ThreeBond

2011.1.13
Three Bond Co., Ltd.

# Technical Data
# ThreeBond 2418
# Pre-coated bolts MEC process
# (water-based, acrylic heat resistance type)

## 1. Product description

ThreeBond 2418 is an acrylic-based sealing and locking agent for pre-coated bolts. 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 2418 is screwed, the microcapsules are broken, and the acrylic resin reacts with the curing agent to prevent leaking and loosening of the threaded portion.

Hereinafter, ThreeBond is abbreviated as TB.

## 2. Features

(1) Medium level of fixing strength
(2) Excellent heat resistance (Locking: 150°C, Sealing:170°C)
(3) Applicable to minimum screw diameter of M3
(4) Standard drying conditions: 25°C for 24 hours

## 3. Applications

Locking and sealing of bolts and screws

## 4. Properties

**Table 1. Properties**

| | |
|---|---|
| Product name | TB2418 |
| Primary component | Acrylic resin |
| Color | Yellow |

## 5. Characteristics

5.1 Curing rate

After the bolts are processed with TB2418 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
- 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 | 35.3 to 43.7 | 39.6 |
| 3 | 38.8 to 44.4 | 41.7 |
| 6 | 40.6 to 44.5 | 42.6 |
| 12 | 40.7 to 48.8 | 44.1 |
| 24 | 43.6 to 50.2 | 45.2 |
| 48 | 44.8 to 52.3 | 49.4 |
| 72 | 46.0 to 52.4 | 49.3 |

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 | 35.7 to 42.7 | 40.0 |
| 3 | 38.7 to 47.6 | 43.1 |
| 6 | 41.4 to 47.4 | 44.1 |
| 12 | 42.6 to 49.7 | 45.1 |
| 24 | 42.5 to 50.6 | 47.9 |
| 48 | 46.2 to 51.8 | 49.8 |
| 72 | 46.5 to 53.0 | 50.0 |

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 | 38.5 to 42.9 | 40.3 |
| 3 | 40.4 to 47.8 | 44.0 |
| 6 | 41.9 to 49.1 | 45.4 |
| 12 | 42.3 to 50.8 | 46.2 |
| 24 | 44.6 to 51.9 | 48.0 |
| 48 | 46.6 to 52.8 | 49.5 |
| 72 | 47.1 to 52.3 | 50.4 |

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 | 39.2 to 43.1 | 40.8 |
| 3 | 39.7 to 49.1 | 45.1 |
| 6 | 43.1 to 50.6 | 48.0 |
| 12 | 43.2 to 52.3 | 48.7 |
| 24 | 44.1 to 50.9 | 49.1 |
| 48 | 48.7 to 51.8 | 50.4 |

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 | 39.3 to 43.2 | 41.0 |
| 3 | 41.1 to 50.0 | 46.9 |
| 6 | 42.9 to 50.8 | 48.5 |
| 12 | 43.8 to 51.5 | 48.3 |
| 24 | 43.9 to 52.3 | 49.3 |
| 48 | 44.8 to 52.6 | 50.0 |

