

Review Article

Analysis of Standard Situation of PSA Tapes in China and Abroad

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Abstract: The establishment organization of standards for PSA (Pressure Sensitive Adhesive) tapes in China and abroad was introduced. International standardization organizations, government agencies or trade associations are engaged in the establishment and revision of PSA tape standards. ISO and IEC are international standardization organizations. CEN is European regional government standardization organizations. SAC, DIN, BSI, JISC are government national standardizations. GTF is an alliance organization in PSA tape field widely participated by the major adhesive tape industry associations. The standards in China were analyzed according to the classification of standards. The classification and distribution of standards in PSA tapes field in China and abroad were reviewed from different perspectives. The standards of PSA tape are classified into fundamental standards, method standards and product standards. At present, there are three fundamental standards in China, and there are no equivalent fundamental standards abroad. Finally, the development trend of standard establishment for PSA tapes in China was expected to speed up the standards development of PSA tape products related to strategic emerging industries. At the same time, actively participate in international standards work, and strive to promote the advanced standards of China to international standards, thus further improving the influence of the standard technology of PSA tape in the world.

Keywords: Pressure Sensitive Adhesive (PSA), PSA Tape, Standard, China, Development Trend

1. Introduction

PSA (Pressure Sensitive Adhesive) is a kind of adhesive which is sensitive to pressure. It is a kind of viscoelastic combination with viscosity property from liquid and elasticity property from solid, and can bear the influence of many factors such as peeling force, cohesive force and anchorage force in the process of bonding. It is a special type of adhesive which can be bonded by finger pressing and easily removed without leaving an adhesive residue [1]. Usually, PSA is not used for bonding directly, and must be applied to a strip substrate to be made into various PSA products (including adhesive tape and label) before using.

The PSA tape is made of pressure sensitive adhesive on a strip substrate. It is usually made up of several components such as pressure sensitive adhesive, backing, primer, release

or release liner. According to the structure of the PSA tape, it can be classified into double-sided adhesive tape, single-sided adhesive tape and transfer tape (tape without backing). According to the chemical composition of PSA used, it can be classified into acrylic type PSA tape, rubber type PSA tape and silicone type PSA tape. Based on the solvent used in pressure sensitive adhesive, it can be classified into solvent based PSA tape, water-born PSA tape and solvent free PSA tape. According to the type of backing used, it can be classified into paper backing PSA tape, filmic backing PSA tape, foam backing PSA tape, metal foil backing PSA tape and so on.

With the growth of the variety of PSA tapes and the expansion of the application field, the number of various standards made by different organizations in China and abroad is increasing. There are some differences among

similar standards made by different organizations [2]. Therefore, this study makes a statistical analysis and summary of the PSA tape standards, in order to promote the revision and renewal of the PSA tape standards in China.

2. Establishment Organization for PSA Tape Standards

2.1. Establishment Organization Worldwide for PSA Tape Standards

The main organizations worldwide participating in the establishment of PSA tape standard are shown in Table 1.

Table 1. The establishment organizations worldwide for PSA tape standards.

Abbreviation	Establishment organization	Abbreviation	Establishment organization
ISO	International Organization for Standardization	AFNOR	Association Française de Normalisation
IEC	International Electrotechnical Commission	JISC	Japanese Industrial Standards Committee
CEN	European Committee for Standardization	ASTM	American Society for Testing and Materials
SAC	Standardization Administration of the People's Republic of China	PSTC	Pressure Sensitive Tape Council
DIN	German Institute for Standardization	AFERA	European Association for the Self Adhesive Tape Industry
BSI	British Standards Institution	GTMC	Global Test Methods Committee
ANSI	American National Standards Institute	UL	Underwriter Laboratories

