ThreeBond
TECHNICAL NEWS

Three Bond Technical News
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"Female thread precoat locking agent" and "Newly developed precoat sealants"

Introduction

Currently, Three Bond bolts, precoated using the MEC process (Mec bolts) are used in fasteners in a variety of fields.

However, because the MEC process cannot be used when screws are directly screwed into parts, anaerobic sealants and mechanical fasteners (castled nut etc.) have been used.

In response Three Bond has developed a MEC process for nuts. We are pleased to introduce the Three Bond 2481 which has the microcapsule coating on the inside of the nut.

We will also introduce a new precoat sealant, the Three Bond 2353 which has greatly improved seal performance and chemical resistance compared to our Sealock products. (Three Bond refers to parts, such as bolts and plugs, that are fastened with sealant as Sealock.)

(* MEC is an abbreviation for microencapsulation.)

Contents

I. Three Bond

1. Necessity of "MEC nuts"

1-1. Types and features of locking agents

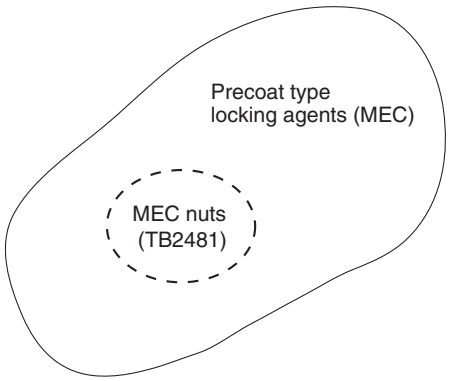
Form	Solvent locking agent	Anaerobic locking agent	Precoat locking agent
Features	Hardens through the vaporization of the organic solvent. Slow hardening, low strength and they are easy to paint due to a comparatively low viscosity. Inexpensive and good storage stability.	Hardens mainly through reactions to the removal of the atmospheric oxygen. Various strengths and hardening speeds are available. Excellent chemical resistance.	Hardens through the reaction of the main agent and hardener released by the destruction of the microcapsule. Good performance at assembly. Hardens even when the screws' threads have imperfections.
Applications	Used for sealing screws, fitted parts, and junction planes. Widely used for small to large diameter pipe threads. As for the screws, they are used to affix small screws in parts with a minimal electric current.	Used for sealing screws, fitted parts, and junction planes. Used for locking bolts that need comparatively high strength.	Exclusively used for screws. Used in a variety of applications: from glasses to large diameter bolts for construction machinery etc. There are a lot of small diameter screws used for small diameter pipe fasteners in automotive parts.
Product Name	TB1400 series	TB1300 series TB3000 series TB1110B	TB2400 series

1-2. The position of MEC as a locking agents

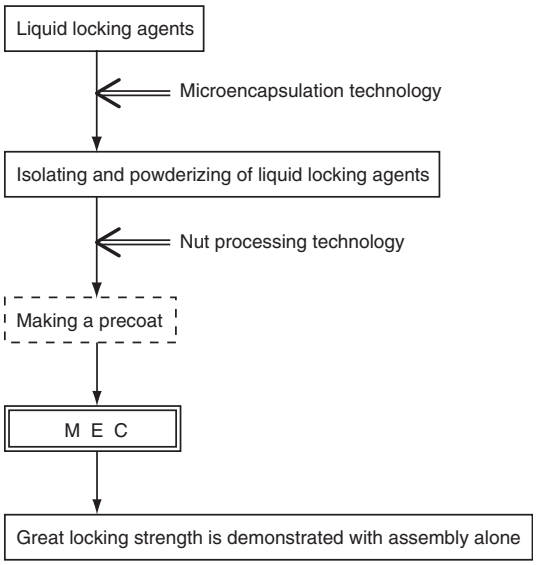
Liquid locking agents

Downside of liquid locking agents

1) Application work (Workability, time, applicator)
2) Environmental pollution and shrinkage (solvent type)
3) Skin irritation and odor (anaerobic)
4) Uneven application
5) Inferior immediate effectiveness
(Not appropriate for the assembly line because of solvent vaporization and hardening time)



1-3. What are MEC nuts?



Processing technology which gives the nut itself extra locking strength through applying the microcapsuled high-reactivity locking agent which prevents screws from loosing.

MEC bolts as well as the development of MEC nuts have made large contributions to the industrial world in the area of fasteners.