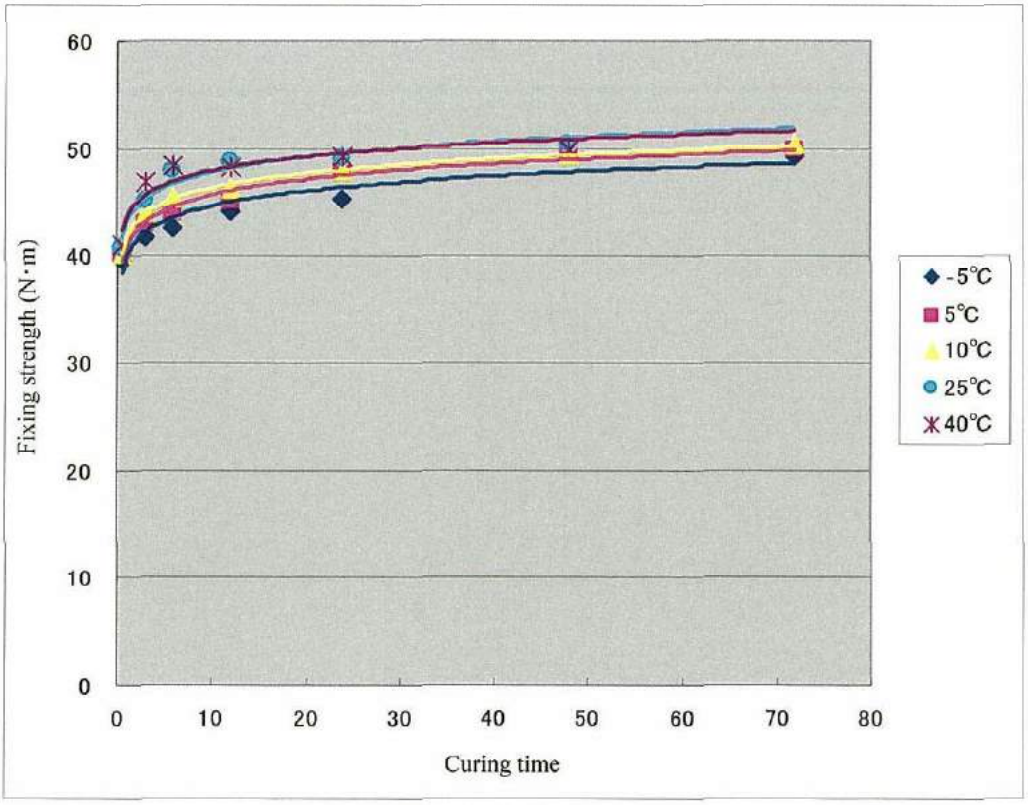


**Fig.1 Curing rate**

5.2 Fixing strength by size

After bolts treated with TB2418 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
- Measuring conditions: 3TS-306-05 (M10 bolt) 3TS-306-02 (except M10 bolt)

**Table 7. Fixing strength at each size**

| Bolts 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 | 1.1 |
| M4 P0.7 | 2.0 | 2.0 to 2.3 | 2.2 |
| M6 P1.0 | 8.0 | 9.2 to 11.0 | 10.2 |
| M8 P1.25 | 15 | 18.5 to 20.5 | 19.5 |
| M10 P1.25 | 30 | 45.9 to 51.3 | 49.4 |
| M10 P1.5 | 30 | 44.1 to 50.9 | 49.1 |
| M12 P1.25 | 50 | 75.0 to 85.0 | 81.4 |
| M12 P1.5 | 50 | 79.0 to 83.0 | 80.7 |
| M12 P1.75 | 50 | 73.0 to 80.0 | 77.1 |
| M14 P2.0 | 90 | 124.0 to 138.0 | 128.8 |

5.3 Fixing strength to various materials

After bolts treated with TB2418 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)
- Measurement conditions: 3TS-306-05

**Table 8. Fixing strength to each material**

| Bolts and nuts materials | Fixing strength (breaking torque) Range (N·m) | Average (N·m) |
|---|---|---|
| Plain steel | 49.2 to 50.4 | 49.8 |
| Zinc plating chromate treatment | 44.1 to 50.9 | 49.1 |
| Chromium plating | 48.1 to 52.6 | 50.3 |
| Nickel plating | 46.9 to 53.5 | 50.4 |
| Unichrome plating | 48.3 to 52.0 | 50.2 |
| Black oxide | 43.7 to 47.8 | 46.1 |
| SUS304 | 45.3 to 52.9 | 47.8 |
| Brass | 23.0 to 29.9 | 26.2 |
| Aluminum | 24.4 to 29.9 | 26.8 |

