

# Development of JIS Z 0130 Series of Standards on Packaging and the Environment

## 1. Introduction

Packaging products are used in almost all industrial sectors. In Japan, strenuous efforts have been made in each industrial sector to reduce environmental impact of packaging since the Act on the Promotion of Sorted Collection and Recycling of Containers and Packaging (for short, Container and Packaging Recycling Law) was enacted in 1995. However, there were no standardized means for reducing environmental load and evaluating the reduction thereof, and each company used its own measures. This situation brought about complaints and confusion by claiming that different users requested the environmental impact evaluation in different methods, and that evaluation results obtained through the company's own method were not widely accepted. Needs for an objective measuring scale was the prime mover of the international standards in this area. In response to the establishment of the international standards, the work for preparing related JIS standards was undertaken.

It is planned that various aspects of environmental consideration related to packaging would be provided for in a series of six JIS standards "Packaging and the environment." Three of them—JIS Z 0130-1 General requirements; JIS Z 0130-2 Optimization of the packaging system; and JIS Z 0130-3 Reuse—have been established first in May 2015. With three more standards—ISO 18604 Material recycling, ISO 18605 Energy recovery, and ISO 18605 Organic recycling to be converted to JIS standards (JIS Z 0130-4 through 0130-6) published in December 2015, there have been a total of six standards in place, which make full stipulations concerning procedures and standards for evaluation of environmental consideration in packaging.

In this document, the circumstances of related ISO standards development and standard outlines will be introduced for better understanding and application by every user of the standards.

## 2. Circumstances of ISO Standards Development

In the 1990s, reduction of packaging waste became a serious challenge in Japan, and the promotion of reduction, reuse and recycling, commonly dubbed as 3Rs, in packaging was developed as the joint work by citizens, the local government and the industry. The legal framework was being made steadily with the Act on the Promotion of Effective Utilization of Resources enacted in 1991, the Act on the Promotion of Sorted Collection and Recycling of Containers and Packaging partly enforced in 1995 followed by full enforcement in 2000, and the Basic Act on Establishing a Sound Material-Cycle Society enforced in 2001, together with development of social infrastructure required for these activities. These moves

helped to promote the 3R initiatives in packaging and packaging waste in various industrial sectors.

Around the same time, the 3R ideas in packaging became recognized keenly in Europe, too, and actual initiatives were carried out. As a result, EU directive 94/62/EC on packaging and packaging waste was established in 1994, with the European standard on packaging and the environment subsequently issued in 2000.

In response to the Program for Promotion of Establishment of Environmental JIS issued by the Ministry of Economy, Trade and Industry (METI) of Japan in 2003, the Japan Packaging Institute (JPI) formed a committee and set out for standardization in the area of environmental consideration in packaging. In the first stage, the work was undertaken to make JIS standards referring to the European Norms, and some draft standards were prepared. Then it was noticed that the work being made in Europe were to develop ISO standards based on the European Norms, so the committee changed direction. JPI believed that the circumstances of countries and regions other than European countries should be widely considered. In order to do so, Japan asked Korea and China as well as other Asian Packaging Federation (APF) member countries for cooperation, and prepared Asia Guidelines in 2008 which were English translation of the related JIS drafts. Thus JPI actively cooperated in the ISO development efforts by establishing a firm basis for presenting views from Asian countries.

In the International Organization for Standardization (ISO), a new subcommittee SC4 responsible for packaging and environment was formed under Technical Committee TC122 (Packaging) in 2009 with both European standards and Asian Guidelines set as discussion bases. Development of standards began in seven working groups each responsible for a standard draft. Japan was appointed 1 convener and 2 project- leader for three working groups. In 2013, six ISO standards (No. ISO 18601 through 18606) and two technical reports (ISO/TR 16218 and 17098) were made public after 5-year discussion.

