# DEVELOPMENT OF A STANDARD SPECIFICATION FOR LATEX HARVESTING UTENSIL (LHU) TO ASSIST PROCUREMENT PROCESS

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**ABSTRACT**

*Over the years, evolution on how rubber latex has been collected can be observed. Various types of material have been used as the latex collection cup, and the most commonly used is plastic cup. It is important to use the right collection cup to ensure ease of handling and to preserve the quality latex harvested. The main objective of this paper is to share on the specification developed for latex harvesting utensil (LHU), a set of components, comprising of cup, spout, hanger and spring. Firstly, comparison was made between existing specification for LHU, i.e.: MRB specification and RISDA specification, which both specifications only specify design and dimension for each component of LHU. The main differences observed between the two were the design for spout and spring, whereby those specified in the MRB specification are better. Next, a simple, quantitative, and measurable performance requirement for each component of LHU were developed and established. From the studies, the material selection for plastic cup shall be specified as semi crystalline thermoplastics based on the chemical analysis and the weathering test conducted. The performance test for the plastic cup shall be the compression test, with the minimum breaking point at 1600 N. The hanger and spring shall use galvanised low carbon steel wire with a thickness of 2.34 mm and 1.50 mm respectively. The spring shall have the straight gap between the coils to hold and secure the hanger firmly. The spout shall use galvanised steel sheet with jagged-end for easier affixation to the bark of a rubber tree. The performance test for hanger, spring and spout shall be the bending test, with the minimum bending point at 145 N, 62 N, and 12 N respectively. Finally, the carefully identified and selected design, requirement, and performance test for each of the LHU components were then specified in the standard specification. The standard specification is a simplified document which can be used by both producer and user of LHU. The standard specification developed for LHU would make it easier for the industry players to be more efficient, since standards bring real and measurable benefits to everyone and therefore, ensure products are reliable and of good quality.*

Key words: certification, latex, latex harvesting utensil, standard, quality

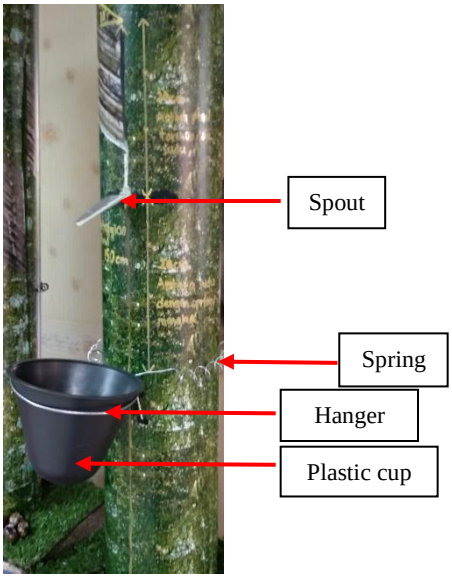
## INTRODUCTION

A standard is a document that provides requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose. (International Standards Organization (ISO), 2005). Standard is used every day in all aspects of our daily life. For example, standards in IT govern interoperability between a variety of digital devices and platforms, standardised production of various machine parts allows uniform repair and reproduction. Standardisation in accounting, health care, or agriculture sector promotes best industry practices that emphasize safety and quality control. Standard also allow fast introduction of innovative products into the market, and provide interoperability between new and existing products, services and processes. In another words, standards provide people and organisations with a basis for mutual understanding, and are used as tools to facilitate communication, measurement, trade and manufacturing.

Three character of standard that has effect on economic growth as mentioned by Zhang, H. et. at., 2019, is consistency, compatibility, and compliance. They further explained that standards would enable products to be consistent with requirements and gain market recognition. A market with certificated products will have less uncertainty and further enhanced integration. Compatibility of standards is reflected in helping products integrate as standards can shorten the time for new products to appear on the market, promote the widespread use of innovative products and create a fair innovation environment for large and small enterprises. Finally, compliance to a certain standard established a trust system and secure the market order. Standard can be a basis for two parties to reach a contract and reduce the uncertainty in economic activities by making merchandises quality information available to consumers.

