Henkel

Henkel –
Your partner worldwide

U.S.A.
Henkel Corporation
Engineering Adhesives
One Henkel Way
(formerly 1001 Trout Brook Crossing)
Rocky Hill, Connecticut 06067
Phone: 860.571.5100
Fax: 860.571.5465
Customer Service: 1.800.434.1836

Canada
Henkel Canada Corporation
2225 Meadowpine Blvd.
Mississauga, ON L5N 7P2
Phone: 905.814.6511
Fax: 905.814.5391
Customer Service: 1.800.263.5043

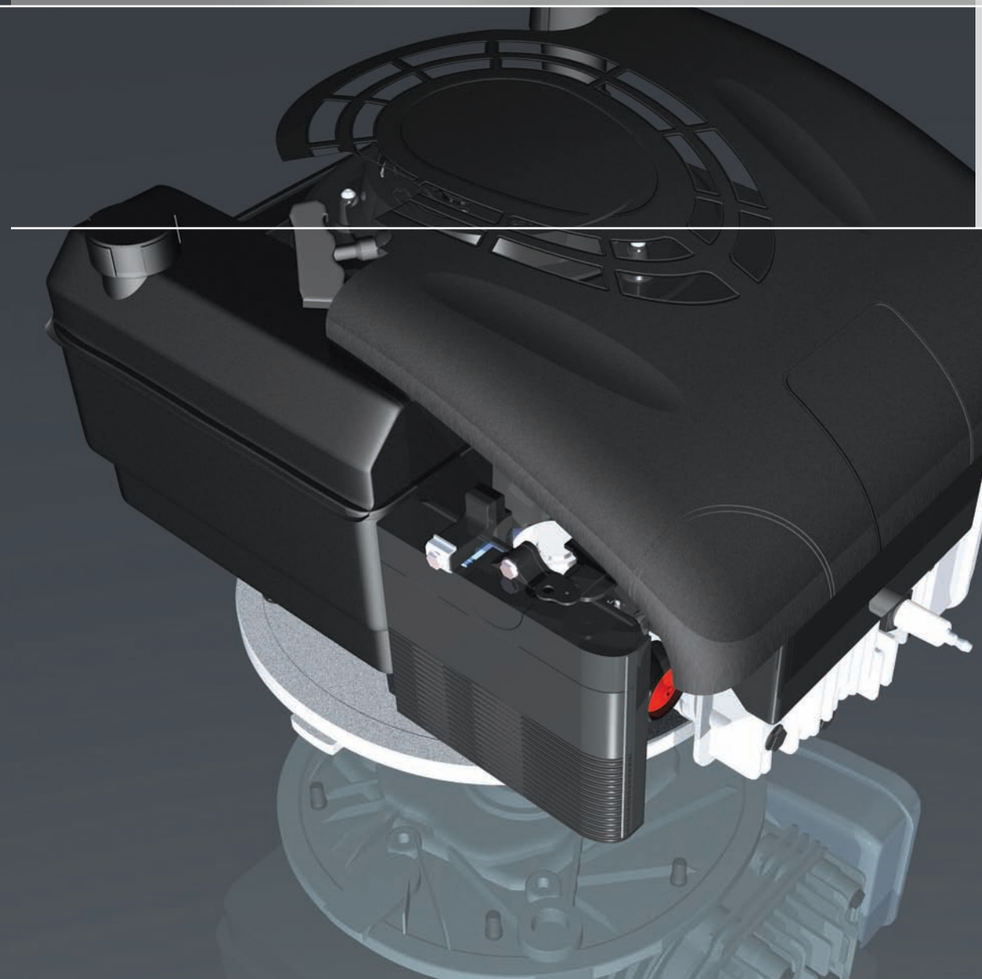
Mexico
Henkel Capital, S.A. de C.V.
Calz. De la Viga s/n,
Fracc. Los Laureles 55090
Ecatepec, Edo. De México
Phone: +52.55.3300.3600
Fax: +52.55.5836.1475

Henkel Corporation
Engineering Adhesives
One Henkel Way
(formerly 1001 Trout Brook Crossing)
Rocky Hill, Connecticut 06067

KRAYDEN, INC.
AUTHORIZED DISTRIBUTOR
1-800-448-0406

LOCTITE®

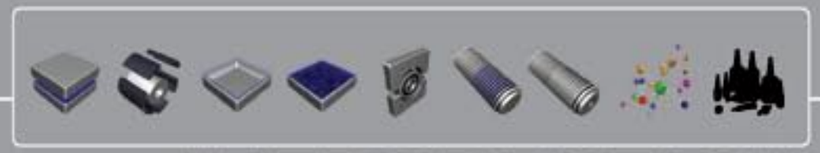
DESIGN GUIDE FOR
SMALL ENGINES



Henkel

SMALL ENGINES

TABLE OF CONTENTS



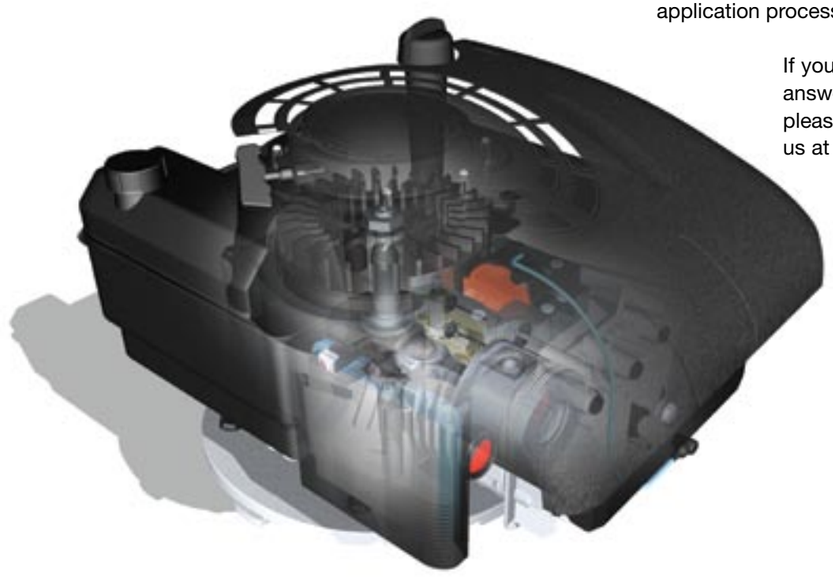
INTRODUCTION

INTRODUCTION

Are you getting the most out of adhesives and sealants?

For more than 40 years small engine manufacturers have used Loctite® branded products to improve performance, reduce costs, and facilitate the manufacturing process. While almost all manufacturers use adhesives and sealants in some assembly operations, very few have developed the experience to fully take advantage of their potential.

The objective of this guide is to educate small engine design and manufacturing engineers on where, and most importantly why, adhesives and sealants are commonly used to help them recognize their full potential.



