TIRES

1 Introduction

Approximately 146 million vehicle tires were produced in 2016, 4% less than in 2015, and the amount of rubber used for tires also declined by 4%. 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 an intensification of technological development to further enhance the environmental friendliness and economic efficiency of tires in addition to their basic safety performance. Tire manufacturers are focusing on fuel-efficient tires as they work on making products with a low environmental impact.

The Japan Automobile Tyre Manufacturers Association (JATMA) was a forerunner in introducing voluntary industry standards for a tire labeling system that rates rolling resistance and wet grip performance. It also conducts consumer information activities.

Regulations on tires include safety performance and environmental performance regulations. 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 Asian countries and regions where they had not yet been introduced. In terms of environmental performance, regulations can be divided into those that stipulate the minimum required performance, and those that set labels for grades that inform customers of the performance level of the tire. Efforts to spread environmental performance regulations throughout the world, including in South Korea, Russia, Brazil, the Middle-East, and Malaysia, have stood out since their introduction of in Europe and Turkey.

2 Tire Production, Sales, and Results

Table 1 shows the vehicle tire production results for 2016, which exhibit a decline of 4% compared to 2015, as well a decline of 4% in the amount of rubber used for tire production. While this represents a recovery from the 2009 low of 139 million tires, production has still not returned to pre-global financial crisis levels.

Table 2 shows the tire sales results. These results indicate that the number of tires sold in Japan for new vehicles fell by approximately 1% compared to 2015, while the number sold for commercial use in Japan remained essentially the same and sales of tires intended for export declined by 5%. The total demand, which includes both tires for Japan and tires for export, decreased by 1%.

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 2016. Tire cord, natural rubber, synthetic rubber and carbon black consumption decreased compared to 2015, with the 5% drop for synthetic rubbers standing out as particularly large.

4 Trends in Tire Technologies

4. 1. General Trends

Due to environmental concerns prompted by global warming, as well as 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 examined and applied to the development of technologies for next-generation tires

Table 1 Vehicle tire production results

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

		2012	2013	2014	2015	2016
Amount of rubber	For passenger vehicles	535 354	523 064	526 341	505 586	486 732
	For small trucks	142 125	146 561	148 518	139 477	130 183
	For trucks and buses	263 370	259 638	263 082	239 596	229 072
	Others	206 056	198 687	183 121	172 911	173 814
	Total	1 146 905	1 127 950	1 121 062	1 057 570	1 019 801
Number of tires	For passenger vehicles	120 609	119 485	120 005	113 821	110 002
	For small trucks	23 194	24 682	24 649	23 141	21 783
	For trucks and buses	10 843	10 808	11 001	10 266	9 888
	Others	4 553	4 656	4 770	4 587	4 702
	Total	159 199	159 631	160 425	151 815	146 375

Source: JATMA

Table 2 Vehicle tire and tube sales results

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

		2012	2013	2014	2015	2016
Number of tires	For new vehicles	48 526	46 928	47 013	45 016	44 434
	Commercial (Japanese total)	71 092	73 825	76 264	72 766	72 267
		119 618	120 753	123 277	117 782	116 701
	For export	54 157	51 819	53 100	49 757	47 283
	(Total demand)	173 775	172 572	176 377	167 539	163 984

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)

		2012	2013	2014	2015	2016
Tire cords	Nylon	21 722	18 013	17 940	17 817	17 495
	Steel cord	223 637	223 216	232 360	220 973	212 651
	Polyester	42 577	42 540	42 152	41 557	40 159
	High-tenacity rayon	3 281	3 174	3 610	3 717	3 930
	Others	794	717	734	736	339
	Total	292 011	287 660	296 796	284 800	274 574
Natural rubber		631 311	622 210	618 744	604 777	598 093
Synthetic rubber		479 669	478 045	480 042	435 559	415 426
Carbon black		551 701	540 334	538 526	502 572	481 561

Source: JATMA

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.

One new theme is the start of discussions on ISO regulations incorporating radio frequency identification RFID primarily aimed at establishing a tire tracking system, which is making technical studies across a broad range of fields necessary.

4. 2. Reducing Weight and Rolling Resistance

With worldwide initiatives to address the preservation of the environment making vehicles ever more fuel efficient, the need for products that take consumer awareness of environmental protection into account in the tire market is rising, leading to increasingly stringent demand for lighter tires with lower rolling resistance.

Research and development focused on the adoption of streamlined materials as well as new materials and structures is leading to greater weight reduction. In contrast, since rolling resistance is mainly due to tire deformation due to 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 with 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 tire with a large outer diameter are seeing greater adoption to mitigate deformation during tire contact.