Among them, ISO is an independent international organization with a membership of 160 national standards bodies. Its members are the foremost standards organizations in their countries and there is only one member per country. Each member represents ISO in its country. Individuals or companies cannot become ISO members. PSA tape related standards issued by ISO mainly include ISO 29862 - 2018 (Self adhesive tapes - Determination of peel adhesion properties), ISO 29863 - 2018 (Self adhesive tapes - Measurement of static shear adhesion) and ISO 29864 - 2018 (Self adhesive tapes - Measurement of breaking strength and elongation at break) [3-5]. IEC is the world's earliest international electrical standardization organization, which is responsible for international standardization in the field of electrical engineering and electronic engineering. At present, there are two main categories of PSA tape standards issued by IEC. One is IEC 60454 (Specifications for pressure-sensitive adhesive tapes for electrical purposes), including general requirements, methods of test, and the specifications for individual materials. The other is IEC 61249.3 (Materials for printed boards and other interconnecting structures - Part 3, printed board and other interconnect structure with third parts of the material), including three standards for polyester tape, polyimide tape and transfer tape, respectively.

The Underwriter Laboratories Inc. (UL) is the most authoritative non-governmental organization in the United States engaged in safety testing and appraisal. The standards for pressure sensitive adhesive tape issued by UL include UL 510 (Standard for Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape), UL 510A (Standard for Component Tapes) and 94 (Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances).

According to Table 1, there are many types of PSA tape standard establishment organizations. These organizations include international standardization organizations, such as the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). There are various governmental organizations, such as the regional or national standardization committees like CEN, SAC, DIN and so on. There are industrial associations for PSA tape or material, such as the American Society for Testing and Materials (ASTM), Pressure Sensitive Tape Council (PSTC) and The European Association for the Self Adhesive Tape Industry (AFERA).

The GTF (Global Tape Forum) and the GTMC (Global Test Methods Committee) are the tape association alliances jointly launched and widely participated by the major adhesive tape industry associations. At present, the participating members are PSTC, AFERA, Middle East and India self adhesive belt industry association, CATIA (China Adhesive and adhesive Tape Industry Association), JATMA (Japanese adhesive tape manufacturing association) and TAAT (Taiwan Regional Association of Adhesive Tape Manufacturers). An important purpose of holding the global adhesive tape forum is to unify the measuring method of PSA tape [6]. Three testing methods were first unified through ISO channel by GTF members. These three testing methods are ISO 29862 (peeling strength test), ISO 29863 (static shear performance measurement) and ISO 29864 (tensile strength and elongation test). The first testing method unified method through GTF channel is the testing method for shear adhesion fail temperature, abbreviated as SAFT [7]. In addition, the measurement method for PSA tape thickness by PSTC/AFERA was approved by other members. It was agreed to designate a GTF standard number for this thickness standard. In addition to the international standard, government agencies such as SAC, DIN, JISC, and PSA tape or materials association (such as ASTM, PSTC and AFERA) have also established standards related to the PSA tapes.

2.2. Establishment Organization in China for PSA Tape Standards

In China, PSA tape originated from the plaster for the pain treatment in the Han Dynasty in the 1600 B. C., but it was not until 1978 when China opened to the outside world that the PSA tape industry in China began to develop rapidly [8]. The first standard of PSA tape in China is GB 2792 - 1981 standard [9], drafted by Shanghai Rubber Products Research Institute.

At present, China's main organizations involved in the formulation of standards for PSA tape are shown in Table 2.

Table 2. The establishment organization in China for PSA tape standards.

Organization Code	Establishment Organization
SAC/TC185	National technical committee for the standardization of adhesives
SAC/TC185/SC1	National technical committee for the standardization of adhesives tapes
SAC/TC51	National technical committee for the standardization of insulation materials
SAC/TC195	National technical committee for light and decoration building materials
SAC/TC462	National technical committee for postal administration standardization
-	State food and drug administration
-	National center for the standardization of light industrial packaging

