Plant Oxford: MINI Manufacturing Tour
26 May 2005

Overall impressions:

- Quality is evident.
- BMW is committed to the MINI and Oxford; a major new expansion is underway to increase production to up to 600 cars per day.
- Automation and logistics are cutting edge.
- It's impressive that there is no incoming parts inventory or outgoing staging of completed cars. Everything is JIT.
- The plant is remarkably clean and bright, despite the age of some of the buildings
- Workers are efficient and appear to be well-trained.
- The tour is close to the action – so close that sparks fly around, and sometimes, on you.
- As a MINI owner, it's interesting to see how everything about the car, from the design of the MINI web site, to the printed materials about the car to the televisions commercials and all the way through the factory is built on the premise that MINI has innovation, attitude, function and fun.

My arrangements to visit the MINI factory were made with Pedro from the BMW Group about three weeks before the visit. He sent a detailed packet of information via e-mail to help me prepare. After arriving at Heathrow Airport from Frankfurt, Germany, I took the Oxford Bus Lines (£18 round trip) from Heathrow. It's about a 70-minute ride. Once in Oxford, I took the #10 bus from City Center to Cowley and my hotel.

On Thursday morning, I left the Travelinn Hotel and walked to Gate 5. (Since I was walking, not driving, I went in Gate 5, above. The instructions from BMW were to go in Gate 7). It's about a 15-minute walk. The only directions provided by Pedro were to "look for the flying MINI" and enter the building. The entrance is directly under the car on wall...

As you can see, some of the buildings are quite old. In fact, this site has been producing automobiles since about 1913.

The tour begins by signing in and getting an audio listening device, safety glasses and a bright orange work smock. My tour had a group of UK engineers who were doing the tour as part of a teambuilding exercise, a young couple from Singapore (who owned a 2002 Cooper S and a curious-about-MINIs father and son from Reading, England. In addition, there was another large group from Russia who was touring UK factories. We shared the first portion of the tour with the Russians then split into two groups.

The first part of the tour was in the Reception Center. Walking past the original Austin Powers “spy-mobile” and three of the Coopers from the Italian Job, we headed to a small theatre to see a presentation on plant facts and figures, then a video on the Paint Shop.

During the slide show, I was surprised to see that the US has almost passed the UK in annual units sold. It was also interesting to note that the Convertible accounts for about 25% of total worldwide sales.

Too bad we could not see the Paint Shop. Due to extremely high standards to protect the facility from dust, lint and other contamination, visitors are not allowed to enter this building. The video, though, is quite good and shows the entire process.

It takes about 10 hours to clean and prime a MINI. Robots then paint the cars in another amazing mechanical dance. Those with contrasting roofs get another step, done by

humans, to tape off the body. The roof is then painted by robot. The line can change paint colors from one car to another without delay. Cars are not painted based on an actual order but rather according to the forecast needs as determined by Logistics. As part of the environmental program, all paint vapors are collected and incinerated in a catalytic converter.

Based on my tour, it did not look like any color was any more popular than another; there seemed to be an even distribution.

According to the video, the primer, undercoat and paint finishes, after application, is a full millimeter thick — actually thicker than human skin - declares the video. Before the cars leave the paint shop, all internal cavities are sprayed, not by robots, but by workers with a penetrating wax to assure corrosion protection. MINIs have a twelve-year guarantee against rust — and I can see why.

When the video ends, we walk out the front of the building, under the flying MINI and onto a waiting coach bus, The bus is painted dark blue with “Union Jack” MINIs driving all around it. The bus advert declares, “It’s a MINI adventure.”

We take a short drive to Building 30 “Body in White” to see the process of welding the sheet metal together. Walking in, we adjust our listening devices so we can hear the guide over the sounds of the factory. At our first stop, we see pairs of robots working in unison to weld the middle section of the car together. Once this is done, the joined pieces have a small transducer mounted to the location where the pedals will be placed later. This transducer will tell the robots what model is to be built as the car moves through the shop.

For instance, while the middle section is the same for each car, the rear of other models can be different. For instance, Cooper S has a different rear end construction as it holds the battery. Making an S then requires a different rear end. A Convertible requires additional bracing to account for the lack of stiffening provided by the roof. Robots grab the right parts and perform the correct welding based upon the information provided by the car’s transducer. At this stage, the car is not built to a customer’s order but rather to the requirements dictated by Logistics.

I was quite amazed that sparks from welding were flying all around us, and occasionally, upon us. Fortunately, BMW is not nearly as concerned about liability issues as the typical American firm. This made for a much more enjoyable and up-close tour. We were allowed to walk around, within reason, as we pleased - provided we did not get too far away from the main group and not in the way of the work! While there are hundreds of robots at work here, you don’t see many people. Occasionally, there is a forklift driver with materials driving by or, even less frequently, a number of technicians in black polo shirts standing around a machine. Our guide told us they appear whenever a problem starts to develop with a machine.

