

TIRES

1 Introduction

Approximately 137 million automobile tires were manufactured in 2021, an increase of approximately 18% in rubber volume and approximately 14% in terms of number of tires compared to 2020. Although demand is recovering from the large drop caused by the impact of the COVID-19 pandemic in 2020, it remains 5% less than in 2019 for the amount of rubber, and about 6% less for the number of tires.

In addition to basic safety performance, trends in tire technology have focused on preserving the environment through the development technology that improves environmental friendliness and economic efficiency. As various countries continue to tighten their regulations on automobile fuel efficiency and emissions and the transition toward electric vehicles intensifies, tire manufacturers are working to bring out a lineup of low environmental impact products centering on fuel-efficient tires. The SDGs are also being addressed through raw materials and recycling technology development initiatives.

The Japan Automobile Tyre Manufacturers Association (JATMA) was a forerunner in introducing voluntary industry standards enacted in January 2010 for a tire labeling system that rates rolling resistance and wet grip performance. It also provides consumers with information related to safety and the environment.

Regulations on tires cover both environmental and safety performance. In terms of safety performance, the UN regulations adopted in Europe, Japan, and other regions, along with the U.S. FMVSS, are the main regulations adopted in many countries to ensure vehicle safety, and they are also spreading to other countries and regions. Regulations on environmental performance can be divided into those that stipulate minimum performance requirements, and those of that set labels for grades that inform customers of the performance level of the tire. Following their introduction in Europe and Turkey, envi-

ronmental performance regulations have been enacted in regions such as South Korea, Russia, Brazil, Middle-East, Malaysia and Thailand and are continuing to further spread throughout the world.

Since June 2016, the UAE has made it mandatory to affix tire identification labels with embedded radio frequency identification (RFID) tags on all tires sold or put on display. This endeavor is intended to provide traceability, offer users information about the tire, and allow authorities to verify certification. The recent trend of requiring two-dimensional codes or RFID in Russia, and QR codes in the EU and Thailand, is continuing.

2 Tire Production, Sales, and Results

Production results for automobile tires (Table 1) is recovering from the large drop in demand caused by the COVID-19 pandemic, with the amount of rubber increasing by about 18% and the number of tires increasing by

Table 1 Vehicle Tire Production Results

(Units: Number of tires = 1,000 tires, amount of rubber = tons)

		2017	2018	2019	2020	2021
Amount of rubber	For passenger vehicles	471,774	477,617	475,369	384,946	439,825
	For light-duty trucks	127,179	129,239	132,489	113,080	132,905
	For trucks and buses	241,319	241,150	243,713	197,352	234,640
	Others	186,178	211,672	214,021	167,900	207,364
	Total	1,026,450	1,059,678	1,065,592	863,278	1,014,734
Number of tires	For passenger vehicles	108,258	109,816	109,327	89,014	100,322
	For light-duty trucks	21,527	21,921	22,081	19,167	22,067
	For trucks and buses	10,499	10,513	10,614	8,617	10,159
	Others	4,639	4,499	4,523	4,026	4,961
	Total	144,923	146,749	146,545	120,824	137,509

Source: JATMA

Table 2 Vehicle Tire and Tube Sales Results

(Units: Number of tires = 1,000 tires)

		2017	2018	2019	2020	2021
Number of tires	For new vehicles	46,377	46,103	45,523	37,781	36,933
	Commercial	73,979	73,725	72,573	64,866	69,613
	(Japanese total)	120,356	119,828	118,096	102,647	106,546
	For export	43,302	43,352	44,271	35,905	43,316
	(Total demand)	163,658	163,180	162,367	138,552	149,862

Source: JATMA

*1 Imported products are included for new and commercial vehicles

Table 3 Trends for Consumption of Main Raw Materials for Vehicle Tires and Tubes
(Units: Amount of consumption = tons)

		2017	2018	2019	2020	2021
Tire cords	Nylon	15,541	15,460	15,713	12,366	14,666
	Steel cord	217,683	227,707	230,144	187,703	221,821
	Polyester	41,295	41,991	42,846	35,565	40,901
	Rayon	3,734	3,178	2,640	2,022	2,495
	Other	476	384	378	307	350
	Total	278,729	288,720	291,721	237,963	280,233
Natural rubber		595,027	621,200	632,616	511,499	608,065
Synthetic rubber		417,281	424,920	422,001	343,260	402,597
Carbon black		476,946	492,329	490,592	394,137	465,480

Source: JATMA

about 14%. The sales results (Table 2), show that sales in Japan decreased by about 2% for new vehicles, but increased by about 7% for commercial use, while exports rose by about 21%. The combined total demand domestic and export demand increased by about 8%.