Most of the domestic PSA tape standards are managed by the national technical committee for the standardization of adhesives (SAC/TC185), and the sub technical committee for pressure sensitive adhesive products (SAC/TC185/SC1) is responsible for the establishment or revision of most of the domestic PSA tape standards. A few standards are managed by the national technical committee for the standardization of insulation materials (JB/T 5658 - 2015, JB/T 5659 - 2015, GB/T 20631.1 - 2006 and GB/T 20631.2 - 2006). The standard established by national technical committee for light and decoration building materials is JC/T 942 - 2004. The standard established by State food and drug administration is YY/T 0148 - 2006. The standards managed by national center for the standardization of light industrial packaging are QB/T 2422 - 1998, QB/T 2423 - 1998, QB/T 2425 - 1998 and QB/T 2426 - 1998. The standards established by national technical committee for postal administration standardization are YZ/T 0160-2017.

3. Classification of PSA Tape Standards

The standards related to PSA tapes can be basically

Table 3. Fundamental standards for PSA tapes.

Standard no.	Title of standard	Implementation date	Equivalent/reference standard
GB/T 22375—2008	Guide for manufacture, application and recycle of pressure sensitive adhesive products	2009-05-01	-
GB/T 22396—2008	Terminology relating to pressure sensitive adhesive products	2009-05-01	-
GB/T 29596—2013	Classification of pressure sensitive adhesive products	2013-12-01	-

3.2. Standards for Test Methods

Test method standards refer to the standards set up to characterize the properties or performance of a PSA tape. They are also divided into test method standards for basic properties and test method standards for special properties.

The basic and main function of PSA tape is bonding. Bonding performance is usually expressed as three mechanical properties shown as magic triangle in Figure 1. Tack is greatly influenced by the wetting capability of the PSA to the substrate, and it reflects how quickly a PSA sticks to a substrate under short contact. Adhesion, or peel strength measures the bonding strength between a PSA and a substrate after applying the pressure necessary to wet the substrate. Cohesion, or shear strength is a measure of the internal or cohesive strength of the PSA. A balanced combination of tack, adhesion and cohesion is required for optimal mechanical performance [1]. The main indicators of backing properties are tensile strength and

classified into three main categories: fundamental standards, method standards and product standards.

3.1. Fundamental Standards

Fundamental standards can be used directly in a certain field, and can also be used as the base for the establishment or revision of other standards, and the compilation of technical documents and books and periodicals. Fundamental standards usually include standardized work guidelines, general technical terms standards and production guidelines. A total of three fundamental standards were established since 2008, as shown in Table 3. At present, there is no similar fundamental standards found outside of China. At the GTF meeting in 2016 [10], it was proposed by CATIA that GB/T 29596 - 2013 standard was used as the standard basis for the classification of global PSA products. The proposal was approved by GTMC to agree with the adoption of similar product classification methods by countries, but the specific classification standards were determined by the organizations of the countries.

elongation rate. Another type of standards for basic properties is related to the dimension of a PSA tape, which determine thickness, width and length of a PSA tape. The main standard institutions both at home and abroad have set up The relevant standards for the three basic bonding properties (tack, adhesion and cohesion properties), tensile strength and elongation rate, and the dimension of a PSA tape. These standards are shown in Table 4.

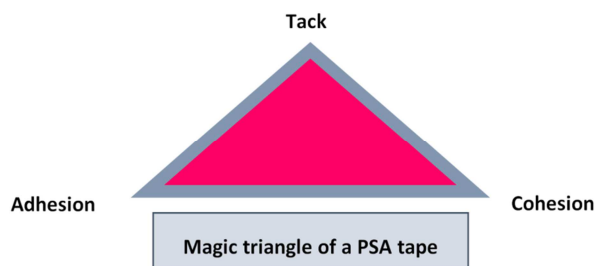


Figure 1. Basic mechanical properties of a PSA tape.

Table 4. Standards for basic properties of PSA tape.

