The Tape Buyers Guide

How to find exactly the right adhesive tape for your application, without wasting your time or money

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July 2013

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The Tape Buyers Guide

This guide is written to help the purchasing professional evaluate tape products and suppliers, to get the best deal buying technical products in a sometimes confusing market.

It is especially applicable to double-sided tapes, but much of the information is common to all types of tape.

1) How the Tape Industry is Structured

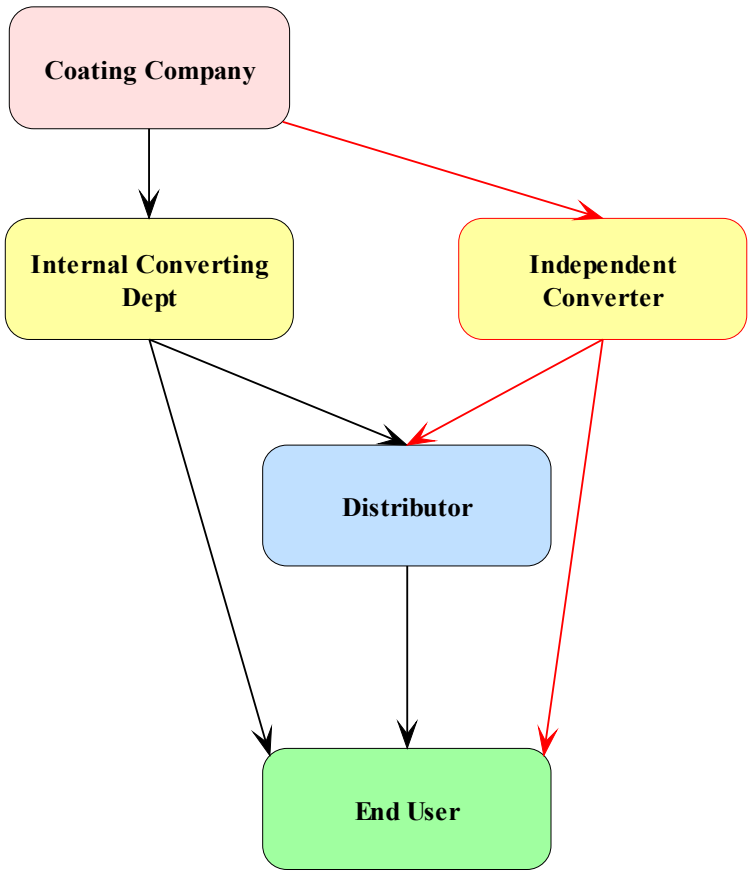
Q: Why do I care?
A: The different routes to market provide different advantages and disadvantages, and depending on your particular needs, some of these will be more important to you than others.

There are three "tiers" of company supplying adhesive tape to users: coating companies, converting companies and distributors, with some overlap between them.

Coating companies coat the wet adhesives on to the various substrates ("carriers") used as the tape base, and interleave a release liner, to produce bulk rolls of tape. Coating companies will typically have an internal converting department of some sort to convert the bulk tape to smaller sizes. They will supply direct to the market or to converters or distributors.

Alongside this, there are independent **converting companies** such as Technibond who specialize in converting bulk or intermediate tapes to customer requirements. They buy from the coating companies and supply direct to users, or to distributors.

Finally there are **distributors**, who stock converted tapes bought from coating companies or converters, and supply to end users. Diagrammatically the routes to market look like this:



In the early days, the route to market was simple. The coating company would slit the bulk product into standard sized rolls, then supply these direct to large users, and to distributors to service smaller users. Some set up extensive distributor networks.

As the industry developed customers became more demanding, the number of tapes increased, and this model no longer met all needs.

From about 1970 a number of independent tape converters started to appear. These companies buy from the coating companies and supply the market alongside the coating companies. Many coating companies took advantage of this by concentrating their sales through these independent converters.

The Coating Company

Photo: © Orafol

Tape coaters range from the well known global brands, to some quite small specialist coaters.

The large companies have a brand reputation to maintain, and quality is usually high. These companies also have significant in-house technical knowledge, but this is mainly for the development and quality control of products and may not easily be available to customers.

Most larger companies will develop and manufacture their own adhesives, some will even polymerize their own polymers. Some will also siliconize their own release liners. Smaller companies will tend to buy in most of these components.

Adhesive coating is a high volume, capital intensive business, so these companies are driven by their coating departments. A modern coating machine is a large and complex piece of equipment. It has rewinds and unwinds that will perform "flying splices" without stopping. There are precision coating heads using different coating techniques depending on the product and weight being coated.

The drying oven will be in many different zones, each with its own temperature and air flow control. There is automatic coat weight control, web pre-treatment and post-treatment, and sophisticated tension control.

Tapes are therefore normally coated in batches of several thousand square metres at a time. Adhesive changes require long periods of unproductive "down time". Companies will try to run all the products using one adhesive, before changing to another adhesive The resulting product is usually conditioned for up to 2 weeks to allow cooling, and for stabilization and cross-linking reactions to take place.

Coating cannot be switched on and off to suit the day to day demands of customers!

Most coating companies therefore operate at least in part via converters and distributors. Some operate exclusively or largely via these third parties, especially outside their home countries, so the products of many coating companies are not available direct to end users.

Best For: Large volumes, standard products and sizes, scheduled deliveries
Limited: **A**vailability, flexibility, speed of delivery, service

The Tape Converter

The tape converter is now an established part of the tape supply chain and some have been in existence for decades (Technibond was established in 1982).

The first companies set up only to produce specialized conversions such as die cut parts that the coating companies could not really offer, especially outside their home territory.

It was soon realized by the companies themselves, their customers and also by the coating companies, that these independent tape converters were a valuable means of supplying a wide range of tapes. They were able to offer more flexibility of size and quantity; better customer support and faster lead times.

Most coating companies are happy to supply bulk tapes to converters, so there may be no price penalty to the end user. Some coating companies have concentrated their resources purely on coating, with little or no conversion, and sell largely through tape converters.

Foreign coating companies will often convert for their home market, but sell exclusively to independent converters to service other countries.