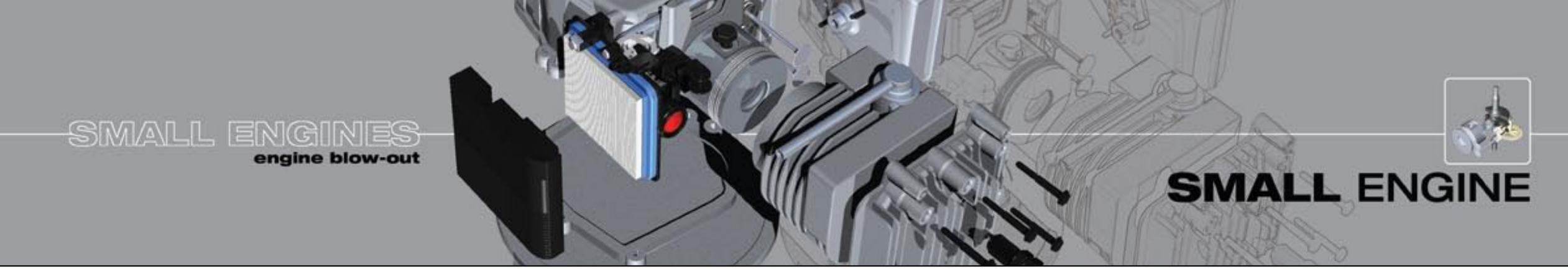
To accomplish this, the following key areas are reviewed in this design guide:

Application Call-Outs: The first pages of this guide and the start of each section focuses on where Loctite® branded products can be used to increase performance and reduce cost in small engine manufacturing.

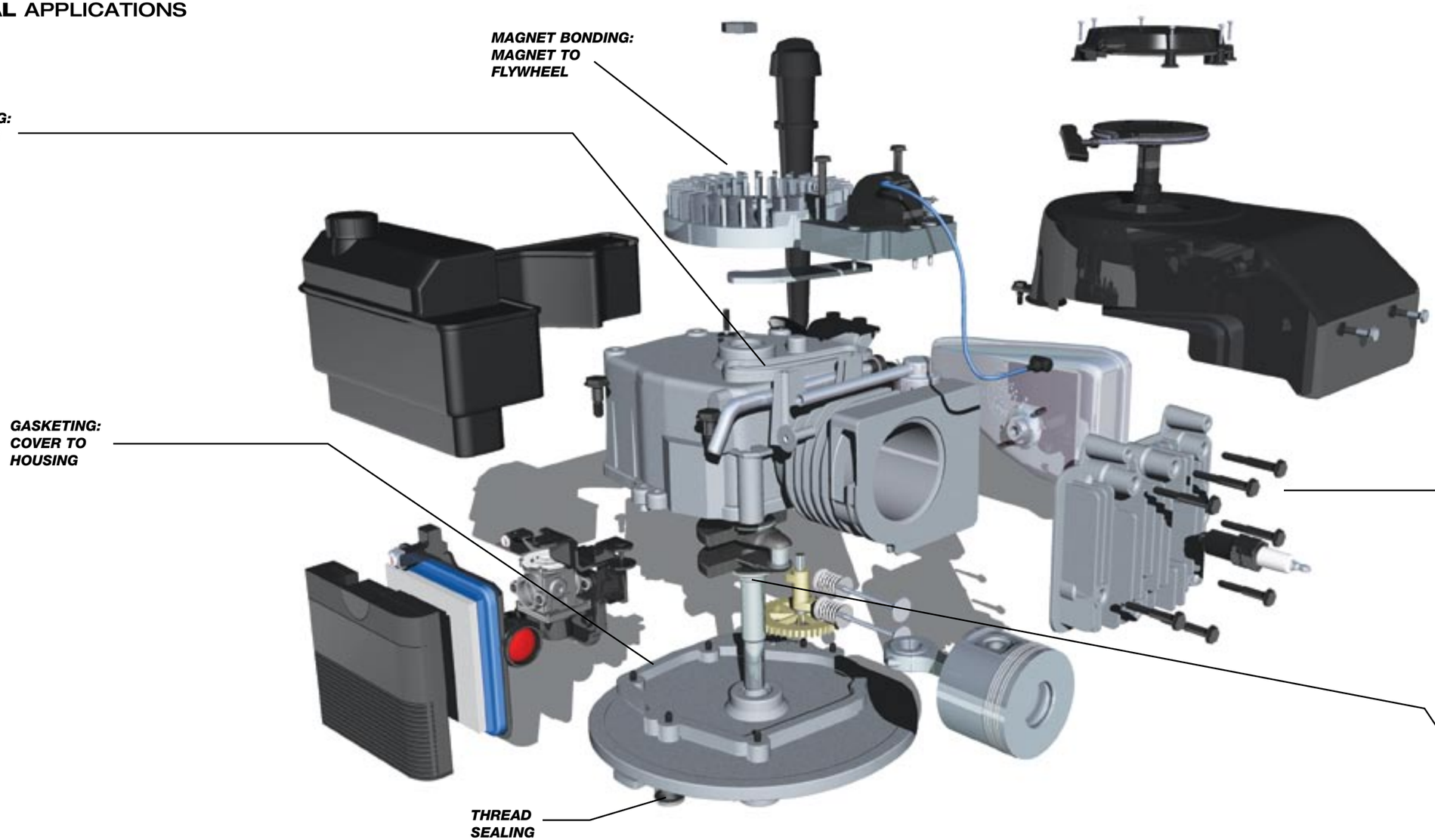
Application Categories: The majority of this guide is a detailed breakdown of the application categories. These include a summary of the benefits of adhesives and sealants for each application and a decision tree to help you select the right product for your application.

Dispensing Equipment: The final section of this guide details the Loctite® dispensing equipment available. Our goal is to provide you with a fully integrated solution including the right product and application process for your production line.

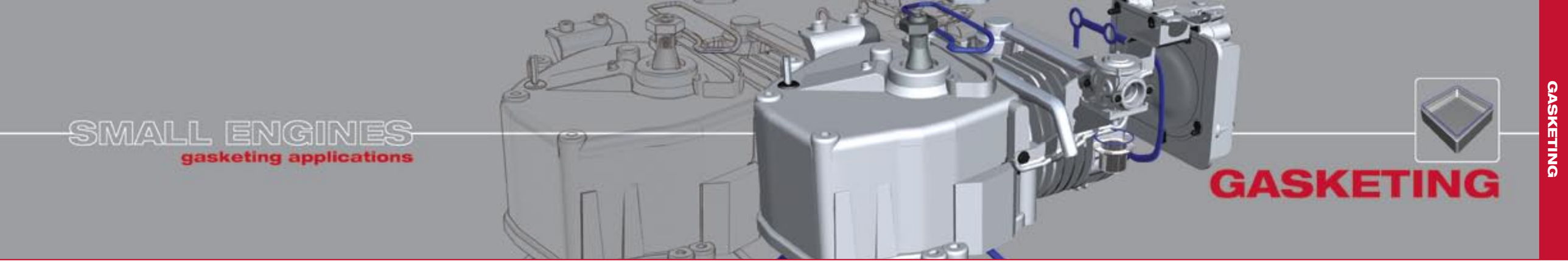
If you have questions that are not answered by this design guide, please feel free to contact us at 1-800-LOCTITE.



