

## Simplicity Revisited — the JD 6003 Series Tractor

The size and simplicity of the John Deere 6003 Series Tractor may be reminiscent of earlier times, but it is definitely a twenty-first century machine – born of the cooperative efforts of engineers in three countries and destined for a worldwide market. “The design of the 6003 Series was driven by Deere’s desire to become a bigger player in the global, lower specification tractor market,” according to Darrell Wright, John Deere Project Engineer. Marketed as “easy to own,” the design focuses on simplicity of operation, ease of service, fuel efficiency and affordability.

Besides easy to own, the 6003 needed to be easy to manufacture and simple enough for the limited infrastructure in developing countries to support its maintenance and service requirements. “We tried to make things simple enough that a farmer or a local machine shop – anyone with a welder and some basic tools – could make a repair or even fabricate a replacement part,” said Jay Tschetter, RFA Project Engineer. RFA was brought onto the project in 1998 at the beginning of the design phase to help Deere’s Product

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**Jay Tschetter,**  
RFA Project Engineer



**John Deere 6003 Series Tractor**

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Engineering Center meet its target of 1,000 days from team formation to production.

As a cost-reduced version, the 6003 Series borrowed some features (such as engines, hood, fenders and other cosmetic parts) from Deere's existing 6000 and 7000 tractors. The engines (a 4.5 L with 85 PTO hp on the 6403 model and a 6.8 L turbocharged POWERTECH with 95 PTO hp on the 6603) were designed by Deere in Waterloo. The narrow engine profile and hood design allow good visibility for row-crop and loader applications. Deere's plant in Coffeyville, Kansas designed a transmission with nine forward and three reverse gears. RFA was assigned design responsibility for the chassis, engine auxiliaries, operator station, controls, front axle installation, hydraulic line routing, and electrical wire routing.

The operator station alone presented a number of challenges. Although it has no modern amenities like air conditioning and stereo, it still needed to incorporate the latest ergonomic and safety features. Using Pro/ENGINEER solid modeling software, RFA designed an uncluttered platform with easy access to all tractor and implement controls, including gear shift, PTO, MFWD, hitch and hydraulic levers. "Easy access" was not as simple as it sounds. Because the tractors would be used all over the world by individuals of various statures, designers had to factor in a wide variety of dimensions for height, leg and arm lengths, seeking optimum positions for both small and tall operators. Another challenge was making all the mechanical linkages fit. Unlike electrical or cable-type controls, which can be routed around obstacles, the solid-linkage controls required an unblocked path between points.

RFA also did considerable work on the hydraulic system, including component mounting, controls, and line routing. They made sure there was adequate fender clearance for different sized tires, monitored the "attitude" of the tractor with different tire combinations, and made sure the overspeed ratio on the 4WD system was within John Deere's typical limits.

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**Darrell Wright,**  
John Deere Project Engineer

Throughout the project, cost control was critical. "We used as many parts from existing tractors as we could – any nut or bolt or spring – to keep their inventory down," said Tschetter. Other components RFA worked on were the fuel tank, steps, engine intake and exhaust, side screens, front grill, electrical wire routing, front and rear lighting packages and controls and the front axle support casting.

The first 6003 was built in Deere's prototype shop in Monterrey, Mexico. This feasibility build was used to determine the capabilities of the tractor, whether it would meet marketing requirements, and the placement of major components. The second prototype, a durability build, was done in the Deere plant in Saltillo, Mexico. The goal was to use production tooling to build a model as close to a production version as possible. Then the tractors were taken to various test sites in Arizona,

Arkansas and California, as well as Mexico, where they were subjected to many hours of use.

"One of the most interesting things about this project was the geography involved," said Tschetter. RFA engineers in Eden Prairie, Minnesota interfaced with engineers in Waterloo, Iowa (source of design direction and the engine), Coffeyville, Kansas (source of the transmission design), Saltillo, Mexico (manufacturing plant) and Welland, Ontario (the John Deere plant that builds loaders). The Welland unit and RFA worked together to make sure the loader mount would clear the fuel tank, the operator area and the wheels.

Good documentation, important on all engineering projects, turned out to be a crucial tool as engineers tried to communicate around geographic and cultural barriers. "During the first prototype build, we worked with technicians who spoke no English and we spoke no Spanish. There was a lot of pointing at documents!" said Tschetter. Drawings, it turned out, were a universal language. "Clear communication," according to Darrell Wright, "was a key to building a robust team and to the project success. The use of Pro/ENGINEER assembly drawings was invaluable to global communications." Tschetter elaborated by saying, "Our method of communication evolved over the course of the project. In the beginning we depended on faxes and phone calls. But then we discovered what a great tool Microsoft PowerPoint is for sending information to a group of people simultaneously." Even at a test site, an engineer with a laptop can receive the latest assembly drawings, digital photos, even short video clips. Or a prototype shop can show everyone involved exactly what a problem is.

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## Smart Staffing with RFA

As the lead article in this issue illustrates, there are many good reasons for an engineering department to turn to RFA for help on a project.

The most common reason is the time factor. If you're understaffed, deadlines can be difficult to meet. You need to maintain product development schedules . . . but excessive overtime can lead to mistakes and low morale. In an overload situation, RFA can provide the right help at the right time. Most clients use our services as a management tool to control their variable workload while maintaining a constant level of staffing. Another common reason clients seek our help is simply to obtain new ideas, a fresh perspective. Bringing a "new set of eyes" to a design problem is often all that is needed to move forward.