4. 3. Studless Winter Tires

Table 4 shows that the number of winter tires sold in Japan decreased by approximately 3% compared to the

Table 4 Number of winter tires sold and comparisons to previous years

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

	Number of tires sold				
	2012	2013	2014	2015	2016
Snow tires	23 043	24 958	25 958	23 284	22 604
Compared to previous year	104.3%	108.3%	104.0%	89.7%	97.1%

Source: JATMA

previous year.

On the technical front, the various tire manufacturers have accumulated their own unique technologies for the removal of the water film on iced surfaces to improve tire friction, or for special rubbers for studless tires. In addition, they are working on technical development involving thread 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 studless winter tires to turn the compacted snow into mirror-smooth, surfaces (black ice). At the same time, the development of products that also takes performance on dry and wet roads and rolling resistance into consideration is being pursued.

4. 4. Vehicle Exterior Noise

The need to reduce vehicle noise is rising under the influence of global concerns over environmental protection, and 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/WP29) 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 and meet the new regulation values. 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 (UN R117-02).

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 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. The structure of run-flat tires makes the tire itself heavier than a normal tire, and they also tend to have a higher longitudinal spring constant. A low weight and rolling resistance are crucial to counterbalancing 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.

In light of such issues and current market needs (environmental regulations, user preferences), there is a high 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.

JATMA is participating in the ongoing ISO discussions on standardizing the performance and labeling requirements for next-generation run-flat tires. At the same time, standards for methods to measure tire rigidity while running flat are being examined to account for inputs into the chassis when run-flat tires are installed.

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). Since June 2015, the UAE has made it mandatory to affix tire identification labels with embedded RFID tags on tires sold or displayed in stores. Ordinary barcodes are subject to the risk of being copied, and using RFID is seen as contributing to lowering that risk.

Such cases of adoption of RFID in tires have prompted the start of discussions concerning the publication of an ISO standard on RFID tire tags, which are defined as a means of identifying individual tires, in ISO/TC 31 (Tyres, rims and valves).

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

Recycling use (in 2015) totaled 922,000 tons, representing a recycling rate of 92%. The main uses included processing of the original product (reclaimed rubber, crumb

rubber, casings for retreaded tires), heating, and exports outside Japan, 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 negotiating the purchase of cut or crushed waste rubber from other countries, a situation indicative of the extent of the ongoing vigorous demand for waste tires as an alternative fuel.

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 2017 JATMA Year Book

5. 1. 1. General

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

For passenger vehicles, one new size of tire for the 50 and 55 series, and one new T-type spare tire size were established.

5. 1. 3. Tires for Small Trucks

In response to Revision 2 of Regulation No. 117 (UN R117-02), all 50 sizes in the N-range were newly established.

5. 1. 4. Tires for Trucks and Buses

New metric sizes (two sizes) were established as substitutes for 11R22.5.

5. 1. 5. Other tires

In addition to establishing one new size of bias tires for driving wheels and three new sizes of tractor radial tires in the section on agricultural tires, the necessity of making vehicles destined for Europe compliant with Regulation No. 106 (UN R106) led, for certification purposes, to the addition of five sizes with tire load capacity (LI) and nominal maximum speed (SS) to the ply rating indications, as well as the establishment of supplementary standards covering 10 sizes of garden tractor tires.

Three new sizes were established for motorcycle tires.

5. 2. ISO/TC 31 Tire Standards

At its December 2016 meeting in Sanya, China, ISO/TC 31/WG 10 (RFID tyre tags) engaged in a lively debate, in which JATMA also participated, on the technical details of a new ISO standard proposal.

6 Tire Safety Issues

6. 1. On-Road Tire Inspections

Table 5 shows the results of 36 on-road tire inspections conducted between January and December 2016 by JATMA with the cooperation of prefectural police departments, the Transportation Bureau, each Nippon Expressway Company, and other automotive- or tire-related organizations. According to these results, 15.8% of all the vehicles that were inspected had poor tire maintenance, an 8% improvement over the 2015 results. By road type, the rate of poor tire maintenance found on the national expressways was 27.3%, the same level as in 2015. The rate of poor tire maintenance found on general roads was 11.6%, a 10.3% improvement. Poor tire maintenance was also examined according to the different inspection items or types of poor maintenance problems. As in previous years, the most common problem was improper tire pressure, which accounted for 10.7% of all the problems.

Two main tire-related initiatives are being undertaken to make vehicles more fuel efficient. One is to improve the performance of the tire itself by reducing rolling resistance. The other is to make sure that all tires are inflated to the proper air pressure. The relevant industries are deploying various activities to educate drivers about the importance of maintaining the proper tire air pressure since this affects the environment, vehicle fuel efficiency, and safety. While significant improvement was seen in 2016, there is still a need for a proactive awareness campaign about managing tire air pressure, in the same vein as those promoting less electric power consumption and energy conservation in the home.

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 established 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 per-

Table 5 Results of on-road tire inspections in 2016 (January to December).

