



One could be forgiven for thinking that the new Challenger MT900B series tractors are AGCO Corporation's first foray into the rarified world of 4WD agricultural tractors. Earlier four-wheel drivers that now fall under the AGCO umbrella include 1928's Massey Harris General Purpose tractor, perhaps the world's first such tractor, the Minneapolis-Moline A4T-1400, the White 4-150 Field Boss, the Allis-Chalmers Super Beast, the Massey-Ferguson 4000, and the AGCOStar which ceased production in 2002.

But that same year, AGCO acquired Caterpillar's highly regarded Challenger line of rubber-

tracked behemoths, giving it a highly competitive range capable of matching and even surpassing many of the 4WD units in the market. However, farming practices die hard, and although there had been converts to the track-type machines, there were many farmers who were unwilling or unable to make the change. Also, companies such as Case IH and John Deere were upping the ante with extra horsepower, more torque and bigger tyres.

Never one to miss an opportunity, Robert Ratliff, AGCO's founder and then-executive chairman, decided there was a hole that needed to be filled in the company's tractor lineup. However, not just any tractor

Tall order

MAKING THE WORLD'S LARGEST AND MOST POWERFUL 4WD AGRICULTURAL TRACTOR CALLED FOR SPECIAL DESIGN AND ENGINEERING INPUTS





would do: the hole was to be filled by the world's largest, most powerful 4WD agricultural tractor – the Challenger MT900B series.

New beginnings

Tasked with the job, the then Dekalb, Illinois-based Challenger engineering group made several key personnel appointments that brought in 4WD engineering talent, giving the project a running start.

The challenge was to develop an articulated 4WD tractor that would complement the successful Challenger MT800 series rubber-tracked tractor, yet provide an entirely new paradigm for the Challenger brand. A small exploratory team was formed to identify the key defining features and specifications of the MT800B tracked machine that were critical to the Challenger brand and needed to be incorporated into the new tractor. This exercise was followed by extensive review and benchmark testing of competitors in the areas of chassis configuration, weight and

balance, hydraulics, steering and overall ergonomics. This initial work resulted in a preliminary product specification that would guide both marketing and engineering.

After a few months it became clear that another piece of the puzzle was missing, namely an industrial design and styling input. While it was a given that the tractor needed to maintain a family appearance and keep the hood and grille of the Challenger track machines, it became obvious that there were many other areas where choices needed to be made.

It was at this point that Montgomery Design International (MDI), a Chicago-based design, development and styling firm that had worked in the agricultural and construction equipment machinery industry for 25 years, was brought on board. MDI had collaborated with Caterpillar on the original

Challenger tracked machine and had penned its well-known Challenger script logo. It had also worked on several 4WD tractor projects for both Case IH and New Holland when it was contracted with CNH Global.

MDI's first input to the project was the fuel-tank design and improved visibility to the hitch. With a machine this size, visibility can be a struggle due to the large tyres, fenders, engine hoods and fuel tanks. The industrial design and engineering team explored a number of options capable of achieving the desired results, but only one design stood out as a solution that fitted the overall form factor of the tractor and achieved all the other goals for the design. The now-concave rear surface of the MT900 fuel tank became another immediately recognisable design element, as well as providing excellent visibility to the hitch.

ABOVE: The Challenger 4WD was the first tractor to use the new Michelin Axiobib radial which is capable of handling 20% more weight

LEFT AND BELOW: Concave fuel tank blends with vehicle form language and provides excellent visibility to hitch





Still working on the rear half of the articulated Challenger, MDI then began investigating rear fender shapes and access steps to the fuel tank. A number of options were explored in sketch form; some providing more tyre coverage, some less. The overall design was complicated by the fact that the world's largest tractor would also need the world's heaviest duty agricultural tyre. The MT900B became the first tractor to fit Michelin's huge new Axiobib radial tyre, capable of handling 20% more weight at the same tyre pressures as standard tyres.

It was eventually decided that a more minimal fender would be offered for the base machine, and that any increased coverage requirements could be handled with optional fender extensions. The front fenders were designed to match the rear and incorporated a

step on the left side for filter access and on the right for exhaust clearance.

The concepts and ideas generated during this first phase would eventually find their way onto the first prototype, but more immediately there was another area that needed attention. The AGCO design team began working closely with an Indian engineering firm that was contracted to construct the front and rear frames, source the prototype frame components locally and perform final construction. The Indian company also conducted the FEA, which was then reviewed by the AGCO engineers.

It was around this time that AGCO decided to relocate Challenger design engineering to its facility in Jackson, Minnesota, where the manufacturing base for track-type tractors had been moved the previous year. This decision could have delayed the project as several

new members were added to the team at the Jackson facility, and not all of the DeKalb members were willing to move with the project. However, in time, the move was accomplished and the project was running smoothly again.