Independent tape converters can source their tape from a much wider range of suppliers than would otherwise be available to end users, and can therefore source very competitively. Most converters offer slit rolls and die-cuts; some also laminate, rewind, sheet and bobbin wind.

A few, such as Technibond, even have their own laboratory for technical support, quality control and to develop new products with the coating companies. These can offer excellent technical support.

If you are dealing with a converter or distributor you may well want to know the source of the material to give you confidence in its quality and reliability.

Best For: Medium to large volumes, flexibility, customer support
Limited: Most have limited technical resources *via* the coating company.

The Tape Distributor

There are three main types of distributor: specialist tape distributors, general industrial distributors, and industry-specific distributors. Some operate nationally or internationally, some operate locally.

General industrial distributors supply a wide range of products, and some have a significant online presence. The product range often depends on the historical origin of the company but may include consumables, trade tools, or office supplies. Specialist tape knowledge is likely to be limited.

Industry-specific distributors supply particular markets, for instance the sign industry or the electronics industry, with all the components required by that industry. They naturally know that industry and its requirements very well, and offer convenience of supply. They probably will not have technical tape knowledge and will only offer a few standard tapes.

Specialist tape distributors are often allied to one or more of the global tape coating companies, which may limit their product range. They do, however, usually have good tape knowledge and experience, with good back-up from the coating company. Many are regional and know their local area and industries well, and can deliver stock product very quickly.

A common feature of all distributors is that they stock rather than convert product so they are limited to standard sizes and formats, unless they deal with a tape converter.

Best For: Fast local service, smaller volumes, "one stop shop" convenience.
Limited: Technical support, product flexibility.

Our Advice: Spend a few minutes to consider what type of company will most likely to be the best for you. Make sure you understand where your current supplier sits. Is he the right type of company for your current and future needs? Do you understand his supply chain?

2) Choosing the Right Company

Q: What do you mean by "Right"?
A: Ultimately, it's what is right for you. But here are some important points to consider.

We suggest you start by asking yourself the following questions:

- How important is the **product performance**?
- What are the **consequences of failure**?
- How **specialized** is your requirement?
- How important is **on-time delivery**?
- How much **tape expertise** do you have in your company?

Product performance and the consequences of failure

There are some tape applications where the performance requirement is very low. Examples may include temporary fixing, other short term applications and "trivial" indoor applications on easy surfaces where no load is involved.

In this case the choice of supplier may be relatively unimportant. Failure is very unlikely to happen and if it does, the consequences will not be serious. Factors such as price and convenience will determine the best supplier and you will be safe in the knowledge that should you be let down, you can quickly and easily re-source from another supplier.

In most applications, performance is important or very important and the reasons for this may include:

- The functional requirements
- Your brand image and market reputation.
- Your customer demands.
- Distribution is complex and recalls difficult.
- The cost of rectifying defective product is high.

The more of these that are relevant to you, the more you need to rely on the professionalism and technical expertise of the supplier. A good supplier should spend time understanding your particular requirements and should be able to explain the basis of his product recommendation and what alternatives are available.

In many cases he should be able to give you test data on your materials. A data sheet alone may not be very helpful and statements such as "this product is equivalent to..." are common but meaningless.

Unfortunately, a "try this product to check that it works" attitude is also common. This is a form of disclaimer in case of later failure. It doesn't tell you whether the next batch will work, whether it will work when the weather gets warm (or cold) and whether it will still be working in a year's time.

If your supplier does not have the technical expertise in house, he should be able to demonstrate the technical support available to him, preferably by a joint visit.

Our advice: Carefully consider how much technical expertise you need from your supplier and how quickly you may need support in an emergency, and be sure that directly or indirectly he can provide it.

How Specialized is your requirement?

The point of understanding this is to know to what extent you are in your supplier's hands and therefore how careful you have to be in selecting that supplier. There are always alternatives; finding an alternative at short notice is another matter.

If you are buying *brand X product Y* from a distributor you have few issues (unless *brand X* suddenly discontinues *product Y*!) as you could source the product from another distributor.

If you are buying a non-standard product or an unbranded product you need to take more care in your choice of supplier as it might be difficult to re-source quickly if he lets you down.

The supply chain and the lead time involved is not generally given much attention, and of course the customer should not have to concern himself with the entire supply chain.

Be aware, however, that many of the essential tape components are always made to order. They are not "off the shelf" components.

All of our release films, for instance, are made to order. The combination of polymer, colour, thickness and silicone formulation is probably unique to us. Other combinations might also give satisfactory results, but due to the number of variations the product is always made to order.

In this example the base film is first extruded, and due to cleaning / changeover times, film extrusion companies run their different colours in a set sequence. Therefore there is a lead time attached to this process.

The extruded film is then conditioned and slit. The slit film is coated on one side with silicone, then conditioned again to cure it to avoid "blocking". The film is siliconized on the second side and finally conditioned, then trimmed and supplied to us.

The total lead time is normally about 6 weeks, but at very busy times it has gone out to 12 weeks or more. We very carefully manage this situation and hold large stocks of critical products, but we suggest you check your own supplier's business and product continuity planning to make sure they do the same. You really do not want to be told that he is waiting for deliveries before he can supply you.

A note about dual sourcing:
Dual sourcing might appear the answer, but there are difficulties. No two products are ever exactly the same, so you should have excellent traceability in case of problems. One of your suppliers is likely to be better and easier to deal with. Why would you want to deal with the poorer one? And if your volume is large, the second supplier would probably not be able very quickly to take up the additional volume in an emergency.

Our advice: If you deal with a converter or distributor give some attention to the supply chain. You may well want to know the source of the material to give you confidence in its

quality and reliability.

How important is on-time delivery?

Naturally, on-time delivery is important. But is it quite important or critically important? And if the goods are going to be late, are you informed in time to re-arrange production?

You may hold sufficient stock, and your own customers may place their orders in sufficient time so that this is not an issue. More and more, however, the whole manufacturing chain is trying to reduce stock and lead times, and orders are placed at short notice. For most of us it is critically important always to supply on time:

- We don't want to lose potential new business
- We don't want to jeopardize existing business
- We don't want to strain customer relations
- We don't want to waste customer time on apologies.
- We don't want to inconvenience the customer to re-arrange his production.
- We **do** want to maintain complete customer confidence in us.

