JAB CM009

ISO 14001 JQA-EM7212

ISO 9001 JQA-1190

Precision Reduction Gear RV™

Turntable Gearhead

RS

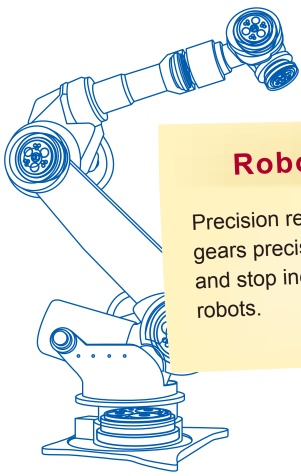
RS Series

Nabtesco

Nabtesco's technologies supporting society

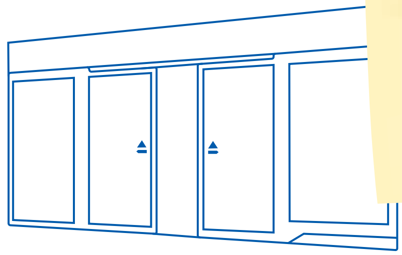
Contributing to society with our ‘Moving it. Stopping it.’ technologies

Nabtesco manufactures products which are used in everyday life. Our high-accuracy components are essential for moving objects; they may be rarely visible, but are the foundation of everyday objects that you see moving and wonder how. Nabtesco’s technologies are found throughout objects that move and stop people’s lives.



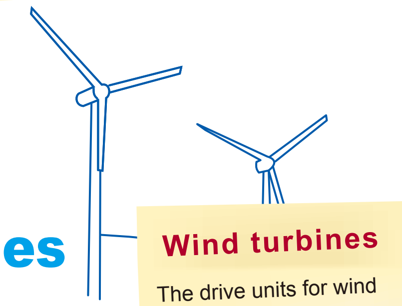
Robots

Precision reduction gears precisely move and stop industrial robots.



Doors

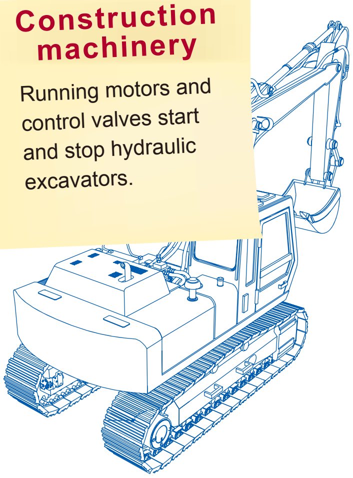
Nabtesco technology opens and closes automatic doors in buildings and platform doors at train stations.



Wind turbines

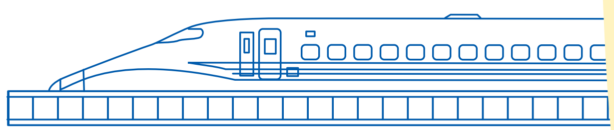
The drive units for wind turbine generators control the orientation of the wind turbine and the angle of the blades.

Nabtesco technologies are at work in many areas of our daily lives.



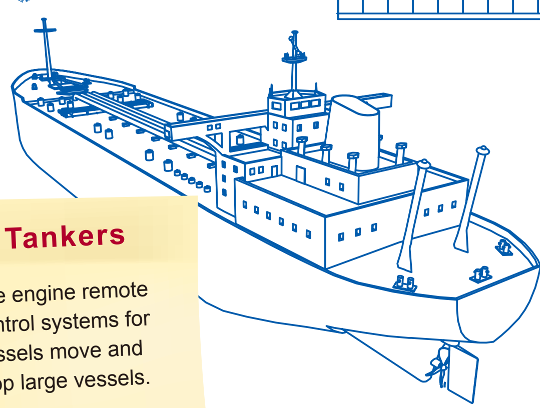
Construction machinery

Running motors and control valves start and stop hydraulic excavators.



Bullet trains

Brakes and doors ensure safety and comfort for the world-famous Shinkansen bullet trains.



Tankers

The engine remote control systems for vessels move and stop large vessels.

Airplanes

The flight control systems are crucial for the flight safety of aircraft.

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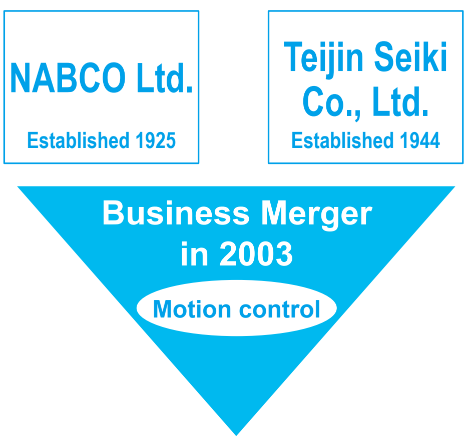
Who is Nabtesco?

The key words for Nabtesco are 'motion control'. We use our strengths in the fields of component and systems technologies to develop highly creative products. Through the Nabtesco Group as a whole, we can also utilize our advantage of expertise to maximum effect in order to further enhance these strengths.
In the air, on land and at sea, we have a leading share in various fields of both international and domestic markets. Nabtesco will continue to evolve by utilizing its strengths in many fields and by exploring the possibilities of the future.



Nabtesco

April 2002 Initiation of hydraulic equipment business alliance
October 2003 Business merger

The business alliance between Teijin Seiki and NABCO on hydraulic equipment projects was the beginning of a mutual confirmation by the companies of the other's product configuration, core technologies, corporate strategies and corporate culture. This led to a common recognition that a business merger would be an extremely effective means of increasing corporate value and achieving long-term development. Based on this mutual judgment, in 2003 an equity transfer was conducted to establish Nabtesco as a pure holding company, with both firms as wholly owned subsidiaries. After a year of preparation, both companies were absorbed and amalgamated by means of a short form merger, and Nabtesco was transitioned to an operating holding company.

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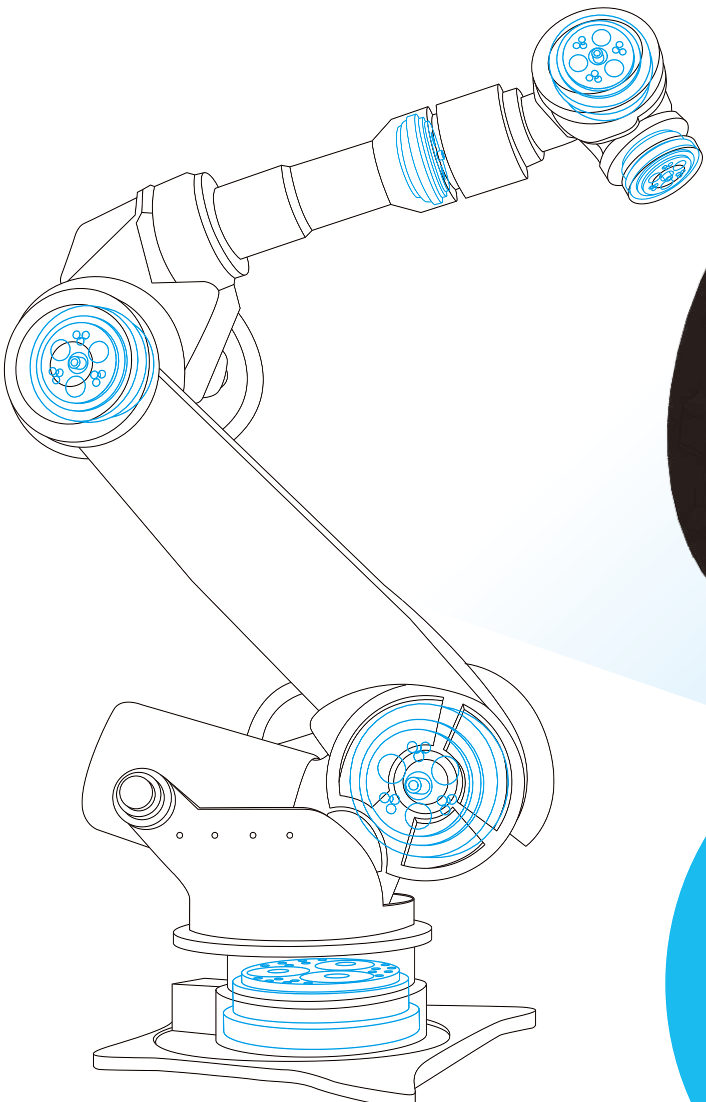
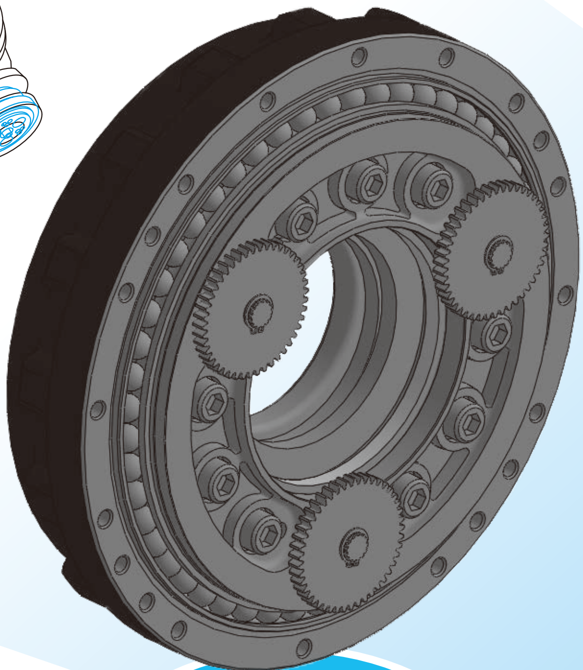
RS Series Eliminates Turntable Problems!



Industrial robot



Precision Reduction Gear RV™

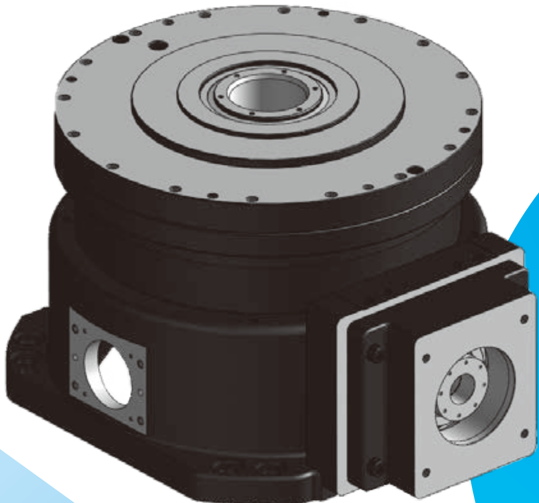
Precision Reduction Gear RV enables the precision movements of industrial robots and also ensures their strength.
Precision Reduction Gear RV has been praised for being compact and lightweight while offering high precision and rigidity.
Since its debut in 1985, Precision Reduction Gear RV has been selected for use by most major industrial robot manufacturers around the world.

Market share

Industrial robot (vertical articulated robot) joints — ***60%*** **share of global market *1**

Machine tool ATC drive units — ***80%*** **share of Japanese market *2**

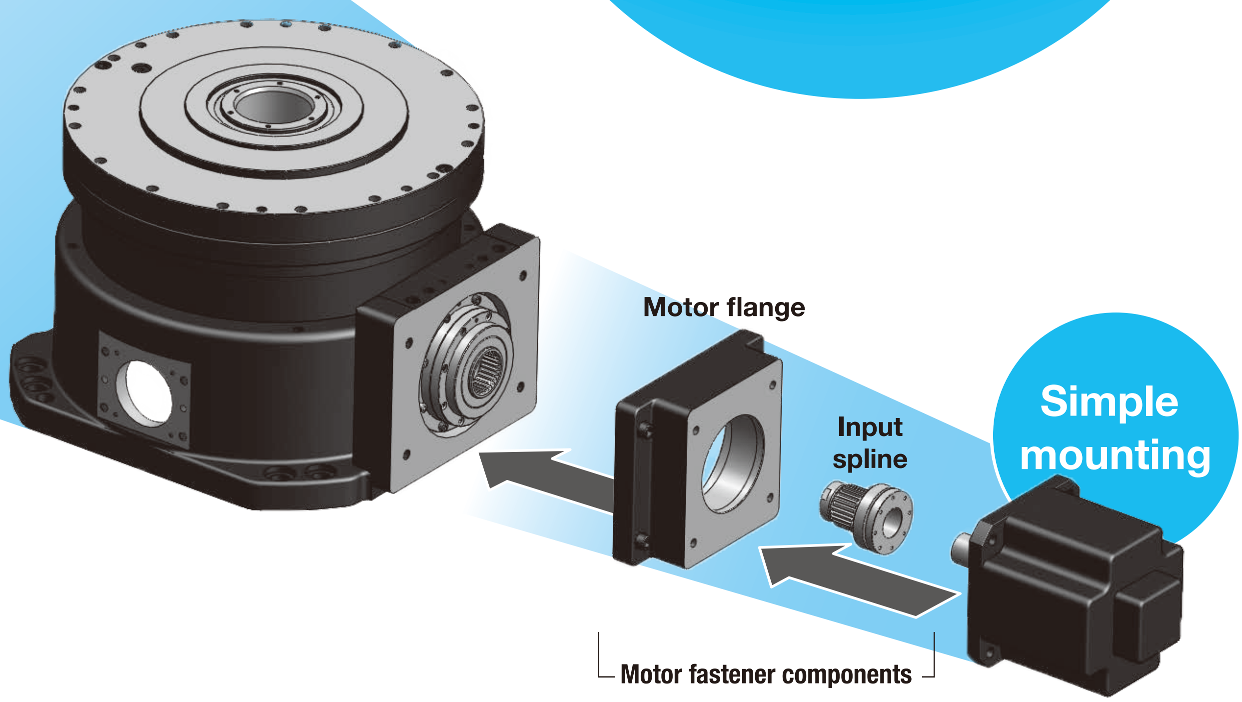
*1/2 Based on Nabtesco studies
*2 Only for units with precision reduction gears



Precision Gearhead

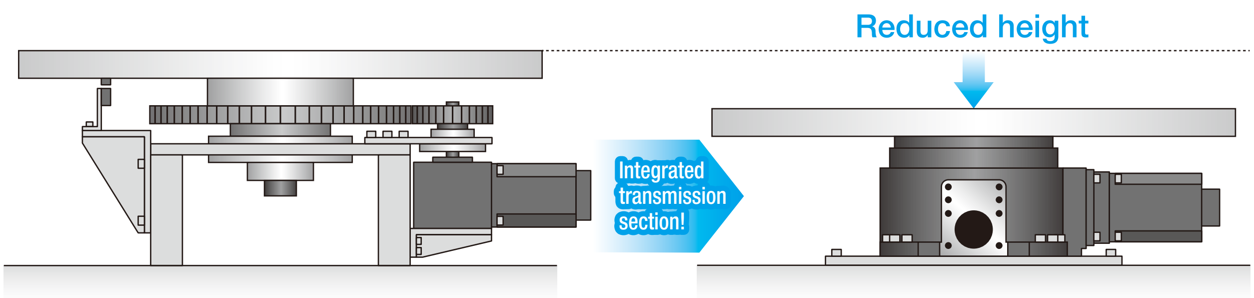
RS Series

The RS Series continues the success of Nabtesco's world-leading RV series of precision reduction gears. These low profile gearheads are pre-lubricated with a sealed structure and are available in three types to suit different load capacities. Each type comes with dedicated fasteners that allow it to be mounted on all major motors for immediate use. As well as reducing the time needed for adjustment, the RS Series significantly decreases both design and component requirements.