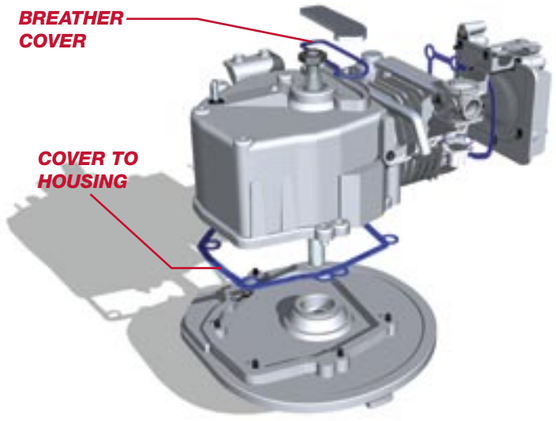
TYPICAL APPLICATIONS



Category	Page
Gasketing	6-7
Magnet Bonding	8-9
Retaining	10-11
Threadlocking	12-13
Thread Sealing	14-15
Chemistries	16-19



TYPICAL APPLICATIONS

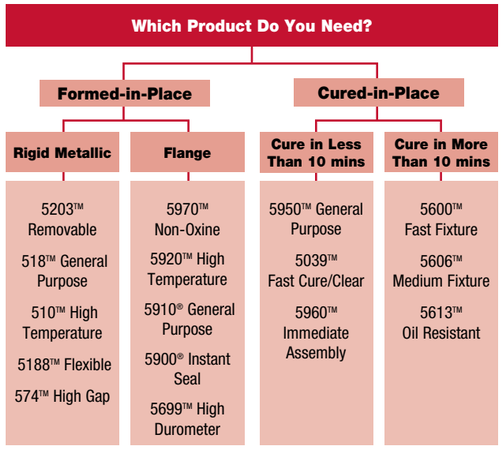


OVERVIEW

Henkel has been providing gasketing solutions to replace or augment the performance of cut gaskets for decades. Formed-in-place gaskets are the most commonly used “liquid gaskets.” They are dispensed on a flange as liquid. When the flange is mated to the second flange, the liquid hardens and bonds to both flanges forming a seal.

They offer the following benefits over cut gaskets, molded gaskets and O-rings:

- Easy to automate
- No misaligned gaskets
- One adhesive can seal many different flange configurations
- Lower labor and inventory costs
- Lower machining costs
- No gasket creep or gasket compression set



EASY TO SERVICE / REMOVABLE AND REUSABLE

If the flange you are sealing requires convenient and/or frequent removal and reusability then a cure-in-place gasket is right for you. Cure-in-place gaskets are almost exclusively achieved with silicone adhesives. Due to the fact that the product profile and location on the flange is so critical for this application, it requires fully automated dispensing and curing equipment to achieve consistent gasket performance.

BONDS AND SEALS THE FLANGE / EASY TO APPLY

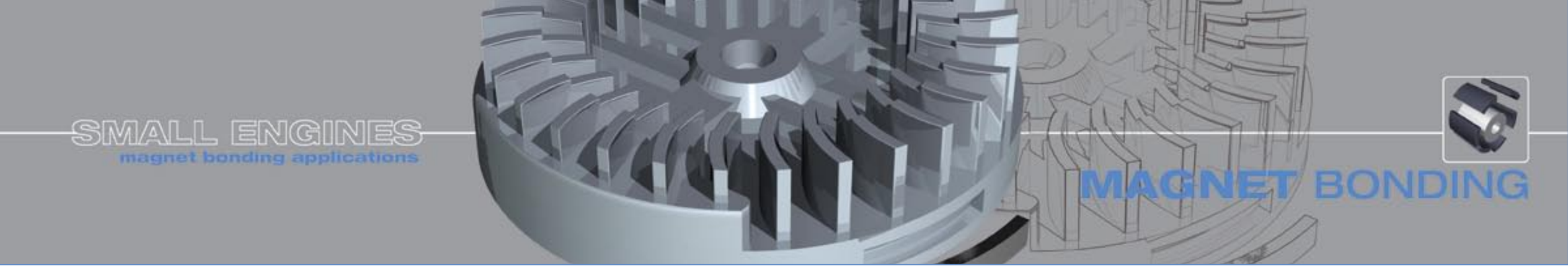
Form-in-place gaskets can be created with anaerobic or silicone adhesives and are well suited for manual, semi-automated and fully automated processes. Key selection criteria for these chemistries are flange type, gap fill, and temperature resistance. See table 1 to find the right product for your application.

TABLE 1. COMPARISON OF ADHESIVE TYPES FOR GASKETING

		BONDS & SEALS / EASY TO APPLY		EASY TO SERVICE / REMOVABLE & REUSABLE	
ATTRIBUTE		FORMED-IN-PLACE		CURED-IN-PLACE	
		ANAEROBIC	SILICONE, RTV	SILICONE, LIGHT CURE	SILICONE, TWO-PART
		CAST METALLIC FLANGE	STAMPED METALLIC / PLASTIC FLANGE	CURE TIME <10 MINUTES	CURE TIME >10 MINUTES
OVERVIEW					
Key Benefits		• No compression set • Adds structural strength • High pressure seal	• No compression set • High joint movement • High gap fill • High temperature resistance	• Serviceable • Fastest cure time • Immediate properties • High gap fill	• Serviceable • Excellent temperature resistance • Excellent adhesion • High gap fill
Key Limitations		• Metal flanges only • Rigid flanges only	• Limited open time • Not for high pressure applications	• Must have dispensing and curing equipment • Not for high pressure applications	• Must have dispensing and curing equipment • Not for high pressure applications
PERFORMANCE					
Flange Type		Rigid	Rigid or Flexible	Rigid or Flexible	Rigid or Flexible
Suitable for Use With	Metals	Yes	Yes	Yes	Yes
	Plastics	No	Yes	Yes	Yes
Gap Fill	Ideal	0.001 - 0.005"	0.004 - 0.006"	0.020 - 0.060"	0.020 - 0.060"
	Maximum	0.020"	0.25"	0.125"	0.250"
Temperature Resistance	Typical	-65°F to 300°F	-65°F to 400°F	-65°F to 350°F	-65°F to 400°F
	Maximum	400°F	600°F	400°F	600°F
PROCESSING					
Cure Speed	Initial Cure	15 - 30 minutes	15 - 30 minutes	15 - 30 seconds	10 minutes
	Full Cure	24 hours	24 hours - 7 days	24 hours - 7 days	24 hours - 7 days
Manual Dispensing		Yes	Yes	No	No
LOCTITE® PRODUCTS					
		• 5203™ – Removable • 518™ - General purpose • 510™ – High temperature • 5188™ – Flexible • 574™ – High gap	• 5970™ – Non-Oxine • 5920™ – High temperature • 5910® – General purpose • 5900® – Instant seal • 5699™ – High durometer	• 5950™ – General purpose • 5039™ – Fast cure • 5960™ – Immediate assembly	• 5600™ – Fast fixture • 5606™ – Medium fixture • 5613™ – Oil resistant

