



**RAYS
GROUP
INFORMATION**

RAYS Company Limited
5-3-18 Nagatanishi, Higashiosaka-City
Osaka, ZIP 577-0016, Japan
T. +81.6.6746.1010 F. +81.6.6746.6652
www.Rayswheels.co.jp

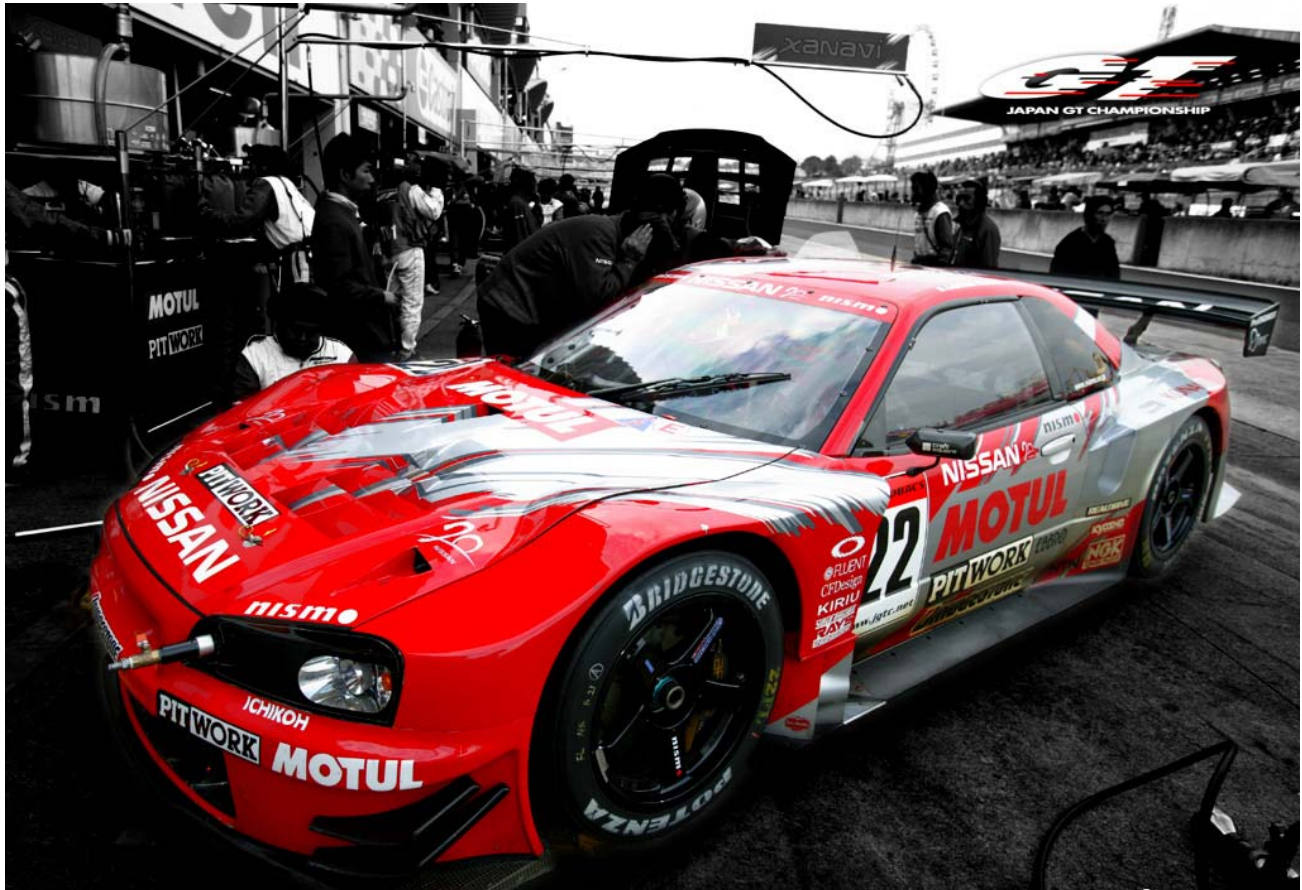
What is RAYS?