What assurances should you seek from your supplier to minimize the risk of failing to deliver on time? Some of the following may be applicable:

- Guaranteed finished product stock
- Guaranteed raw material stock
- Proven on-time delivery
- Company policies, such as quality policy
- Access to senior management or Directors

Our Advice: if possible always visit your supplier to see the whole operation and meet the key people for yourself. Make sure a professional front does not conceal a shambolic company.

3) Understanding what the Data Sheet means to you

Q: Why do I need to? The product either works or it doesn't.
A: Yes, but it is your purchasing specification. If the product fails, the supplier will judge whether it is faulty or not by whether it conforms to the data sheet. The data sheet can also help you judge value, and whether a competitive quote is really like-for like.

Let's look at the different elements of a typical data sheet.

Product Description

This is generally a summary of the tape construction; the adhesive, carrier and release liner. The description is sometimes very vague. Look in particular at the adhesive. For acrylic adhesives the data sheet should somewhere tell you whether it is pure or modified, if it is cross-linked, and if it is solvent or water based. Many do not.

Beware of qualitative performance descriptions, which are meaningless. We have seen products described as "High Shear", and when we have measured the actual shear performance it was a fraction of our lowest shear product!

Applications / suitability / benefits

The data sheet should be able to guide you as to what uses, materials and conditions the product is particularly suitable for. If well written, this section (or sections) is probably the most useful part of the data sheet as it can give relevant real life information to guide the user.

At best it can tell you that the product is already used for exactly your application. Perhaps more likely, you can match your materials and conditions of use against the product claims and see that the product is designed to cope well with all your needs. At worst, it will be vague and generalized and will offer no useful information.

Bear in mind that due to the number of applications and variables within applications, the data sheet can only ever be a guide to suitability. **We suggest you always speak directly to the company to explain your application to an expert**. Then really challenge the company by asking them to put their recommendation in writing!

NB Technibond also states the limitations of each product, to help the user by warning against conditions where another product might be more appropriate. Few people do this as they wrongly believe that product limitations are product negatives. The fact is, there is no product that is ideal in all situations and the user should be warned against conditions that the tape is not designed for.

The Data

The technical data, the group of quantitative performance measurements, is the heart of the data sheet, but is the area most likely to be misinterpreted.

Firstly, while most companies use standard industry test methods, the methods of implementing and interpreting these adhesive tests varies significantly from company to company. Apparently small differences in the test conditions can easily give measurement differences of 25% or more.

On top of this, differences in interpretation of the test result can in some cases give differences of 50% or more.

And finally, companies differ in how they publish their data. In some cases it is an average, in some cases a minimum figure. Sometimes the figures seem to us rather optimistic. All Technibond data, by the way, is conservative.

It will be clear from this that the same tape, measured by different companies, may well give very different figures on the data sheets.

Our advice: never use technical data to compare products from different suppliers. The only way to compare product performance is side-by-side testing in the same laboratory.

a) Temperature Range

There is no standard for measuring temperature range so these figures are particularly open to interpretation.

The **minimum temperature** is the easiest. Generally, it is the point at which the adhesive hardens to the point of becoming brittle. At that point it won't necessarily fail, but a shock or small force could easily fracture the bond.

The **maximum temperature** is a matter of judgement. All pressure-sensitive adhesives gradually soften and lose performance as the temperature increases. There is no sharp melting point. So we have to judge at what point the adhesive becomes, in effect, useless. That of course depends on the application, and we cannot predict all the applications a product may end up being used for.

Some data sheets give two figures, **short term and long term**. This is applicable to applications such as splicing, where the product goes through an oven at very high temperatures but is only exposed for a few seconds.

In many cases, particularly with film and foam tapes, the temperature may be limited by the carrier rather than the adhesive. The performance at that limiting temperature could vary widely, depending on the adhesive.

Some companies quote a **Shear Adhesion Failure Test (SAFT)** result. This is measured by performing a shear test (see below) in a programmable oven and increasing the temperature at a set rate. At the point of failure, the temperature is recorded. It was introduced to try to take away the subjective element of high temperature testing.

This test is good for comparative purposes, but in our view it can badly mislead users. It greatly overstates the real temperature performance of the tape, as the temperature continues to rise well after the tape has started to fail. The measurement is taken when it completely fails, not when it starts to fail.

Our advice: If high temperature performance is important to you, consult a technically competent supplier and expect to see test results at the temperature you require.

b) Minimum Application Temperature

This is quite different to the minimum temperature described above. It is the minimum temperature at which you can apply the product and still get good results. Once bonded, the adhesive will withstand much lower temperatures.

This is important where the tape, or your taped component, is being applied outdoors or in unheated or poorly heated conditions. Low temperature decreases the adhesive tack. At some point the tack will be so low that it will be very difficult to get a good bond, even with firm pressure.

Unfortunately, again, there is no recognized test method so you need to be able to trust your supplier. Please be very suspicious of claims that the tape can be applied at 0°C or below! Even if it theoretically could, condensation and frost make it very unlikely that you could achieve this in practice. We never recommend application below +5°C.

c) Tack

Tack is how quickly an adhesive wets a surface and builds up its bond strength. A low tack product requires more pressure, more time and warmer conditions to achieve a good bond. In applications where this is not possible, a high tack product may be required.