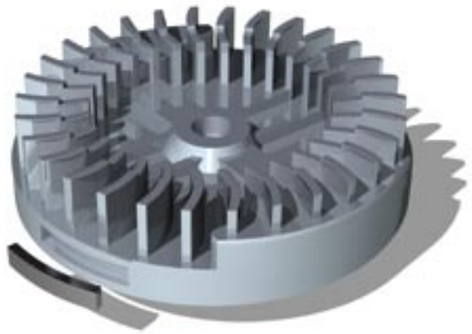
For additional information on the Loctite® products listed, please refer to the product selector in the back of this guide or visit www.loctite.com/data sheets.

For more detailed information on a specific adhesive type, including an in-depth discussion of processing, please refer to that chapter of this guide.



TYPICAL APPLICATIONS

MAGNET SEGMENTS TO HOUSING



OVERVIEW

Magnets in small engines are almost exclusively assembled today using adhesives. While a handful of different adhesive technologies are employed to meet the unique challenges of each specific engine's performance and processing requirements, it is widely accepted that adhesives create a higher quality joint at a lower cost than mechanical fasteners such as clips and bolts.

The key benefits of adhesives over clips and bolts are:

- Stronger, more durable final assembly
- Decreased inventory cost
- Easier to automate
- Will not chip magnets
- Prevents vibrational noise
- Prevents corrosion

NO HEAT REQUIRED

Most magnet bonding applications today do not use heat and utilize one of two acrylic adhesive technologies. Two-step acrylics require the application of an adhesive to one part and an activator to the other. The need to control two dispenses is the critical consideration for this technology. The long on-part life of the adhesive and activator provide long open times and allow for significant process flexibility. Once mated the adhesive cures quickly, typically fixturing in 1-2 minutes. External mix acrylics require only a single adhesive dispense. The two parts mix in the air and fall onto the part. This eliminates the cost of mix nozzles and the need for purging adhesive between parts. The major consideration here is that precision dispensing of this technology is hard to achieve so it is typically only an option onlarger magnets.

HEAT ACCEPTABLE FULL CURE REQUIRED QUICKLY

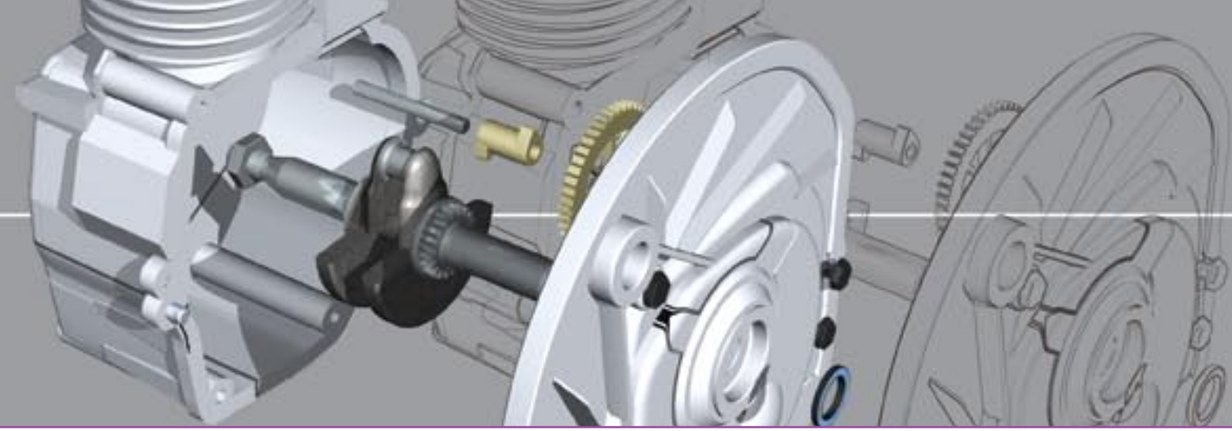
If heat curing is an option and/or full cure is required quickly, then induction cure epoxies are a great fit. Specialized induction-curing equipment creates an electromagnetic field that is used to heat up the adhesive rapidly. Lab testing shows shear strengths of over 2,000 psi within 1 minute of induction curing. In production, automated turntables can eliminate safety issues that arise with heated parts and eliminate work-in-process typically associated with oven cure adhesives.

TABLE 2. COMPARISON OF ADHESIVE TYPES FOR BONDING MAGNETS

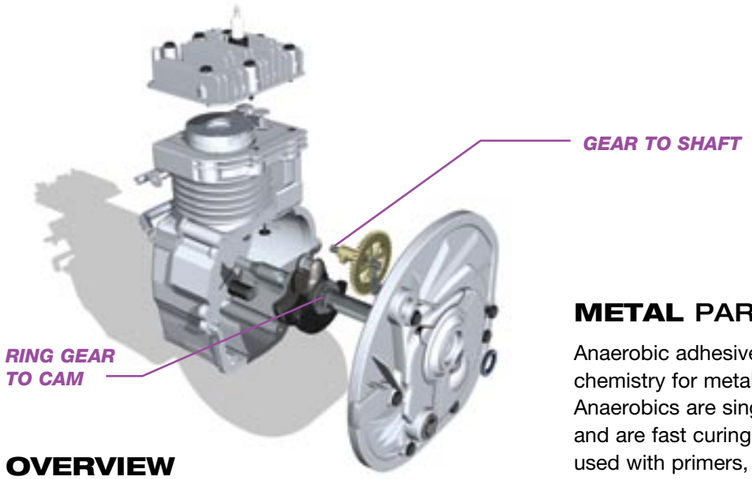
ATTRIBUTE		NO HEAT REQUIRED: UNLIMITED OPEN TIME SMALL MAGNETS	NO HEAT REQUIRED: ONE-STEP APPLICATION LARGER MAGNETS	FULL CURE REQUIRED QUICKLY HEAT CURE ACCEPTABLE
		ACRYLIC, TWO-STEP	ACRYLIC, EXTERNAL MIX	EPOXY, ONE-PART INDUCTION CURE
OVERVIEW				
Key Benefits		• Fast fixture • No mixing • High impact strength • Light cure available • Acid-free available	• Fast fixture • No liquid activator • No static mix tips • Acid-free available • Single step	• Single component • High gap fill • Excellent temperature resistance • Fully cured in one minute • Acid-free
Key Limitations		• Limited gap fill • Must control activator dispense/ application precisely • Activator may contain solvents • Full cure in 24 hours	• 60 - 90 seconds open time • Dispense location difficult to control on small magnets • Full cure in 24 hours	• Curing equipment with part-specific coils required • Must allow parts to cool
PERFORMANCE				
Gap Fill	Metals	0.002 - 0.004"	0.001 - 0.006"	0.004 - 0.006"
	Plastics	0.020"	0.050"	>0.050"
Temperature Resistance	Typical	-65°F to 300°F	-65°F to 300°F	-65°F to 350°F
	Maximum	400°F	300°F	400°F
Impact Strength (Steel)		Excellent	Excellent	Good
PROCESSING				
Fixture Time	Average	1 - 2 minutes	90 seconds	2 minutes
	Fastest	15 - 30 seconds	90 seconds	30 seconds
Full Cure		24 hours	24 hours	Once cooled
LOCTITE® PRODUCTS				
		• 331™ – Best in class • 392™ – General purpose • 326™ – Fast cure • 334™ – High temperature & impact • 332™ – Severe environment • 3920™ – Light cure	• 3060™ – Best in class	• E-220IC™ – Magnet substrates

