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Motor-Vehicle Tyre Ecosystem in Malaysia – A Status Review

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Abstract – *Issues related to tyre safety are one of the major concerns when discussing the motor-vehicles' safety. Moreover, various articles reported in the print and electronic media on tyre failures, particularly involving retread tyres were often associated as the cause of crashes. However, before any effective solutions can be proposed to the relevant authorities, weaknesses and loopholes in the current ecosystem needs to be identified. Thus, this paper is aimed at reviewing the current status of motor vehicle tyre ecosystem in the country and establishing the knowledge on current related issues. This paper will look into five stages in the ecosystem, from tyre production until disposal and tyre scraping. Current and potential gaps are identified and recommendations to improve the situations are put forward. To enable a clearer explanation of the issues found and the proposed recommendations, the findings are tabulated according to each stage. The findings are expected to provide useful insights into the current status and issues in the ecosystem, and providing a useful and beneficial method of solution.*

Keywords: Tyre safety, ecosystem, certification, importation, production, distribution, retreading, scrapping

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1.0 INTRODUCTION

The primary function of tyres is to provide the interface between the vehicle and the road surface. The ability of vehicles to start, stop and turn corners results from friction between the road and the tyres. Tyre tread designs enable water to escape from the tyre-road contact area to minimize hydroplaning while providing a reasonable balance between traction and noise level (Cheah et al., 2015). With regards to tyre safety, it covers both passive and active requirements. Koštial et al. (2012) concurred that passive elements of the tyres depend on the quality of the production of a tyre casing, the applied technology and used materials. On the other hand,

elements of active tyre safety are particularly high running safety on various types of road surfaces, breakdown resistance, speed resistance and high life of materials used for the production of tyres (Klein & Black, 1999).

In the context of the local transportation mode, since public transport-oriented mobility in the country is still not at a satisfactory level when benchmarked to the world's standard, personal road vehicles in the forms of motorcycles and cars are the most convenient options for the daily commuting needs (Rahman et al., 2014). Furthermore, car ownership among Malaysians is not only the highest in the ASEAN but also has the highest incidence of multiple car ownership with 54% of Malaysian households own more than one car (Jawi et al., 2017). The increasing volume of cars means more tyres on the road thus will have a chain effect in increasing the numbers of tyres to be scrapped. Similar to the automotive world as have been discussed in previous literature (Jawi et al., 2013), the current tyre ecosystem in Malaysia can be considered as incomplete. Using the water in the bathtub as an example, the philosophy is the same. The tyres keep coming into the "tub" and there is no proper outflow from the system that raises two main concerns – environmental and safety issues (Figure 1) (Jawi et al., 2013; Meadows & Wright, 2011).

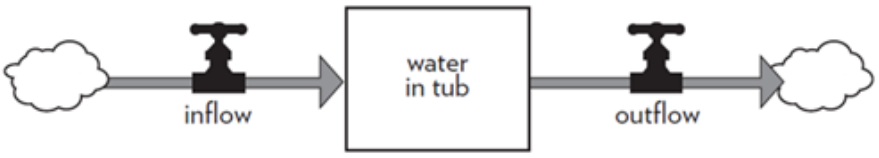


Figure 1: Understanding complex systems using water in tub example (Meadows & Wright, 2011)

On the other hand, the increase in the tyres used on the road may also contribute to higher numbers of road crashes due to tyre failures, if the ecosystem is not performing well (Abdul Khalid et al., 2018). In the US, a previous research study found that 12.6% of the overall number of crashes occurred due to vehicular tyre and wheels failures (Klein & Black, 1999). Moreover, throughout the year 2007 to 2010, NASS-CDS data showed that 11,047 crashes had occurred due to tyre failure and 1.77% (195) of the crash were involving fatalities (NHTSA, 2014).

In Malaysia, data from MIROS in-depth investigation and reconstruction study has revealed that 37% of crashes involving tyre issues had caused for more than three fatalities in one single crash (Zainal Abidin et al., 2012). All tyres need to be tested through standardized procedures to ensure the performance, quality and safety of the products. Various standard certification marks are being used worldwide in the tyre industry such as CCC (China Compulsory Certificate) mark for China standard, SNI (Indonesian National Standard) for Indonesia, ECE marking under the Economic Commission for Europe, DOT mark which is the standard marking from Department of Transport of USA, and several others. In Malaysia, tyres that to be made available on market are required to pass a certain level of safety standards of either MS (refers to Malaysian Standard), E or DOT mark. The E mark represents that the tyres have been tested by accredited test lab and certified according to UNECE Regulations while DOT mark indicates that the tyres met or exceeded the safety standards that were established by Department of Transport.

To provide recommendations that are more comprehensive to the entire spectrum of the tyre usage and industry in Malaysia, loopholes in the current tyre ecosystem (Figure 2) needs

to be identified and thorough understanding of the ecosystem is required. Thus, this paper discusses what is regarded as the preliminary findings on the current status of tyre ecosystem in Malaysia. It is expected that from this study, the critical area which requires proper intervention will be identified, enabling relevant authorities to conduct effective and efficient solutions to improve the current situation with regards to tyre ecosystem in the country.

