ThreeBond

2010.8.25
Three Bond Co., Ltd.

Technical Data
ThreeBond 2488
Pre-coated bolts MEC process
(water-based acrylic type for nut)

1. Product description

ThreeBond 2488 is an acrylic-based locking agent for pre-coated nuts. This product is a water-based agent, does not containing organic solvents, is an environmentally-friendly microencapsulated thread locking agent.

When a bolt processed with ThreeBond 2488 is screwed, the microcapsules are broken, and the acrylic resin reacts with the curing agent to prevent loosening of the threaded portion.

Hereinafter, ThreeBond is abbreviated as TB.

2. Features

(1) Medium level of fixing strength
(2) Excellent heat resistance (Locking 130°C: Projection rate 50%)
(3) Applicable to minimum nut diameter of M3
(4) Standard drying conditions: 25°C for 24 hours

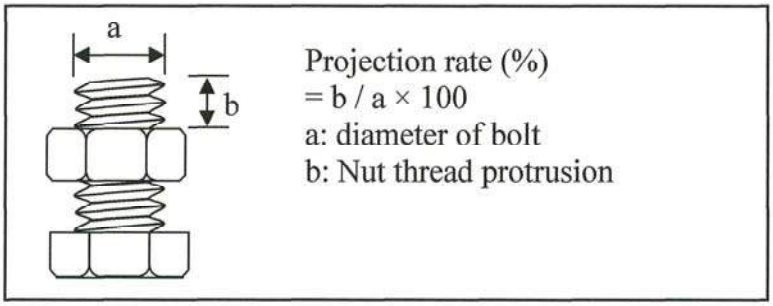

Fig.1 Projection rate

3. Applications

Nut locking

4. Properties

Table 1. Properties

Product name	TB2488
Primary component	Acrylic resin
Color	Blue

5. Characteristics

5.1 Curing rate

After the nuts are processed with TB2488 are tightened at the specified temperature, the fixing strength is measured after the specified time has elapsed.

- Bolts, nuts: JIS class 2 M10 x P1.5
  zinc plating chromate treatment
- Number of test pieces: n=5
- Tightening torque: 30N·m
- Projection rate: 50%
- Curing temperature conditions: -5°C, 5°C, 10°C, 25°C, 40°C
- Measurement conditions: 3TS-306-05

1) Curing rate at -5°C

Table 2. Curing rate at -5°C

Elapsed time (h)	Fixing strength (breaking torque) Range (N·m)	Average (N·m)
0.5	31.9 to 37.1	34.4
3	36.0 to 39.3	37.8
6	36.7 to 40.3	38.4
12	38.9 to 42.0	39.7
24	37.4 to 44.1	40.6
48	38.1 to 44.3	41.4
72	40.0 to 46.1	42.3

2) Curing rate at 5°C

Table 3. Curing rate at 5°C

Elapsed time (hrs)	Fixing strength (breaking torque) Range (N·m)	Average (N·m)
0.5	32.6 to 37.5	34.9
3	36.6 to 40.5	38.3
6	35.8 to 41.9	38.4
12	38.4 to 43.5	40.4
24	38.3 to 47.6	42.9
48	38.2 to 47.0	43.4
72	40.2 to 48.5	43.8

3) Curing rate at 10°C

Table 4. Curing rate at 10°C

Elapsed time (hrs)	Fixing strength (breaking torque) Range (N·m)	Average (N·m)
0.5	34.2 to 39.3	36.7
3	37.0 to 44.0	39.8
6	37.1 to 43.2	40.0
12	38.2 to 44.7	41.1
24	39.2 to 44.9	42.0
48	39.4 to 48.9	43.7
72	40.4 to 47.3	45.2

4) Curing rate at 25°C

Table 5. Curing rate at 25°C

Elapsed time (hrs)	Fixing strength (breaking torque) Range (N·m)	Average (N·m)
0.5	35.9 to 39.7	37.8
3	38.6 to 44.4	40.6
6	38.3 to 43.9	41.7
12	38.3 to 46.6	42.4
24	44.0 to 46.0	44.9
48	40.8 to 48.9	45.0

5) Curing rate at 40°C

Table 6. Curing rate at 40°C

Elapsed time (hrs)	Fixing strength (breaking torque) Range (N·m)	Average (N·m)
0.5	35.9 to 39.9	38.6
3	39.4 to 44.5	41.7
6	39.9 to 45.2	42.2
12	39.2 to 46.2	43.1
24	40.5 to 47.9	44.3
48	41.7 to 48.6	45.1

