TIRES

1 Introduction

Approximately 145 million tires were produced in 2017, and the amount of rubber used for tires and the number of tires produced was nearly the same as in 2016. The tire industry still has not recovered to the over 180 million tires level it had reached before the global financial crisis.

From the standpoint of protecting the environment, one of the trends seen in tire technologies has been for tire manufacturers to focus on fuel-efficient tires as they work on making products with low environmental impact to further enhance the environmental friendliness and economic efficiency of tires in addition to their basic safety performance. However, a further tightening of regulations is on the horizon for the vehicle fuel efficiency and emissions standards of various countries. The Japan Automobile Tyre Manufacturers Association (JATMA) was a forerunner in introducing voluntary industry standards for a tire labeling system introduced in January 2010 that rates rolling resistance and wet grip performance. It also conducts consumer information activities.

In terms of safety performance, the UN regulations adopted in Europe, Japan, and other regions, along with the U.S. FMVSS, are the main tire-related regulations adopted in many countries to ensure vehicle safety, and they are spreading to Asian countries and regions. Regulations on environmental performance can be divided into those that stipulate the minimum required performance, 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, environmental performance regulations have been enacted in regions such as South Korea, Russia, Brazil, and the Middle-East and are continuing to further spread throughout the world.

2 Tire Production, Sales, and Results

Table 1 shows the vehicle tire production results for 2017. The amount of rubber used for tires and the number of tires produced was nearly the same as in 2016, indicating that the tire industry still has not recovered to the levels before the global financial crisis.

The tire sales results (Table 2) indicate that the number of tires sold in Japan increased by 8% compared to 2016, while the number of tires for export decreased by 8%. Thus, the total demand did not change.

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 in 2017. Following the trend in production and sales results, the consumption of tire

Table 1 Vehicle Tire Production Results

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

		2013	2014	2015	2016	2017
Amount of rubber	For passenger vehicles	523,064	526,341	505,586	486,732	471,774
	For small trucks	146,561	148,518	139,477	130,183	127,179
	For trucks and buses	259,638	263,082	239,596	229,072	241,319
	Others	198,687	183,121	172,911	173,814	186,178
	Total	1,127,950	1,121,062	1,057,570	1,019,801	1,026,450
Number of tires	For passenger vehicles	119,485	120,005	113,821	110,002	108,258
	For small trucks	24,682	24,649	23,141	21,783	21,527
	For trucks and buses	10,808	11,001	10,266	9,888	10,499
	Others	4,656	4,770	4,587	4,702	4,639
	Total	159,631	160,425	151,815	146,375	144,923

Source: JATMA

Table 2 Vehicle Tire and Tube Sales Results

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

		2013	2014	2015	2016	2017
Number of tires	For new vehicles	46,928	47,013	45,016	44,434	46,377
	Commercial	73,825	76,264	72,766	72,175	73,979
	(Japanese total)	120,753	123,277	117,782	116,609	120,356
	For export	51,819	53,100	49,757	47,283	43,302
	(Total demand)	172,572	176,377	167,539	163,892	163,658

Source: JATMA

*1 As of 2007, imported tires are included in the figures for new vehicles.

Table 3 Trends for Consumption of Main Raw Materials for Vehicle Tires and Tubes

(Units: Amount of consumption = tons)

		2013	2014	2015	2016	2017
Tire cords	Nylon	18,013	17,940	17,817	17,495	15,541
	Steel cord	223,216	232,360	220,973	212,651	217,683
	Polyester	42,540	42,152	41,557	40,159	41,295
	High-tenacity rayon	3,174	3,610	3,717	3,930	3,734
	Others	717	734	736	339	476
	Total	287,660	296,796	284,800	274,574	278,729
Natural rubber		622,210	618,744	604,777	598,093	595,027
Synthetic rubber		478,045	480,042	435,559	415,426	417,281
Carbon black		540,334	538,526	502,572	481,561	476,946

Source: JATMA

cord, natural rubber, synthetic rubber and carbon black are essentially unchanged from 2016.

4 Trends in Tire Technologies

4. 1. General Trends

To respond to the introduction of environmental regulations around the world, tire manufacturers are developing tires that help the environment through higher fuel efficiency and lower noise and weight, and emphasize economic efficiency and environmental friendliness while maintaining safety and reliability.