Latex harvesting utensil (LHU) is a set of products comprising four main components: a plastic cup, a metal spout, a metal cup holder (hanger) and a metal spring as shown in Figure 1. Evolution on how latex has been collected has been observed over the years. The continuous effort in the evolvement of the cup used to collect latex has shown that, it is important to find a proper collection container to preserve the quality latex harvested and ease of handling. Different types of latex collection cup have been used, such as ceramic cup, glass cup, bamboo, polyethylene bag and the commonly used are plastic cup.

**Figure 1. Components of LHU affix on rubber tree**




Currently, various types of LHU (in terms of material, design, and dimension) are being used by rubber grower, supplied, and purchased with no specific or published documentation as the guideline for its quality nor design. In another word, there is no standard been developed for LHU.

The basic design and dimensions for each component of LHU are based on the requirements made in the Low Intensity Tapping System Scheme for the third round (LITS 3), a survey carried out in 2007 – 2010. The scheme was launched by the Malaysian Rubber Board (MRB). The LITS 3 project involved 289 locations, 7,436 participants, 7,106 lots of smallholdings that encompassed an area of 17,071 hectares on mature rubber trees throughout the country (Ramli Osman 2012). Based on this data, it is estimated, more than 5 million sets of LHU were procured. This showed the needs for LHU will always be there every time a new tapping panel is ready to be opened for a rubber plantation or if there is a large-scale agricultural input activity by relevant agencies to be given to smallholders.

The requirements for LHU as per LITS 3, are still referred to; even after the survey ended in 2010. It has been generally accepted that the LHU specification specified in the LITS 3, is known as MRB specification. Since then, it has been widely used, by all rubber growers and even by MRB, in purchasing LHUs. However, as pointed out earlier, it is not published to be publicly accessible to product manufacturer nor rubber grower as user of the product.

## METHODOLOGY

*Survey on the current usage of LHU*

To understand the current usage of LHU by rubber growers, a survey was conducted. The survey entitled "Effectiveness of the Use of Latex Harvesting Utensil for Rubber Crops" was carried out to obtain feedback on the effectiveness of the LHU used by the rubber growers. The questionnaire was formulated, to compare the LHU they currently used against the available specification, i.e., MRB specification. A total of 2,430 respondents replied the questionnaire posted. The study also noted that there is another specification available in the market. In this paper, the other known specification is recognised as RISDA specification, since it is developed by RISDA These two specifications are similar, however the main differences observed were the design for spout and spring, which will be elaborated later in the results and discussion.

*Test method development for product performance*

As both *MRB specification* and *RISDA specification* are focusing heavily on the design and dimension, they are lacking on the quantitative and measurable performance requirement for each of the LHU components.

The plastic cups' material properties were studied, to correlate with the two performance tests investigated for the plastic cup, compression test and endurance test. Whereas for the metal components, hanger, spring and spout, bending test was explored.

Compositional analysis for plastic cup was carried out using thermogravimetric analysis together with Fourier transform infrared (FTIR) analysis. Compression test, endurance test and bending test were three new test methods developed specifically for LHU components. To enable the compositional analysis, three types of samples, labelled as A, B and C, were used in this study.

The compression test of the plastic cup was carried out using Universal Testing Machine; at 5 mm/minute using 10 kN load in accordance with ISO 604 (ISO, 2002). For the endurance test of the plastic cup, the test was carried out so that one end of the cup will touch the other end, repeatedly in a cycle when tested to measure its durability.

As for the bending tests for the metal components, the same Universal Testing Machine was used at 1 mm/minute with 25 kN load cell. The test jig was fabricated in accordance with ASTM E290 (ASTM International, 2014), whereby the position of the sample holder can be changed following the thickness of the test sample. The guided-bend test use a plunger with defined dimension to force the mid-length of the test sample between two supports separated by a defined space. The calculation used for the jig fabrication as given in the ASTM E290 is given below:

$$C = 2r + 3t \pm \left(\frac{t}{2}\right) \quad (1)$$

where,

$C$ is the distance between lower supports,
$r$ is the radius of the end of the mandrel or plunger, and
$t$ is the specimen thickness (or specimen diameter).

## RESULTS AND DISCUSSION

*Review on available specifications*

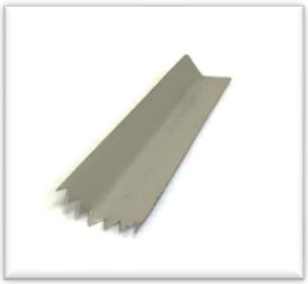
The two specifications being referred to by producer for LHU, *MRB specification* and *RISDA specification* were not publicly available, as they are mainly intended to be used by both organisation internally. As a result, user of LHU namely rubber growers would buy anything that is available in the market in the absence of any available LHU specification.

