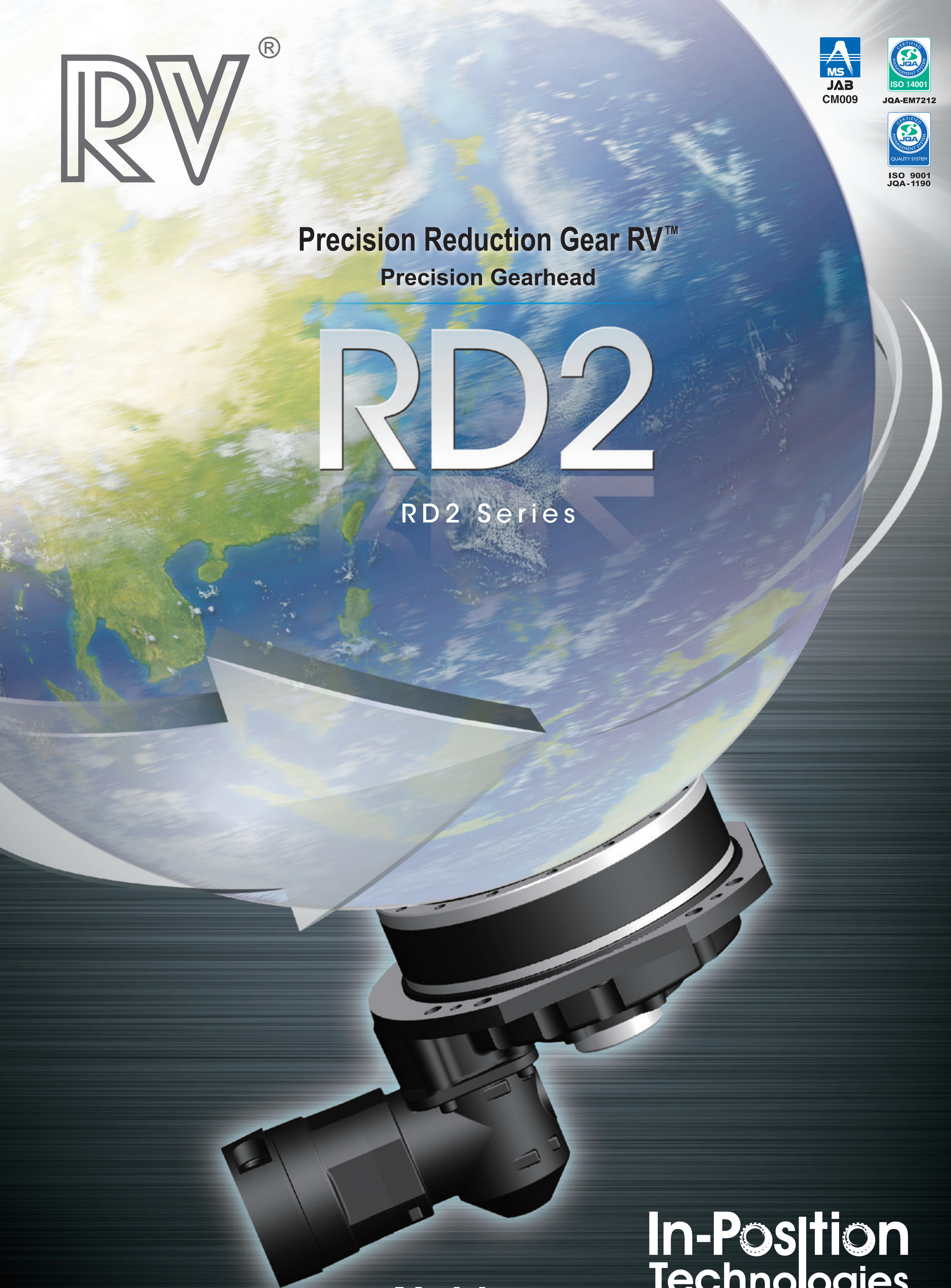
RV®

Precision Reduction Gear RV™

Precision Gearhead

RD2

RD2 Series



MS JAB CM009

ISO 14001 JQA-EM7212

ISO 9001 JQA-1190

Nabtesco

In-Position Technologies

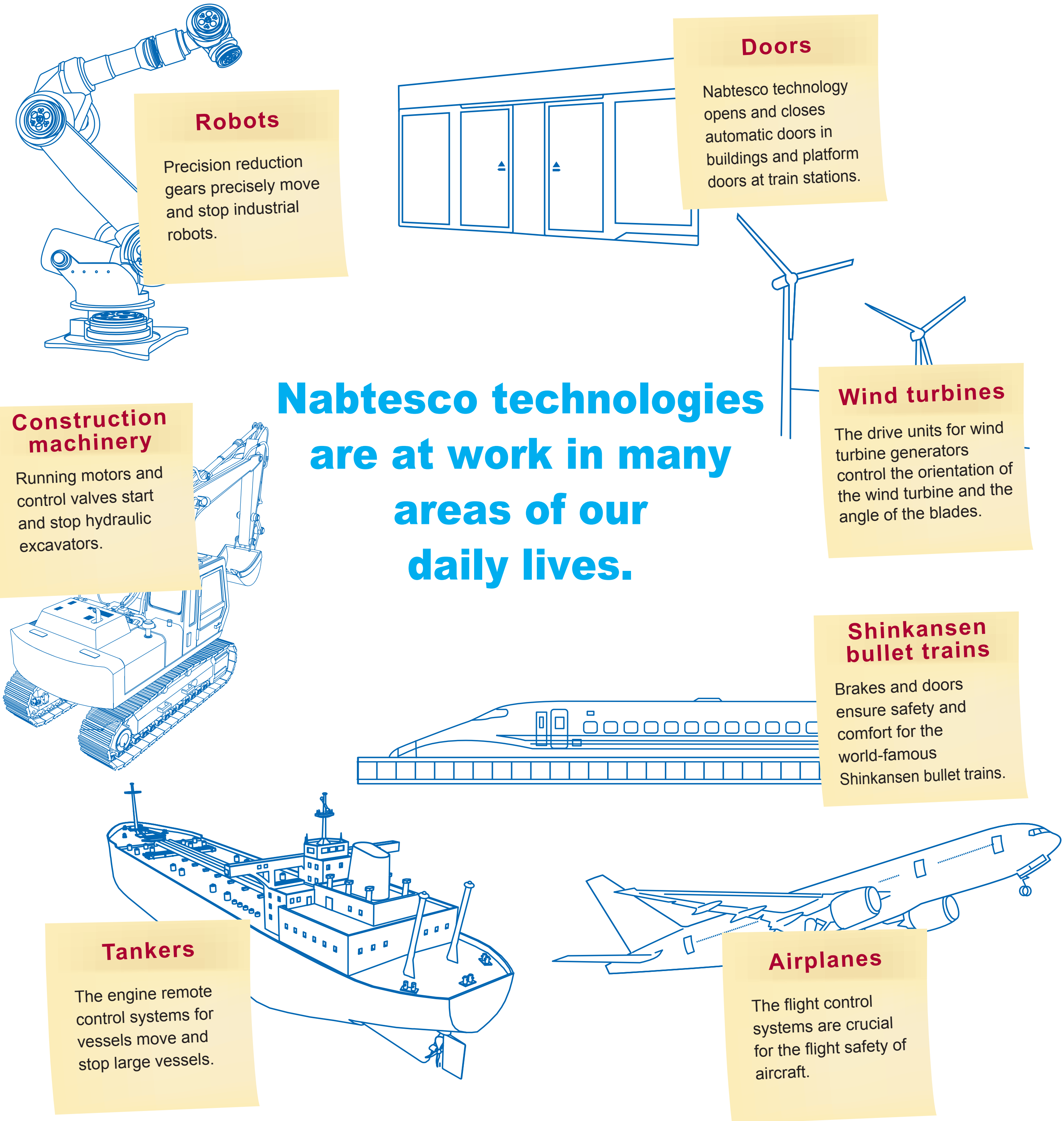
www.iptech1.com | (877) 478-3241 | help@iptech1.com

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.

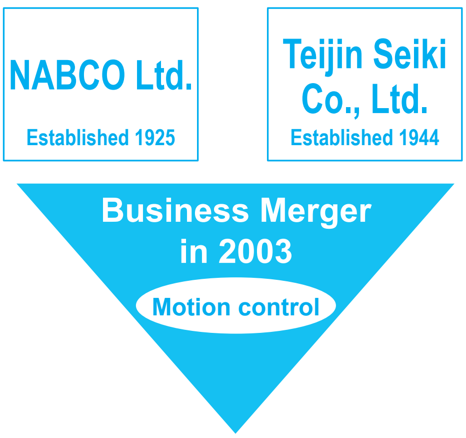
Nabtesco technologies are at work in many areas of our daily lives.



CONTENTS

Who is Nabtesco?