### **3. Background and Purposes of JIS Establishment**

In Japan, 3R initiatives in packaging have been progressed since 1995 based on the Container and Packaging Recycling Law, as mentioned above. In relation to this, the work has been made not only for package recycling but also for consideration of 3R factors in the product design and manufacturing stages (packaging design with environmental consideration).

This design principle requires environmental consideration in packaging while ensuring the inherent functions of packages are maintained. For example, if the packaging reduction principle were sought excessively, it would not be possible to maintain the inherent packaging function of protecting the product and would rather inflict damage on it. This would result in more serious burden to be inflicted on the environment.

Companies have been making strenuous efforts continuously to optimize their

product packaging, but there are no specific indexes in place based on which the work can be evaluated objectively, and the work performed by the packaging industry and consumer goods manufacturers are not necessarily understood well. So it was widely expected that a comprehensive system be set up in which objective evaluation standards are established, evaluation results are announced openly, and the corporate work is made public in a fair manner.

The series of ISO standards were issued in 2013, and there was expectation that those standards would make clear criteria for objective evaluation. Against such background the development work of JIS progressed.

In order to reduce generation of packaging waste, ensure sorted collection and recovered packaging after use, it is strongly required to pursue the 3R-based approach in each stage of packaging design, manufacture, consumption and discharge while ensuring inherent packaging protection functions are kept.

#### **4. Features of the JIS Standards**

Sorted discharge, collection and recycling of used packaging are being operated in accordance with the rules set forth by the national and local governments. The related JIS standards are voluntary standards, and it is expected that those be utilized for 3R initiatives and objective evaluation in each stage of package design, manufacture, consumption and discard.

These JIS concern each individual product package. In these standards, the procedures and requirements necessary to declare that each packaging conforms to environmental consideration provisions are clarified. The objective of the standards is to minimize environmental impact while satisfying the inherent packaging function.

These standards introduce methods and criteria for objective judgment. At the same time, these standards are prepared so that flexible handling can be made even in developing countries or small-sized businesses, in which it is hard to obtain sufficient manpower and testing equipment.

The standards stipulate that assessment “can be performed by the first party(manufacturer or supplier), the second party(user or purchaser), or by the support of the third party (independent body).” Since it is allowed to make self-evaluation and self-declaration, and third-party certification is not required, it is expected that these standards be fully utilized in trading of small-sized businesses.

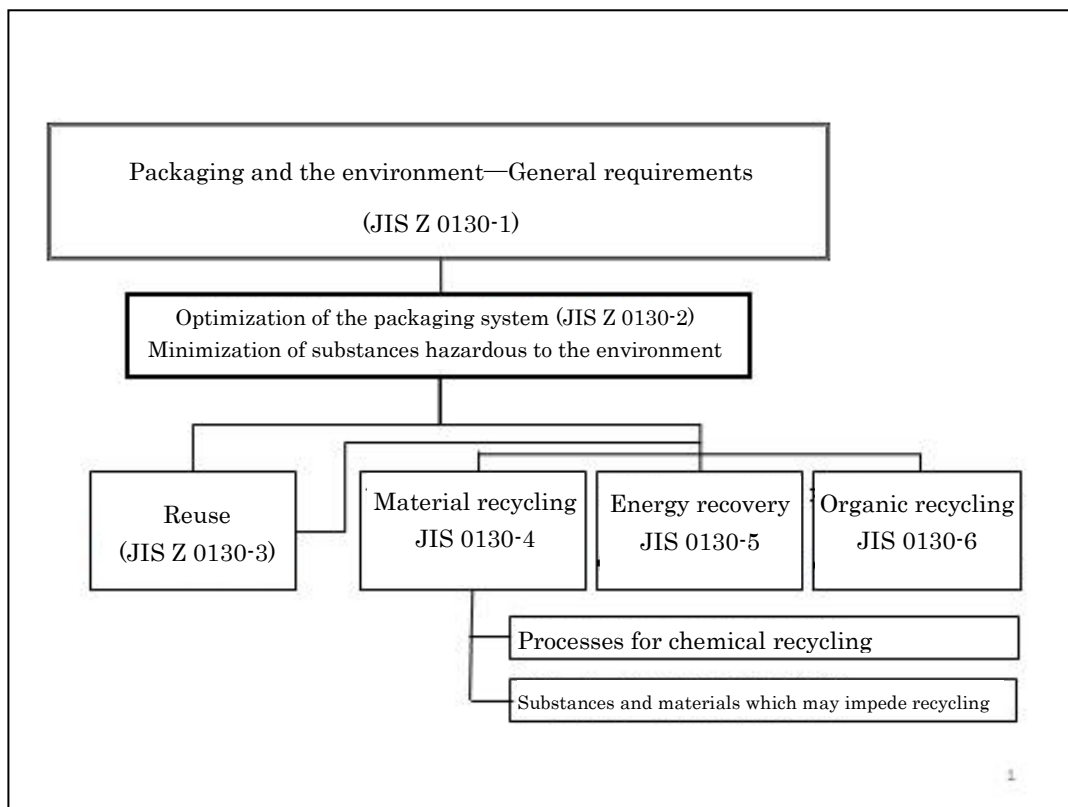
According to these standards, it is possible to confirm in writing the compliance of certain levels of packaging products used in international trading, or existence in packaging materials of substances that are harmful or detrimental to recycling. As mentioned above, the assessment methods are so flexible that even developing countries can perform them. It is expected that these standards will be promoted widely in industrial sectors.

