

Gsxr Suzuki production



SUZUKI MOTORCYCLES GSX R

Can we make one for you?



It should be amply clear that the technology behind every **Suzuki Gsxr** - from the original 1985 machine to today's range of three race-ready Superbikes - is not just impressive but carefully planned to allow **Suzuki moto** to build the **Gsxrs** and sell them into an incredibly price-sensitive market.

Beyond **Suzuki's** traditional traits - making the most of its engineering dollars by, in part, connecting the production and racing cycles at close intervals - is the fact that the company has worked extremely hard to streamline the actual production of the machines.



How quick, and how efficient? Consider this fact: at the end of the assembly line at the Toyokawa plant in the Aichi Prefecture, one sparkling new **Suzuki Gsxr** rolls off the end-under its own power-every fifty-six seconds.

It takes a mere forty-five minutes from the initial assembly procedure on the main line - fitting the bare frame onto a machine that simultaneously presses in the steering-head bearing cups and stamps the vehicle identification number (VIN) - to the very first running of the engine under the heat of combustion.



To consider this feat from the perspective of your easy chair is to be surprised and, perhaps, amused; to be on the floor at Toyokawa and watch it happen is to be astonished. Such production savvy comes from a long history of assembly-line evolution and a full-bodied embrace of "just-in-time" manufacturing.

This process dramatically reduces the amount of product that must be stored at the assembly plant and increases efficiency by an equally dramatic amount. What's more, just-in-time is designed for quick turnover in the production line, so that

batches of a given product can be made in the precise size to match any number of variables, including market demand (global or regional), shipping ability, and even seasonality. With this system, a manufacturer is not locked into producing a given number of a particular product on a predetermined schedule.



In fact, this is an amazingly fluid environment, where variables can be accommodated without a hitch. Typical of modern manufacturers, many of the **Gsxr**'s components come from outside vendors- Keihin for the fuel injection, Showa or Kayaba (KYB) for the suspension, Tokico or Nissin for the brakes, and on down the line. In Japan, the manufacturer/

vendor relationship is strongly rooted and carefully nurtured, while at the same time it's well known that competition keeps everyone performing to the maximum.

All of this is beneath the surface when you're confronted with the massive realities of series production. The Toyokawa plant is a densely packed beehive of activity that proceeds at an orderly yet boisterous pace. No one ever seems to be running from one place to another in a flat panic, but you will not see anyone (besides visiting journalists) standing around. Where, precisely, your **motorcycle** first begins to take shape - even, actually, when - depends on your point of view.

If you view it as centering on the engine, then the first sparks of life begin in the massive engine-assembly plant adjacent to **Suzuki**'s headquarters outside the city of Hamamatsu. All machining operations are performed at **Suzuki moto**, as are component subassembly and final assembly. This is not a one-man, one-engine process. For example, after machining, the cylinder heads follow a separate line that sees the valves and guides installed, followed by the camshafts. Bottomend work continues on its own line.

The engine final assembly takes place in much the same way as the **motorcycle** assembly (which is described in this chapter) with a final inspection of the engine accompanied by a "running" of the engine by means of an external electric motor.

This test ensures that the engine has compression and doesn't make any nasty sounds, but it is done without the engine really running. That will take place later.

Meanwhile, at the main assembly plant, your motorcycle is starting to take life as the components of the frame. (Some of the frames in the accompanying photographs are for the **Suzuki Gsxr Hayabusa 1300**, but the basic process is the same for the **Gsxr 1000**.)

Suzuki moto uses robotics wherever it makes sense and currently employs robotic welding machines in the frame shop. Look at the outside of the main robotic welding apparatus and you'll be hard-pressed to tell what's happening inside.

Spools of welding wire as big as 55-gallon drums line the walkway outside the machine, and you can just see the wire being pulled up into the mystery machine at a prodigious rate. Inside the great machine, robotic welders tackle the majority of the frame welds, with the exception of a few segments inside the frame that cannot be reached by the welding head (those will be done by hand afterward).

Of course, all of these operations are controlled by computer and carefully designed and monitored so that each frame is properly and accurately welded.

