

Tape Structure. Brother's laminated tapes consist of six layers of materials, resulting in thin, yet extremely strong labels. Characters formed with thermal transfer ink are actually printed onto the underside of a laminate. Sandwiched between two layers of PET (polyethylene) film, the characters are virtually indestructible.

Abrasion Resistant. Tapes were tested with a weighted (1kg) sand eraser device. After 50 "round-trip" passes, the tapes lamination was only slightly scratched. The characters underneath were completely unaffected.

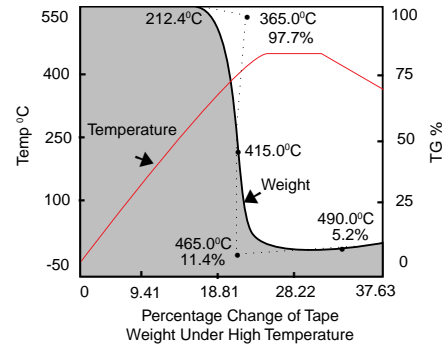
Dielectric Strength. In tests, white P-Touch tapes with black characters began to lose their electric resistance at an applied voltage of 8kv, and lost their resistance entirely at 11kv. Most other color variations will have a similar resistance. However though they meet the majority of Japan Industrial Standards for electrical insulator tape, P-Touch tapes are not designed to be used as electrical insulation, and Brother recommends that they not be used as such. It is important to note that tapes with "metallic" (gold, silver) backgrounds or characters contain aluminum, and that tapes with black backgrounds contain carbon, and therefore have lower dielectric strength than the standard color styles.

Tapes	(a) (mm)	(b) (kV)	(c) (k,V/mm)	(d) (kV)
Black on White	0.110	11	100	8
Black on Gold	0.110	6	55	4
Black on Silver	0.110	6	55	5

- (a) Tape's Thickness
- (b) Dielectric Breakdown Voltage
- (c) Dielectric Strength for 1mm in thickness (a)/(b)
- (d) The Maximum Voltage which can be applied before the insulator ruptures

Taking the Heat. Brother's P-Touch tapes retain their integrity even at extremely high temperatures. Tapes were placed in an analysis chamber. Then, starting at room temperature, the chamber was heated at a rate of 20°C increase per minute. Decomposition of the tapes did not begin until the temperature reached 365°C. In other words, under general working environments the tapes will retain their form and readability. Tapes began to decompose more rapidly before and after temperature reached 415.5°C. People often ask about using P-Touch tapes in conjunction with Diazo copy machines and

with laminators. Copying an original document with a label attached will not cause problems with a Diazo machine. However, attaching a label to Diazo output may be difficult, due to the outputted document's wetness or coatings. As for lamination machines, extreme heat and pressure can cause the label's structure and printed characters to be damaged. For this reason, items with P-Touch labels attached should not be fed through a laminator.



Adhesive Strength. A label that falls off ceases to perform its function. Anybody who has experience using embossed stiff films knows that their reduced surface adhesion area decreases the tape's ability to cling to items.

Adhesion to Various Materials. First, Brother tested their tapes' adhesive strength under ordinary conditions when applied to various materials. Though the exact forces required to remove the labels varied, the finding was that in a general working environment, even after handling, P-Touch tapes will remain affixed.

	Adhesive Strength (gf/12mm)
Stainless Steel	780
Glass	730
PVC	880
Acrylic	700
Polypropylene	340
Polyester Coated Wood	650

Adhesive Strength: gf/12m: Required Force to remove 12mm wide tapes

Adhesion After Exposure to Heat and Cold. Next, tapes attached to stainless steel slightly roughened with abrasive paper were heated and cooled. After two hours in -50°C, a force of 710 gf was required to remove the P-Touch tape. No change in tape or adhesive color had occurred. Heating, on the other hand, actually increased the tapes' adhesive strength, due to a slight softening and spreading of adhesive. After two hours in 200°C though, the tape's white backing and adhesive had slightly discolored.

	Adhesive Strength (gf/12mm)
-50°C x 2 Hours	710
200°C x 2 Hours	1100

Adhesion in High Temperature & High Humidity. The combination of high temperature and high humidity was no problem for Brother's tapes. The highest adhesion strength of any test were registered after the tapes' exposure to 40°C temperatures and 5% salt water baths. No change in ink color occurred, and no adhesive was left behind when tapes were removed.