In the development of the corresponding international standards that are bases for the JIS, Japan has been involved for ten years from the development start by presenting views of Japan, although not all of our views were necessarily accepted in the international standards. The JIS standards were established in consideration of the circumstances of ISO development; they are as faithful translation as possible and are easy for everyone to understand.

## **5. Outlines of the JIS Standards**

JIS Z 0130-1 Packaging and the environment—General requirements is an umbrella standard for all the others, and sets forth the procedures to assess how environmental consideration is made in packaging, and presents the mutual relationship between the related individual standards. JIS Z 0130-2 Optimization of the packaging system stipulates compulsory requirements, which any packaging available on the market should comply with. JIS Z 0130-3 Reuse, JIS Z 0130-4 Material recycling, JIS Z 0130-5 Energy recovery, and JIS Z 0130-6 Organic recycling are individual standards, stipulating requirements for reuse or recycling. The details in application of the related provisions are shown in the umbrella standard.

The structure of the related JIS standards and relationship are shown in Fig. 1. While chemical recovery processes are shown in a technical report within the ISO standard structure, these processes are now firmly established as important recycling methods in Japan. In the structure of Japanese standards, it is now in the Annex to JIS Z 0130-4 Material recycling, even though it is a MOD (modification of the ISO standard). Similarly, “Report on substances and materials which may impede recycling” is in another technical report in the ISO structure. In Japan, it is in the Annex to JIS Z 0130-4 Material recycling, since it is a report concerning important reference points for the evaluation of compliance to certain requirements given in this standard. Outline of each standard follows.



**Fig 1 Structure and Relationship of JIS**

### **5.1 JIS Z 0130-1 Packaging and the environment—General requirements:**

This standard is an umbrella standard of JIS Z 0130-2 to Z 0130-6 on environmental consideration in packaging, providing for general requirements in applying any of these standards and related procedures as well as how these standards are interrelated.

This umbrella standard indicates which standard to choose and apply in intending to demonstrate that packaging is optimized in terms of weight/volume reduction while inherent package functions are maintained, that packages can be reused (if reuse is claimed), that packages can be recovered and that packaging can be handled properly and safely in recovery and final disposal. Examples of the functions that the packaging should fulfill are shown in Annex A just like the example shown in Table 1.

