

**Cable Tie Kits in Plastic Boxes—
KP-506A/KP506A-0
Cable Ties and
Accessories Kit**



KP-509 Designer's Kit



**Cable Tie Kits in Steel
Boxes—
K-504 Cable Ties and
Accessories Kit**



**K-205 Cable Ties and
Terminal Kit**



Part Number	Part Description	Std. Pkg. Qty.
KP-506A	INDOOR Kit Contents in Plastic Box: (100) PLT1M (100) PLT1.5I (100) PLT2S (50) ABM2S-A Mounts	1
KP-506A-0	OUTDOOR Kit Contents in Plastic Box: (100) PLT1M-0 (100) PLT1.5I-0 (100) PLT2S-0 (50) ABM2S-AT-0 Mounts	1
KP-509	Contains cable ties and wiring accessories for prototyping and new product development. Contains over 600 pieces including <i>PAN-TY™</i> Cable Ties (in various styles, sizes, colours, and materials) along with a variety of cable tie mounts (25), wiring accessories (30).	1
KB-550	<i>PAN-TY™</i> Cable Tie Bag contains: <u>Natural Nylon 6.6</u> (15) PLT1M (15) PLT1.5I (15) PLT2S (15) PLT3S <u>Black Weather Resistant Nylon 6.6</u> (10) PLT1M-0 (10) PLT1.5I-0 (10) PLT2S-0 (10) PLT3S-0	1
KB-551	<i>DOME-TOP™</i> Barb Ty Cable Tie Bag contains: <u>Natural Nylon 6.6</u> (15) BT1M (15) BT1.5I (15) BT2S (15) BT3S <u>Black Weather Resistant Nylon 6.6</u> (10) BT1M-0 (10) BT1.5I-0 (10) BT2S-0 (10) BT3S-0	1
K-504	Kit contents: <u>Natural Nylon 6.6 Cable Ties</u> (100) PLT1M-C (100) PLT1.5I-C (100) PLT2S-C (100) PLC2S-S10-C (1) STS2 Installation Tool <u>Mounts</u> (100) TM2S8-C (100) ABM2S-A-C	1
SR2	2-drawer slide rack to hold K-504 cable tie kit or K-1000 series terminal kit	1
K-205	Kit contains: (1) Steel kit box (1) GTS cable tie installation tool (1) CT-100 crimping tool <u>Natural Nylon 6.6 Cable Ties</u> (100) PLT1M-C (100) PLT1.5I-C (100) PLT2S-C <u>Terminals</u> (100) PV18-6LF-C (100) PV14-8LF-C (100) PV14-10LF-C (50) PV10-10LF-L <u>Splices</u> (50) BSV10X-L (100) BSV14X-C (100) BSV18X-C	1

Cable Tie Installation Tools

The *PANDUIT* Selection... *PANDUIT* offers the greatest selection of job-matched tools:



Tool Controlled Tension and Cutoff Tools



Pneumatic Tool Controlled Tension and Cutoff Tools



Operator Controlled Tension and Cutoff Tools



PAT1M/PAT1.5M Automatic Cable Tie Installation Systems

Choosing the right tool increases productivity...

Whatever the need; Original Equipment Manufacturer (high, medium, low volume), maintenance/repair or construction; *PANDUIT* has the tool to help lower your total installed cost. The following chart can be used as a guide for tool selection:

Tool	Cable Tie Cross Section	Cable Tie Usage		Operation	Typical Application (s)
		Per Minute	Per Year		
GTS	Submin. Min., Int. or Std.	4-6	Under 50,000	Hand	Low to Medium Volume OEM tie usage, maintenance/repair or construction
GS2B	Min., Int. or Std.				
GTH	Std. Lt. Hvy. or Hvy.				
GS4H					
GS4H/B	Std., Hvy. Std., Lt. Hvy. or Hvy.				
GS4H121W					
GS4EH	Lt. Hvy., Hvy. or Ex. Hvy.				
STS2	Min., Int. or Std.	1-4	Under 10,000	Hand	Maintenance/repair or construction
STH2	Std., Lt. Hvy. or Hvy.				
ST2EH	Lt. Hvy., Hvy. or Ex. Hvy.				
PTS	Submin., Min., Int. or Std.	5-8	Up to 250,000	Pneumatic	Medium to High Volume OEM tie usage where a variety of tie sizes are needed
PPTS	Min., Int. or Std.				
PPTEH	Lt. Hvy., Hvy. or Ex. Hvy.				
PAT1M/PAT1.5M Systems (Automatic)	Min.	30-40	250,000 and above	Pneumatic/Electric	High Volume OEM tie usage

Hand-Operated Tools — Tool-Controlled Tension and Cut-Off






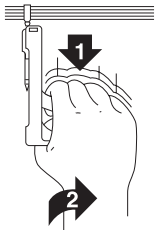


- *PANDUIT* cable tie installation tooling ensures quick, secure cable installations. Tool-controlled tension allows ties to be installed without abrading or damaging cable.
- Requires no special maintenance
- Lightweight and balanced
- High reliability
- Easy to change tension adjustment and easy to operate
- Proven features to help lower installed costs; a combination of design, operating, and construction features provides a long service life
- Provides a comfortable grip and handle for all hand sizes
- Engineered to promote worker safety, reduce downtime, increase productivity, and provide the lowest total installed cost
- Replacement blade and accessories available see page 53
- Installs *PANDUIT* Cable Ties up to 12.7mm wide

	Part Number	Part Description	Std. Pkg. Qty.
	GTS	New ergonomic design. Installs Subminiature, Miniature, Intermediate and Standard cross section cable ties. Qualified Product Listed per Mil. Std. MS90387-1 and Mil. Spec. MIL-T-81306A. Colour Identification: Black Trigger Handle Body: Grey Polymer Housing with Black Selector Knob Weight: 249g	1
	GS2B	Installs Miniature, Intermediate and Standard cross section cable ties. Qualified Product Listed per Mil. Std. MS90387-1 and Mil. Spec. MIL-T-81306A. Colour Identification: Black Trigger Handle Body: Grey Metal Housing with Black Selector Knob Weight: 327g	1
	GTH	New ergonomic design. Installs Standard, Heavy-Standard, Light-Heavy and Heavy cross section cable ties. Colour Identification: Red Trigger Handle Body: Grey Polymer Housing with Red Selector Knob Weight: 318g	1
	GS4H	Installs Standard, Light-Heavy and Heavy cross section cable ties. Qualified Product Listed per Mil. Std. MS90387-1 and Mil. Spec. MIL-T-81306A. Colour Identification: Red Trigger Handle Body: Grey Metal Housing with Red Selector Knob Weight: 454g	1
	GS4H/B	Installs Light-Heavy and Heavy cross section cable ties. High tension is factory set and non-adjustable. Colour Identification: Blue Trigger Handle Body: Grey Metal Housing Weight: 454g	1
	GS4H121W	Installs Light-Heavy and Heavy cross section cable ties. Provides greater tension, especially on 778N strength ties, for a tighter bundle. Colour Identification: Green Trigger Handle Body: Grey Metal Housing with Green Selector Knob Weight: 454g	1
	GS4EH	Installs Light-Heavy, Heavy and Extra-Heavy cross section cable ties. Colour Identification: Blue Trigger Handle Body: Grey Metal Housing with Blue Selector Knob Weight: 454g	1

Hand-Operated Tools — Installer-Controlled Tension and Cut-Off



- Economical Series of Tools for maintenance or construction applications
- Operator-controlled tension and cut-off
- Used with the full line of *PANDUIT* Cable Ties
- Excellent tool for low volume applications

Part Number	Part Description	Std. Pkg. Qty.
 <p>STS2</p>	<p>Installs Miniature, Intermediate and Standard cross section cable ties. Inexpensive, maintenance-free, all purpose tool. Ergonomic handle design and short handle span. Top loading feature for right or left-handed users.</p> <p>Colour Identification: Black Weight: 71g</p> 	1
 <p>STH2</p>	<p>Installs Standard, Heavy-Standard, Light-Heavy and Heavy cross section cable ties. Inexpensive, maintenance-free, all purpose tool. Ergonomic handle design and short handle span. Top loading feature for right or left-handed users.</p> <p>Colour Identification: Red Weight: 71g</p> 	1
 <p>ST2EH</p>	<p>Installs Light-Heavy, Heavy and Extra-Heavy cross section cable ties. Durable all steel construction with comfortable rubber handles.</p> <p>Colour Identification: Black Handles Weight: 454g</p> 	1



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Pneumatic Hand Tools — Tool-Controlled Tension and Cut-Off

PANDUIT pneumatic tools tension and cut off excess tie after it is hand-installed around the bundle, minimising operator fatigue. Tools are rugged, yet lightweight.