	Adhesive Strength (gf/12mm)
40°C Distilled Water x 24 Hours	1440
40°C 5% Salt Water x 24 Hours	1560

Objects: Stainless Steel rubbed with
abrasive paper #280

	ADHESIVE STRENGTH (gf/12mm)
SPEULAR GLOSS STAINLESS STEEL	560
STAINLESS STEEL RUBBED WITH A.P. #280	780
STAINLESS STEEL RUBBED WITH A.P. #240	750
STAINLESS STEEL RUBBED WITH A.P. #180	710
STAINLESS STEEL RUBBED WITH A.P. #120	730
STAINLESS STEEL RUBBED WITH A.P. #80	660

Chemicals & Water. P-Touch tapes, attached to glass slides, were bathed in a variety of materials for two hours. Despite some changes in appearance and structure, all tapes remained affixed to their slides.

Adhesion to Rounded Objects. Adhesion strength on rounded objects was also tested. Tapes were attached to stainless steel poles of various diameters, prepared with #280 abrasive paper. The poles were then placed in a variety of environments. On tightly-rounded, 8mm-diameter poles, after 24 hours in 65°C and 80% humidity, some labels' ends pulled up slightly from the pole up (up to 3mm), and in a few cases, the background tape remained attached while the laminate pulled up (i.e. some tape separation occurred). In both normal and cold temperatures, even on the 8mm-diameter poles, no loss of adhesion was noted. More importantly, on all poles with larger diameters (from 12mm to 24mm), no loss of contact between label and pole resulted.

TOULENE	Slight adhesive swelling Slight puffing of tape and laminate
HEXANE:	No noticeable change
ETHANOL:	Slight adhesive swelling Slight puffing of tape
ETHYL ACETATE:	Slight adhesive swelling Slight puffing of laminate
ACETONE:	Some adhesive dissolving Slight puffing of laminate
1.1.1 TRICHLOROETHANE:	Slight adhesive swelling Slight puffing of laminate
MINERAL SPIRITS:	Slight adhesive swelling Slight puffing of laminate
WATER	No noticeable change in structure Very slight weakening of adhesive
0.1N HCl:	No noticeable change in structure Very slight weakening of adhesive
0.1N NaOH:	No noticeable change in structure Very slight weakening of adhesive

Changes of Appearance and
Structure in Various Chemicals

ENVIRONMENTAL CONDITION	PEELING AMOUNT			
	ADHESION PROBLEM	1 MM OR LESS (0.04" OR LESS)	1-3 MM (0.04"-1/8")	3MM OR MORE (1/8" OR MORE)
65°C x 24 HOURS	SEPARATED	20%	50%	0
	DETACHED	20%	0	0
23°C x 24 HOURS	SEPARATED	0	0	0
	DETACHED	0	0	0
-20°C x 24 HOURS	SEPARATED	0	0	0
	DETACHED	0	0	0

Percentage of tapes which detached from substrate or
separated on 8mm (1/3") - diameter poles

Adhesion to Rough Surface. The last adhesion tests addressed the issue of surface roughness. Stainless steel samples were prepared using a variety of abrasive paper weights. Roughening the surface actually increased the Brother tapes' adhesion strengths.

Also, though soaking labels in chemicals for two hours caused some changes, rubbing P-Touch labels with cloths soaked in those same chemicals had no effect on the tapes. This implies that even if chemicals are spilled on the P-Touch tapes, quick wiping should prevent damage. Here, Brother's laminated tape technology clearly protects the printed characters.

Fading Resistance. Brother's laminated tapes of various background colors were attached to coated metal plates (similar to a car's surface), and placed in a fade-inducing chamber at 83°C. They were left for 100 hours to simulate a year in sunny surroundings. Afterwards, measurements of the change in reflective strength (ΔE) were taken, with results as shown: Only yellow tape showed significant fading. The other background films, though yielding measurable ΔE s, were not overly affected to the eye. Ink remained basically unchanged and all characters were still completely legible.

TAPES' BACKGROUND	FADE -O- METER		
	20 HOURS	50 HOURS	100 HOURS
CLEAR	0.09	0.06	0.26
WHITE	0.13	0.11	0.16
RED	0.30	0.46	0.74
BLUE	0.80	0.82	0.52
YELLOW	1.14	2.32	4.13
GREEN	0.32	0.29	0.91
GRAY	0.52	0.71	1.09
BLACK	0.24	0.11	0.35

Next, tape samples were placed in a sunshine weather-o-meter at 63°C for 400 hours. They were subjected to not only heat and light, but also water, to simulate a year of outdoor conditions. Again, yellow tapes were the most affected, with these results:

TAPES' BACKGROUND	WEATHER -O- METER		
	100 HOURS	200 HOURS	400 HOURS
CLEAR	1.94	2.58	3.78
WHITE	1.13	1.99	3.54
RED	0.79	1.58	2.47
BLUE	1.56	2.08	4.37
YELLOW	3.02	4.82	6.27
GREEN	1.09	1.52	3.32
GRAY	1.24	1.54	2.28
BLACK	0.70	1.35	2.58