3 Trends in Consumption of Main Raw Materials for Tires

Table 3 shows the trends in the consumption of the main raw materials for tires up to 2021. The consumption of tire cord, synthetic rubber and carbon black increased by 17 to 29% compared to 2020.

4 Trends in Tire Technologies

4.1. General Trends

In response to the introduction of environmental regulations around the world, tire manufacturers are developing low environmental impact tires offering improved fuel efficiency and reduced noise and weight without sacrificing safety or reliability. Research on developed materials, structure selection, new tire profiles, and tread design, as well as the optimal way to combine them, is being carried out and applied to the development of technologies for next-generation tires that meet even more stringent requirements. Notably, the trade-off between rolling resistance and wet grip performance makes it crucial to develop technology that achieves both at a high level. Also, tires with improved load capacity (high load capacity tires (HLC)) for electric vehicles, which are becoming more widespread as part of efforts to reduce CO₂ emissions, have been standardized. Manufacturers are therefore developing tires with reduced rolling resistance while giving careful consideration to the overall balance of performance, and are striving to spread the use of fuel-efficient tires.

Table 4 Number of Winter Tires Sold and Comparisons to Previous Years
(Units: Number of tires sold = 1,000 tires)

	Number of tires sold				
	2017	2018	2019	2020	2021
Snow tires	24,303	25,787	23,769	20,202	23,463
Compared to previous year	107.5%	106.1%	92.2%	85.0%	116.1%

Source: JATMA

In addition, studless winter tires offering enhanced safety when driving on ice and snow, as well as next-generation run-flat tires (enhanced mobility tires (EMT)) that address safety and resource conservation concerns by emphasizing environmental performance and ride comfort more strongly than current run-flat tires. With the publication of an ISO standard on RFID covering tire traceability and the provision of tire information to users, technical studies across a broad range of fields have become necessary.

New themes include the development of next-generation tires for passenger and commercial vehicles that utilize automated driving technology for a wide range of services such as transportation, logistics, and product sales, as well as raw materials and recycling technologies from the standpoint of the SDGs.

4.2. Reducing Weight and Rolling Resistance

Global concerns about environmental protection have led to even more fuel-efficient vehicles, and Japan has joined the U.S. (California), Canada, and China in the movement to eliminate gasoline vehicles initiated by the U.K. announcement that it would ban sales of new gasoline vehicles starting in 2030. This has created more stringent demand for reducing the weight and lowering the rolling resistance of both tires installed on new cars and tires distributed for sale. Research and development focused on the adoption of streamlined materials, as well as new materials and structures is leading to greater weight reduction. Moreover, since rolling resistance is mainly due to tire deformation caused by heat generation while driving, reducing the rubber heat generation and adjusting parameters such as tire profiles to control the deformation reduces rolling resistance. Technological development efforts are leveraging research and development on materials, the finite element method, as well as optimization technologies, to achieve a balance between safety and other areas of performance.

4.3. Studless Winter Tires

The number of winter tires sold in 2021 increased by

16% compared to 2020 (Table 4). On the technical front, the various tire manufacturers have accumulated their own unique technologies for special rubbers for studless tires, such as the removal of the water film on iced surfaces to improve tire friction. In addition, they are working on technical development involving tread design as well as structural and material aspects. These efforts are aimed at improving performance on very slippery compacted snow surfaces (black ice). Products targeting even better environmental safety performance in areas such as dry and wet grip performance, lower rolling resistance, reduced weight, and longer wear life are also being developed.