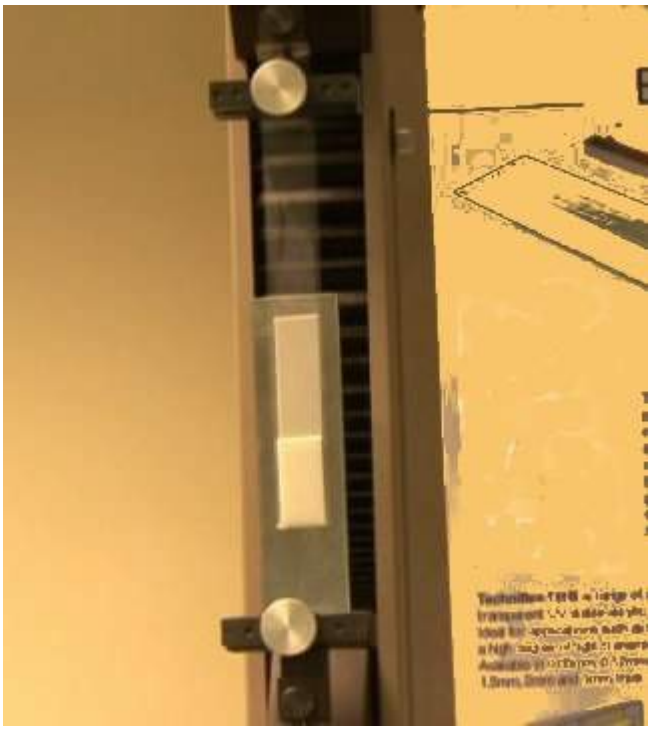
Note: High tack does not equal high bond strength; the opposite is more likely.

Unfortunately, despite its importance, tack is extremely difficult to measure meaningfully. We have extensively researched all the methods of measuring tack. We can quite easily produce figures to show a low tack product outperforming a high tack product! We have been quite unable to find a method that correlates with the real tack of a product.

The test method most widely used in the industry nowadays, **loop tack**, is actually an adhesion test. It does not measure tack.

Our advice: Is tack really important? If it is, ignore the figures and trust your thumb. But do the "thumb test" with a clean thumb at the lowest temperature the product will be used.

d) Adhesion



Also known as "peel adhesion"; 180º peel adhesion; "adhesion to steel".

Adhesion is a **standard test method**. It is intended to measure how strongly the tape sticks to a surface. It is one of two components of bond strength, the other being cohesion (see shear).

This test is made by applying a 25mm wide strip of tape to a standard substrate under standard conditions of pressure and temperature. It is allowed to rest for a standard period of time, then peeled off at a standard speed in a tensile tester, which measures the force produced.

The standard substrate is stainless steel of a particular composition with a particular surface finish. This test plate is used because it can be thoroughly cleaned between tests using quite aggressive solvents without affecting the surface.

Adhesion is a universal test, particularly used for quality control as it is quick to perform and the results are reproducible. From a customer point of view, we have a number of reservations:

- Hardly any of our customers actually want to bond stainless steel, and a tape that performs well on stainless steel will not necessarily perform well on the customer's material.
- The test conditions are all very favourable to the tape. In most applications the tape will be expected to cope with considerably less favourable application conditions.
- The standard test is performed at 23ºC. Most tapes will have to perform at higher temperatures. Even at 30 to 40ºC, the performance will be very different
- A tape almost never fails by being pulled back on itself at an extreme angle. Usually, any failure is caused by peeling at a very low angle, which can give quite different results.
- A tape is never naturally exposed to this sort of fast peel. If a tape fails, it fails by peeling very slowly over a long period of time. Again, this is not comparable.

A supplier should be able to give you guidance on the first three of these and may publish some additional data. We publish data for adhesion at 70ºC. We also perform many tests on other materials, but we do not publish this in data sheets as those materials are not controllable.

We believe the last two points are better investigated by shear tests.

Our advice: if you are starting a new project or looking for an alternative tape, insist on seeing test results <u>on your own material</u>

e) Shear

Also known as "static shear" or "shear adhesion" and also a **standard test**.

The shear test is intended to measure the <u>cohesion</u> of the adhesive, which is the other component of bond strength after adhesion. Treacle has good adhesion, but as a liquid it has little cohesion, so a bond made with treacle will be weak.

Pressure sensitive adhesives are visco-elastic. Generally they behave as rubbery solids, but under sustained stress they can behave as liquids. The cohesion or resistance to liquid flow is therefore a critical property. We believe that shear is usually the most important adhesive property, and certainly it tends to correlate with price.

The shear test is performed by bonding a standard area of tape, 25mm x 25mm, between standard substrates and applying a sustained force to the bond. The test can be performed in two ways. Either a set load is applied and the time to fail is measured, or a the maximum load that the tape can withstand for a specified time, is measured.

The first of these appears more obvious, but tape performance varies so widely they could not all be put on the same scale. A single load would cause one tape to fail very quickly but another tape would last hundreds of hours.

The commonest method therefore is the AFERA method which quotes the maximum load that a tape will withstand for four hours. This is convenient for quality control purposes, and it allows all tapes to be put on a single scale. The drawbacks of this are:

- Four hours is a very short period of time. We expect tapes to last for years not hours. Accelerating failure times to this extent makes comparisons less valid.
- Quite large differences in performance are disguised, and appear as relatively small

differences in figures.

Shear is even more affected by temperature than adhesion. The rate that shear drops with temperature varies enormously between tapes but is always large. In our view all data sheets should quote shear at an elevated temperature as well as at 23°C.

Our advice: if the tape has to support any load long term, view shear as the most important property. In comparing data, remember that 25N compared to 20N is at least a doubling of cohesion, not a difference of 25%. And expect to see shear test results at realistic temperatures for your application.

4) What are you paying for?

Q: I want to pay as little as possible, why should I care how it is achieved?
A: Paying a little more may give quality or productivity savings that outweigh the cost, but expensive components are not always justified.

There are three main components in a double-sided tape:- adhesive, carrier, and release liner. Very roughly, the typical proportion that each contributes to the total tape cost is:

% of cost	Liner	Carrier	Adhesive
Transfer Tape	20 - 40	0	60 - 80
Tissue Tape	20 - 35	15 - 30	35 - 65
Filmic Tape	20 - 25	15 - 25	35 - 75
Foam Tape	20 - 30	25 - 35	35 - 60
Acrylic Tape	5 - 15	85 to 95	

Looking at these in turn, the main options and price implications are:

The Release Liner

Release liners are papers or films that are siliconized on both sides so they remove easily from the adhesive.

Silicones are extremely expensive materials, so the silicone coating is very thin - around 1 gram per square metre, or even less. Yet the silicone coating has to be absolutely perfect, with no streaks, misses or even pinholes. Choice of a quality supplier is essential.

