TIRES

1 Introduction

Approximately 152 million vehicle tires were produced in 2015, about 5% less than the number produced in 2014. The amount of rubber used for tires also declined by approximately 6%. The tire industry still has not recovered to the levels before the global financial crisis.

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.

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.

In November 2012, Europe introduced new tire regulations covering the three areas of rolling resistance, external vehicle noise, and wet grip performance, along with a new tire labeling system displaying how the tire rates in each of those three areas, providing a good example of trends in tire regulations. Similar regulations have also been put into effect in South Korea, where tires must now be labeled with the grades the tires for rolling resistance and wet grip performance (as of December 2012) and the required minimum level of performance (as of December 2013).

In the U.S., preparations are underway to issue legislation that will require tires to be labeled with grades for tire rolling resistance, wet traction, and wear performance as part of a tire fuel efficiency program.

Brazil also recently issued news laws and regulations, with a tire labeling system that provides ratings for rolling resistance, vehicle exterior noise, and wet grip performance similar to the system in Europe, as well as minimum performance requirements, coming into effect in April 2015.

With the adoption of a tire labeling system with ratings for rolling resistance and wet grip performance, as well as of minimum performance requirements in November 2015 in Saudi Arabian and in January 2016 in other Persian Gulf countries, the Middle East provides another example of the intensifying global trend toward legislation targeting environmental issues.

Similarly, in Japan, the partial amendment of the Safety Regulations for Road Vehicles that was issued and came into effect on October 8, 2015, directly quotes regulations equivalent to the European ones in the relevant United Nations agreements, and makes compliance with technical requirements for tire rolling resistance, vehicle exterior noise and wet grip performance mandatory.

2 Tire Production, Sales, and Results

Table 1 shows the vehicle tire production results for 2015. Overall, the results indicate a decline of approximately 5% from the number of tires produced in 2014 and a decline of 6% in the amount of rubber used for tire production. This means that, while the tire industry has largely recovered from the downturn due to the global financial crisis, it has still not returned to per-crisis levels.

Table 2 shows the tire sales results for 2015. These results indicate that the number of tires sold in Japan for new vehicles fell by approximately 3% compared to 2014, while the number sold for commercial use in Japan decreased by 5% and sales of tires intended for export declined by 6%. The total number of tires that were sold (i.e., the total demand), which includes both tires for Japan and tires for export, decreased by 5%.

3 Trends in the Consumption of Main Raw Materials and Production Energy for Tires

Table 3 shows the trends in the consumption of the main raw materials for tires. Tire cord, natural rubber, synthetic rubber and carbon black consumption decreased compared to 2014, with the 9% drop for synthetic rubbers standing out as particularly large.

4 Trends in Tire Technologies

4. 1. General trends

In light of environmental concerns prompted by global warming, as well as 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. These tires also emphasize economic efficiency and environmental friendliness while maintaining safety and reliability.

The development of tire technologies has spurred the examination of ways to optimize the materials, structure, tire profile, and tread design, which is also leading to the development of technologies for next-generation tires that meet even more stringent requirements. Tires are expected to exhibit high performance in many areas, including basic functions. Since reducing rolling resistance creates a conflict between wet and dry performance, tire technologies that improve wet and dry performance while also reducing rolling resistance are being developed. 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.

New themes include regulations incorporating radio frequency identification (RFID) to establish a tire tracking system, and with the start of discussions on regulations on tire noise drum test methods, technical studies will become necessary across a broad range of fields.

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 in the tire market is rising, leading to increasingly stringent demand for lighter tires with lower rolling resistance.

In terms of weight reduction, research and development is focusing on the adoption of streamlined materials as well as new materials and structures. Since rolling resistance is mainly due to tire deformation due to heat generation while driving, countermeasures involve reducing the rubber heat generation and adjusting tire profiles to control the deformation and reduce rolling resistance. Technological development efforts seek to maximize research and development on materials, the finite element method and optimization to achieve a balance with other areas of performance, such as safety.