Table 1 Functions to be provided by packaging

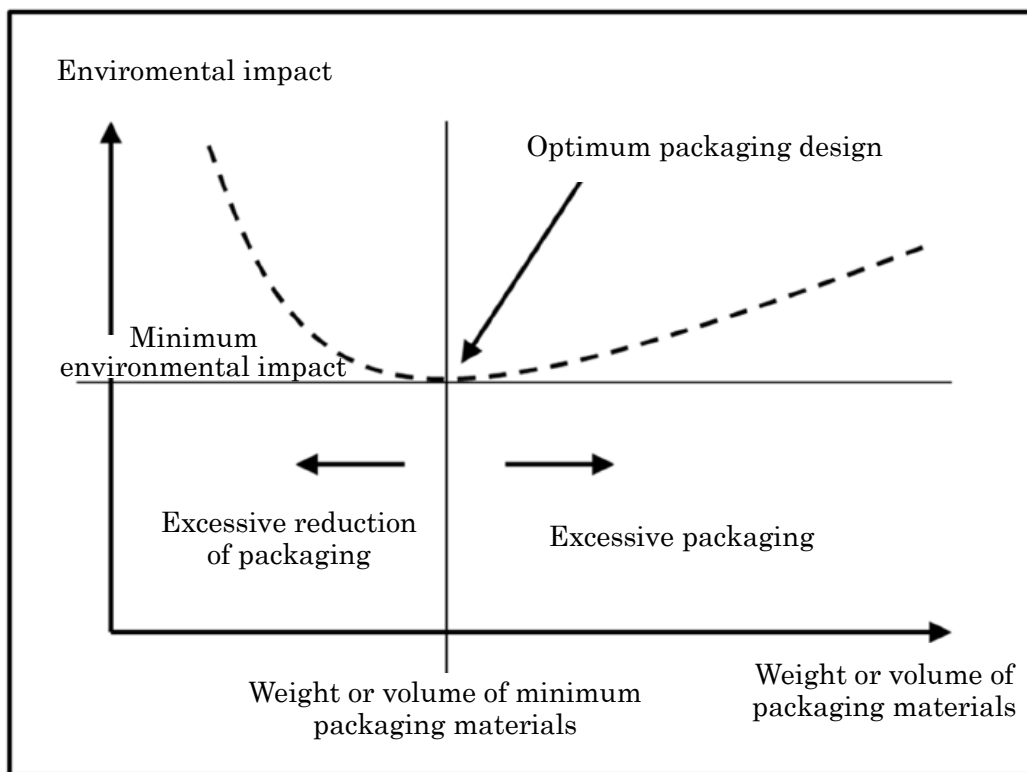
Item	Function
Containment	Containing goods in usable quantities
Protection	Increasing shelf life Preventing breakage (mechanical protection) Preventing contamination, tampering and theft Preventing spoilage Providing a barrier
Handling/Transport	Point of sale display Provision of consumer units Provision of retail and transport units Transport from producer to user
Storage	Safe storage of goods in warehouse, depot, retail outlet or by the user
Convenience	Portioning Product preparation and serving
Information	Contact information Description of product End of life management Legally required information about the product and packaging List of ingredients Nutritional and storage data Opening instructions Product identification Product preparation and usage Promotional messages and branding Safety warnings
Presentation	Identify the product Identify the brand Product features & benefits Promotes the properties of the product

At the beginning of the assessment, the package under review should fulfill the requirements shown in JIS Z 0130-2 Optimization of the packaging system. One of

the requirements stipulates that the existence of four heavy metals (lead, cadmium, hexavalent chromium and mercury) and other substances hazardous to the environment in the packaging should be evaluated in accordance with the guidelines shown in the Annex to JIS Z 0130-2, and that it should be guaranteed that the existence is minimized in compliance with the national and local regulations. Another requirement says that package intended to be reused should fulfill the requirements given in JIS Z 0130-3 Reuse. Also it is stipulated that all packages, whether intended to be reused or not, should satisfy the requirements given in at least one of the three standards—JIS Z 0130-4 Material recycling, 0130-5 Energy recovery or 0130-6 Organic recycling.