This chart shows the approximate relative cost of the main options:

Liner	**Price Comparison**	**Benefits**
Standard Glassine Kraft Paper	1	Low cost, wide availability
Heavy Duty PE Coated Paper	2 to 2.5	Moisture stable, strong, kiss-cuttable
Plastic Film	1.5 to 2	Moisture stable, flexible and strong

a) Glassine Kraft

Naturally, the cheapest option is the standard so-called glassine kraft paper liner. Most commonly it is a yellow/brown colour, the next commonest is white, other colours are rarer. Actually this paper is not a glassine at all; it is a supercalendered kraft. It is made in bulk by several paper mills, generally in the range 70gsm to 90gsm, 90gsm being the commonest.

This product is economical and functional, and suitable for most purposes. There are two drawbacks:

- Glassine kraft paper is strong in tensile strength but weak in tear strength, so it can tear during removal especially if the edges are nicked by poor slitting or poor handling. It needs to be removed with some care.
- It is very moisture sensitive and is likely to cockle or "pipe" with changes in air humidity. This can be a particular problem in sheets and wide rolls.

b) PE coated paper

PE coated papers are a strong kraft papers coated (usually on both sides) with a thin polyethylene film, then siliconized. The PE coating adds tear strength and it protects the paper from humidity. These products are typically 140gsm and only made by a few paper mills, usually in white or brown. They are sometimes described as "lay flat" papers due to the excellent dimensional stability.

Not surprisingly, these are expensive papers so they tend to be reserved for applications where the good stability is really needed, such as wide width rolls and sheets for diecutting. Because this paper is quite thick and very controlled in thickness, it is ideal for kiss-diecutting. PE coated papers are also used where strength or thickness is important, and the papers have a quality "feel" to them.

Versions in other colours are particularly expensive and here you are paying an additional premium for branding or appearance rather than performance.

c) Plastic Film

Plastic films are generally made from LDPE (low density polyethylene), HDPE (high density polyethylene)or PP (polypropylene).

LDPE is the most flexible film but the most difficult to siliconize and feels very "floppy". HDPE is the most widely used film with good tensile and tear strength. PP is very strong, has slightly better temperature resistance but is less flexible. All the films have very good tear strength and are resistant to moisture.

Plastic films are usually 70 to 120 microns thick (paper is described by weight as it varies in bulk, films are always described by thickness). Naturally, thickness affects cost, but it also positively affects ease of use. Thin films are more difficult for the end user to remove, as they have little rigidity and tend to cling to the adhesive rather than flick off. We use 80 or 90 micron HDPE films on most of our products.

Because films are so strong, they can be removed very quickly in situations where paper may tear. Special techniques can be used to accurately place parts in position before removing the liner (contact us for details). In many applications the relatively small increase in the cost of film compared to paper is amply repaid by increases in productivity.

White or neutral films are the "standard" but various colours are commonly available.

The only drawbacks of films are:

- They are prone to static, and in a production environment the waste film may stick to the operator's hands and clothes rather than drop into a bin. Seemingly trivial, this can cause real frustration. (We apply our own films, slowly and with positive static control, and have largely eliminated this problem)
- There are technical issues with coloured films due to the sensitivity of the silicone curing process. **Please be careful to use technically reliable suppliers when specifying coloured films**.

Our Advice: Only use P E Coated papers if you need to, but consider the benefits that a film may offer in your production, or to your customer.

The Carrier

The carrier is the support onto both sides of which the adhesive is coated. The main carriers are tissue, film, fabric and foam. Tissues and fabrics are porous and act as a single reinforced layer of adhesive. Films and foams are solid which gives the possibility of coating different weights or even different adhesives on the two sides.

Transfer tapes do not have a carrier at all, they are just a coating of adhesive on the release liner.

This chart shows the approximate relative cost of the various options

Carrier	Price Comparison	Benefits
Tissue	1-1.5	Thin, flexible, tearable by hand
Film	1-3	Reinforcing, strong, clear or coloured
Cloth	2-4	Strong, very conformable
Foam	2-5	Gap-filling

a) Transfer Tapes

With no carrier, this should be the cheapest option, and sometimes it is. There are technical difficulties, because the adhesive must always stick to one side of the release paper and not the other, but still easily release from the tighter side later. This needs very careful control of release levels, which adds cost.

Transfer tapes can be very thin, giving good die-cutting and resulting in an invisible bond line. Nowadays, there are thin film double sided tapes that are equally good.

Transfer tapes are also extremely flexible and conformable, and useful for bonding materials such as fabrics and foams where you want to retain the handle or drape or elasticity of the material. In this situation there is no other tape quite as good.

In many cases, however, transfer tapes are used because they always have been!

Drawbacks of transfer tapes are:

- With little strength or integrity, the adhesive film will easily stick to and be ruined by contact with fingers or other materials.
- The roll edges may tend to stick together resulting in "picking" of the adhesive on unwind.
- For the same reasons conversion of the material is difficult and high waste may result.

Our Advice: Use transfer tapes where they are really the best option; otherwise consider a tissue or film tape as an alternative, which will be easier to handle and may be better value.

b) Tissue Tapes

Tissue tape is perhaps the most widely used double sided tape, for some demanding as well as general purpose applications. Most tapes use a specialized paper tissue which limits the use in frequently wet environments, as it absorbs water and may become blackened by mildew growth. Some tapes use a thin synthetic non-woven tissue to avoid this, at a slight premium in price.

In all cases, the tissue becomes impregnated with adhesive during coating, so very low coating weights and therefore very thin tapes are not possible. Tissue tapes, by their nature, cannot be clear. But tissue is excellent where the tape is applied by hand as it can easily be torn. Tissue also does not impose any additional temperature restriction on the adhesive.

Compared to transfer tapes, tissue tapes are reinforced, dimensionally stable and easy to handle.

c) Film Tapes

In comparison to tissue, films are solid and the adhesive sits on the surface of the film. This allows some options not available with tissue. Very low coat-weights and very thin products are possible. Different adhesives can be coated on the two different sides. Perfectly clear tapes are possible.