Standard no.	Title of Standard	Implementation date	Equivalent/reference standard
GB/T 4852—2002	Test method for tack of pressure sensitive adhesive tapes by rolling ball	2002-12-01	JIS Z0237—1991
GB/T 2792—2014	Measurement of peel adhesion properties for adhesive tapes	2014-12-01	ISO 29862—2007
GB/T 4851—2014	Measurement of static shear adhesion for adhesive types	2014-12-01	ISO 29863—2007
GB/T 30776—2014	Measurement of break strength and elongate at break for adhesive tapes	2014-12-01	ISO 29864—2007
GB/T 7125—2014	Test method for thickness of adhesive tapes	2014-12-01	-
GB/T 31125—2014	Test method of adhesive tapes—Loop tack	2015-01-01	-
GB/T 32370—2015	Determination of the length and width for adhesive tapes	2016-07-01	-
GB/T 33332—2016	Test method for dynamic shear strength of adhesive tapes	2017-07-01	-

In addition to basic properties, PSA tape must also meet specific application requirements. These special requirements include electrical, flame retardancy, thermal performance, reliability and so on, as shown in Table 5.

Table 5. Standards for special properties of PSA tape.

Standard no.	Title of Standard	Implementation date	Equivalent/reference standard
GB/T 15330—1994	Test method for water penetration rate of pressure-sensitive tapes	1995-10-01	ASTM D3816—1988
GB/T 15331—1994	Test method for water vapor transmission of pressure-sensitive tapes	1995-10-01	-
GB/T 15903—1995	Test method for flame resistance of pressure-sensitive adhesive tapes	1996-08-01	-
GB/T 4850—2002	Test method for unwinding force of pressure sensitive adhesive tapes at low speed	2002-12-01	ASTM D3811—1996
GB/T 32368—2015	Measurement of resistance to elevated temperature and humidity for adhesive tapes	2016-07-01	-
GB/T 33375—2016	Measurement for electrostatic properties of adhesive tape	2017-07-01	-

3.3. Product Standards

Product standards refer to the technical regulations for product structure, specifications, quality and inspection methods. PSAs are used in a wide variety of applications such as adhesive tapes [11], labels, postage stamps [12, 13], paper note pads, transdermal patches [14]. Among the various application of PSAs, adhesive tapes are widely used in medical, electrical, consumer electronics, automotive, rail transportation and smart home industries. In addition to

national technical committee for the standardization of adhesives, others national technical committees for standardization have also established some standards of adhesive tape used in different industries. The main product standards are shown in Table 6. It is known from table 6 that, in addition to national standards, the current industry standards for PSA tape are mainly distributed in the construction, medical, light industry, machinery and chemical industries, and the chemical industry accounts for the majority.

Table 6. Product Standards for PSA Tapes.

Standard no.	Title of Standard	implementation date	Equivalent/reference standard
GB/T 7752—1987	Test method for electric of insulating adhesive tape at power frequency	1987-12-01	-
GB/T 15333—1994	Test method for electrolysis corrosion of electrical insulating adhesive tapes	1995-10-01	-
GB/T 20631.1—2006	Pressure sensitive adhesive tapes for electrical purposes - Part 1: General requirements	2007-04-01	IEC 60454.1—1992
GB/T 20631.2—2006	Pressure sensitive adhesive tapes for electrical purposes - Part 2: Methods of test	2007-04-01	IEC 60454.2—1994
GB/T 22378—2008	Pressure sensitive adhesives tapes of BOPP for general purpose	2009-05-01	-
GB/T 29593—2013	Kraft paper adhesive tape for surface protection	2013-12-01	-
GB/T 30775—2014	Pressure sensitive adhesive tapes of PE protective film	2014-12-01	-
HG/T 2408—1992	Kraft paper pressure sensitive adhesive tape	1994-12-01	-
HG/T 3658—1999	Double-sided pressure sensitive adhesive tape	1999-07-01	JIS Z 1528—1991
HG/T 4139—2010	Release materials for pressure sensitive adhesive products	2011-03-01	-
HG/T 2406—2014	Pressure sensitive adhesive label	2014-10-01	-
HG/T 4914—2016	Over laminated pressure sensitive adhesive tape	2016-07-01	-
HG/T 3949—2016	Masking tape	2017-04-01	-
HG/T 5055—2016	Adhesive tapes for electrode protect in lithium battery	2017-04-01	-
JB/T 5658—2015	PSA tapes for electrical purposes-Polyester film tapes with rubber thermosetting, rubber thermoplastic or acrylic crosslinked adhesives	2015-10-01	IEC 60454.3.2—2006
JB/T 5659—2015	PSA tapes for electrical purposes-Polyimide film tapes with PSA for electrical purposes	2015-10-01	IEC 60454.3.7—1998
JB/T 12168—2015	PSA tapes for electrical purposes - PVC film tapes with PSA	2015-10-01	IEC 60454.3.1—2001
JB/T 12171—2015	PSA tapes for electrical purposes - Polytetrafluoroethylene film tapes with PSA	2015-10-01	IEC 60454.3.14—2001
JC/T 942—2004	Butyl rubber adhesive tape for waterproof and sealing	2004-11-01	-
QB/T 2422—1998	BOPP PSA tape for carton sealing application	1999-07-01	JIS Z 1539—1991
QB/T 2423—1998	PVC insulation tape	1999-07-01	JIS C 2336—91