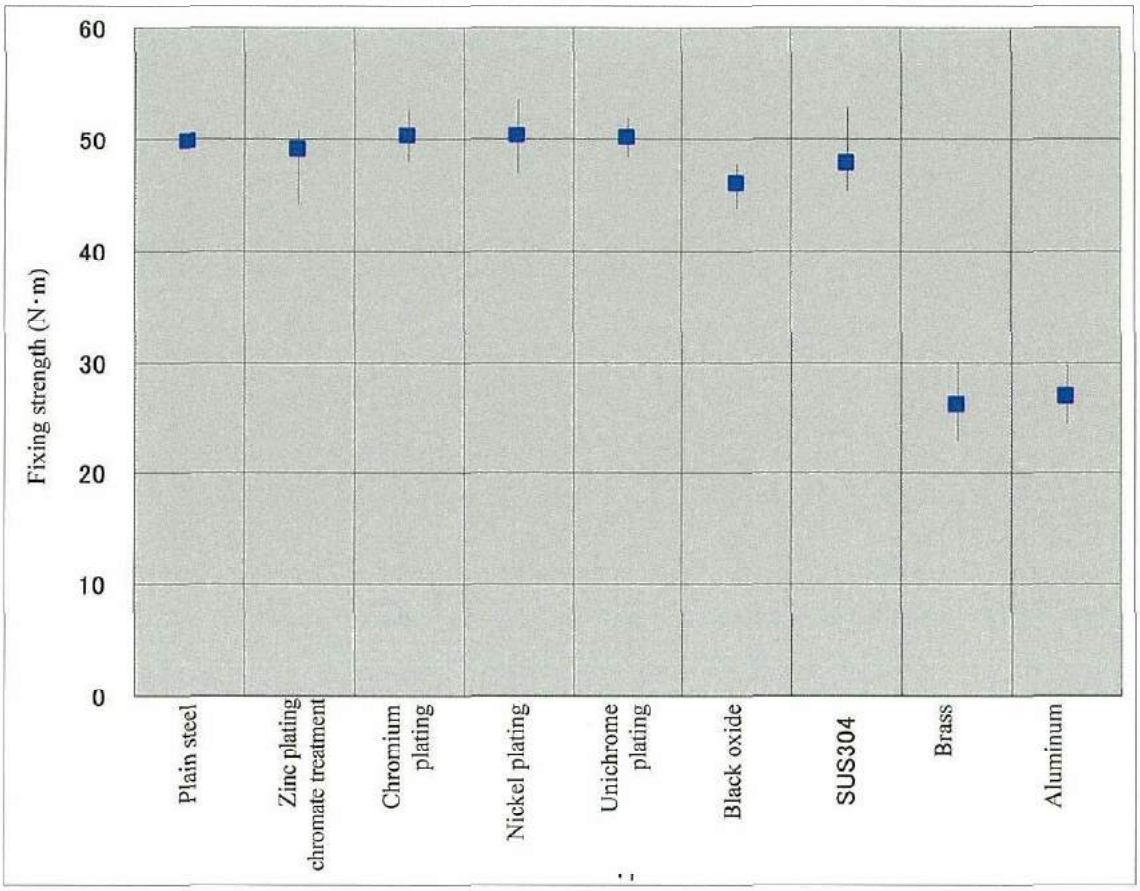


**Fig. 2 Fixing strength to each material**

5.4 Chemical resistance test

After bolts treated with TB2418 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
- Measurement conditions: 3TS-306-05

**Table 9. Chemical resistance test**

| Test medium | Immersion conditions | Fixing strength (breaking torque) Range (N·m) | Average (N·m) |
|---|---|---|---|
| Blank | | 44.1 to 50.9 | 49.1 |
| NaOH 10%aq | 25°C×7 days | 43.4 to 53.9 | 50.5 |
| Gas oil | 40°C×7 days | 42.8 to 46.0 | 44.1 |
| Gasoline | 40°C×7 days | 43.3 to 50.5 | 46.0 |
| n-hexane | 40°C×7 days | 43.0 to 47.6 | 45.6 |
| Methanol | 40°C×7 days | 45.4 to 52.1 | 49.2 |
| Water | 100°C×7 days | 48.1 to 50.1 | 48.9 |
| ethylene glycol | 100°C×7 days | 44.4 to 48.2 | 45.5 |
| ethylene glycol 50%aq | 100°C×7 days | 41.0 to 50.0 | 44.0 |
| Engine oil | 100°C×7 days | 38.9 to 46.0 | 42.7 |
| Turbine oil | 100°C×7 days | 40.4 to 45.8 | 42.7 |
| ATF | 100°C×7 days | 39.4 to 46.9 | 42.1 |
| Gear oil | 100°C×7 days | 41.9 to 46.3 | 44.1 |