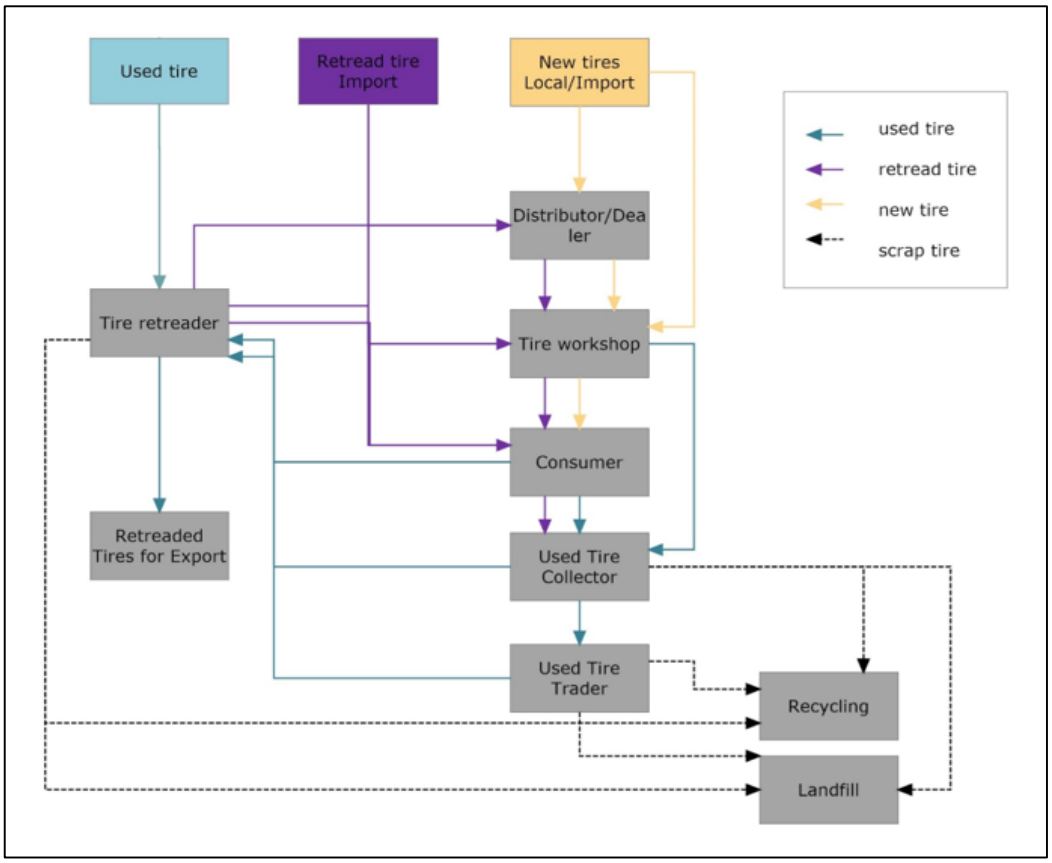


Figure 2: The motor-vehicle tyre ecosystem in Malaysia

2.0 METHODOLOGY

The study was conducted over three stages; literature review, on-field technical visits, stakeholder engagements and in-depth interviews (IDI's) with relevant professionals related to the field of study. The ecosystem was categorized into six scopes of interest; tyres production, sales and distribution, importation, certification, retread process, and tyre scrapping. The literature review was carried out by studying all of the above-mentioned processes.

The research team conducted engagement sessions with the relevant stakeholders with separate in-depth interviews (IDI's) which took approximately one to two others each. In each of the IDI sessions, a set of questions was priory prepared by the research team, from the context of the interviewee scope of expertise/focus areas, but within the scopes of interest of the study mentioned beforehand. In total, eight engagement sessions and IDI's were conducted consisting of the certification body, automotive and rubber-related research institutes, enforcement authorities, tyre industry and non-government organizations related to tyres. The list of stakeholder engagements and IDI's are shown in Table 1.

Table 1: Stakeholders engagement and IDI according to the scope of interests

Stakeholders Engagement	Scope of Interest
SIRIM QAS Sdn. Bhd.	Certification
Malaysian Rubber Board (MRB)	Certification
Ministry of Domestic Trade and Consumer Affairs (MDTCA)	Production, Sales and Distribution
Malaysia Automotive, Robotics and IoT Institute (MARII)	Production, Sales and Distribution, and Scrapping
Road Transport Department (RTD)	Certification, Enforcement
Tyre Retreading Manufacturers Association of Malaysia (TRMAM)	Production, Sales and Distribution
Royal Malaysian Customs (Customs/JKDM)	Importation, Enforcement
Continental Tyre PJ Malaysia Sdn. Bhd.	Production, Sales and Distribution

In addition to that, in order to provide a better understanding on the processes related to the processes within the ecosystem, four on-field technical visits were carried out to new tyres manufacturers premises, tyre retreaders and also to the Customs Department based in Port Klang, for processes related to tyres' importation.

3.0 RESULTS AND DISCUSSION

This section shall discuss the findings from this study in six separate sections.

3.1 Certification

In Malaysia, several agencies have been appointed to conduct, certify, or confirm the originality of the certification for new and retreaded tyre. Table 2 lists the relevant agencies (not limited to) in accordance to the certification and conformity of production for Malaysian Standard (MS) and UNECE regulations (UN R) related to pneumatic and retreaded tyres.