### 5.2 JIS Z 0130-2 Optimization of the packaging system

Fig. 2 shows that the impact inflicted on the environment by extreme package reduction would be more serious than the environmental load caused by overpackaging and that it is important for packaging to perform required functions.



**Fig. 2 Optimization of Packaging**

This standard provides for requirements in minimizing the weight or volume of packaging while ensuring to fulfill functions required from packaging and related

procedures to guarantee it. It is required to evaluate all the objective packaging and declare conformity.

The packaging system, i.e. full set of packaging made up of one or more of the following — primary packaging, secondary packaging, transportation and/or distribution (tertiary) packaging—chosen in accordance with the product to be packaged, is to be evaluated. In order to determine the achievable level of packaging optimization, it is required to evaluate the following ten areas based on the guidelines given in Annex A, specify at least one critical area that would exercise influence on the achievable limitation, and optimize it.

Ten areas to assess when determining achievable level of packaging optimization

- protection of goods;
- packaging manufacturing process;
- packaging/filling process;
- logistics (including transport, warehousing and handling);
- presentation and marketing of goods;
- user/consumer acceptance;
- information;
- safety;
- legislation;
- other issues.

This standard also provides for the evaluation method and minimization of substances hazardous to the environment. Determination shall be made as to whether any substances hazardous to the environment exist in the package materials based on safety data sheets (SDS) or other means, concentration shall be measured in an affirmative case, minimization shall be made referring to the procedures shown in Annex C, and these points shall be recorded accordingly. In the same manner, the existence of the four heavy metals ((lead, cadmium, hexavalent chromium and mercury) shall also be minimized, and conformity to the national and local standards shall be confirmed.

### **5.3 JIS Z 0130-3 Reuse**

This standard sets forth the requirements for the determination as to whether the packaging concerned is reusable or not, and also provides for requirements for a system necessary for reconditioning, i.e. recovery, cleaning, repair, etc., as well as assessment procedures.

The requirements given in this standard refer to the following two items:



a) The packer, filler, supplier, emptier or other relevant entities concerned shall be able to demonstrate that the packaging is capable of reuse for the application intended in normally predictable conditions of use;

b) The packer, filler, supplier, emptier or other relevant entities concerned shall be able to demonstrate that a system for reuse, including reconditioning, exists.

This standard lists three types of reuse systems together with applicable standards for each type of reuse system: 1) closed loop system—performed by a corporation or a corporate group; 2) open loop system—made with the packaging specifications agreed to by system participants, the packaging being owned by the then owner within the loop, and 3) hybrid system—reusable packages remain with the last user and are refilled by means of auxiliary products. In our legal structure, however, it is doubtful to include the hybrid system in the reuse systems.

Annex B provides for the items necessary for an original state restoration system, from which appropriate selection and application shall be made as needed.

#### **5.4 JIS Z 0130-4 Material recycling**

This standard stipulates the requirements for the determination as to whether material recycling is possible for the packaging concerned, as well as provides for the procedures required for the assessment of meeting the requirements, and requires the recyclable mass percentage be declared.

Those who put the packaging or packages to the market shall assess the conformity to the material recycling concerning each of the following:

- Control of packaging construction/composition and processing
- Suitability for available recycling technologies
- Releases to the environment caused by the recycling of used packaging

in each packaging lifecycle step in accordance with Annexes A and B. The standards of each Applicable item shown in Table 2 are shown in Annex B.

Table 2 Elaboration of requirements by a decision matrix with interactions between lifecycle steps and criteria for material recycling of packaging

	Criteria for recyclable packaging		
Life cycle steps	Control of packaging construction/composition and processing	Suitability for available recycling technologies	Releases to the environment caused by the recycling of used packaging
Design	Relevant	Relevant	Relevant
Production	Relevant	Relevant	Relevant
Utilization	Relevant	--	Relevant
Sorting by the end-user	Relevant	--	Relevant
Collection/sorting	Relevant	Relevant	Relevant

Annex C shows methods of determining the recyclable percentage of a package unit and examples of statements to be made by standard users.