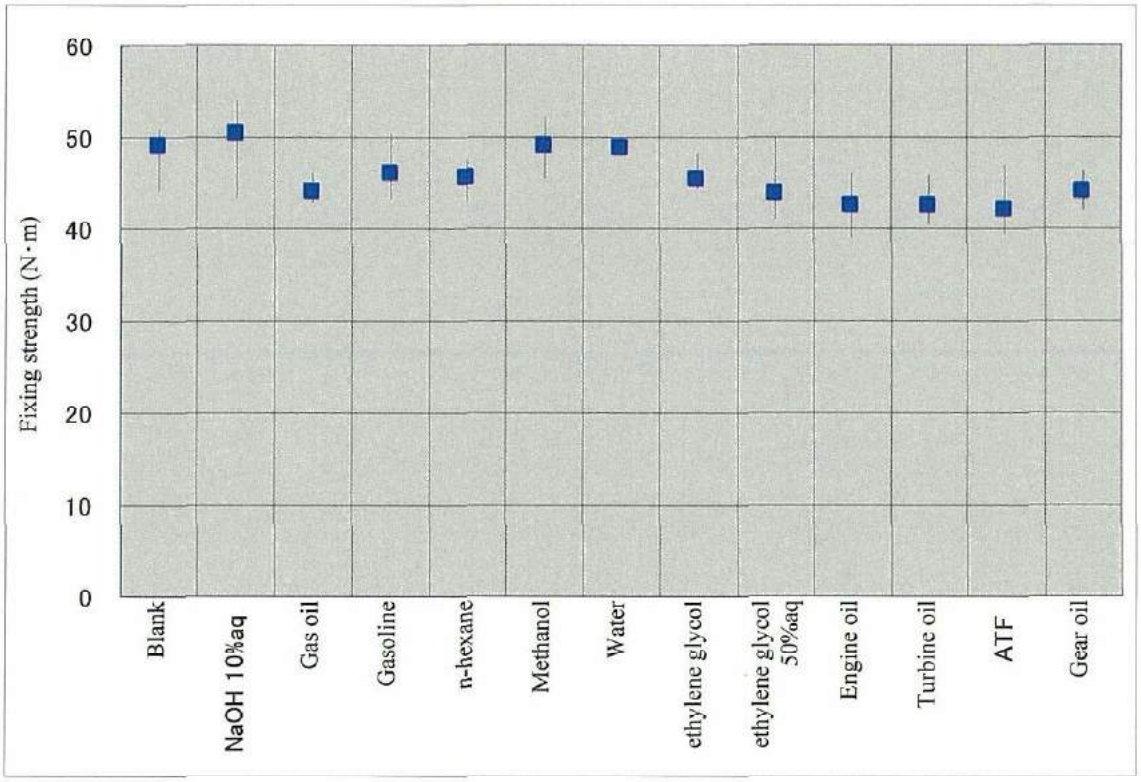


**Fig. 3 Chemical resistance test**

5.5 Heat deterioration test

Bolts processed with TB2418 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
- Temperature conditions: 100°C, 120°C, 150°C
- Measurement conditions: 3TS-306-05

1) 100°C

**Table 10. Heat deterioration test at 100°C**

| Time of exposure | Fixing strength (breaking torque) Range (N·m) | Average (N·m) |
|---|---|---|
| Initial | 44.1 to 50.9 | 49.1 |
| 7 days | 45.3 to 50.7 | 48.3 |
| 14 days | 46.7 to 50.5 | 48.7 |
| 21 days | 44.0 to 50.2 | 47.9 |
| 28 days | 43.5 to 49.8 | 48.2 |

2) 120°C

**Table 11. Heat deterioration test at 120°C**

| Time of exposure | Fixing strength (breaking torque) Range (N·m) | Average (N·m) |
|---|---|---|
| Initial | 44.1 to 50.9 | 49.1 |
| 7 days | 45.5 to 50.9 | 48.7 |
| 14 days | 42.4 to 48.8 | 46.6 |
| 21 days | 43.4 to 50.9 | 46.1 |
| 28 days | 42.3 to 48.8 | 45.3 |

3) 150°C

**Table 12. Heat deterioration test at 150°C**

| Time of exposure | Fixing strength (breaking torque) Range (N·m) | Average (N·m) |
|---|---|---|
| Initial | 44.1 to 50.9 | 49.1 |
| 7 days | 45.0 to 48.5 | 46.3 |
| 14 days | 42.3 to 49.1 | 45.0 |
| 21 days | 40.0 to 48.6 | 43.7 |
| 28 days | 40.1 to 45.5 | 42.7 |