Table 2: Relevant agencies to conduct, certify or confirm the standard

Process	Standard	Agency
Certification	UN R30, UN R54, UN R108 and UN R109	JPJ / MRB / IDIADA / TUV Rheinland / VCA
	MS 1394 and MS 149	SIRIM / MRB
Conformity of Production	UN R30, UN R54, UN R108 and UN R109	JPJ / MRB / IDIADA / TUV Rheinland / VCA
	MS 1394 and MS 149	SIRIM / MRB

In 2004, Malaysia, through the Ministry of Transport (MOT) became a member of the World Forum for Harmonisation of Vehicle Regulations (WP 29) working group. The working group requires its members to implement mandatory standards on tyres and accepting the UN regulations. For this purpose, the Road Transport Department of Malaysia (RTD), has been recognized as approval authority for UN Regulation in Malaysia since 20th of July 2012 (Abdul Wahab et al., 2017). Within the endorsement, RTD can issue UN R52 and appointed an accredited technical service to conduct the testing (e.g. IDIADA, TUV Rheinland, VCA). For MS, the certification of the standard is issued by SIRIM, the technical service appointed by the

DSM to develop the MS and the agent for distribution and sales of the standards. The performance testing can be conducted in an accredited laboratory. The process flow of product certification approval for MS, specifically in this case referring to the tyre is shown in Figure 3.

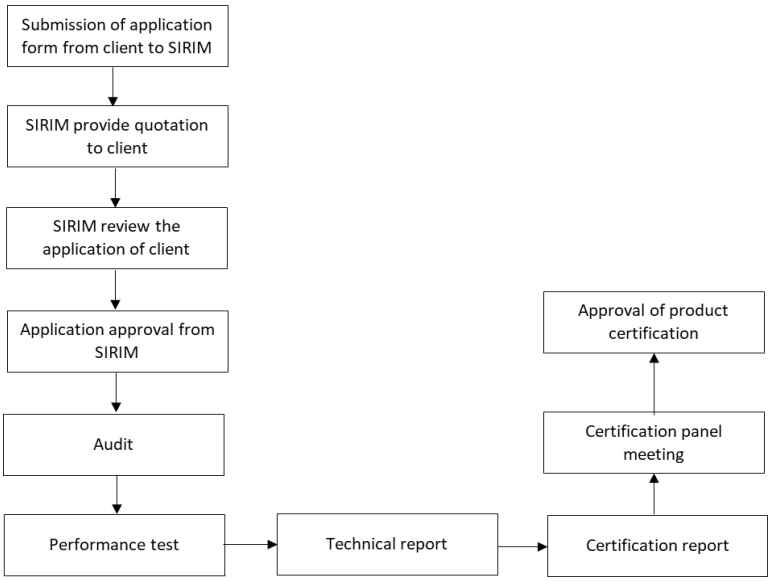


Figure 3: Process flow of product certification approval for Malaysian Standard (MS)

For motor vehicle tyres, the Malaysian Rubber Board (MRB) is one of the accredited laboratories that can conduct technical testing for tyre certification or can be conducted in the client's laboratory, witnessed by SIRIM officers. As part of the application process, the manufacturer must apply for MS certification if their tyres do not possess certification approval of either from DOT nor UNECE. Only tyre manufacturers with MS certification can place the certification mark on their tyre products. Upon issuance of the certification, periodic surveillance audit and testing are conducted by SIRIM. The current mandatory MS certification marks related to motor vehicle tyres are as follows:

i. **MS 1394** – New Pneumatic Tyres for Highway Vehicles other than Passenger Cars (Mandatory)
ii. **MS 149** – New Pneumatic Passenger Car Tyres – Specification (Mandatory)
iii. **MS 224** – Retreaded Pneumatic Rubber Tyres for Passenger Cars and Commercial Vehicles – Specification (Mandatory)

Other voluntarily MS certifications that can be applied by tyre manufacturers are listed in Table 3.

As confirmed in the IDI sessions with the relevant stakeholders, in general, requirements stipulated under DOT and UN regulations are considered less stringent compared to MS. There have been cases on the ground whereby the manufacturers still apply for MS certification even though their products already possessed DOT or UNECE marking, as a strategy to boost their penetrating power into the local market. However, for FMVSS standard with DOT Tyre Identification Number, the traceability of the products is rather challenging, since the markings are based on self-declaration from the manufacturers (products meet all FMVSS requirements).