The key word of Nabtesco is '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 established a large 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.



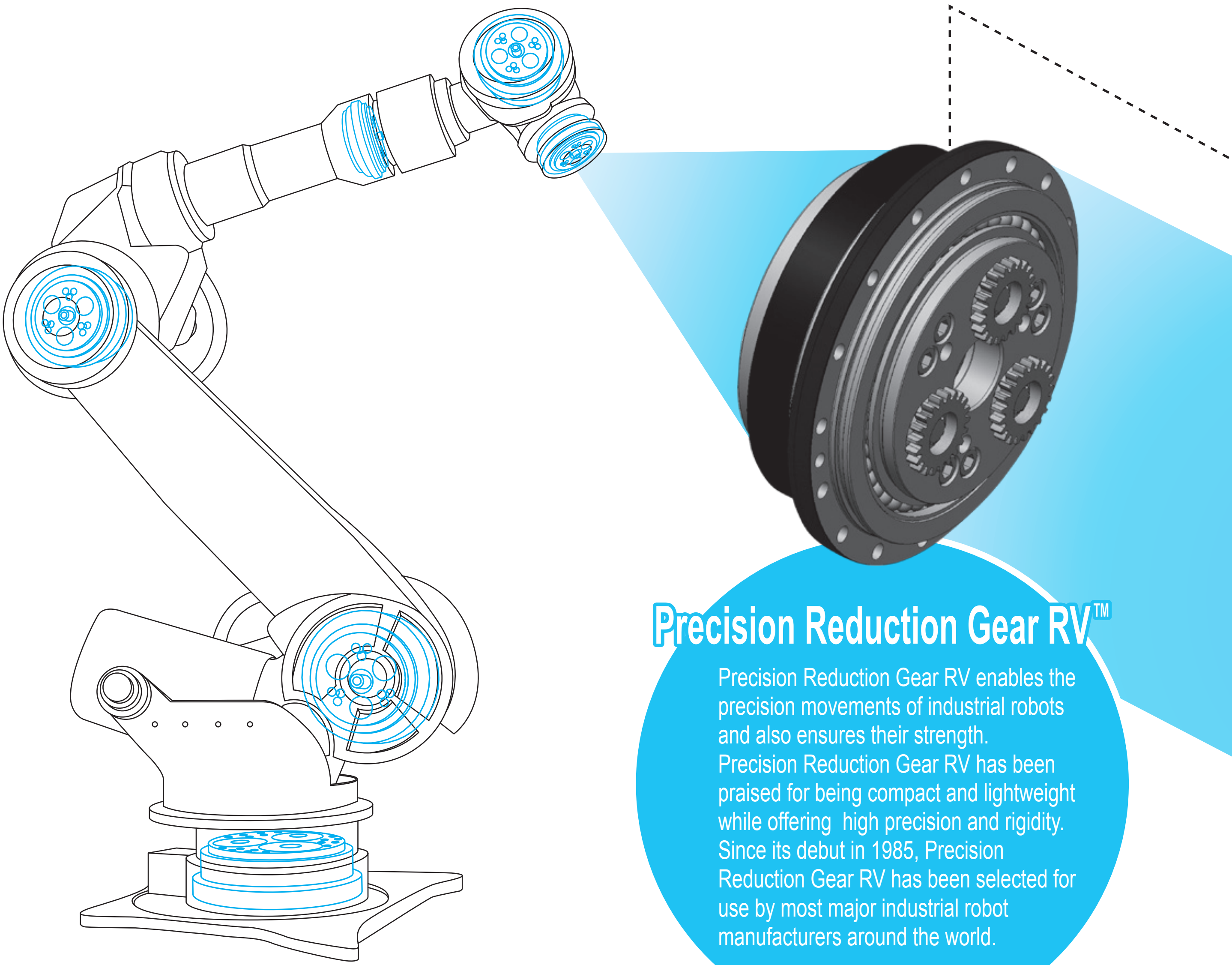
Nabtesco

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.