And though it's tempting to believe that machines are better than people, the fact is that the **Gsxr** frame emerges from the robotic welding system into the hands of skilled workers who visually inspect every weld on the frame and perform any touch-ups required. The next step is to place the frame back into the hands of a quality-assurance technician to verify that it is dimensionally faithful to the plans.

The frame is placed freely on a padded table and checked from point to point using standardized fixtures, which look as though they could be templates derived from NASCAR.

One set of these, for example, makes sure that the machined holes on each side of the frame - engine mounts, swingarm pivot, subframe mounts - are aligned. Another fixture checks to see if the distance from the swingarm-pivot holes to the threaded upper-tank mount holes is the correct distance. From there, the frame travels a few feet to a station where it is checked for cracks and voids by being sprayed with a red dye penetrant.

The exterior coating is removed, and the frame is visually inspected for any remaining dye. The dye will remain in any cracks and be clearly visible when the surface is cleaned.

Perhaps the most surprising part of the frame-welding area is the amount of finish work performed after the frame is actually built. The frame arrives at a series of stations where workers handfinish the external welds and use a mild abrasive to dress any nicks or other exterior blemishes. The frame is lightly polished even though it's heading across the factory to be painted.

Prepped frames join up in racks of twelve and are taken over to the painting area in another corner of the plant. Two places in the manufacturing process form the greatest bottleneck for the **Suzuki Gsxr**, and they are, not surprisingly, paint and fuel tank manufacturing. "We can meet our production goals with one shift in the assembly area, but the tank manufacturing and paint application are run on two shifts," says Yukio Yano, group leader at the Toyokawa plant.

It's difficult to paint well when you're working on one part at a time, but it's vastly more trying when output must be balanced against quality. At **Suzuki moto**, as at most modern manufacturing concerns, application of paint is an automated affair, with tanks and frames hung on an overhead rail and drawn through the various painting processes in steps.

A cleaning stage ensures no dust and debris are on the surface. In quick succession, the frames are primed and painted and then placed into a drying chamber. (Outsiders don't get to see the painting process in action, but because it all takes place inside a machine, there's not a lot of thrill to viewing it, anyway.)

The finished frames emerge, still on the overhead racks, into a small holding area, where they are returned to the rolling carts. These carts, in turn, are brought over to a staging area at the head of the main production lines. That covers the frame section, but the fuel tank bottleneck comes both from the primary manufacturing stream and painting.

Suzuki moto uses a proprietary stamping technology to build the **Gsxr** tanks, among other models. Traditionally, a steel fuel tank was built in three or more sections, with a simple stamping creating the bottom plate and symmetrical top plates.

These plates are seam-welded together, trimmed, and filed smooth. In fact, **Suzuki moto** has machines that can do these processes in successive steps without having to remove the tank from the fixture. The **Suzuki Gsxr** tank is made from only two stampings.

That much we can tell you, because it's patently obvious to anyone familiar with manufacturing; in other words, there's no other logical way to do it. However, **Suzuki moto** uses a special process

to perform the top stamping that dramatically reduces blemishes and, at the same time, permits complex shapes to be created in the thin-gauge steel.

It's an inscrutable process much like the paint process: sheets of flat steel go on the conveyor belt at one end and a stamped half tank chugs out the other side.

In another corner of the plant, your **Gsxr's** engine has arrived from Hamamatsu on a massive pallet. According to precise timing of the production schedule, it is pulled down from the pallet and subjected to minor prep work that includes installing any exterior hoses and taping over the inlet tubes to prevent anything from falling in.

Then the engine is placed into a large cart, which acts as a staging location. The engine actually heads downstairs via a small powered platform, like a dumbwaiter, and moves in dedicated tunnels under each assembly line.

When the time comes, each engine rises on a powered platform from the basement to a position next to where it will be installed into the frame. Once again, the engine travels the shortest distance possible between incoming pallet and the actual motorcycle.

Meanwhile - a term used often here because so much happens simultaneously - subassembly areas on the periphery of the plant get to work on a host of parts. For example, technicians working for the fuel-injection supplier unpack throttle bodies, inspect them, and fit them with the throttle cables and a few of the sensors.

These parts are assembled and staged in rolling carts. When the cart is full, it is wheeled either to another small staging area at the head of the line or directly to the assembly line itself.