Advantages of RS Series

More components increase assembly and adjustment times…



Fewer parts!

Easier installation!

Simplified design!

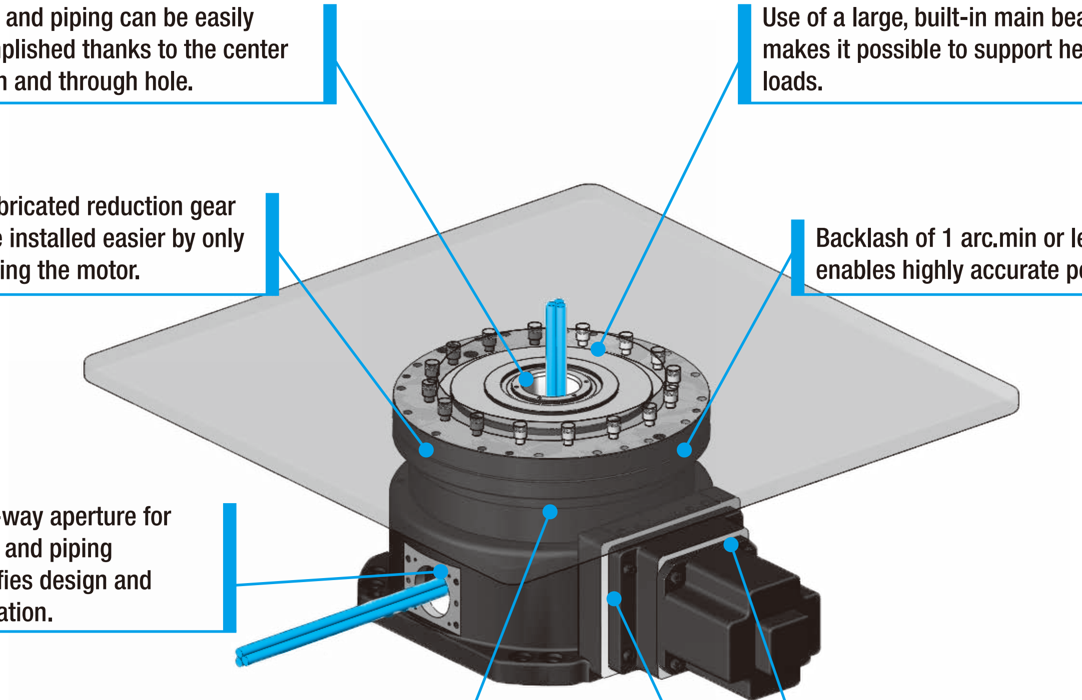
Individual features of RS Series

Wiring and piping can be easily accomplished thanks to the center section and through hole.

Use of a large, built-in main bearing makes it possible to support heavy loads.

Pre-lubricated reduction gear can be installed easier by only mounting the motor.

Backlash of 1 arc.min or less enables highly accurate positioning.



Three-way aperture for wiring and piping simplifies design and installation.

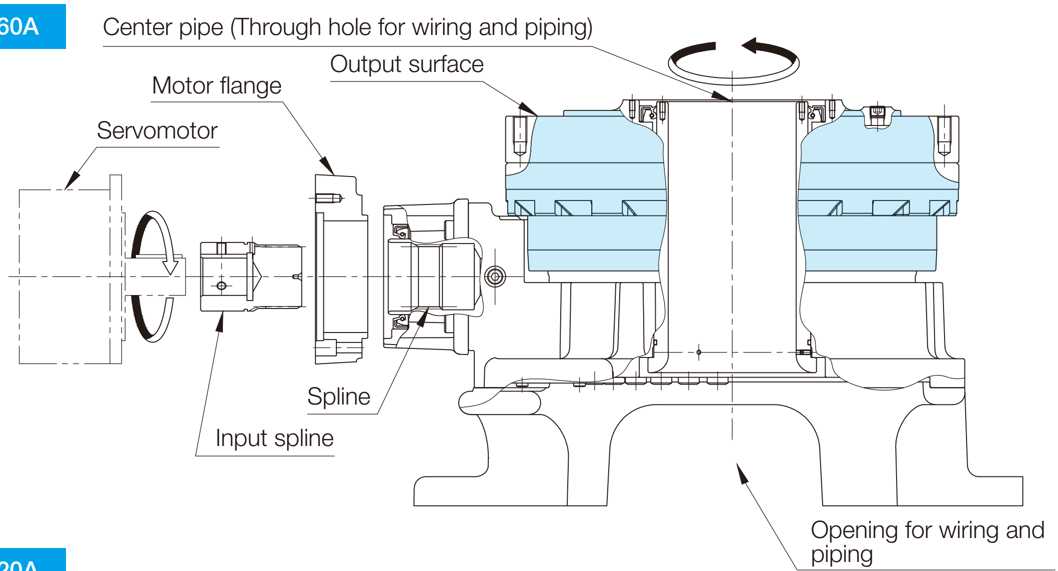
Integrated input spline and motor flange supports many motor types.

Use of RV precision reduction gears designed for industrial robots creates a highly accurate and rigid device.

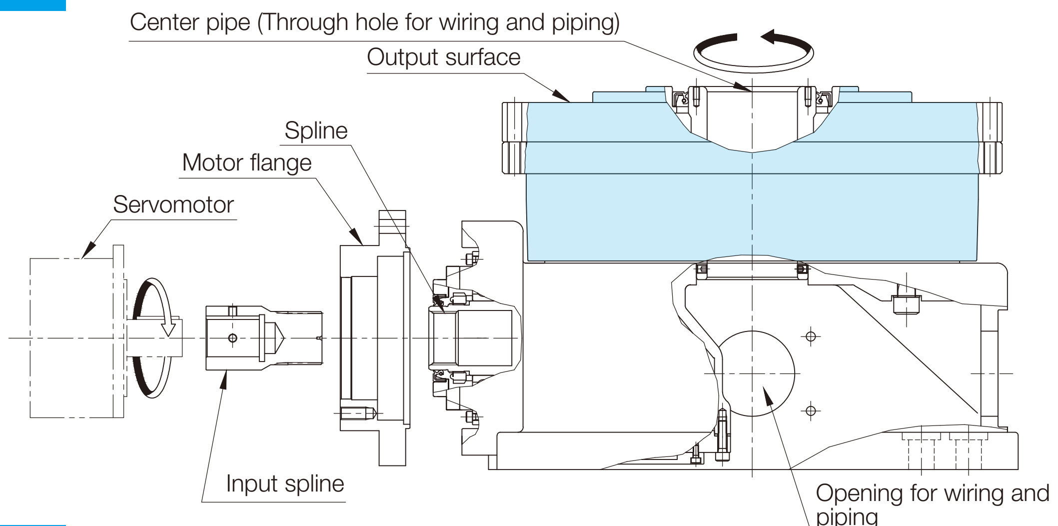
Installation of a right angle input shaft makes the device more compact.

Structure and rotation directions

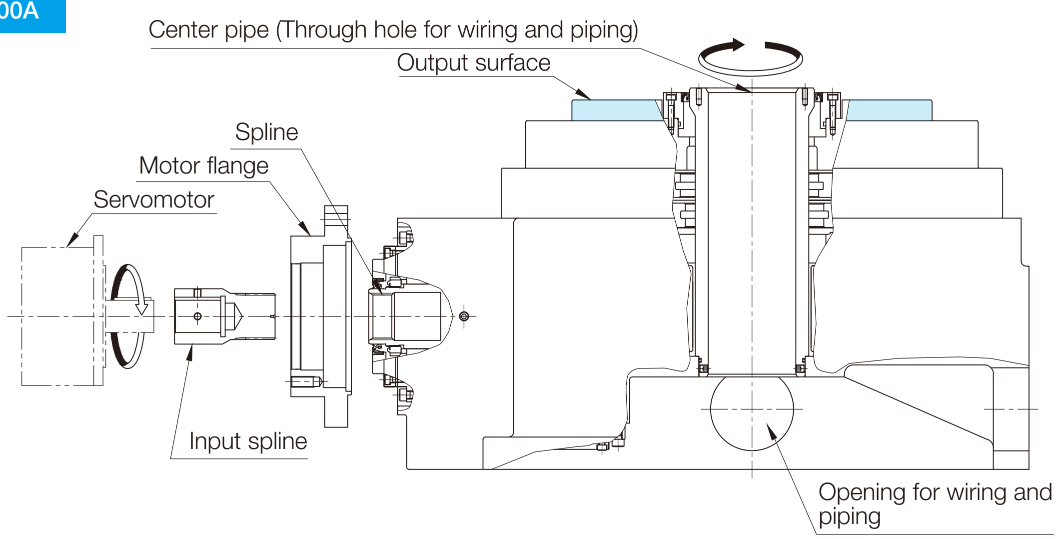
RS-260A



RS-320A



RS-900A

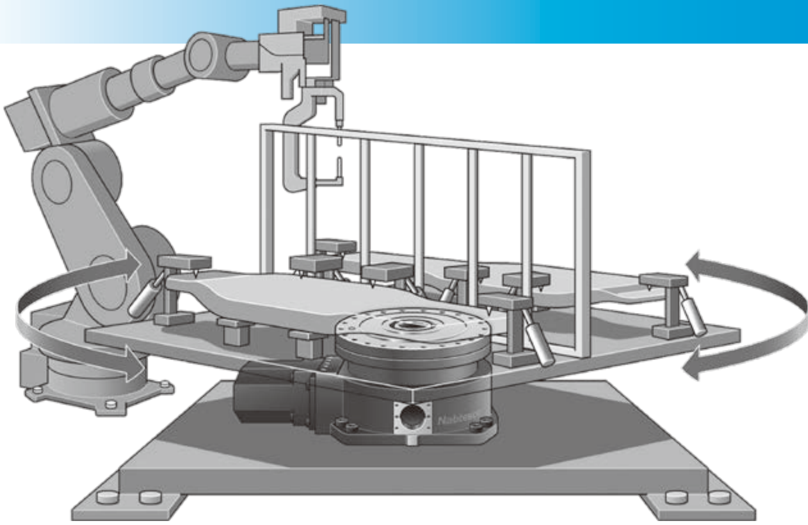


With the RS-260A, RS-320A and RS-900A, the rotation direction of the output shaft and servo motor differs.

Note: The areas indicate output rotation sections.

Main RS Series applications

Welding turntables



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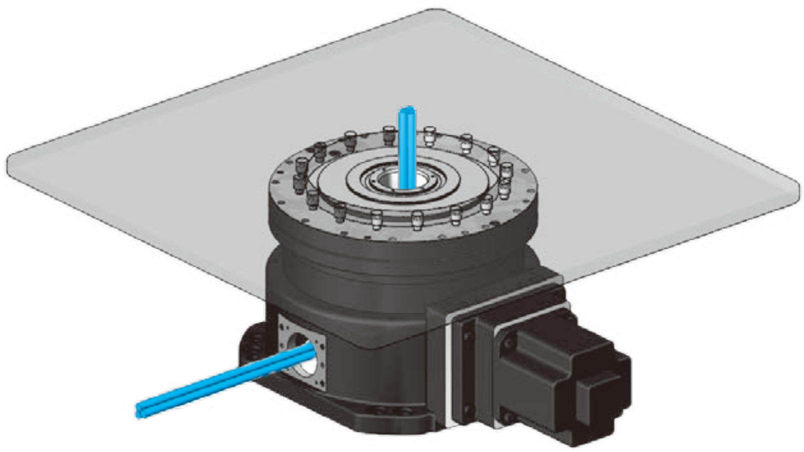
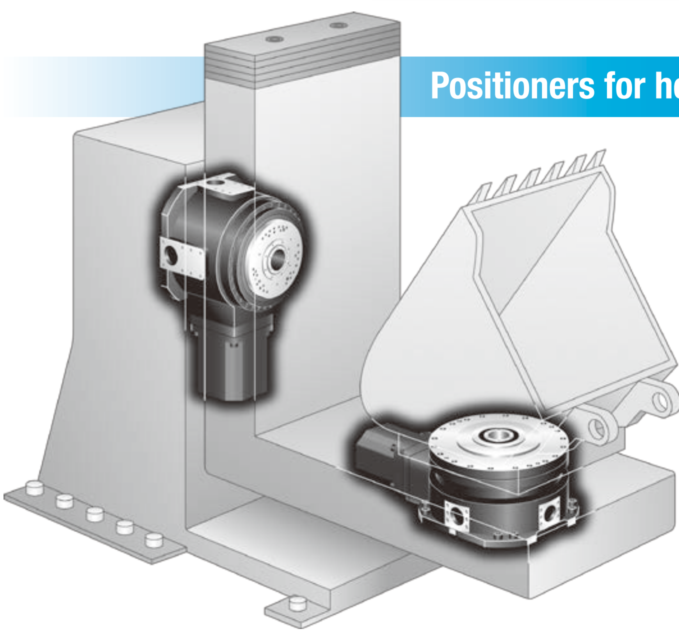


Positioners for heavy welding (rotary axis, tilting axis)



RS series model code

Product code

RS – 260 A – 120 – SXA – XB

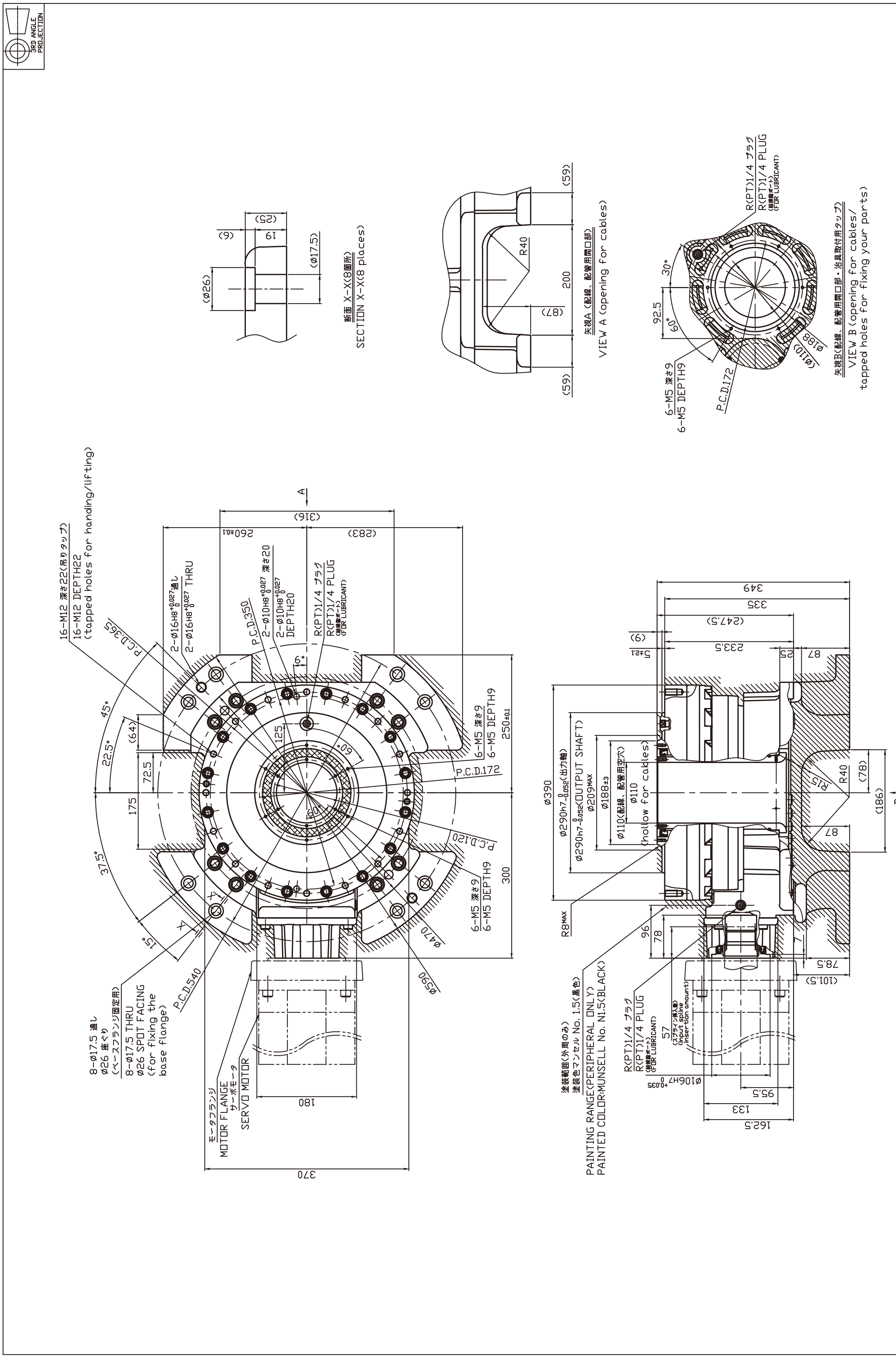
Model code	Frame number	Ratio code	Input spline code	Motor flange code
RS	260A	120	Standard component: 3 alphabetic characters. Third character may be numerical. (Code will differ depending on motor to be attached.) None: ZZZ	Standard component: 2-letter code (code will differ depending on motor to be attached) None: ZZ
	320A	170		
	900A	194 , 240		

