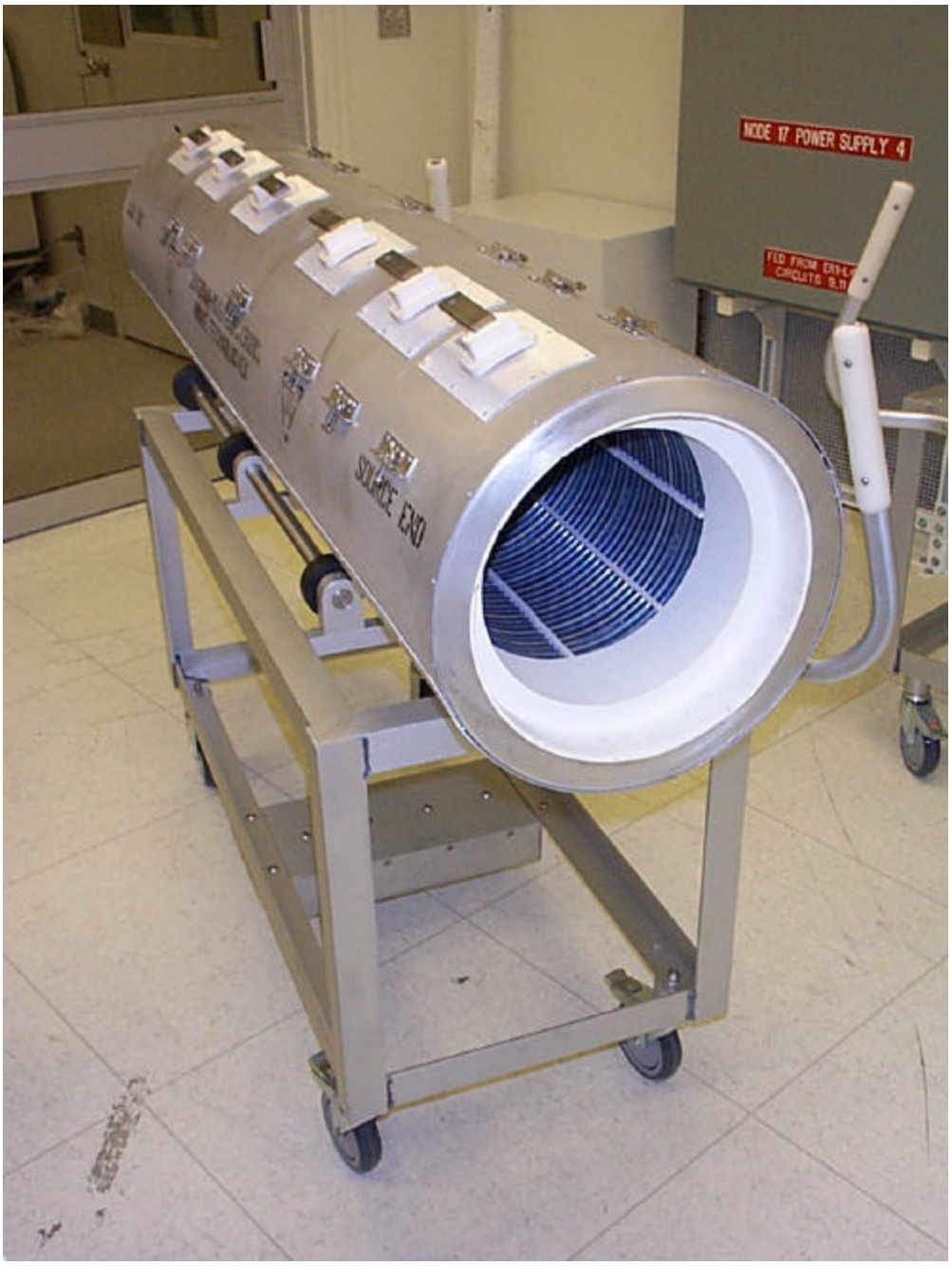
Hoist with heater core attached and ready for installation



Heater core attached to manipulator and ready for extraction



Close-up of the manipulator showing heater core attachment



Heater core on dedicated cart. Note rollers which allow the core to be rotated for preparation work and handles to guide cart from both ends. Counter weight (bottom center) adds stability to the cart.

Crane installed to assist maintenance technicians in lifting heater cores

Heater core being lifted onto cart by preclean crane