HENKEL ADHESIVES.

TECHNICAL SUPPORT GROUP

APPLICATION ENGINEERING LABORATORY REPORT

TITLE:	Bonding trials and application process for bonding braided stainless steel wire to turnbuckle ends for cosmetic use on stair units
Project Number	PN12353
CUSTOMER:	**FH Brundle** 81-82 Middlemore Industrial Estate Middlemore Road Smethwick Birmingham B66 2EP
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20th January 2009

SUMMARY:
Henkel Loctite Adhesives were tasked to assess the best was to bond stainless steel cables to stainless turnbuckles after several types of adhesive were tested, Tests on Loctite 454 indicated that the product could be suitable for this application however further testing with this product in the application is recommended.

The data contained herein are furnished for information only and are believed to be reliable.
It is recommended that each user tests the proposed application before use, using this data as a guide

1. INTRODUCTION.

FH Brundle approached Henkel to look at the bonding of turnbuckle ends to stainless steel braided cable, these were to be used on stair units joining the banister to the lower section, although they are essentially cosmetic. A roll of cable with number of ends were supplied for trials, although cutting this cable with various tools at Henkel caused the cable to fray, the best option was to use a guillotine, this was not perfect but gave a consistent result to test various adhesives with.

2. PRODUCT

LOCTITE® 638 is designed for the bonding of cylindrical fitting parts, particularly where bond gaps can approach 0.25 mm (0.01 in.) and where maximum strength at room temperature is required. The product cures when confined in the absence of air between close fitting metal surfaces and prevents loosening and leakage from shock and vibration. Typical applications include locking bushings and sleeves into housings and on shafts.

LOCTITE® 7649™ is used where increased cure speed of LOCTITE® anaerobic products is required. It is especially recommended for applications with passive metals or inert surfaces and with large bond gaps. LOCTITE® 7649™ is particularly recommended when prevailing temperature is low (<15 °C).

LOCTITE® 480™ is a rubber toughened adhesive with increased flexibility and peel strength along with enhanced resistance to shock.

LOCTITE® 435™ is a rubber toughened adhesive with increased flexibility and peel strength along with enhanced resistance to shock. The product provides rapid bonding on a wide range of materials, including metals, plastics and elastomers, as well as porous and absorbent materials like wood, paper, leather and fabric.

LOCTITE® 454™ is designed for the assembly of difficult to-bond materials which require uniform stress distribution and strong tension and/or shear strength. The product provides rapid bonding of a wide range of materials, including metals, plastics and elastomers. LOCTITE® 454™ is particularly suited for bonding porous or absorbent materials such as wood, paper, leather and fabric. The gel consistency prevents adhesive flow even on vertical surfaces.

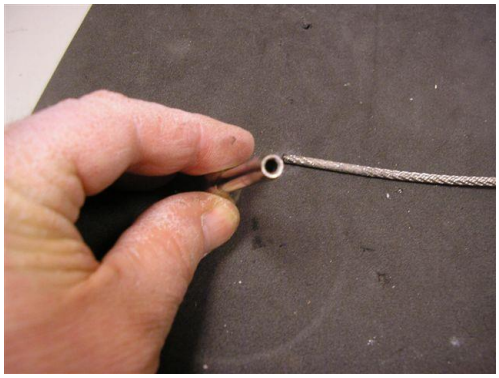
Hyson® 3430™ is a two component, clear epoxy adhesive which cures rapidly at room temperature after mixing. It is a general purpose adhesive which develops high strength on a wide range of substrates. The gap filling properties make this adhesive system suitable for rough and poorly fitting surfaces made from metal, ceramic, rigid plastics or wood.

3. INITIAL TESTING

All parts were cleaned with Loctite 7063 a non-CFC solvent based formulation for cleaning and degreasing of surfaces to be bonded with Loctite® adhesives. The product can also be used for cleaning and degreasing machine components during maintenance operations.
Initial testing was carried out on these parts with an anaerobic curing acrylic adhesive, due to the configuration of the joint, effectively you have a pin into a hole, However, anaerobic grades which cure in the absence of air on active metal, will only ever gap fill to 0.5mm It was ascertained that to effect a cure on this material activator 7649 was required,
To test the products a tensile test machine was utilised by clamping the turnbuckle at one end and the cables tightly clamped at the other.

Product	Where adhesive applied	Strength in N	Strength in Kg
638	Cable	102N	10.4Kg
638	Cable	194N	19.8Kg
638	In the turnbuckle	654N	66.7Kg

A limited number of parts were tested and logistically it is easier to apply the adhesive to the cable, although it was proven that the air trapped in the hole when the cable was inserted effective pushed some of the adhesive out of the hole, and thus low results were obtained. The strength on the one part tested where the adhesive applied to the turnbuckle was considerably higher as more adhesive would be left in the joint



Product	Where adhesive applied	Strength in N	Strength in Kg
638 with 7649	Cable	871N	88.8Kg
638 with 7649	In the turnbuckle	2149N	219.1Kg
638 with 7649	In the turnbuckle	1625N	165.6 Kg

Again a limited number of tests were carried out, however it can be seen that the use of the activator enabled the product to better fill the gaps created inside the joint which gave increased strength, and in this case the strength on the joint where adhesive was applied to the cable was improved although the trapped air would still be an issue and it would be difficult to achieve consistency.

Further testing was then carried out with the other adhesives mentioned above on single parts, this would give us indications rather evidence of good bonds as one test would always be considered inconclusive.

Product	Where adhesive applied	Strength in N	Strength in Kg

3430 epoxy	In the turnbuckle	2508N	255.7Kg
480 rubber toughened	In the turnbuckle	311N	31.7Kg
454 Gel	In the turnbuckle	1355N	138.1Kg
435 clear rubber toughened	In the turnbuckle	818N	83,4Kg

It was found that although the epoxy gave the best strength, it proved a very messy process and would not adapt well to a production process.
Cyanoacrylates require 12 hours for full cure and the above parts were left in excess of that time before testing, however initial grab is very good and further handling can be carried out within a few minutes.
The application of 454 was shown on a visit to the customer to the lab, and a test after 90minuteswas carried out:

Product	Where adhesive applied	Strength in N	When Tested	Strength in Kg
454		575N	After 90minutes	58.6Kg

To prove further curing was require the same test was repeated after full cure:

Product	Where adhesive applied	Strength in N	When Tested	Strength in Kg
454		3166N	72hours (weekend)	322.7Kg

4. DISCUSSION

A very small number of parts were tested with the various adhesives, and although inconclusive this trial indicated that the 454 would prove the most practical product to use in manufacture, and left long enough to fully cure gave comparable strengths to other adhesive types tested.
It is recommend before any commitment is given to this product that more intensive testing is carried out by the customer to ensure that the product can provide the consistency and strength required.

5. CONCLUSION:

A number of adhesive technologies could be used on this application as strength was not a major issue. Although Anaerobic curing acrylics would normally be the first choice, due to the inconsistency of the gaps caused by the braiding, this type of adhesive was disregarded. An epoxy proved too messy, although very strong. A range of Cyanoacrylates were tested and 454 gel proved to offer the best option of fast grab and good strength. Further testing should be carried out before adopting this product.

END