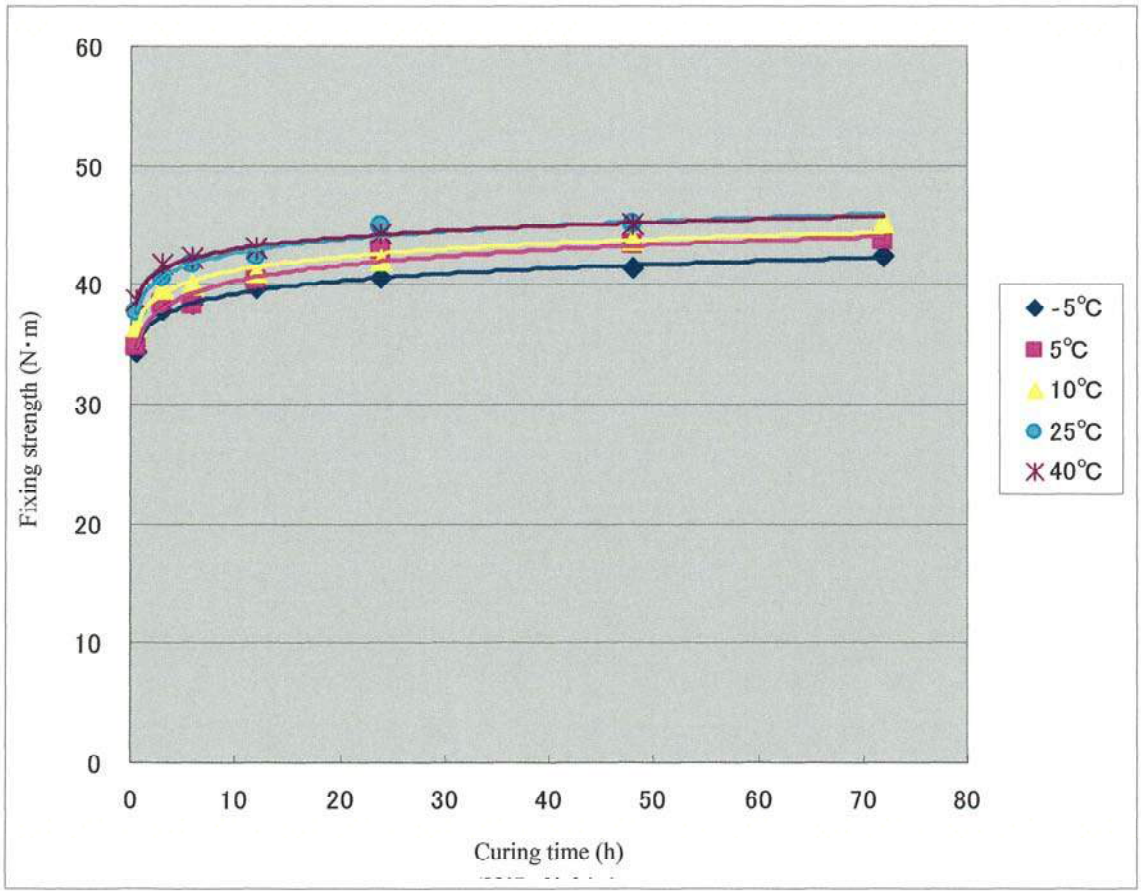

Fig.2 Curing rate

5.2 Projection rate and fixing strength

After nuts treated with TB2488 are tightened at each projection rate and the agent is cured at 25°C for 24 hours, the fixing strength is measured.

- Bolts, nuts: JIS class 2 M10 x P1.5
  zinc plating chromate treatment
- Number of test pieces: n=5
- Tightening torque: 30N·m
- Measurement conditions: 3TS-306-02

Table 7. Projection rate and fixing strength

Projection rate (%)	Fixing strength (breaking torque) Range (N·m)	Average (N·m)
0	41.0 to 42.0	41.7
25	42.5 to 45.0	43.8
50	44.0 to 46.0	44.9
75	42.0 to 44.5	43.5
100	40.5 to 45.0	43.0
125	41.5 to 44.0	43.3
150	40.0 to 42.5	41.0