For additional information on the Loctite® products listed, please refer to the product selector in the back of this guide or visit www.loctite.com/data sheets.

For more detailed information on a specific adhesive type, including an in-depth discussion of processing, please refer to that chapter of this guide.



TYPICAL APPLICATIONS



OVERVIEW

Retaining by definition is the structural joining of close-fitting cylindrical parts. Based on that, it should be no surprise that most of the retaining applications in small engines involve bonding rotor components onto the motor shaft. Adhesives have been used in small engines for decades to augment or replace frictional methods, such as press and shrink fits, and mechanical methods, such as splines, keys and locking pins.

Benefits of adhesives vs. press or shrink fits:

- Lower cost components due to wider tolerance capability
- Lower energy costs and easier to automate
- Eliminates wallowing and backlash of mechanical fits
- Eliminates run-out and warping of shaft
- Prevents vibrational noise
- Prevents fretting corrosion
- Prevents galvanic corrosion

METAL PARTS

Anaerobic adhesives are the dominant adhesive chemistry for metal-to-metal retaining applications. Anaerobics are single component, high strength, and are fast curing at room temperature. When used with primers, they can achieve fixture times of less than 10 seconds. Anaerobic products can be used to augment press fits, increasing the strength of the assembly and allowing for a looser press fit to achieve comparable or higher strengths while eliminating fretting and galvanic corrosion. They can also be used with slip fits to provide shear strengths in excess of 3,000 psi. Different solutions are suggested for press and slip fits, see table 3 to help you choose the right product for your application.

PLASTIC PARTS

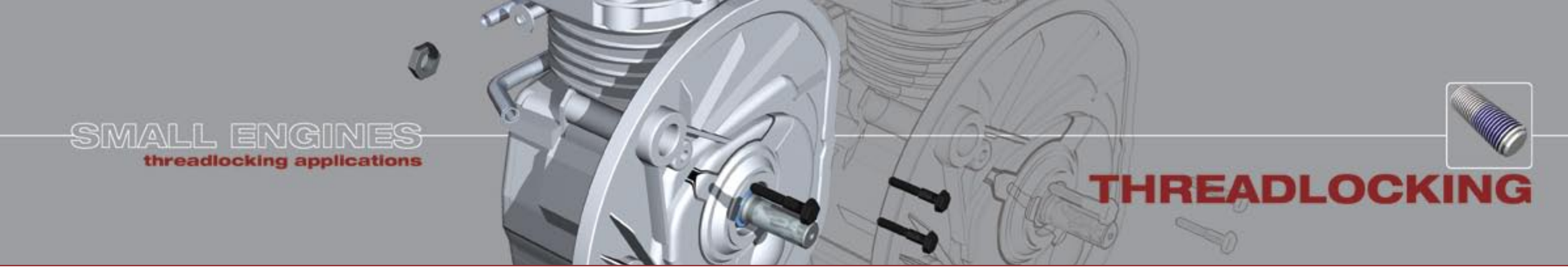
When plastic components require retaining, cyanoacrylate adhesives are commonly used. They cure quickly on plastics, achieve high bond strengths and generally do not cause stress cracking of plastics typical of anaerobic adhesives. There are options for high strength, high temperature and even light curing options to allow for fast fixture and fillet curing. See table 3 to help you choose the right product for your application.

TABLE 3. COMPARISON OF ADHESIVE TYPES FOR RETAINING

		METAL PARTS	PLASTIC OR METAL PARTS
ATTRIBUTE		**ANAEROBIC**	**CYANOACRYLATE**
OVERVIEW			
Key Benefits		• Fast cure • No mixing • High Strength • Excellent chemical resistance • High temperature resistance available	• Fast cure • High adhesion to plastics and elastomers • Light cure available
Key Limitations		• Cure speed highly dependent upon substrate • May require use of primer • Poor adhesion to and may stress crack plastics	• Low temperature resistance (250°F) • Susceptible to corrosion on metals • May bloom • May require use of accelerator • Cure speed sensitive to relative humidity
PERFORMANCE			
Shear Strength (steel)		3,000 - 4,000 psi	2,500 - 4,000 psi
Impact Strength (steel)		Moderate	Moderate
Gap Fill	**Ideal**	0.001 - 0.003"	0.001 - 0.003"
	Maximum	0.010"	0.010"
Temperature Resistance	**Typical**	-65°F to 300°F	-65°F to 180°F
	Maximum	400°F	250°F
PROCESSING			
Fixture Time	**Average**	5 - 10 minutes	20 - 30 seconds
	Fastest	30 - 60 minutes	5 seconds
Full Cure		24 hours	24 hours
LOCTITE® PRODUCTS			
		Press Fit: • 603™ – General purpose • 648™ – Fast cure Slip Fit: • 620™ – High temperature • 638™ – High strength • 680™ – Fast cure	• 435™ – High durability • 401™ – Fast cure • 4205™ – High temperature • 4307™ – Light cure

For additional information on the Loctite® products listed, please refer to the product selector in the back of this guide or visit www.loctite.com/data sheets.

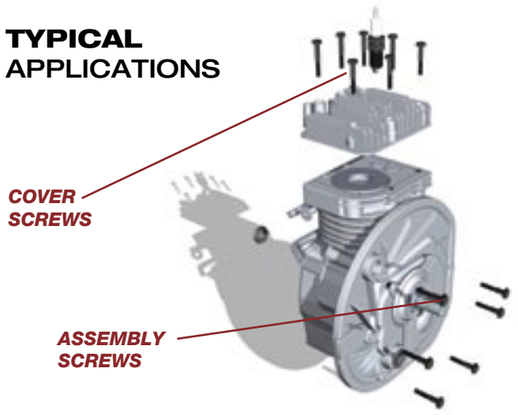
For more detailed information on a specific adhesive type, including an in-depth discussion of processing, please refer to that chapter of this guide.