1-4. The birth of "MEC nuts"

Threebond has been concentrating on research and development with our focus being "to develop products that are higher quality and cost less at the same time." We have introduced the solvent type locking agent (TB1400 series) and the anaerobic locking agent (TB1300 series), which have become very well trusted. However, when liquid locking agents are used for screws, workability decreases. This combined with the fact that precoated nuts and bolts result in a reduction of total cost has lead to a tendency toward precoated nuts and bolts.

Moreover there has been demand for the reduction of weight in the transportation industry as a result of the desire to protect natural resources and to reduce environmental pollution, etc.. As for the fastening industry, it has shifted from mechanical fasteners, split pins and caulking plates, to chemical fasteners like anaerobic locking agents and MEC.

As a result, Three Bond focused on researching and developing our nut processing technology, which lead to the establishment of nut processing technology and the birth of our newly formulated "MEC nuts" (Three Bond 2481). This newly formulated product resolves the problem we had with our existing products (when nuts were fastened deeper the amount of capsule remaining on the fastening surface decrease, reducing the locking power).

2. Outline

Three bond 2481(Hereafter, abbreviated as TB2481) is a product in which the microcapsule locking agent is applied to the inner side of nuts, which results in the same excellent locking strength and chemical resistance as existing MEC processed products.

As for the coating that is applied the inner side of nuts, there was a problem whereby nuts that were fastened deeper, resulted in a decrease in the amount of the capsule that remained on the fastening surface, which in turn lead to a decrease in locking strength. However, the TB2481 because of its original formula is able to achieve the same locking strength as the MEC ,mid-strength bolts even when it is fastened to a deeper level.

Here is the comparison of the extrusion rate[*1] and adhesive strength of existing MEC products, not including those where the nut is coated on the inside, with TB 2481. (Figure 1)

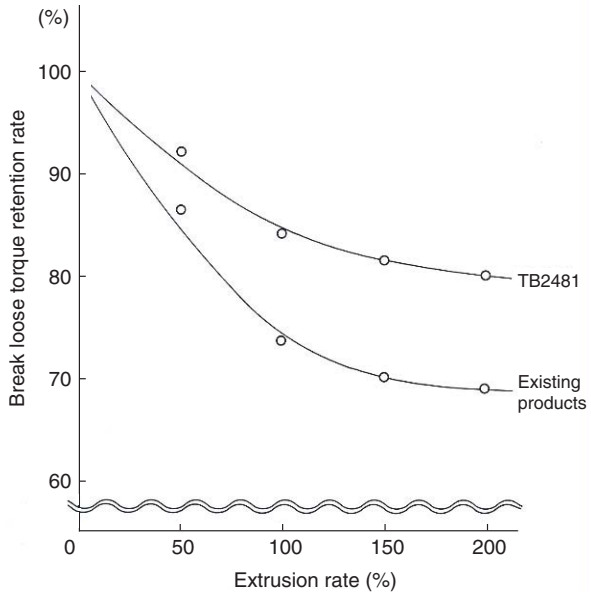
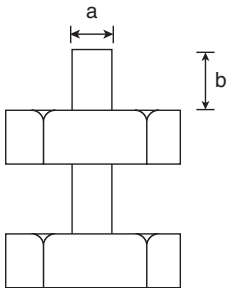


Figure 1

<Test conditions>

- Tightening torque.....29N•m{300kgf•cm}

*1 • Extrusion rate.....S(%) = b/a×100



a: Bolt diameter

b: Flush length from the nut

2-1. General properties

Appearance	Standard hardening time	Adhesive strength *2 N•m{kgf•cm}
Red	25°C 48 hours	40{410} ~ 60{610}

*2: JIS Class 2 M10×P1.5 plain steel bolt, Nut 29N•m{300kgf•cm}

Return torque after leaving at 25°C for 48 hour

2-2. Hardening mechanism

The resistance when the screw is fastened ruptures the microcapsules and the adhesives in the microcapsules ooze out. Those adhesives harden in short period of time at room temperature, and demonstrate the adhesive strength.
(Figure 2)

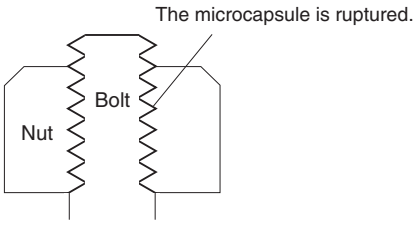


Figure 2

3. Feature

3-1. Shelf-life

The nuts treated with the TB 2481 coating processes show minimal degradation over time, and the adhesive perform at their initial strength after 6 months at room temperature.

