

XGT2-C / XGL2-C / XGS2-C Flexible Couplings - High - gain Rubber Type Patented

Zero Backlash High gain supported High torque High Rigidity Vibration absorption Electrical Insulation

Structure

Clamping Type

XGT2-C Standard type → P.xxxx

XGL2-C Long type → P.xxxx

XGS2-C Short type → P.xxxx



Internal Structure



Material/Finish

| | XGT2-C / XGL2-C / XGS2-C |
|---------------------------|--|
| Hub | A2017 |
| High-Gain Rubber | FKM *1 |
| Hex Socket Head Cap Screw | SCM435 Ferrosoferric Oxide Film (Black) |

*1: **XGT2-68C** uses HNBR high-gain rubber.

Applicable motors

| | XGT2-C / XGL2-C / XGS2-C |
|-----------------------|--------------------------|
| Servomotor | ○ |
| Stepping Motor | ○ |
| General-purpose Motor | ● |

○: Excellent ●: Available

Property

| | XGT2-C (O.D. φ56 or Less) / XGL2-C / XGS2-C | XGT2-C (O.D. φ68) |
|--------------------------------------|---|-------------------|
| Zero Backlash | ○ | ○ |
| For Servomotor High Gain | ○ | ○ |
| High Torque | ○ | ○ |
| High Torsional Stiffness | ○ | ○ |
| Allowable Misalignment | ○ | ○ |
| Vibration Absorption Characteristics | ○ | ○ |
| Electrical Insulation | ○ | — |
| Allowable Operating Temperature | −10°C to 120°C | −20°C to 80°C |

○: Excellent ○: Very good

• High-gain flexible coupling which surpasses **XGT-C** **XGL-C** **XGS-C** in performance. This is a single-piece construction with the two aluminum hubs molded with high-gain rubber.

• The optimal damping and rigidity design enables realization of even greater servomotor gain, leading to reduced stabilization time.

• Technical information → P.xxxx

• Suppressing speed unevenness control during stepping motor operation is effective. → P.xxxx

• Contributes to improved productivity and quality by suppressing residual vibration during positioning.

• O.D. φ15 - φ56 types use high-gain fluoro-resin rubber. Heat resistance, oil resistance, and chemical resistance are excellent. → P.xxxx

• Standard type **XGT2-C** / long type **XGL2-C** / short type **XGS2-C** are now standardized.

Application

Semiconductor manufacturing equipment / Mount machines / Machine tools / Packaging machines

Part number specification

XGT2-19C-6-8

Product Code Size Bore Diameter

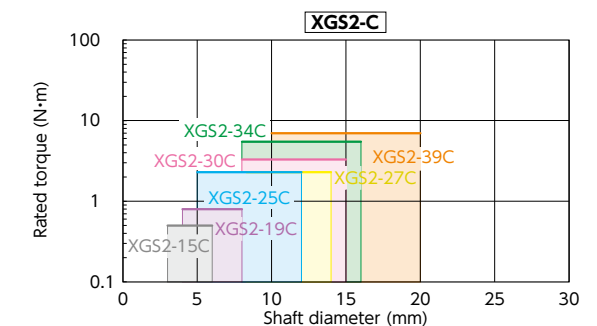
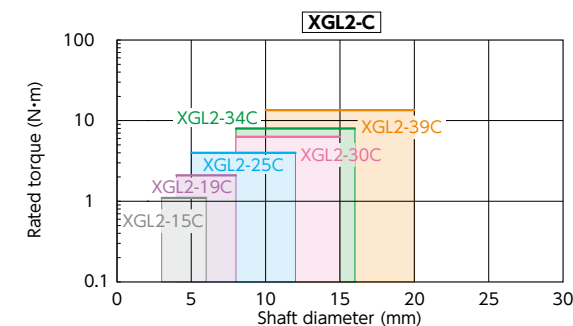
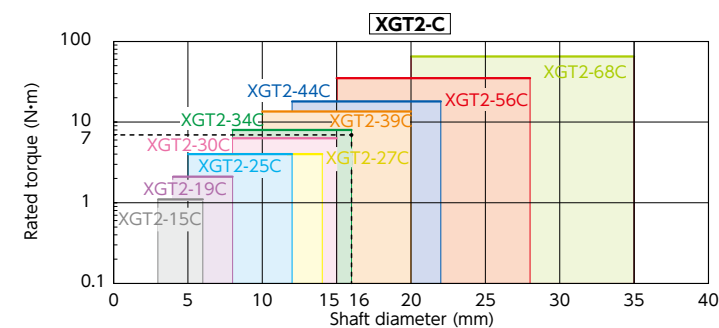
Please refer to dimensional table for part number specification.



Selection

Selection Based on Shaft Diameter and Rated Torque

The area bounded by the shaft diameter and rated torque indicates the selection size.



Selection Example

In case of selected parameters of shaft diameter of φ16 and load torque of 7N·m, the selected size is

XGT2-34C.