Table 3: Malaysian Standard (MS) regarding tyre with voluntary status

MS Number	Requirement Status	Title
MS 1565	Voluntarily	Motorcycle Tyre Dimensions and Rims (Inch Code Designated Series)
MS 1566	Voluntarily	Definition of Common Terms Used in The Tyre Industry – Solid Tyres
MS ISO 4000	Voluntarily	Passenger Car Tyres and Rims – Part 1: Tyres (Metric Series)
MS 1348	Voluntarily	Cushion Gum Used in Precured Retreading of Tyres – Specification
MS 1208	Voluntarily	Precured Tread for Retreading Tyres – Specification
MS 1097	Voluntarily	Rubber Tread Compound for Hot (Conventional) Retreading of Passenger Car and Commercial Vehicle Tyres A – Specification
MS 150	Voluntarily	Road Vehicles – Determination of Bead Unseating Resistance of a Tubeless Passenger Car Tyre
MS 1107	Voluntarily	Specification for Steel Disc Wheels for Motor Vehicles
MS 1025	Voluntarily	Wheel Rims for Motorcycle and Assembly – Specification
MS 2398	Voluntarily	Motorcycle Spoke Nipples – Specification
MS 2455	Voluntarily	Motorcycle Spokes – Specification

3.2 Importation

Along with exports, imports form the backbone of international trade. In Malaysia, the importation process is being governed by the Royal Malaysian Customs (Customs) through Customs (Prohibition of Imports) Order 2017 under Customs Act 1967. For the case of tyres, the importation of tyres into Malaysia is categorized into new pneumatic snow tyres, newly retreaded snow tyres, new pneumatic tyres, new retreaded pneumatic tyres, used pneumatic tyres and used retreaded pneumatic tyres (JKDM, 2018). According to United Nations Regulation 117 (UN R117), "snow tyre" means a tyre whose tread pattern, tread compound or structure is primarily designed to achieve in snow conditions a performance better than that of a normal tyre concerning its ability to initiate or maintain vehicle motion. UN R117 also defined a tyre category of "snow tyre for use in severe snow conditions", which means a snow tyre whose tread pattern, tread compound or structure is specifically designed to be used in severe snow conditions and that fulfils the requirements of that regulation.

By referring to the requirements of UN R117 (tyres with regards to rolling sound emission) and UN R54 (tyres for commercial vehicles and their trailers), the inscription M+S or M.S or M&S must be marked to the tyre if the tyre is classified in the category of used "snow tyre" and "Alpine" symbol (3-peak-mountain with snowflake) shall be added if the snow tyre is classified as "snow tyre for use in severe snow conditions". Malaysian authorities have agreed not to allow the latter category of tyres to be imported, sell and used in Malaysia due to the fact it may accelerate the damages of road, deterioration of performance, and high probability for the tyre to fail if operated during summer (Jansen et al., 2014). It is because Malaysia is a tropical country characterized as warm and humid which the climatic elements categorized as high temperature and uniform diurnal pattern throughout the year with an annual mean temperature of 26.4°C and average daily maximum temperature of 34°C (Al-Tamimi &

Syed Fadzil, 2011). But since inscription "M+S" or "M.S" or "M&S" also marked on the tyre together with Alpine symbols, it may confuse the Customs.

The importation of new tyres does not require any Approved Permit (AP). However, all imported tyres must comply with specific standards. Overall, the importation manners of tyres are as summarised in Table 4.

Table 4: Summary of tyre importation (JKDM, 2018)

Type of Tyre	Snow (excluding M+S and M&S Tyre)				Others			
	New		Used		New		Used	
Pneumatic Tyre	Pneumatic Tyre	Retreaded Tyre	Pneumatic Tyre	Retreaded Tyre	Pneumatic Tyre	Retreaded Tyre	Pneumatic Tyre	Retreaded Tyre
Manner of Import	Absolutely prohibited for import	Absolutely prohibited for import	Import must be accompanied by a letter of approval issued by or on behalf of SIRIM Berhad	Import must be accompanied by a letter of approval issued by or on behalf of SIRIM Berhad	Import must be accompanied by certificate of compliance and the product bearing certification mark either UNECE Regulations (E-mark) of WP29 or Malaysian Standard (MS mark) or FMVSS (DOT mark).	Import must be accompanied by certificate of compliance and the product bearing certification mark either UNECE Regulations (E-mark) of WP29 or Malaysian Standard (MS mark) or FMVSS (DOT mark).	Import must be accompanied by a letter of approval issued by or on behalf of SIRIM Berhad	Import must be accompanied by a letter of approval issued by or on behalf of SIRIM Berhad

On the contrary, AP was used to be required for importation of used tyres. These AP's will only be issued to tyre retreaders which have obtained MS 224 product certification. However, this requirement was then retracted on 1st of August 2016, and importation of used tyres from then on did not require any AP instead changed to Letter of Approval (LoA) issued by, or on behalf of SIRIM Berhad (SIRIM), as the recognized third party appointed by the Department of Standards Malaysia (DSM). In the process flow, SIRIM was tasked to ensure that the imported used tyres complied with the requirements. SIRIM will carry out inspection based on sampling on the imported used tyre before the used tyres can be released to be used for retreading purposes. With regards to retreaded tyres, all imported retreaded tyres must be accompanied by a DOT or E-mark UN R108/R109 issued by recognised technical service or MS 224 certificate issued by SIRIM.

3.3 Production

New tyres are either manufactured locally or imported and distributed by tyre dealers to the consumers. In both cases, upon production at tyre plants, new tyres will be sent to tyre dealers before the tyres reach the tyre shops. Under the current requirement, all tyres manufactured in Malaysia shall comply with the Malaysian Standards (MS) or UNECE or FMVSS (for DOT mark) requirement which is implemented by SIRIM with the appointment by DSM. Series of testing shall be conducted by the accredited testing laboratories on a specific number of tyre samples according to the MS requirement. Upon production, a process known as Conformity of Production shall be performed by the certification body, or in the case of MS refers to

SIRIM, on the certified manufacturers. Physically, these tyres shall have the MS certification mark on the sidewalls.