For PANDUIT Cable Ties up to 12.7mm wide

- Easy to change tension adjustment
- Requires no special training to use
- Durable, lightweight, easy to operate, and designed to reduce operator fatigue
- Tensions and cuts off excess tie in a fraction of a second
- Operates on non-lubricated air, without special maintenance

	Part Number	Part Description	Std. Pkg. Qty.
	PTS	Pneumatic hand tool. Operates on 4.8 – 6.1 bar, non-lubricated air without special maintenance. Installs the following cable tie cross sections: Subminiature (36N); Miniature (80N); Intermediate (178N); Standard (222N) Weight:17.3 oz. (490g); Grey plastic moulded housing; Black Trigger Button; Black Selector Knob.	1
	PPTS	Installs Miniature, Intermediate, or Standard cross section cable ties Colour identification: Black Selector Knob Weight: 427g Replacement part kits can be part of a scheduled maintenance program	1
	PTH	Pneumatic hand tool. Operates on 4.8 – 6.8 bar, non-lubricated air without special maintenance. Installs the following cable tie cross sections: Standard (222N); Heavy-Standard (378N); Light-Heavy (534N); Heavy (778N) Weight: 32.0 oz. (907g); Grey plastic moulded housing; Red Trigger Button; Red Selector Knob.	1
<p>Filter Regulator and Hose</p> 	PPH10G	3m hose assembly with 3.2mm male connector (to regulator) and a 15.5mm quick disconnect socket (to tool).	1
	MK06	Filter / Regulator 4 micron (max) element, 0.5 bar pressure drop @ 6.3 bar pressure and 260 litres flow per minute @ 6.3 bar. The MK06 comes with: > on the left site a DIN push-in connector. > on the right site a Series C Fitting suitable for 6/4mm hose (PPH10G) Use with PTS and PTH.	1

Note: PTS, PPTS and PPTH tools require the PPH10G hose and MK06 Filter/Regulator for proper operation.



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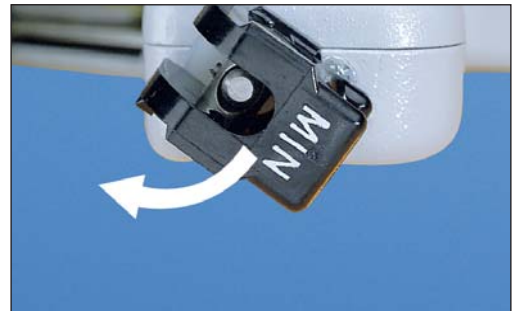
Adjustment Features

Each cross section of cable ties can be installed with a variety of tensions to meet the application. The proper tension range is marked on each package of cable ties.

Fast and Easy Selection



GTS Tool — Tension Setting Dial



GS2B Tool — Tension Setting Knob

Tool Tension Lock Kits

Certain applications require a locking device on the selector knob (one cross-section size and tension only).

Part Number	Part Description	Std. Pkg. Qty.
KGSTL	Tool Tension Locking Kit for GTS Tool	1
KGHTL	Tool Tension Locking Kit for GTH Tool	1
KPTSTL	Tool Tension Locking Kit for PTS Tool	1
TTLK3	Tool Tension Locking Kit for use with GS-family tools.	1

Repair Parts

Can be part of a scheduled maintenance plan or use only when cutoffs are not clean and crisp.

Tool Repair Parts - Blade Replacement and Gripper Replacement Kits

KGTSBLD	Blade Replacement Kit for GTS/PTS Tool	1
KGTHBLD	Blade Replacement Kit for GTH Tool	1
K2-BLD2	Blade Replacement Kit for GS2B and PPTS (all versions)	1
K4H-BLD	Blade Replacement Kit for GS4H Series (3-screw blade guard only)	1
K4EH-BLD	Blade Replacement Kit for GS4EH Series	1
KPTEHB	Blade Replacement Kit for PPTEH	1
KPTEHG	Gripper Replacement Kit for PPTEH	1
KPTSG	Gripper Replacement Kit for PPTS	1
KST2EHG	Gripper Replacement Kit for ST2EH	1



**GHH —
HOLSTER**

Hand Tool Accessory

GHH	Specifically designed to hold GTS and GS (series) or PPTS tool. Used wherever the hand tools are used — construction sites to assembly lines for a convenient and handy place for the the tool.	1
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PAT1M/PAT1.5M Reel-Fed Systems for Miniature Cross Section Cable Ties – 80N minimum loop tensile strength



- The system consists of the tool head, dispenser, feeder hose and continuously moulded, reel-fed cable ties (5000 ties per reel). Each system will install a cable tie in less than one second
- Choice of two tool head sizes for bundle diameters up to 21mm or up to 33mm
- The dispenser and hose are designed to operate with either tool head for maximum versatility and economy
- The system design permits complete mobility in the use of the tool and location of the dispenser
- The system operates on 4.42bar. (minimum) non-lubricated, filtered air and 100 - 240 VAC, 50 or 60 Hz - Automatically adjusts within this range
- Optional bench mount shown on page 55
- Choice of 3 materials

Tool Heads



Dispenser



Feeder Hose



Other Components



Part Number	Part Description	Std. Pkg. Qty.
PAT1M	Tool head for cable ties up to 21mm bundle diameter (PLT1M-XMR). <ul style="list-style-type: none"> • Lightweight - no counter-balance required. • Slim ergonomically designed handle for operator comfort and greater productivity. • Reduces potential for repetitive motion injuries. • Right or left hand operation. • Durable, one-piece cable tie tip collector (for cut-off tips). • Includes tension adjustment. • Built-in safety interlock prevents false triggering if anything obstructs jaw path. 	1
PAT1.5M	Tool head for cable ties up to 33mm bundle diameter (PLT1.5M-XMR). <ul style="list-style-type: none"> • Lightweight - no counter-balance required. • Slim ergonomically designed handle for operator comfort and greater productivity. • Reduces potential for repetitive motion injuries. • Right or left hand operation. • Durable, one-piece cable tie tip collector (for cut-off tips). • Includes tension adjustment. • Built-in safety interlock prevents false triggering if anything obstructs jaw path 	1
PDM	Stationary dispenser for 100 VAC 120 VAC and 230 VAC. <ul style="list-style-type: none"> • LCD display monitors performance. If an error occurs, an alarm is sounded. • On-line HELP menu. • Multi-language capability via LCD display (English, Spanish, German, Italian or French). • Cable tie reels are easily loaded into the dispenser, reducing downtime. • Audible reload signal when reel is empty. • Minimum maintenance required. • Power cord included. 	1
PHM1	1m, 2m and 3m Feeder Hose <ul style="list-style-type: none"> • Transfers cable ties and signal from dispenser to tool. 	1
PHM2	<ul style="list-style-type: none"> • Available in three lengths for either tool head. • Reversible. 	1
PHM3	<ul style="list-style-type: none"> • Large electrical connectors for quick, easy and secure connections. 	1
HS3X	Filter/regulator 25 micron (max.) element, 0.3bar (max.) pressure drop @ 5.8bar pressure, and 425 litres per minute flow @ 5.8bar; 9.5mm ports. Air hose from filter/regulator to dispenser, 3m. Includes standard air fittings.	1

PATMBM Bench Mount used with PAT1M/PAT1.5M Automatic Systems for Miniature Cross Section Cable Ties (80N) minimum loop tensile strength



For Operations Where the Application is Brought to the Tool

- Used with either PAT1M or PAT1.5M tool head
- Supplied with a foot-actuated pedal to allow operator to work with both hands
- A tool can be installed in the mount in seconds
- Supplied with a four-hole base plate
- The bench mount operates on 4.4bar non-lubricated, filtered air which pilots off of the dispenser.