Rating table

Model				RS-260A	RS-320A	RS-900A	
	Speed ratio	R		120	170	193.6	240
	Ratio code			120	170	194	240
	Rated torque	To	Nm		3,136	8,820	
	Rated output speed	No	rpm	15	15	15	
	Rated life	K	h	6,000	6,000	6,000	
	Allowable acceleration/ deceleration torque	T_{S1}	Nm	6,370	7,840	17,640	
	Momentary maximum allowable torque	T_{S2}	Nm	12,740	15,680	35,280	
	Allowable output speed [Duty ratio: 100%] Note 2	N_{S0}	rpm	21.5	20	10	
	Backlash		arc.min.	1.0	1.0	1.0	
	Lost motion		arc.min.	1.0	1.0	1.0	
	Startup efficiency (central value)		%	75	75	70	
Capacity of main bearing	Allowable moment Note 4	M_{O1}	Nm	12,740	20,580	44,100	
Capacity of main bearing	Momentary maximum allowable moment	M_{O2}	Nm	25,480	39,200	88,200	
Capacity of main bearing	Maximum thrust load	Fo	N	24,500	49,000	88,200	
Capacity of main bearing	Allowable radial load	Wr	N	39,900	54,676	101,754	
	Moment of inertia $I(I=GD^2/4)$ Input shaft conversion value Note 3		kgm^2	5.76×10^{-3}	3.40×10^{-3}	1.16×10^{-2}	1.14×10^{-2}
	Mass		kg	165	290	480	

Note:
1. The Rating Table shows the specification values of each individual reduction gear.
2. The allowable output speed may be limited by heat depending on the operating rate. Make sure that the surface temperature of the reduction gear does not exceed 60°C during use.
3. The inertia moment value is for the reduction gear. It does not include the inertia moment for the input gear.
4. The allowable moment will differ depending on the thrust load. Check the allowable moment diagram (p. 26).
5. For the moment rigidity and torsional rigidity, refer to the calculation of tilt angle and the torsion angle (p. 27).
6. The rated torque is the value that produces the rated service life based on operation at the rated output speed; it does not indicate the maximum load. Refer to “Glossary” (p.16) and “Product selection flowchart” (p.17).
7. The specifications above are based on Nabtesco evaluation methods; this product should only be used after confirming that it is appropriate for the operating conditions of your system.

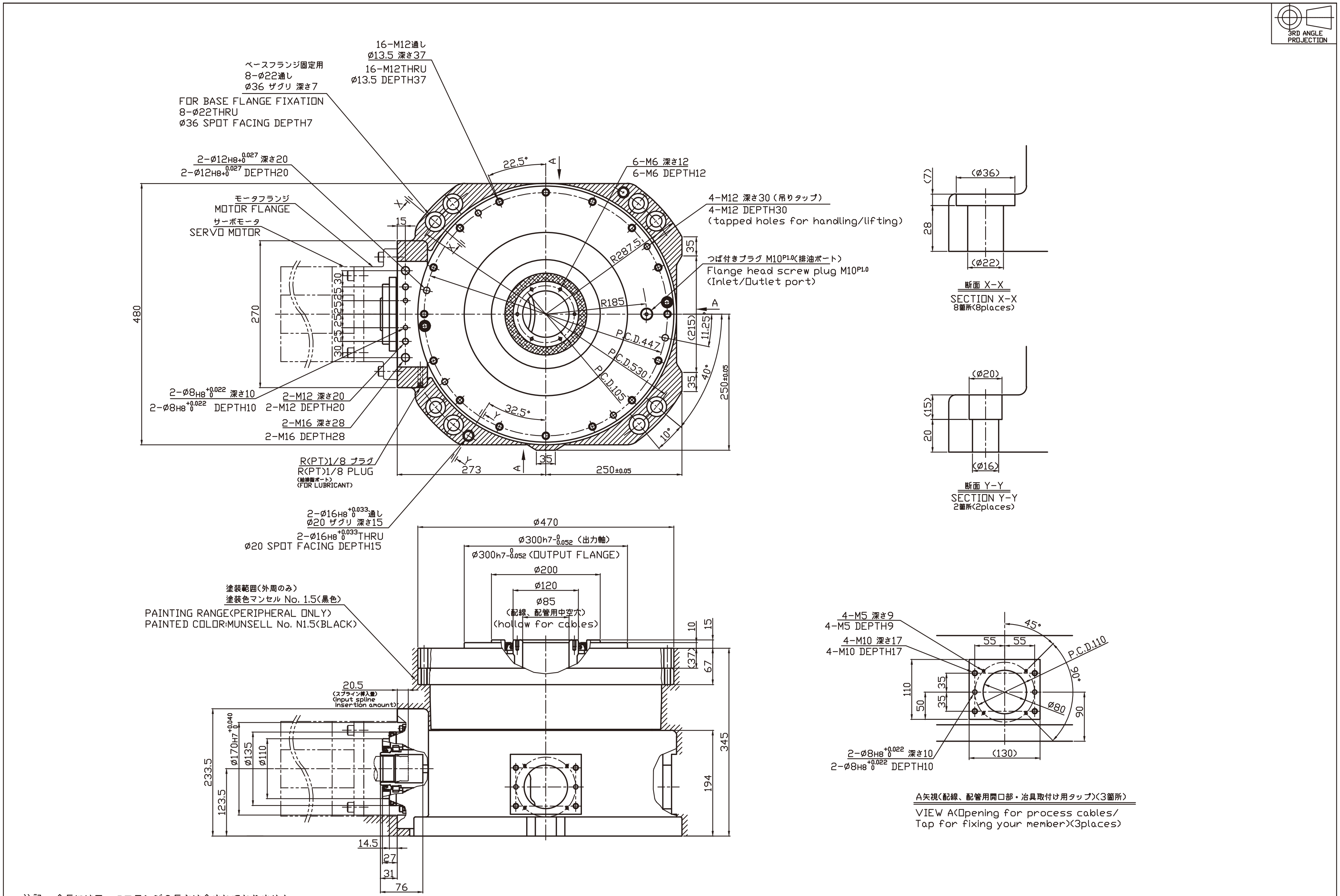
RS-260A



注記：全長にはモータフランジの長さは含まれておりません。
Note : The total length dose not include the length of the motor flange.

Specifications and dimensions are subject to change without notice.

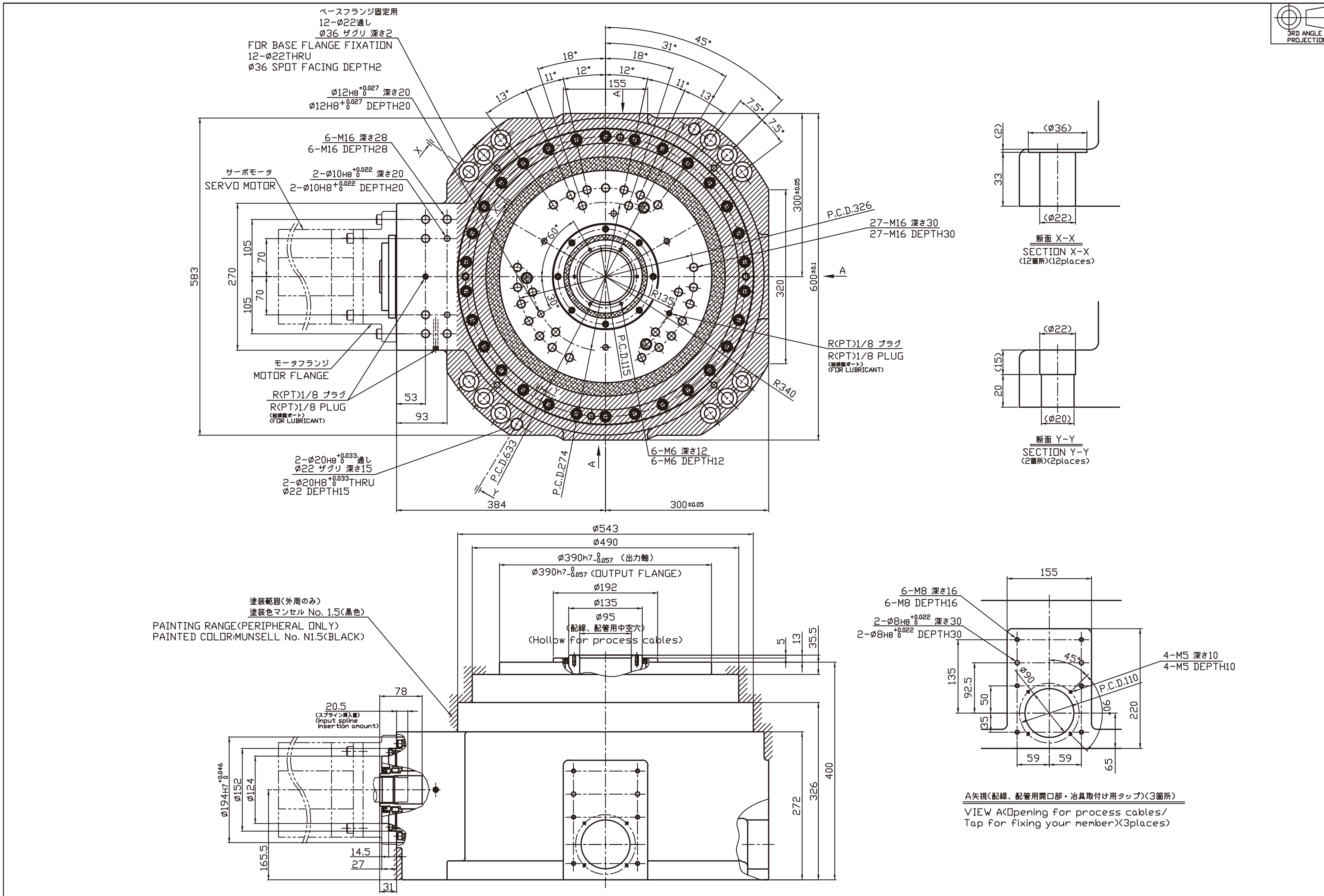
RS-320A



注記：全長にはモータフランジの長さは含まれておりません。
Note：The total length dose not include the length of the motor flange.

Specifications and dimensions are subject to change without notice.

RS-900A

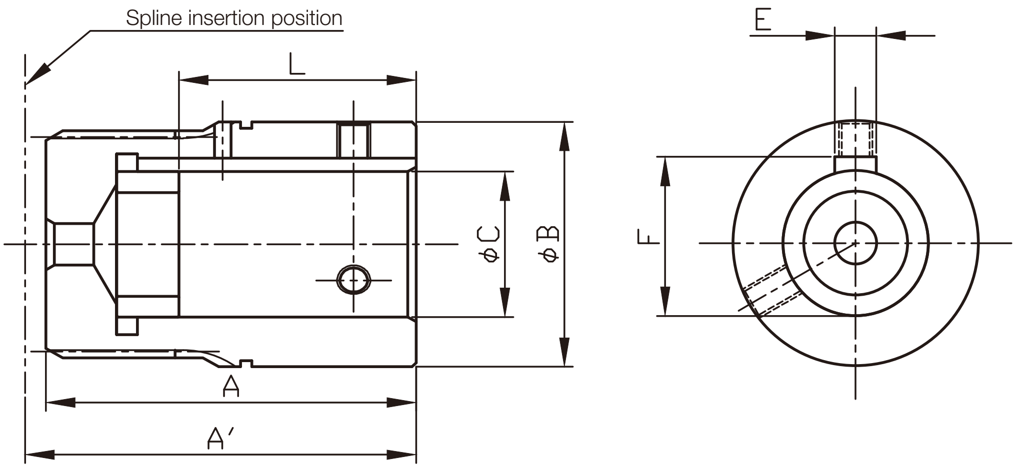


注記：全長にはモータフランジの長さは含まれておりません。
Note : The total length dose not include the length of the motor flange.

Specifications and dimensions are subject to change without notice.