The robots capture your attention. As the first piece of sheet metal (the hump) rolls to the first station to meet the rear end, the robots seem to wake up with a start, snap to a near vertical position like some metallic velociraptor and then rotate and descend upon the sheet metal to begin their fire breathing. With sparks and hisses, the deed is done. The newly married pieces move to their next station to receive the front end in a drama that's repeated up to 370 times each day. The robots do not take "tea breaks," but people do and so we had to move along before we missed more of the action to come.

We walked along a busy aisle of robots, all making the beginnings of new MINIs. We climbed a short stairs that allowed us to see a good deal of Body in White facility. Just below our perch, robots were selecting roofs to be welded to the newly formed bodies. Again, based on the transducer in each car, the robots knew whether to select a solid roof, a sunroof, or a stiffening brace (as needed for the Convertible). Just in front of our bridge, the body would wait while the roof was lowered. Then, as before, the robots "woke up" and went smartly to work, welding here and there as required by the pre-programmed instructions. At this station, the robots could change their robot welding hand to allow for each robot to do different kinds of welds. Further along the line, the doors were added and the body of the car was now ready for painting.

As we prepared to leave the building, we made one more stop at a testing station. Here, a technician was using an ultrasound analyzer to test various welds that he had sampled from the robots. On a portable PC, we could see the distinctive pattern on the screen that indicated a good weld. By wanding a piece without a weld, we could see a very different pattern. Thus, the tech could be assured that the welds were acceptable. If he finds poor welds, they sample 10 pieces ahead to see if the welds were then acceptable and work backward to find when the pieces went out of tolerance. They also stop the robot and make the necessary adjustments to produce acceptable welds.

Stepping back outside again to re-board the coach, we were told that our next stop would be Assembly. We drove past the paint shop, but could not see inside. We were told that no MINI sees the light of day as it moves between manufacturing steps. Cars are transported between buildings through tunnels or underground. As we arrive in front of the Assembly building, we see a few MINIs here and there, apparently being used as work vehicles.

Inside the building, we are instructed to check that all jewelry is covered. On display are two mannequins, dressed as visitors and properly gowned, as our examples. We stow our listening devices and snap all snaps on our smocks. Our guide tells us that we'll see a lot more people in this building and she indiscreetly mentions that some of the workers get tired of so many visitors, especially those who get in the way of work.

First up, so to speak, are two MINIs hanging from the ceiling: one is a Cooper S while the other is a Convertible. From underneath, it's easy to see the extra bracing, called a V-brace, which the Convertible has to stiffen its frame. It's called a V-brace even though, as our guide said, it doesn't look like a V. Now the engineers in the group get interested. They commented on various details that a "commoner" like me failed to notice.

As we enter the Assembly area, we're told that we'd be going backwards or back up the line from finish to start. She says it's the preference of BMW to conduct their tours this way, but I found it hard to get a sense of where we really were as the tour continued.

First, you must keep your eyes open. Newly minted MINIs are being driven off the line and directly across our path (some of them with a chirp of the tires!). Each one starts up for the first time with four liters of petrol (about a gallon of gas) provided by BMW's

worldwide supplier, Esso. The worker-driver takes each car for a short sprint over to a quality inspection point. Two vehicles each day are selected for a complete audit, that is, every part and fitting is checked for proper placement and alignment.

Moving up the line, the last thing that happens to a MINI and the first thing we see in Assembly is the placement of the MINI badge, followed by the programming of the keys. Each key must be matched to its MINI. It takes only a few seconds for each key to be matched to its car. A flashing overhead monitor tells when the process is complete. We saw an entire pallet of gearshift knobs being consumed as each manual transmission got its shift knob.

Since I couldn't take pictures or notes, I may have the order incorrect (or skipped a step or two) but I recall the next step was adding back the doors. As our guide explained, the doors are first attached to the car while in Body in White, painted in the Paint Shop and then removed for separate finishing. Without doors on the cars, the workers can accomplish the interior finishing much easier and without worrying about scratching the car. The remarkable thing about this step is that the doors appear from a second floor conveyor and are lowered to the car just as they're needed. Since every car going down the line is a different color and/or model, the original doors must match each car as they're needed. It's an interesting bit of synchronization that wasn't explained but obviously works. It takes about 40 seconds to install the door, down from 60 seconds when the plant first opened. The guide explained that it's one of the more difficult jobs.

Each assembly employee is generally trained in four tasks: two complex and two that are easier. The task and teams are rotated to prevent boredom. Also, as needed, robots lift cars up to the workers to avoid unnecessary bending or stooping. A great deal of attention was paid to the ergonomics of the assembly area to prevent repetitive motion injuries.

It was also interesting to see the use of daily, weekly and monthly production and quality metrics at each station. Every worker knows what's happening. At one station, the top five defects were noted for the previous period. In this case, the #1 defect was missing or loose aerials.