Selection Based on the Rated Output of the Servomotor

| Rated Output (W) | Servomotor Specifications*1 | | | Selection Size | | |
|------------------|------------------------------|--------------------|---------------------------------|----------------|--------|--------|
| | Diameter of Motor Shaft (mm) | Rated Torque (N·m) | Instantaneous Max. Torque (N·m) | XGT2-C | XGL2-C | XGS2-C |
| 10 | 5 - 6 | 0.032 | 0.096 | 15C | 15C | 15C |
| 20 | 5 - 6 | 0.064 | 0.19 | 15C | 15C | 15C |
| 30 | 5 - 7 | 0.096 | 0.29 | 19C | 19C | 19C |
| 50 | 6 - 8 | 0.16 | 0.48 | 19C | 19C | 19C |
| 100 | 8 | 0.32 | 0.95 | 19C | 19C | 25C |
| 200 | 9 - 14 | 0.64 | 1.9 | 27C | 30C | 27C |
| 400 | 14 | 1.3 | 3.8 | 27C | 30C | 34C |
| 750 | 16 - 19 | 2.4 | 7.2 | 39C | 39C | — |

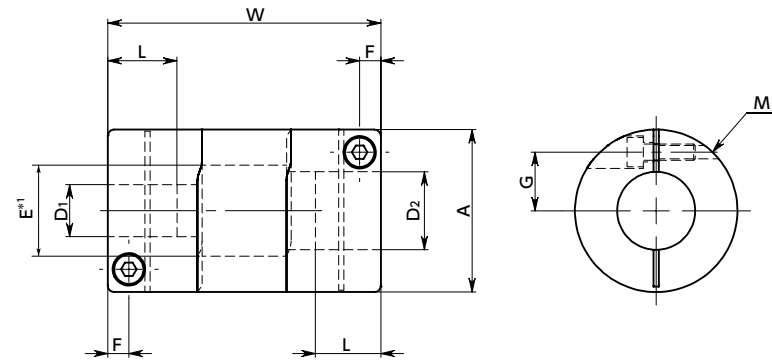
*1: Motor specifications are based on general values. For details, see the motor manufacturer's catalogs. This is the size for cases where devices such as reduction gears are not used.

Additional Keyway at Shaft Hole → P.xxxx Cleanroom Wash & Packaging → P.xxxx Change to Stainless Steel Screw → P.xxxx
Available / Add'l charge Please combine with Stainless Steel Screw Alteration Service Available / Add'l charge

XGL2-C Flexible Couplings - High - gain Rubber Type - Long Type Patented

Zero Backlash High gain supported High torque High Rigidity Vibration absorption Electrical Insulation

XGL2-C



* 1 : $E = D_2 + 0.5 (D_2 < 5)$
 $E = D_2 + 1 (D_2 \geq 5)$

Dimensions

Unit : mm

| Part Number | A | L | W | F | G | M | Screw Tightening Torque (N·m) |
|-----------------|----|------|----|------|-------|------|-------------------------------|
| XGL2-15C | 15 | 6.5 | 30 | 2.15 | 5 | M1.6 | 0.25 |
| XGL2-19C | 19 | 7.7 | 34 | 2.65 | 6.5 | M2 | 0.5 |
| XGL2-25C | 25 | 9.5 | 42 | 3.25 | 9 | M2.5 | 1 |
| XGL2-30C | 30 | 11 | 42 | 4 | 11 | M3 | 1.5 |
| XGL2-34C | 34 | 12 | 44 | 4 | 12.25 | M3 | 1.5 |
| XGL2-39C | 39 | 15.5 | 55 | 4.5 | 14.5 | M4 | 2.5 |

| Part Number | Standard Bore Diameter D1-D2 | | | | | | | | | |
|-----------------|------------------------------|---------|---------|----------|---------|---------|----------|---------|----------|---------|
| XGL2-15C | 3 - 5 | 5 - 5 | 5 - 6 | | | | | | | |
| XGL2-19C | 4 - 5 | 5 - 5 | 5 - 6 | 5 - 7 | 5 - 8 | 6 - 6 | 6 - 6.35 | 6 - 8 | 6.35 - 8 | 8 - 8 |
| XGL2-25C | 5 - 8 | 6 - 8 | 6 - 10 | 6.35 - 8 | 8 - 8 | 8 - 10 | 8 - 11 | 8 - 12 | 10 - 10 | 10 - 12 |
| XGL2-30C | 8 - 8 | 8 - 10 | 8 - 11 | 8 - 12 | 8 - 14 | 8 - 15 | 10 - 10 | 10 - 11 | 10 - 14 | 11 - 12 |
| XGL2-34C | 8 - 8 | 8 - 10 | 8 - 12 | 8 - 14 | 10 - 11 | 10 - 14 | 11 - 12 | 12 - 14 | 14 - 15 | |
| XGL2-39C | 10 - 10 | 10 - 12 | 10 - 14 | 12 - 14 | 14 - 15 | 15 - 19 | | | | |

- All products are provided with hex socket head cap screw.
- Recommended tolerance for shaft diameters is h6 and h7.
- In case of mounting on D-cut shaft, be careful about the position of the D-cut surface of the shaft.
- For the shaft insertion amount to the coupling, see Mounting/maintenance.