Other approaches include reducing the drag resistance of the tires themselves to improve vehicle fuel efficiency, as well as proposals intended to mitigate deformation during tire contact through unique tire sizes involving a low flat narrow tire with a large outer diameter.

4. 3. Studless tire technologies

Table 4 shows the number of winter tires that were sold in Japan. It indicates that the number sold in 2015 decreased by approximately 10% compared to the previous year. The low amount of snowfall is seen as the main cause of this decline.

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 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

In Europe, the United Nations World Forum for Harmonization of Vehicle Regulations (UN/WP 29) put UN Regulation No. R117 (UN R117-02), which strengthens the rules on tire vehicle exterior noise and establishes prescriptions for rolling resistance and wet grip performance, into effect in November 2012. Tire vehicle exterior noise requirements have become significantly stricter.

Table 1 Vehicle tire production results.

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

		2011	2012	2013	2014	2015
Amount of rubber	For passenger vehicles	583 792	535 354	523 064	526 341	505 586
	For small trucks	144 734	142 125	146 561	148 518	139 477
	For trucks and buses	282 053	263 370	259 638	263 082	239 596
	Others	201 384	206 056	198 687	183 121	172 911
	Total	1 211 963	1 146 905	1 127 950	1 121 062	1 057 570
Number of tires	For passenger vehicles	126 998	120 609	119 485	120 005	113 821
	For small trucks	22 604	23 194	24 682	24 649	23 141
	For trucks and buses	11 387	10 843	10 808	11 001	10 266
	Others	5 453	4 553	4 656	4 770	4 587
	Total	166 442	159 199	159 631	160 425	151 815

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

Table 2 Vehicle tire and tube sales results.

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

		2011	2012	2013	2014	2015
Number of tires	For new vehicles	42 389	48 526	46 928	47 013	45 016
	Commercial	71 686	71 092	73 825	76 264	72 766
	(Japanese total)	114 075	119 618	120 753	123 277	117 782
	For export	67 874	54 157	51 819	53 100	49 757
	(Total demand)	181 949	173 775	172 572	176 377	167 539

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

		2011	2012	2013	2014	2015
Tire cords	Nylon	22 447	21 722	18 013	17 940	17 817
	Steel cord	242 643	223 637	223 216	232 360	220 973
	Polyester	45 188	42 577	42 540	42 152	41 557
	High-tenacity rayon	3 998	3 281	3 174	3 610	3 717
	Others	1 041	794	717	734	736
	Total	315 317	292 011	287 660	296 796	284 800
Natural rubber		681 568	631 311	622 210	618 744	604 777
Synthetic rubber		512 333	479 669	478 045	480 042	435 559
Carbon black		602 077	551 701	540 334	538 526	502 572

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

Consequently, tire manufacturers are working on developing technologies in fields such as tread, structural, and material design to further improve low-noise performance and meet the new regulation values. Furthermore, a revised ISO 10844 (Acoustics – Specifications of Test Tracks for Measuring Noise Emitted by Road Vehicles and Their Tires) was released in 2011 to minimize the variation in sound levels produced on the different test tracks where measurements were taken. The adoption of the stipulations in this standard into the above agreements and rules is under consideration.

In addition, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and Ministry of the Environment (MOE) in Japan established a tire noise regulation investigative committee in February 2012 made up of experts from academia and other fields. Following the examination by the committee, compliance with the technical requirements for tire vehicle exterior noise in UN Regulation No. R117 (UN R117-02) was made mandatory as part of the partial amendment to the Safety Regulations for Road Vehicles that was issued and came into force on October 8, 2015.

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

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

	Number of tires sold				
	2011	2012	2013	2014	2015
Snow tires	22 093	23 043	24 958	25 958	23 284
Compared to previous year	120.0%	104.3%	108.3%	104.0%	89.7%

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

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. Weight reduction and lower 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 rising demand, particularly for European vehicles, 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. Such tires have been developed, and started to be installed on vehicles in Europe in 2005. By 2016 or so, these next-generation run-flat tires are expected to represent a sizable proportion of the run-flat tires on European vehicles.