4. 4. Vehicle Exterior Noise

The strengthening of regulations concerning vehicle and tire noise by the Working Party on Noise (GRB) of the World Forum for Harmonization of Vehicle Regulations (UN/ECE/WP.29) has made regulation values significantly stricter. Tire manufacturers are working on developing technologies in fields such as tread, structural, and material design. Furthermore, ISO 10844 (Acoustics - Specifications of Test Tracks for Measuring Noise Emitted by Road Vehicles and Their Tires) was revised with a new version in 2014 to minimize the variation in sound levels produced on the different test tracks where measurements were taken, and its stipulations have been incorporated into Regulation No. 117. In Japan, Regulation 117 annexed to the 1958 Agreement has been introduced for tires installed on new vehicles for passenger vehicles from 2018, and for tires installed on light-duty trucks starting in 2019. It has also been decided to apply them to medium- and heavy-duty trucks and buses from 2023.

4. 5. High Load Capacity (HLC) Tires

The increasingly common electric vehicles need a tire standard with a higher load capacity due to the increase in vehicle weight caused by heavier batteries. The European Tyre and Rim Technical Organisation (ETRTO) has standardized HLC tires, which raise load capacity while maintaining the same dimensions and air pressure as conventional extra load tires. Furthermore, the introduction of that standard in ISO 4000-1 (Passenger car tyres and rims-Part 1) is under consideration for international harmonization and standardization.

4. 6. Run-Flat Tires, EMT

The number of vehicles equipped with run-flat-tire, especially in Europe, is increasing as automakers leave out

spare tires to conserve resources and make more efficient use of space. The self-supporting reinforced side structure of mainstream run-flat tires makes them heavier than normal tires and gives them a higher longitudinal spring constant. This makes it necessary to keep weight and rolling resistance down sufficiently for the decrease in CO₂ emissions resulting from leaving out the spare tire to exceed the increase in those emissions from the use of run-flat tires.

This situation is creating demand, particularly in Europe, for next-generation run-flat tires that place more emphasis on ride comfort, weight reduction and lower rolling resistance than current run-flat tires. Many European vehicles feature these next-generation tires. Such next-generation tires have been defined as extended mobility tires (EMTs), and ISO 16992, which standardizes performance and labeling requirements, was revised and published in August 2018. In addition, the revision of Regulations No. 30 and No. 64 in January 2020, legally recognized EMTs as radial tires.

4. 7. Radio Frequency Identification (RFID) Tyre Tag

The use of RFID to ensure tire traceability (tire manufacturing information, management of sales, users, vehicles, and repair history), provide tire information matched to user attributes, and allowing checks for certification with government authorities at customs or in other situations is becoming more common. The UAE has mandate the affixing of labels with embedded RFID tags since June 2016 to eliminate poor quality products by relying on the difficulty of copying or reusing such tags. Russia has followed suit since November 2020 with the introduction of RFID based on its own rules.

The ISO standards for RFID tags attached to tires were discussed in ISO/TC 31 (Tyres, rims and valves), and all four standards concerning matters such as specifications and test methods were issued in April 2020. In 2021, ETRTO proposed the building of a database to provide users with the various information recorded in RFID tags based on its purpose. JATMA is also participating in evaluating and implementing this database.

4. 8. Recycling of Waste (Used) Tires in Japan

Recycled waste use in 2021 decreased by about 1% from 2020, totaling 904,000 tons, and the recycling rate also decreased by about 3% to 92%. About 65% of the recycling waste is used for heating in paper manufacturing or chemical factories. The recycling situation described

Table 5 Results of On-Road Tire Inspections in 2021 (January to December)

Source: The Japan Automobile Tyre Manufacturer's Association, Inc. (JATMA)