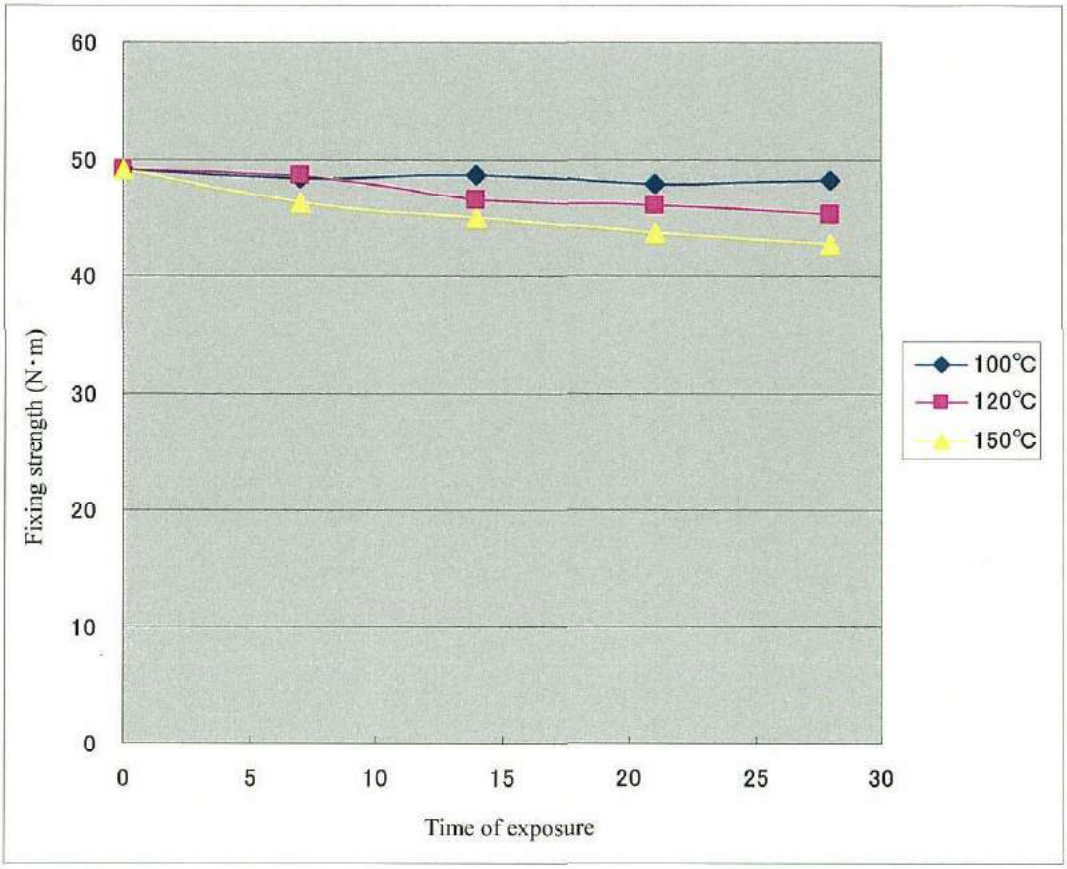


**Fig. 4 Heat deterioration test**

5.6 Fixing strength test at each temperatures

After tightening the bolts processed with TB2418, 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
- Measurement conditions: 3TS-306-02

**Table 13. Fixing strength at each temperature**

| Test temperature (°C) | Fixing strength (breaking torque) Range (N·m) | Average (N·m) |
|---|---|---|
| 25 | 44.1 to 50.9 | 49.1 |
| 60 | 43.5 to 47.0 | 45.6 |
| 80 | 41.0 to 44.5 | 42.9 |
| 100 | 38.0 to 42.0 | 40.5 |
| 130 | 37.0 to 39.5 | 38.3 |
| 150 | 32.0 to 34.0 | 33.2 |
| 180 | 23.0 to 29.0 | 26.2 |
| 200 | 18.0 to 20.0 | 19.0 |