RD2: The gear that will change everything

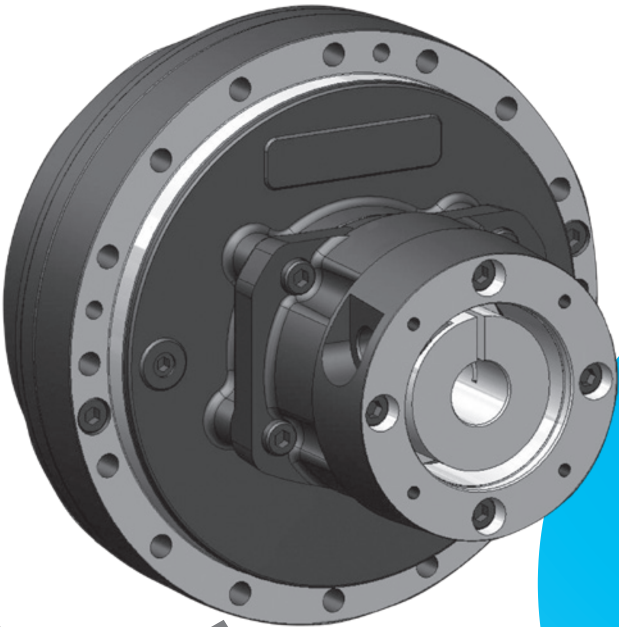
A highly developed Precision Reduction Gear RV™ that offers high quality, high performance and ease of use.



Industrial robot

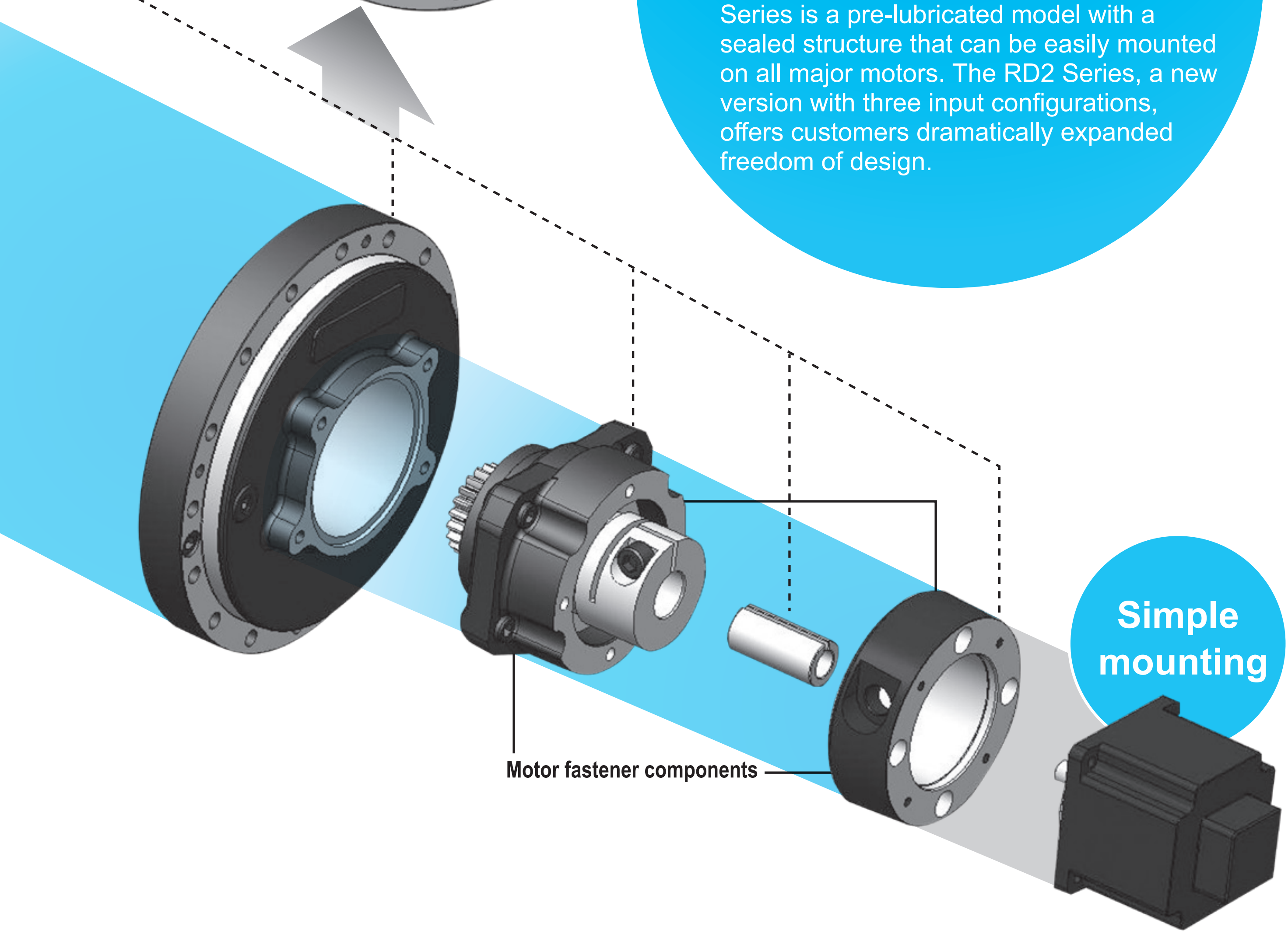
Precision Reduction Gear RV™

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.