In addition to tool head, dispenser, feeder hose and cable ties on reels; order the following:

Part Number	Part Description	Std. Pkg. Qty.
PATMBM	Bench mount and foot pedal for PAT1M/PAT1.5M system, four-hole base plate.	1

Cable Ties for PAT1M/PAT1.5M Systems

Continuously moulded cable ties in sizes, colour and material options to meet the application.



Cable Ties on Reels



- Miniature cross section cable ties
- Self-Locking
- UL Recognized & UL Listed

Part Number	Colour	Max. Bundle Dia.	Length	Width	Min. Loop Tensile Str.	Use with PANDUIT Installation System
		mm	mm	mm	N	

Nylon 6.6 for indoor use up to 85°C

PLT1M-XMR	Natural	21	102	2.5	80	PAT1M
PLT1M-XMR1	Brown					
PLT1M-XMR2	Red					
PLT1M-XMR3	Orange					
PLT1M-XMR4	Yellow					
PLT1M-XMR5	Green					
PLT1M-XMR6	Blue					
PLT1M-XMR7	Purple					
PLT1M-XMR8	Grey					
PLT1M-XMR10	White					
PLT1.5M-XMR	Natural	33	142			PAT1.5M

Weather-Resistant Nylon for outdoor use up to 85°C

PLT1M-XMR0	Black	21	102	2.5	80	PAT1M
PLT1.5M-XMR0		33	142			PAT1.5M

Heat Stabilised Nylon for indoor use up to 115°C

PLT1M-XMR30	Black	21	102	2.5	80	PAT1M
PLT1.5M-XMR30		33	142	2.5	80	PAT1.5M

Weather Resistant Nylon

PLT1M-XMR00	Black	21	102	2.5	80	PAT1M
PLT1.5M-XMR00		33	142	2.5	80	PAT1.5M

Flammability Rating: UL94V-2, ATB < sec. per ASTM-D635
5,000 ties/reel - 2 reels/ctn.



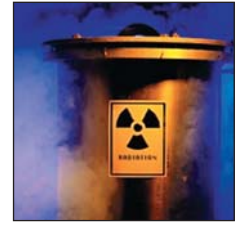
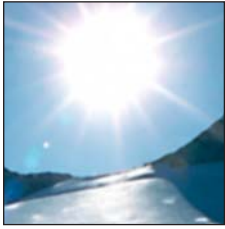
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Selecting the Proper Cable Tie Material for Your Application



By using this information as a guide, the user will be better equipped to select the best suited cable tie and material to perform its intended function over a long period of time.

For long life and dependable service, there are many factors to consider when selecting the proper cable tie for each application. Since it is impossible for *PANDUIT* to provide data on all the various combinations of conditions which may arise, it is suggested that this data be used as a guide. Sample cable ties should be tested under actual end-use conditions to determine the correct cable tie for the application.

To select the optimum cable tie for a specific application, the following table can be used as a quick reference. First, determine the most critical design criteria and then read across the table to find which material is most suitable to meet this need (10 = Most Suitable and 1 = Least Suitable). Next, review the other criteria by scanning in a vertical direction on the chart and then make your final selection.

Design Criteria	Natural Nylon 6.6	Weather Resistant Nylon 6.6	Heat Stabilised Black Nylon 6.6	Heat Stabilised Natural Nylon 6.6	Heat Stabilised Weather Resistant Nylon 6.6	Flame Retardant Black Nylon 6.6	Flame Retardant Nylon 6.6	Weather Resistant Nylon 12	Natural Polypropylene	Weather Resistant Polypropylene	TEFZEL [®]	HALAR [®]	Weather Resistant Acetal	Stainless Steel *
Part Number Suffix Material Designation	None	-0	-30	-39	-300	-60	-69	-120	-109	-100	-76	-702Y	N/A	N/A
Loop Tensile Strength	7	7	7	7	7	7	7	6	5	5	7	5	9	10
Low Temperature Service	6	6	6	6	6	5	5	6	6	6	7	7	6	10
High Temperature Service	5	5	6	6	6	5	5	5	5	5	8	7	3	10
Flammability	6	6	6	6	6	8	8	3	2	2	9	9	2	10
Ultraviolet Resistance	1	6	4	1	6	1	1	7	1	6	9	9	9	10
Radiation Resistance	3	3	3	3	3	3	3	4	5	5	9	9	3	10
Overall Chemical Resistance	6	6	6	6	6	6	6	8	8	8	10	10	5	9
- Hydrocarbons	9	9	9	9	9	9	9	9	6	6	10	10	9	10
- Chlorinated Hydrocarbons	7	7	7	7	7	7	7	8	5	5	10	10	8	10
- Acids	2	2	2	2	2	2	2	6	9	9	10	10	2	10
- Bases	7	7	7	7	7	7	7	7	9	9	10	10	2	8
- Salts	3	3	3	3	3	3	3	8	10	10	10	10	4	9
Relative Price	Low	Low	Low	Low	Med.	Med.	Med.	Med.	Low	Low	High	High	Med.	High

*See page 64 (Table C) for chemical resistance of 304 & 316 stainless steel.

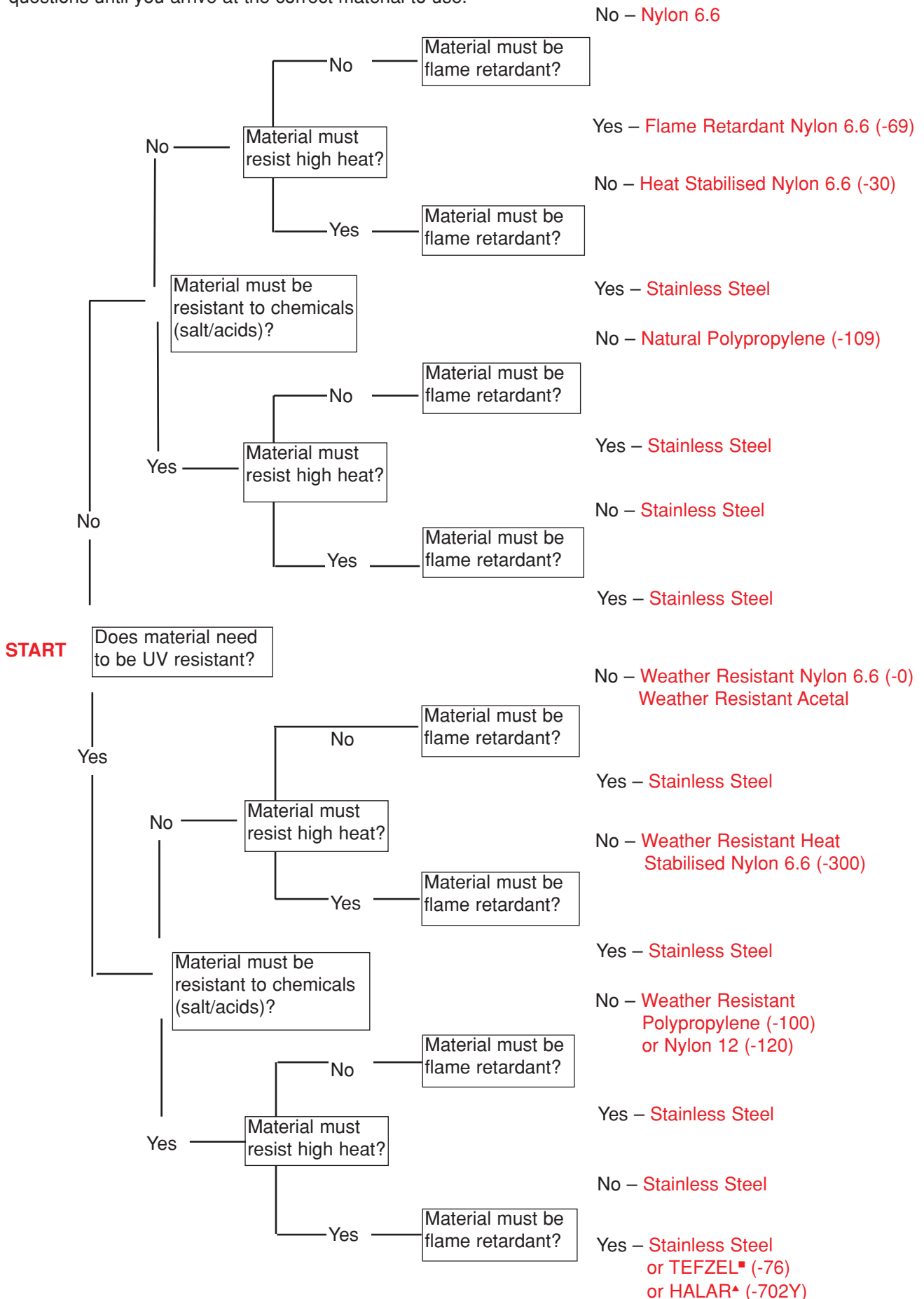
Example No.1:

Application	Selection
If the application requires high radiation (2 x 10 ⁸ rads) resistance, excellent resistance to hydrocarbons and the price is not critical.	The best choice is TEFZEL, HALAR or stainless steel. The price is higher than other materials, but both have high ratings in resistance to radiation and hydrocarbons.

Example No.2:

Application	Selection
If the application requires a low cost material, good ultraviolet resistance and good resistance to acid rains	The best choice is weather resistant polypropylene. Cost is low; it has a rating of 6 in ultraviolet resistance and a rating of 9 in resistance to acids.

To select the proper cable tie for your application, start at the left of the chart and answer the "Yes" and "No" questions until you arrive at the correct material to use.



▲ HALAR is the Registered Trademark of Solvay Solexis, Inc.
 ■ TEFZEL is Registered Trademark of E. I. DuPont de Nemours Co.

Weathering

Ultraviolet (which is a component of sunlight) attacks, over a period of time, most plastic materials and reduces their properties by breaking the molecular chain. The material breakdown is accompanied by reductions in tensile strength and elongation, increased brittleness, colour changes and loss of surface gloss.

Carbon black, which is used in *PANDUIT* nylon and polypropylene cable ties, is one of the most effective stabilisers known today. A uniform dispersion of carbon black provides good ultraviolet light resistance without adversely affecting physical properties. The addition of carbon black, or any other ultraviolet light stabilizer, prolongs the useful life of plastic products used outdoors, but it does not totally eliminate the destructive effects of the light. Some plastics, such as TEFZEL[■] or HALAR[▲], are intrinsically very resistant to ultraviolet light and do not require stabilising additives.



Weathering Test Methods

In order to monitor the effects of ultraviolet light and the effectiveness of the ultraviolet stabilizers, *PANDUIT*, in conformance with industry standards, adopted two methods of weatherability testing: Outdoor Ageing and Accelerated Weather Ageing.

Outdoor Ageing

The Outdoor Ageing method is probably the best and most realistic method of the two. It is conducted in accordance with ASTM D1435 Standard Practice for Outdoor Weathering of Plastics, and allows the material to be affected by not only ultraviolet light, but by all other outdoor elements as well. Although this may more closely approximate an actual application, two drawbacks do exist. The period of time required to produce property decay and material failure may be quite long, and varying adverse chemical environments cannot be tested.

Accelerated Weather Ageing

Accelerated weathering tests are conducted to estimate the rate of degradation due to a combination of ultraviolet light, temperature and moisture. The methods used are in accordance with the following standard:

- ASTM D1499, Operating Light and Water Exposure Apparatus (Carbon-Arc type) for exposure to plastics
- ASTM G53, Operating Light and Water Exposure (Fluorescent U.V. Condensation type) for exposure of non-metallic materials

The condition specified in ASTM D1499 utilises a carbon arc to simulate natural sunshine and a water spray. The test chamber is operated 20 hrs/day with a two hour cycle of 108 minutes of simulated sunshine and 12 minutes of sunshine and water spray. The temperature of a black body inside the chamber is approximately 63°C during the "Sunshine Only" portion of the cycle. Humidity is not controlled inside the chamber.

The test chamber per ASTM G53 uses fluorescent sun lamps to generate ultraviolet light only. A heated water pan produces condensation during a portion of the cycle. The daily cycle is composed of 20 hours of light followed by 4 hours of condensation. Black body temperature during the light cycle are 50°C and 40°C during the condensation cycle.

PANDUIT has also designed a special chamber which is used to simulate the effect of acid rain and ultraviolet light on cable tie materials. The effect of other common chemicals, such as road salt, are also evaluated in this chamber.

These methods are effective in quickly determining the ultraviolet light resistance of the various cable tie materials, but it must be emphasised that there are no exact correlations between accelerated ageing and actual outdoor exposure.



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Material Failure Testing

Property decay can lead to three different modes of failure: loss of strength, loss of toughness or change in appearance. The critical mode for any given application would depend upon the application and the requirement it places upon the material itself.

Loss of strength is monitored by tensile testing samples of the material before and after it has been weathered. This test will reveal the decreasing strength accompanied by extended weathering.

Loss of toughness can be monitored by measuring changes in elongation and impact strength. As ultraviolet light exposure time increases and the material becomes brittle, its elongation and impact strength are greatly reduced. It is important to note that brittle failure can occur even when the tensile strength shows no change.

Although change in appearance is normally not a failure mode for cable ties, the plastic does tend to discolour and lose its surface gloss as exposure increases. These changes can be measured by colour difference using Adams units which are similar to National Bureau of Standard units.

PANDUIT has its own weathering test programme to determine estimated life of various cable tie materials. This includes examining many previously aged samples obtained throughout the world.

In all cases, the amount of property decay increased with increasing exposure to ultraviolet light. The principal signs of degradation were found to be brittleness, cracking and loss of surface gloss. It was also determined that the time for failure to occur was shorter than indicated from industry tests performed on material samples. This discrepancy is in part due to the fact that cable ties were tested in an end use, stressed condition, while most plastic resin suppliers conduct weathering tests using unstressed test bars.

Four cable tie materials (TEFZEL[®], HALAR[®], Weather Resistant Acetal and Stainless Steel) have superior ultraviolet light stability, which have to be considered. These factors are listed below and should be considered before specifying a cable tie material.

Determining the outdoor life expectancy of any material is difficult since there are other factors, besides ultraviolet light stability, which have to be considered. These factors are listed below and should be considered before specifying a cable tie material.

Table A - External Factors Which Affect the Life of a Cable Tie

FACTORS	DECREASED LIFE
Chemicals	Applications which have chemicals present can reduce the life. This is the most detrimental factor to the life of a tie
Bundle Diameter	As the bundle diameter is reduced, the tie has more bending stress. A thick strap on a small diameter has more stress.
Loading	If the tie is under high loading, this will add additional stress on the tie body
Thickness	A thinner tie will have a decreased life since surface cracks will penetrate the thickness of the tie faster
Vibration	Applications with high vibrations will cause impact which will propagate any surface cracks.
Degree of Exposure	No shield or shade, southern exposure, higher altitudes and high temperatures decrease the life of the cable tie.
Moisture	Dry environments cause nylon 6.6 ties to become more brittle. High humidity plus high temperatures can result in degradation due to hydrolysis in nylon.
Galvanised Metals	Acid rain and acid moisture acting on galvanised metals release chemicals known to attack nylon 6.6.