Films add more strength and reinforcement to the adhesive, and film tapes will reinforce the product they are bonded to, in all directions. They are sometimes used to prevent stretch. At the same time they reduce the conformability of the adhesive, so these tapes are less suitable where the product is or may become concave or convex. Films often impose a temperature restriction on the tape, depending on the film used. These tapes cannot easily be broken by hand; they require scissors or a knife. On the other hand this strength means they can be used, with the right adhesives, for removable tapes.

Three films are commonly used, Polypropylene, Polyester and PVC.

Polypropylene.(PP)

PP is cheap, clear and a good general purpose film, occasionally available in white. It will stretch slightly. PP film is usually limited to about 120ºC.

Polyester (PES)

PES like-for-like is more expensive than PP but it is stronger, often used in thinner grades, so the premium may be slight. Usually clear, it is also available black and occasionally white.

PES is more rigid than PP so it stretches less and is better for die-cutting. It can be used up to 160ºC, or higher for short periods. Unless one of these is important to you, PES and PP are probably interchangeable, and PP is slightly cheaper.

PVC

PVC is a relatively inexpensive film, but is limited to temperatures of 70 to 80°C. It tends to be used in thicker gauges for general purpose applications where gap-filling is required. A combination of thick film and a thick adhesive coating can achieve a total tape thickness of 200 to 300 microns (.2 to .3mm). PVC films can be clear or white.

Our advice on tissue and film tapes: look at the benefits and limitations above and consider whether they are applicable to your application. If not, go for tissue but remain open minded about the options.

Interestingly, individual coating companies tend to favour either tissue or film, and their product range is likely to be much stronger in one than the other. They will often price one more favourably than the other. Looking at direct alternatives from a competitor may not result in the best option for you.

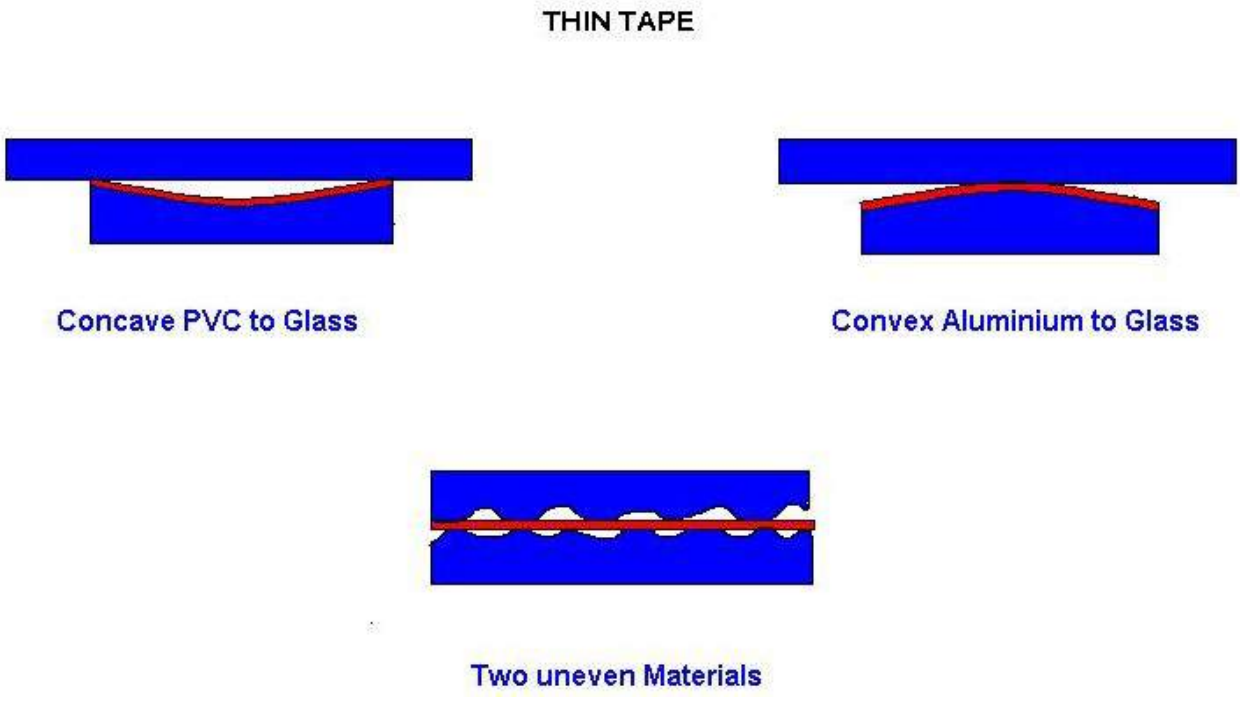
d) Cloth Tapes

These are specialist tapes, based on woven cotton or a woven synthetic material. They reinforce in two directions, but not diagonally. They will prevent stretch and sometimes allow removal. Unlike films, cloth is conformable and can be used on quite uneven materials such as floors. Cloth is relatively thick and requires a heavy coat weight of adhesive, so the adhesives tend to be inexpensive and therefore of low performance (there are exceptions).