SMALL ENGINES
threadlocking applications

THREADLOCKING

TYPICAL APPLICATIONS



OVERVIEW

Threadlockers prevent the loosening of threaded fasteners by completely filling the space between the threads, hardening to a strong polymer and bonding to both surfaces. Various viscosities and strengths are available to accommodate all fastener sizes and application requirements. Threadlockers have a long history of improving the performance and reliability of threaded assemblies versus other methods such as lock washers or stop nuts.

Benefits of threadlockers vs. mechanical alternatives:

- Lower cost per application
- More effective at preventing vibrational loosening (see graph 1)
- Ease of automation
- Controlled strengths
- Prevents corrosion

METAL PARTS

Loctite® branded liquid threadlockers have been providing a reliable solution to vibrational loosening in engines for over 50 years. Low and medium strength solutions are available for assemblies that require servicing, and high strength solutions are available for parts you never want to come apart. The latest innovation in this technology is a high temperature series of products capable of resisting over 600°F.

Non-migratory gel and paste threadlockers are another recent Loctite® innovation that offers the same performance of a liquid anaerobic threadlocker in a semisolid form. The semisolid paste is available in a stick form for manual applications and cartridges for semi-automated or automated applications. Both the semisolid and the gel formulations allow for the threadlocker to be applied to a nut or screw in any orientation without drips and ensures that excess adhesive will not migrate into the motor bearings or moving parts which could cause reliability issues.

PLASTIC PARTS

When threadlocking plastic fasteners or tamper-proofing the heads of screws, cyanoacrylates are normally used. They rapidly cure in plastic joints and will not stress crack most plastics. Anaerobic threadlockers will not cure without the presence of metal and may stress crack some plastics.

GRAPH 1. THREADLOCKER BENEFITS

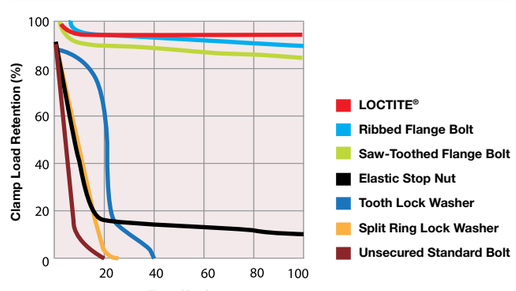
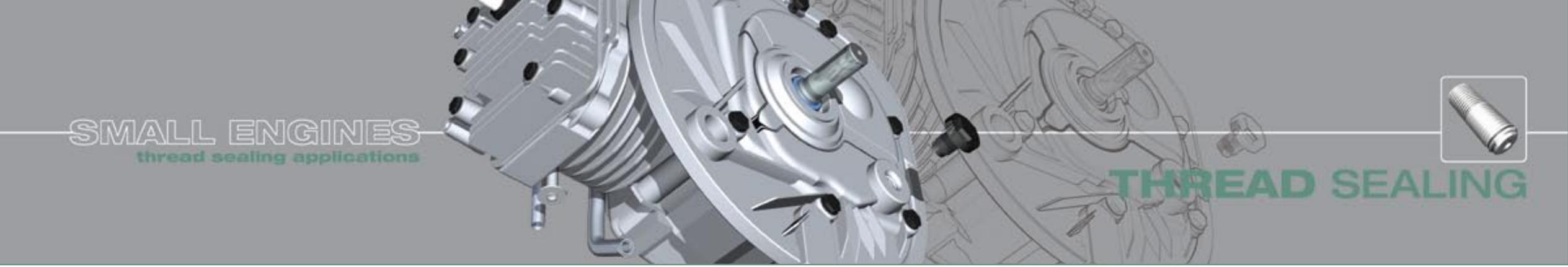


TABLE 4. COMPARISON OF ADHESIVE TYPES FOR THREADLOCKING

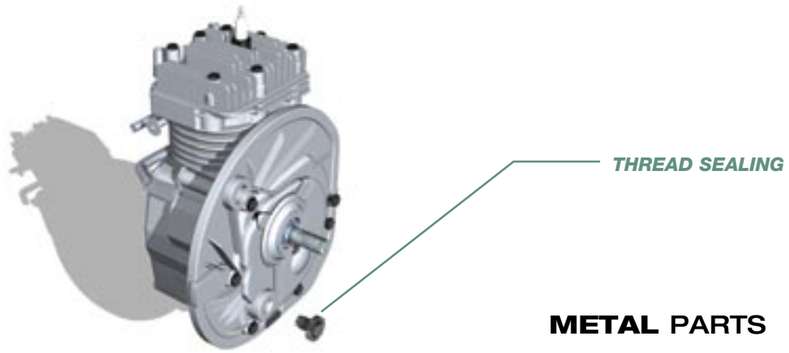
ATTRIBUTE		METAL PARTS		PLASTIC OR METAL PARTS
		TRADITIONAL LIQUID SOLUTION	NON-MIGRATORY/ LESS MESSY	CYANOACRYLATE
OVERVIEW				
Key Benefits		• Controlled strengths • Variety of viscosities • Color coded • High thermal and chemical resistance • Can post-apply wicking grade products • Wide variety of products available	• Semisolid form will not drip or migrate • Controlled strengths • Color coded • High thermal and chemical resistance • Packaged for manual, semi-automated and fully automated applications	• Compatible with plastics • Fast cure
Key Limitations		• Not for use on plastics	• Not for use on plastics • Cannot be post-applied	• Low thermal and chemical resistance
PERFORMANCE				
Suitable For Use With	Metals	Yes	Yes	Yes
	Plastics	No	No	Yes
Temperature Resistance	Typical	-65°F to 300°F	-65°F to 300°F	-65°F to 180°F
	Maximum	450°F	300°F	180°F
PROCESSING				
Cure Speed	Fixture	5 - 10 minutes	1.5 minutes	1.5 minutes
	Full Cure	24 hours	24 hours	24 hours
LOCTITE® PRODUCTS		• 243™ – General purpose • 222™ – Low strength • 262™ – High strength • 290™ – Wicking grade • 2422™ – High temperature/removable • 2620™ – High temperature/high strength	• 248™ – General purpose paste • 268™ – High strength paste • 2033™ – General purpose gel	• 425™ – General purpose

For additional information on the Loctite® products listed, please refer to the product selector in the back of this guide or visit www.loctite.com/data sheets.

For more detailed information on a specific adhesive type, including an in-depth discussion of processing, please refer to that chapter of this guide.



TYPICAL APPLICATIONS



OVERVIEW

Anaerobic thread sealants seal and secure metal pipes and fittings by completely filling the space between the threads and hardening to prevent leakage. They have additives that facilitate assembly and maintain controlled strength to allow for easy removal with basic hand tools. The cured product has excellent temperature and chemical resistance, which is compatible with many of the most severe operating environments.

Anaerobic thread sealants have been replacing alternatives such as Teflon tape, pipe dope and specialty fittings for decades.