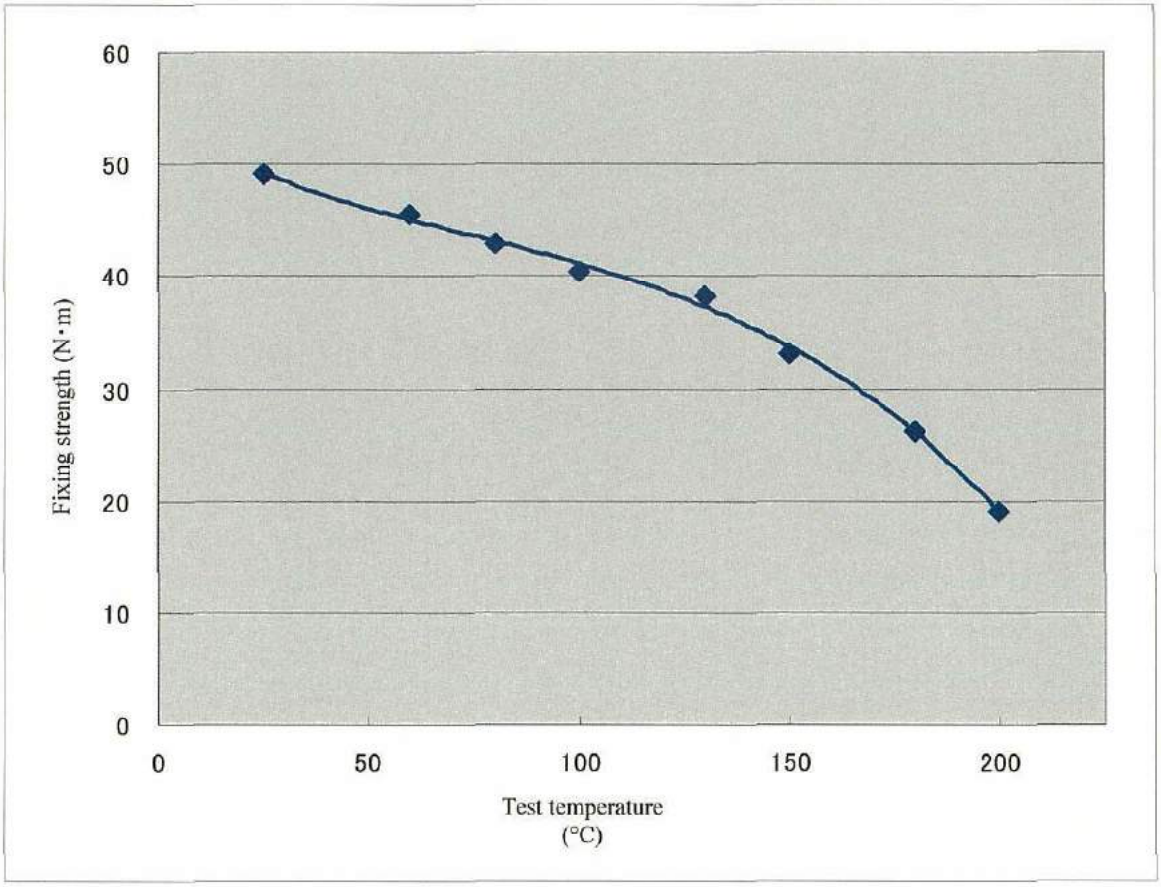


**Fig. 5 Fixing strength at each temperature**

5.7 Axial force at each tightening torque

Bolts treated with TB2418 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 14. Axial force at each tightening torque**

| Tightening torque (N·m) | Axial force (kN) | | | |
|---|---|---|---|---|
| | TB2418 | | Non-coating | |
| | Range | Average | Range | Average |
| 20 | 4.6 to 6.7 | 5.4 | 3.4 to 4.9 | 4.1 |
| 30 | 6.7 to 8.6 | 7.9 | 5.2 to 7.3 | 6.2 |
| 40 | 9.5 to 12.8 | 10.9 | 7.1 to 9.8 | 8.4 |
| 50 | 11.5 to 15.3 | 13.6 | 9.0 to 12.2 | 10.6 |
| 60 | 13.6 to 17.8 | 16.0 | 10.9 to 14.6 | 12.8 |