Table 5 shows tyre manufacturers with locally manufactured products, types of tyres being produced and their respective tyre models. At the time this study was conducted, these are the only manufacturers producing tyres in Malaysian plant, thus having the MS mark. Where else, other manufacturers deal only with importation and operate as tyre distributors.

Table 5: Tyre brands manufactured in Malaysian plants

Manufacturer	Type of Tyre	Brand Name
Goodyear	Passenger Car	Goodyear Kelly
	Commercial Vehicle	Goodyear
Silverstone	Passenger Car	Toyo Nitto Silverstone
	Commercial Vehicle	Silverstone Silverdolf
Continental	Passenger Car	Continental Viking Dunlop
	Commercial Vehicle	Continental Dunlop General

According to the Ministry of International Trades and Industry (MITI), the industry size related with tyres and tyre-related products currently possess around 120 players which vary in different sub-sectors, comprising tyre producers (nine players, 7.5%), while the remaining companies produce tyre treads for retreading, valves and other accessories (92.5%). With regards to passenger car tyres, in Malaysia, five local tyre manufacturers have acquired MS 149:2008 certification for new pneumatic tyres for passenger vehicles. The certified manufacturers are:

i. Continental Tyre AS Malaysia Sdn. Bhd.
ii. Goodyear Malaysia Bhd.
iii. GTS Manufacturing Sdn Bhd.
iv. Kian Hon Tyres Sdn Bhd.
v. Silverstone Bhd.

However, it is to be noted that under the MS requirement, some of the other non-local tyre manufacturers have also been certified with MS 149 certification, which comprises of three manufacturers from Indonesia, Thailand (two manufacturers) and China (one manufacturer). These manufacturers have obtained the MS 149:2008 certification for the purpose of exporting their products into the Malaysian market. Furthermore, in regards to commercial vehicle tyres, currently in Malaysia, ten local tyre manufactures have acquired MS 1394:2008 certification (commercial vehicles). These manufacturers are as followed:

i. CB LongMarch Tyre Sdn. Bhd.
ii. Continental Tyre AS Malaysia Sdn. Bhd.
iii. Continental Tyre PJ Malaysia Sdn. Bhd.
iv. Everthrough Rubber Products Sdn. Bhd.
v. Fortune Everlink Sdn. Bhd.

vi. Goodyear Malaysia Bhd.
vii. GTS Manufacturing Sdn. Bhd.
viii. Kian Hon Tyres Sdn. Bhd.
ix. Klang Yew Huat Trailer Parts & Tyres Sdn. Bhd.
x. Silverstone Bhd.

Similar to MS 149 for passenger car tyres, some foreign tyre manufacturers have also acquired the MS certification for MS 1394 enabling them to compete for sales within the local market. At the time of this study was conducted, these manufacturers are four from Thailand, two from China and one from Indonesia.

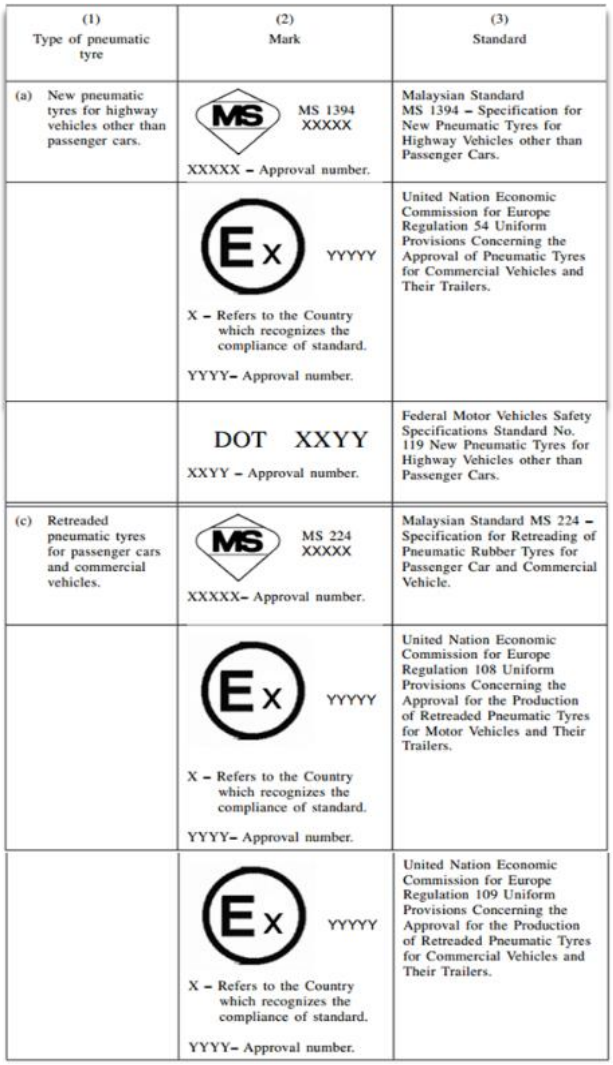
With the mixture of local and non-local manufacturers certified with the relevant MS, the related authority needs to carefully check and detect the misuse of the marking by other none certified manufacturers as this may bring confusion, even to the enforcement officers on the ground.