Timing is so good here that remarkably few carts are in the staging areas.

Other subassemblies are going together elsewhere in the plant, although a few have been completed by the vendors off-site. For example, the suspension supplier will place both fork legs into the lower triple clamp, which is complete with stem, lower bearing, and steering damper. The wheels come shod with tires, already mounted and balanced.

The brake rotors are already on the wheels. At this point in your **Gsxr's** gestation, all the parts are in the plant and ready to be assembled. But first the line has to be prepared for the **Gsxr 1000**.

On our visit, **Suzuki moto** was "running a selection of sportbikes on the No.4 assembly line. In the morning, 20th Anniversary **Gsxr 750s** were rolling off the line, about one a minute.

Then, just after the lunch break, the line churned out a couple of hours' worth of Hayabusas. (Let's see, one per minute, excluding changeover time; call it 120 units. On that day.) Just-in-time means more than just having the parts arrive in a reasonable amount of time before the vehicle is to be assembled, but the most amazing part to watch is the line changeover.

The main assembly line is just that, a straight line with forty-five stations and people working from both sides. The motorized belt keeps churning except for the twice-daily ten-minute breaks.

The moving line is the focus of all the work, with the technician stations flanking it and the supply carts outboard still. It's possible to walk the corridor between assembly lines-**Suzuki moto** has six parallel lines at Toyokawa-and hardly see what's being assembled inside for all the equipment, parts, and parts trolleys stacked up.

As the last **Gsxr Hayabusa 1300** slides down the line toward life, the supply carts that flank the line are pulled one by one. when the technician at one station installs onto the **Gsxr Hayabusa 1300** the last part from the cart, the empty cart is pulled out of the way, often within seconds. Behind it, in a smaller staging area, is the replacement cart holding **Gsxr** components, which is deftly slid into place. Stand back and you can find where the last Hayabusa is on the line by watching for a flurry of moving carts.

On this day, **Suzuki moto** left two spots in the line open between the last **Gsxr Hayabusa 1300** and the first **Gsxr** ... all of two minutes. The painted frames arrive at the main assembly line on large carts that hold approximately a dozen frames. Your **Gsxr's** frame is pulled from this cart and placed into a fixture that sets the steering-head bearing cups into the frame itself at the same time a computerized punch inscribes the cast steering-stem area with the **motorcycle's** VIN.

This process takes less than thirty seconds. But while the VIN punch is doing its thing, the **Gsxr's** rear subframe is hoisted over from another cart and bolted into place. The technicians take great care starting the subframe bolts; it's not at all about shoving the fastener into the hole and following it with the pneumatic wrench.

Instead, they start the threads by hand while manually supporting the subframe. Immediately adjacent to the first operation is a technician who expertly places the main wiring harness.

Actually, it sounds harder than it is, considering not a lot is attached to the frame just yet. The next step is for one of the technicians to pick up the frame/subframe combination and place it, upside down, into the first segment of the moving line.

The frame is held in place through the steering head and rests by the seat mount boss atop a urethane pad. From this point on, the frame starts taking on parts at an almost dizzying rate.

Swingarm assemblies-with the chain, chain guard, and threaded axle adjusters-wait by the line. One worker places the swingarm in place while another slides the axle home.

A quick rap with the impact socket and the deal is done. Immediately after, the shock linkage is bolted to the frame and to the swingarm, and before you can turn and say, "Look at that," the shock itself has been plucked out of a massive bin full of them and slid down into the frame with the top clevis already in place. When did that happen?

At about the same time, another technician takes one of the **Gsxr 1000's** titanium mufflers off the cart. It comes with the SET valve installed in the lead-in pipe and cabling already attached.

It is bolted loosely to the footpeg bracket to allow for the later installation of the main exhaust system. Also while the frame is upside down, other components are bolted in place, such as the sidestand and the footpeg carriers with the shift linkage and rear-brake master cylinder already in place. Wiring connectors' strategic placement allows the technicians to connect items such as brake-light switches and sidestand-interlock switches without missing a beat.

Soon after these steps are completed, the frame is righted and placed on a second, separate moving line.