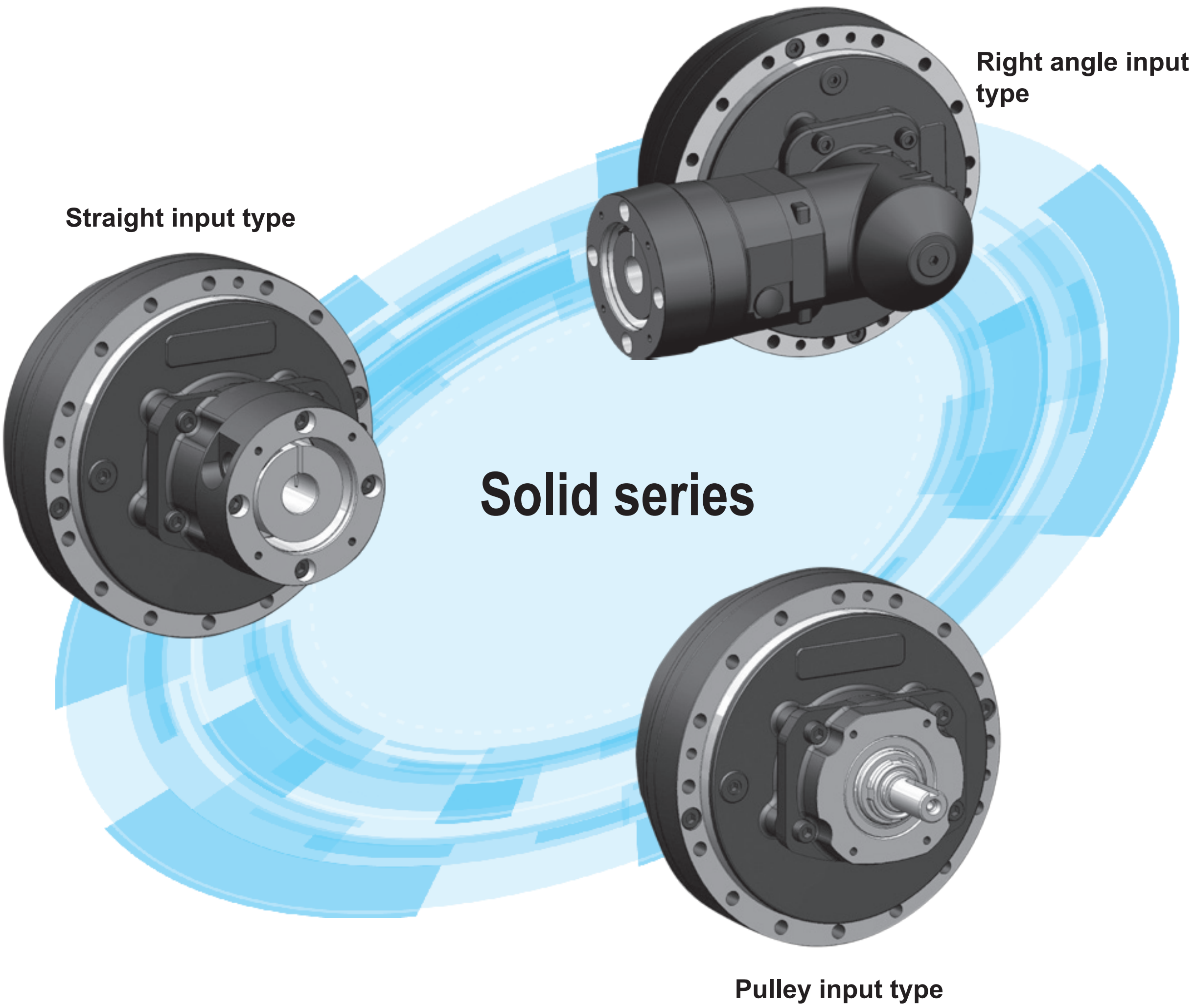


Precision Gearhead
RD2 Series

Nabtesco took the Precision Reduction Gear RV, which is highly trusted and valued in the industry and created the RD Series. The RD Series is a pre-lubricated model with a sealed structure that can be easily mounted on all major motors. The RD2 Series, a new version with three input configurations, offers customers dramatically expanded freedom of design.