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

By year / By road type / Inspection items		2015			2016								
		Expressway	General road	Total	Expressway	Change from previous year		General road	Change from previous year		Total	Change from previous year	
Number of inspections (times)		12	21	33	14	2		22	1		36	3	
Number of vehicles inspected (A)		417	720	1 137	451	34		1 218	498		1 669	532	
Number of vehicles with poor tire maintenance (B)		113	158	271	123	10		141	−17		264	−7	
Percentage of problems (B/A) (%)		27.1	21.9	23.8	27.3	0.2		11.6	−10.3		15.8	−8.0	
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 %	Change	Number of problems	Percentage of problems %	Change	Number of problems	Percentage of problems %	Change
Breakdown of poor tire maintenance items	Insufficient tire tread	11	2.6	10	1.4	21	1.8	14	3.1	0.5	18	1.5	0.1	32	1.9	0.1
	Uneven wear	10	2.4	23	3.2	33	2.9	14	3.1	0.7	34	2.8	−0.4	48	2.9	0.0
	External damage (reaching the cords)	3	0.7	1	0.1	4	0.4	3	0.7	0.0	0	0.0	−0.1	3	0.2	−0.2
	Imbedded nail or other foreign object	2	0.5	2	0.3	4	0.4	4	0.9	0.4	1	0.1	−0.2	5	0.3	−0.1
	Insufficient tire pressure	85	20.4	110	15.3	195	17.2	91	20.2	−0.2	87	7.1	−8.2	178	10.7	−6.5
	Others	18	4.3	30	4.2	48	4.2	13	2.9	−1.4	23	1.9	−2.3	36	2.2	−2.0
	Total	129	—	176	—	305	—	139	—	—	163	—	—	302	—	—

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.

formance according to voluntary industry standards was introduced in January 2010.

In its Future Policy for Motor Vehicle Noise Reduction (Second Report) of April 19, 2012, the Central Environmental Council of Japan recommended the introduction of the tire noise restrictions in Regulation No. 117. In February 2013, the Ministry of Land, Infrastructure Transport and Tourism and the Ministry of the Environment jointly established a study group on tire noise regulations consisting of experts from academia and other fields. After deliberation, the study group concluded, in an interim report released in March 2014, that it would be appropriate to introduce Regulation No. 117 (Tire Rolling Sound Emissions, Adhesion on Wet Surfaces, and Rolling Resistance) in Japan. Based on that interim report, the Expert Committee on Motor Vehicle Noise of the Air/Noise and Vibration Committee of the Central Environmental Council, established by the Ministry of the Environment, studied the issue and issued its third report in July 2015. In accordance with that third report, 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 vehicle 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 tire labeling system for tire rolling resistance, wet traction, and wear performance was announced in the Federal Register as the U.S. Tire Fuel Efficiency Consumer Information Program Part 575.106, and the next steps are being watched closely as the Trump administration has put the publication process on hold.

6. 2. 1. 3. Europe

EC Directive 92/23/EEC, which was later amended by EC directive 2001/43/EC, stipulated that tire noise regulations would be gradually applied in EU member nations starting in February 2003. At the same time, 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 No-

vember 2012. Customers are now provided with information about the performance grades and ratings of tires.

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

Following in the footsteps of Europe, Israel has applied grade labeling for tire rolling resistance 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.

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.

In Malaysia, noise regulations (Regulation No. 117 stage 1 levels) have been applied since January 2015, and the rolling resistance, vehicle exterior noise, and wet grip stipulations of Regulation No. 117 are scheduled to apply gradually starting in November 2017.

China is assessing the introduction of regulations similar to those in Europe concerning a labeling system for rolling resistance, vehicle exterior noise and wet grip performance, and the number of countries making environmental and safety regulations mandatory is rising rapidly.

6. 2. 1. 6. Brazil

The INMETRO Regulation No. 544/2012 was issued, and has applied minimum guaranteed performance and grading systems for tire vehicle exterior noise, rolling resistance, and wet grip performance since April 2015.

6. 2. 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 and 54. Similarly, Thailand has also established new Thai standards (TIS) following the criteria in those Regulations, and is assessing their enforcement.

6. 2. 3. Other

6. 2. 3. 1. Harmonization of Standards

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. This was followed by the WP29 approval of amendments aimed at harmonization with the latest related UN regulations in November 2016.

Similarly, discussions to harmonize the standards for light-duty truck tires began in January 2017.

6. 2. 3. 2. International Mutual Recognition

At the World Forum for Harmonization of Vehicle Regulations (UN/ECE/WP29), Japan proposed 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 is under consideration.

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

There are also unique regulations such as the one requiring tire identification labels with embedded RFID tags in the UAE, as well as legislative efforts targeting the aging of tires, such as limits on tire purchases or use. It is necessary to continue monitoring global trends closely to address the increasingly diverse and complex certification systems and regulations established in various countries.