External dimensions Input spline

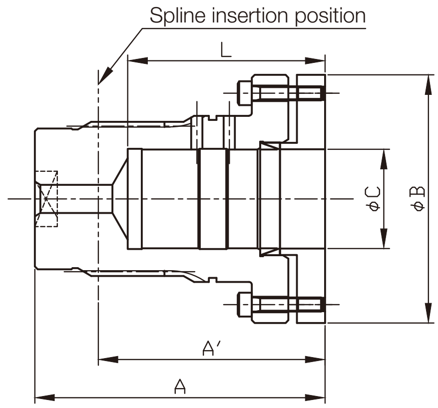
Straight shaft (with key)

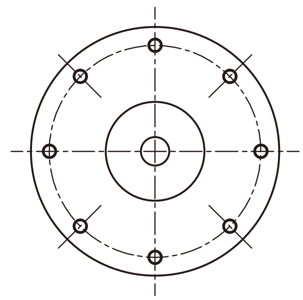


Model	Code	Order item number	Input spline dimensions (mm)									Inertia moment I ($I=GD^2/4$) Input shaft equivalent (kgm^2)
			A	A'*	øB	øC		L	E		F	
RS-260A	WXS	60WA140-*	87	85.5 to 87.5	59	32H7	+0.025 0	45	10	±0.018	35.3	6.69×10^{-4}
	WXB	60WA140B*	89	87.5 to 90	59	35	+0.035 +0.010	72	10	±0.018	38.3	6.40×10^{-4}
	WB2	60WA423B*	89	87.5 to 90	59	35	+0.035 +0.010	57	10	±0.018	38.3	6.65×10^{-4}
	WXC	60WA140C*	83	81.5 to 83.5	59	28H7	+0.021 0	49	8	±0.018	31.3	6.48×10^{-4}
RS-320A RS-900A	YXA	67WA422A*	68	64 to 72	45	28H7	+0.021 0	52	8	±0.018	31.3	2.44×10^{-4}
	YXD	67WA422D*	68	64 to 72	45	28H7	+0.021 0	52	10	±0.018	31.3	2.44×10^{-4}
	YXF	67WA140F*	145	150 to 159	56	38H7	+0.025 0	66.5	10	±0.018	41.3	7.47×10^{-4}
	YXG	67WA140G*	95	113.5 to 120.5	55	32H7	+0.025 0	45	10	±0.018	35.3	5.01×10^{-4}
	YXK	67WA140K*	109	126.5 to 133.5	60	35H7	+0.025 0	55	10	±0.018	38.3	7.11×10^{-4}
	YXL	67WA140L*	81	98.5 to 105.5	55	32	+0.043 +0.018	31	10	±0.018	35.3	4.17×10^{-4}
	YXM	67WA140M*	57	74.5 to 81.5	45	24	+0.034 +0.013	23	8	±0.018	27.3	2.26×10^{-4}
	YXN	67WA140N*	109	126.5 to 133.5	60	35	+0.035 +0.010	55	10	±0.018	38.3	7.11×10^{-4}
	YXP	67WA140P*	89	106.5 to 113.5	45	24H7	+0.021 0	55	8	±0.018	27.3	3.18×10^{-4}
	YXQ	67WA140Q*	144.5	162 to 169	60	35H7	+0.025 0	55	10	±0.018	38.3	9.38×10^{-4}
	YXR	67WA140R*	125	142.5 to 149.5	60	35	+0.035 +0.010	70	10	±0.018	38.3	8.43×10^{-4}
	YS2	67WA140S*	142	159.5 to 166.5	60	42H7	+0.025 0	80	12	±0.0215	45.3	8.89×10^{-4}

* Ensure that length A' of the spline insertion position is within the range indicated in the table above.

Straight shaft (without key)

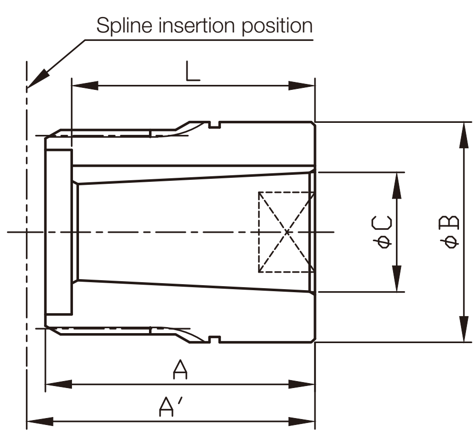


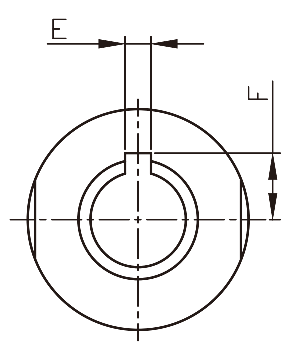


Model	Code	Order item number	Input spline dimensions (mm)						Inertia moment I ($I=GD^2/4$) Input shaft equivalent (kgm^2)	Transmission torque Nm
			A	A'*	øB	øC		L		
RS-260A	WXD	60WA421D*	103	86.5 to 88.5	88	35	+0.035 +0.010	70	1.52×10^{-3}	106.5
	WD2	60WA431D*	103	86.5 to 88.5	88	35	+0.035 +0.010	55	1.53×10^{-3}	106.5
RS-320A RS-900A	YXB	67WA421B*	86	86 to 92	75	35	+0.035 +0.010	73	7.34×10^{-4}	106.5
	YXC	67WA421C*	82	84.5 to 87	75	32H7	+0.025 0	33	7.55×10^{-4}	170.8
	YE2	67WA421E*	86	86 to 92	75	35	+0.035 +0.010	58	7.48×10^{-4}	106.5
	YXH	67WA421H*	144	140.5 to 149.5	77	42H7	+0.025 0	62	9.73×10^{-4}	277.3
RS-900A	ZS2	96WA421-*	149	143.5 to 152.5	110	55H7	+0.030 0	53	3.83×10^{-3}	657

* Ensure that length A' of the spline insertion position is within the range indicated in the table above.

1/10 tapered shaft

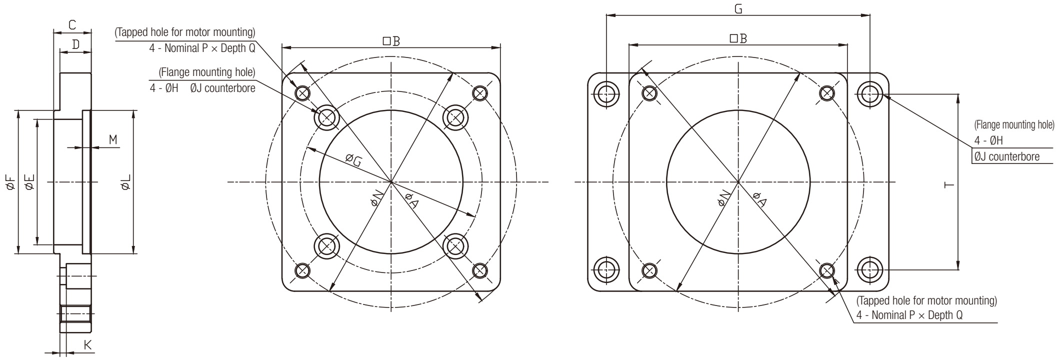




Model	Code	Order item number	Input spline dimensions (mm)									Inertia moment I ($I=GD^2/4$) Input shaft equivalent (kgm^2)
			A	A'*	øB	øC		L	E		F	
RS-260A	WXA	60WA140A*	72	73.5 to 75.5	59	32	+0.10 0	65	7	+0.049 +0.013	17.75	5.08×10^{-4}
	WXE	60WA140E*	89	87.5 to 90	59	35	+0.10 0	57	6	+0.2 +0.1	18.85	6.53×10^{-4}
RS-320A RS-900A	YXS	67WA140-*	60	54 to 69.5	50	32	+0.10 0	60	7	+0.08 +0.043	17.75	2.06×10^{-4}
	YXE	67WA140E*	81	81.5 to 87.5	50	35	+0.10 0	55	6	+0.040 +0.010	18.55	2.74×10^{-4}

* Ensure that length A' of the spline insertion position is within the range indicated in the table above.

Round type



Model	Code	Order item number	Flange outer dimensions (mm)					Reduction gear mounting dimensions (mm)							Motor mounting dimensions (mm)						
			øA	øB	C	D	øE	øF		øG	T	øH	øJ	K	øL		M	øN	P	Q	R
RS-260A	GA	35PA203GA*	140	129	43	38	96	106h7	0 -0.035	122	-	9	14	22	95	+0.038 +0.013	7	115	M8	15	-
	GB	35PA203GB*	175	130	45	40	96	106h7	0 -0.035	122	-	9	14	22	110	+0.038 +0.013	7	135	M8	15	-
	GC	35PA203GC*	175	130	45	40	96	106h7	0 -0.035	122	-	9	14	22	110	+0.038 +0.013	7	145	M8	15	-
	GD	35PA203GD*	232	176	45	40	96	106h7	0 -0.035	122	-	9	14	22	114.3	+0.038 +0.013	5	200	M12	22	-
	GE	35PA203GE*	232	176	45	40	96	106h7	0 -0.035	122	-	9	14	22	130	+0.039 +0.014	6	165	M10	18	-
	GF	35PA203GF*	294	220	45	40	96	106h7	0 -0.035	122	-	9	14	22	200	+0.04 +0.015	6	235	M12	22	-
	GG	35PA203GG*	170	130	55	50	96	106h7	0 -0.035	122	-	9	14	22	110	+0.038 +0.013	7	145	M8	15	-
	GH	35PA203GH*	226	176	55	50	96	106h7	0 -0.035	122	-	9	14	22	114.3	+0.038 +0.013	5	200	M12	22	-
	GJ	35PA203GJ*	170	130	50	45	96	106h7	0 -0.035	122	-	9	14	22	110	+0.038 +0.013	7	145	M8	15	-
	GK	35PA203GK*	175	130	45	40	96	106h7	0 -0.035	122	-	9	14	22	110	+0.038 +0.013	7	130	M8	15	-
RS-320A	YS	67WA203-*	247	174	65.5	61.5	114.3	170h7	0 -0.040	210	140	13	-	25	114.3H7	+0.035 0	10	200	M12	24	-
	YA	67WA203A*	238	174	75.5	71.5	114.3	170h7	0 -0.040	210	140	13	20	25	114.3H7	+0.035 0	10	200	M12	24	-
	YB	67WA203B*	317	220	75.5	71.5	148	170h7	0 -0.040	210	140	13	20	25.5	200H7	+0.046 0	10	235	M12	24	-
	YC	67WA203C*	317	220	85.5	81.5	148	170h7	0 -0.040	210	140	13	20	25.5	200H7	+0.046 0	10	235	M12	24	-
	YD	67WA203D*	245	200	180	176	114.3	170h7	0 -0.040	210	140	13	20	25	114.3H7	+0.035 0	10	200	M12	24	-
	YE	67WA203E*	317	220	124	120	148	170h7	0 -0.040	210	140	13	20	25	200H7	+0.046 0	10	235	M12	24	-
	YG	67WA203G*	317	220	80	76	148	170h7	0 -0.040	210	140	13	20	25	200H7	+0.046 0	10	235	M12	24	-
	YH	67WA203H*	305	200	110	106	114.3	170h7	0 -0.040	210	140	13	20	25	114.3H7	+0.035 0	10	200	M12	24	-
	YJ	67WA203J*	310	220	104	100	110	170h7	0 -0.040	210	140	13	-	25	110H7	+0.035 0	10	145	M8	16	-
	YK	67WA203K*	305	200	139	135	114.3	170h7	0 -0.040	210	140	13	20	25	114.3H7	+0.035 0	10	200	M12	24	-
RS-900A	ZS	96WA203-*	317	240	139	135	163	194h7	0 -0.046	210	140	13.5	20	100	200H7	+0.046 0	7	235	M12	24	-
	ZA	96WA203A*	238	200	65.5	61.5	114.3	194h7	0 -0.046	210	140	13	20	25	114.3H7	+0.035 0	10	200	M12	24	-
	ZB	96WA203B*	244	200	165	161	114.3	194h7	0 -0.046	210	140	13	20	25	114.3H7	+0.035 0	10	200	M12	24	-
	ZC	96WA203C*	258	200	79.5	75.5	114.3	194h7	0 -0.046	210	140	13	20	25	114.3H7	+0.035 0	10	200	M12	24	-
	ZD	96WA203D*	312	213	80.5	76.5	180	194h7	0 -0.046	210	140	13	20	25.5	200H7	+0.046 0	10	235	M12	24	-
	ZE	96WA203E*	238	200	110.5	106.5	114.3	194h7	0 -0.046	210	140	13	20	25	114.3H7	+0.035 0	10	200	M12	24	-
	ZF	96WA203F*	312	220	85.5	81.5	175	194h7	0 -0.046	210	140	13.5	20	25.5	200H7	+0.046 0	10	235	M12	24	-

Considering the use of the RS Series

This product features high precision and high rigidity, however, it is necessary to strictly comply with various restrictions and make considerations to maximize the product's features. Please read this technical document thoroughly and select and adopt an appropriate model based on the actual operating environment, method, and conditions at your facility.

Export

- When this product is exported from Japan, it may be subject to the export regulations provided in the "Foreign Exchange Order and Export Trade Control Order". Be sure to take sufficient precautions and perform the required export procedures in advance if the final operating party is related to the military or the product is to be used in the manufacture of weapons, etc.

Application

- If failure or malfunction of the product may directly endanger human life or if it is used in units which may injure the human body (atomic facilities, space equipment, medical equipment, safety units, etc.), examination of individual situations is required. Contact our agent or nearest business office in such a case.

Safety measures

- Although this product has been manufactured under strict quality control, a mistake in operation or misuse can result in breakdown or damage, or an accident resulting in injury or death. Be sure to take all appropriate safety measures, such as the installation of independent safeguards.

Product specifications indicated in this catalog

- The specifications indicated in this catalog are based on Nabtesco evaluation methods. This product should only be used after confirming that it is appropriate for the operating conditions of your system.

Operating environment

Use the reduction gear under the following environment:	Do not install the reduction gear at the following locations.
· Location where the ambient temperature is within the range from -10°C to 40°C. · Location where the humidity is less than 85% and no condensation occurs. · Location where the altitude is less than 1000 m. · Well-ventilated location	· Locations where a lot of dust is collected. · Outdoor areas that are directly affected by wind and rain · Locations near to areas that contains combustible, explosive, or corrosive gases and flammable materials. · Locations that are heated due to heat transfer and radiation from peripherals and direct sun. · Locations where the performance of the motor can be affected by magnetic fields or vibration.

Note 1: If the required operating environment cannot be established/met, contact us in advance.
2: When using the reduction gear under special conditions (clean room, equipment for food, concentrated alkali, high-pressure steam, etc.), contact our agent or nearest business office in advance.

Maintenance

- The standard replacement time for lubricant is 20,000 hours. However, when operation involves a reduction gear surface temperature above 40°C, the state of degradation of the lubricant should be checked in advance of that and the grease replaced earlier as necessary.

Reduction gear temperature

- When the reduction gear is used under high load and at a high duty ratio, it may overheat and the surface temperature may exceed the allowable temperature. Be aware of conditions so that the surface temperature of the reduction gear does not exceed 60°C while it is in operation. There is a possibility of damage (to the product) if the surface temperature exceeds 60°C.

Reduction gear output rotation angle

- When the range of the rotation angle is small (10 degrees or less), the service life of the reduction gear may be reduced due to poor lubrication or the internal parts being subject to a concentrated load.

  Note: Contact us in case the rotation angle is 10 degrees or less.

Manuals

- Safety information and detail product instructions are indicated in the operation manual.
  The operation manual can be downloaded from the following website.
  http://precision.nabtesco.com/

Glossary

Rated service life

The lifetime resulting from the operation with the rated torque and the rated output speed is referred to as the “rated service life”.

Allowable acceleration/deceleration torque

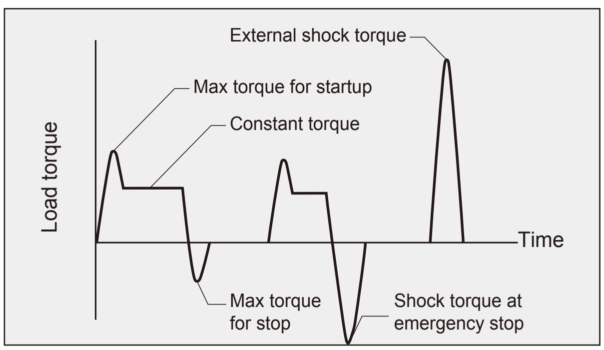
When the machine starts or stops, the load torque to be applied to the reduction gear is larger than the constant-speed load torque due to the effect of the inertia torque of the rotating part. In such a situation, the allowable torque during acceleration/deceleration is referred to as “allowable acceleration/deceleration torque”.

Note: Be careful that the load torque, which is applied at startup and stop, does not exceed the allowable acceleration/deceleration torque.

Momentary maximum allowable torque

A large torque may be applied to the reduction gear due to execution of emergency stop or by an external shock. In such a situation, the allowable value of the momentary applied torque is referred to as “momentary maximum allowable torque”.