RAYS Co. Ltd., established in 1973, is the premier Japanese manufacturer of high end wheels for both Motorsports and street use. By following their virtual goal of "contributing to the promotion of motor sports culture," RAYS continues to manufacture wheels with innovative design and the highest technology. RAYS strives to stay ahead of the competition by forging strong trusting relationship with top race and tuning teams around the world and continually researching new materials and technologies to make the future racing wheels a reality today.



RAYS is a comprehensive manufacturer of wheels with the ability to provide solutions in all aspects of the wheel business. All processes from concept, design, manufacturing, and logistics is done "in house" for the most accurate and efficient service possible.

Committed to being the world leader in wheel design, manufacturing, and strategic solutions, RAYS delivers on a worldwide scale.



The History of RAYS

"Made by the racer, for the racer" - RAYS was conceived by a small group of highly motivated racing enthusiasts and engineers who wanted to find the leading edge when it came to racing. After examining a racecar's dynamics, there was one area that definitely needed improvement; the wheel.

"If you build it, they will come" - RAYS realized through research and development that in order to build the best wheel possible, the best materials and manufacturing processes was not good enough. They needed to innovate and create the best of the best.

By establishing the most efficient and innovative wheel manufacturing techniques possible, RAYS became a successful racing-only wheel supplier to those that realized the true value in strong and lightweight wheels.



Many "Works Teams", which are factory backed racing teams of Nissan, Honda, Toyota, Mazda, and others turned to RAYS to manufacture wheels for their top-tier racing programs. RAYS has competed and have had their wheels on winning teams that have participated in JGTC (Japan all Grand Touring Championship), Formula Racing, 24Hours of Lemans, BTCC (British Touring Car Championship) and more.

As more people realized the potential of a strong and lightweight wheel, RAYS naturally turned their sights to the aftermarket where they are now recognized on a world-wide level. Their most popular in house brand, "Volk Racing" is one of the most prestigious and coveted brands in both leading edge designs and technology.



By introducing new manufacturing techniques that make the traditionally expensive forged wheels more available to the general public, many OEMS have learned and have had the chance to experience the RAYS wheel at first through their racing programs and now, to the streets on special edition models (i.e. Nissan 350Z Track Model) and high performance OEM Vehicles.

Today, RAYS has the capability to manufacture all types of wheels at the highest quality possible. RAYS has received the coveted ISO 9001 rating in 2004 as they now set their sites on being a top level supplier to OEMS and private label brand clients around the world.

The pursuit of the Perfect Wheel

From the conceptual stage, the engineers at RAYS utilized all the data supplied to them through exhaustive data collected from real world situations and especially from racing to plan the proper high performance wheel for the correct application.

Through this research and development, RAYS has established the following main fundamental concepts when developing a wheel:

1. Strength
2. Lightness
3. Exterior Design
4. Balance



Before we address these concepts, we will discuss first the different types of wheel manufacturing available today -

The different types of wheels:

"Not all wheels are created equal"

•One-piece Cast Wheels

A cast wheel is made by pouring molten aluminum into a mold; the metal then takes the mold's shape as it cools and hardens. There are several types of casting methods which include low pressure/gravity, counter pressure, and high counter pressure molding (HCM); each method has its place in today's market. A wheel manufacturer will select a particular method according to the weight, strength and finish that they have specified for that design. The benefit of casting wheels is the relative low cost for set up and manufacturing. However cast wheels are typically heavier and less robust compared to a wheel manufactured using a forging method.

•Forged One-piece Wheels

A forged wheel is made by forming a wheel under extreme high pressure. The material used is an aluminum billet—a solid piece of dense aluminum. A forging press, a huge machine that exerts thousands of tons of pressure on the metal, basically presses or rolls the billet into its fundamental form. This forging is then machined to final finish. This process allows wheels to be built with much less material, allowing for lighter weight and unique designs, because the process creates a much stronger wheel than other methods. Many premium wheels are made using forging technology.