Standard no.	Title of Standard	implementation date	Equivalent/reference standard
QB/T 2425—1998	Rewet kraft paper tape for carton sealing	1999-07-01	JIS Z 1511—1975
QB/T 2426—1998	Rewet kraft paper tape for plywood	1999-07-01	-
YY/T 0148—2006	Medical adhesive bandages-General requirements	2007-04-01	
YZ/T 0160.1-2017	Postal industry encapsulation tape-Part 1: Traditional adhesive tape	2017-10-01	
YZ/T 0160.2-2017	Postal industry encapsulation tape-Part 2: Biodegradable adhesive tape	2017-10-01	

4. Development Trend of PSA Tape Standards in China

Compared with standards established abroad, the establishment of domestic standards in China started late. From table 3, table 4, table 5 and table 6, it is known that most of the domestic standards are established in late 1980s; but domestic standards have developed rapidly, especially since the founding of PSA sub-committee of national technical committee for the standardization of adhesives in 2008. A large number of fundamental standards, method standards and product standards have been established and revised. At present, the China national government has identified seven strategic emerging industries plans, which also put forward new requirements for the PSA tape standards used in these industries, and will be mainly embodied in the establishment of product standards. The national technical committee for the standardization of adhesives has established a product standard for the PSA tape (national standard establishment plan No.: 20170493-T-606) for the sealing of ground photovoltaic components. In the field of new energy vehicle industry, the standards of insulation and flame retardant adhesive tape for power batteries have also been put on the agenda. In addition, as people pay more and more attention to environmental protection, many product standards have environmental regulations. The standard committee is speeding up the formulation of standards for environmental protection determination and product standards, such as product standards for the protection of adhesive tape and the limits of harmful substances in adhesive tape.

On the international stage of PSA tape standards, China is no longer simply adopting foreign standards. Instead, we actively participate in the work of ISO, GTF and GTMC, and strive to extend our country's unique advanced standards to international standards, which will enable our standards to reach the world level and even lead the world level.

5. Conclusion

The establishment organization of standards for PSA (pressure sensitive adhesive) tapes in China and abroad was introduced. International standardization organizations, government agencies or trade associations are engaged in the establishment and revision of PSA tape standards. ISO and IEC are international standardization organizations. CEN is European regional government standardization organizations. SAC, DIN, BSI, JISC are government national standardizations. GTF is an alliance organization in PSA tape

field widely participated by the major adhesive tape industry associations.

The standards of PSA tape can be classified into fundamental standards, method standards and product standards. At present, there are three fundamental standards in China, and there are no equivalent fundamental standards abroad.

The development trend of PSA tape standards in China is to speed up the standards development of PSA tape products related to strategic emerging industries. At the same time, actively participate in international standards work, and strive to promote the advanced standards of China to international standards, thus further improving the influence of the standard technology of PSA tape in the world.

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