3-2. Hardening speed

When TB2481 is applied to an M10 plain steel bolt, it reaches its maximum strength at room temperature 48 hours after fastening. (Refer to Figure 3)

<Test conditions>

- Tightening torque•29N•m{300kgf•cm}
- Extrusion rate•50%
- The bolt used•JIS class 2 M10×P1.5 plain steel

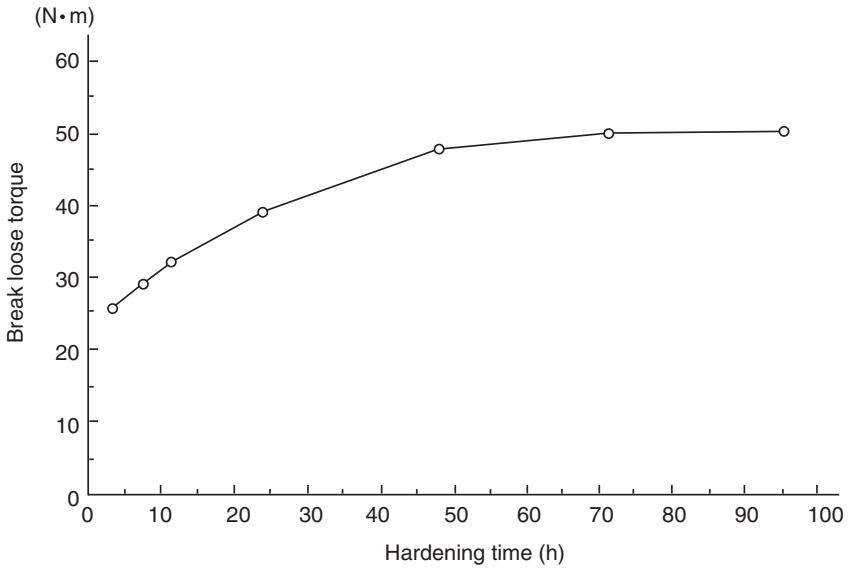


Figure 3

3-3. Relevance between material and adhesive strength

Adhesive strength varies slightly varies depending on the type of nuts and bolts used, however, most materials exhibit excellent adhesive strength. (Refer to Figure 4.)

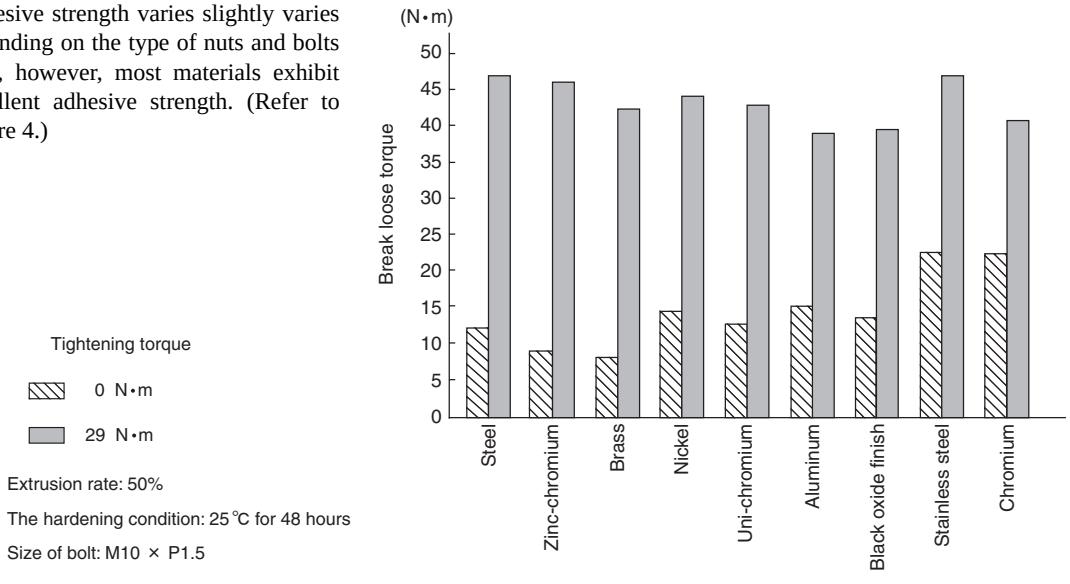


Figure 4

3-4. Adhesive strength at various temperatures

The adhesive strength of TB 2481 decreases when it is heated, however, the adhesive strength is greater than the initial tightening torque even around 100°C. (Refer to Figure 5.)