•Multi-piece Wheels

The processes mentioned above can be combined to produce a wheel of a particular strength and weight. For example, some wheels have a cast aluminum center, welded to a steel outer. Another type of two-piece construction features a billet center welded to a rolled outer (extruded aluminum rolled into a hoop). Still other wheels feature a split outer so that widths and offsets can be made to custom specifications. This last method is the three-piece type construction. In this type of wheel, the center which can be cast, billet or forged, is usually attached to the outer assembly by special screws or rivets.

RAYS Forged –

The Real Forged Wheel Technology Produced by RAYS.

In the pursuit of the perfect wheel, RAYS has established that a hi-performance wheel must exhibit the following attributes: Superior **Strength**, Exceptional **Lightness**, Leading Edge **Design**, and Complete **Balance**.

RAYS has chosen that their best wheels must be manufactured by forging. RAYS has developed their own proprietary forging techniques in 1998 that allow them to progressively grow closer to their goal of making the “perfect wheel”.

“Artisan Spirit” – RAYS has maintained since its foundation that the artisan spirit is the keyword for the development of its products. State of the art machinery, equipment and computers are employed to attain the best quality. Like an experienced blacksmith forging the perfect sword, RAYS still adopts the “Artisan Spirit” ideology to manufacture wheels correctly without indulging in the overconfidence of its own technology.

As previously mentioned, a forged wheel due to its manufacturing method, allows for a wheel that is stronger and lighter than any other type of wheel manufacturing. RAYS chooses to make the lightest and strongest forged wheel possible because of the huge performance benefits that the vehicle can potentially possess.



“Reducing Unsprung Weight” - The weight from the Suspension apparatus which includes the Tire and Wheel combination is called “Unsprung Weight”, and reducing the weight of this section is crucial to the performance of the vehicle. If 1kg of weight is saved from the suspension system, the value of a 15kg weight loss from the vehicle’s overall weight can be saved. This means if an aluminum wheel which is 1kg lighter than a stock steel wheel is installed, 60kg of total of body weight can be saved.

“Rotating Weight” – During the driving of a vehicle, there is a pressure that is applied to the tires and wheels of the vehicle. This is called the Gyroscope effect. Especially during high performance driving conditions - acceleration, turning, and braking is all effected by these rotating forces. Reducing weight while retaining superior strength results in success in hi-performance driving.



It is now clear that a lighter wheel can positively alter a vehicles performance in many ways. The car will experience faster acceleration, better braking, improved handling, less strain on the drive-train, and even better gas mileage.

“Solid Strength” – A forged wheel starts out life as an aluminum billet and is then subjected to thousand of tons of pressure to form the wheel into its desired shape. The density of the aluminum allows the wheel to be exceptionally strong compared to cast wheels. This is the most important part of any wheel. Although a wheel should be manufactured to be as light as possible, a perfect balance between weight and strength must be achieved to ensure not only performance, but ultimate safety.

“Not all forged wheels are created equal” – There are several companies in the world that can say that they are a forged wheel manufacturer. Owning a forging press is an important factor, but the most important factor is the ability to understand the concept of forging and the best method of making this happen.

“The RAYS Forging Process” – Superior **Strength** and Exceptional **Lightness**



A RAYS Monoblock Forged Wheel begins its life as a piece of solid aluminum billet. The aluminum used is aircraft grade aluminum (6061) which is important for forging due to its high tensile strength, hardness, and light weight.

The RAYS Advantage: Each piece of billet is subject to in-house microscopic and tensile testing to ensure proper quality from start to finish.

Each aluminum billet is then super heated in a specialized furnace that can precisely control the time to heat and the proper temperature for correct forging.

The RAYS Advantage: Note that almost every process is controlled in a robotic environment to ensure safety, preciseness, and efficiency. RAYS invests heavily in efficiency which results in reliability, control, and customer satisfaction.