Performance

| Part Number | Max. Bore Diameter (mm) | Keyway Additional Modification Max. Bore Diameter (mm) | Rated *1 Torque (N·m) | Max. Rotational Frequency (min ⁻¹) | Moment*2 of Inertia (kg·m ²) | Static Torsional Stiffness (N·m/rad) | Max. Lateral Misalignment (mm) | Max. Angular Misalignment (°) | Max. Axial Misalignment (mm) | Mass *2 (g) |
|-----------------|-------------------------|--|-----------------------|--|--|--------------------------------------|--------------------------------|-------------------------------|------------------------------|-------------|
| XGL2-15C | 6 | — | 1.1 | 42000 | 3.6×10^{-7} | 82 | 0.15 | 1.5 | ±0.2 | 11 |
| XGL2-19C | 8 | 6 | 2.1 | 33000 | 1.0×10^{-6} | 210 | 0.15 | 1.5 | ±0.2 | 20 |
| XGL2-25C | 12 | 9 | 4 | 25000 | 3.8×10^{-6} | 300 | 0.15 | 1.5 | ±0.2 | 40 |
| XGL2-30C | 15 | 11 | 6.3 | 21000 | 7.6×10^{-6} | 540 | 0.2 | 1.5 | ±0.3 | 56 |
| XGL2-34C | 16 | 12 | 8 | 18000 | 1.4×10^{-5} | 640 | 0.2 | 1.5 | ±0.3 | 78 |
| XGL2-39C | 20 | 15 | 13.5 | 16000 | 2.9×10^{-5} | 950 | 0.2 | 1.5 | ±0.3 | 122 |

*1 : Correction of rated torque due to load fluctuation is not required. If ambient temperature exceeds 30°C, be sure to correct the rated torque with temperature correction factor shown in the following table.

The allowable operating temperature of **XGL2-C** is -10°C to 120°C.

※ The shaft's slip torque may be smaller than the coupling's rated torque depending on the shaft bore. ➡ P.xxxx

*2 : These are values with max. bore diameter.

● Ambient Temperature / Temperature Correction Factor

| Ambient Temperature | Temperature Correction Factor |
|---------------------|-------------------------------|
| -10°C to 30°C | 1.00 |
| 30°C to 40°C | 0.80 |
| 40°C to 60°C | 0.70 |
| 60°C to 120°C | 0.55 |

● Part number specification

XGL2-15C - 5-5

1 2

Additional Keyway at Shaft Hole ➡ P.xxxx Cleanroom Wash & Packaging ➡ P.xxxx SUS Change to Stainless Steel Screw ➡ P.xxxx
 Available / Add'l charge Please combine with Stainless Steel Screw Alteration Service Available / Add'l charge

XGT2-C/XGL2-C/XGS2-C Flexible Couplings - High-gain Rubber Type Patented

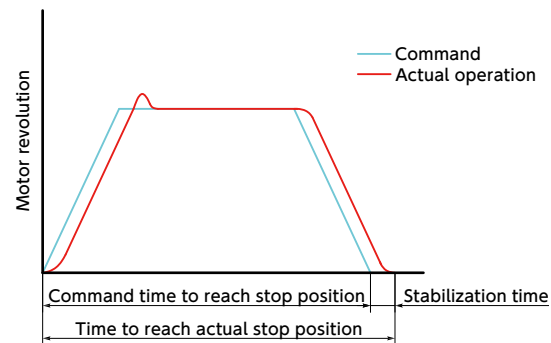
Zero Backlash High gain supported High torque High Rigidity Vibration absorption Electrical Insulation

Technical Information

Productivity and stabilization time

In a production facility which uses servomotors, single-axis actuators and ball screws, the key to improved productivity is operating these components accurately, as directed by a program. However, occasionally the command execution may be delayed.

For example, when trying to stop the actuator at a predetermined position, sometimes it will stop later than the command, which we refer to as a delay in stabilization time. Since the operation does not shift to the next process until the actuator completely stops, it is important to shorten stabilization time and thereby improve productivity.



Gain and stabilization time of servomotor

This shows how the servomotor gain movement follows the command.

Increasing the gain helps to reduce stabilization time, but increasing it too far causes hunting, making servomotor control impossible. Increasing the gain while suppressing hunting requires fine adjustment of the servomotor parameters.

However, when a servomotor is combined with a coupling with a metal disk type in the elastic segment, raising the gain tends to cause hunting, making it difficult to resolve the problem by fine adjustments to parameters.

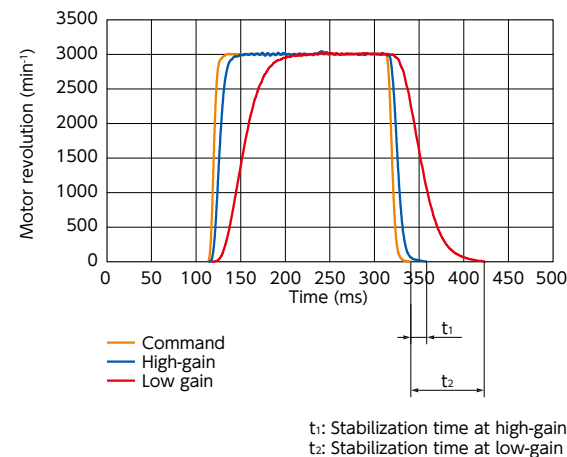
When hunting occurs, it is generally recommended to change to a coupling with higher rigidity to increase the rigidity of the rotating system.

However, in reality, it is not possible to increase the rigidity of the entire rotating system including the ball screw simply by changing the coupling; so changing to a highly rigid coupling such as a disk type may not be effective.

High-gain Rubber Type

XGT2-C XGL2-C XGS2-C XGT XGL XGS

The high-gain rubber type can be used at even higher gain than high-rigidity couplings such as the disk type, enabling reduction of stabilization time. The vibration absorption function reduces the amount of parameter adjustment work, and lowers the time required to find optimal parameters.