The main differences observed between the two specifications as shown in Figure 2 and Figure 3, were the design for spout and spring. Spout as per *RISDA specification* is flat-end as compared to the jagged-end for MRB specification. The jagged-end for a spout is important to ensure that it is easily affix to the bark of a rubber tree. A flat-end spout would require additional force when it is fixed to a rubber tree. As a result, flat-end spout is prone to bending due to the additional knocking force.

For the spring, the straight gap between the spring coils as per *MRB specification* as shown in Figure 3 was design in such a way that it could hold and secure the hanger which will hold and support the plastic cup. The stiffness of the spring is also important to ensure it could hold the latex weight and at the same time it could expand accordingly as the girth of a rubber tree increased.

Therefore, in terms of the design and dimension, those specified in the *MRB specification* are better.

**Figure 2. The difference in design for spout**



(a) *MRB specification*

(b) *RISDA specification*

**Figure 3. The difference in design for spring**

(a) *MRB specification*

(b) *RISDA specification*

*Specification and performance test for plastic cup*

*a) Survey outcome*

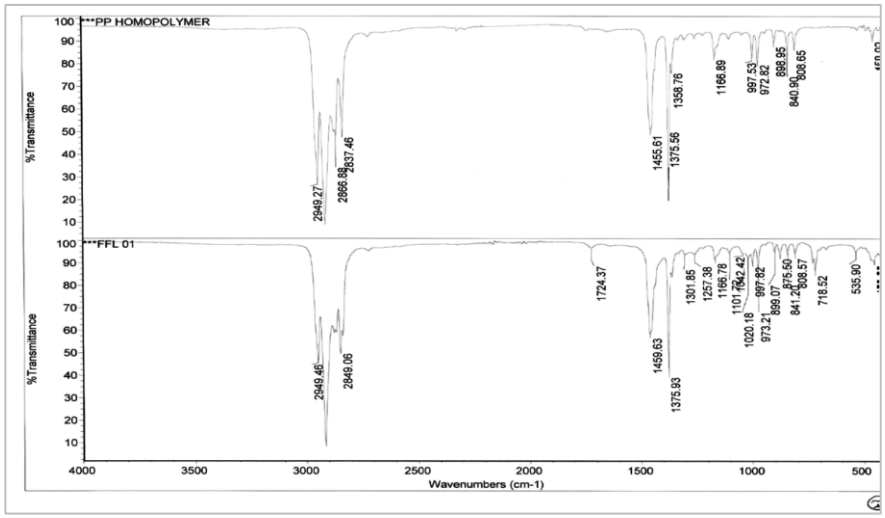
From the total of 2,430 respondents of the survey carried out, only 61% of the respondents used the recommended 1.2 L plastic cup as shown in MRB specification. 25% of the respondents are using plastic cup other than 1.2 L such as 900 mL, 1.5 L and 2 L depending on their yield. The other 14% of the respondents are still using primitive but practical containers available to them such as coconut shell, ceramic cup, and plastic bottle. About 81.3% from those using the recommended 1.2 L plastic cup indicated that the plastic cup they used can last for 1-5 years and the most common problem faced by them was the plastic cup used were easily broken.

*b) Design, dimension and performance test*

The plastic cup's design and dimension specified in the *MRB specification* was observed to be practical and would be incorporated in the new standard specification.

However, the term 'polyplastic' indicated in the *MRB specification* as material for plastic cup is vague and loose. From the FTIR analysis, the results showed that the polymer type for all plastic cup sample tested are polypropylene (PP), which are semi crystalline thermoplastics. Figure 4 shows the FTIR spectra for the plastic cup against the PP homopolymer resin. Low grade recycles materials or amorphous thermoplastics can also be used to produce the plastic cup. However, semi crystalline thermoplastics has better resistant to stress cracking and fatigue resistance as compared to amorphous thermoplastics as well as wear resistance.