JATMA is participating in currently ongoing ISO discussions aimed at standardizing the performance and marking 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 run-flat tire inputs into the chassis.

4. 6 Radio frequency identification (RFID)

The introduction of regulations and standards incorporating RFID as part of a tire tracking system intended to manage detailed tire information concerning aspects such as service, sales, users, vehicles, repairs and product history, as well as to eliminate the import of non-certified tiers (verify certification).

Since June 2015, the UAE has made it mandatory to affix tyre identification labels with embedded RFID tags on tires sold or displayed in stores. RFID is used because ordinary barcodes are subject to a high risk of being copied.

Such cases of adoption of RFID in tires have prompted the start of technical discussions concerning the standardization of RFID tyre tags in ISO/TC 31 (Tyres, rims and valves).

4. 7. Other – Recycling of waste (used) tires in Japan

Recycling use (in 2014) totaled 921,000 tons, representing a recycling rate of 88%. The mains 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 2016 JATMA Year Book

5. 1. 1. General

In Japan, the amendments to the Safety Regulations for Road Vehicles directly quote UN Regulations No. 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

With regard to tires for passenger vehicles, the maximum growth width for 47 sizes was revised to harmonize them with both UN regulations and the addition of one size to both the 35- and 55-series.

5. 1. 3. Tires for trucks and buses

Harmonization with UN regulations also prompted the elimination of the shallow groove (HW-J) dimension standard and the addition of a new size to the 80-series.

5. 1. 4. Other tires

For agricultural machinery, seven new sizes were established for tractor tires. In addition, with UN Regulation No. 106 (UN/R106) coming into effect in Europe in January 2016, four sizes with tire load capacity (LI) and nominal maximum speed (SS) added to the ply rating indications and 18 sizes of garden tractor tires were newly established as supplementary standards for certification purposes.

Two new sizes were established for motorcycle tires.

5. 2. ISO/TC 31 tire standards

Meetings were held in Luxembourg in April 2015, for ISO/TC 31/SC 3 (Passenger car tyres), SC 10 (Cycle, moped, motorcycle tyres and rims) and in Sapporo in June for SC 5 (Agricultural tyres and rims), SC 6 (Off-the-road tyres and rims) and SC 7 (Industrial tyres and rims). Each of these meetings, including each WG, engaged in lively debates on the standardization of tire and rim standards, and, in particular, on proposals for new ISO

Table 5 Results of on-road tire inspections in 2013 (January to December).

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

Inspection items \ By year / By road type		2014			2015								
		National expressways	General roads	Total	National expressways	Change from previous year		General roads	Change from previous year		Total	Change from previous year	
Number of inspections (times)		12	32	44	12	0		21	−11		33	−11	
Number of vehicles inspected (A)		463	1 599	2 062	417	−46		720	−879		1 137	−925	
Number of vehicles with poor tire maintenance (B)		136	269	405	113	−23		158	−111		271	−134	
Percentage of problems (B/A) (%)		29.4	16.8	19.6	27.1	−2.3		21.9	5.1		23.8	4.2	
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
Tire maintenance Breakdown of poor maintenance	Insufficient tire tread	10	2.2	17	1.1	27	1.3	11	2.6	0.4	10	1.4	0.3	21	1.8	0.5
	Uneven wear	13	2.8	49	3.1	62	3.0	10	2.4	−0.4	23	3.2	0.1	33	2.9	−0.1
	External damage (reaching the cords)	3	0.6	2	0.1	5	0.2	3	0.7	0.1	1	0.1	0.0	4	0.4	0.2
	Imbedded nail or other foreign object	1	0.2	1	0.1	2	0.1	2	0.5	0.3	2	0.3	0.2	4	0.4	0.3
	Insufficient tire pressure	103	22.2	182	11.4	285	13.8	85	20.4	−1.8	110	15.3	3.9	195	17.2	3.4
	Others	15	3.2	73	4.6	88	4.3	18	4.3	1.1	30	4.2	−0.4	48	4.2	−0.1
	Total	145	—	324	—	469	—	129	—	—	176	—	—	305	—	—

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.

standards, with JATMA participating in those debates.