Now, with the swingarm in position and located by the shock, the bike can be supported by the threaded bosses in the swingarm that will eventually hold your track-stand spools.

Supporting the front of the frame is the fork/front wheel assembly, which has been pulled from a cart carrying the preassembly. In this case, the wheel, tire, fender, and brake calipers are already in place, as are the steering damper and lower triple clamp. Just as the frame is reaching horizontal from being flipped right side up, a technician expertly slides the steering stem up through the frame and places the top bearing races, spacer, and threaded collar in place. The bike continues down the line, gaining clip-on handlebars-which are, as you can guess, already assembled with switches, levers, perches, front-brake master cylinder, and hand grips. The handlebars are left loose for the time being.

A station or two down the line, the frame is ready for the engine. From the staging area, the engine travels underground and appears, on time, at a small platform to the right side of the bike.

An overhead crane arrangement allows a single worker to grab the engine by means of horizontal prongs, heft it off the platform, and bring it carefully-but quickly-under the main-frame rails and into position. It takes longer to read about it than to do it. The engine mounts to the frame with the help of threaded spacers.

Those castellated nuts you see surrounding the engine-mount bolts are there to accommodate engine-to-engine and frameframe variances. The engine is slid into place and the mounting bolts are driven in.

Then the castlehead adjusters are driven tight. This process makes the engine installation go very quickly. While a pair of technicians places the engine in the frame, others install the chain over the countershaft sprocket and hook up the engine wiring harness to the main harness. Next in line, the throttle body assembly is placed on the engine and connected electrically.

A pair of technicians maneuver the exhaust headers into place and bolt them down with an ease that makes all of us who have fought with pipes feel like dullards. At the next station, a technician uses a pivoting fixture to bring the rear wheel over to the bike.

With practiced hands, he slides the wheel in place while a worker on the other side drives the axle into place. (Now you know why **Suzukis** have the axle nut on the left side.) A quick jab with the

impact driver and the nut is tight. Soon after the bike gets a rear wheel and an exhaust system, the radiator and oil cooler are assembled as a set with the cooling fan-arrive on the bike. Now with the coolant and oil systems sealed up, they can be filled, a process that's done automatically through overhead supply lines that are flexible enough to be able to follow the bike as it moves down the line. Speaking of fluids) at this point a worker installs the brake lines and then, some steps down the line, another worker, again with automatic equipment, fills the systems with fluid. The brake fluid is provided under pressure) and there's no bleeding of the brakes from the caliper side. Another worker installs the airbox assembly, and the bike is ready for the fuel tank. On a side line, painted fuel tanks are lined up on moving carts. A small subassembly line immediately adjacent to the main line installs the combination bottom plate/fuel pump/level sender apparatus.

The tank is then dipped into a shallow bath and a small amount of air pressure is applied (less than 1 psi) while the technician looks for bubbles. Seeing none, the tank is hoisted out of the pool) dried briefly, and placed on the **motorcycle**.

Once the fuel lines and electrical connections have been made, the tank is bolted down and the gas cap is installed. The key, which has been in the ignition all this time, is checked to see that it works in the newly installed cap. Then the bike is filled with a small amount of fuel-just enough to pressurize the injection pump and injectors and run the bike at the end of the line.

With the tank in place and most major systems serviced and ready for action, your **Gsx R** stands getting its bodywork. As expected, the fairings are preassembled in areas surrounding the main assembly lines and so are ready to go when they reach the carts. When bodywork is installed it is quickly covered with a protective pad to prevent scrapes and scratches that might result from the remaining assembly tasks.

The forward fairing is installed complete with the instruments, ram-air ducts, and mirrors already in place. One quick click on an electrical connector and a couple of bolts through the fairing bracket, and your **motorcycle** has a face. The lower fairings are a bit more involved, because small air deflectors around the radiator must be installed.

Still, it's the work of just a few seconds, and soon the side panels are in place as well. Next comes the passenger saddle. The rider's saddle is left off for the moment so that a technician can hook the battery leads to an overhead cable that provides 12 volts to the **motorcycle**. At this time, the ignition is turned on and the lights checked for the first time.