WEATHERING LIFE EXPECTANCY	
Materials (P/N Suffix)	Years*
Natural Polypropylene (-109)	1
Natural Nylon 6.6	1-2
Flame Retardant Black Nylon 6.6 (-60)	1-2
Flame Retardant Nylon 6.6 (-69)	1-2
Heat Stabilised Black Nylon 6.6 (-30)	4-5
Heat Stabilised Natural Nylon 6.6 (-39)	1-2
Weather Resistant Nylon 6.6 (-0)	7-9
Heat Stabilised Weather Resistant Nylon 6.6 (-300)	7-9
Weather Resistant Polypropylene (-100)	7-9
Weather Resistant Nylon 12 (-120)	12-15
TEFZEL [®] (-76)	>15
HAFLAR [®] (-702)	>15
Acetal	>20
Stainless Steel (MLT prefix)	>30

*Based on assumption of minimum loading, no chemical attack and impact-free conditions.

Flammability

A number of test procedures have been developed which can be used for the evaluation and comparison of various materials to support combustion.

UL94 Vertical Burning Test

Samples of a material, with dimensions 127mm by 12.7mm and the thickness of the intended end use product, are tested in an unaged “as manufactured” state and in an aged state 7 days at 70°C. The test requires the placement of a precisely controlled flame under a vertically supported specimen for a 10 second period. The flame is removed and the duration of flaming is recorded. If the flame extinguishes, the specimen is immediately subjected to a second 10 second ignition period. Duration of flaming is again recorded. A piece of surgical cotton is placed under the specimen. If drips ignite the cotton, this fact is also recorded.



MATERIALS CLASSIFIED 94V-0

Materials classed 94V-0 shall:

- Not have any specimens which burn with flaming combustion for more than 10 seconds after either application of the test flame
- Not have a total flaming combustion time exceeding 50 seconds for the 10 flame applications for each set of five specimens
- Not have any specimens which burn with flaming or glowing combustion up to the holding clamp
- Not have any specimens which drip flaming particles that ignite the dry absorbent surgical cotton located 305mm below the test specimen
- Not have any specimens with glowing combustion which persists for more than 30 seconds after the second removal of the test flame

MATERIALS CLASSIFIED 94V-1

Materials classed 94V-1 shall:

- Not have any specimens which burn with flaming combustion for more than 30 seconds after either application of the test flame
- Not have a total flaming combustion time exceeding 250 seconds for the 10 flame applications for each set of five specimens
- Not have any specimens which burn with flaming or glowing combustion up to the holding clamp
- Not have any specimens which drip flaming particles that ignite the dry absorbent surgical cotton located 305mm below the test specimen
- Not have any specimens with glowing combustion which persists for more than 60 seconds after the second removal of the test flame

MATERIALS CLASSIFIED AS 94V-2

Materials classified 94V-2 shall:

- Not have any specimens which burn with flaming combustion for more than 30 seconds after either application of the test flame
- Not have a total flaming combustion time exceeding 250 seconds for the 10 flame applications for each set of five specimens
- Not have any specimens which burn with flaming or glowing combustion up to the holding clamp
- Be permitted to have specimens that drip flaming particles which burn only briefly, some of which ignite the dry absorbent surgical cotton placed 305mm below the test specimen
- Not have any specimens with glowing combustion which persists for more than 60 seconds after the second removal of the test flame

ASTM D 635

Samples of a material, with dimensions 125mm by 12.5mm and the thickness of the intended end use product, are tested in an unaged "as manufactured" state. A precisely controlled flame is applied to the specimen and a stopwatch is started. The flame is applied for 30 seconds. The stopwatch is stopped when burning or glowing combustion ceases or when the flame has proceeded to a mark 100mm from the free end. Ten specimens are tested.

Burning Rate

- If two or more specimens have burned to the 100mm mark then Average Burning Rate (cm/min.) shall be reported as the average of the burning rates of all specimens which have burned to the 100mm mark

Average Time of Burning and Average Extent of Burning

- Average time of burning and average extent of burning of the samples shall be reported if none of ten samples or no more than one of twenty specimens have burned to the 100mm mark

- Average Time of Burning (ATB): • Average Extent of Burning (AEB):

$$ATB,s = \frac{\sum_0^N [\text{time(sec)} - 30(\text{sec})]}{N}$$

Rounded to the nearest 5 sec.

$$AEB,mm = \frac{\sum_0^N [10(\text{mm}) - \text{unburned length(mm)}]}{N}$$

Rounded to the nearest 5mm

N = Number of Specimens Tested

Flammability Ratings

Materials	UL94	ASTM D635
Natural Nylon 6.6	94V-2 @ 0.71mm	AEB = 20mm ATB = 5 seconds
Weather Resistant Nylon 6.6 (-00)	94V-2 @ 0.71mm	AEB = 20mm ATB = 5 seconds
Weather Resistant Nylon 6.6 (-0)	94V-2 @ 0.71mm	AEB = 20mm ATB = 5 seconds
Heat Stabilised Nylon 6.6 (-30)	94V-2 @ 0.71mm	AEB = 20mm ATB = 5 seconds
Heat Stabilised Natural Nylon 6.6 (-39)	94V-2 @ 0.71mm	AEB = 20mm ATB = 5 seconds
Heat Stabilised Weather Resistant Nylon 6.6 (-300)	94V-2 @ 0.71mm	AEB = 20mm ATB = 5 seconds
Flame Retardant Black Nylon 6.6 (-60)	94V-0 @ 0.81mm	AEB = 15mm ATB < 5 seconds
Flame Retardant Nylon 6.6 (-69)	94V-0 @ 0.81mm	AEB = 15mm ATB < 5 seconds
Weather Resistant Nylon 12 (-120)	Not Recognised	Ave. Burning Rate 1.6 cm/min.
Natural Polypropylene (-109)	Not Recognised	Ave. Burning Rate 2 cm/min.
Weather Resistant Polypropylene (-100)	94 HB @ 0.94mm	Ave. Burning Rate 2 cm/min.
TEFZEL [▪] (-76)	94V-0 (1.6mm)	AEB < 15mm ATB < 5 seconds
HALAR [▲] (-702)	94V-0 (1.6mm)	AEB = 15mm ATB < 5 seconds*
Weather Resistant Acetal (DT Series) (-0)	94 HB (1.5mm)	Ave. Burning Rate 2.8 cm/min.
Stainless Steel (MLT prefix)	Not Applicable	Not Applicable

* Rating based on 3.2mm thick test samples

Radiation

Installed cable ties of various materials have been exposed to different amounts of radiation to determine the maximum acceptable limit. These tests were conducted by *PANDUIT* mainly to determine the acceptability for use in various areas of nuclear power plants (accumulated over 40 year life). See Table B (Page 63) for radiation resistance rating.



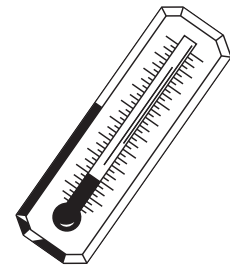
Moisture

Many plastics when exposed to high humidity absorb water and, as such, the tensile strength of the material can change dramatically. Nylon 6.6 when exposed to 100% relative humidity, will absorb as much as 8.5% water which will reduce tensile strength by 50% when compared to a dry cable tie. Polypropylene, HALAR[▲], Type 12 Nylon, TEFZEL[■] and Acetal are low water absorbing materials and, as such, the effect of water is minimal. See Table B (Page 63) for moisture absorption.



Temperatures

Plastic materials normally undergo property loss during exposure to high temperature due to oxidation. The Maximum Continuous Use Temperature for cable tie materials depends upon the time at the elevated temperature as well as other environmental conditions. Initially, plastics become more flexible and weaker when exposed to high temperatures. After a period of time, oxidation may occur which will cause embrittlement, making plastic cable ties more susceptible to failure from impact and vibration.



