# TIRES

## 1 Introduction

Approximately 147 million vehicle tires were produced in 2019, the same number as in 2018, while the amount of rubber used for tires increased very slightly by 1%. 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, tire technologies have sought to complement the basic safety performance of tires with enhanced environmental friendliness and economic efficiency. With a further tightening of regulations looming on the horizon for vehicle fuel efficiency and emissions standards in various countries, tire manufacturers have focused on fuel-efficient tires in an effort to offer products with low environmental impact.

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. The association 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 applied in many countries to ensure vehicle safety, and they are also spreading to other Asian 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, environmental performance regulations have been enacted in regions such as South Korea, Russia, Brazil, the Middle East, Malaysia and Thailand, and are continuing to 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 newer initiative is intended to provide traceability, offer users information about the tire, and allow authorities to verify certification.

## 2 Tire Production, Sales, and Results

Table 1 shows the vehicle tire production results for 2019. Overall, the number of tires remained the same as in 2018, with a slight increase of approximately 1% 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. The tire sales results (Table 2) indicate that the number of tires sold in Japan for new vehicles and for commercial use, as well as sales of tires for ex-

**Table 1** Vehicle Tire Production Results

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

| | | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|
| Amount of rubber | For passenger vehicles | 505,586 | 486,732 | 471,774 | 477,617 | 475,369 |
| | For light-duty trucks | 139,477 | 130,183 | 127,179 | 129,239 | 132,489 |
| | For trucks and buses | 239,596 | 229,072 | 241,319 | 241,150 | 243,713 |
| | Others | 172,911 | 173,814 | 186,178 | 211,672 | 214,021 |
| | Total | 1,057,570 | 1,019,801 | 1,026,450 | 1,059,678 | 1,065,592 |
| Number of tires | For passenger vehicles | 113,821 | 110,002 | 108,258 | 109,816 | 109,327 |
| | For light-duty trucks | 23,141 | 21,783 | 21,527 | 21,921 | 22,081 |
| | For trucks and buses | 10,266 | 9,888 | 10,499 | 10,513 | 10,614 |
| | Others | 4,587 | 4,702 | 4,639 | 4,499 | 4,523 |
| | Total | 151,815 | 146,375 | 144,923 | 146,749 | 146,545 |

Source: JATMA

**Table 2** Vehicle Tire and Tube Sales Results

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

| | | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|
| Number of tires | For new vehicles | 45,016 | 44,434 | 46,377 | 46,103 | 45,523 |
| | Commercial | 72,766 | 72,175 | 73,979 | 73,725 | 72,573 |
| | (Japanese total) | 117,782 | 116,609 | 120,356 | 119,828 | 118,096 |
| | For export | 49,757 | 47,283 | 43,302 | 43,352 | 44,271 |
| | (Total demand) | 167,539 | 163,892 | 163,658 | 163,180 | 162,367 |

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)

| | | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|
| Tire cords | Nylon | 17,817 | 17,495 | 15,541 | 15,460 | 15,713 |
| | Steel cord | 220,973 | 212,651 | 217,683 | 227,707 | 230,144 |
| | Polyester | 41,557 | 40,159 | 41,295 | 41,991 | 42,846 |
| | Rayon | 3,717 | 3,930 | 3,734 | 3,178 | 2,640 |
| | Others | 736 | 339 | 476 | 384 | 378 |
| | Total | 284,800 | 274,574 | 278,729 | 288,720 | 291,721 |
| Natural rubber | | 604,777 | 598,093 | 595,027 | 621,200 | 632,616 |
| Synthetic rubber | | 435,559 | 415,426 | 417,281 | 424,920 | 422,001 |
| Carbon black | | 502,572 | 481,561 | 476,946 | 492,329 | 490,592 |

Source: JATMA

port, all rose or dropped within 1 to 2% of 2018 levels. The total demand, which includes both tires for Japan and for export remained virtually unchanged.

## 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 2019. The consumption of tire cord, synthetic rubber and carbon black consumption matched 2018 levels, and rose by 2% for natural rubbers.

## 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, reducing rolling resistance tends to worsen wet grip performance, making it crucial to develop technologies that achieve high levels of performance for both of these characteristics. 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.

In addition, studless winter tires, which enhance safety when driving on ice and snow, as well as, 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 both becoming more widespread. 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.

One new trend involves the spread of electric vehicles common in response to environmental regulations and electric vehicles equipped with autonomous driving technology creating a need for tires with a greater load capacity than in the past. The recent announcements of plans to make use of autonomous driving for a broad array of services, including mobility, distribution, and the sale of goods, presents the challenge of developing such next-generation tires for both passenger and commercial vehicles.