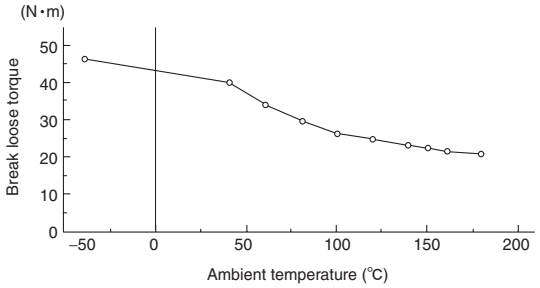


Figure 5

<Test conditions>

Tighten to 29N•Em, leave at 25°C for 48 hours to harden. The nuts are then left at a constant temperature for two hours after which the break loose torque is measured. This is repeated for several temperatures.

- Extrusion rate 50%
- Nuts and bolts used .....JIS class 2 M10×P1.5 Zinc chromated

3-5. Heat deterioration test

There is only a minimal decrease in adhesive strength in the heat deterioration test (240hours at 150°C) and a stable adhesive strength is achieved. (Refer to Figure 6.)

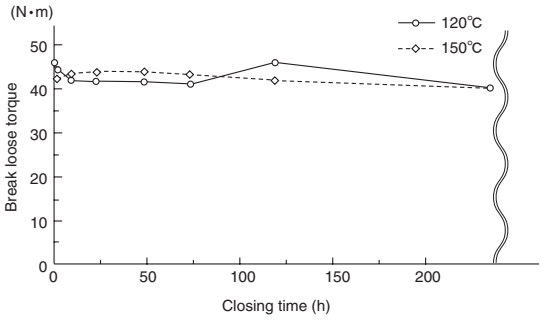


Figure 6

<Test conditions>

Tighten to 29N•Em, harden at 25 °C for 48 hours, then expose to a certain temperature and remove it after a certain period of time, let it cool and measure the break loose torque. Repeat at different temperatures.

- Ambient temperature.....12°C, 150°C
- Nuts and bolts used .....JIS class 2 M10×P1.5 Zinc chromated
- Extrusion rate 50%

4. Summary

There are several different locking methods for the screw fasteners, however, applications for TB2481 will increase when mechanical fastening is replaced by the precoat chemical fastening methods due to recent demand for a reduction in weight, labor or cost.

II. Three bond 2353

1. Outline

Recently, the performance requirements for heat resistance, weight reduction and long-term durability in the transportation industry have increased. Three Bond 2353 has been developed to satisfy those performance requirements (Hereafter, abbreviated as TB2353).

TB2353 Sealock is a fluorocarbon polymer, whose principal component is acrylic resin, with superb sealing performance, heat resistance, chemical resistance and is not easily chewed up when the bolt is tightened.

Possible uses include sealing the piping and plugs in the oil systems, water systems and fuel systems in engines and transmissions.

1-1. General characteristics

Appearance	Sealing performance (M10 bolt Tightening torque 29N•m{300kgf•cm})
White	Heating at 150°C 78Mpa{80kgf•cm^2} or more

1-2. Performance comparison with existing products

Material product name	Color	Temperature limits	Pencil hardness	Water (95°C)	Engine oil (95°C)	ASTM No.2 oil (95°C)	Principal component	Main properties
TB2310	Yellow	150°C	6B	5	4	4	Silicone	Excellent heat resistance Low tightening resistance
TB2302	Green	100°C	HB	5	5	5	Alkyd	For general use Excellent chemical resistance
TB2306	Red	120°C	2H	5	5	5	Melamine	Excellent chemical resistance
TB2350	White	80°C	2B	4	4	5	Acrylic•Fluorine	The tightening frictional resistance is low.
TB2350B	White	80°C	3B	4	4	5	Acrylic•Fluorine	The tightening frictional resistance is low.
TB2353	White	150°C or more	6B or less	5	5	5	Acrylic•Fluorine	Excellent heat resistance Good seal performance Excellent chemical resistance Little tightening resistance, hard to chew up.

Note) 5 is better than 4

1-3. Sealing functions

The paint film of TB2353 is flexible and easy to stretch when tightening, even the small gaps are filled. Therefore, the TB2353 exhibits good seal performance even if the screws have minor imperfections.