The Maximum Continuous Use Temperature, otherwise known as the Relative Thermal Index (mechanical without impact) is determined per UL746B. It is one indicator of a material's ability to retain a particular physical property when exposed to elevated temperatures over an extended period of time. It is based on the assumption that there is no loading, no chemical attack and impact free condition. The Maximum Continuous Use Temperatures for cable tie materials are listed in Table B (see page 63).

Low temperature exposure will also make plastics more brittle during the exposure, but little property loss occurs when the material is returned to room temperatures. The Minimum Continuous Use Temperatures for cable tie materials are listed in Table B (see page 63).

Tensile Strength

Most cable ties are selected based on material, length and minimum loop tensile strength. Minimum loop tensile strength was established under SAE Aerospace Standard AS23190. Each cross section cable tie (Miniature-M, Intermediate-I, Standard-S, Light-Heavy-LH, Heavy-H, Heavy-Standard-HS and Extra-Heavy-EH) has a different loop tensile strength when tested per AS23190.

The cable tie is first conditioned at 49°C, 20% relative humidity for 24 hours, then the cable tie is installed on a split mandrel and the halves of the mandrel separated at a rate of 25.4mm per minute (Fig.1). The separating force required to unlock or break the cable tie is the loop tensile strength. Loop tensile strength is dependent both on the locking design and the tensile strength (bar) of the material. As an example, the tensile strength of polypropylene material is approximately 1/2 to 1/3 of nylon 6.6; thus the loop tensile strength of a given cross section tie made of polypropylene would be much less than a tie made of nylon 6.6. This is another property to be considered when selecting a cable tie. The various representative loop tensile strengths are listed in Table B (Page 63).

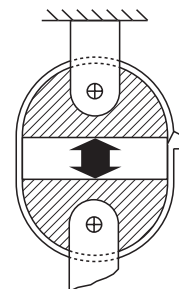


Fig. 1



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TABLE B

Design Criteria	Natural 6.6 Nylon	Weather Resistant Nylon 6.6	Heat Stabilised Nylon 6.6	Heat Stabilised Nylon 6.6	Heat Stabilised Weather Resistant Nylon 6.6	Flame Retardant Nylon 6.6	Flame Retardant Nylon 6.6	Weather Resistant Nylon 12	Natural Polypropylene	Weather Resistant Polypropylene	TEFZEL [▪]	HALAR [▲]	Weather Resistant Acetal	Stainless Steel
Part Number Suffix/ Material Designation	None	-0 and -00	-30	-39	-300	-60	-69	-120	-109	-100	-76	-702	N/A	N/A
Tensile Strength 23°C (bar)	12,000 (Note 1)	12,000 (Note 1)	12,000 (Note 1)	12,000 (Note 1)	12,000 (Note 1)	12,000 (Note 1)	12,000 (Note 1)	8,100 (Note 1)	4,100 (Note 1)	4,100 (Note 1)	7,500 (Note 1)	7,000 (Note 1)	6,500 (Note 2)	90,000 (Note 3)
Colour	Natural	Black	Black	Natural	Black	Black	Ivory	Black	Green	Black	Aqua	Maroon	Black	Stainless
UL Flammability	See Page 60-61													
Oxygen Index	28	28	26	26	26	34	34	NA	NA	NA	30	60	NA	NA
Radiation Resistance	1 x 10 ⁵ Rads	1 x 10 ⁵ Rads	1 x 10 ⁵ Rads	1 x 10 ⁵ Rads	1 x 10 ⁵ Rads	1 x 10 ⁵ Rads	1 x 10 ⁵ Rads	3.5 x 10 ⁵ Rads	1 x 10 ⁵ Rads	1 x 10 ⁵ Rads	2 x 10 ⁸ Rads	2 x 10 ⁸ Rads	6 x 10 ⁵ Rads	2 x 10 ⁸ Rads
Water Absorption (24 hours)	1.2%	1.2%	1.2%	1.2%	1.2%	1.1%	1.1%	0.3%	0.1%	0.1%	<0.03%	<0.05%	<0.45%	None
Ultraviolet Light Resistance	Poor	Good	Fair	Poor	Good	Poor	Poor	Good	Poor	Good	Very Good	Very Good	Excellent	Excellent
Max. Continuous Use Temperature	85°C	85°C	115°C	115°C	100°C (Note 5)	105°C	105°C	90°C	115°C	115°C	170°C	150°C	85°C	537°C (Note 6)
Min. Continuous Use Temperature*	-60°C	-60°C	-60°C	-60°C	-60°C	-60°C	-60°C	-60°C	-60°C	-60°C	-60°C	-60°C	-60°C	-60°C
Minimum Loop Tensile Strength @49°C 20% RH	Submin.	36N	36N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Min. Int.	80N	80N	80N	80N	80N	80N	80N	80N	80N	80N	80N	80N	N/A
	Std.	178N	178N	178N	178N	178N	178N	178N	111N	80N	80N	111N	N/A	N/A
	Hvy. Std.	222N	222N	222N	222N	222N	222N	222N	178N	133N	133N	222N	222N	890N
EH	Lt. Hvy. Hvy.	378N	278N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Hvy.	534N	534N	534N	534N	534N	534N	534N	400N	222N	222N	534N	N/A	1112N
EH	1112N	1112N	1112N	1112N	N/A	N/A	N/A	N/A	400N	400N	N/A	N/A	1112N	2669N

1. ASTM D638
2. Telcordia TR-TSY-000789
3. ASTM E8
4. See page 60 — Temperature
5. Estimated
6. (-321) goes to 923°C
7. After installation



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▲ HALAR is the Registered Trademark of Solvay Solexis, Inc.
▪ TEFZEL is Registered Trademark of E. I. DuPont de Nemours Co.

TABLE C
Chemical Resistance

Many factors combine to determine the useful life of a cable tie material and none is as important as chemical exposure. Various chemicals will have different effects on plastics depending on such things as chemical concentrations, temperature, stress and ultraviolet light. Table C is an excellent guideline for the selection of the best cable tie material. It should be noted that the exposure temperature for this chemical resistance chart is 21°C.



Resistance of PANDUIT Cable Tie Materials to Chemical Attack at 21° C

- = Not Tested
- E = Excellent
- S = Satisfactory
- B = Slight Attack
- U = Attacked
- 1 = Pitting occurs under some conditions
- 2 = Attack may occur if sulfuric acid present
- Aq. = Aqueous
- C. S. = Cold Saturated