3.4 Sales and Distributions

The Malaysian Parliament passed the Trade Descriptions Act on August 18, 2011 (Laws of Malaysia, 2016). The Act empowered the Enforcement Division of the Ministry of Domestic Trade, Cooperatives and Consumerism (MDTCA) to take criminal action against the infringer, including the seizure of infringing goods bearing the false trade description. The act recognises three standards which are Malaysia Standard (MS marking), United Nation Regulation (E-Mark) and Federal Motor Vehicles Safety Specification Standard (DOT marking). Under the Act, the MDTCA is empowered to conduct monitoring and inspection on-premises and if any wrongdoings or substandard products were identified, the ministry has the authority to summon the premise and for the products to be confiscated. However, due to the limited human resource as compared to the vast coverage under the act, most on-market enforcement activities were conducted based on consumer complaints with also some periodical proactive inspections in place.

In regards to vehicle tyres, the Trade Descriptions Order for Marking of Pneumatic Tyre (Federal Government Gazette, 2012) comes into operation in Malaysia on 1st of September 2012. For passenger car tyre, it must be labelled with either MS 149 or UN R30 or FMVSS Specification Standard No. 109. For the commercial vehicle tyre, the marking of either MS 1394 or UN R54 or FMVSS Standard No. 119 must be visible on the sidewall of the tyre. As for retreaded tyre, the marking of MS 224 or UN R108 or R109 must be labelled on the tyre. The details of the trade description requirement for the pneumatic tyre is as illustrated in Figure 4.

Thus, for new tyres, only tyres fulfilling the abovementioned certification are legal to be on the market. However, it is important to note that currently, the substandard tyres are still available on the market in numbers of tyre premises particularly in East Malaysia where the demand for such tyres still widely exists. In regards to used tyres, it was noted that these tyres are usually being imported to Malaysia for the purpose of retreading. However, some tyre dealers were reported to have sold the used tyres directly to the consumers for usage and not for retreading since the tyres still have 50-60% of available tread.



(1) Type of pneumatic tyre	(2) Mark	(3) Standard
(a) New pneumatic tyres for highway vehicles other than passenger cars.	MS 1394 XXXXX XXXXX – Approval number.	Malaysian Standard MS 1394 – Specification for New Pneumatic Tyres for Highway Vehicles other than Passenger Cars.
	Ex YYYYY X – Refers to the Country which recognizes the compliance of standard. YYYY– Approval number.	United Nation Economic Commission for Europe Regulation 54 Uniform Provisions Concerning the Approval of Pneumatic Tyres for Commercial Vehicles and Their Trailers.
	DOT XXYY XXYY – Approval number.	Federal Motor Vehicles Safety Specifications Standard No. 119 New Pneumatic Tyres for Highway Vehicles other than Passenger Cars.
(c) Retreaded pneumatic tyres for passenger cars and commercial vehicles.	MS 224 XXXXX XXXXX– Approval number.	Malaysian Standard MS 224 – Specification for Retreading of Pneumatic Rubber Tyres for Passenger Car and Commercial Vehicle.
	Ex YYYYY X – Refers to the Country which recognizes the compliance of standard. YYYY– Approval number.	United Nation Economic Commission for Europe Regulation 108 Uniform Provisions Concerning the Approval for the Production of Retreaded Pneumatic Tyres for Motor Vehicles and Their Trailers.
	Ex YYYYY X – Refers to the Country which recognizes the compliance of standard. YYYY– Approval number.	United Nation Economic Commission for Europe Regulation 109 Uniform Provisions Concerning the Approval for the Production of Retreaded Pneumatic Tyres for Commercial Vehicles and Their Trailers.

Figure 4: The trade description requirement for passenger car, commercial vehicle and retreaded tyre (Federal Government Gazette, 2012)

3.5 Retreading

In tyre retreading industry, the used tyre was remanufactured by removing worn tread surface and replacing with a new tread. The casing of the used tyres may still intact and structurally strong. Remanufacturing used tyre can provide economic benefit to the logistic industry because it can reduce the cost of operation. A proper retreading process inspects the condition of the used tyres before they are used for retreading. The process involves the diagnostic process, surgical process (buffing, skiving and repair), new life process (cementing and curing) and finishing process (high-pressure testing and final inspection). Used tyres that are structurally weak should be rejected from being retreaded during the process of diagnostic.

Tyre retreading manufacturers usually obtain used tyres from tyre workshop or the commercial vehicle fleet operators. However, the tyre retreading manufacturers also obtain their source of used tyres through importing from foreign countries. According to current regulation, only tyre retreading manufacturers with MS 224 product certification are allowed to import used tyres. Referring to the Malaysian Certification database, as of 3rd of May 2018, SIRIM has issued MS 224:2005 product certification in Malaysia to 60 companies.

However, according to Tyre Retreading Manufacturers Association of Malaysia (TRMAM), some tyre retreading manufacturers are still operating without obtaining the required product certification. Without product certification, these tyre retreading manufacturers run their businesses by supplying uncertified tyres to the market. Besides, some tyre retreading manufacturers even purchased product certification markers from certified manufacturers and applied the markers on their non-certified retreaded tyres. The retreaded tyre can only be considered as a safe product if it was done in accordance with the applicable standard as the usage of none certified tyres may end up with tyre failure issues and compromise safety.