Inspection items		By year		2021				
		By road type		Expressway		General road		Total
Number of inspections (times)				2		8		10
Number of vehicles inspected (A)				25		152		177
Number of vehicles with poor tire maintenance (B)				12		86		98
Percentage of problems (B/A) (%)				48.0		56.6		55.4
Number of problems found and percentage of problems		Number of problems	Percentage of problems	Number of problems	Percentage of problems	Number of problems	Percentage of problems	
Breakdown of poor tire maintenance items	Insufficient tire tread	3	12.0	2	1.3	5	2.8	
	Uneven wear	2	8.0	14	9.2	16	9.0	
	External damage (reaching the cords)	0	0.0	0	0.0	0	0.0	
	Imbedded nail or other foreign object	0	0.0	0	0.0	0	0.0	
	Insufficient tire pressure	8	32.0	75	49.3	83	46.9	
	Others	0	0.0	19	12.5	19	10.7	
	Total	13	—	110	—	123	—	

Note: 1) In some cases, a single vehicle had multiple items of poor tire maintenance, so the number of vehicles with poor tire maintenance and the number of poor tire maintenance problems found do not always match up.

2) Percentage of problems: Number of vehicles with poor tire maintenance or number of poor tire maintenance problems / Number of vehicles inspected × 100 (rounded to two decimal places)

3) National expressways include those exclusively for four-wheeled vehicles.

4) Tire air pressures were measured through both visual inspections and actual measurement with an air gauge. Hot air was included as a tire state.

above only takes statistics on waste (used) tires produced in Japan, and does not include imported products.

5 Tire Standards

5.1. Main Revisions in the 2022 JATMA Year Book

- (1) General In Japan, the direct quoting of UN Regulations Nos. 30, 54, 75, and 117 in the amendments to the Safety Regulations for Road Vehicles, led JATMA to revise its standards to harmonize them with the UN regulations and ISO standards.
- (2) Passenger Vehicle Tires A total of three new sizes for the standard load 40, 45, and 55 series, and of six new sizes for the extra load 40, 45, 50, and 60 series have been added.
- (3) Motorcycle Tires One new size was established in the 70 series.
- (4) Agricultural Machinery Tires Three new sizes were established in the 70 and 80 series.

6 Tire Safety Issues

6.1. On-Road Tire Inspections

Table 5 shows the results of ten on-road tire inspections conducted in 2021 in Japan by JATMA with the cooperation of prefectural police departments, transportation bureau branch offices, the Nippon Expressway Companies, and other automotive- or tire-related organi-

zations. Poor tire maintenance was found in 55.4% of vehicles, with an insufficient air pressure being overwhelmingly high at 46.9%. Insufficient air pressure not only has a negative impact on fuel efficiency, but also present the risk of puncturing. Therefore, activities to raise awareness of tire safety inspections are carried out for safety purposes.

6.2. Laws and Regulations

(1) Trends Concerning Environmental Performance Regulations

The Fuel-Efficient Tire Promotion Council was established based on the recommendations of the International Energy Agency (IEA) and global environmental protection movements. In January 2010, JATMA led the way in introducing a tire labeling system requiring the indication of grades for rolling resistance and wet grip performance according to voluntary industry standards.

In preparation for the introduction of a regulation on the tires themselves, the partial amendment of the Safety Regulations for Road Vehicles, which was issued and came into effect on October 8, 2015, ultimately made compliance with the technical requirements for tire exterior noise, rolling resistance, and wet grip performance in UN Regulation No. R117 gradually mandatory starting in April 2018.

In Europe, tire noise regulations have been strengthened since November 2012, and UN Regulation No. 117,

which also covers rolling resistance and wet grip performance, is already in effect. A further strengthening of the tire rolling resistance regulations (Stage 2) began in November 2016. A tire labeling system (Regulation (EC) 1222/2009) that requires the display of grades for these three areas of tire performance was introduced in November 2012, and a new labeling system (Regulation (EU) 2020/740) was introduced in May 2021. The new system partially modifies the performance grades, and uses QR codes to provide information to consumers.

Following in the footsteps of Europe, in the Middle East, Israel has applied the grade labeling since June 2013, and UN Regulation No. R117 since January 2015. A switch to the same labeling system as in Europe was made in January 2021. In addition, a tire labeling system with grades for rolling resistance and wet grip performance, as well as minimum performance requirements, has been applied since November 2015 in Saudi Arabia and since January 2016 in other Persian Gulf countries. Iran started applying UN Regulation No. 117 and the European grade labeling system to imported tires in August 2016 and March 2017, respectively.