Why can gain be increased even further with high-gain rubber types than with disk types?

The Bode plot makes it clear why the high-gain rubber type can increase servomotor gain beyond the capacity of the disk type.

The width of the gain relative to 0 dB when the phase delay on the Bode plot is -180° is called the gain margin and the phase width relative to the frequency intersecting at 180° is called the phase margin.

General guidelines for servo systems call for setting the gain margin between 10 and 20 dB and the phase margin between 40° and 60° , but as the servomotor gain is increased, the gain margin decreases. When the gain margin falls below 10 dB, hunting tends to occur.

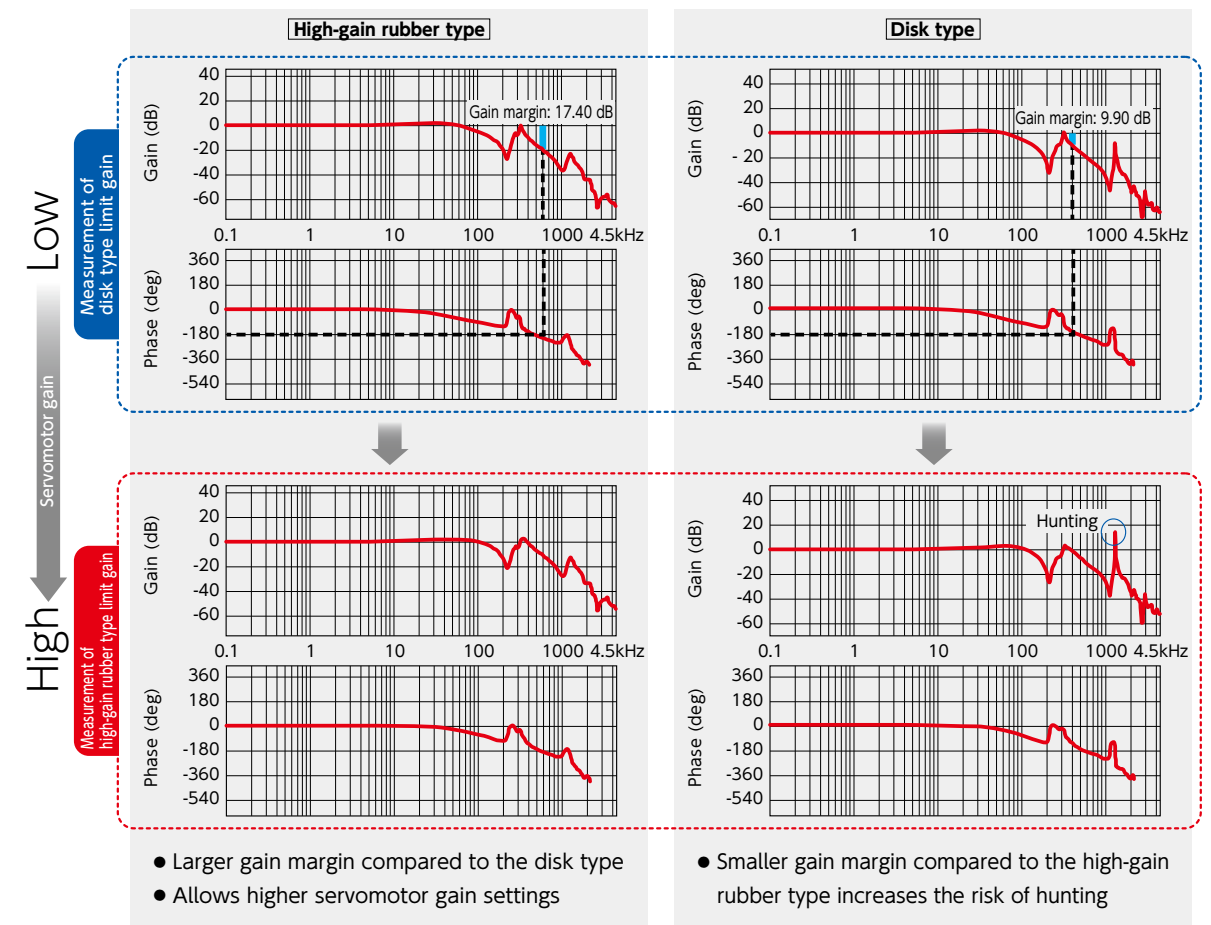
A comparison with the disk type limit gain (upper limit of the gain in which coupling can be used without hunting) shows not only that the high-gain rubber type features a larger gain margin, but also that the gain margin is over 10 dB. This is why the high-gain rubber type allows greater servomotor gain than the disk type. To increase the gain margin, both the coupling damping performance and its dynamic rigidity must be high. ➔ P. xxxx