The advantages of anaerobic thread sealants over these methods are:

- Easy to automate
- No solvents
- Will not shred and contaminate systems
- Easy assembly
- Corrosion protection

METAL PARTS

Anaerobic thread sealants are the most widely used liquid product for sealing NPT pipe fittings. There is a large line of Loctite® Thread Sealants that offer a variety of viscosities, colors, strengths and cure speeds. The latest product innovation is a high temperature thread sealant capable of withstanding temperatures up to 550°F.

Loctite® QuickStix™ products are another recent Loctite® innovation that offers the same performance of a liquid anaerobic thread sealant in a non-migratory semisolid stick. The stick form allows the thread sealant to be applied to a fitting in any orientation without drips and ensures that excess adhesive will not migrate into the motor housing or moving parts, which could cause reliability issues.

PLASTIC PARTS

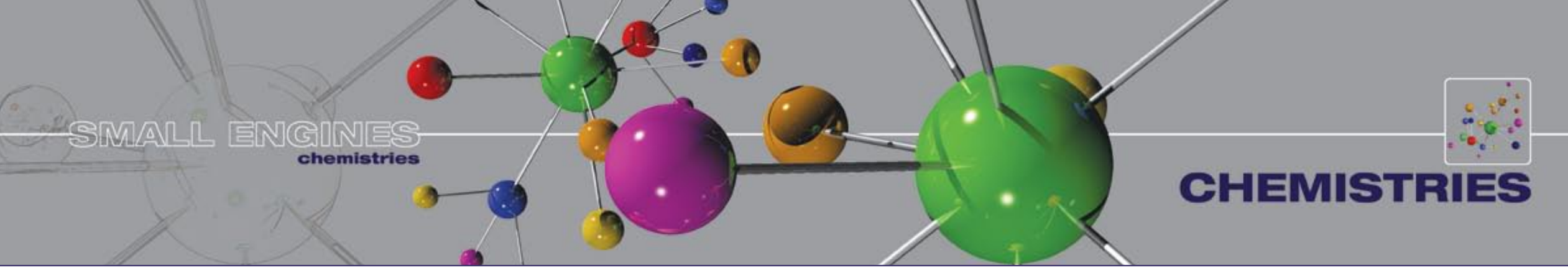
When thread sealing plastic fittings, Loctite® offers No More Leaks™ a solvent-based product that will not cause stress cracking of the plastic. Alternatively, Loctite® 55™ Sealing Cord may also be used. This is a PTFE-based cord that is used in a similar manner to Teflon tape.

TABLE 5. COMPARISON OF ADHESIVE TYPES FOR THREAD SEALING

ATTRIBUTE		METAL PARTS		PLASTIC OR METAL PARTS
		TRADITIONAL LIQUID SOLUTION	NON-MIGRATORY/ LESS MESSY	
OVERVIEW				
Key Benefits		• Controlled strengths • Variety of viscosities • High thermal and chemical resistance • Wide variety of products available	• Semisolid form will not drip or migrate • High thermal and chemical resistance	• Compatible with plastics
Key Limitations		• Not for use on plastics	• Not for use on plastics • Manual application only	• May contain solvents
PERFORMANCE				
Suitable For Use With	Metals	Yes	Yes	Yes
	Plastics	No	No	Yes
Temperature Resistance	Typical	-65°F to 300°F	-65°F to 300°F	-65°F to 300°F
	Maximum	400°F	300°F	400°F
PROCESSING				
Seals Operating Pressure		4 hours	4 hours	Instant
LOCTITE® PRODUCTS				
		• 565™ – General purpose • 545™ – Hydraulic/Pneumatic • 554™ – Refrigerant • 579™ – Instant seal • 592™ – Slow cure • 5770™ – High temperature	• 561™ – General purpose	• No More Leaks™ – Plastic fittings • Thread Sealant with PTFE – metal fittings • 55™ – Sealing Cord

For additional information on the Loctite® products listed, please refer to the product selector in the back of this guide or visit www.loctite.com/data sheets.

For more detailed information on a specific adhesive type, including an in-depth discussion of processing, please refer to that chapter of this guide.



OVERVIEW

For the efficient selection of adhesives, a three-step process is normally used.

1. Select chemistries. The adhesive chemistries that are best suited for the application are selected.

2. Identify candidates. The best adhesive grades from each chemistry are identified for further consideration.

3. Validate performance. Prototypes are created to validate that the assembly process meets all requirements.

Tables 6 and 7 are designed to assist design, manufacturing and quality engineers in understanding where different adhesive chemistries are used on small engines and to simplify comparisons between the adhesive chemistries.

Table 6 describes the typical applications of adhesives and sealants as they relate to each component.

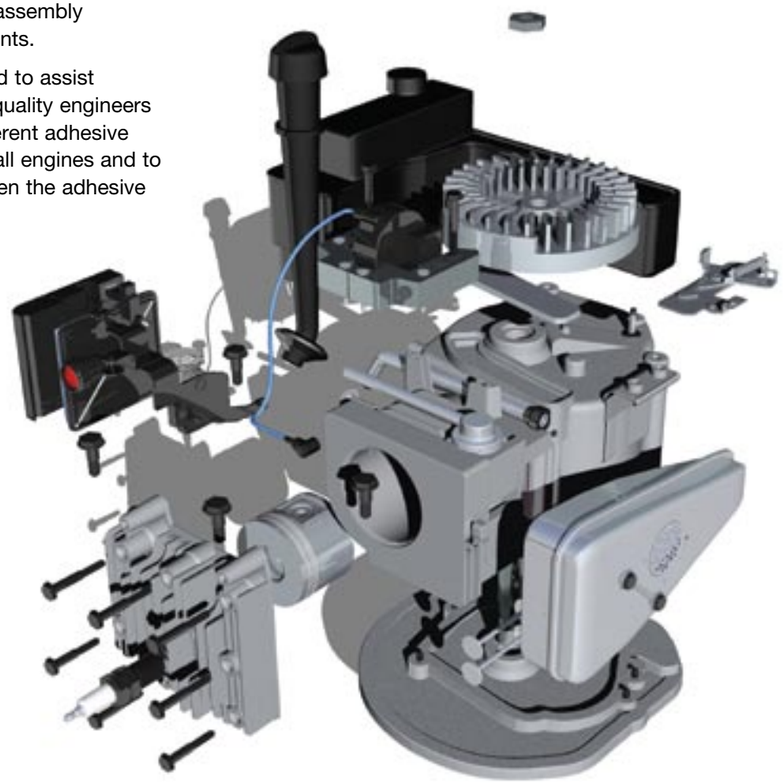


TABLE 6: APPLICATIONS SUMMARY

ENGINE COMPONENT	APPLICATIONS	ADHESIVE TYPES								
		ACRYLIC, TWO-STEP	ACRYLIC, TWO-PART	ANAEROBIC	CYANOACRYLATE	EPOXY	HOT MELT	LIGHT CURE	POLYURETHANE	SILICONE
Bearings	Retaining to housings or shafts			●	●					
Bolts	Preventing loosening and corrosion			●						
Brackets	Bonding to stators or housings	●	●		●					
Fittings	Sealing threaded fittings			●						
Gaskets	Replacing or augmenting gaskets			●						●
Gearboxes	Sealing covers, plugs and joint with housing			●						●
Housing	Attaching covers to block, plastic to plastic	●	●		●	●	●			
Ignition Coil	Potting wire and lamination stacks					●		●		
Keys	Retaining in slots on shafts			●	●					
Laminates	Bonding and unitizing	●		●	●	●		●		
Magnets	Bonding to rotors or housings	●	●			●	●			
Nameplates	Bonding to housing	●			●	●	●			
Rotors	Retaining to shafts			●	●					
Screws	Preventing loosening and corrosion			●	●					
Connectors	Sealing, potting and reinforcing						●		●	●