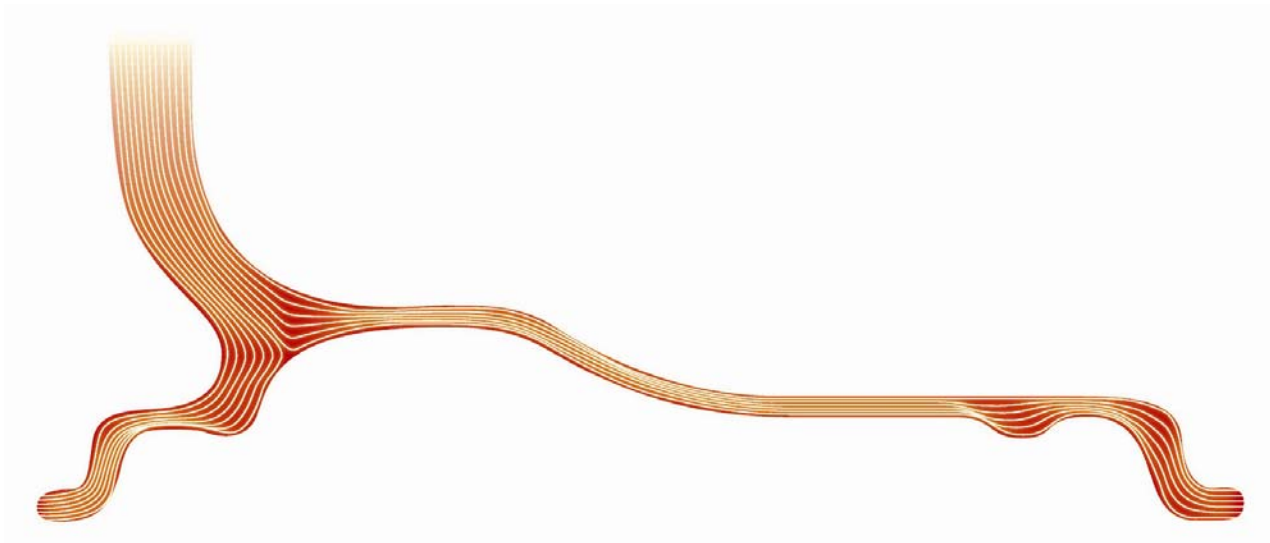
The billet is then subjected to over 8,000 TONS of pressure to achieve its initial shape. This process will start the organization of the microstructure of the aluminum which is called the “Metal Flow Line”. The forging pressurizes the aluminum which increases the density of the metal. This allows the metal to become durable.

The RAYS Advantage: A “Normal” forged wheel manufacturer will utilize a forging press which will forge a “pancake” or a flat surface, which will be machined to achieve its desired shape. A RAYS forged wheel is “mold forged” where the center disk’s shape is actually forged into the design. This allows for the continuity of the “Metal Flow Line” which allows for an even stronger type of forged wheel with no disruption in the flow of the metal. The Metal Flow Line equals minimum machining which simplifies the product and is also proof of its inherent strength.



The Forged disk will be subjected to additional forging to finalize the shape of the spoke in preparation for the elongation of the rim. This maximizes the metal flow line within the center disk.

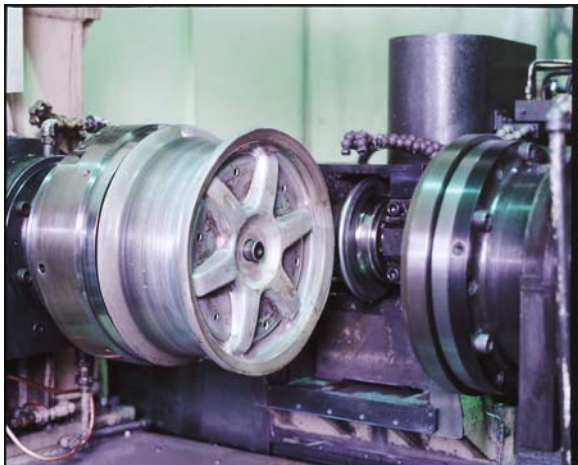
The RAYS Advantage: Like the fibers of a human muscle, the “Metal Flow Line” in addition to being strong, also exhibits flexibility. A cast wheel is prone to cracking due to the porosity or air pockets that reside in the metal alloy due to the casting process. The “Metal Flow Line” is not only more resistant to impacts, but in the case of a severe impact, will tend to bend rather than crack. This is an important safety feature of a RAYS forged wheel.