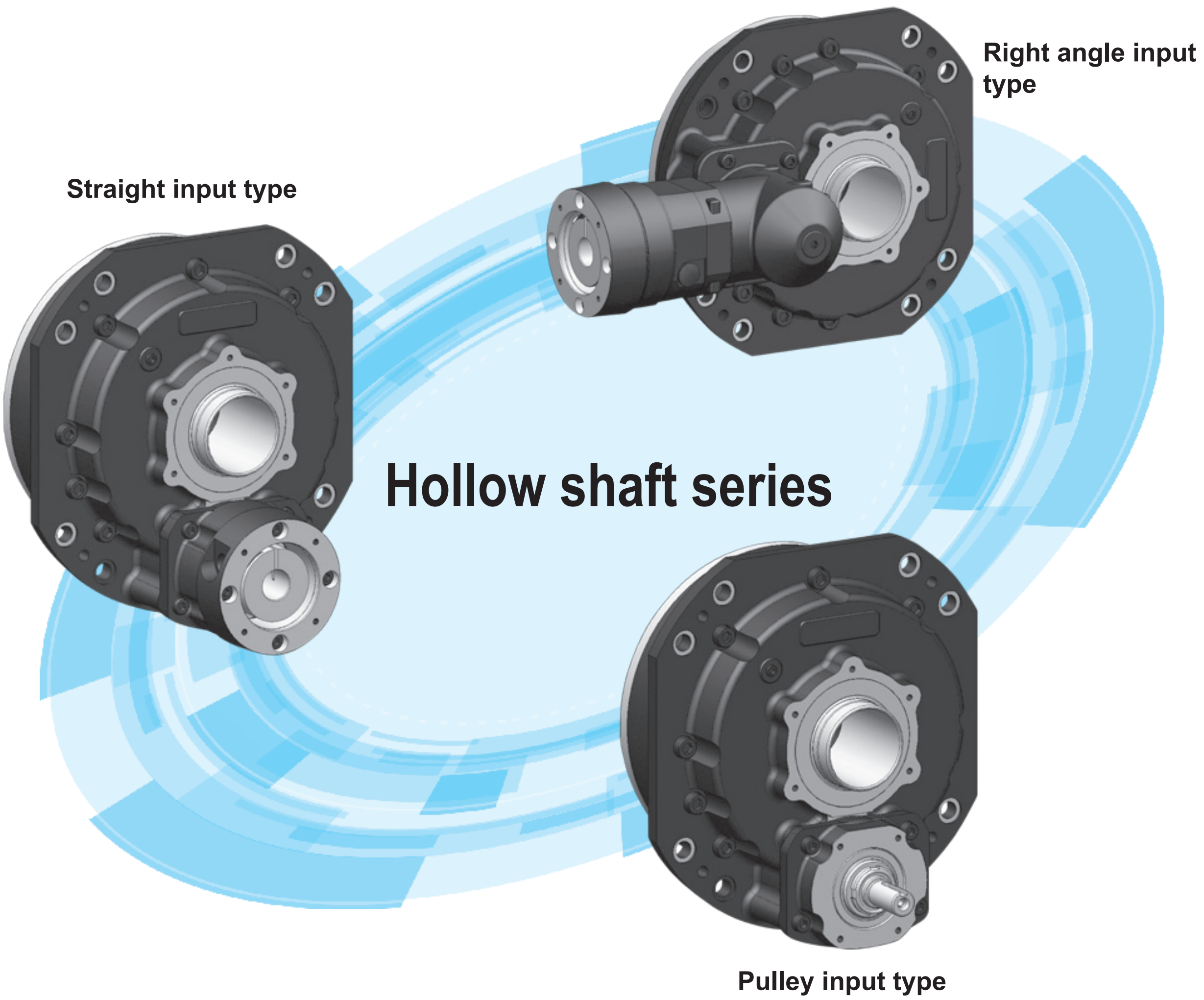


RD2 Series: Designed to meet a variety of customer needs



3...