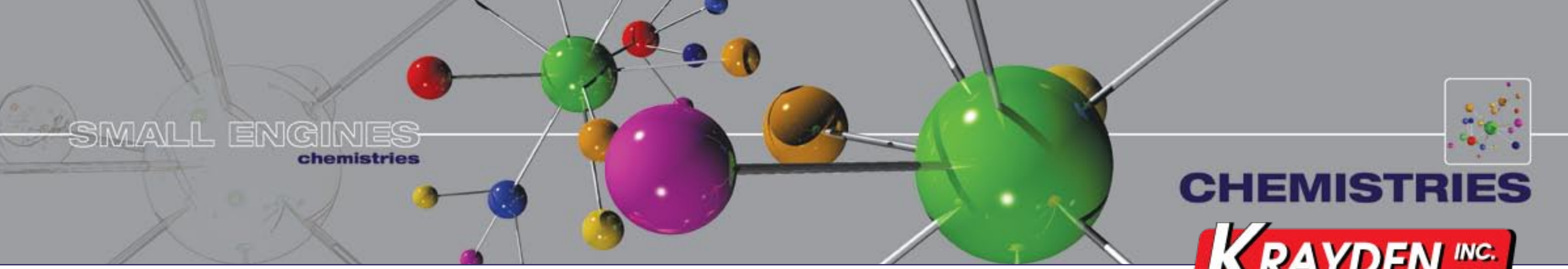


Table 7 is a summary that compares and contrasts the key attributes of the 10 different adhesive chemistries typically used on small engines.

TABLE 7. COMPARISON OF ALL ADHESIVE TYPES

ATTRIBUTE		ACRYLIC, LIGHT CURE	ACRYLIC, TWO-STEP	ACRYLIC, TWO-PART	ANAEROBIC	CYANOACRYLATE		EPOXY, ONE-PART HEAT CURE	EPOXY, TWO-PART	HOT MELT	SILICONES, RTV	URETHANES, TWO-PART
OVERVIEW												
Key Benefits		• Fast fixture speed • Fast full cure • Good adhesion	• Fast fixture speed • No mixing • High impact strength • Light cure available	• High gap fill • Structural strengths • High impact strength • Able to cut through surface contaminants	• High strength • Excellent chemical resistance to polar solvents • Good temperature resistance	• Fast fixture speed • Excellent adhesion to plastics and elastomers • Light cure available		• High gap fill • Excellent temperature resistance • Excellent chemical resistance • Fully cured in one hour	• Room temperature cure • High gap fill • Excellent temperature resistance • Wide variety of formulations	• Fast fixture speed • Low volumetric cost • Many types of hot melts offer a wide range of performance	• High thermal resistance • High flexibility • High gap fill • Excellent environmental resistance • Light cure available	• Low volumetric cost • High flexibility • Good UV resistance
Key Limitations		• Light source required • Shadowed areas may not cure • Low gap fill	• Limited gap fill • Must control activator amount precisely • Activator may contain solvents	• Long cure time • Will cure in mix tip during idle times • May have strong odor • May have flammable vapors	• Cure speed dependent upon substrate • May require use of primer • Poor adhesion to and may stress crack plastics	• Low gap fill • Low temperature resistance • Durability may be affected by substrate corrosion		• Curing equipment required • Long cure times • Parts must withstand heat • Must allow parts to cool	• Long cure times • Adhesive cures in mix tip • Limited adhesion to plastics and elastomers • Equipment needed for bulk dispensing	• Dispensing equipment required • Hot dispense point • May have poor adhesion to metals • Durability may be affected by substrate corrosion	• Slow moisture cure • Low cohesive strength • Low chemical resistance • Cannot be painted	• Must be mixed • Long cure time • Sensitive to moisture during processing • Must handle isocyanates
PERFORMANCE												
Adhesive to Substrates	**Metals**	Good	Excellent	Excellent	Excellent	Very Good		Excellent	Excellent	Good	Good	Good
	Plastics	Excellent	Good	Very Good	Poor	Excellent		Good	Good	Very Good	Fair	Very Good
Gap Fill	**Ideal**	0.002 - 0.010"	0.002 - 0.004"	0.010 - 0.040"	0.001 - 0.005"	0.002 - 0.006"		0.004 - 0.006"	0.002 - 0.010"	0.002 - 0.005"	0.004 – 0.006"	0.004" – 0.006"
	Maximum	0.250"	0.040"	>0.50"	0.020"	0.010"		>0.50"	>0.50"	0.25"	0.25"	>0.50"
Shear Strength		High	High	High	High	High		High	High	Low	Low	Medium
Peel Strength		Medium	Medium	High	Low	Low		Medium	Medium	Medium	Medium	Medium
Elongation / Flexibility		Medium	Medium	High	Low	Low		Low	Low	High	Very High	High
Temperature Resistance	**Typical Range**	-65°F to 300°F	-65°F to 300°F	-65°F to 300°F	-65°F to 300°F	-65°F to 180°F		-65°F to 350°F	-65°F to 300°F	-65°F to 250°F	-65°F to 400°F	-65°F to 250°F
	Maximum	350°F	400°F	350°F	400°F	250°F		400°F	400°F	330°F	600°F	300°F
PROCESSING												
Number of Components		1	2	2	1	1		1	2	1	1	2
Fixture Time	**Average**	30 seconds	1 - 2 minutes	15 - 30 minutes	30 - 60 minutes	30 seconds		30 - 45 minutes	30 minutes	30 seconds	15 - 30 minutes	30 minutes
	Fastest	5 - 10 seconds	15 - 30 seconds	3 - 5 minutes	5 - 10 minutes	5 - 10 seconds		15 - 30 minutes	3 - 5 minutes	5 - 10 seconds	10 minutes	5 - 10 minutes
Full Cure		30 sec	24 hours	24 hours	24 hours	24 hours		1 hour	24 hours	<4 hours	24 hours - 7 days	24 hours
Light Cure Available		Yes	Yes	No	Yes	Yes		No	Yes	No	Yes	No
Equipment Required		Light Source	No	Two-Part Dispense Equipment	No	No		Heat Cure Oven	Two-Part Dispense Equipment	Hot Melt Dispenser	No	Two-Part Dispense Equipment