Agent	Percent Concentration	* Nylon 6.6	Nylon 12	Polypropylene	TEFZEL*	HALAR*	304 Stainless Steel	316 Stainless Steel
Acetaldehyde	90	S	—	B	E	E	—	—
Acetic Acid	97	U	U	E	E	E	E	E
Acetic Acid	10	B	S	E	E	E	E	E
Acetic Anhydride	90	—	S	E	E	E	E	E
Acetone	100	E	E	E	E	E	E	E
Acetophenone	100	—	—	S	E	E	E	E
Acetylene	100	—	—	E	E	E	E	E
Aluminum Chloride	10	S	E	E	E	E	U	B
Aluminum Fluoride	10	U	U	E	E	E	E	E
Aluminum Hydroxide	Aq. C. S.	—	E	E	E	E	E	E
Aluminum Potassium Sulfate	10	S	E	E	E	E	E	E
Ammonia	All	—	E	E	E	E	E	E
Ammonium Carbonate	1-5	—	E	—	E	E	E	E
Ammonium Chloride	10 to 25	U	E	E	E	E	E	E
Ammonium Hydroxide	10	E	—	—	E	E	—	—
Ammonium Nitrate	100	—	E	E	E	E	E	E
Ammonium Sulfate	10	—	E	E	E	E	E	E
Amyl Acetate	100	—	—	B	E	E	E	E
Aniline	100	—	S	E	E	E	E	E
Antimony Trichloride	All	U	—	E	E	E	E	E
Arsenic Acid	1 to 80	—	—	E	E	E	E	E
Barium Carbonate	All	—	E	E	E	E	E	E
Barium Chloride	All	—	E	E	E	E	E	E
Barium Sulfate	All	—	E	E	E	E	E	E
Barium Sulfide	All	—	E	E	E	E	E	E
Benzene	100	E	E	B	E	E	E	E
Benzoic Acid	100	U	E	E	E	E	E	E
Benzoyl Chloride	100	—	—	B	E	E	—	—
Benzyl Alcohol	100	—	—	E	E	E	—	—
Boric Acid	All	U	E	E	E	E	S	—
Bromine	100	U	U	U	E	E	U	U
Butadiene	100	—	—	B	E	E	E	E
Butane	100	—	E	E	E	E	E	E
Butanediol	100	—	—	E	E	E	—	—
Butyl Acetate	100	—	E	B	E	E	—	—
N. Butyl Alcohol	100	—	E	E	E	E	E	E
Butyl Phthalate	100	—	—	E	E	E	—	—
Butyraldehyde	100	—	—	E	E	E	—	—
Butyric Acid	10 to 100	U	—	E	E	E	E	E
Calcium Carbonate	Aq. C.S.	—	—	E	E	E	E	E
Calcium Chlorate	Aq. C.S.	—	—	E	E	E	E	E

*Includes all Nylon 6.6 (such as Weather Resistant, Heat Stabilised and Flame Retardant)



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TABLE C — (continued)

Resistance of PANDUIT Cable Tie Materials to Chemical Attack at 21°C

Agent	Percent Concentration	* Nylon 6.6	Nylon 12	Polypropylene	TEFZEL*	HALAR*	304 Stainless Steel	316 Stainless Steel
Calcium Chloride	5	B	E	E	E	E	E	E
Calcium Hydroxide	50	—	—	E	E	E	E	E
Calcium Hypochlorite	2	U	—	E	E	E	E	E
Calcium Nitrate	50	—	E	E	E	E	—	—
Calcium Sulfate	2	B	—	E	E	E	E	E
Carbon Tetrachloride	100	E	E	U	E	E	E	E
Carbon Tetrachloride	Aq. 10	—	—	—	—	E	E	E
Chlorine	Dry	—	U	U	E	E	B	B
Chlorine	Wet	—	U	B	E	E	U	U
Chloroacetic Acid	10 to 50	U	—	E	E	E	U	B
Chlorobenzene	100	—	B	E	E	E	—	—
Chloroform	100	E	B	B	E	E	E	E
Chlorosulphonic Acid	10 to 100	U	U	U	S	E	U	U
Chromic Acid	10 to 50	U	U	E	E	E	B	B
Citric Acid	10 to 50	S	S	E	—	E	E	E
Copper Chloride	1 to 10	U	—	E	E	E	E	E
Copper Cyanide	Aq. C.S.	—	—	E	E	E	E	E
Copper Nitrate	50	—	—	E	E	E	E	E
Cresol	100	U	U	—	E	E	E	E
Crotonaldehyde	100	—	—	E	E	E	—	—
Cyclohexane	100	—	E	B	E	E	E	—
Cyclohexanol	100	—	E	E	E	E	E	—
Cyclohexanone	100	—	E	B	E	E	E	—
Dibutyl Phthalate	100	—	—	E	E	E	—	—
Dichloroethane	100	—	—	E	—	E	E	E
Dichloroethylene	100	—	—	B	E	E	—	—
Diesel Fuel	100	—	E	B	E	E	E	E
Diethyl Ether	100	—	E	E	E	E	E	E
Diglycolic Acid	Aq. C.S.	—	—	E	E	E	—	—
Disobutyl Ketone	100	—	—	E	E	E	—	—
Dimethyl Amine	100	—	—	E	E	E	—	—
Dimethyl Formamide	100	—	E	E	E	E	E	—
Dimethyl Sulfate	100	—	—	B	E	E	—	—
Diocetyl Phthalate	100	—	—	E	E	E	E	—
1, 4-Dioxane	100	—	S	B	E	E	E	—
Ethyl Acetate	100	E	E	S	E	E	E	E
Ethyl Alcohol	100	E	E	E	E	E	E	E
Ethyl Chloride	100	—	—	B	E	E	E	E
Ethylene Chloride	100	E	B	B	E	E	E	E
Ethylene Glycol	100	E	E	E	E	E	E	E
Ethylene Oxide	100	—	—	B	E	E	—	—
Fatty Acids	100	—	—	E	E	E	—	—
Ferric Chloride	50	U	—	E	E	E	U	U
Ferric Hydroxide	All	—	—	E	E	E	E	E
Ferric Nitrate	All	—	—	E	E	E	E	E
Ferrous Chloride	Aq. C.S.	U	—	E	E	E	U	B
Ferrous Sulfate	10	—	—	E	E	E	E	E
Fluorine (Dry)	100	—	—	U	E	—	U	U
Formaldehyde	40	E	S	E	E	E	E	E
Formic Acid	All	U	U	E	E	E	E	E
Freons	100	E	—	—	E	E	—	—
Fuel Oil	100	—	E	—	E	E	E	E
Furfural	100	E	—	—	E	E	E	E
Gallic Acid	Aq. C.S.	—	—	—	E	E	E	E
Gasoline	100	E	—	B	E	E	E	E

*Includes all Nylon 6.6 (such as Weather Resistant, Heat Stabilised and Flame Retardant)



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TABLE C — (continued)

Resistance of PANDUIT Cable Tie Materials to Chemical Attack at 21°C

Agent	Percent Concentration	* Nylon 6.6	Nylon 12	Polypropylene	TEFZEL*	HALAR*	304 Stainless Steel	316 Stainless Steel
Glycerin	100	—	E	E	—	E	E	E
Glycolic Acidb	40	U	—	E	E	E	—	—
Heptane	100	—	E	E	E	E	E	E
Hexane	100	E	E	E	E	E	E	E
Hydrobromic Acid	All	U	U	E	E	E	U	U
Hydrochloric Acid	All	U	U	E	E	E	U	U
Hydrocyanic Acid	All	—	U	E	E	E	B	B
Hydrofluoric Acid	All	U	U	E	E	E	U	U
Hydrofluorosilicic Acid	30	—	U	E	E	E	U	U
Hydrogen Peroxide	30	U	S	S	E	E	S	E
Hydrogen Sulfide	Dry	—	—	E	E	E	E	E
Hydrogen Sulfide	Wet	U	—	E	E	E	E	E
Hydroquinone	100	—	—	E	E	E	—	—
Iodine	100	—	—	E	E	E	U	U
Iodoform	100	—	—	—	E	E	E	E
Isopropyl Alcohol	100	E	E	E	E	E	E	E
Jet Fuel	100	E	—	E	E	E	E	E
Lactic Acid	10	E	S	E	E	E	E	E
Lanolin	10	E	E	E	E	E	E	E
Lead Acetate	Aq. C.S.	—	—	E	E	E	E	E
Linseed Oil	100	E	E	E	E	E	E	E
Magnesium Carbonate	Aq. C. S.	—	U	E	E	E	E	E
Magnesium Chloride	Aq. C.S.	B	E	E	E	E	E	E
Magnesium Nitrate	Aq. C. S.	—	E	E	E	E	E	E
Maleic Acid	100	—	—	E	E	E	—	—
Malic Acid	Aq. C.S.	—	—	E	E	E	E	E
Mercuric Chloride	Dilute	—	E	E	E	E	E	E
Methyl Alcohol	100	E	E	E	E	E	E	E
Methyl Bromide	100	—	—	U	E	E	—	—
Methyl Chloride	100	—	—	B	E	E	—	E
Methyl Chloroform	100	E	—	B	E	E	—	—
Methyl Ethyl Ketone	100	—	E	B	E	E	E	E
Methyl Isobutol Ketone	100	E	—	B	E	E	E	E
Methylene Chloride	100	B	U	B	E	E	E	E
Naptha	100	—	—	E	E	E	E	E
Napthalene	100	—	S	E	E	E	E	E
Nickel Chloride	Aq. C.S.	—	E	E	E	E	E	E
Nickel Sulfate	Aq. C.S.	—	E	E	E	E	E	E
Nitric Acid	10 to 30	U	U	E	E	E	E	E
Nitric Acid	30 to 68	U	U	U	S	E	E	E
Nitro Benzene	100	—	B	B	E	E	E	E
Nitro Methane	100	E	—	—	E	E	—	—
Nitrous Acid	5	—	—	—	E	E	E	E
Oleic Acid	100	—	B	E	E	E	E	E
Oxalic Acid	10	—	B	E	E	E	E	E
Oxygen	All	—	—	E	E	E	—	—
Paraffin	100	E	E	E	E	E	E	E
Perchloroethylene	100	—	—	B	E	E	E	E
Petroleum Ether	100	—	U	E	E	E	E	E
Phenol	90	U	U	E	E	E	E	E
Phosphoric Acid	10	U	U	E	E	E	E	E
Phosphorous Pentoxide	100	—	U	E	E	E	—	—
Phosphorous Trichloride	100	—	U	B	E	E	E	E
Phthalic Acid	50	—	—	B	E	E	E	E