“The Secret to RAYS Forging: RM Forging” – The next step of the RAYS forging process involves the RAYS world class RM-8000 Machine. This machine has been developed exclusively by RAYS Engineering and this process is patented for use only by RAYS. This special forging process integrates the final forming of the center and the spinning elongation of the rim into one process. This not only simplifies the forging process, it helps to create the perfect continuity of the “Metal Flow Line” from the center disk all the way to the rim edge.



The RAYS Advantage: RAYS RM Forging process allows for a completely forged wheel. If calculated there is approximately **12 Tons** of pressure applied to each square millimeter of the aluminum. This allows for superior wheel durability and with this durability, the wheel can be manufactured with ultra thin cross-sections for maximum lightness. Strength and Lightness – This is the key to RAYS Wheel superiority.



Rim Cold Forging – Once the center portion and the initial rim has been formed. The rim is then cold forged to extend the rim to its desired width.

The RAYS Advantage: This is where the true durability of the metal flow shines where a RAYS Forged wheel will exhibit rim cross sections as thin as 2.5 millimeters.

Heat Treatment and cooling – The formed wheel is then heat-treated to further refine the material and increase the hardness of the aluminum. Once the aged wheel is heat treated, the wheel is then submerged in a cooling tank to lock the hardness into the material.



The RAYS Advantage: This process is an important part of the overall manufacturing of the wheel. Through RAYS vast knowledge of wheel manufacturing techniques and heavy investment in the proper tools, a wheel can be exposed to precisely controlled heating and cooling temperatures to ensure the proper refinement of the aluminum alloy.



Machining Process – “Maintaining True Proportions” RAYS utilizes the latest in CNC Robotic cutting technology to machine all necessary sections such as center bore, lug hole, and wash areas to a tolerance of a hundredth of a millimeter. Manufacturing wheels at such slight tolerances ensures consistency throughout each product manufactured by RAYS.

The RAYS Advantage: RAYS obsession to exactness and keeping true specifications is shown in precise cutting processes to ensure exactness, reliability and quality. Every wheel is manufactured to be consistent and true to form. After each process, every wheel is subject to inspection utilizing advanced quality sample testers including X-Ray inspection machine, Amsler multi-purpose tensile tester, electron scanning microscope, and eddy current flaw testing machine.

Finish Treatment – “Durability from Start to Finish” - Each wheel is Shot-blasted in preparation for the finishing treatment. The Shot-blasting process involves thousands of tiny industrial grade ball bearings pounding the wheel in a controlled environment to further harden the surface of the aluminum.



The RAYS Advantage: The Shot-blasting process is a well known process in many racing circles, where crankshafts, connecting rods, and other internal engine parts are subjected to this process to ensure durability. Race teams will spare no expense to get any advantage. RAYS is no exception when it comes to building wheels. RAYS will not spare any expense when it comes to ensuring superior durability.



Finishing - "Elegant and Durable Finishing" - Each wheel is coated with high- grade surface treatments that are able to cope with severe conditions. Resistance to heat, sun, and corrosion are considered when choosing strong, yet visually appealing finishes.

The RAYS Advantage: Each wheel is coated in a state of the art finishing line where all environmental factors are carefully controlled. Automated and robotically controlled finishing line minimizes human handling and ensures consistency and stability. Advanced solvents and clear coats are able to pass stringent in-house testing and even OEM standards to ensure the best product in every way possible.



Finished Product and Logistics - RAYS institutes a series of inspections systems approved by Government and ISO standards to ensure final quality. RAYS has established strong, worldwide networks to ensure delivery in an efficient and timely manner.

RAYS Wheels strength and lightness is evident in RAYS use of the best materials, unique manufacturing methods, and technology. However it is still the "Artisan Spirit" that drives the staff at RAYS to create and master all aspects of wheel manufacturing.