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

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

| | Number of tires sold | | | | |
|---|---|---|---|---|---|
| | 2015 | 2016 | 2017 | 2018 | 2019 |
| Snow tires | 23,284 | 22,600 | 24,303 | 25,787 | 23,769 |
| Compared to previous year | 89.7% | 97.1% | 107.5% | 106.1% | 92.2% |

Source: JATMA

### 4. 2. Reducing Weight and Rolling Resistance

Global concerns about environmental protection have led to even more fuel-efficient vehicles, as well as even more stringent demand for reducing the weight and lowering the rolling resistance of both tires for new cars and for sale. Research and development focused on the adoption of streamlined materials, as well as new materials and structures is leading to lighter tires. 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 and optimization technologies, to balance safety and other areas of performance.

Similarly, ideas such as molding the sidewalls and reducing the drag resistance of the tires themselves to improve vehicle fuel efficiency have been proposed.

### 4. 3. Studless Winter Tires

The number of winter tires sold in 2019 decreased by 8% compared to 2018 (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 thread 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 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 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. In 2020, it will also apply to medium- and heavy-duty trucks and buses.

### 4. 5. Run-Flat Tires

Europe has led the way in installing run-flat tires and leaving out spare tires to make more efficient use of resources and spaces, as well as to ensure safety in the event of a puncture on an expressway 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 a run-flat tire makes it heavier than a normal tire and also gives it a higher longitudinal spring constant. This means that weight and rolling resistance must be kept reduced sufficiently for the decrease in $CO_2$ emissions resulting from leaving out the spare tire to exceed the increase in $CO_2$ emissions due to the use of run-flat tires.

In light of such issues and the needs of the market (environmental regulations, user preferences), there is 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), was revised and published in August 2018. The introduction of EMT legislation also led to additional revisions to Regulation Nos. 30 and 64 (UN/R30 and UN/R64) in January 2020.

For reference, ISO 19940, which standardizes tire rigidity measurement methods for run-flat tires and EMTs running flat to account for inputs into the vehicle from the tire during installation, had already been issued in 2017.

### 4. 6. 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 customs to check for certification with government authorities has been spreading. As noted earlier, affixing labels with embedded RFID tags on tires sold or put on display has been mandatory in the UAE since June 2016. Since ordinary barcodes present the risk of being copied and reused, the use of RFID also aims to eliminate poor-quality products.

The ISO standards on RFID tire tags have been deliberated in ISO/TC 31 (Tyres, rims and valves) and their publication was .completed in April 2020.

### 4. 7. Other

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

Recycling use in 2018 rose by 32,000 tons over the previous year, totaling 997,000 tons, a 4% increase that brings the recycling rate to 97%. The main uses are heating, at 65%, processing of original product (retreaded tires, reclaimed rubber) at 18%, and exports outside Japan (used tires) at 14%. The most common use, heating, is in high demand in the paper industry, which accounts

**Table 5** Results of On-Road Tire Inspections in 2019 (January to December)

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

| By year / By road type / Inspection items | | 2018 | | | 2019 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Expressway | General road | Total | Expressway | Change from previous year | | General road | Change from previous year | | Total | Change from previous year | |
| Number of inspections (times) | | 13 | 22 | 35 | 18 | 5 | | 19 | − 3 | | 37 | 2 | |
| Number of vehicles inspected (A) | | 491 | 1,362 | 1,853 | 604 | 113 | | 1,409 | 47 | | 2,013 | 160 | |
| Number of vehicles with poor tire maintenance (B) | | 135 | 298 | 433 | 172 | 37 | | 256 | − 42 | | 428 | − 5 | |
| Percentage of problems (B/A) (%) | | 27.5 | 21.9 | 23.4 | 28.5 | 1.0 | | 18.2 | − 3.7 | | 21.3 | − 2.1 | |
| 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 |
| Breakdown of poor tire maintenance items | Insufficient tire tread | 18 | 3.7 | 18 | 1.3 | 36 | 1.9 | 19 | 3.1 | −0.6 | 15 | 11.1 | −0.2 | 34 | 1.7 | −0.2 |
| | Uneven wear | 23 | 4.7 | 38 | 2.8 | 61 | 3.3 | 15 | 2.5 | −2.2 | 22 | 1.6 | −1.2 | 37 | 1.8 | −1.5 |
| | External damage (reaching the cords) | 1 | 0.2 | 2 | 0.1 | 3 | 0.2 | 0 | 0.0 | −0.2 | 1 | 0.1 | 0.0 | 1 | 0.0 | −0.2 |
| | Imbedded nail or other foreign object | 2 | 0.4 | 2 | 0.1 | 4 | 0.2 | 2 | 0.3 | −0.1 | 2 | 0.1 | 0.0 | 4 | 0.2 | 0.0 |
| | Insufficient tire pressure | 95 | 19.3 | 249 | 18.3 | 344 | 18.6 | 141 | 23.3 | 4.0 | 214 | 15.2 | −3.1 | 355 | 17.6 | −1.0 |
| | Others | 9 | 1.8 | 66 | 4.8 | 75 | 4.0 | 7 | 1.2 | −0.6 | 45 | 3.2 | −1.6 | 52 | 2.6 | −1.4 |
| | Total | 148 | — | 375 | — | 523 | — | 184 | — | — | 299 | — | — | 483 | — | — |