Ways to optimize the materials, structure, tire profile, and tread design are being researched and applied to the development of technologies for next-generation tires that meet even more stringent requirements. Tires are expected to achieve a balanced performance in many areas, including basic functions. Since reducing rolling resistance, in particular, tends to worsen wet grip performance, the development of tire technologies that balance these two areas of performance is becoming increasingly important. Tire manufacturers are therefore giving careful consideration to the overall balance of tire performance, launching products with reduced rolling resistance, and striving to spread the use of fuel-efficient tires.

In addition, both studless winter tires, which enhance safety when driving on ice and snow and, in light of safety and resource conservation concerns, next-generation run-flat tires with a stronger emphasis on environmental performance and ride comfort than current run-flat tires, are being developed.

ISO regulations incorporating radio frequency identification (RFID) primarily aimed at establishing a tire tracking system are being discussed, which is making technical studies across a broad range of fields necessary.

Table 4 Number of Winter Tires Sold and Comparisons to Previous Years

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

	Number of tires sold				
	2013	2014	2015	2016	2017
Snow tires	24,958	25,958	23,284	22,600	24,303
Compared to previous year	108.3%	104.0%	89.7%	97.1%	107.5%

Source: JATMA

4. 2. Reducing Weight and Rolling Resistance

With vehicles are becoming more fuel efficient worldwide, the need for products that take environmental protection into account in the tire market is rising, leading to more stringent demand for lighter tires with lower rolling resistance year after year.

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.

Other approaches include reducing the drag resistance of the tires themselves to improve vehicle fuel efficiency, and low flat narrow tires with a large outer diameter are being adopted in some vehicles to mitigate deformation during tire contact.

4. 3. Studless Winter Tires

The number of winter tires sold increased by 8% compared to 2016 (Table 4).

On the technical front, various tire manufacturers have accumulated their own unique technologies for special rubbers for studless tires. 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 roads where repeated stops and starts, especially at intersections, have caused compacted snow surfaces to become smooth (black ice). At the same time, the development of products in which the deterioration of performance on snow and ice is suppressed to complement the usual considerations of performance on dry and wet roads, as well as rolling resistance, is being pursued.

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 to further lower noise levels. Furthermore, ISO 10844 (Acoustics - Specifications of Test Tracks for Measuring Noise Emitted by Road Vehicles and Their Tires) was updated to 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 (UN/R117-02).

In Japan, UN/R117-02 will be introduced in stages, to tires installed on new vehicles for: passenger vehicles starting in 2018, light-duty trucks starting in 2019, and trucks and buses starting in 2020. The regulation of commercial tires is also under consideration.

4. 5. Run-Flat Tires

The number of vehicles equipped with run-flat tires, especially in European vehicles, is increasing as automakers leave out spare tires to conserve resources and make more efficient use of space, as well as in response to the growing need to ensure safety in the event of a puncture on a highway or high-traffic road.

Structurally, there are two broad categories of run-flat tires: self-supporting run-flat tires with reinforced sidewalls, and auxiliary-supported run-flat tire systems where an additional support ring attached to the wheel is inserted inside the tire. Self-supporting run-flat tires with reinforced sidewalls are currently the mainstream. Run-flat tires tend to have a higher longitudinal spring constant and be heavier than a normal tire. Thus, a low weight and rolling resistance that counterbalance the increase in CO_2 emissions due to the use of run-flat tires with the decrease in CO_2 emissions resulting from the lack of a spare tire are crucial.

In light of such issues and current market needs (environmental regulations, user preferences), there is a demand, particularly in Europe, for next-generation run-flat tires with relaxed durability requirements that place more emphasis on ride comfort, weight reduction and lower rolling resistance than current run-flat tires. These next-generation run-flat tires make up the majority of run-flat tires on European vehicles. ISO 16992, which standardizes the next-generation run-flat tire technology represented by extended mobility tyres (EMTs), is expected to be revised and published in August 2018. In Europe, discussions of the revision of UNR30/64 have started in preparation for legislation on EMTs.

4. 6. Radio Frequency Identification (RFID)

The use of RFID has been proposed as part of a tire tracking system intended to manage the manufacturing date, sales, users, vehicles, and repair history concerning tires, as well as to eliminate the import of non-certified tires (verify certification).

Discussions concerning the publication of an ISO standard on RFID tire tags in ISO/TC 31 (Tyres, rims and valves) have been started, with standardization expected in 2019.

4. 7. Other

4. 7. 1. Recycling of Waste (Used) Tires in Japan

Recycling use was 903,000 tons, representing a recycling rate of 91%. The primary use is heating (63%), with demand for old tires that can be recycled as a source of heat remaining high in the paper, cement, steel, and chemical industries. Demand is especially high in the paper manufacturing industry, accounting for approximately 65% of use as a source of heat.