Note: Be careful that the momentary excessive torque does not exceed the momentary maximum allowable torque.



Allowable output speed

The allowable value for the reduction gear’s output speed during operation without a load is referred to as the “allowable output speed”.

Notes: Depending on the conditions of use (duty ratio, load, ambient temperature), the reduction gear temperature may exceed 60°C even when the speed is under the allowable output speed. In such a case, either take cooling measures or use the reduction gear at a speed that keeps the surface temperature at 60°C or lower.

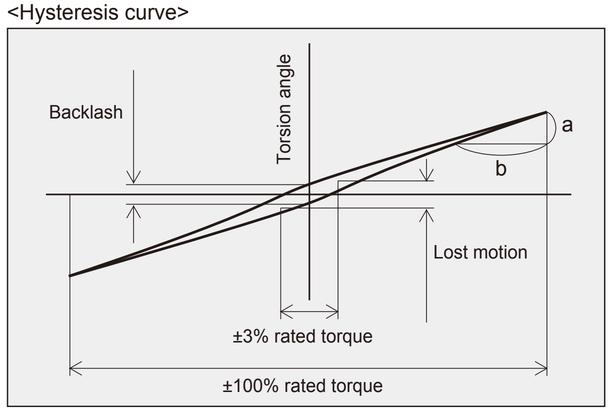
Duty ratio

The duty ratio is defined as the ratio of the sum total time of acceleration, constant speed, and deceleration to the cycle time of the reduction gear.

Torsional rigidity, lost motion, backlash

When a torque is applied to the output shaft while the input shaft is fixed, torsion is generated according to the torque value. The torsion can be shown in the hysteresis curves.
The value of b/a is referred to as “torsional rigidity”.
The torsion angle at the mid point of the hysteresis curve width within ±3% of the rated torque is referred to as “lost motion”.
The torsion angle when the torque indicated by the hysteresis curve is equal to zero is referred to as “backlash”.

<Hysteresis curve>



Startup efficiency

The efficiency of the moment when the reduction gear starts up is referred to as “startup efficiency”.

No-load running torque (input shaft)

The torque for the input shaft that is required to run the reduction gear without load is referred to as “no-load running torque”.

Allowable moment and maximum thrust load

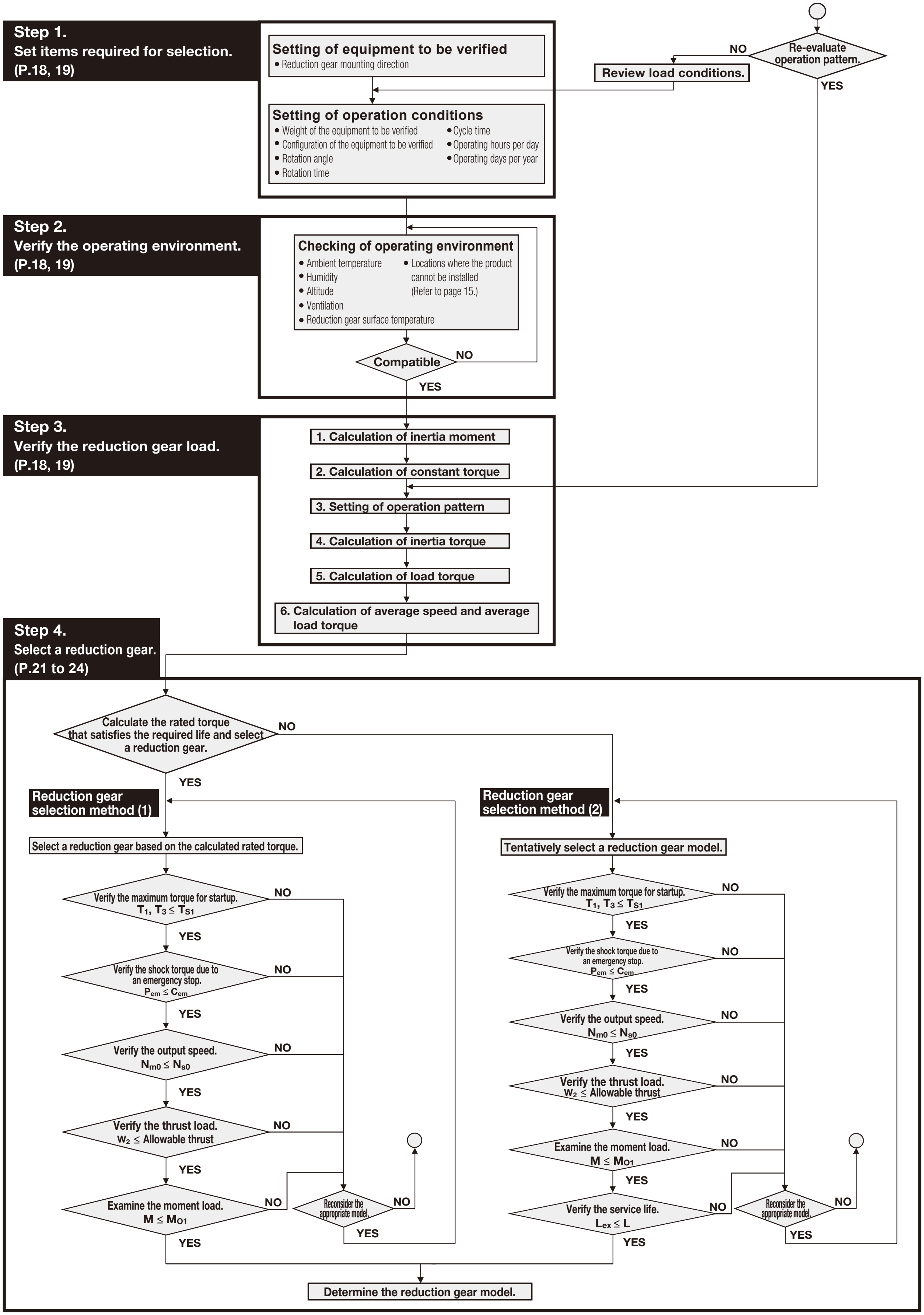
The external load moment may be applied to the reduction gear during normal operation. The allowable values of the external moment and the external axial load at this time are each referred to as “allowable moment” and “maximum thrust load”.

Momentary maximum allowable moment

A large moment may be applied to the reduction gear due to an emergency stop or external shock. The allowable value of the momentary applied moment at this time is referred to as “momentary maximum allowable moment.”

Note: Be careful so that the momentary excessive moment does not exceed the momentary maximum allowable moment.

Product selection flowchart



A limitation is imposed on the motor torque value according to the momentary maximum allowable torque of the selected reduction gear. (Refer to page 25.)

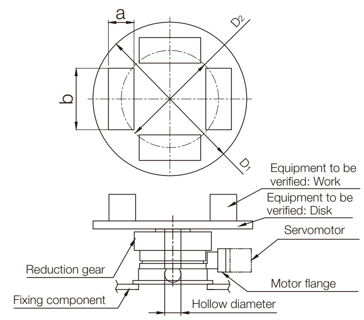
Model code selection examples

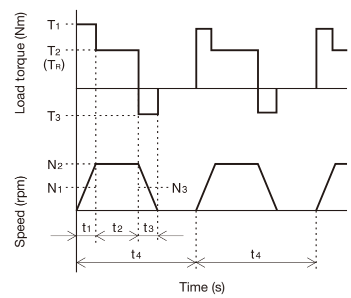
With horizontal rotational transfer

Step 1. Set the items required for selection.

Setting item	Setting
Reduction gear mounting direction	Vertical shaft installation
Equipment weight to be considered	
W_A ——— Disk weight (kg)	2,000
W_B ——— Work weight (kg)	100×4 pieces
Equipment configuration to be considered	
D_1 ——— Disk: D dimension (mm)	1,200
a ——— Workpiece: a dimension (mm)	100
b ——— Workpiece: b dimension (mm)	300
D_2 ——— Workpiece: P.C.D. (mm)	1,000
Operation conditions	
θ ——— Rotation angle (°)*1	180
$[t_1+t_2+t_3]$ —— Rotation time (s)	2.5
$[t_4]$ ——— Cycle time (s)	20
Q_1 ——— Equipment operation hours per day (hours/day)	12
Q_2 ——— Equipment operation days per year (days/year)	365

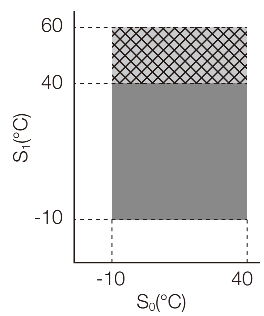
*1. When the range of the rotation angle is small (10 degrees or less), the rating life of the reduction gear may be reduced due to poor lubrication or the internal parts being subject to a concentrated load.





Step 2. Verify the operating environment.

Checkpoint	Standard value
S_0 ——— Ambient temperature (°C)	-10 to +40
S_1 ——— Reduction gear surface temperature (°C)	60 or less



Note: Refer to “Operating environment” on p. 15 for values other than those listed above.

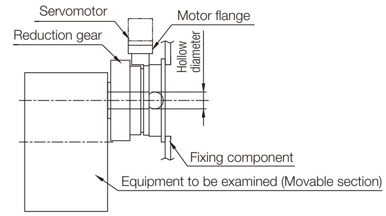
Step 3-1. Examine the reduction gear load

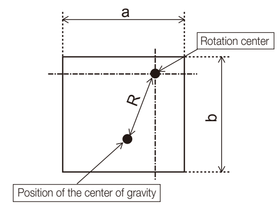
Setting item		Calculation formula	Selection examples
(1) Calculate the inertia moment based the calculation formula on page 52.			
I_R	Load inertia moment (kgm^2)	$I_{R1}=\dfrac{W_A\times\left(\dfrac{D_1}{2\times1{,}000}\right)^2}{2}$ $I_{R2}=\left[\dfrac{W_B}{12}\left\{\left(\dfrac{a}{1{,}000}\right)^2+\left(\dfrac{b}{1{,}000}\right)^2\right\}+W_B\times\left(\dfrac{D_2}{2\times1{,}000}\right)^2\right]\times n$ I_{R1} = Disk inertia moment I_{R2} = Work inertia $I_R = I_{R1}+I_{R2}$ n = Number of Workpieces	$I_{R1}=\dfrac{2{,}000\times\left(\dfrac{1{,}200}{2\times1{,}000}\right)^2}{2}$ $=360$ (kgm^2) $I_{R2}=\left[\dfrac{100}{12}\left\{\left(\dfrac{100}{1{,}000}\right)^2+\left(\dfrac{300}{1{,}000}\right)^2\right\}+100\times\left(\dfrac{1{,}000}{2\times1{,}000}\right)^2\right]\times4$ $=103.3$ (kgm^2) $I_R=360+103.3$ $=463.3$ (kgm^2)
(2) Examine the constant torque.			
T_R	Constant torque (Nm)	$T_R=(W_A+W_B)\times9.8\times\dfrac{D_{in}}{2\times1{,}000}\times\mu$ μ = Friction factor Note: Use 0.015 for this example as the load is applied to the bearing of the precision reduction gear RV. D_{in} = Rolling diameter: Use the pilot diameter which is almost equivalent to the rolling diameter in this selection calculation. Note: If the reduction gear model is not determined, select the following pilot diameter: Maximum pilot diameter: 490 (mm) (RS-900A)	$T_R=(2{,}000+100\times4)\times9.8\times\dfrac{490}{2\times1{,}000}\times0.015$ $=86.4$ (Nm)

Step 3-2: Proceed to p. 20.

With vertical rotational transfer

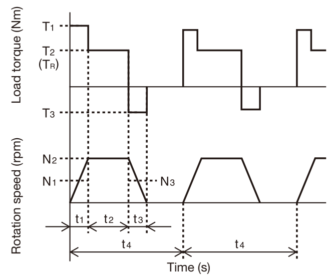
Step 1. Set the items required for selection.





Setting item	Setting
Reduction gear mounting direction	Horizontal shaft installation
Equipment weight to be considered	
W_C ———— Mounted work weight (kg)	2,000
Equipment configuration to be considered	
a ———— a dimension (mm)	500
b ———— b dimension (mm)	500
R ———— R dimension (mm)	320
Operation conditions	
θ ———— Rotation angle (°)*1	90
$[t_1+t_2+t_3]$ ——— Rotation time (s)	1.5
$[t_4]$ ———— Cycle time (s)	20
Q_1 ———— Equipment operation hours per day (hours/day)	24
Q_2 ———— Equipment operation days per year (days/year)	365

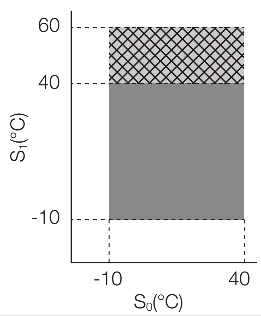
*1. When the range of the rotation angle is small (10 degrees or less), the rating life of the reduction gear may be reduced due to poor lubrication or the internal parts being subject to a concentrated load.



Step 2. Verify the operating environment.

Checkpoint	Standard value
S_0 ———— Ambient temperature (°C)	-10 to +40
S_1 ———— Reduction gear surface temperature (°C)	60 or less

Note: Refer to "Operating environment" on p. 15 for values other than those listed above.



Step 3-1. Examine the reduction gear load.

Setting item		Calculation formula	Selection examples
(1) Calculate the inertia moment.			
I_R	Load inertia moment (kgm^2)	$I_R = \frac{W_C}{12} \times \left\{ \left(\frac{a}{1{,}000}\right)^2 + \left(\frac{b}{1{,}000}\right)^2 \right\} + W_C \times \left(\frac{R}{1{,}000}\right)^2$	$I_R = \frac{2{,}000}{12} \times \left\{ \left(\frac{500}{1{,}000}\right)^2 + \left(\frac{500}{1{,}000}\right)^2 \right\} + 2{,}000 \times \left(\frac{320}{1{,}000}\right)^2$ $= 288.1\ (kgm^2)$
(2) Examine the constant torque.			
T_R	Constant torque (Nm)	$T_R = W_C \times 9.8 \times \frac{R}{1{,}000}$	$T_R = 2{,}000 \times 9.8 \times \frac{320}{1{,}000}$ $= 6{,}272\ (Nm)$

Step 3-2: Proceed to p. 20.
(Refer to "With horizonta5rotational transfer" for selection examples.)

Model code selection examples

Step 3-2. Set items required for selection.

