

### 3 Nut Profile

We produce our nuts with SUS316L, which is the same material for the bolt, to prevent corrosion caused by the corrosion potential differences due to the steel materials.  
The shapes are of those categorized Hexagon regular nuts(style1)-grades A and B; these are designated in the ISO4032:2012, they are finished with lubricating treatment .

#### appearance

Steel material category, strength category, and nominal designation are shown on the upper surface of the nut. Lubricates the nut, to keep the torque coefficient value stable. The surface of the nut is actually coated with black coating material.

#### Proof load test

This nut passed the level of test stress 1,000N/mm<sup>2</sup> at the proof load test. The test conditions are applied mutatis mutandis to JIS B 1054-2.

#### Hardness of the nut

The average hardness of bearing surface of our nuts is HRC29.6.

#### The relative permeability measured with the simple permeability test instrument

Our nuts show the excellent magnetic property with their relative permeability less than 1.05.



Picture 4 The appearance of coated nuts

### 4 Washer Profile

We produce our washers with SUS316L, which is the same material for the bolt and nut, to prevent corrosion caused by the corrosion potential differences due to the steel materials.  
The shape and dimension is of plain normal series - product grade A, the division of hardness is 300HV ; these are designated in the ISO 7089:2000.

#### appearance

The washers are produced by punching the steel sheet, which has been processed with cold skin-pass rolling, into the proper shape and size written above.  
The washers meet the standards on the surface roughness. Nominal designation, materials, division of hardness and manufacturer logos are shown on one side of washers.(Picture 5)  
Yet, we made sure it doesn't matter the torque coefficient value that washers have product information on their surface or which side of the washer is used for upper side.

#### Hardness of washers

The hardness of our washers is between 300HV ~ 400HV.

#### The relative permeability measured with a simple permeability test instrument

Our washers show the excellent magnetic property with their relative permeability less than 1.05.



Picture 5 Appearance of washers

### 5 Contact Us

Recently, the improvement of the durability of structures has been demanded in the market, so we strongly recommend our product set of bolt, nut and washer. They have excellent corrosion resistance, high tensile strength more than 1,000N/mm<sup>2</sup> and they can keep the torque coefficient values stable when tightened.

## Product Information

# Sets of High Stainless Hexagon Bolt



**High Tensile Strength**  
Excellent Corrosion Resistance  
Stable axial force with high-torque fastening

**Bolt**

Bolt A4L-100  
**Tensile strength**  
1,000N/mm<sup>2</sup>

**Nut**

Nut A4L-100  
**Proof load**  
1,000N/mm<sup>2</sup>  
Surface treatment with  
Hama-Coat Plus

**Washer**

**SUS316L**  
300HV



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**HAMANAKA FASTENERS TRADING CO.,LTD.**

# High Stainless Hexagon Bolt Product Properties of the stainless bolt, nut and washer

# A4L-100 UNS S31603



## 1 Abstract

SUS316L is highly regarded as non-magnetic stainless steel with corrosion resistance and it is one of the most popular materials in the world market. With this SUS316L, we developed the bolt whose tensile strength is higher than 1,000N/mm<sup>2</sup>, and the nut and the washer for it as well.

With the focus on the following points, we developed these products :

1. to simplify the manufacturing process
  2. to prevent the products from adhesive wear which is caused by contact friction with the bolt and the nut under high tightening axial force
  3. to use the same materials for the nut and the washer to balance the strength of the bolt
- In addition, by keeping a proper stock of the bolts and the raw materials and by planning production in details, we are sure to deliver our products by the appointed day.

We have some cold forging machines including the largest sized one in Japan and the other specially designed for long bolt manufacturing. With these machines, we are capable of producing bolts widely ranged from M12 to M27 in nominal diameter and sized up to 400mm in the bolt length.

## 2 Bolt Profile

### Simplified manufacturing process

General manufacturing process for stainless bolts, including cold forging, form rolling, passivation treatment

### shape and dimension

Categories of steel and strength are indicated on the hexagon headed cap(\*picture1).

Shapes\* are Hexagon head bolts-grades A and B.

Screw thread tolerance is 6g\*.

\*according to ISO 4014:2011



Picture 1  
Sample of hexagon head with category description

### Size of our standard products in stock

Dimension of our standard bolts, nuts and washers in stock are shown in Table 1.