**Figure 4. FTIR spectra for plastic cup against the PP homopolymer resin**




The compositional analysis carried out using thermogravimetric analysis is given in Table 1. The results showed that samples A and B have similar composition with 93% polymer content and filler content was less than 5%. However, sample C showed higher filler content with the least polymer content at 87%. The ash content, suggesting for the inorganic constituents, are almost similar for all three samples. It is also observed that the sample A has higher amount of carbon black.

**Table 1. Compositional analysis for plastic cup samples using thermogravimetric analysis**

| Composition | Sample | | |
|---|---|---|---|
| | A | B | C |
| Polymer | 92.5 | 92.6 | 86.7 |
| Filler (as $CaCO_3$) | 2.7 | 3.6 | 10.5 |
| Carbon black | 1.7 | 0.5 | 0.4 |
| Ash | 2.5 | 2.7 | 2.0 |

Apart from the polymer type, filler content (usually calcium carbonate) and carbon black content also affect the durability of a plastic cup. Higher filler content will increase the stiffness of the composite and can make a plastic cup brittle. In contrary, by adding carbon black, it would increase the resistance of a plastic cup against weather, resulting for a longer durability.

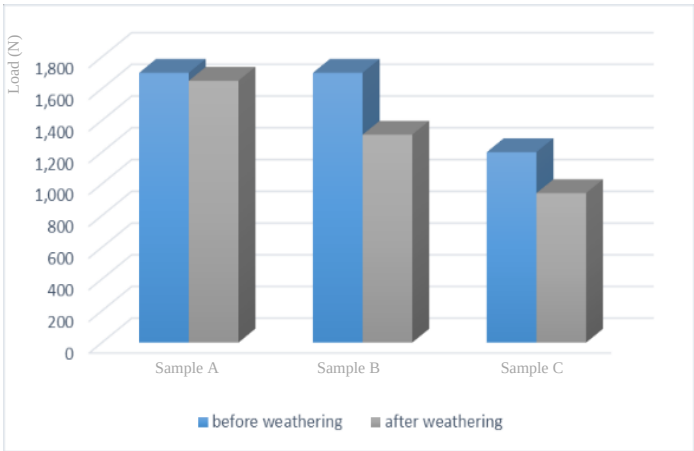
It would be out of proportion against the price of LHU set, which is less than RM 2 per set, if the material requirement and its relevant characterization tests is to be incorporated in the standard specification. Therefore, apart from the crucial design and dimension of the plastic cup, performance test is specified in the standard specification instead.

Two performance tests for the plastic cup were studied. The endurance test carried out for the plastic cup shows that no deformation observed even after 500,000 cycles. Possibility to continue the test to another few million cycles were considered but, this would suggest for a higher cost of testing. Therefore, this test is not feasible to be included in the standard specification. The prolonged endurance test suggested that the plastic material have good fatigue resistance and thus failure was not observed at lower cycle. Therefore, the straightforward compression test was selected as the performance test for plastic cup.

The effect of the weathering for the plastic cup was carried out to suggest the minimum breaking point for the compression test in the standard specification. The compressive stiffness before and after the weathering test is given in Figure 5 below. The samples were subjected under the desired weathering condition which simulates to one-year natural outdoor exposure (Kamarudin et al 2010, Othman K.S. et al 1992 and ASTM International, 2013).

It is observed that samples A and B have similar compressive stiffness before the weathering test, whereas sample C has the lowest compressive stiffness. This result corresponds to the compositional analysis conducted earlier, whereby sample C with the most filler content would show a lower performance compared to samples A and B.

**Figure 5. Comparison of plastic cup compressive stiffness before and after weathering test**




After the weathering test, it is observed that the UV irradiation subjected to the samples could break the polymer bond resulting in the degradation of the samples. Sample C which has the least polymer content showed the most severe effect of degradation in all replicates. It is interesting to observe that 75% of sample B replicates showed sign of degradation, whereas all sample A replicates showed minimal sign of degradation, despite both samples A and B having similar polymer content.

The degradation has subsequently weakened the plastic cup compressive stiffness as shown in Figure 5. It is observed that the percentage difference for sample B and C, before and after weathering test are 22.9% and 21.5% respectively. As for sample A, only 2.9% changes were observed. This observation suggested that the high carbon black content in sample A gave significant impact toward the strength properties of the plastic cup.

These findings suggested that plastic cup with minimum breaking point at 1,600 N would ensure for quality plastic cup produced.