Gain margin at the disk type limit gain

High-gain rubber type: 17.40 dB

Disk type : 9.90 dB

Bode Plot



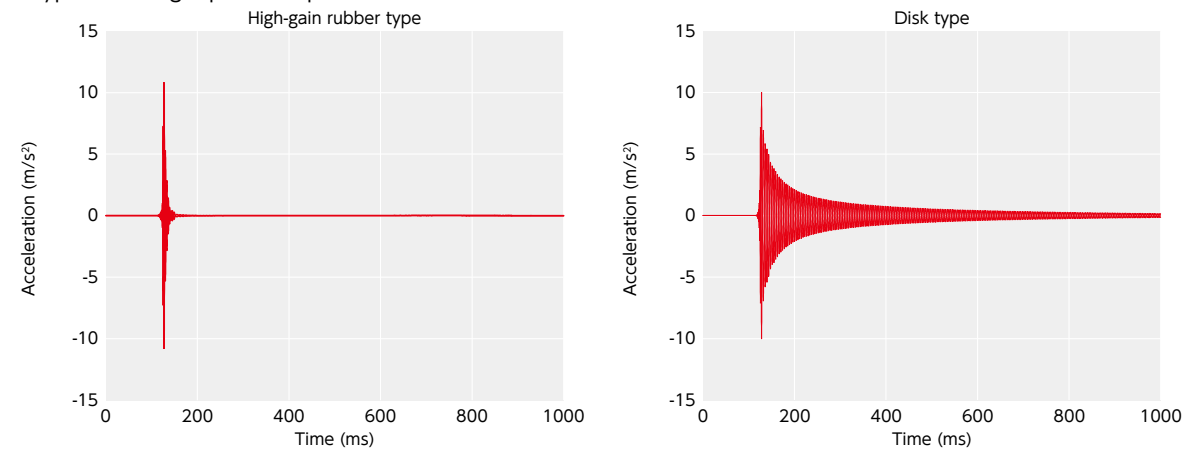
XGT2-C/XGL2-C/XGS2-C Flexible Couplings - High-gain Rubber Type Patented

Zero Backlash
 High gain supported
 High torque
 High Rigidity
 Vibration absorption
 Electrical Insulation

Technical Information

Damping performance comparison of high-gain rubber and disk types

Damping ratio of high-gain rubber type that shows damping characteristics is far higher than that of the disk type, enabling rapid absorption of vibration.



Comparison of High-gain Rubber Type (XG2 Series/XG Series) and Disk Type Couplings

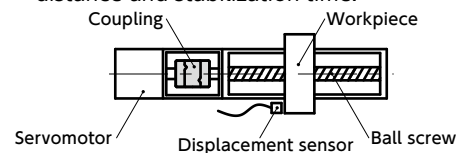
In tests using servo motors and actuators, the following are confirmed.

- Stabilization Time**
 Increasing the gain shortens the stabilization time, and the gain can be set especially high in the XG2 and XG series.
 There were no differences in stabilization time between couplings as long as the gain was the same.
 To reduce stabilization time, higher gain settings enabled by the use of the high-gain rubber types, especially the XG2 series, demonstrate clear advantage against the disk type.
- Positioning Accuracy/Repeated Positioning Accuracy**
 No differences attributable to factors such as gain or coupling were observed.
- Overshoot**
 Increasing the gain increases the overshoot, and the same gain resulted in no difference in the overshoot.
- Conclusion**
 The XG2 Series allows higher gain settings, enabling shorter stabilization time. The positioning accuracy, repetition positioning accuracy and overshoot did not differ due to coupling.
 As a result, it was confirmed that the XG2 series is effective for shortening the cycle time of devices and equipment.

- Test Devices**
 Actuator : MCM08 Manufactured by NSK Co., Ltd.
 * Ball screw lead 10 mm
 Servomotor : HF-KP13 Manufactured by Mitsubishi Electric Corporation
- Test Conditions**
 Motor revolution : 3000 min⁻¹
 Acceleration/deceleration time : 50 ms
 Workpiece load : 3.0 kg
 Ratio of moment of inertia of load : 3.5

- Test Operation**
 Normal rotation (1 rev) → Stop (500 ms) → Reverse rotation (1 rev)

- Test Method**
 Measure the work movement with a displacement sensor and also measure the work piece's travel distance and stabilization time.



Measurement of Stabilization Time, Positioning Accuracy and Overshoot

| Gain*1 | | XG2 Series | XG Series | Disk Type | Consideration |
|--------|------------------------------------|------------|-----------------------|-----------------------|---|
| 25 | Stabilization Time (ms) | 12 | 12 | 12 | This is the upper gain limit for the disk type. XG series and XG2 series have no problems. |
| | Positioning Accuracy (mm) | 0.002 | 0.002 | 0.002 | |
| | Repeated Positioning Accuracy (mm) | ±0.001 | ±0.002 | ±0.002 | |
| | Overshoot (μm) | 0.6 | 0.6 | 0.6 | |
| 27 | Stabilization Time (ms) | 8 | 8 | Occurrence of Hunting | This is the upper gain limit for the XG series. XG2 series has no problems. The disk type is not usable due to hunting. |
| | Positioning Accuracy (mm) | 0.002 | 0.003 | | |
| | Repeated Positioning Accuracy (mm) | ±0.002 | ±0.002 | | |
| | Overshoot (μm) | 1 | 1 | | |
| 32 | Stabilization Time (ms) | 3 | Occurrence of Hunting | Occurrence of Hunting | The disk type and XG series are not usable due to hunting. XG2 series has no problems. |
| | Positioning Accuracy (mm) | 0.003 | | | |
| | Repeated Positioning Accuracy (mm) | ±0.001 | | | |
| | Overshoot (μm) | 1.7 | | | |

*1 : Values with all gains, such as position control gain and speed control gain, adjusted (Min: 1 - Max: 32)

Positioning Accuracy

: Positioning operation is performed and the absolute value of the difference between the target point and the actual stop position is determined. Max. value is found by performing this measurement from the home position at all positions within the max. stroke range.