...Benefits	1	Allows compact equipment design
...Advantages	1	Flexibility
...User-friendly	1	Many ratios available



2 Reduces the number of components needed

3 High reliability

2 Pre-lubricated
Our specialized, environmentally conscious lubricant
RV GREASE LB00

3 Easy mount

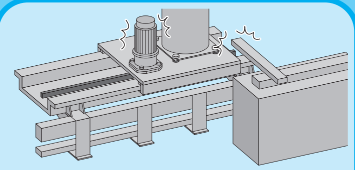
2 Easy installation

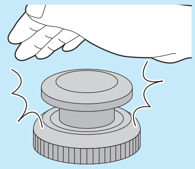
3 Fluorine is used for all oil seals

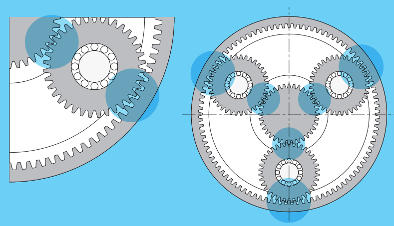
Nabtesco RD2 Series offer a variety of solutions

■ Standard Epicyclic Gear

Low contact ratio and low resistance to impacts



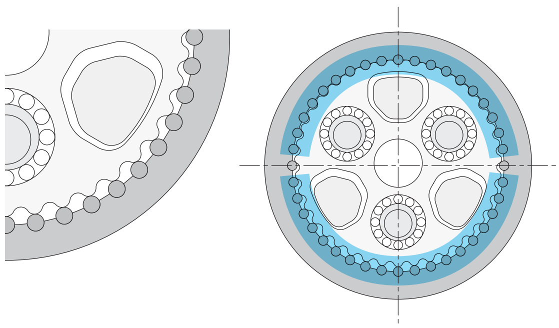




Typical gear is damaged by shock load

■ RD2 Series

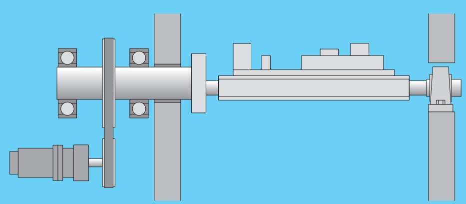
Use of pin/gear mechanism results in high contact ratio and considerable impact resistance



High reliability for your machine

■ Typical equipment

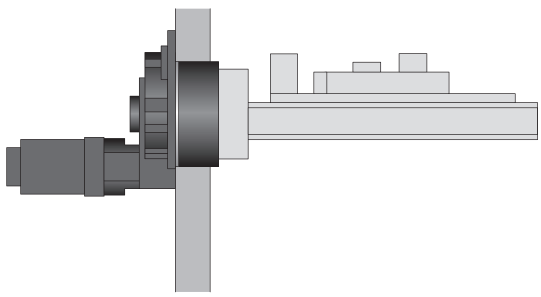
Bearings and external support table are needed



More components
Higher assembly cost
Higher design cost

■ RD2 Series

Integrated large-capacity
⇨External bearings and support table are not needed



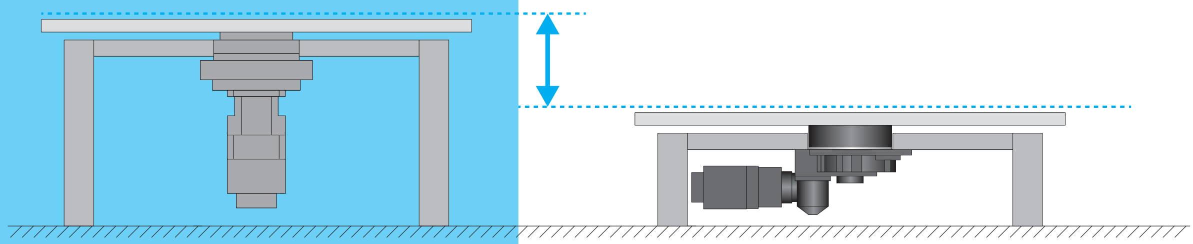
Reduced number of components
Reduced cost of assembly
Reduced cost of design

■ Typical equipment

Reduction gear thickness + motor length + space for motor removal

■ RD2 Series

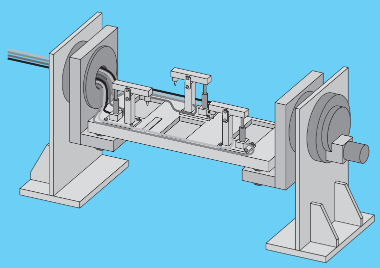
Only the thickness of the reduction gear itself