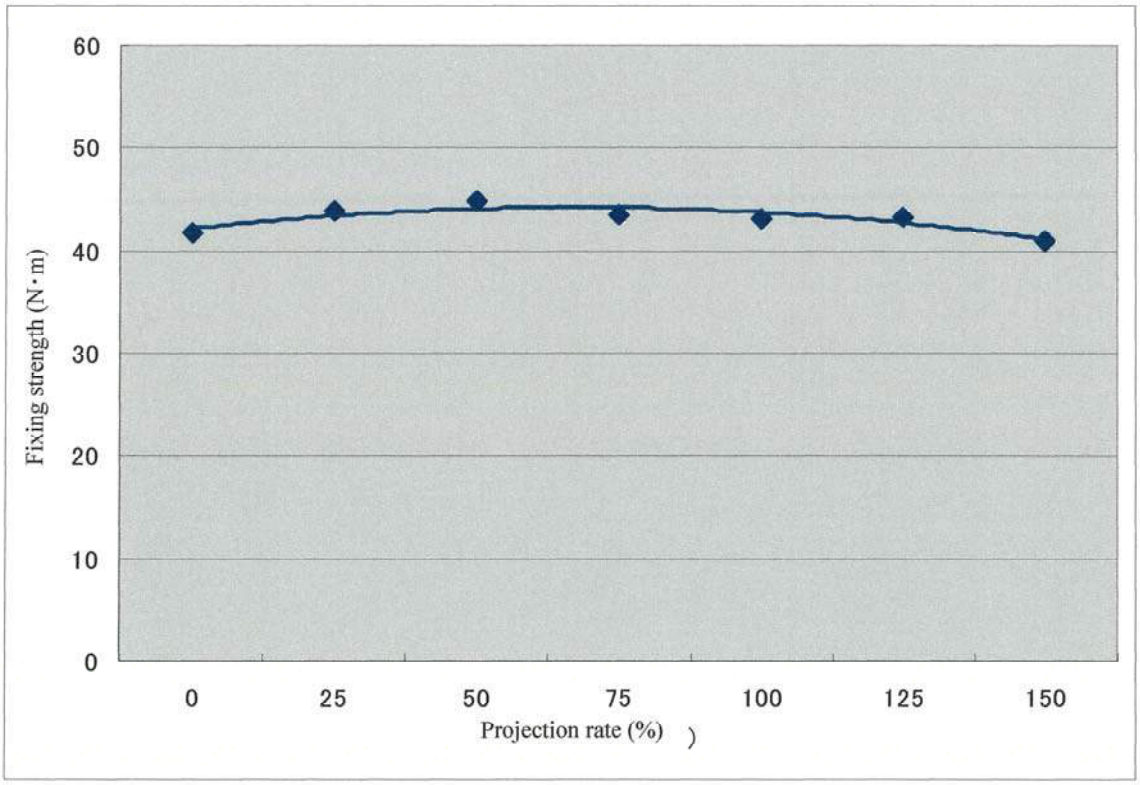

Fig.3 Projection rate and fixing strength

5.3 Fixing strength by size

After nuts treated with TB2488 are tightened and the agent is cured at 25°C for 24 hours, the fixing strength is measured.

- Bolt, nut: Zinc plating chromate treatment Sizes shown in the following table
- Number of test pieces: n=5
- Projection rate: 50%
- Measuring conditions: 3TS-306-05 (M10 nut) 3TS-306-02 (except M10 nut)

Table 8. Fixing strength at each size

Nuts Size pitch	Tightening torque (N·m)	Fixing strength (breaking torque) Range (N·m)	Average (N·m)
M3 P0.35	1.0	1.0 to 1.1	1.0
M4 P0.7	2.0	2.0 to 2.2	2.1
M6 P1.0	8.0	9.6 to 10.2	9.9
M8 P1.25	15	18.0 to 20.0	18.9
M10 P1.25	30	42.0 to 46.5	44.5
M10 P1.5	30	44.0 to 46.0	44.9
M12 P1.25	50	64.0 to 67.0	65.6
M12 P1.5	50	62.0 to 65.0	63.2
M12 P1.75	50	61.0 to 66.0	63.0
M14 P2.0	90	108.0 to 114.0	110.8

5.4 Fixing strength to various materials

After nuts treated with TB2488 are tightened and the agent is cured at 25°C for 24 hours, the fixing strength is measured.

- Bolts, nuts: JIS class 2 M10 x P1.5
- Number of test pieces: n=5
- Tightening torque: 30N·m (Only Brass and aluminum bolts: 15N·m)
- Projection rate: 50%
- Measurement conditions: 3TS-306-05

Table 9. Fixing strength to each material

Bolts and nuts materials	Fixing strength (breaking torque) Range (N·m)	Average (N·m)
Plain steel	42.1 to 44.1	43.1
Zinc plating chromate treatment	44.0 to 46.0	44.9
Chromium plating	39.4 to 45.7	42.5
Nickel plating	38.9 to 43.2	40.8
Unichrome plating	40.2 to 43.2	41.5
Black oxide	39.2 to 43.8	40.8
SUS304	39.4 to 43.9	41.1
Brass	35.2 to 38.6	36.5
Aluminum	20.9 to 24.9	22.4