Leading Edge Design –

RAYS has been recognized on a worldwide scale as a leader in wheel design. RAYS creative minds are not only gifted in the arts, they are also absolute car enthusiasts that can apply their design skills to the design of proper wheels. Fully familiar with the forging process, they take into consideration all aspects of wheel function, application matching, and visual appeal during the wheel design process.



Wheels manufactured by RAYS, equipped with original technologies and high potential, exhibit leading edge designs that bring the future of wheels into the present.



RAYS designs wheels for several vehicle genres, including but not limited to sports car applications, sedan and luxury vehicles, sport compact enthusiast street wheels and full racing magnesium forged alloy applications.

RAYS as a group believes that cars are important partners that share enjoyable times with their drivers. Not only are RAYS Wheels superior in quality, strength, lightness, they are also visually appealing – *“The Total Package”* from one powerful source.



Complete Balance –

To ensure completeness as a wheel manufacturer, RAYS has employed severe in house testing procedures to ensure proper usage margins based on RAYS vast Racing and Market experience.



JWL – Many may have noticed a marking on wheels with a visible logo “JWL”. Japanese wheels must have a "JWL" logo on the wheel and "JWL" (Japan Light Wheel Alloy) is a compilation of standards defined by the Japanese Government to ensure the vehicle's safety for aluminum road wheels. However this standard is the minimum requirement for safety conducted by the Japanese Government.

“Bigger is Better” - In recent years, OEM vehicles have been equipped with more performance features than ever. Engines have more horsepower, larger brakes, chassis are much stronger. Wheels have also progressively increased in size. Aftermarket wheels have taken this a step further with “Plus Sizing”. Plus sizing is installing a wheel with a larger diameter with a lower profiled tire to match the size of the stock vehicle wheel and tire combination. The increase in size of wheels and tires is the best way to improve both performance and appearance of the vehicle. However, it is important to maintain the overall diameter of the tire because it is possible to change odometer and speed meter readings and adversely affect handling. By using a low-profile tire, quickness in steering response and better lateral stability is gained. At the same time, the car becomes visually impressive.



A lower profile tire with a plus sized wheel results in a loss of air volume at the same time. This means that a lower profile tire exposes the wheel to potential damage more easily from road hazards such as bumps or potholes and also increases rides harshness. A "60 Profile" tire is the most popular tread height for OEM Vehicles and there is enough air volume to absorb the impact from the road surface. However, recent trends dictate that wheels on the road are now 17 inch or 18 inch in diameter. In addition, even 19 inch and 20 inch wheels (or more!) are now popular sizes in the aftermarket. These wheels are using tire profiles of 40 or below! Therefore, these larger wheel diameters are being subjected to more impact force and stress because of less air volume.



“Just meeting the minimum is not enough” This is the reason why RAYS created our own standards "JWL+R". RAYS JWL+R standard is much more severe than the "JWL" standards which are conducted by Japanese government. You can have more confidence and obtain more reliability from our “MADE IN JAPAN” wheels.

[JWL Standards]

JWL (Japan Light Alloy Wheel) is a compilation of Safety Standards for Passenger Car Wheels approved by the Japanese Ministry of Transport. All wheel products are registered under VIA (Vehicle Inspection Association) regulations after strict quality testing by three types of testing methods approved by JWL (Japan Light Alloy Wheel) Testing Council.

[RAYS JWL+R Standards]



※JWL+R SPEC2商品は2つのPOPとリム内側のシール(写真)が目印です。

JWL+R Spec 1-

RAYS JWL+R Spec 1 standards refer to RAYS cast wheels which are designed and manufactured utilizing RAYS vast wheel experience to ensure lightness and durability. RAYS designs their cast wheels to have the proper reinforcement in the appropriate areas to avoid unnecessary weight, and retain the proper structural integrity.

JWL+R Spec 2-

RAYS JWL+R Spec 2 standards apply to RAYS Forged wheels which are designed and manufactured to exhibit the ultimate in durability, strength, and lightness. The "Metal Flow" within a RAYS Forged wheel ensures the ultimate in strength which allows RAYS to design wheel cross-sections as thin as 2.5 millimeters, which results in unmatched lightness paired with ultimate strength.