*Specification and performance test for metal components: hanger, spring and spout*

*a) Survey outcome*

From the survey carried out, it is observed that 80% of the respondents used the recommended hangers and springs as per MRB specification. They also indicated the components can last for 1-5 years.

Based on the survey, the most common problem faced by the respondents related to the hangers and springs were that these components are easily rusted. There were also comments made specifically towards the hangers. It was stated that the material used were too soft and this had caused the plastic cup to overturn when it is filled with latex, as the hanger could not withstand the weight of the latex collected.

From the survey, 55.4% of the respondents used the recommended spout and indicated that the spout can be used for 1-2 years. It was highlighted that spout used were too thin, ductile, and easily bent and easily rusted.

*b) Design, dimension and performance test*

For the metal components of the LHU, the producer of LHU would procure the raw material and then produce the hanger, spring, and spout according to the design and dimension as per MRB specification. The hanger and spring are both produced using galvanised wire. The wire thickness for hanger and spring are different, based on its intended use. While the spout is produced using galvanized steel plate.

It was observed that the wire gauge number and its corresponding diameter (thickness) for hanger and spring in the *MRB specification* do not tally with the current wire gauge number. Therefore, for the standard specification, the wire gauge number has been revised as follow:

- Hanger: 2.34 mm, wire gauge No. 11
- Spring: 1.5 mm or wire gauge No. 15

As per the plastic cup, it would be out of proportion against the price of LHU set, for material requirement and its relevant characterisation tests to be incorporated in the standard specification. Therefore, a simple performance test was developed for the metal parts to be included in the standard specification.

Bend tests for ductility provide a simple way to evaluate the quality of materials by their ability to resist cracking or other surface irregularities during one continuous bend. In this test, galvanised low carbon steel wire (used for hanger and spring) and galvanised

steel sheet (used for spout) is bended until it breaks, and the maximum force exerted is measured. After bending, the convex surface of the bend is examined for evidence of crack or surface irregularities. If the specimen fractures, the material is considered failed.

The bending value is determined by the maximum load exerted for bending. Based on the bending results obtained, the average value is taken as the minimum bending value to be specified in the standard specification to ensure the quality of each component. The minimum bending value for each component is as follow:

- Hanger: 145 N
- Spring: 62 N
- Spout: 12 N

It is also noted that all test specimens tested showed no fracture at the end of the bending test. This indicates that the bending test is suitable to be specified as the performance test for the metal components of LHU.

*Development of a standard specification for LHU*

Based on data gathered on each component of LHU and the performance test identified, the new standard specification for LHU has been established. The standard specification entitled "Latex harvesting utensils – Specification" specifies the designs, dimensions, and performance requirements for each of the components of LHU used in rubber plantations.

The standard specification would make it easier for producer of LHU to produce a quality LHU. This voluntary standard specification could be used to gain product certification from MRB. The standard specification would also make it easier for the industry especially the rubber growers to refer when they are planning to purchase the LHU. This standard specification would be a simple document to guide rubber grower in accessing LHU they received from supplier or even when they bought them in the open market. For bigger rubber plantation which implement Good Agricultural Practices (GAP) in their rubber plantation, this standard specification would be one of their reference documents in compliance to the GAP.

Quite often, a higher quality product is associated with higher price, due to increase of cost. However, with high demand of a quality LHU in the market would eventually compensate the initial higher cost incurred to the producer of LHU. To increase such demand, awareness amongst industry player especially, rubber growers on the available standard specification would be substantial. This cycle of demand and supply with the available standard specification would ensure quality LHU is used in rubber plantation to preserve the latex harvested and ease of handling.

## CONCLUSION

The quality of LHU available in the market varies with no established specification for reference to assist procurement of LHUs. From the study, the design for each of the LHU components specified in the *MRB specification* are better compared to RISDA specification. This study has also developed and established a simple, quantitative, and measurable performance requirement for each component of LHU. The performance test for the plastic cup is the compression test and the performance test for hanger, spring and spout is the bending test.

The carefully identified and selected design, requirement, and performance test for each of the LHU components was specified in the standard specification published as "Latex harvesting utensils – Specification". The standard specification is a simplified document which can be used by both producer and user of LHU. The standard specification developed for LHU would make it easier for the industry players to be more efficient, since standards bring real and measurable benefits to everyone and therefore, ensure products are reliable and of good quality.

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