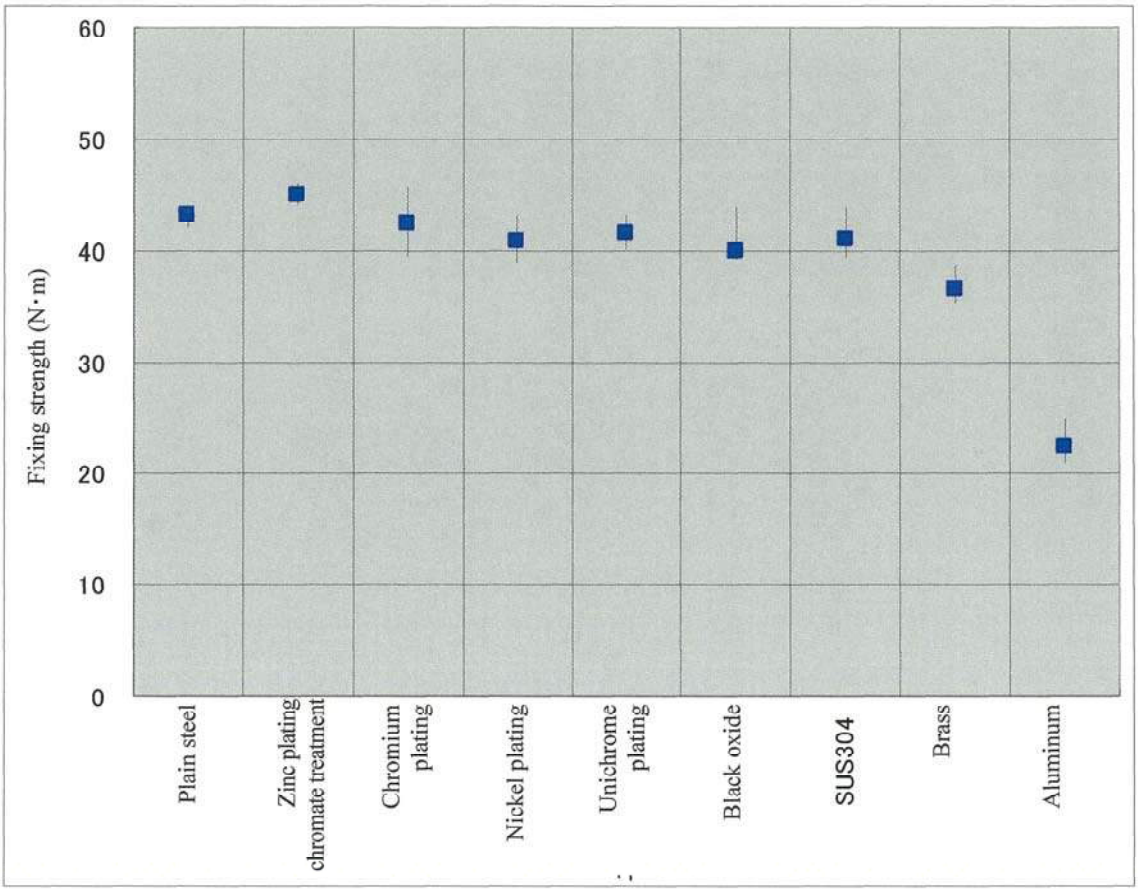

Fig. 4 Fixing strength to each material

5.5 Chemical resistance test

After nuts treated with TB2488 are tightened and the agent is cured at 25°C for 24 hours, the bolts are immersed in each medium. After a lapse of the specified time, the bolts are taken out from the medium, and the fixing strength is measured.

- Bolts, nuts: JIS class 2 M10 x P1.5
  zinc plating chromate treatment
- Number of test pieces: n=5
- Tightening torque: 30N·m
- Projection rate: 50%
- Measurement conditions: 3TS-306-05

Table 10. Chemical resistance test

Test medium	Immersion conditions	Fixing strength (breaking torque) Range (N·m)	Average (N·m)
Blank		44.0 to 44.6	44.9
NaOH 10%aq	25°C×7 days	37.4 to 41.6	40.3
Gas oil	40°C×7 days	38.6 to 43.9	41.2
Gasoline	40°C×7 days	40.8 to 44.3	43.5
n-hexane	40°C×7 days	39.0 to 45.7	41.9
Methanol	40°C×7 days	37.4 to 50.7	44.2
Water	100°C×7 days	37.7 to 45.6	42.0
ethylene glycol	100°C×7 days	38.2 to 50.9	42.3
ethylene glycol 50%aq	100°C×7 days	35.4 to 44.3	40.3
Engine oil	100°C×7 days	38.3 to 42.4	40.2
Turbine oil	100°C×7 days	37.0 to 45.8	41.2
AT Oil	100°C×7 days	35.1 to 46.2	41.3
Gear oil	100°C×7 days	37.1 to 41.7	39.5