Repeated Positioning Accuracy

: Positioning is repeated 7 times from the same direction of movement to a randomly-selected point, the stopping positions are measured, and the difference between the max. and minimum values of the stopping position is determined. This method of measurement is applied at positions at the middle and both ends of the max. stroke range, then the max. value becomes the measured value, halved and prefixed with ±.

- The values in the table vary depending on testing conditions.

XGT2-C/XGL2-C/XGS2-C Flexible Couplings - High-gain Rubber Type Patented

Zero Backlash High gain supported High torque High Rigidity Vibration absorption Electrical Insulation

Technical Information

Changes in performance after cycles

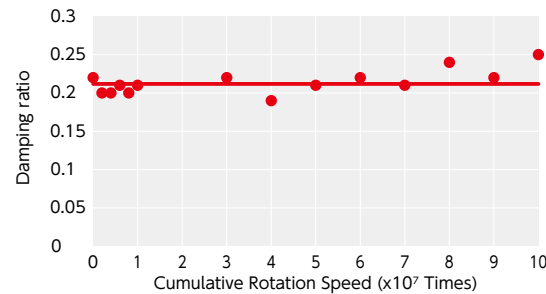
Test Method ①

Rated torque load is applied to a coupling which rotates in a single direction, and the damping ratio and dynamic rigidity are measured.

Couplings

XGT2-25C-12-12

Changes in Damping Ratio Depending on Number of Cycles (Cumulative Rotation Speed)



*No changes are observed in the damping ratio or dynamic rigidity after cumulative rotation speed of 10⁸ times.

Test Method ②

A motor and coupling are mounted on a single-axis actuator, the workpiece is set in reciprocating motion and the damping ratio is measured.

Couplings

XGT-25C-8-8

Test Operation

Forward rotation (10 rev) → Reverse rotation (10 rev) This operation is repeated.
Stroke 100 mm, total travel distance 4400 km

Measurement of Damping Ratio and Dynamic Rigidity

| | Before Testing | After Testing |
|---------------|----------------|---------------|
| Damping Ratio | 0.07 | 0.07 |

*No changes are observed in the damping ratio even after a total travel distance of 4400 km.

Test Devices

Actuator : BG46 Manufactured by Nippon Bearing Co., Ltd.
* Ball screw lead 10 mm
Servomotor : HF-KP13 Manufactured by Mitsubishi Electric Corporation

Test Conditions

Motor revolution : 3000 min⁻¹
Acceleration/deceleration time : 10 ms
Workpiece load : 3.0 kg
Ratio of moment of inertia of load : 3.5

Test Method

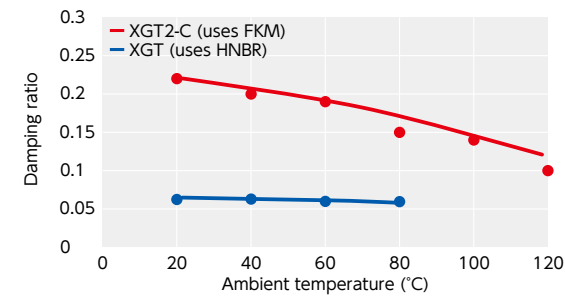
The damping ratio of the coupling is measured before and after the testing.

Temperature-triggered changes in performance

Test Method

A coupling is left at the prescribed ambient temperature for 4 hours and damping ratio and dynamic rigidity measured.

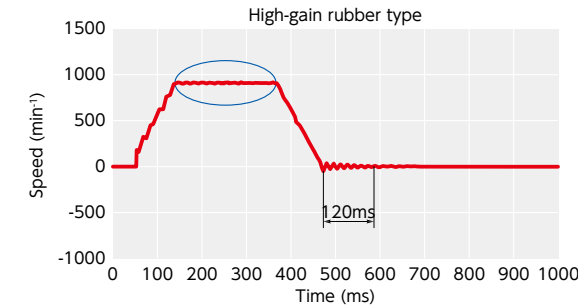
Temperature-triggered Changes in Damping Ratio



*Although the damping ratio and dynamic rigidity decrease as the temperature rises, **XGT2** exceeds the damping ratio and dynamic rigidity of **XGT** across the entire temperature range.

* **XGT2-68C** uses HNBR high-gain rubber.

Suppressing speed unevenness Control during Stepping Motor Operation



Test Devices

Motor : α step AR66AK-1
Manufactured by Oriental Motor Co., Ltd.
Set voltage—24 VDC
Resolution—1000 p/r
Moment of inertia—1250×10⁻⁷kg·cm²
Encoder : RD5000 Manufactured by Nikon Corporation