e) Foam Tapes

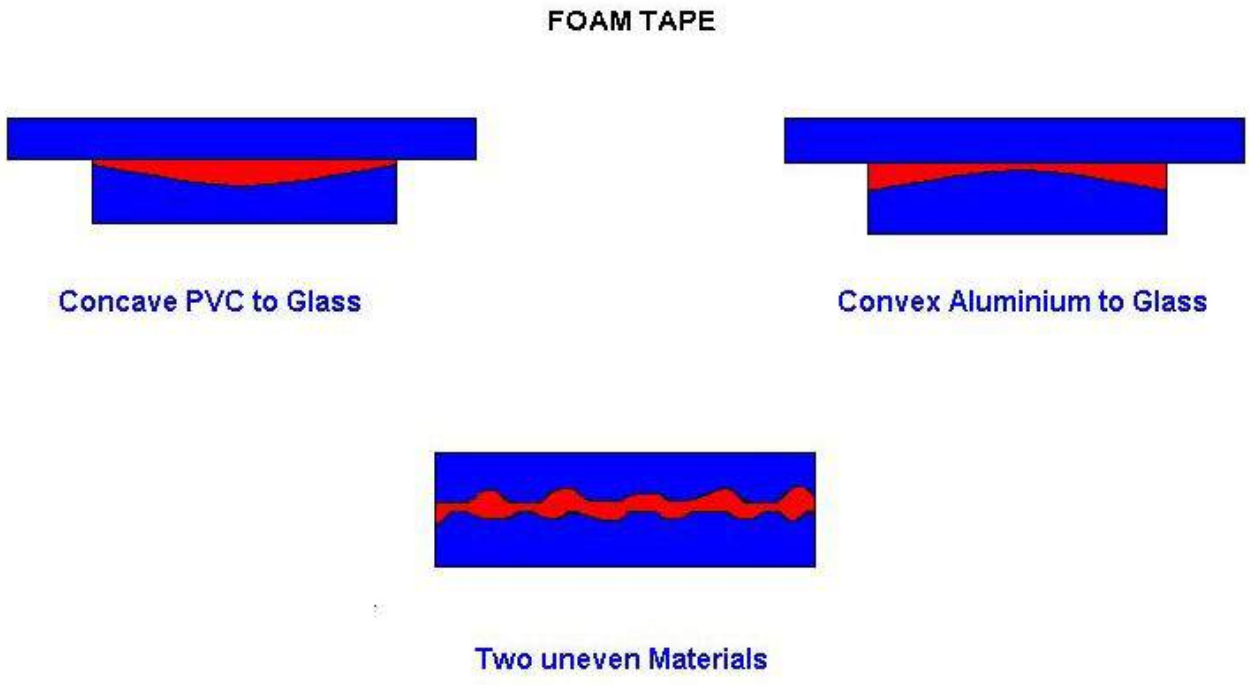
Foam tapes have a specific purpose: filling the gap between two rigid materials. If either one of the materials is flexible, a foam is not normally needed. If both materials are rigid, there is no tape option as effective as a foam tape.

Most rigid materials are not perfectly smooth and even, so thin solid tapes will only bond at the "high" spots. Commonly, only 50% or less contact will be made. A foam tape will achieve close to 100% contact with both materials, giving the full bond strength.



Exceptions where thin tapes can be used include bonding glass to glass, or acrylic sheet ("Perspex") to itself. These materials are genuinely flat.

Gap Filling:



In addition, where two different rigid materials are being bonded together there is likely to be <u>differential movement</u> between them caused by changes in humidity and temperature:

Wood and some other materials will shrink or expand with changes in air humidity.

All materials will shrink or expand with changes in temperature, but different materials will move by different amounts. Plastics move much more than most other materials. Laminates of plastics to non-plastics cause particular problems. These differential movements put great strain on a thin tape, which may eventually fail. Foam tapes are elastic, and can absorb much of this movement.

f) Acrylic Tapes

Note: acrylic tapes have an acrylic <u>carrier</u> as well as an acrylic adhesive. Acrylic adhesives are covered in the next section.

Acrylic tapes were invented by 3M and marketed as VHB™ ("Very High Bond"). The original patents have now expired and many other manufacturers have produced their own acrylic tapes. Unfortunately, many of these are of variable quality and offer poor performance. There are a large number of companies in the Far East purporting to manufacture acrylic tapes. There is also a large amount of inter-trading between companies, and it is often very unclear who the actual manufacturer is. Please take care.

Technibond sells its own acrylic tapes under the brand name Techniflex™. These are coated for us by a long-established company in South Korea who we have been dealing with for many

years. They are high quality products, comparable in performance to 3M's VHB.

Acrylic tapes have in our opinion often been oversold, and in many cases a foam tape would give better results at less cost. The advantages and disadvantages of acrylic tapes compared to foam tapes are:

Advantages of acrylic tapes

- They withstand flexing and movement even better than foam (hence "Techniflex")
- A clear thick bond is possible
- Temperature resistance may be better
- They withstand vandalism and extreme forces, where a foam might split
- They provide a more rigid bond, ideal for stiffeners

Disadvantages of acrylic tapes

- They are much more expensive
- They have rather lower shear than the best foam tapes
- They do not compress easily, which makes application more difficult
- They are difficult to diecut or bobbin wind

Our advice: For some applications, an acrylic tape is the best option, but only if it from a quality supplier. Ask your supplier about the origin of the product, and ask why an acrylic tape has been recommended rather than a foam tape.

The Adhesive

The adhesive is usually the component that contributes most to the total tape cost. It is the component, therefore, that many suppliers will try to cut down on to produce an attractive price, or to maximize their own profits. The buyer should therefore look carefully at exactly what adhesive is being proposed.

- The dry weight costs of different "acrylic" adhesives can vary by a factor of x3
- On top of this, the amount of adhesive on a tape can vary by a factor of x3

So, what does this variation mean in terms of performance?

a) Adhesive weight ("coat-weight")

Generally, more adhesive is better, but you obviously do not want to pay for more than you need.

Increasing the coat-weight has the following effects:

- It somewhat increases the adhesion (up to a point)
- It increases the tack
- It greatly increases the ability to bond to rough or imperfect surfaces
- It tends to improve performance at low temperatures
- It slightly reduces the shear performance

Generally, more adhesive will make the tape easier to apply, and more tolerant of the surface and application conditions. Low coat-weights can perform very well on good clean surfaces, warm conditions and with firm pressure. That gives good results on a data sheet. Unfortunately, the product is more likely to fail in the field if conditions vary from this ideal.

Most suppliers do not publish the coat-weight of adhesive on their tapes, but usually you can approximately determine this for thin tapes by subtracting the carrier thickness or grammage from the total thickness (excluding release liner). Adhesives all have a specific gravity close to 1.0, so the adhesive thickness directly relates to the adhesive weight.

A 210µ tape with a 12µ PES carrier = 200µ adhesive approx
= 200 grams per square metre of adhesive

Most tissues and polyesters are 12µ thick. PP and PVC vary in thickness. This formula will not work for foam tapes.