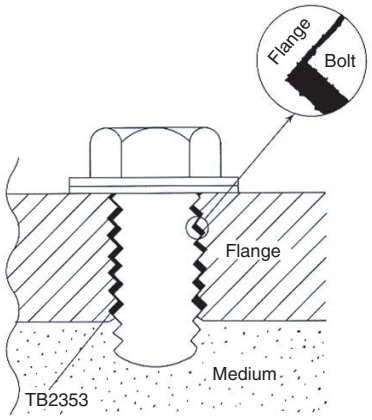


Figure 1

2. Feature

2-1. Shelf-life

The bolts (plug) coated with the TB2353 process experience minimal degradation over time and perform up to initial standards after 6 months at room temperature.

The change in tightening resistance of the bolts coated with the TB2353 process compared with bolts coated with the existing Sealock TB2350 process is shown in Figure 2.

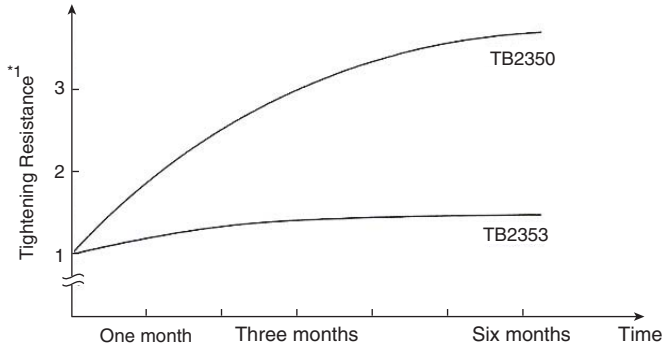


Figure 2

*1 Tightening resistance: Tightening resistance was measured over the storage period. The tightening resistance of the bolt immediately after processing is 1.

2-2. Seal performance test

Comparison between existing products and TB2353

a) Seal performance tests at room temperature

Figure 5 shows the leakage when the pressure maintained on the screw was up to 2.0MPa{20kgf/cm^2}. The test equipment is shown in Figures 3 and Figures 4.

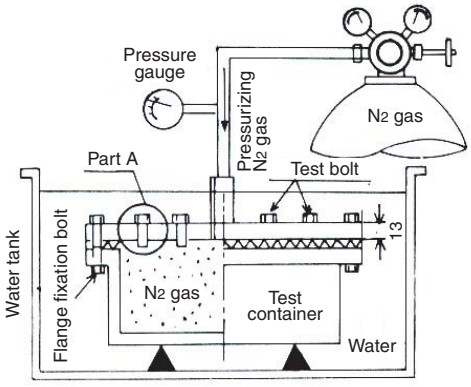


Figure 3. Overview

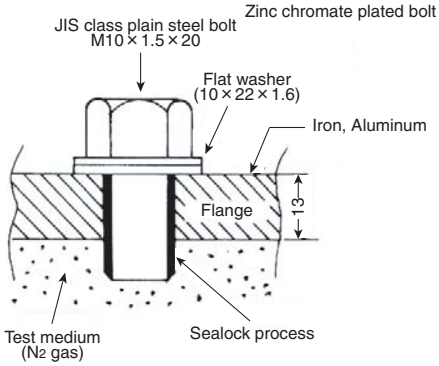


Figure 4. Detailed view of part A

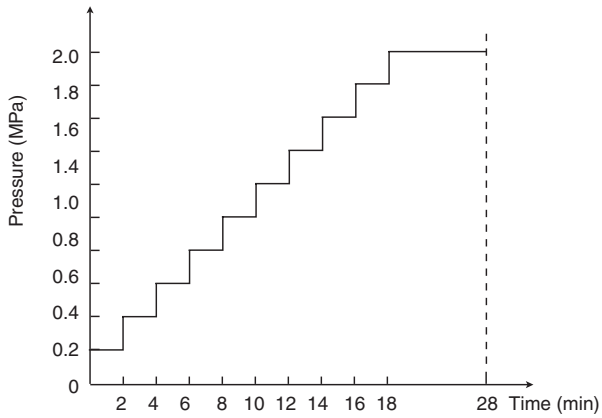


Figure 5

Tightening torque	29N•m{300kgf•cm}
Flange	Steel, Aluminum
Test medium	N2 gas
The number of the bolt tested	n=10

<Test results>

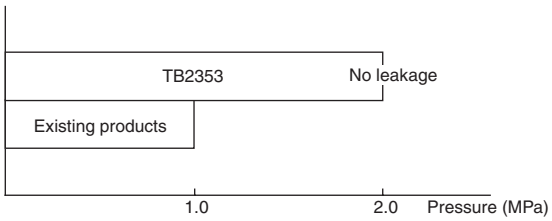


Figure 6

b) Seal performance tested under the heat

Leakage was checked using the methods described in a) and the equipment shown in Figure 7 and Figure 8.