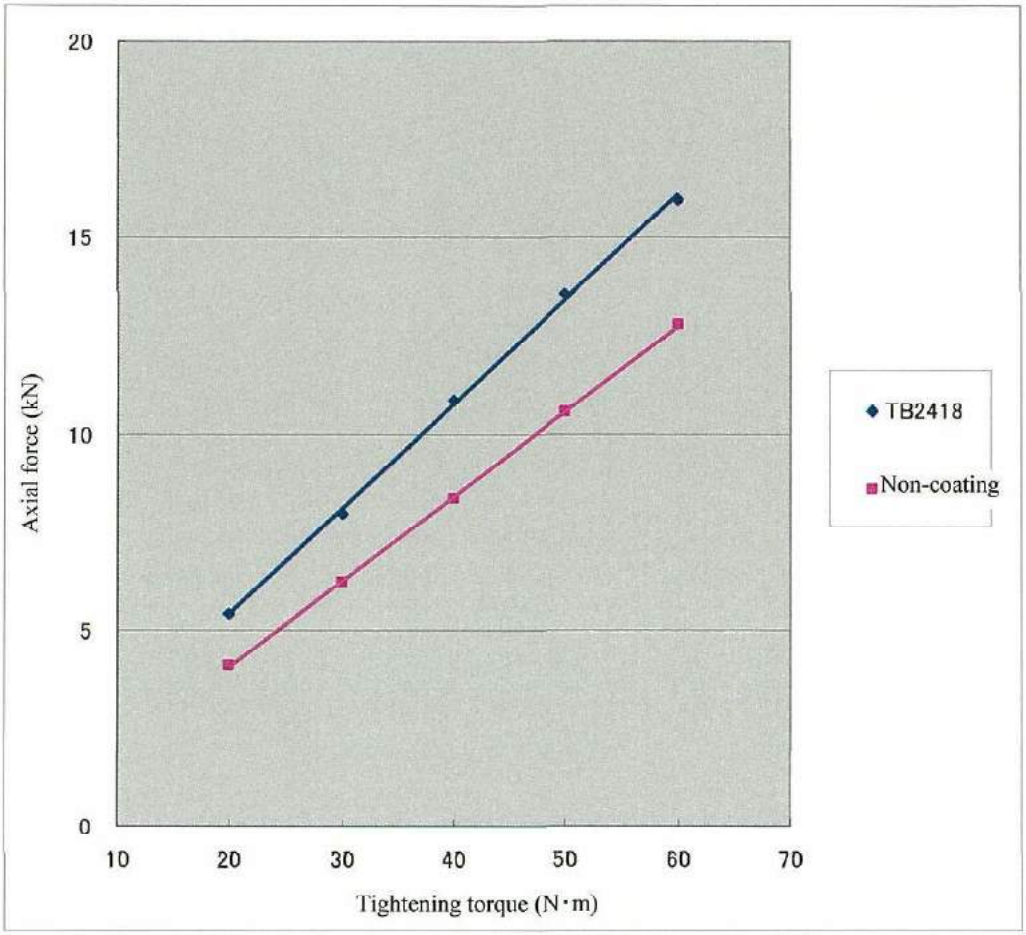


**Fig.6 Axial force at each tightening torque**

5.8 Sealing test (air tightness)

Bolts treated with TB2418 are tightened on a seal test block at the specified torque, and the agent is cured at 25°C for 24 hours. Then, the block is mounted on seal testing equipment. Immediately the nitrogen gas pressure is increased to 0.5 MPa, and the block is kept at the pressure for 5 minutes, for which the bolts are checked for leak. Then, the pressure is increased by 0.5 MPa up to 2.0 MPa. The block is kept at each pressure for 2 minutes. The bolts are checked for leak at each pressure under water.

- Bolt: JIS, class 2 M10×1.5, zinc plated chromate treatment
- Sealing test block: Steel and Aluminum
- Tightening torque: 30N·m
- Test temperature: 25 °C
- Test medium: Nitrogen gas
- Number of test pieces: n=10
- Measurement conditions: 3TS-350-01

**Table 15. Sealing test (air tightness)**

| Seal test Material of block | Test temperature (°C) | Pressure (Mpa) | | | |
|---|---|---|---|---|---|
| | | 0.5 | 1.0 | 1.5 | 2.0 |
| Iron | 25 | 0/10 | 0/10 | 0/10 | 0/10 |
| Aluminum | 25 | 0/10 | 0/10 | 0/10 | 0/10 |

* 0/10 indicates that none of the ten bolts showed any leak.