Setting item		Calculation formula	Selection examples (With horizontal rotational transfer)
(3) Set the acceleration/deceleration time, constant-speed operation time, and output speed.			
t_1	Acceleration time (s)	• The operation pattern does not need to be verified if it is already set. • If the operation pattern has not been determined, use the following formula to calculate the reference operation pattern. $t_1 = t_3 = \text{Rotation}\ [t_1 + t_2 + t_3] - \dfrac{\theta}{\left(\dfrac{N_2}{60} \times 360\right)}$ $t_2 = \text{Rotation}\ [t_1 + t_2 + t_3] - (t_1 + t_3)$ Note: 1. Assume that t_1 and t_3 are the same. Note: 2. N_2 = 15 rpm if the reduction gear output speed (N_2) is not known. Note: 3. If t_1 and t_3 is less than 0, increase the output speed or extend the rotation time.	Examine the operation pattern using N_2 = 15 rpm as the reduction gear output speed is unknown. $t_1 = t_3 = 2.5 - \dfrac{180}{\left(\dfrac{15}{60} \times 360\right)} = 0.5$ (s) $t_2 = 2.5 - (0.5 + 0.5) = 1.5$ (s) $\therefore t_1 = t_3 = 0.5$ (s) $t_2 = 1.5$ (s) $N_2 = 15$ (rpm)
t_2	Constant-speed operation time (s)		
t_3	Deceleration time (s)		
N_2	Constant speed (rpm)		
N_1	Average speed for startup (rpm)	$N_1 = \dfrac{N_2}{2}$	$N_1 = \dfrac{15}{2} = 7.5$ (rpm)
N_3	Average speed for stop (rpm)	$N_3 = \dfrac{N_2}{2}$	$N_3 = \dfrac{15}{2} = 7.5$ (rpm)
(4) Calculate the inertia torque for acceleration/deceleration.			
T_A	Inertia torque for acceleration (Nm)	$T_A = \left\{\dfrac{I_R \times (N_2 - 0)}{t_1}\right\} \times \dfrac{2\pi}{60}$	$T_A = \left\{\dfrac{463.3 \times (15 - 0)}{0.5}\right\} \times \dfrac{2\pi}{60}$ $= 1{,}455$ (Nm)
T_D	Inertia torque for deceleration (Nm)	$T_D = \left\{\dfrac{I_R \times (0 - N_2)}{t_3}\right\} \times \dfrac{2\pi}{60}$	$T_D = \left\{\dfrac{463.3 \times (0 - 15)}{0.5}\right\} \times \dfrac{2\pi}{60}$ $= -1{,}455$ (Nm)
(5) Calculate the load torque for acceleration/deceleration.			
T_1	Maximum torque for startup (Nm)	$T_1 = \lvert T_A + T_R \rvert$ T_R : Constant torque With horizontal rotational transfer Refer to page 18 With vertical rotational transfer Refer to page 19	$T_1 = \lvert 1{,}455 + 86.4 \rvert$ $= 1{,}541.4$ (Nm)
T_2	Constant maximum torque (Nm)	$T_2 = \lvert T_R \rvert$	$T_2 = 86.4$ (Nm)
T_3	Maximum torque for stop (Nm)	$T_3 = \lvert T_D + T_R \rvert$ T_R : Constant torque With horizontal rotational transfer Refer to page 18 With vertical rotational transfer Refer to page 19	$T_3 = \lvert -1{,}455 + 86.4 \rvert$ $= 1{,}368.6$ (Nm)
(6)-1 Calculate the average speed.			
N_m	Average speed (rpm)	$N_m = \dfrac{t_1 \times N_1 + t_2 \times N_2 + t_3 \times N_3}{t_1 + t_2 + t_3}$	$N_m = \dfrac{0.5 \times 7.5 + 1.5 \times 15 + 0.5 \times 7.5}{0.5 + 1.5 + 0.5}$ $= 12$ (rpm)
(6)-2 Calculate the average load torque.			
T_m	Average load torque (Nm)	$T_m = \sqrt[\frac{10}{3}]{\dfrac{t_1 \times N_1 \times T_1^{\frac{10}{3}} + t_2 \times N_2 \times T_2^{\frac{10}{3}} + t_3 \times N_3 \times T_3^{\frac{10}{3}}}{t_1 \times N_1 + t_2 \times N_2 + t_3 \times N_3}}$	$T_m = \sqrt[\frac{10}{3}]{\dfrac{0.5 \times 7.5 \times 1{,}541.4^{\frac{10}{3}} + 1.5 \times 15 \times 86.4^{\frac{10}{3}} + 0.5 \times 7.5 \times 1{,}368.6^{\frac{10}{3}}}{0.5 \times 7.5 + 1.5 \times 15 + 0.5 \times 7.5}}$ $= 963.9$ (Nm)

Go to page 21 if the reduction gear model is verified based on the required life.
Go to page 23 if the service life is verified based on the reduction gear model.

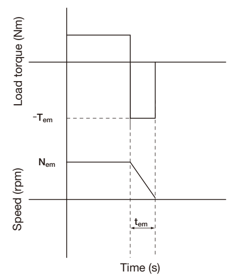
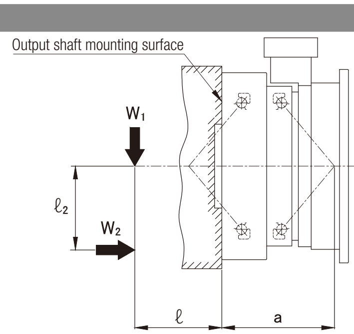
Step 4. Select a reduction gear.

Reduction gear selection method (1) Calculate the required torque based on the load conditions and required life and select a reduction gear.

Setting/verification item		Calculation formula	Selection examples (With horizontal rotational transfer)
(1) Calculate the rated torque for the reduction gear that satisfies the required life.			
L_{ex}	Required life (year)	Based on the operation conditions	20 years
Q_{1cy}	Number of cycles per day (times)	$Q_{1cy} = \frac{Q_1 \times 60 \times 60}{t_4}$	$Q_{1cy} = \frac{12 \times 60 \times 60}{20}$ $= 2{,}160$ (times)
Q_3	Operating hours of reduction gear per day (h)	$Q_3 = \frac{Q_{1cy} \times (t_1 + t_2 + t_3)}{60 \times 60}$	$Q_3 = \frac{2{,}160 \times (0.5 + 1.5 + 0.5)}{60 \times 60}$ $= 1.5$ (h)
Q_4	Operating hours of reduction gear per year (h)	$Q_4 = Q_3 \times Q_2$	$Q_4 = 1.5 \times 365$ $= 548$ (h)
L_{hour}	Reduction gear service life (h)	$L_{hour} = Q_4 \times L_{ex}$	$L_{hour} = 548 \times 20$ $= 10{,}960$ (h)
T_O'	Reduction gear rated torque that satisfies the required life (Nm)	$T_0' = T_m \times \sqrt[\frac{10}{3}]{\frac{L_{hour}}{K} \times \frac{N_m}{N_0}}$ K : Reduction gear rated life (h) N_0 : Reduction gear rated output speed (rpm)	$T_0' = 963.9 \times \sqrt[\frac{10}{3}]{\frac{10{,}960}{6{,}000} \times \frac{12}{15}}$ $= 1.080$ (Nm)
(2) Tentatively select a reduction gear model based on the calculated rated torque.			
Tentative selection of the reduction gear		Select a reduction gear for which the rated torque of the reduction gear $[T_0]$*1 is equal to or greater than the rated torque of the reduction gear that satisfies the required life $[T_0']$. *1 $[T_0]$: Refer to the rating table on page 8.	RS-260A that meets the following condition is tentatively selected: $[T_0]$ 2,548 (Nm) ≥ $[T_0']$ 1.080 (Nm)
(3) Verify the maximum torque for startup and stop.			
Verification of maximum torque for startup and stop		Check the following conditions: The allowable acceleration/deceleration torque $[T_{s1}]$*1 is equal to or greater than the maximum starting torque $[T_1]$*2 and maximum stopping torque $[T_3]$*2 If the tentatively selected reduction gear is outside of the specifications, change the reduction gear model. *1 $[T_{s1}]$: Refer to the rating table on page 8. *2 $[T_1]$ and $[T_3]$: Refer to page 24.	$[T_{s1}]$ 6,370 (Nm) ≥ $[T_1]$ 1,541.4 (Nm) $[T_3]$ 1,368.6 (Nm) According to the above conditions, the tentatively selected model should be no problem.
(4) Verify the output speed.			
N_{m0}	Average speed per cycle (rpm)	$N_{m0} = \frac{t_1 \times N_1 + t_2 \times N_2 + t_3 \times N_3}{t_4}$	$N_{m0} = \frac{0.5 \times 7.5 + 1.5 \times 15 + 0.5 \times 7.5}{20}$ $= 1.5$ (rpm)
Verification of output speed		Check the following condition: The allowable output speed $[N_{s0}]$*1 is equal to or greater than the average speed per cycle $[N_{m0}]$ If the tentatively selected reduction gear is outside of the specifications, change the reduction gear model. Contact us regarding use of the model at a speed outside the allowable output speed $[N_{S0}]$*1. Note: The value of $[N_{S0}]$ is the speed at which the case temperature is balanced at 60ºC for 30 minutes. *1 $[N_{S0}]$ and $[N_{S1}]$: Refer to the rating table on page 8.	$[N_{s0}]$ 21.5 (rpm) ≥ $[N_{m0}]$ 1.5 (rpm) According to the above condition, the tentatively selected model should be no problem.

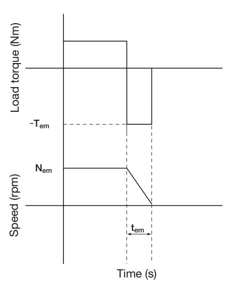
Model code selection examples

Reduction gear selection method (1) Calculate the required torque based on the load conditions and required life and select a reduction gear.

Setting/verification item	Calculation formula	Selection examples (With horizontal rotational transfer)
(5) Verify the shock torque at the time of an emergency stop.		
P_{em} —— Expected number of emergency stop times (times)	Based on the operation conditions.	For example, an emergency stop occurs once a month. $[P_{em}]$ = 1 x 12 x required life (year) $[L_{ex}]$ = 12×20=240 (times)
T_{em} —— Shock torque due to an emergency stop (Nm)		For example, $[T_{em}]$ = 5,000 (Nm)
N_{em} —— Speed at the time of an emergency stop (rpm)		For example, $[N_{em}]$ = 15 (rpm)
t_{em} —— Deceleration time at the time of an emergency stop (s)	 Set the operation conditions that meet the following requirement: Shock torque due to an emergency stop $[T_{em}]$ is equal to or less than the momentary maximum allowable torque $[T_{s2}]$	For example, $[t_{em}]$ = 0.05 (s)
Z_4 —— Number of pins for reduction gear	Model / Number of pins (Z_4): RS-260A, RS-320A: 60 RS-900A: 58	Number of pins for RS-260A: 60
C_{em} —— Allowable number of shock torque application times	$C_{em} = \dfrac{775 \times \left(\dfrac{T_{S2}}{T_{em}}\right)^{\frac{10}{3}}}{Z_4 \times \dfrac{N_{em}}{60} \times t_{em}}$ Note $[T_{s2}]$: Momentary maximum allowable torque, refer to the rating table on page 8.	$C_{em} = \dfrac{775 \times \left(\dfrac{12{,}740}{5{,}000}\right)^{\frac{10}{3}}}{60 \times \dfrac{15}{60} \times 0.05}$ = 23,347 (times)
Verification of shock torque due to an emergency stop	Check the following condition: The allowable shock torque application count $[C_{em}]$ is equal to or greater than the expected emergency stop count $[P_{em}]$ If the tentatively selected reduction gear is outside of the specifications, change the reduction gear model.	$[C_{em}]$ 23,347 ≥ $[P_{em}]$ 240 According to the above condition, the tentatively selected model should be no problem.
(6) Verify the thrust load and moment load.		
W_1 —— R adial load (N)		0 (N)
ℓ —— Distance to the point of radial load application (mm)		0 (mm)
W_2 —— Thrust load (N)		In this example, $W_2 = W_A + W_B = (2{,}000 + 100 \times 4) \times 9.8$ $= 23{,}520$ (N) Note W_A, W_B : Refer to page 18.
ℓ_2 —— Distance to the point of thrust load application (mm)		0 (mm) (As the workpiece center is located on the rotation axis)
M —— Moment load (Nm)	 $M = \dfrac{W_1 \times (\ell + a) + W_2 \times \ell_2}{1{,}000}$ a: Refer to the calculation of the tilt angle on page 27.	RS-260A As dimension a = 232.4 (mm): $M = \dfrac{0 \times (0 + 232.4) + 23{,}520 \times 0}{1{,}000}$ $= 0$ (Nm)
Verify the thrust load and moment load	Check that the thrust load and moment load are within the range in the allowable moment diagram on page 26. When radial load W_1 is applied within dimension b, use the reduction gear within the allowable radial load. Wr: Allowable radial load, see the rating table on page 8. If the tentatively selected reduction gear is outside of the specifications, change the reduction gear model.	For this example, Thrust load $[W_2]$ = 23,520 (N) Moment load [M] = 0 (N) As the above values are within the range in the allowable moment diagram, the tentatively selected model should be no problem.

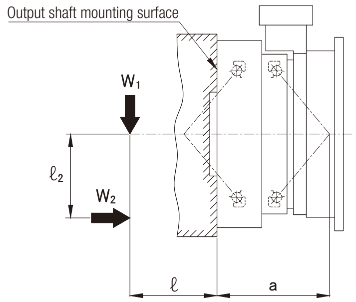
Select the reduction gear model that satisfies all the conditions of the above verification items. The actual reduction ratio is determined based on the motor speed, input torque, and inertia moment. Check with the motor manufacturer.	Based on the above verification result, RS-260A is selected.

Reduction gear selection method (2): Tentatively select a reduction gear model and evaluate the service life.

Setting/verification item	Calculation formula	Selection examples (With horizontal rotational transfer)
(1) Tentatively select a desired reduction gear model.		
Tentative selection of a reduction gear	Tentatively select a desired reduction gear model.	For example, tentatively select RS-260A.
(2) Verify the maximum torque for startup and stop.		
Verification of maximum torque for startup and stop	Check the following conditions: The allowable acceleration/deceleration torque [T_{s1}]*1 is equal to or greater than the maximum starting torque [T_1]*2 and maximum stopping torque [T_3]*2 If the tentatively selected reduction gear is outside of the specifications, change the reduction gear model. *1 [T_{s1}]: Refer to the rating table on page 8. *2 [T_1] and [T_3]: Refer to page 20.	[T_{s1}] 6,370 (Nm) ≥ [T_1] 1,541.4 (Nm) [T_3] 1,368.6 (Nm) According to the above conditions, the tentatively selected model should be no problem.
(3) Verify the output speed.		
N_{m0} —— Average speed per cycle (rpm)	$N_{m0} = \frac{t_1 \times N_1 + t_2 \times N_2 + t_3 \times N_3}{t_4}$	$N_{m0} = \frac{0.5 \times 7.5 + 1.5 \times 15 + 0.5 \times 7.5}{20}$ $= 1.5$ (rpm)
Verification of output speed	Check the following condition: The allowable output speed [N_{s0}]*1 is equal to or greater than the average speed per cycle [N_{m0}] If the tentatively selected reduction gear is outside of the specifications, change the reduction gear model. Contact us regarding use of the model at a speed outside the allowable output speed [N_{S0}]*1. Note: The value of [N_{S0}] is the speed at which the case temperature is balanced at 60°C for 30 minutes. *1 [N_{S0}] and [N_{S1}]: Refer to the rating table on page 8.	[N_{s0}] 21.5 (rpm) ≥ [N_{m0}] 1.5 (rpm) According to the above condition, the tentatively selected model should be no problem.
(4) Verify the shock torque at the time of an emergency stop.		
P_{em} —— Expected number of emergency stop times (times)	Based on the operation conditions.	For example, an emergency stop occurs once a month. [P_{em}] = 1 x 12 x required life (year) [L_{ex}] = 12×20=240 (times)
T_{em} —— Shock torque due to an emergency stop (Nm)		For example, [T_{em}] = 500 (Nm)
N_{em} —— Speed at the time of an emergency stop (rpm)		For example, [N_{em}] = 15 (rpm)
t_{em} —— Deceleration time at the time of an emergency stop (s)	Set the operation conditions that meet the following requirement: Shock torque due to an emergency stop [T_{em}] is equal to or less than the momentary maximum allowable torque [T_{s2}]	For example, [t_{em}] = 0.05 (s)
Z_4 —— Number of pins for reduction gear	Model / Number of pins (Z_4) RS-260A, RS-320A / 60 RS-900A / 58	Number of pins for RS-260A: 60
C_{em} —— Allowable number of shock torque application times	$C_{em} = \frac{775 \times \left(\frac{T_{S2}}{T_{em}}\right)^{\frac{10}{3}}}{Z_4 \times \frac{N_{em}}{60} \times t_{em}}$ Note [T_{s2}]: Momentary maximum allowable torque, refer to the rating table on page 8.	$C_{em} = \frac{775 \times \left(\frac{1,225}{500}\right)^{\frac{10}{3}}}{40 \times \frac{15}{60} \times 0.05} = 30,729$ (times)
Verification of shock torque due to an emergency stop	Check the following condition: The allowable shock torque application count [C_{em}] is equal to or greater than the expected emergency stop count [P_{em}] If the tentatively selected reduction gear is outside of the specifications, change the reduction gear model.	[C_{em}] 23,347 ≥ [P_{em}] 240 According to the above condition, the tentatively selected model should be no problem.