Drive Parameters

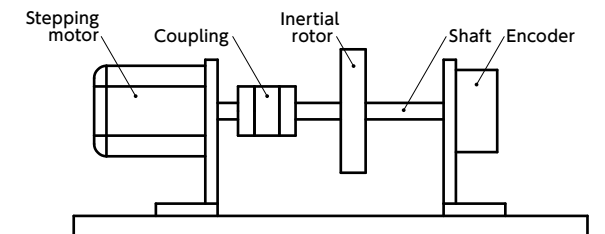
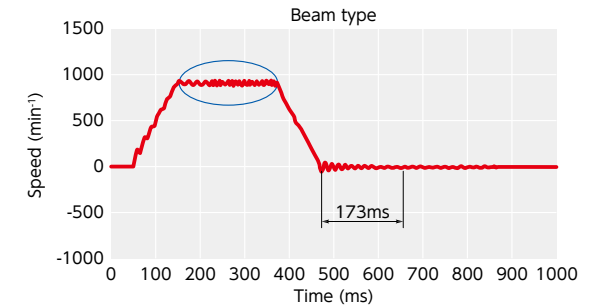
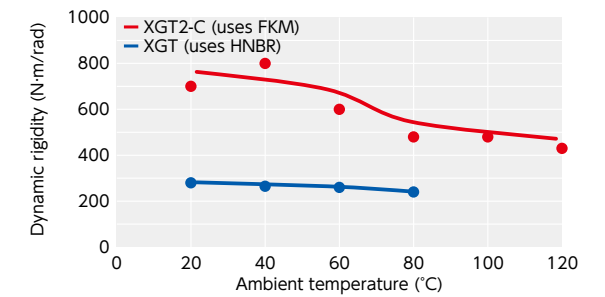
Startup speed : 60 min⁻¹
Drive speed : 900 min⁻¹
Rotation angle : 180°
Acceleration/deceleration time : 100 ms

*The high-gain rubber type is effective to suppress speed unevenness during fixed-speed rotation.

Couplings

XGT2-25C-12-12 **XGT-25C-12-12**

Temperature-triggered Changes in Dynamic Rigidity

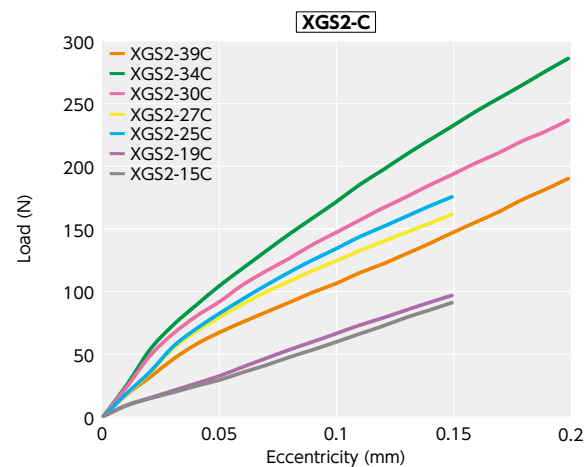
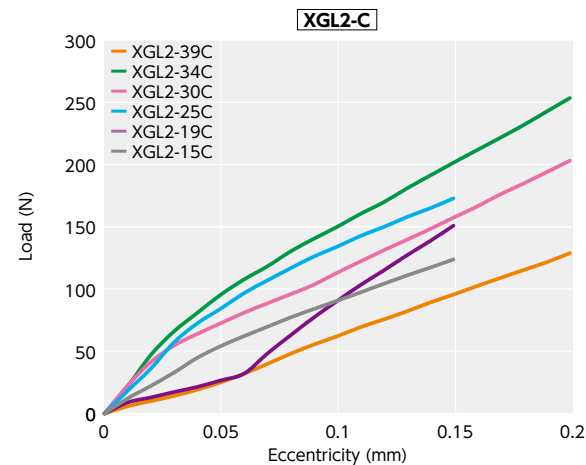
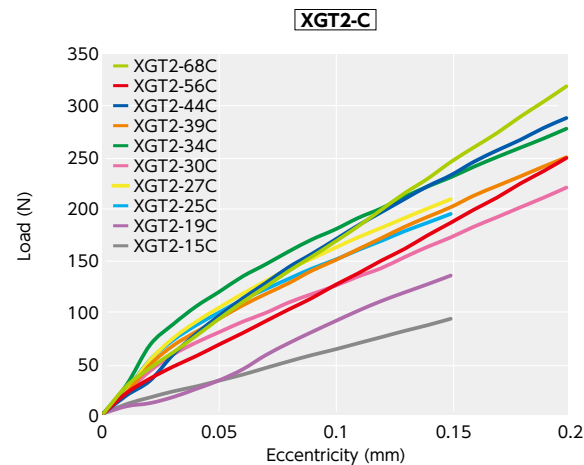


XGT2-C / XGL2-C / XGS2-C Flexible Couplings - High-gain Rubber Type Patented

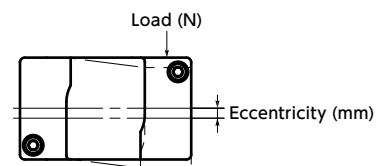
Zero Backlash High gain supported High torque High Rigidity Vibration absorption Electrical Insulation

Technical Information

• Eccentric Reaction Force



This is the force generated when placing **XGT2-C**, **XGL2-C**, **XGS2-C** in an eccentric condition. As the eccentric reaction force becomes smaller, the force acting on the shaft bearing also becomes smaller.