Work on your bike now slows appreciably, with quality-assurance inspectors starting to take over. Every surface is checked for blemishes, and any small nicks and scratches are buffed out on the spot. (There are remarkably few of these.) A small auxiliary battery is pulled from a cart, and its leads are clipped to the bike's battery cables.

Once again, the lights are checked, the horn honked, and the instruments scrutinized for the proper indications. The next step is to roll the bike off the rear stand and onto both wheels for the first time.

At this point, the bike is off the rolling assembly line, which has conspicuously fewer stations per foot of track, so that the inspectors at the end of the line have more time to do their critical jobs. Rolling now but still not alive, the bike is pushed over a pneumatic center stand that hoists the bike off the ground so the wheels can be checked for freedom of movement, and the steering head is checked from lock to lock.

This step takes ten or fifteen seconds. The next phase in the motorcycle gestation is perhaps the most exciting for onlookers but seems utterly routine for the workers. The bike is rolled over to an in-ground dyno. The worker turns on the ignition again, grabs the clutch lever, and... lights the fire. Your fuel-injected **Suzuki Gsxr** wakes immediately into a smooth, even idle.

A puff of blue smoke-the result of assembly lubrication burning off in the no-longer-virgin combustion chambers-wafts a foot or so before it is sucked up into a collector that has risen from the floor behind the bike. The technician gives your **Gsx R** a gentle prod or two of the throttle and pushes a button to lock the front wheel into a special chock so that the rear wheel is centered over the rollers in the floor.

Now, with the engine alive for perhaps ten or fifteen seconds, the technician pops it into first gear, lets out the clutch, and sets the rear wheel in motion. There's no look of concern on his face. Is everything tight in there?

Did anyone forget a step? Nothing. Rev it up in first gear, then grab second. Then third. Fourth. Fifth and sixth, and then a short run in top gear at what is later explained is between 80 and 100 kph (50 and 60 mph). Call it 4,500 rpm, max. The technician quickly checks an overhead monitor that shows the results of the test. Then, clutch in, click-click back through to neutral. (He gets it the first time.)

Another check of the lights and horn, and he pushes the button that drops the chock. Once more into first gear, the bike is driven under its own power-all of a hundred feet or so-to the final inspection station. With the engine not yet up to temperature, the muffler still cool to the touch, your **Gsxr** is shut off for the last time in the land of its origin.

There's no time for reflection. Your **Suzuki Gsxr** is moved to a short line where the fuel is removed (and recycled, naturally) and the rider's saddle bolted in place. Another set of quick inspections-including one under bright lights to look for leaks and assembly miscues-and the bike is ready for crating. In preparation for this, thin sheets of protective material are placed on the bodywork and a support is installed into the hollow swingarm pivot. The crate is literally built around the **motorcycle**.

A baseplate is pulled onto a rolling line, and the **motorcycle** is hoisted up and over to the plate, where it is quickly secured. Then the thin metal sides of the crate are built up around the bike as various paperwork is placed alongside the bike. The windscreen is added to the crate, and a cardboard cover is readied and then gently lifted over the bike.

It is secured to the metal base by machine screws. It's a short forklift ride from the end of the crating line to the small warehouse in back, but not many bikes stay home for long. In fact, the **Suzuki Gsxr 1000** we watched start out as a collection of parts - perhaps your **Gsxr 1000** - was forklifted directly to a waiting truck for shipment to the port.

From the moment the VIN puncher first kissed its steel into the soft aluminum frame until the bike was loaded onto the truck-oil still slightly warm, coolant in the radiator just starting to mix with the warmer antifreeze from the water jackets-astoundingly little time passes. Seventy-five minutes. Give or take.



Suzuki Gsxr 750-Gsxr
1100: 1985 - 1987



Suzuki Gsxr 750-Gsxr
1100: 1988 - 1991



Suzuki Gsxr 750-Gsxr
1100: 1992 - 1995



Suzuki Gsxr 600-Gsxr 750-
Gsxr 1100: 1996 - 1999



Suzuki Gsxr 600-Gsxr 750-
Gsxr 1000: 2000 - k1 - k2



Suzuki Gsxr 600-Gsxr 750-
Gsxr 1000: k3 - k4 - k5



Suzuki Gsx R 600-Gsxr
750-Gsxr 1000: k5 - k6 -
k7