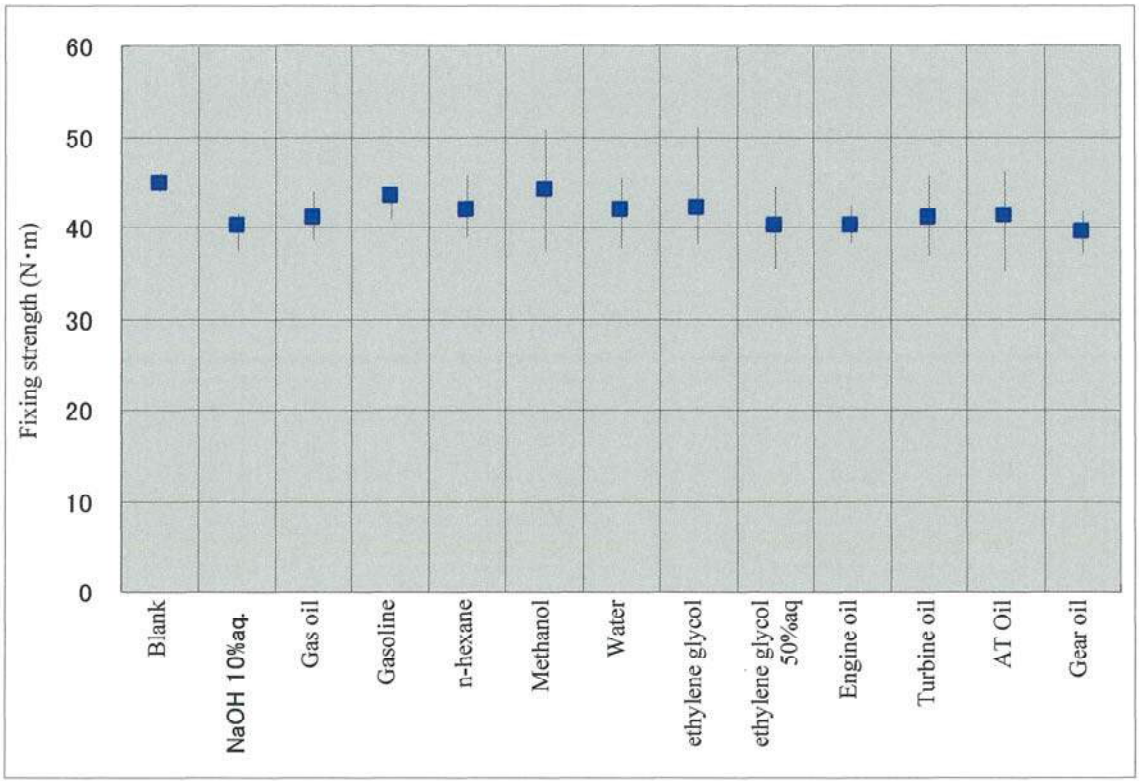

Fig. 5 Chemical resistance test

5.6 Heat deterioration test

Nuts processed with TB2488 are tightened, and they are exposed to each temperature after the agent is cured at 25°C for 24 hours. The bolts are taken out after a lapse of the specified time and cooled to room temperature, and the fixing strength is measured.

- Bolts, nuts: JIS class 2 M10 x P1.5
  zinc plating chromate treatment
- Number of test pieces: n=5
- Tightening torque: 30N·m
- Projection rate: 50%
- Temperature conditions: 100°C, 120°C, 150°C
- Measurement conditions: 3TS-306-05

1) 100°C

Table 11. Heat deterioration test at 100°C

Time of exposure	Fixing strength (breaking torque) Range (N·m)	Average (N·m)
Initial	44.0 to 46.0	44.9
7 days	39.5 to 48.1	42.3
14 days	39.5 to 42.1	41.2
21 days	36.9 to 41.5	40.0
28 days	36.6 to 41.4	39.9

2) 120°C

Table 12. Heat deterioration test at 120°C

Time of exposure	Fixing strength (breaking torque) Range (N·m)	Average (N·m)
Initial	44.0 to 46.0	44.9
7 days	37.8 to 43.4	40.5
14 days	38.0 to 45.9	40.4
21 days	37.2 to 42.2	39.4
28 days	36.4 to 40.0	38.3

3) 150°C

Table 13. Heat deterioration test at 150°C

Time of exposure	Fixing strength (breaking torque) Range (N·m)	Average (N·m)
Initial	44.0 to 46.0	44.9
7 days	36.3 to 40.6	38.6
14 days	35.6 to 40.5	37.7
21 days	34.8 to 40.2	37.4
28 days	34.7 to 39.1	36.8