Table 1 Size of our standard products in stock

Bolt length (under head)	M12	M16	M20	M22	M24	M27
40	○					
50	○	○				
55	○	○				
60	○	○	○			
65		○	○	○	○	
70			○	○	○	
75				○	○	
80				○	○	
85					○	
90		○	○	○	○	
95				○	○	
100			○	○		○
110					○	○
120						
130						

### Mechanical properties at room temperature

Table 2 shows the test results of mechanical properties measured at room temperature under the conditions deviated from the standard of JISB1054-1. With any sized products, tensile strength is ensured to be more than 1,000N/mm<sup>2</sup>, proof stress is to be more than 700N/mm<sup>2</sup>, and elongation of nominal diameter is to be more than 30%.

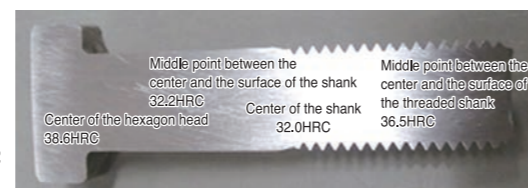
Table 2 Test results of tensile strength and proof stress of each product

	Proof stress N/mm <sup>2</sup> 700UP	Tensile strength N/mm <sup>2</sup> 1000UP	elongation 0.3d UP
M12	777	1017	0.4
	818	1014	0.34
	849	1023	0.33
M16	1026	1198	0.44
	989	1191	0.41
	1053	1135	0.36
M20	833	1101	0.38
	852	1101	0.34
	918	1094	0.38
M24	891	1190	0.39
	902	1191	0.36
	1144	1175	0.34
M27	892	1098	0.40
	886	1102	0.33
	864	1093	0.41

### Hardness of the parts of axial cross section

Picture 2 is the cross section of the bolt cut near the axis in the axial direction, and it shows the hardness of each part of the bolt ; hexagon head, grip and threaded shank.

Picture 2  
The hardness of M16 bolt



### Hardness of screw threads

Figure 1 shows the hardness test result of the middle point of the screw thread on the pitch line and that on the thread root line.

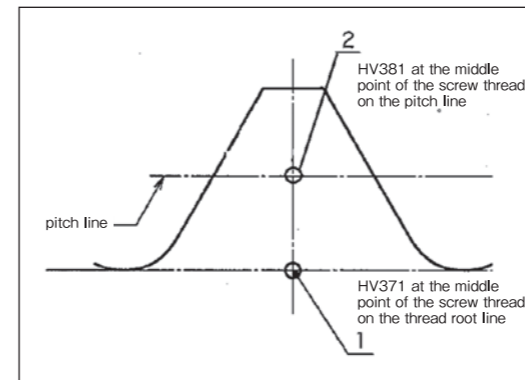


Figure 1  
Hardness of the middle point of the screw thread on both the pitch line and the thread root line.

### Property of low-temperature impact strength

To make sure the impact strength of our bolt at a low temperature, we had a Charpy impact test. The test pieces were taken from our M16 bolt and shaped in the designated size (v notched full size JISZ2242). Then the impact value was measured with them at 0°C and -40°C. The impact value at -40°C was slightly lower than that at 0°C.

Table 3 Comparison of impact strength at different temperatures

Test temperature 0°C	Test temperature -40°C
174J (17.7Kgf·m)	171J (17.4Kgf·m)
180J (18.4Kgf·m)	180J (18.4Kgf·m)
188J (19.2Kgf·m)	172J (17.6Kgf·m)

### Test result of tensile strength at a high temperature

We carried out the tensile strength test at high temperatures with collared test pieces. The specimen were taken from our M24 bolt which was made of SUS316L in grade 1,000N/mm<sup>2</sup>, and for comparison, other specimen were taken from our mass production type bolt made of SUS304J3 in grade 600N/mm<sup>2</sup> and also from our bolt made of SUS304 in grade 1,000N/mm<sup>2</sup>. All these specimen were cut into a designated shape with collars, according to the conditions applying mutatis mutandis to JISG0567. The results were shown in Figure 2 and 3.