3.6 Scrapping

From the info gathered, it is learned that currently, although not closely regulated and monitored, scrap tyres treatment can be segregated into four processes which are; energy recovery, recycling, landfill and illegal dumping. With regards to energy recovery, scrap tyres are burned for crude oil but currently, there are minimum burning activities of scrap tyres due to health and environment issues which contravene the Environmental Quality Act 1974 (Laws of Malaysia, 2006). Currently, it was informed that a few cement manufacturers i.e. Lafarge Malayan Cement and YTL Cement used the scrap tyres to fuel its cement kiln for energy recovery as supplementary fuels.

Scrap tyres could also be recycled into commodities and resources, such as concrete, asphalt and other products. To convert the scrap tyres into a valuable product, it must first be reduced in size and then recycled. The tyres need to be shredded into small manageable chips, which are then cooled to cryogenic temperatures, causing the pieces to become brittle (MHLG, 2011). These brittle pieces are then pulverized and the remaining fibre and magnetic material are separated from the pulverized material using a magnetic separator and a vibrational separator. This form of recycling is environmentally friendly and allows a valuable resource to be used again and again. Other potential products from scrap tyres include asphalt paving mixtures and as extenders in a variety of rubber products such as roofing materials, walk pads, carpet and flooring underlay and other products (MHLG, 2011). This study found out that currently only one recycler, namely the G-Cycle that process scrap tyre into rubber granules. These rubber granules are further processed to enable it to be used to manufacture rubber secondary product while other materials from the tyre i.e. steel wire residue are sold to the steel mill for further processing.

In Malaysia, there are no disposal facilities specifically designed for the disposal of scrap tyres. Most of our landfill sites receive scrap tyres as mixed waste with normal household waste. This poses some serious issues on the environment and pollution. Issues such as fee charged by authorised landfill is too high and the scrap tyres in landfills are usually not segregated from other domestic waste has caused some illegal dumping of waste tyres.

4.0 CONCLUSION AND RECOMMENDATIONS

This section shall discuss the conclusion and recommendations for certification, importation, sales and distribution, retreading and scrapping.

4.1 Certification

Relevant agencies and the industry have highlighted concerns on traceability of tyre products carrying DOT marks (FMVSS standard). The system is quite different as compared to MSs and UN R standards, whereby the latter two can be tracked by its serial number. The Tyre Identification Number (TIN) in the DOT marking consisted of up to four groups of symbols, in which the first group identifies the manufacturer of the tyre. The code differentiates between the production of new tyres and retreaded tyre. The application of the codes is based on the request to the National Highway Traffic Safety Administration (NHTSA), whereby manufacturers and retreaders need to provide contact information and information about the tyres. While the marking under controlled within the US, local authorities face difficulties to track the origin of tyres with DOT markings imported into Malaysia. Thus, quality control of these tyres is uncertain which have caused other reported issues such as fake documentation and resulted in Malaysia to be the dumping ground for unwanted tyres.

The authors were made to understand that currently there are a great number of local retreaded tyre companies that even does not comply to either MS or UNECE requirement for their retread tyre products, instead opting for DOT markings. As far as the legal point of view, this is permissible as the Trade Order under the MDTCA permits tyre products of having either one of those certification marks, i.e. MS or E or DOT. As the mechanism of DOT is self-declared by the manufacturers, that will be the easiest escape route for irresponsible market players. With the demand for untested retreaded tyres in the market is still high considering its lower prices as compared to retreaded tyre with proper certification markings the issue becomes worsen. Retreaded tyres which are not adhering to the recommended retreading protocols and quality checks, either by MS, UN R or genuine FMVSS requirement may also use tyre casing with low qualities, that could lead to failure of retreaded tyres on the road. One of the solutions to the problem is by harmonizing the test requirement under MS with the relevant UN R thus indirectly encouraging local players to apply for MS certification, at the same time avoiding any manipulation by the irresponsible industry players with regards to the markings option.

On another note, improvement in terms of current MS certification requirements is also evident. In an example, the current mechanism for the printing of MS marks on tyre products is conducted by the manufacturers. The issuance (DSM and/or SIRIM) provides only the guidelines on how the mark should being printed. In order to ensure that the markings are not being misused, instead are consumed according to the certification, the printing of MS standard should be controlled by the issuance themselves.

Also, MS 224 standard does not itemize mechanical test to be conducted in an accredited lab, as the standard focusing generally on the process of retreading. Instead, the process can be conducted at the non-accredited laboratory or even manufacturers' lab, witnessed by SIRIM officer. The results from the non-accredited laboratories are recognized if the test reports are endorsed by an accredited laboratory for that test. The requirement of testing in an accredited lab is to ensure that the laboratory is technically competent to carry out specific testing activity required in the standard, thus producing reliable results. Furthermore, there is

no Conformity of Production (COP) required for products with MS markings. Test on samples is conducted only during the application of certification and audit process. COP should be included as part of the certification requirement for MS.