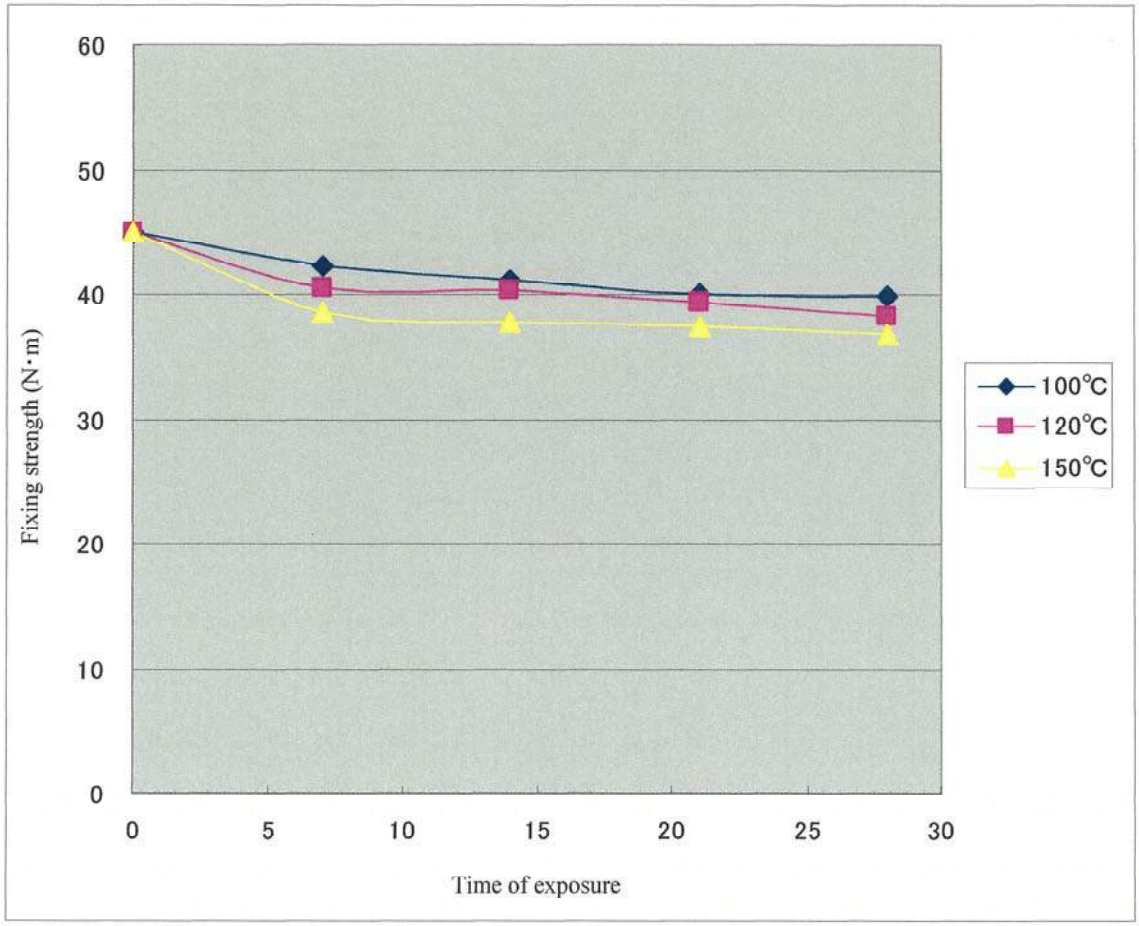

Fig. 6 Heat deterioration test

5.7 Fixing strength test at each temperatures

After tightening the nuts processed with TB2488, the bolts are cured at 25°C for 24 hours. Next, the bolts are held at specified temperatures for 2 hours then the fixing strength is measured at the specified temperature.

- Bolts, nuts: JIS class 2 M10 x P1.5
  zinc plating chromate treatment
- Number of test pieces: n=5
- Tightening torque: 30N·m
- Projection rate: 50%
- Measurement conditions: 3TS-306-02

Table 14. Fixing strength at each temperature

Test temperature (°C)	Fixing strength (breaking torque) Range (N·m)	Average (N·m)
25	44.0 to 46.0	44.9
60	35.0 to 40.0	37.5
80	35.0 to 38.0	36.4
100	30.5 to 37.0	34.7
120	32.0 to 34.5	33.4
130	30.0 to 33.5	31.4
150	24.5 to 28.5	27.4
180	20.0 to 23.0	21.1