Next up, the wheels are mounted to the car. As MINI owners, we know there are a dizzying number of options for wheels and covers. Like everything else, the correct set of wheels appear, as if by magic, from an upstairs chute. The wheels are checked for correctness with a bar code and then mounted to the car. I was surprised that it was quiet, not like the usual pneumatic whine that bolts on wheels. This operation appeared to be electric, thus quiet.

At each step, the MINI is looking less and less like a new car since we are working backwards from the end. We turned the corner and apparently skipped several steps. MINIs here had no seats, dashboard or other interiors features except speakers. Here, we watched interior sound deadening being added to the roof of the car. The material,

to our surprise, was ordinary cardboard. We were told that even high-end Rolls and BMWs use cardboard as a lightweight and effective sound barrier. A robot applies a long, circuitous stripe of adhesive to the cardboard before it is picked up by a person and fitted inside. Next a robot reaches in and applies pressure to assure a good seal.

Our next stop was the finishing of the roof. Solid roofs get minimal work, but sunroofs are interesting to watch. (The robots “know” what model they’re building based on the transducer which has been re-located on the front grill where the MINI badge goes.) A robot picks up the assembled sunroof and slides it through the opening of the windshield. The machine then attaches the roof while another robot lift the glass using suction cups from the outside.

Like the sunroof and unlike most of the other operations here, robots install all the window glass. Front, rear and side windows are lifted into place and attached as specified. We did not see the addition of the convertible top.

It was difficult to determine the order of things as we moved back and forth around the building. We saw a different assembly line working on the engine and transaxle assembly. Just behind us, MINIs were coming from one side and lifted high so a worker could add various pieces, including the firewall and heat shield. As he finished, the MINI’s specified engine appeared on cue and was lifted up and mounted to the underside by robots. The entire process was nearly silent and

Back on the exterior trim side of the line, we watched as the front grills were snapped into place. Yes, they’re just snapped into place by a worker who grabs either a chrome or painted piece, depending on the customers order sheet, from a large pallet on the side of the line. As I paid a premium for a chrome grill, I see that this is must be a nice profit point for BMW. It would have been nice to just grab another chrome grill from the line, but....

At the cable assembly point, we saw another example of just-in-time production and mass customization. Standard MINI cabling is made by a supplier in Romania and then shipped to Birmingham in the UK for customization as specified by the order. The final package is then placed into a large blue nylon-type tote and bar-coded with its identification. On the line, somehow the right bag is in place when its car needs it. The bag is scanned and its contents brought to the car. Now the most intense part of the assembly was seen. More workers were in and around the car than at any other time. Each worker was routing and connecting the cables for his task while the rest of the team did theirs. Remember, there are no doors or windows on (nor is any of the interior in place at this time), so they can move around quite quickly.

Our last stop was to watch the cockpit or as we say, the dashboard, get mounted. Our guide explained that this part is assembled in Birmingham according to the customer’s specification. As MINI owners, we know that we can personalize our MINI’s cockpit from a variety of choices. Each MINI needs to have its cockpit here at this precise time in

order to be completed. Thus, every 45 minutes for the two shifts each day, about 40 cockpits are delivered by truck from Birmingham. Any delay in the process means trouble on the line.

To guard against delays and out-of-stocks by suppliers, BMW has carefully selected its suppliers and negotiated considerable fines if parts are not ready “just-in-time” for production. While the guide could not tell us what the fines were, she did point out that there was a helicopter pad just outside in case a supplier wished to race parts to the line to avoid a fine. There is no way to verify this story, but it makes for an interesting story.

Walking back to the end of the line, we were in the way as worker-drivers tried to get cars off the line and over to the final quality checks. When we arrived, they had already produced 179 cars for the day according to the large red digital sign in the Assembly building. As we left, they were approaching 212. Our guide said it was likely they’d make 340 or so by day’s end.

Heading back outside to our waiting coach, we drove around and saw the staging area for finished MINIs. These cars were waiting for their daily pickup by chartered train and transport to Southampton for overseas deliver or for a UK truck to pick them up for domestic customers. There were no MINIs in some remote parking lot just waiting around for shipment. Every day, each car is shipped to its final destination.

Circling around the plant, we saw a major expansion of the Assembly building. BMW hopes to be able to nearly double capacity to 600 cars per day. The current assembly building is the second most expensive project in the UK after the Millennium Dome (and a lot more successful).

We were also told that there would be a new model next year and two new colors. I did not think the new model had been confirmed, yet.

It’s clear that BMW is heavily invested in this product and in Oxford. They’ve done a remarkable job here. I was told by one of the guides that BMW kept most of the workers on the job after the old Rover was discontinued and before the new MINI bowed. In some case, workers were sent to other plants, even to Germany, to build cars. In other cases, workers painted buildings or fences in the interim.

On my way out of the plant, I saw this little guy. Years after he was made here, he returns to help build the next generation of MINIs.

I highly recommend the tour to anyone with the opportunity to go to Oxford. I don't think it's worth making a special trip, like I did, but it does give you considerable insight into the making of this remarkable little automobile.