4.2 Importation

In case of new pneumatic tyres and new retreaded pneumatic tyres, it was reported that many tyre importers import sub-standard tyres which possess imitated FMVSS compliance marking (marked with 'DOT'). This is because the FMVSS compliance is only self-declaration and only the Department of Transport (DOT) of the USA possesses the authority to charge for cases of falsifying the said marking. Currently, Malaysia does not have an agreement with the USA to ease the enforcement for the product that falsifying DOT marking and due to that matter, the relevant authority such as RTD is unable to identify or confirm whether the imported tyres comply with FMVSS or not. Thus, there is needs to seek immediate legal mechanism for the local authorities to cater to the issues related to falsifying the DOT marks. Tyre dealers who are found to import, possess, distribute and sell these uncertified tyres need to be imposed with stern actions.

Other than that, RTD is one of the approval authorities under WP 29 framework under United Nations and able to confirm the genuineness of the compliance document for UN Regulations (E-mark) while compliance to Malaysian Standard (MS) can be confirmed by DSM and SIRIM. The current requirement on manners of imports for new pneumatic tyre and new retreaded pneumatic tyre has clearly stated that it needs to comply to the standard as prescribed under the Motor Vehicle (Construction and Use) Rules 1959 governed by RTD (Abdul Wahab et al., 2017). As such, the importation of the tyres must be accompanied by the certificate of compliance and the product bearing certification mark either UN Regulations (E-mark) of WP 29 or Malaysian Standard (MS mark) or FMVSS (DOT mark). However, it was made known that in many cases, the importation of the tyres is not referred to RTD. Systematic data sharing and collaboration in on-the-ground inspection processes among relevant authorities i.e. Customs and RTD are crucially needed to rectify the loophole.

4.3 Sales and Distributions

With regards to monitoring and record-keeping of these on-market tyres, it was noted that currently, no centralized system is available which can enable the monitoring mechanism on the distribution of tyres according to models and tyre sizes. This will result in occurrence whereby even tyre dealers are unable to trace their tyres based on tyre's serial number. This provides an imminent loophole in tyre tracking and allows the possibility of illegal tyre rebranding and raised the potential issue of tyre cloning. This has resulted in the unsatisfactory level of enforcement from relevant authorities, i.e. MDTCA in ensuring that all on-market tyres are certified by MS, UN R or DOT standards and possess relevant markings. Thus, this issue can be overcome by having a centralized database system of tyre products by each manufacturer. Furthermore, some stakeholders also mentioned that currently there are tyre manufacturers from China who have built their plants in Malaysia to export the tyres to other countries, to avoid the effect of trade barrier policy implied by certain countries against China. However, further inquiries are needed to verify this claim.

4.4 Retreading

Retreaded tyres a safe to be used if the retreading process and selection of tyre casing is being conducted correctly, by adhering to established standards and test protocols. One of the main reasons for retread tyre failure on the road is due to a problem arises from the quality of retreading which includes utilizing unfit tyre casings. Therefore, some controlling mechanism is required to ensure the manufacturing process of the retreaded tyre is properly conducted in the entire spectrum of the industry. Hence, to properly regulate the sales of the retreaded tyre, MDTCA had already instructed all tyre retreading manufacturers to comply with MS 224 or the equivalent UN R108 and UN R109 and FMVSS regulation. However, loophole still exists because manufacturers have the option to choose between the three standards, and due to the nature of DOT marks which are self-declared. This may be manipulated by irresponsible parties in the industry.

To resolve the issue, when unaccepting DOT marked products may seem to be wrong in terms of global trading ethics, close collaboration with the USA DOT to find solutions in terms of legal action by local authorities to those found using falsified the marks should be in place. At the same time, the local certification body may need to think of other ways including harmonizing the technical discrepancies between local and international standards and regulations to reduce the opportunity of ill manipulation in terms of product certification. With this in place, enforcement by relevant authorities such as MDTCA and RTD will be more effective and manufacturers who are found to operate without the required product certifications can be taken into justice. On the other hand, another possible solution is to make compliance of the standards as a mandatory requirement in obtaining the manufacturing license for tyre retreading manufacturers. This will eliminate any possibility of uncertified industry players producing unsafe retread tyres. Without supply, this approach may also help to reduce the demand for cheap uncertified tyres. This can be implemented under the jurisdiction of the Malaysian Investment Development Authority (MIDA).

4.5 Scrapping

As the disposal of scrap tyres in landfills has proven to pose a negative impact to the environment which not only taking up a great deal of space within a landfill, but their process of decomposing has created a wide variety of issues that have made their disposal in landfills unfeasible and in many regions and thus, banned. The process of bubbling of trapped methane gas has been linked to increased mosquito and other insect breeding which increases the risk of the disease spreading, contamination of both underground and above groundwater systems, as well as chemically destroying many beneficial bacteria that grow in the soil within and surrounding a landfill.

The most obvious hazard associated with the uncontrolled disposal and accumulation of large amounts of tyres outdoors is the potential for large fires which are extremely detrimental to the environment. Once a large pile catches fire, it is very hard, if not impossible, to extinguish. The scrap tyre management should be regulated, monitored and enforcement intensified with penalties for non-compliance. There is a lack of exciting rewards for the industry to embark on recycling of scrap tyres. Little or no obvious initiatives are seen to encourage public or industry players on the importance of recycling of scrap tyres to protect the environment.

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