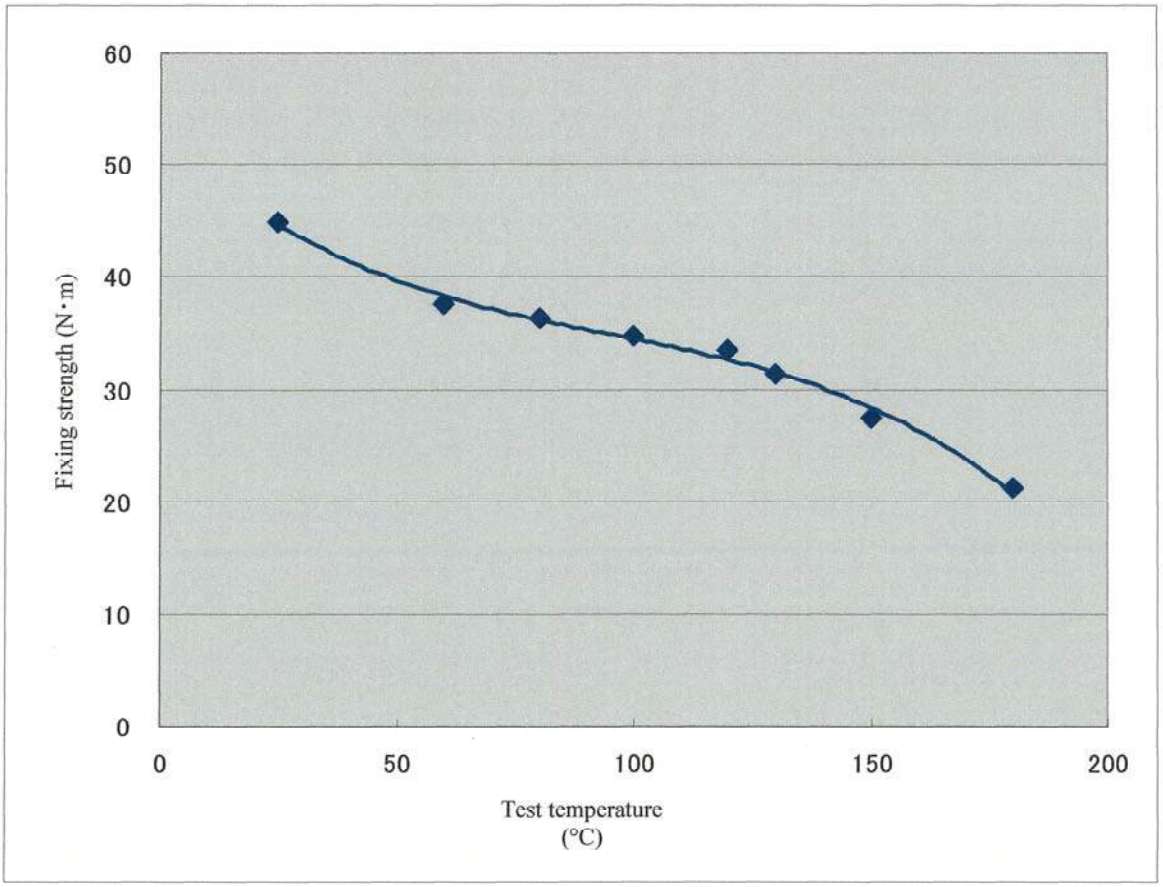

Fig. 7 Fixing strength at each temperature

5.8 Axial force at each tightening torque

Nuts treated with TB2488 are set on tightening testing equipment, and the axial force at each tightening torque is measured.

- Bolt: JIS, class 2 M10×1.5, zinc plated chromate treatment, hexagon headed bolts, tensile strength rank 10.9
- Nut: ISO Type 1, zinc plated chromate treatment, hexagon nuts
- Number of test pieces: n=5
- Testing equipment: Tightening testing equipment NST-500NM made by Japan Instrumentation System Co., Ltd.

Table 15. Axial force at each tightening torque

Tightening torque (N·m)	TB2488 Axial force (kN)			
	Projection rate 50%		Projection rate 80%	
	Range	Average	Range	Average
20	4.0 to 6.5	5.4	4.8 to 6.4	5.8
30	6.4 to 9.3	8.1	7.5 to 9.6	8.6
40	8.8 to 12.0	10.7	9.9 to 12.7	11.2
50	11.4 to 14.7	13.3	12.2 to 15.5	13.9
60	14.0 to 17.2	15.9	14.7 to 18.2	16.5
Tightening torque (N·m)	Non-coating Axial force (kN)			
	Projection rate 50%		Projection rate 80%	
	Range	Average	Range	Average
20	3.5 to 4.8	3.9	3.8 to 4.9	4.4
30	5.3 to 6.8	5.9	6.2 to 7.1	6.7
40	7.2 to 8.9	7.9	8.5 to 9.4	8.9
50	9.1 to 10.8	9.8	10.6 to 11.6	11.1
60	10.9 to 12.6	11.7	12.6 to 13.7	13.1