The chemical recycling process is positioned as Annex JA of this standard, in which chemical recycling methodology of used packages is exemplified. In these standard series, chemical recycling is included in the category of material recycling.

Annex JB “Report on substances and materials which may impede recycling” gives examples of substances and materials that may cause continuous trouble to the recycling activities, in an attempt to help with conformity evaluation to the requirements of this standard. Here are given the substances or materials that cause a problem, impede recycling processes or badly affect the quality of recycled materials for which the development of a technical solution cannot easily be expected in the near future.

### 5.5 JIS Z 0130-5 Energy recovery

This standard stipulates requirements to determine energy-recoverable packaging, and provides for the procedures of assessment of meeting requirements. In order to achieve the optimum energy recovery in an industrial system, calorific gain shall definitely be more than zero.

In combusting used packaging, combusting temperature shall reach the standard

temperature (referred to as “reference temperature”) stipulated in each country or exceed it. Heat gain greater than zero means that the amount of heat obtained when combusting a used package at the reference temperature under the ambient temperature (or environmental temperature) is obviously greater than the heat amount required to heat combustion products, air necessary for combustion and ash from the environmental temperature to reference temperature.

The calculation method is shown in Annex A of this standard, while Annex B presents a step-by-step means to reach the net minimum heat amount from energy recoverable packaging used in the actual industrial system by applying heat amount data of various packaging materials. The calculation results are shown in Table 3. The packaging will be considered to be energy recoverable if the heat amount is greater than the minimum net calorific value shown in the Table.

Heat data of a number of packaging materials can be calculated from published data, so this table is helpful for the determination of energy recoverability.

Table 3 Minimum net calorific value to make energy recoverable (calculated at each reference temperature) (environmental temperature: 25°C, oxygen concentration: 6 %)

Calorific value	Reference temperature ( $T_a$ °C)			
	800	850	900	1 000
Theoretical minimum net calorific value $q_{\text{net,min,theor}}$ (MJ/kg)	1.7	1.9	2.1	2.6
Confidence interval (MJ/kg)	±0.6	±0.6	±0.7	±0.8
Minimum net calorific value <sup>a)</sup> $q_{\text{net,min,real}}$ (MJ/kg)	4.6	5.0	5.6	6.8
<b>Note</b> <sup>a)</sup> $q_{\text{net,min,real}} = [q_{\text{net,min,theor}} + (\text{Positive side confidence interval})] \times 2$				

## 5.6 JIS Z 0130-6 Organic recycling

The industrial-scale organic recycling of used packages is not yet implemented in Japan, but if it is implemented in a certain industrial level as a result of technological development and infrastructure establishment, this standard may become helpful as an objective judgment basis.

This standard stipulates the procedures and requirements for the determination as to whether the package is applicable to organic recycling focused on the following four aspects:

- a) biodegradation;
- b) disintegration during biological waste treatment process (i.e. composting);

- c) negative effects on the biological process;
- d) negative effects on the quality of the resulting compost, including the presence of high levels of regulated metals and other substances hazardous to the environment.

One basic requirement prohibits the intentional use of harmful substances specified in Annex A as well as any component that is likely to be detrimental to the environment.

In order to determine whether the package or its parts is organic-recyclable or not, it is required to proceed with the five evaluation steps, as follows:

- characterization
- biodegradation
- disintegration, including effects on the biological treatment process
- compost quality
- recognizability

The assessment procedure of each of these steps together with requirement are specified with the five basic requirements and six detailed requirements in this standard.

## **6. Conclusion**

The series of JIS of packaging and the environment provides effective means of objective evaluation as to whether the packaging is reusable, recyclable or recoverable while it continues to fulfill the inherent functions as packaging and is minimized in either weight or volume. We are determined to ensure that these standards be effectively used for product development and design and that products with less environmental impact be marketed, and thus to promote these standards to obtain strong support from the society.

*Reported by Japan Packaging Institute*