RFA acts as an extension of your own engineering department, providing the same type of services as your own staff. We assist our clients in all phases of the design process. We have staff members with experience in concepting, design, CAD modeling, layout, detail documentation, prototype procurement and analysis, including FEA. Often we work on a well-defined portion or subsystem of a machine, sometimes the entire project. That's up to the client. Whether it's new product design and development or redesign for cost reduction, RFA can provide appropriate personnel on an as-needed basis – protecting you from the cycle of hiring and laying off.

Our work covers a diverse range of consumer, recreational and industrial products, including one-of-a-kind special manufacturing machines. While much of our work involves heavy mobile equipment, such as mining, forestry, agriculture and construction machines, we have also worked on commercial and residential lawn mowers, household appliances, industrial control valves, manufacturing production machines,

tooling, molded parts, medical products, etc. RFA may not have worked on your *exact* product, but chances are we've worked on similar products. Our staff has good basic mechanical engineering knowledge and skills, as well as experience transferring and adapting that knowledge to new applications.

RFA is owned and operated by engineers. If you've ever been subjected to a high pressure sales pitch from someone who doesn't really understand your needs, you'll appreciate the fact that we speak your language. We know what skills are required for specific jobs and can evaluate the suitability of our services to your project. Getting the right fit is as important when choosing an outside engineering source as it is when hiring an employee or choosing a vendor. And getting the right fit is as important to RFA as it is to you.

RFA operates a variety of CAD systems to insure compatibility with the client's software. Using the same CAD software as the client, RFA personnel create drawings and models to the client's specifications, in the client's format. We run Pro/ENGINEER, Cadkey, AutoCAD, Mechanical Desktop, SolidWorks, HP Solids and Unigraphics. In addition, we perform finite element analysis using ANSYS, Parametric Technology's ProMechanica (structure and motion), Working Model and HyperMesh. We recently added CFXDesign (Computational Fluid Dynamics). To insure the accuracy of our work, we have two Senior Geometric Dimensioning and Tolerancing Professionals, one of whom teaches Y14.5 dimensional standards.

Because up-to-date communication is so important to our business, we often use collaborative softwares to conduct design reviews with clients. We also have the ability to create an FTP (File Transfer Protocol) site for each client, if

necessary, and, to insure security, our T-1 line has a Checkpoint Firewall. Our emphasis on organization and planning is served by MS Project and Sure Track.

For new customers, we often start with a small, well-defined project that won't require a big commitment from the client – a "demo," if you will. This allows you to see our capabilities in action and builds mutual trust so we can move on to larger projects with confidence. We learn your procedures, your systems and your documentation style.

Throughout a project there is continual communication between our engineering liaison and yours. If problems should arise, they are handled quickly. Frequent reviews as the design is evolving allow the client to verify and approve RFA's work. The client maintains control and always has the right to change direction or to make revisions. RFA plans the schedule with you and the cost is predictable and carefully accounted for week by week. Some potential clients worry about losing control of their own project. That doesn't happen at RFA. Whether you are a small, single-product company or a multinational corporation, it is *your* project. You are always in control.

All of our projects are governed by an Engineering Service Agreement, which establishes the working relationship between the client and RFA and covers confidentiality, patents and copyrights, and liability. All work (patents, ideas, calculations, drawings, etc.) is the exclusive property of our clients.

Whether you have a project in mind or would just like to know more about RFA, we invite you to call or visit our office in Eden Prairie.

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## Deere

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Parts management and Bill of Materials tracking became a large, time-consuming aspect of the project as designers identified and referenced existing John Deere parts. This was the first project on which RFA was allowed remote access to a client's database and it was also part of a pilot program for Deere. RFA was one of the first four companies allowed outside access to the Deere parts and design database. Direct access allowed RFA to retrieve and submit CAD files, select common parts based on cost and volume, and view drawings of existing parts already in production on other vehicles. Tschetter said, "This access saved time, lowered product cost, and required only minimal support from Deere."

Extensive travel was an inherent part of the 6003 project. Cross-functional

teams of engineers, designers, marketing, manufacturing, plant management, and vendors met for design reviews and cost reduction planning. Besides Monterrey and Saltillo and the various test sites, RFA staff made numerous visits to the Product Engineering Center in Waterloo, as well as vendor locations and pattern shops. But they also made use of NetMeetings, which allowed a gathering of representatives from all the facilities without the inconvenience and expense of travel. "You can have a NetMeeting at a moment's notice," said Tschetter enthusiastically.

Asked what he liked best about working with RFA designers, Darrell Wright sited their agricultural background – their "feet in the dirt" knowledge – as a valuable asset, along with their prior experience with John Deere products and the

John Deere systems. "The designers' dedication and support to the project from concept all the way to production implementation was outstanding!"

Though not a big tractor by U.S. standards, the 6003 will be considered a heavy work tractor, pulling plows and other tillage implements, in the developing countries which are Deere's primary target for marketing. But there is also a potential market in the United States, Canada, and Western Europe, where applications would include small livestock and dairy farms (hay and silage) and governmental uses such as roadside mowing.

Whether it's loading hay bales in Montana, digging post holes in Mexico or pulling a plow in China, the John Deere 6003 Series is clearly a versatile modern workhorse.

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Address Correction Requested

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