5.9 Sealing test (oil tightness)

Bolts treated with TB2418 are tightened on a seal test block at the specified torque, and the agent is cured at 25°C for 24 hours. Then, the block is mounted on seal testing equipment. Immediately the hydraulic pressure is increased to 2.0 MPa, and the block is kept at the pressure for 5 minutes, for which the bolts are checked for leak. Then, the pressure is increased by 2.0 MPa to up to 10 MPa. The block is kept at each pressure for 2 minutes. The bolts are visually checked for leak at each pressure using a developer.

- Bolt: JIS, class 2 M10×1.5, zinc plated chromate treatment
- Sealing test block: Steel and Aluminum
- Tightening torque: 30N·m
- Test temperature: 25°C and 170°C
- Test medium: Turbine oil
- Number of test pieces: n=10
- Measurement conditions: 3TS-350-01

**Table 16. Sealing test (oil tightness)**

| Seal test Material of block | Test temperature (°C) | Pressure (Mpa) | | | | |
|---|---|---|---|---|---|---|
| | | 2.0 | 4.0 | 6.0 | 8.0 | 10 |
| Iron | 25 | 0/10 | 0/10 | 0/10 | 0/10 | 0/10 |
| | 170 | 0/10 | 0/10 | 0/10 | 0/10 | 0/10 |
| Aluminum | 25 | 0/10 | 0/10 | 0/10 | 0/10 | 0/10 |
| | 170 | 0/10 | 0/10 | 0/10 | 0/10 | 0/10 |

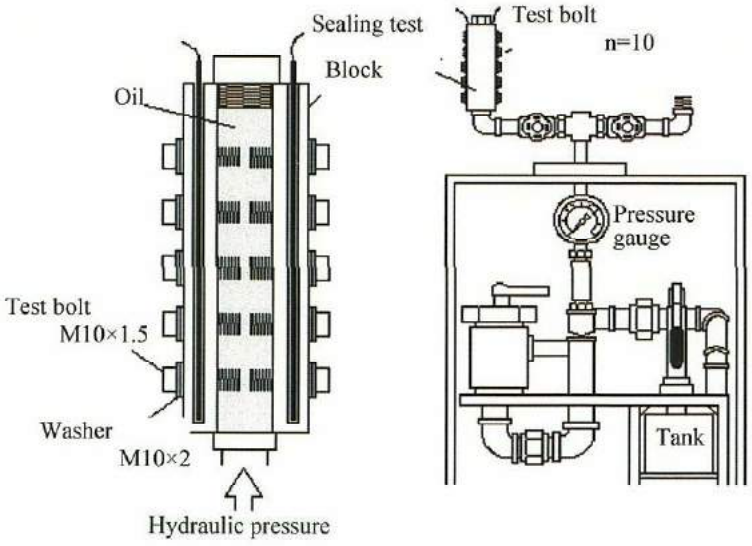


**Fig.7 Seal testing equipment**

## 6. Precautions for handling and storage

6.1 Health effects and precautions

- Pre-coated bolts 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.

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 or sealing ability.
  (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 bolts

3) Material of mating part
- The material may be cracked or deformed by screwing the pre-coated bolt depending on the strength of the internal threads. 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 bolt 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, other contaminants.
- Store the product in a sealed state in a low dust environment, or lid or cover the pre-coated bolt container.

2) Attention to collision

- Take care that the coating of the pre-coated bolts is not removed by hard collision of bolts during transportation. Take special care when handling heavy bolts.

3) Storage and conditions of use

- The quality of the MEC treatment bolt 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 bolts and plugs 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 an example of experimental values obtained by our specified test method, and are not guaranteed values. We do not guarantee that the uses described herein do not conflict with any intellectual property right.
- Users are asked to examine whether the product is appropriate to the purpose of use and can be used safely before they use it and bear all responsibilities and hazards involved in its 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 detailed safety information of the product, 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.