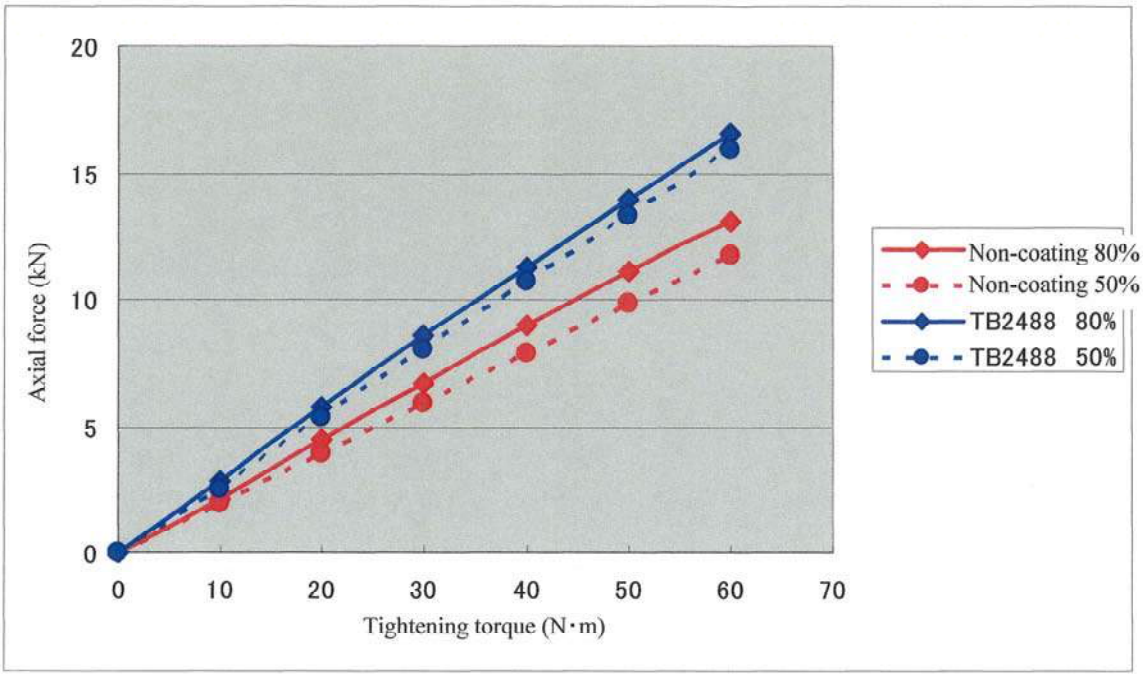

Fig.8 Axial force at each tightening torque

6. Precautions for handling and storage

6.1 Health effects and precautions

- Pre-coated nuts are delivered to customers after a pre-coating agent is applied to the threads and dried. Therefore, it is rare that the pre-coating agent adheres to the fingers or hands or gets in the eyes or mouth. However, flakes generated during tightening.
- The irritation is a medical physiological phenomenon, and the degree of irritation greatly varies between individuals. It is difficult to completely prevent the irritation. It is important to examine how to handle pre-coated bolts to avoid irritation. The skin may be irritated after you handle them several times. When handling them, observe the following instructions.
  (1) People who have sensitive skin should not handle them.
  (2) Wear impervious gloves to prevent direct contact of the hands with treated portions and adhesion of flakes of the agent to the hands.
  (3) If flakes of the pre-coating agent adhere to fingers or hands, thoroughly wash them with soap.
  If the flakes cannot be removed, it is effective to wipe them off with a solvent (thinner). However, take care not to chap the hands.
  (4) If in eyes, rinse thoroughly with clean water, and get medical attention.
  (5) If in mouth, spit out immediately, and get medical attention.
  (6) If any bodily abnormalities occur, discontinue use, and get medical attention.
  (7) For hazard and toxicity information not mentioned herein, see the material safety data sheet (MSDS).

6.2 Directions for use

1) Use of product for special purposes, such as medical and food manufacturing

purposes.

- This product was developed for general industrial use. We do not confirm the safety of the use of the product in medical devices or food-related equipment. If it is used for such a purpose, conduct the preliminary verification test appropriate to the purpose of use, and sufficiently confirm the safety prior to use. Never use it for medical implant products.

2) Improper conditions of use

- In the following cases, the product will not exhibit sufficient fixing strength.
  (1) Foreign substances (water, oil, solvents, dust, etc.) have adhered to the threaded portions.
  (2) Improper tightening (excessive or insufficient tightening)
  (3) Too large clearance
  (4) Out of working temperature range during and after tightening
  (5) In case of reusing pre-coated nuts

3) Material of mating part

- The material may be cracked or deformed by screwing the pre-coated bolt depending on the strength of the bolt. Check the strength in advance.

4) Removal of attached flakes

- To remove pre-coating agent from clothing, using a glove or air blower.
- To remove the pre-coating agent on work, it is effective to blow air or wipe with a solvent (thinner). If the pre-coating agent cannot be removed by wiping, it must be physically peeled off because it has cured.

5) When using a parts feeder

- In a parts feeder, pre-coated parts get into contact with one another, and flakes of the pre-coating agent can be generated. The flakes stick to the parts feeder, and it may not operate normally. To prevent this, clean the parts feeder on a daily basis to remove the flakes.

6.3 Instructions for storage and transportation

- Note that the MEC process pre-coating agent does not exhibit its original performance if appropriate storage conditions are not met.

1) Prevention of adhesion of foreign substances

- Keep the bolts away from water, oil, solvents, and other contaminants.
- Store the product in a sealed state in a low dust environment, or lid or cover the pre-coated nut container.

2) Attention to collision

- Take care that the coating of the pre-coated nuts is not removed by hard collision of nuts during transportation.

3) Storage and conditions of use

- The quality of the MEC treatment pre-coating agent deteriorates under the influence of high temperature, moisture and UV light. To prevent deterioration due to these factors and entry of foreign substances, observe the following instructions.
  (1) Store the product, if possible, in a sealed state in an indoor dark place with as low humidity as possible at 0 to 25°C away from direct sunlight and rain. (Use of a desiccant is effective in prevention of deterioration due to humidity.)

(2) Do not allow condensation to occur.
(3) Use the bolts on a first-in, first-out basis.
(4) In a season with high temperature and humidity, use the bolts as soon as possible.

7. Treatment and delivery system

We have established a system for treating the nuts supplied by customers at our plant and delivering them after treatment. For the details, contact one of our sales offices.

8. Cautions

For Industrial Use Only (Do not use for household purposes)

This product was developed for general industrial use. Before using this product, users must accept the following terms.

- The technical data given herein are not guaranteed values, but examples of experimental values obtained by our specified test methods. We do not guarantee that the uses described herein do not conflict with any intellectual property right.
- Before using this product, confirm the appropriateness and safety of the use for the application in question, and bear all responsibilities and risks involved in the use. Never use the product for medical implants that may be embedded, injected or left in the body.
- We are not liable for personal injury or property damage caused by improper handling of this product. If the properties or usage of the product to be used are unclear, never use it.
- For more information on product safety, see the material safety data sheet (MSDS). To obtain the MSDS, contact our sales office or customer service center.
- Information in this technical document is subject to change at our discretion without notice.