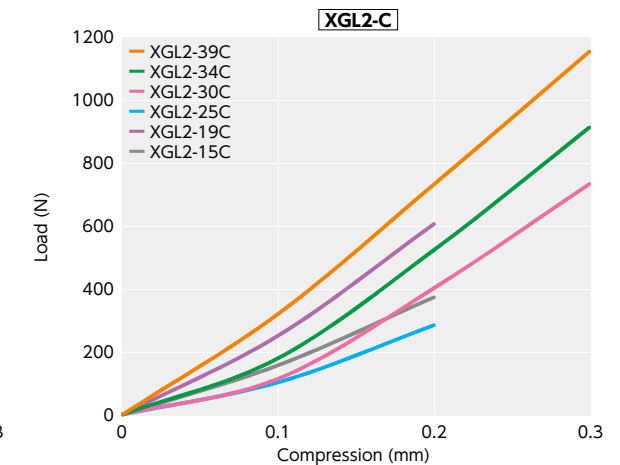
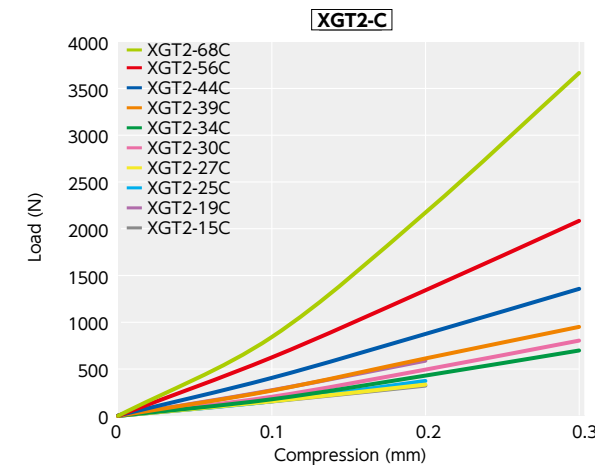


• Physical properties and chemical resistance of high-gain type rubber

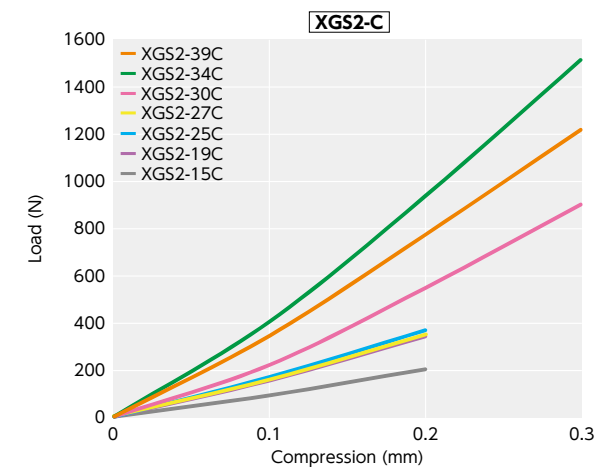
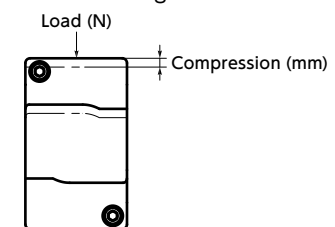
| | Effect | |
|-----------------------------------|--------|-------|
| | FKM | HNBR |
| Aging Resistance | ○ | ○ |
| Weather Resistance | ○ | ○ |
| Ozone Resistance | ○ | ○ |
| Gasoline / Gas Oil | ○ | ○ - ○ |
| Benzene / Toluene | ○ | △ - ○ |
| Alcohol | ○ | ○ |
| Ether | x - △ | x - △ |
| Ketone (MEK) | x | x |
| Ethyl Acetate | x | x - △ |
| Water | ○ | ○ |
| Organic Acid | x | ○ |
| High Concentration Inorganic Acid | ○ | ○ |
| Low Concentration Inorganic Acid | ○ | ○ |
| Strong Alkali | x | ○ |
| Weak Alkali | △ | ○ |

○: Excellent ○: Available △: Available depending on conditions x: Not available

• Thrust Reaction Force



This is the force generated when compressing **XGT2-C**, **XGL2-C**, **XGS2-C** in the axial direction. As the thrust reaction force becomes smaller, the force acting on the motor also becomes smaller.



• Slip Torque

As in the table below, the clamping types **XGT2-C**, **XGL2-C**, and **XGS2-C** have different slip torque according to the bore diameter. Take care during selection.

| Outside Diameter | Bore Diameter (mm) | | | | | | | | | | | | | | | | |
|------------------|--------------------|-----|-----|-----|-----|------|-----|-----|----|----|----|----|----|----|----|----|----|
| | 3 | 4 | 4.5 | 5 | 6 | 6.35 | 7 | 8 | 10 | 11 | 12 | 14 | 15 | 16 | 17 | 19 | 20 |
| 15 | 1 | 1.3 | 1.5 | 1.7 | 1.9 | | | | | | | | | | | | |
| 19 | | 2.2 | | 2.7 | 3.1 | 3.3 | 3.8 | | | | | | | | | | |
| 25 | | | | 4.3 | 5 | 5.5 | | 6.8 | | | | | | | | | |
| 27 | | | | 3.8 | 5 | | | 6.8 | | | | | | | | | |
| 30 | | | | | | | | 7.5 | 10 | 12 | | | | | | | |
| 34 | | | | | | | | 8.3 | 10 | 10 | 12 | 13 | | | | | |
| 39 | | | | | | | | | 13 | | 15 | 17 | 18 | 18 | 23 | 25 | |
| 44 | | | | | | | | | | | 16 | 19 | 20 | 21 | 23 | 25 | 27 |
| 56 | | | | | | | | | | | | | 45 | | | 50 | 61 |

• These are test values based on the conditions of shaft dimensional allowance: h7, hardness: 34 - 40 HRC, and screw tightening torque of the values described in **XGT2-C**, **XGL2-C**, **XGS2-C** dimension tables. They are not guaranteed values.

• Slip torque changes with usage conditions. Carry out tests under conditions similar to actual conditions in advance.