6 Tire Safety Issues

6. 1. On-road tire inspections

Table 5 shows the results of 33 on-road tire inspections conducted between January and December 2015 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, 23.8% of all the vehicles that were inspected had poor tire maintenance, a 4.2% degradation over the 2014 figures. According to the type of road on which the results were obtained, the rate of poor tire maintenance found on the national expressways was 27.1%, a 2.3% improvement from 2014. The rate of poor tire maintenance found on general roads was 21.9%, a 5.1% degradation over 2014. 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 17.2% 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. However, the results of the on-road inspections found that the number of vehicles with improper tire pressure in 2015 remained high. 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 are greatly desirable.

6. 2. Laws and regulations

6. 2. 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 performance according to voluntary industry standards was introduced in January 2010.

The partial amendment of the Safety Regulations for Road Vehicles that was newly issued and came into effect on October 8, 2015, makes compliance with the technical requirements for tire vehicle exterior noise, rolling resistance and wet grip performance in UN Regulation No. R117 (UN R117-02) mandatory. Starting with passenger vehicles in April 2018, these regulations will apply to

light-, medium- and heavy-duty commercial vehicles as well as, gradually, to tires installed on new vehicles.

6. 2. 2. U.S.

A large tire recall triggered the enactment of the Transportation Recall Enhancement Accountability and Document (TREAD) Act in 2000. This act mandated the phasing in of tire pressure monitoring systems (TPMS) starting in October 2005. Since September 2007 it has been mandatory for all vehicles sold in the U.S. to be equipped with TPMS.

The U.S. Congress also enacted the Energy Independence and Security Act of 2007 in December 2007, which led to the creation of a consumer tire information program after the President signed it into law. In December 2011 the Final Rule regarding the tire labeling system 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, and the specifics of this rule are currently being examined. The rule is expected to be issued in 2017 and come into force in 2018.

6. 2. 3. Europe

EC Directive 92/23/EEC (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) will begin in November 2016. A tire labeling system that requires the display of grades for the above three areas of tire performance was introduced in November 2012, providing customers with information about the performance grades of tires.

6. 2. 4. Asia, Middle East, Africa, and South America

Countries in these regions have also begun putting tire certification systems and regulations into effect in recent years. They are also increasingly proactive about introducing minimum performance guarantees and rating systems (labeling systems) for tire rolling resistance and wet grip performance.

A recent example is the INMETRO Regulation No. 544/2012 that was issued in Brazil. This regulation applies both tire labeling and minimum required performance systems for tire vehicle exterior noise, rolling resistance, and wet grip performance. Similarly, various Middle-Eastern countries have institute tire labeling and minimum required performance systems.

Malaysia had decided to apply UN Regulation No. R117 (UN R117-02) on vehicle exterior noise, rolling resistance and wet grip performance to tires installed on new vehicles starting in November 2017. China is assessing the introduction of regulations similar to those in Europe concerning a labeling system that rates rolling resistance, vehicle exterior noise and wet grip performance, and the number of countries adopting mandatory environmental and safety regulations is rising rapidly.

There are also unique regulations such as the one requiring tyre 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.

Under the umbrella of the United Nations Economic Commission for Europe (UNECE), the Working Party on Brakes and Running Gear (WP 29/GRRF) is promoting the examination and formation of a Global Technical Regulation (GTR) for tires to develop worldwide unified safety standards for the tire certification systems that are continuing to appear in an increasing number of countries. The GTR was officially issued on January 16, 2015, and work to achieve harmonization with the latest revisions to the relevant UN regulations is underway.