Users such as the paper manufacturing industry have continued to supplement the insufficient supply of recycled tires in Japan by purchasing waste tires from other countries.

The recycling situation described 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 2018 JATMA Year Book

5. 1. 1. General Trends

In Japan, the amendments to the Safety Regulations for Road Vehicles directly quote UN Regulations Nos. 30, 54, 75, and Revision 2 of Regulation No. 117 (UN R30/R54/R75/R117-02), leading JATMA to revise its standards to harmonize them with the UN regulations and ISO standards.

5. 1. 2. Tires for Passenger Vehicles

The overall diameter for 93 sizes were revised to harmonize them with both UN R30 and each of the new size added in the 50- and 55- series, respectively.

5. 1. 3. Tires for Small Trucks

One size was established and two sizes were deleted

to reflect actual market conditions. The overall width and the overall diameter of 51 sizes were revised and harmonized with UN R54.

5. 1. 4. Tires for Trucks and Buses

The J range (100 km/h) load capacity coefficient exceeding 100 km/h and the F range (80 km/h) load capacity coefficient were deleted. The overall width and the overall diameter of 23 sizes were revised and harmonized with UN R54.

5. 1. 5. Other Tires

One new size for agricultural machinery tires and one new size for motorcycle tires were established. For motorcycle tires, the definition of on-road tires and tires for both uneven roads and on-road were revised and harmonized with UN R75.

6 Tire Safety Issues

6. 1. On-Road Tire Inspections

Table 5 shows the results of 36 on-road tire inspections conducted in 2017 in Japan by JATMA with the cooperation of prefectural police departments, transportation bureau branch offices, the three Nippon Expressway Companies, and other automotive- or tire-related organizations. The number of vehicles with poor tire maintenance was 19.6%, a 3.8 point increase over the 2016 inspection results. The most prevalent problem was deficient air pressure at 14.6%, which is overwhelmingly higher than the second most common, uneven wear, at 2.3%.

To make tires more fuel efficient, it is important to not only reduce rolling resistance of the tire itself but also to properly manage the air pressure. The relevant industries are deploying activities to educate drivers about the importance of maintaining the proper air pressure since this affects not just the environment and vehicle fuel efficiency but also safety. The results from 2016 indicated that the number of vehicles with improper tire pressure had dropped by 8%, but this deteriorated in 2017. This is attributed, in part, to a drop in opportunities to have the air pressure inspected due to the spread of self-service gas stations. A more proactive awareness campaign to educate drivers about managing tire air pressures, in the same vein as recent campaigns to promote less electric power consumption and energy conservation in the home, is greatly desirable.

6. 2. Laws and Regulations

6. 2. 1. Trends Concerning Environmental Performance Regulations

6. 2. 1. 1. Japan

The Fuel-Efficient Tire Promotion Council was estab-

Table 5 Results of On-Road Tire Inspections in 2017 (January to December).

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

By year / By road type / Inspection items		2016						2017								
		Expressway		General road		Total		Expressway			General road			Total		
									Change from previous year			Change from previous year			Change from previous year	
Number of inspections (times)		14		22		36		14	0		22	0		36	0	
Number of vehicles inspected (A)		451		1,218		1,669		405	−46		1,195	−23		1,600	−69	
Number of vehicles with poor tire maintenance (B)		123		141		264		96	−27		218	77		314	50	
Percentage of problems (B/A) (%)		27.3		11.6		15.8		23.7	−3.6		18.2	6.6		19.6	3.8	
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	Number of problems	Percentage of problems		Number of problems	Percentage of problems		Number of problems	Percentage of problems	
									%	Change		%	Change		%	Change
Tire maintenance Breakdown of poor maintenance	Insufficient tire tread	14	3.1	18	1.5	32	1.9	6	1.5	−1.6	13	1.1	−0.4	19	1.2	−0.7
	Uneven wear	14	3.1	34	2.8	48	2.9	6	1.5	−1.6	30	2.5	−0.3	36	2.3	−0.6
	External damage (reaching the cords)	3	0.7	0	0.0	3	0.2	0	0.0	−0.7	0	0.0	0.0	0	0.0	−0.2
	Imbedded nail or other foreign object	4	0.9	1	0.1	5	0.3	4	1.0	0.1	3	0.3	0.2	7	0.4	0.1
	Insufficient tire pressure	91	20.2	87	7.1	178	10.7	76	18.8	−1.4	157	13.1	6.0	233	14.6	3.9
	Others	13	2.9	23	1.9	36	2.2	11	2.7	−0.2	56	4.7	2.8	67	4.2	2.0
	Total	139	—	163	—	302	—	103	—	—	259	—	—	362	—	—

Notes: 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
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.

lished based on the recommendations of the International Energy Agency (IEA) and global environmental protection movements. A tire labeling system requiring the indication of grades for rolling resistance and wet grip performance according to voluntary industry standards was introduced by JATMA in January 2010.