Good pedigree

One of the early decisions made regarding the MT900B project was that it should heavily leverage existing components from the MT800B track-type tractor. This commonality of parts benefitted the internal production and purchasing departments, and shortened time to market by reducing validation requirements on new components. It also meant there were fewer new parts requiring expensive tooling and servicing.

The complete engine, including all installation and cooling packages, was taken directly from the MT800B. For product identity purposes and the elimination of expensive new tooling, the hood, grille and lighting package were similarly adopted –

LEFT & ABOVE: Small adjustments were made to the cab used on the tracked models, including relocated door components

BELOW: Alias CAID file for new Challenger fenders



CASE STUDY

slightly modified – for the rubber-tired chassis. Caterpillar's 16-speed powershift transmission in the new four-wheel drive tractor has some unique parts owing to gear ratios and higher road speeds, but it too is borrowed in large part from the MT800B transmission.

MDI helped to modify the MT800B cab for use on the new tractor. Taking its basic structure, the first project was to reorient entry/egress to the cab by incorporating a front-hinged door with a relocated and redesigned latch mechanism, actuator and trim cover.

Several concepts were looked at in sketch form and, after selecting a design, prototype hinges, latch and cover were constructed in MDI's workshop for fitment to a prototype

cab. Another major styling challenge was to provide rear side panel covers and a lower rear trim panel for the cab that masked the former fender cutouts for the MT800B tracks and matched up with an HVAC duct and upper trim panel that had to be carried over for cost reasons.

MDI provided the concept design, styling and CAID surface development and, ultimately, CNC machining of masters or moulds of all these components plus hand-laid fibreglass parts where required. Other items included in this phase of the project were revised controls and displays and a new custom steering wheel intended for use on all Jackson-built products.

One of the final and more critical design elements that MDI was

field tests and analytical analysis. The front and rear frames underwent extensive FEA followed by strain-gauge testing on prototype tractors to verify strength. The hydraulic system underwent exhaustive lab testing including a full vehicle cold-room test to verify proper functionality under extreme conditions.

Powertrain components were tested individually on dynos as well as undergoing thousands of hours of field testing in the most demanding applications. Key performance metrics were tested and measured using a towed dynamometer on the concrete test track at the Jackson Design Engineering Center. This allowed the engineers to verify that the new tractor would meet their goals and customer expectations.



ABOVE: MDI concept sketch and CNC machining operation for new steering wheel

BOTTOM: MDI sketch proposal for new 4WD Challenger tractor

Sweet smell of success

In 2006, the Challenger MT900B received the PTC Design Award, recognising the use of Pro/Engineer in getting the concept to market with a substantial saving in design and engineering time.

Most recently, the tractor was recognised with a Good Design award from the Chicago Athenaeum and Museum of Architecture and Design. This most prestigious and long-established design competition rewards designers and manufacturers for their adherence to good design principles in the development of new products. Each year, thousands of products from hundreds of countries are evaluated by an international team of highly respected jurors, and awards are then bestowed on the most deserving products and designers in 20 categories.

The MT900B won its award in the transportation category along with other notable products such as the Boeing 787 Dreamliner aircraft, and the newest incarnation of the BMW M Series Coupé – fast competition, perhaps, but then that's why they call it the Challenger...

Winners will be on display at the newest museum in the Athenaeum group, the European Centre for Architecture, Art and Design in Athens, Greece, from 5 September until 30 November 2008. The Challenger 4WD will be represented by a one-sixteenth-scale model detailed by MDI, with field photographs of the production tractor. More information on The Good Design Show 2008 can be found at MDI's website: www.montgomerydesign.com



responsible for during this phase was the design and styling of the fenders. Steps were incorporated to access the fuel fill at the rear, and a platform on the front fenders gave access to the engine and filter.

This drew on MDI's Alias software package, used throughout the automotive industry to provide class 'A' surfacing for exterior body-panel design. Upon completion, MDI's files were transferred directly into AGCO's ProE CAD platform for output to its vendor for prototype parts and production tooling.

Testing times

The MT900B's validation process relied on a combination of lab tests,

Production of the MT900B series tractor began at Jackson in January 2007. Standing nearly 13ft at its highest point with an overall length of 25ft and a weight of 60,000 lb, plus a maximum output of 615bhp from its 18.1-litre engine, the new Challenger tractor is indeed the largest and most powerful ag tractor in the world. Recently completed official testing at the University of Nebraska, has confirmed all of this and more. The complete testing results will be soon be made available to the general public.

As for its impact, people always seems to enjoy seeing the biggest version of anything – and the MT900B has not disappointed. **ivt**