Pressure of up to 7.8MPa{80kgf/cm^2} was maintained on the screw while exposed to a temperature of 150°C.

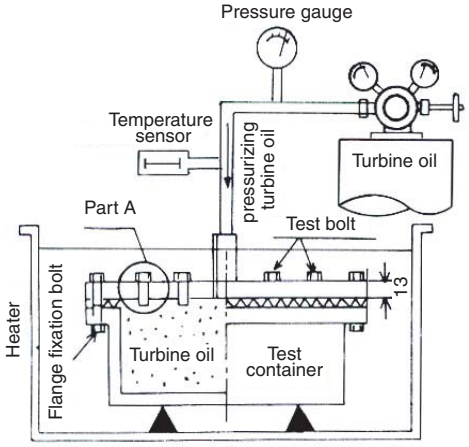


Figure 7. Overview

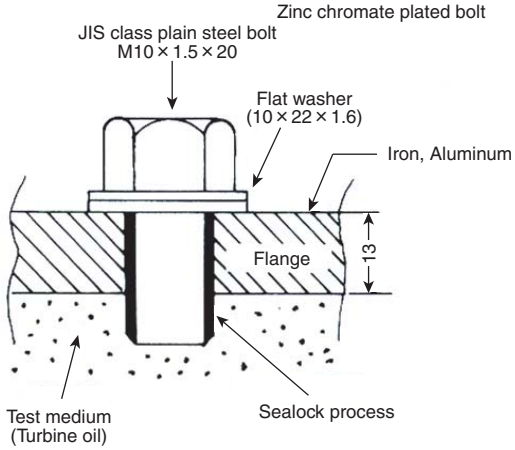


Figure 8. Detailed view of part A

Tightening torque	29N•m{300kgf•cm}
Flange	Steel, Aluminum
Test medium	Turbine oil
The number of the bolt	tested n=10
Test temperature	150°C

<Test results>

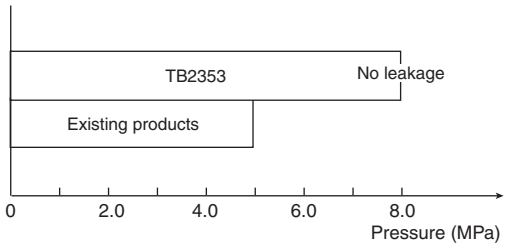


Figure 9

Note) The above-mentioned test results are not product standards.

Please use after checking with the parts in

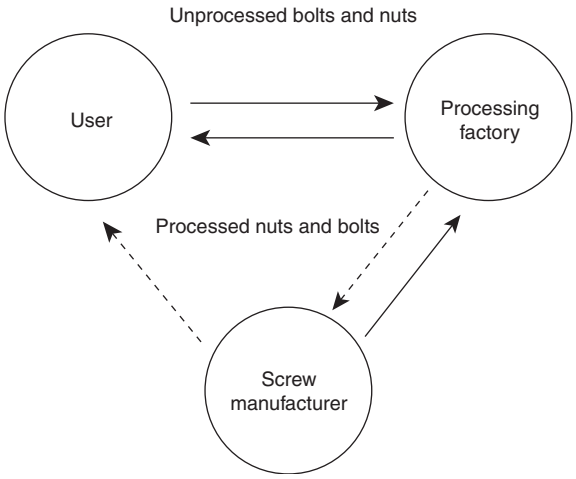
3. Summary

Over the years, Three Bond has researched and developed Sealock, a product that gives the screw itself the ability to form a seal because of the application of a resin to the threads of bolts. Three Bond through its ability to overcome many difficult problems has been able to adequately meet our customer’s needs.

TB2353 was developed to meet the needs of those customers whose needs have become more strict and complex and we will continue to pursue our goal of reducing labor, weight and costs for our customers in the future.

III. Processing and Sales system

Currently we ask our customers to supply the nuts and bolts they are using at their factory or get them sent directly from the screw manufacturer, we then apply the MEC process to those nuts and bolts at one of our nine factories in Japan and finally we deliver them directly or through the screw manufacturer.



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