*Includes all Nylon 6.6 (such as Weather Resistant, Heat Stabilised and Flame Retardant)



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TABLE C — (continued)

Resistance of PANDUIT Cable Tie Materials to Chemical Attack at 21°C

Agent	Percent Concentration	* Nylon 6.6	Nylon 12	Polypropylene	TEFZEL*	HALAR*	304 Stainless Steel	316 Stainless Steel
Pictic Acid	1	—	—	E	E	E	E	E
Potassium Borate	1	—	—	E	E	E	—	—
Potassium Bromide	Aq. C.S.	—	—	E	E	E	E	E
Potassium Carbonate	Aq. C.S.	—	B	E	E	E	E	E
Potassium Chlorate	Aq. C. S.	—	S	E	E	E	E	E
Potassium Chloride	5	—	E	E	E	E	E	E
Potassium Dichromate	Aq. C.S.	—	U	E	E	E	E	E
Potassium Ferrocyanide	25	—	—	E	E	E	E	E
Potassium Hydroxide	30	B	—	E	E	E	B	B
Potassium Iodide	Aq. C.S.	—	E	E	—	E	E	E
Potassium Nitrate	Aq. C.S.	—	E	E	E	E	E	E
Potassium Perchlorate	1	—	—	E	E	E	—	—
Potassium Permanganate	5	U	U	E	E	E	E	E
Potassium Persulfate	All	—	—	E	E	E	—	—
Potassium Sulfate	Aq. C.S.	—	E	E	E	E	E	E
Potassium Sulfide	Aq. C.S.	—	—	E	E	E	E	E
Propionic Acid	50	—	—	E	E	E	—	—
Propyl Alcohol	100	E	—	E	E	E	E	E
Pyridine	100	—	E	B	E	E	B	B
Sea Water	100	—	E	E	E	E	E	E
Silver Chloride	Aq. C.S.	—	U	E	E	E	U	U
Silver Nitrate	10	—	E	E	E	E	E	E
Sodium Acetate	Aq. C.S.	E	—	E	E	E	E	E
Sodium Benzoate	Aq. C.S.	—	—	E	E	E	—	—
Sodium Bicarbonate	Aq. C.S.	E	E	E	E	E	E	E
Sodium Bisulfate	10	—	—	E	E	E	E	E
Sodium Bisulfite	Aq. C.S.	—	S	E	E	E	E	E
Sodium Borate	Aq. C.S.	—	—	E	E	E	E	E
Sodium Carbonate	2	U	U	E	E	E	E	E
Sodium Chlorate	25	—	B	E	E	E	E	E
Sodium Chloride	10	E	E	E	E	E	E1	E
Sodium Chromate	Aq. C.S.	U	—	E	E	E	E	E
Sodium Fluoride	5	—	—	E	E	E	E	E
Sodium Hydroxide	10	E	E	E	E	E	E	E
Sodium Hypochlorite	5	S	B	E	E	E	E	E
Sodium Hyposulfite	Aq.C.S.	—	—	—	E	E	E	E
Sodium Nitrate	5	E	E	E	E	E	E	E
Sodium Nitrite	Aq. C.S.	—	B	E	E	E	E	E
Sodium Perborate	Aq. C.S.	—	S	E	E	E	—	B
Sodium Perchlorate	10	—	—	—	E	E	E	E
Sodium Phosphate	5	—	E	E	E	E	E	E
Sodium Sulfate	5	—	U	E	E	E	E	E
Sodium Sulfide	5	—	U	E	E	E	E	E
Sodium Thiosulfate	25	—	E	E	E	E	E	E
Stannic Chloride	Aq. C.S.	U	—	E	E	E	U	B
Stannous Chloride	Aq. C.S.	—	E	E	E	E	B	S
Stearic Acid	100	—	B	E	E	E	E	E
Succinic Acid	100	—	S	E	E	E	—	—
Sulfur	100	—	U	E	E	E	S	B
Sulfur Dioxide	All	U	—	B	E	E	E	E
Sulfuric Acid	5	U	B	E	E	E	B	E
Sulfuric Acid	50	U	U	E	E	E	U	B
Sulfuric Acid	Concentrate	U	U	B	E	E	B	B
Sulfurous Acid	10	E	—	E	E	E	E	E
Tannic Acid	10	—	—	E	E	E	E	E
Tartaric Acid	50	—	S	E	E	E	E	E
Tetrahydrofuran	100	—	B	B	E	E	E	E
Toluene	100	E	E	B	E	E	E	E
Trichloroacetic Acid	10	U	—	S	E	E	U	U
Trichloroethylene	100	—	U	B	E	E	E	E
Turpentine	100	—	S	U	E	E	E	E
Urea	50	—	U	E	E	E	—	—
Vinyl Acetate	100	—	—	E	E	E	—	—
Xylene	100	E	—	U	E	E	E	E
Zinc Chloride	70	U	E	E	E	E	E	E
Zinc Nitrate	Aq. C.S.	—	E	E	E	E	E	E
Zinc Sulfate	Aq. C.S.	—	E	E	E	E	E	E

*Includes all Nylon 6.6 (such as Weather Resistant, Heat Stabilised and Flame Retardant)

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The owner-operated concept makes employees responsible for their areas of the manufacturing process.



Operator inspection is an important *PANDUIT* TQA procedure.



Members of ETQ Teams search for ways to improve product quality.

PANDUIT Total Quality Assurance (TQA) initiative spans more than two decades. During that time we have furnished quality training to all levels of our employees, enabling them to participate in our Excellence Through Quality (ETQ) program of continuous quality improvement.

Our quality policies and major improvement projects are chosen and monitored by the Corporate Process Improvement Committee. This group is comprised of the top management representatives from each of *PANDUIT* business segments.

PANDUIT Engineering and Manufacturing groups work together to design quality into the products and the production processes. Service quality is equally important and our customer service group takes the lead in assuring superior performance from the supporting departments.

Our high degree of product and service quality is due in part to heavy investment in technology by *PANDUIT*. However, people are really the foundation for our quality achievements. We believe in Quality at the Source.

By introducing Quality at the Source throughout the company, we have provided the training, equipment and moved the responsibility for performance to the employees doing the work. Their pride in products and service is demonstrated every day in how we serve our customers.

PANDUIT ISO 9001 and QS-9000 registrations serve notice to our customers that we support their business through our reliable quality systems. When necessary to meet the needs of specific industries, we incorporate additional quality requirements in our systems.

At *PANDUIT*, our commitment is Total Quality Assurance.