(1) Cornering Fatigue Test (Drum Endurance Test)

JWL pass criteria: 500,000 cycles **JWL+R Spec 1 pass criteria: 800,000 cycles**
JWL+R Spec 2 pass criteria: 1,000,000 cycles



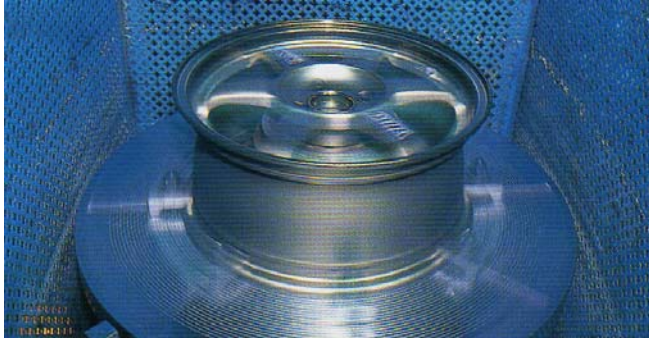
The purpose of this test is for checking wheel rim strength and durability. Place a wheel assembly with tire on test equipment. Radial stress is then added to simulate vehicle weight.

Test run 500,000 cycles (JWL+R Spec 1 - 800,000 cycles, JWL+R Spec 2 - 1,000,000 cycles).

After 500,000 cycles (JWL+R Spec 1 - 800,000 cycles, JWL+R Spec 2 - 1,000,000 cycles), inspect for cracks, deformation and any nut loosening.

(2) Radial Load Fatigue Test (Rotary Bending Test)

JWL pass criteria: 100,000 cycles JWL+R Spec 1 pass criteria: 150,000 cycles
JWL+R Spec 2 pass criteria: 200,000 cycles



The purpose of this test is for checking durability of the wheel disc. The spokes and the hub are the first point of weight distribution from the vehicle and spoke strength is gauged by this test.

Place a wheel on testing equipment and by adding bending stress to center of disc –

Test run 100,000 cycles (JWL+R Spec 1 - 150,000 cycles, JWL+R Spec 2 – 200,000 cycles).

After 100,000 cycles (JWL+R Spec 1 - 150,000 cycles, JWL+R Spec 2 - 200,000 cycles), inspect for cracks, deformation and any nut loosening.

(3) 13 Degree Impact Test

JWL pass criteria: 594 kg JWL+R Spec 1 and Spec 2 pass criteria: 610 kg

The main purpose of test is for checking strength between rim and disc cross section. The “joint” or the area where the spoke and the rim meet is an important structural area that is subject to great stress. The horizontal weight of the rim and the vertical stress of the spokes meet at this joint and proper structural stability is crucial for a proper wheel.

The wheel assembly is placed with tire tilted 13 degrees from horizontal plane on testing equipment.

A preset weight is dropped on the outer sidewall of tire, thus giving impact to the wheel/tire. Then inspect for cracks, deformation and air leak.



This test is very important for the recent trend of a larger/wider wheel with lower profile tire combination, because there is less air volume than OE wheel/tire and more stress to inner rim section. This test simulates actual usage condition such as hitting corner curb or objects from side.

[RAYS JWLR Standards]

The following tests are not required by JWLR and subject RAYS test wheels to more severe and “realistic” road conditions.

(1) 90 Degree Impact Test

JWLR Spec 2 pass criteria: 1 ton from 140mm high



The purpose of test is for checking strength between the rim and disc cross section and for any potential air leakage. Place a wheel assembly with tire 90 degrees from a horizontal plane on testing equipment. A weight is then dropped on the tire, giving impact to the wheel/tire. Then inspect for any cracks, deformation and air leakage.