Model code selection examples

Reduction gear selection method (2): Tentatively select a reduction gear model and evaluate the service life.

Setting/verification item		Calculation formula	Selection examples (With horizontal rotational transfer)
(5) Verify the thrust load and moment load.			
W_1	Radial load (N)		0 (N)
ℓ	Distance to the point of radial load application (mm)		0 (mm)
W_2	Thrust load (N)		$W_2 = W_A + W_B = (2{,}000 + 100 \times 4) \times 9.8$ $= 23{,}520$ (N) Note WA, WB: Refer to page 18.
ℓ_2	Distance to the point of thrust load application (mm)		0 (mm) (As the workpiece center is located on the rotation axis)
M	Moment load (Nm)	$M = \frac{W_1 \times (\ell + a) + W_2 \times \ell_2}{1{,}000}$ a: Refer to the calculation of the tilt angle on page 27.	RS-260A As dimension a = 232.4 (mm): $M = \frac{0 \times (0 + 232.4) + 23{,}520 \times 0}{1{,}000}$ $= 0$ (Nm)
Verify the thrust load and moment load		Check that the thrust load and moment load are within the range in the allowable moment diagram on page 26. When radial load W_1 is applied within dimension b, use the reduction gear within the allowable radial load. Wr: Allowable radial load, see the rating table on page 8. If the tentatively selected reduction gear is outside of the specifications, change the reduction gear model.	For this example, Thrust load [W_2] = 2,548 (N) Moment load [M] = 0 (N) As the above values are within the range in the allowable moment diagram, the tentatively selected model should be no problem.
(6) Verify the reduction gear service life.			
L_h	Life (h)	$L_h = 6{,}000 \times \frac{N_0}{N_m} \times \left(\frac{T_0}{T_m}\right)^{\frac{10}{3}}$	$L_h = 6{,}000 \times \frac{15}{12} \times \left(\frac{2{,}548}{963.9}\right)^{\frac{10}{3}}$ $= 191{,}552$(h)
Q_{1cy}	Number of cycles per day (times)	$Q_{1cy} = \frac{Q_1 \times 60 \times 60}{t_4}$	$Q_{1cy} = \frac{12 \times 60 \times 60}{20} = 2{,}160$ (times)
Q_3	Operating hours per day (h)	$Q_3 = \frac{Q_{1cy} \times (t_1 + t_2 + t_3)}{60 \times 60}$	$Q_3 = \frac{2{,}160 \times (0.5 + 1.5 + 0.5)}{60 \times 60} = 1.5$ (h)
Q_4	Operating hours per year (h)	$Q_4 = Q_3 \times Q_2$	$Q_4 = 1.5 \times 365 = 548$ (h)
L_{year}	Reduction gear service life (year)	$L_{year} = \frac{L_h}{Q_4}$	$L_{year} = \frac{191{,}552}{548} = 349.5$ (year)
L_{ex}	Required life (year)	Based on the operation conditions	20 years
Verification of the service life		Check the following condition: [L_{ex}] is equal to or less than [L_{year}] If the tentatively selected reduction gear is outside of the specifications, change the reduction gear model.	[L_{ex}] 20 (year) ≤ [L_{year}] 349.5 (year) According to the above condition, the tentatively selected model should be no problem.

Select the reduction gear model that satisfies all the conditions of the above verification items. The actual reduction ratio is determined based on the motor speed, input torque,and inertia moment. Check with the motor manufacturer.	Based on the above verification result, RS-260A is selected.

Limitation on the motor torque

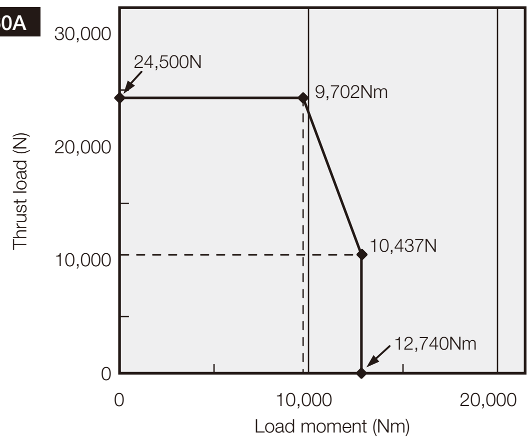
A limitation is imposed on the motor torque value so that the shock torque applied to the reduction gear does not exceed the momentary maximum allowable torque.

Setting/verification item	Calculation formula	Selection examples (With horizontal rotational transfer)
T_{M1} —— Motor momentary maximum torque (Nm)	Determine based on the motor specifications.	For example, T_{M1} = 90 (Nm)
T_{M1OUT} —— Maximum torque generated at the output shaft for the reduction gear (Nm) (When an external shock is applied at the time of an emergency stop or motor stop)	$T_{M1out} = T_{M1} \times R \times \frac{100}{\eta}$ R: Actual reduction ratio η : Startup efficiency (%) ,refer to the rating table on page 8.	For example, calculate the maximum torque generated at the output shaft for the reduction gear based on the specifications when RS-260A-120 was selected. $T_{M1out} = 90 \times 120 \times \frac{100}{75}$ $= 14{,}400$ (Nm)
T_{M2OUT} —— Maximum torque generated at the output shaft for the reduction gear (Nm) (When a shock is applied to the output shaft due to hitting by an obstacle)	$T_{M2out} = T_{M1} \times R \times \frac{\eta}{100}$	$T_{M2out} = 10 \times 120 \times \frac{75}{100}$ $= 8{,}100$ (Nm)
Limitation on motor torque value	Check the following condition: The momentary maximum allowable torque [T_{S2}]*1 is equal to or greater than the maximum torque generated at the output shaft for the reduction gear [T_{M1OUT}] and [T_{M2OUT}] If the above condition is not satisfied, a limitation is imposed on the maximum torque value of the motor. *1 [T_{S2}]: Refer to the rating table on page 8.	[T_{S2}] 12,740 (Nm) ≤ [T_{M1OUT}] 14,400 (Nm) and [T_{M2OUT}] 8,100 (Nm) According to the above condition, the torque limit is set for the motor.

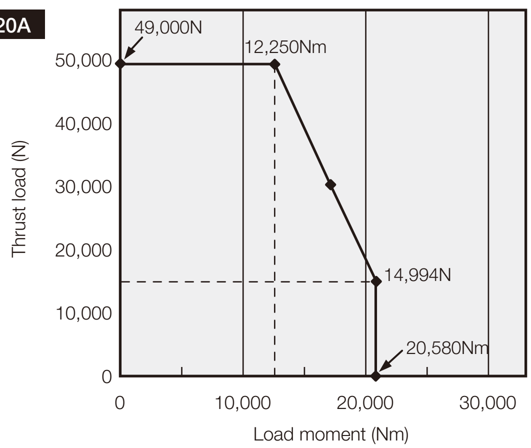
Product Selection

Allowable moment diagram

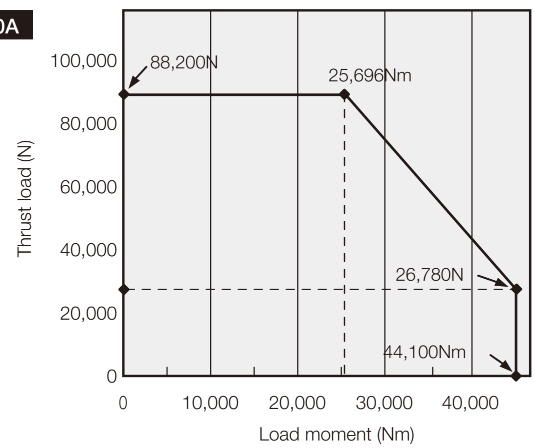
RS-260A



RS-320A



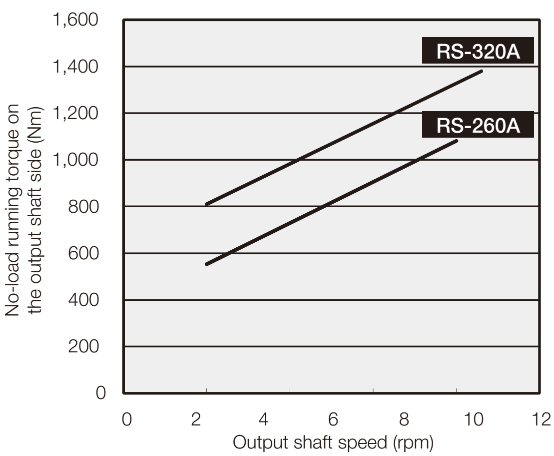
RS-900A

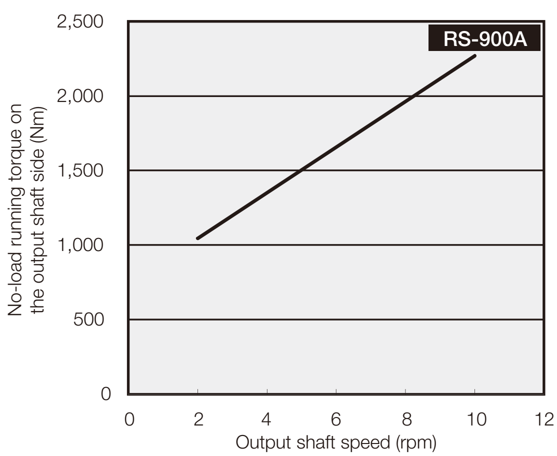


When the load moment and the axial load are applied concurrently, ensure that the reduction gear is used within the corresponding allowable moment range, which is indicated in the allowable moment diagram.

Technical Data

No-load running torque





The no-load running torque that is converted to the input shaft side value should be calculated using the following equation:

$$\text{No-load running torque on the input shaft side (Nm)} = \frac{\text{No-load running torque on the output shaft side (Nm)}}{\text{Speed ratio}}$$

(Measurement conditions)
Case temperature: 20°C
Lubricant: VIGO GREASE RE0 (RS-260A)
Molywhite RE00 (RS-320A, RS-900A)

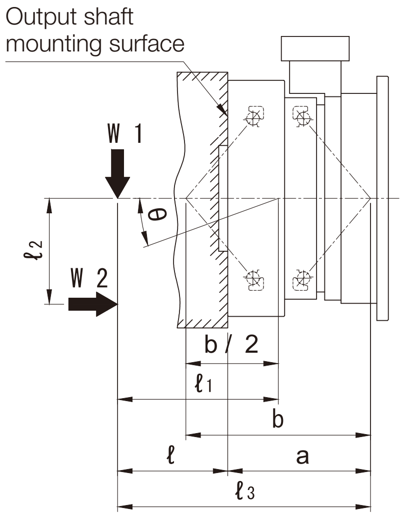
Calculation of tilt angle and torsion angle

Calculation of tilt angle

When a load moment occurs with an external load applied, the output shaft will tilt in proportion to the load moment (If ℓ_3 is larger than b)
The moment rigidity indicates the rigidity of the main bearing, and it is represented by the load moment value required for tilting the main bearing by 1 arc.min.

$$\theta = \frac{W_1\ell_1 + W_2\ell_2}{M_1 \times 10^3}$$

θ : Tilt angle of the output shaft (arc.min.)
M_1 : Moment rigidity (Nm/arc.min.)
W_1, W_2 : Load (N)
ℓ_1, ℓ_2 : Distance to the point of load application (mm)
ℓ_1 : $\ell + \frac{b}{2} + a - b$
ℓ : Distance from the output shaft installation surface to the point of load application (mm)



Model	Moment rigidity (central value) (Nm/arc.min.)	Dimensions (mm)	
		a	b
RS-260A	8,320	232.4	319.3
RS-320A	12,740	268.5	376.4
RS-900A	37,730	325.4	433.4

Calculation of torsion angle

Calculate the torsion angle when the torque is applied in a single direction, using an example of RS-260A.

1) When the load torque is 50 Nm.................Torsion angle (ST_1)
When the load torque is within the lost motion range

$$ST_1 = \frac{50}{76.4} \times \frac{1\ (\text{arc.min.})}{2} = 0.33\text{arc.min. or less}$$

2) When the load torque is 1,300 Nm.................Torsion angle (ST_2)
When the load torque is within the rated torque range

$$ST_2 = \frac{1}{2} + \frac{2{,}100-76.4}{1{,}540} = 1.81\text{arc.min.}$$

Note: 1. The torsion angles that are calculated above are for a single reduction gear.
2. Contact us for the customized specifications for lost motion.

Model	Torsional rigidity (central value) (Nm/arc.min.)	Lost motion		Backlash (arc.min.)
		Lost motion (arc.min.)	Measured torque (Nm)	
RS-260A	1,540	1.0	±76.4	1.0
RS-320A	1,570		±94.1	
RS-900A	4,900		±264.6	

Design Points
Reduction gear installation components

Installation of the reduction gear and mounting it to the output shaft

When installing the reduction gear and mounting it to the output shaft, use hexagon socket head cap screws and tighten to the torque, as specified below, in order to satisfy the momentary maximum allowable torque, which is noted in the rating table.
The use of the serrated lock washers are recommended to prevent the hexagon socket head cap screws from loosening and to protect the seat surface from flaws.

• Hexagon socket head cap screw

<Bolt tightening torque and tightening force>

Hexagon socket head cap screw nominal size x pitch (mm)	Tightening torque (Nm)	Tightening force F (N)	Bolt specification
M5 × 0.8	9.01 ± 0.49	9,310	Hexagon socket head cap screw JIS B 1176: 2006 Strength class JIS B 1051: 2000 12.9 Thread JIS B 0209: 2001 6g
M6 × 1.0	15.6 ± 0.78	13,180	
M8 × 1.25	37.2 ± 1.86	23,960	
M10 × 1.5	73.5 ± 3.43	38,080	
M12 × 1.75	129 ± 6.37	55,100	
M16 × 2.0	319 ± 15.9	103,410	
M18 × 2.5	441 ± 22.0	126,720	
M20 × 2.5	493 ± 24.6	132,170	

Note: 1. The tightening torque values listed are for steel or cast iron material.
2. If softer material, such as aluminum or stainless, is used, limit the tightening torque. Also take the transmission torque and load moment into due consideration.