In Asia, the Noise and Vibration Control Act (tire noise regulation and noise level application) has been gradually applied in South Korea since 2020 in addition to legislation on grade labeling and minimum performance requirements for tire rolling resistance and wet grip performance. In Malaysia, noise regulations (UN Regulation No. 117 Stage 1) have been applied since July 2015. The rolling resistance (Stage 2), vehicle exterior noise (Stage 2), and wet grip performance stipulations from UN Regulation No. 117 have been gradually applied since November 2017. Thailand also has started applying performance requirements similar to European Regulation No. 117 and the grade labeling system for the rolling resistance, vehicle exterior noise, and wet grip performance since September 2021, and providing grade information to consumers by QR code has been mandatory since 2021.

In Brazil, the INMETRO Regulation No. 544/2012 was issued, and came into effect in April 2015, imposing minimum performance requirements and a grading systems for tire vehicle exterior noise, rolling resistance, and wet grip performance.

The minimum performance requirements for rolling resistance, vehicle exterior noise, and wet grip performance from Regulation No. 117 are also in effect in Turkey, Russia, Iran, and the U.K.

In the U.S., the Final Rule regarding the grading systems for tire rolling resistance, wet traction, and wear resistance performance was published in the Federal Register as the U.S. Tire Fuel Efficiency Consumer Information Program Part 575.106 in December 2011. No new progress has been seen since the transition from the Trump administration, where the movement toward enforcement was stagnant, to the Biden administration, but it is necessary to pay close attention to future developments.

Other countries that plan on introducing a minimum requirement performance system similar to the above include China and India. Both of those countries are also considering introducing grade labeling systems using their own labels.

(2) Trends Concerning Safety Performance Regulations

Safety performance regulations are gradually being introduced in Asia. Vietnam has established new certification rules for new tires that have the same technical criteria as Regulation Nos. 30, 54 and 75. Similarly, Thailand has also established new Thai standards (TIS) that have the same technical criteria as Regulation Nos. 30, 54 and 75, and they have been applied since January 2019. More recently, Cambodia started applying Regulation Nos. 30, 54 and 75 in January 2020, and the Philippines are considering introducing legislation that partially adopts Regulation Nos. 30, 54, and 75. Similar legislation is also under consideration in Laos, Myanmar, and Pakistan.

The ASEAN nations concluded a Mutual Recognition Arrangement in January 2021, and further expansion is anticipated in light of moves to adopt Regulation Nos. 30, 54 and 75 as tire safety regulations.

(3) Other

The Working Party on Brakes and Running Gear (GRRF) of the World Forum for Harmonization of Vehicle Regulations (UN/ECE/WP29) examined and formulated a Global Technical Regulation (GTR) for tires to develop globally unified safety standards for the tire certification systems appearing in a growing number of countries, and GTR No. 16 was officially issued on January 16, 2015. Revision 1, which harmonizes with the latest related UN regulations, was subsequently issued in March 2017. In addition, discussions to harmonize the standards for light-duty truck tires initiated in January 2017 led to issuing Revision 2 in October 2020.

At the World Forum for Harmonization of Vehicle

Regulations (UN/ECE/WP.29), Japan submitted the International Whole Vehicle Type Approval (IWVTA) proposal to build a new international mutual recognition framework for vehicle approval. The proposal was established as Regulation No. 0 in August 2018. The tire-related requirements in that proposal consist of the UN regulations (Nos. 30, 54, and 117).

A noteworthy future trend in tire-related regulations is the institutionalization of the wet grip performance evaluation of worn tires with respect to the performance

and environmental performance of winter tires from 2023. There are also aging-related issues, including RFID, additional discussion on wear evaluation, and deadlines concerning tire purchase and use. The Working Party on Noise and Tyres (GRBP) of the World Forum for Harmonization of Vehicle Regulations (UN/ECE/WP.29) continues to discuss new regulations and revisions to existing ones, and it will be necessary to continue monitoring global trends closely to address increasingly diverse and complex certification systems and regulations.