(2) Drum Endurance Test after 90 Degree Impact Test

**JWLR Spec 2 pass criteria: (1) 90 degree impact test – 1ton from 13mm high
(2) 800,000 cycles for 18 inch wheel/tire**



The purpose of this test is to check wheel rim strength / durability and for potential air leakage. Place a wheel assembly with tire 90 degrees from a horizontal plane on testing equipment. A one ton weight is then dropped on the tire from 13mm high, giving impact to the wheel/tire. The wheel assembly with installed tire which was subjected to the previous 90 degree impact test from 13mm/1ton high is placed on test equipment. Then by adding radial stress, test run 800,000 cycles for an 18 inch wheel. After 800,000 cycles, inspect for cracks, deformation and any nut loosening.

The RAYS Advantage: The market's demands for safety to aluminum wheels are growing due to the increase in vehicle performance and the increase of vehicle weight every year. However, safety standards of ALUMINUM wheels such as JWLR have not changed to deal with this situation. The RAYS JWLR Standards are “Real Spec” meaning that RAYS in house standards more accurately simulate and prepare for situations that may arise in today's road conditions.

(3) Wheel Coat Quality Test

RAYS performs exhaustive in-house paint and film quality tests before a wheel can be released to market. Tests included are: Salt spray, Compound corrosion, Weather resistance, Ultra – Violet ray test, chipping tests, and many more to ensure not only wheel structural integrity, but finish durability as well.

The RAYS Advantage: RAYS is the only manufacturer that subjects wheels to these severe in house tests to once again prove their quality and real world worthiness. This is why more OEMs have been attracted to RAYS as a supplier due to vast experience, quality, and ability to offer wheel solutions in any situation. Cast or Forged, a RAYS wheel is at the top of its class.

RAYS – A Comprehensive Wheel Maker.

Since its establishment, RAYS has forged strong mutual partnerships around the world to provide wheel solutions.

- Utilizing vast knowledge gained from experience in racing and market experience, RAYS can interpret and plan for wheel solutions that fit our customer needs.
- By incorporating unique design capabilities paired with innovative and exclusive technologies, RAYS has the ability to manufacture a comprehensive wheel package that enhances the customers image and performance.
- Uncompromised testing from JWLR allows for product quality, durability and reliability to meet and exceed all customer expectations.

Forging the way to new and exciting solutions, RAYS will continue to contribute and promote the “Motorsports Culture”



RAYS Group Profile

*Establishment	1973
*Capital Stock	\$1,800,000.00 USD
*Employees	330
*RAYS Group Consolidated Accounts (Annual Sales / 2002)	\$166,500,000.00 USD
- Group Companies -	
*RAYS Co., Ltd.	President : Masumi Shiba
*RAYS Engineering Co., Ltd.	Forging Factories Capacity - Forged 1pc. -30,000pcs/ mo. Capacity - Forged 2pc. - 5,000pcs/ mo.
*RAYS R & D Co., Ltd.	Research and Development
*RAYS Foundry Co., Ltd.	Main Casting Factory Capacity (Total) - Cast 1pc. - 60,000pcs/ mo. Capacity (Total) - Cast 2pc. - 10,000pcs/ mo.
*Fuji Pacific Alloy Co., Ltd.	Casting Factory
*Pacific Alloy Logistics Co., Ltd.	Processing and Painting
*RAYS Creative Co., Ltd.	Designing and Planning
*Tsubaki Precision Mold Industry Co., Ltd.	Modeling and Tooling
*Twin Co., Ltd.	Wholesale Distribution (Japan)
*RESU Co., Ltd.	Wholesale Distribution (Japan)
RAYS USA Inc. (Mackin Industries, Inc.)	OEM and Private Brand Sales (USA)

Main Clients -

Autobacs Seven Co., Ltd.
 Bridgestone Co., Ltd.
 Fuji Heavy Industries Ltd.
 Mazdaspeed Division
 Mugen Co., Ltd.
 Nissan Motorsports International Co., Ltd. (NISMO Japan)
 Nissan Motor Co., Ltd.
 Ralliart Inc. (Mitsubishi Motorsport)
 Subaru Technica International Inc.
 Sumitomo Rubber Industries Ltd.
 Toyo Tire & Rubber Co., Ltd.
 Toyota Technocraft Co., Ltd. (Toyota Racing Development Japan)
 Yellow Hat Co., Ltd.
 Yokohama Tire Co., Ltd.
 Etc...