<Calculation of allowable transmission torque of bolts>

$$T = F \times \mu \times \frac{D}{2\times1,000} \times n$$

T	Allowable transmission torque by tightening bolt (Nm)
F	Bolt tightening force (N)
D	Bolt mounting P.C.D. (mm)
μ	Friction factor μ=0.15: When lubricant remains on the mating face. μ=0.20: When lubricant is removed from the mating face.
n	Number of bolts (pcs.)

• Serrated lock washer for hexagon socket head cap screw

Name: Belleville spring washer (made by Heiwa Hatsujyo Industry Co., Ltd.)

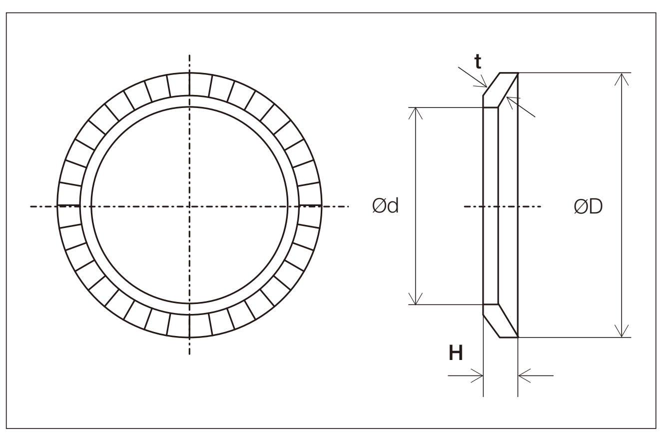
Corporation symbol: CDW-H
CDW-L (Only for M5)

Material: S50C to S70C

Hardness: HRC40 to 48

(Unit: mm)

Nominal size	ID and OD of Belleville spring washer		t	H
	Ød	ØD		
5	5.25	8.5	0.6	0.85
6	6.4	10	1.0	1.25
8	8.4	13	1.2	1.55
10	10.6	16	1.5	1.9
12	12.6	18	1.8	2.2
16	16.9	24	2.3	2.8
18	18.9	27	2.6	3.15
20	20.9	30	2.8	3.55



Note: When using any equivalent washer, select it with special care given to its outside diameter D.

Lubrication

- The standard lubrication method for the RS reduction gears is greasing.
  Before the reduction gear is shipped, it is filled with our recommended grease. (For the brand of the pre-filled grease, refer to the following table.)
  When operating a reduction gear filled with the appropriate amount of grease, the standard replacement time due to deterioration of the grease is 20,000 hours.
  When using the gear with deteriorated grease or under an inappropriate ambient temperature condition (40ºC or more), check the deterioration condition of the grease and determine the appropriate replacement cycle.

- Specified grease name

Model	RS-260A	RS-320A, RS-900A
Brand	VIGOGREASE RE0	Molywhite RE00
Manufacture	Nabtesco Corporation	
Ambient temperature	-10 to 40°C	

- It is recommended that the running-in operation is performed.
  Abnormal noise or torque variation may occur during operation due to the characteristics of the lubricant. There is no problem with the quality when the symptom disappears after the running-in operation is performed.

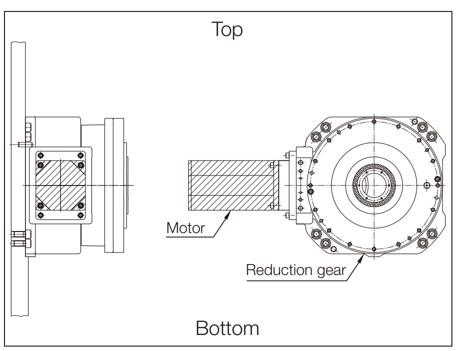
Requirements for equipment design

- If the lubricant leaks from the reduction gear or if the motor fails, the reduction gear must be removed. Design the equipment while taking this into consideration.

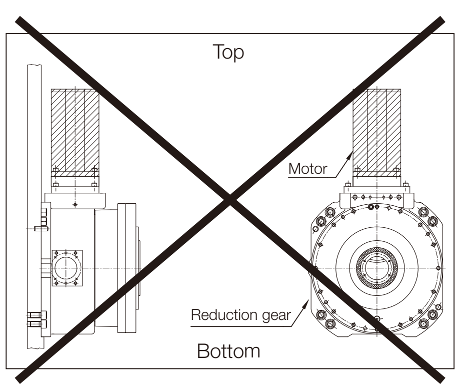
Reduction gear installation

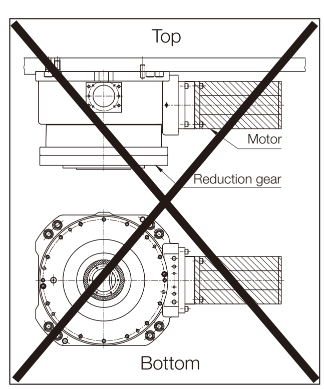
- For the horizontal shaft installation, do not install the reduction gear while the input shaft (motor) position faces upward. (Be sure to confirm that the input shaft position faces right, left, or downward during installation
- If you intend to use the reduction gear attached to the ceiling, contact our customer representative.

Correct installation example

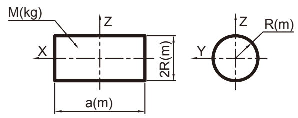


Incorrect installation example





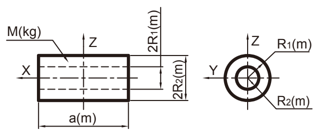
Inertia moment calculation formula

<table>
<tr><th>Shape</th><th>I(kgm²)</th></tr>
<tr><td>1. Cylinder solid

</td><td>

$I_x = \frac{1}{2} M R^2$

$I_y = \frac{1}{4} M \left(R^2 + \frac{a^2}{3}\right)$

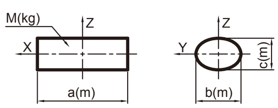
$I_z = I_y$

</td></tr>
<tr><td>2. Cylinder hollow

</td><td>

$I_x = \frac{1}{2} M \left(R_1^2 + R_2^2\right)$

$I_y = \frac{1}{4} M \left\{\left(R_1^2 + R_2^2\right) + \frac{a^2}{3}\right\}$

$I_z = I_y$

</td></tr>
<tr><td>3. Oval cross section

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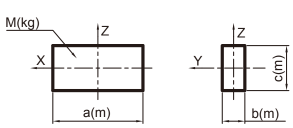
$I_x = \frac{1}{16} M \left(b^2 + c^2\right)$

$I_y = \frac{1}{4} M \left(\frac{c^2}{4} + \frac{a^2}{3}\right)$

$I_z = \frac{1}{4} M \left(\frac{b^2}{4} + \frac{a^2}{3}\right)$

</td></tr>
<tr><td>4. Rectangle

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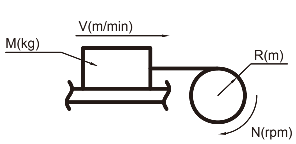
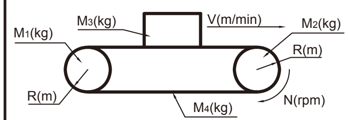
$I_x = \frac{1}{12} M \left(b^2 + c^2\right)$

$I_y = \frac{1}{12} M \left(a^2 + c^2\right)$

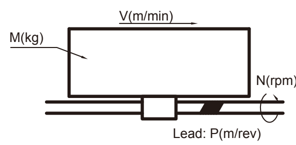
$I_z = \frac{1}{12} M \left(a^2 + b^2\right)$

</td></tr>
<tr><td>5. General application

</td><td>

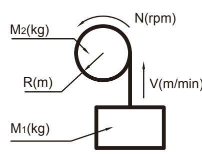
$I = \frac{M}{4} \left(\frac{V}{\pi \times N}\right)^2 = MR^2$

</td></tr>
<tr><td>6. Horizontal movement by conveyor

</td><td>

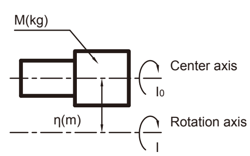
$I = \left(\frac{M_1 + M_2}{2} + M_3 + M_4\right) \times R^2$

</td></tr>
<tr><td>7. Horizontal movement by lead screw

</td><td>

$I = \frac{M}{4} \left(\frac{V}{\pi \times N}\right)^2 = \frac{M}{4} \left(\frac{P}{\pi}\right)^2$

</td></tr>
<tr><td>8. Up/down movement by hoist

</td><td>

$I = M_1 R^2 + \frac{1}{2} M_2 R^2$

</td></tr>
<tr><td>9. Parallel axis theorem

</td><td>

$I = I_0 + M\eta^2$

I_0 : Moment of inertia of any object about an axis through its center of mass

I : Moment of inertia about any axis parallel to the axis through its center of mass

η : Perpendicular distance between the above two axes

</td></tr>
</table>

Troubleshooting checksheet

Check the following items in the case of trouble like abnormal noise, vibration, or malfunctions.
When it is not possible to resolve an abnormality even after verifying the corresponding checkpoint, obtain a “Reduction Gear Investigation Request Sheet” from our Website, fill in the necessary information, and contact our Service Center.

[URL]: **http://precision.nabtesco.com/documents/request.html**

The trouble started immediately after installation of the reduction gear

Checked	Checkpoint
	Make sure the equipment’s drive section (the motor side or the reduction gear output surface side) is not interfering with another component.
	Make sure the equipment is not under a greater than expected load (torque, moment load, thrust load).
	Make sure the required number of bolts are tightened uniformly with the specified tightening torque.
	Make sure the reduction gear, motor, or your company’s components are not installed at a slant.
	Make sure the specified amount of Nabtesco-specified lubricant has been added.
	Make sure there are no problems with the motor’s parameter settings.
	Make sure there are no components resonating in unity.
	Make sure the input gear is appropriately installed on the motor.
	Make sure there is no damage to the surface of the input gear teeth.
	Make sure the input gear specifications (precision, number of teeth, module, shift coefficient, dimensions of each part) are correct.
	Make sure the flange and other components are designed and manufactured with the correct tolerances.

The trouble started during operation

Checked	Checkpoint
	Make sure the equipment has not been in operation longer than the calculated service life.
	Make sure the surface temperature of the reduction gear is not higher than normal during operation.
	Make sure the operation conditions have not been changed.
	Make sure there are no loose or missing bolts.
	Make sure the equipment is not under a greater than expected load (torque, moment load, thrust load).
	Make sure the equipment’s drive section is not interfering with another component.
	Make sure an oil leak is not causing a drop in the amount of lubricant.
	Make sure there are no external contaminants in the gear, such as moisture or metal powder.
	Make sure no lubricant other than that specified is being used.

▶ Area In North and South America / In Europe and Africa / In Asia and others
▶ FAX USA: / Germany: / Osaka Sales Office:
1-248-553-3070 / 49-211-364677 / 81-6-6341-7182

Order Information Sheet (Please complete the form below and send it with your order.)

Date.

Company Name: Dept. Name:

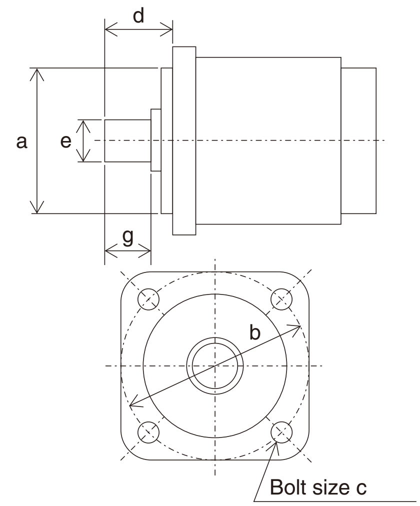
Name: E-mail:

TEL. - - FAX. - -

◆ System configuration and selected motor

We would appreciate if you could provide your system configuration drawing that helps us to understand the speed, constant torque, and load inertia moment of the output shaft for the reduction gear.

System configuration

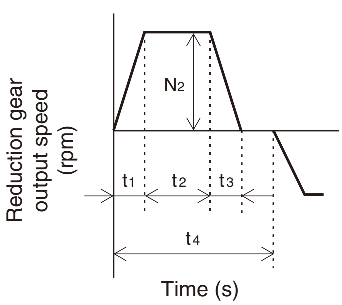


Motor model		
P	Motor rated output (KW)	
T_{M0}	Motor rated torque (Nm)	
T_{M1}	Motor momentary maximum torque (Nm)	
N_{M0}	Motor rated speed (rpm)	

a	Motor mounting pilot diameter (mm)	
b	Motor mounting bolt P.C.D (mm)	
c	Motor mounting bolt size (mm)	
d	Motor shaft length (mm)	
e	Motor shaft diameter (mm)	
g	Motor shaft effective length (mm)	

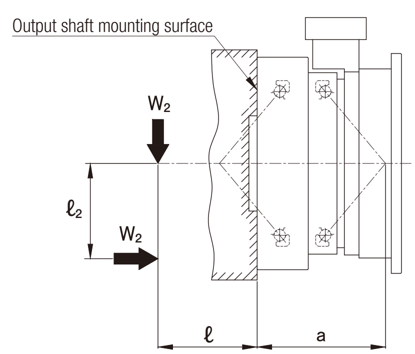
Please inform us of whether a key is attached or not, and when it is attached, also inform us of its dimensions.

◆ Operation pattern (output shaft for the reduction gear)



t_1	Acceleration time (s)	
t_2	Constant speed operation time (s)	
t_3	Deceleration time (s)	
t_4	One operation cycle time (s)	
Q_{1CY}	Number of operation cycles per day (times)	
Q_2	Number of operating days per year (days)	
N_2	Constant speed (rpm)	
T_1	Max. torque for startup (Nm)	
T_2	Constant torque (Nm)	
T_3	Max. torque for stop (Nm)	

◆ External load (output shaft for the reduction gear)



W_1	Radial load (N)	
ℓ	Distance to the point of radial load application (mm)	
W_2	Axial load (N)	
ℓ_2	Distance to the point of axial load application (mm)	

Warranty

1. In the case where Nabtesco confirms that a defect of the Product was caused due to Nabtesco's design or manufacture within the Warranty Period of the Product, Nabtesco shall repair or replace such defective Product at its cost. The Warranty Period shall be from the delivery of the Product by Nabtesco or its distributor to you (“Customer”) until the end of one (1) year thereafter, or the end of two thousand (2,000) hours from the initial operation of Customer's equipment incorporating the Product at end user's production line, whichever comes earlier.
2. Unless otherwise expressly agreed between the parties in writing, the warranty obligations for the Product shall be limited to the repair or replacement set forth herein. OTHER THAN AS PROVIDED HEREIN, THERE ARE NO WARRATIES ON THE PRODUCT, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.
3. The warranty obligation under the Section 1 above shall not apply if:
   a) the defect was caused due to the use of the Product deviated from the Specifications or the working conditions provided by Nabtesco;
   b) the defect was caused due to exposure to foreign substances or contamination (dirt, sand etc.)
   c) lubricant or spare part other than the ones recommended by Nabtesco was used in the Product;
   d) the Product was used in an unusual environment (such as high temperature, high humidity, a lot of dust, corrosive/volatile/inflammable gas, pressurized/depressurized air, under water/liquid or others except for those expressly stated in the Specifications);
   e) the Product was disassembled, re-assembled, repaired or modified by anyone other than Nabtesco;
   f) the defect was caused due to the equipment into which the Product was installed;
   g) the defect was caused due to an accident such as fire, earthquake, lightning, flood or others; or
   h) the defect was due to any cause other than the design or manufacturing of the Product.
4. The warranty period for the repaired/replaced Product/part under the Section 1 above shall be the rest of the initial Warranty Period of the defective Product subjected to such repair/replace.

Rev. 002

Nabtesco

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