If you are offered a similar but thinner tape, bear in mind that it is the adhesive that has been reduced. Test it under the worst conditions.

b) Adhesive type

Chemically there are three main types of pressure-sensitive adhesive; silicone, rubber and acrylic.

Silicone Adhesives (silicone rubber adhesives)

These are extraordinary adhesives but they are exceedingly expensive and are limited to applications where their very special properties are required:

- **Adhesion to very low energy materials such as silicone release liners, silicone rubber.**
- **Performance to very high temperatures, above 150ºC up to 250ºC.**
- **Performance down to extremely low temperatures, below -40ºC down to -100ºC.**
- **Performance under extreme UV light or more intense radiation.**

Rubber Adhesives

Rubber adhesives were the first type of pressure-sensitive adhesive to be developed. Rubber is actually a physical definition not a chemical type. By definition, silicones and even acrylics are also rubbers. In our industry, however, rubber usually means an adhesive based on Isoprene (such as natural rubber) or butadiene (such as SBR). Natural rubber is rarely used nowadays, and modern polymers often also contain Styrene, a crystalline plastic, that adds strength.

Isoprene and butadiene are both "dienes" indicating a double chemical bond. This double bond is vulnerable to attack by agents such as oxygen and UV light. This is an inherent weakness in most rubber adhesives. The styrene component is vulnerable to attack by solvents, which is why they usually also have very poor resistance to plasticizers and solvents.

All rubbers have to be blended with tackifying resins to turn them from a marginally tacky rubber into an adhesive, so they are often called rubber-resin adhesives. The resin reduces the temperature resistance of the rubber.

Traditionally these rubber adhesives were dissolved in solvent to form a solution that could be coated on various substrates - "solvent rubber". In a more modern development, the adhesive is

melted and coated as a hot liquid - "hot melt (rubber)".

The solvent versions are slightly more expensive than the hot melts because of the cost of solvent and the cost and speed of coating. There is a more important difference. Hot melt manufacture and coating damages the rubber due to the high shear involved and oxidation of the hot polymer. A solvent adhesive will always give better performance than a like-for-like hot melt. In practice, hot melt coating is often used where lower performance is acceptable, using cheaper formulations. Solvent coating is used where better performance is required. Solvent coated tapes are often significantly more expensive than hot melts because they use much more expensive formulations.

Acrylic Adhesives

Acrylics are now the dominant tape adhesives. In contrast to rubbers, acrylic polymers contain no double bonds and are much more resistant to the effects of oxygen and UV light. That does not make them completely immune from such effects! In addition, acrylics do not need tackifying, they are self adhesive by nature. Such "pure" acrylics can give the highest performance of all but silicone adhesives.

Acrylics fall into two main groups, solvent acrylics and dispersion (emulsion) acrylics. Solvent acrylics are well developed adhesives with one particular feature: they can be cross-linked. This chemical reaction adds massive cohesive strength to the polymer, increasing its shear and temperature resistance sometimes to very high levels. Dispersion acrylics are far cheaper - perhaps half the cost of solvent acrylics - but they have two disadvantages. They cannot effectively be cross-linked, and they retain a sensitivity to water. Both types have their uses, but you should be clear which type you are being offered as the performance is very different.

Acrylics are also often tackified, like rubbers, with the addition of resins even though they are already tacky. These are often called "modified acrylics". Resin modification applies to solvent and dispersion acrylics and has the following effects:

- It reduces the shear strength and temperature resistance.
- It reduces the solvent and plasticizer resistance.
- It improves the tack, and therefore the ability to bond well in more difficult conditions.
- It improves the ability to bond to low surface energy materials.
- It reduces the cost.

The following table summarizes the performance of the four main acrylic groups and the two rubbers:

	Solvent	**Dispersion**
Pure Acrylic	Shear: Very High Temperature: Very High Solvent Resist: Very Good UV Resist: Very Good Water Resist: Very Good Bond to LSE: Limited Cost: High	Shear: High Temperature: High Solvent Resist: Medium UV Resist: Very Good Water Resist: Medium Bond to LSE: Limited Cost: Medium
Modified Acrylic	Shear: High Temperature: Very High Solvent Resist: Good Water Resist: Good Bond to LSE: Good	Shear: Low to Medium Temperature: Medium Solvent Resist: Fair Water Resist: Medium Bond to LSE: Good

	Cost: Medium	Cost: Low
Rubber	**Solvent** Shear: High Temperature: Medium Solvent Resist: Poor Water Resist: Good Bond to LSE: Very Good Cost: Medium	**Hot Melt** Shear: Medium Temperature: Low Solvent Resist: Poor Water Resist: Good Bond to LSE: Very Good Cost: Low

General Advice:

Indoor Applications: Consider rubber adhesives. They may be unfashionable, but a quality rubber adhesive can give very good performance.

Outdoor Applications: Go for a solvent acrylic. You might get away with a dispersion acrylic but we wouldn't take the chance.

Low Energy Surfaces: Rubbers are best, modified acrylics are second best.

High Temperatures: Solvent acrylics are best, but look at the individual data sheets.

Low Temperatures: Application at low temperatures depends on the exact formulation: see the individual data sheets
For use at low temperatures once bonded, pure acrylics are best. We would avoid rubbers.

General Purpose: Solvent modified acrylics are a great compromise that will perform well in most conditions.

Lowest cost: Look at hot melt rubbers and modified dispersion acrylics.

Last Words

A report like this cannot cover everything but it should hopefully achieve two things. It should give you a good understanding of tapes and the tape industry, and it should arm you against over-optimistic sales people. The right tape used properly will always give good results. The wrong tape may give good results while conditions are in its favour, but fail suddenly when conditions, or a combination of conditions, turn against it. The right tape used wrongly will probably fail.

If you have chosen a good supplier you will be in good hands. The product will have been carefully chosen, knowing all your needs. It will arrive on time, be well presented, and will perform correctly. If something does ever go wrong the problem will be quickly diagnosed and solved.

If you need any further information there is much more available on our web site and particularly our technical pages or you can get free no-obligation advice on **01628 642800.**

I hope you've received good value from this report, and I am always keen to receive feedback and suggestions for improvement.

Best regards,

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