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.

for 66% of that category. The recycling situation above only takes statistics on waste (used) tires produced in Japan into account, and does not include imported products.

## 5 Tire Standards

### 5. 1. Main Revisions in the 2020 JATMA Year Book

**(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.

The descriptions of tire measurement methods were changed to tables for clarity.

**(2) Tires for Passenger Vehicles:** The tire pressure boost correction used for speeds over 160 km/h was revised and harmonized with the ISO and other standards, eliminating the JATMA-specific standard. Provisions on raising load capacity when used at speeds of 60 km/h or less were also added. A total of six new sizes for the standard load 45, 50, 55 and 65 series, and of 8 new sizes for the extra load 30, 35, 40, 45 and 60 series have been added.

**(3) Tires for trucks and buses:** Based on the interpretation of UN/R54, the 285/85R22.5 143/140J and 285/85R22.5 146/143, which are compatible with the 11R22.5 size, were moved from the appendix to the main text to facilitate the revision and ISO metric conversion of the 315/80R22.5 maximum growth width and new tire maximum overall width.

**(4) Other tires:** Two new sizes for agricultural machinery tires and six new sizes for motorcycle tires were established.

## 6 Tire Safety Issues

### 6. 1. On-Road Tire Inspections

Table 5 shows the results of 37 on-road tire inspections conducted in 2019 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 21.3%, a 2.1 point decrease over the 2018 inspection results. The most prevalent problem was deficient air pressure at 17.6%, which is overwhelmingly higher than the second most common, uneven wear, at 1.8%.

The relevant industries are deploying activities to edu-

cate about maintaining proper air pressure, which is not only crucial for tire fuel efficiency, but also for safety and environmental preservation.

### 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 (UN R117-02) gradually mandatory starting in April 2018.

In the U.S., Congress enacted the Energy Independence and Security Act of 2007 in December of that year, 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. The situation will require close monitoring in the face of rumors that the official issuance of the regulation will be pushed back to June 30, 2020.

In Europe, EEC 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 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. Discussions on eventually adding areas of performance other than the three noted above have begun.

In the Middle East, Israel has followed in the footsteps of Europe and 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 applying UN Regulation No. 117 (UN/R117-02) and the European grade labeling system to imported tires in August 2016 and March 2017, respectively.

In 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. Furthermore, the gradual introduction of control methods for noise and vibration (tire noise regulations and the application of noise labels) began in 2020. In Malaysia, noise regulations (UN Regulation No. 117 Stage 1 levels) have been applied since July 2015. The rolling resistance, vehicle exterior noise, and wet grip performance stipulations from UN Regulation No. 117 (Stage 2 levels) have been gradually applied since November 2017. Since September 2019, Thailand has also introduced performance requirements equivalent to the European UN Regulation No. 117, as well as grade labeling for rolling resistance, vehicle exterior noise, and wet grip performance. The Thai labels are notable for making it mandatory to indicate both the performance value and the grade.

Other 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 and India. Both of those countries are also planning to introduce grade labeling systems using their own specific labels.

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.

**(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) that have the same technical criteria as Regulation Nos. 30 and 54, and they have been applied since January 2019. More recently, Cambodia started applying UN Regulation Nos. 30, 54 and 76 in January 2020. Similar legislation is also under consideration in Laos and Myanmar.

**(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. 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 underway since January 2017.

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 (MRA) is under consideration.

Other upcoming tire-related regulations include regulations on RFIDs, on the aging of tires in the context of factors such as further discussions on evaluating abraded tire wet grip performance as part of environmental performance and limits on tire purchases or use, as well as regulations regarding the performance of winter tires. It will be necessary to continue monitoring global trends closely to address the increasingly diverse and complex certification systems and regulations established in various countries.