In accordance with 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 (UN R117-02) gradually mandatory starting in April 2018.

6. 2. 1. 2. The U.S.

In December 2007, the U.S. Congress enacted the Energy Independence and Security Act of 2007, which led to the creation of a consumer tire information program after it was signed into law by the President. In December 2011 the Final Rule regarding the grading systems for tire rolling resistance, wet traction, and wear performance was published in the Federal Register as the U.S. Tire Fuel Efficiency Consumer Information Program Part 575.106. Since then, the process of enforcing the Final Rule had been moving forward, but it has recently been virtually put on hold, especially since the inauguration of the Trump administration. This will require close monitoring in the future.

6. 2. 1. 3. Europe

EEC Directive 92/23/EEC stipulated that tire noise regulations would be gradually applied in EU member nations starting in February 2003. Similarly, UN Regulation No. R117 (UN/R117-02), which significantly strengthens vehicle exterior noise regulations and also includes stipulations on rolling resistance and wet grip performance, came into effect in November 2012. A further strengthening of the tire rolling resistance regulations (Stage 2) began in November 2016. A tire labeling system that requires the display of grades for these three areas of tire performance was introduced in November 2012. Customers are now provided with information about the performance grades of tires.

6. 2. 1. 4. The Middle-East

Following in the footsteps of Europe, Israel has applied grade labeling for tire rolling resistance, vehicle exterior noise, and wet grip performance since June 2013, and minimum performance requirements since January 2015. In addition, a tire labeling system with grades for rolling resistance and wet grip performance, as well as minimum performance requirements, have been applied since November 2015 in Saudi Arabia and since January 2016 in other Persian Gulf countries. Iran started gradually phased in the application of the grade labeling systems of Europe and UN Regulation No. R117 (UN/R117-02) to imported tires in 2016 and 2017.

6. 2. 1. 5. Asia

Legislation on grade labeling for tire rolling resistance and wet grip performance, as well as on minimum performance requirements, has been gradually applied in South Korea since December 2012. Performance regulations on tire noise and additions to the labeling systems will be gradually introduced starting in 2019. In Malaysia, noise regulations (UN Regulation No. 117 Stage 1 levels) have been applied since January 2015. The rolling resistance, vehicle exterior noise, and wet grip performance stipulations from UN Regulation No. 117 have been gradually applied since November 2017. Countries that plan on introducing minimum performance regulations similar to those in Europe concerning rolling resistance, vehicle exterior noise, and wet grip performance include China, Thailand, and India (China also plans to introduce grade labeling systems).

6. 2. 1. 6. Brazil

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

6. 2. 2. Trends Concerning Safety Performance Regulations

6. 2. 2. 1. Asia

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 and 54. Similarly, Thailand has also established new Thai standards (TIS) that have the same technical criteria as Regulation Nos. 30 and 54, and is assessing their enforcement.

6. 2. 3. Other

6. 2. 3. 1. Harmonization of Standards

After the Working Party on Brakes and Running Gear (GRRF) of the World Forum for Harmonization of Vehicle Regulations (UN/ECE/WP.29) 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, GTR No. 16 was officially issued on January 16, 2015. This was followed by the WP.29 approval of amendments aimed at harmonization with the latest related UN regulations in November 2016. Discussions to harmonize the standards for light-duty truck tires have been in progress since January 2017.

6. 2. 3. 2. International Mutual Recognition

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. Examinations for its establishment are underway, and the tire-related UN regulations (Nos. 30, 54, and 117), as well as their requirements, are being assessed.

Similarly, in Asia, an ASEAN Mutual Recognition Arrangement (MRA) is under consideration.

6. 2. 3. 3. Other Tire-Related Regulations

Tire-related regulations that will be intensely examined in the future include regulations regarding the aging of tires, such as RFIDs, limits on tire purchases or use, and regulations regarding the performance of winter tires. It is necessary to continue monitoring global trends closely to address the increasingly diverse and complex certification systems and regulations established in various countries.