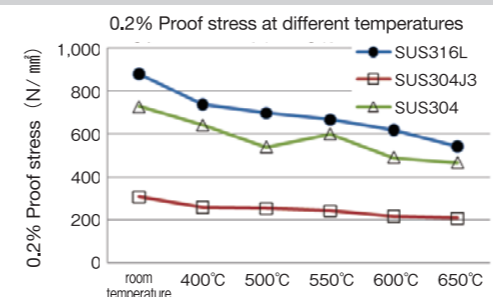


Figure 2 Proof stress at different temperatures

<The test result of the tensile strength at high temperatures>  
SUS316L has the tensile strength of 970N/mm<sup>2</sup> at room temperature. It can keep it 652N/mm<sup>2</sup> at 600°C and this strength is about 67% of that at room temperature.

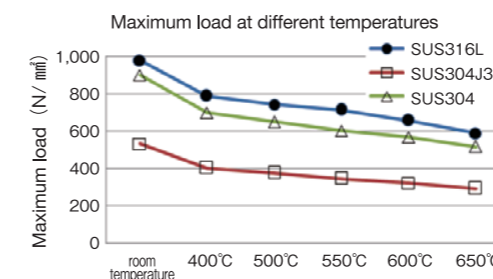


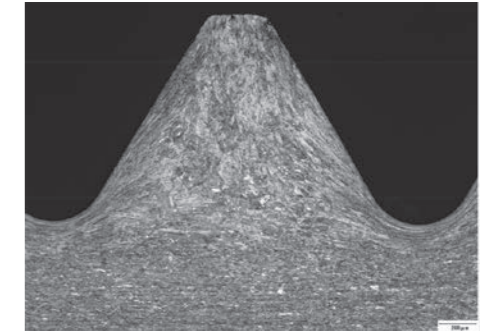
Figure 3 Maximum load at different temperatures

<The test result of the tensile strength at high temperatures>  
SUS316L has the proof stress of 863N/mm<sup>2</sup> at room temperature. It can keep it 614N/mm<sup>2</sup> at 600°C and this value is about 71% of that at room temperature.

### Microstructure of the cross sectional thread in the axial direction

Picture 3 shows the microstructure of the cross sectional ridge in the axial direction.

Microstructure integrity is realized by continuous metal flowing during thread rolling.



Picture 3  
Microstructure of the cross sectional thread of the bolt

### The test result of relative permeability

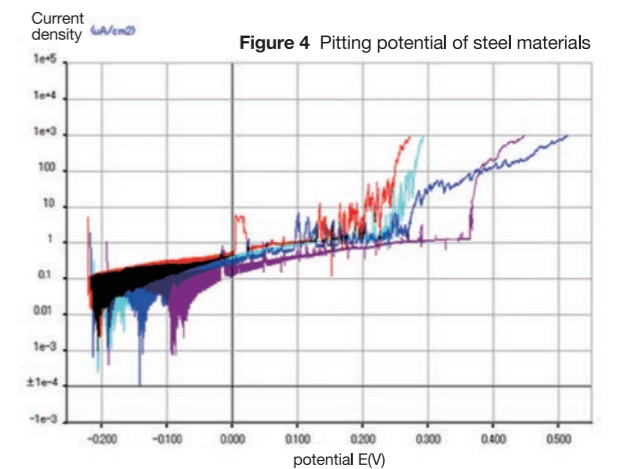
We, with a simple permeability test instrument, measured the relative permeability of our bolt at three points from its surface ; the hexagon head which had the most plastic working, the threaded shank highly processed and the body with minimum process. Any of them shows the excellent magnetic property with the result value under 1.10.

Table 4 The relative permeability at different parts

hexagon head	surface of the body	surface of the threaded shank
1.02/1.05	1.01/1.02	1.01/1.02

### Corrosion resistance of steel materials tested with pitting potential measurement

We tested corrosion resistance of SUS316L, SUS304L and SUS317L with pitting potential measurement (Figure 4). The test conditions were deviated from the standard of JIS G 0577 regarding stainless steels. SUS316L showed the highest performance in corrosion resistance.



Current density Pitting potential at current density 10µA/cm <sup>2</sup>	red...1 SUS304 223mV	blue...2 SUS317L 277mV	light blue...3 SUS304L 263mV	purple...4 SUS316L 368mV
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