Equipment needs increased space

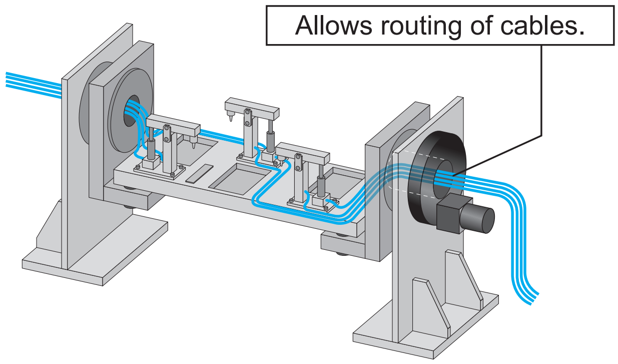
Right angle and pulley models can be used for a lower profile

■ Typical equipment



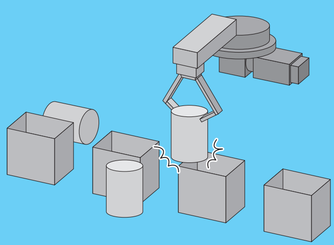
Cable routing is difficult

■ RD2 Series



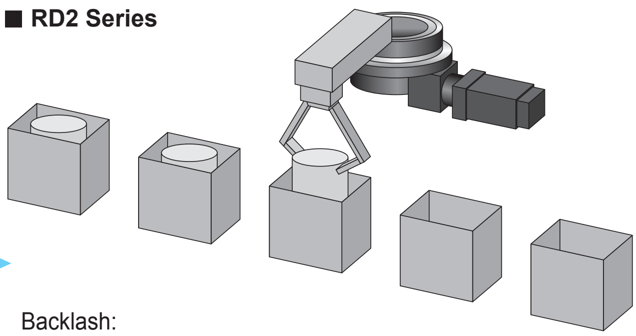
Hollow shaft series also available
Improved layout

■ Typical equipment



High backlash leads to poor repeatability

■ RD2 Series



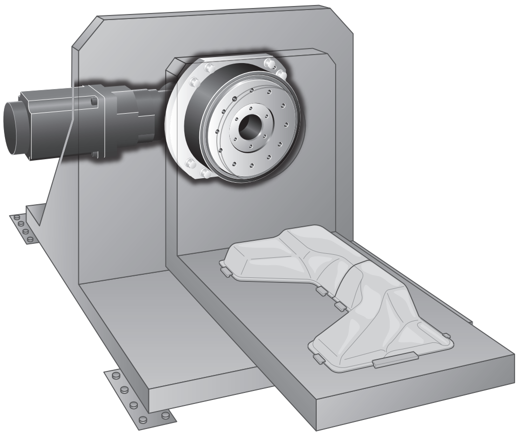
Backlash:
1 arc.min for straight input and pulley input type
1.5 arc.min for right angle input type (except some models)

Highly precise positioning is possible

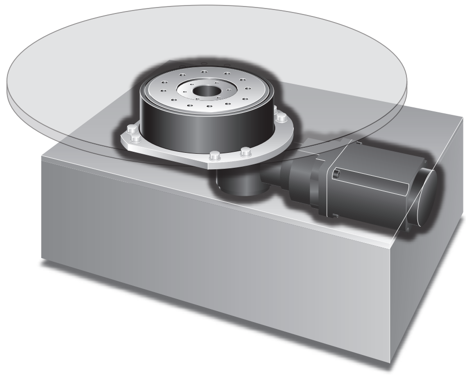
Main Applications

Examples of Uses for the RD2 Series (for reference)

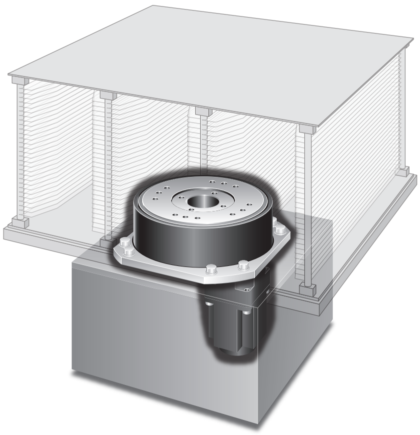
■ Positioner (tilting axis)



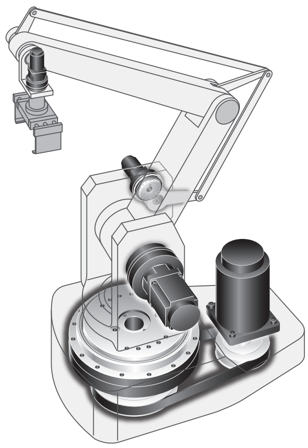
■ Positioner (rotary axis)



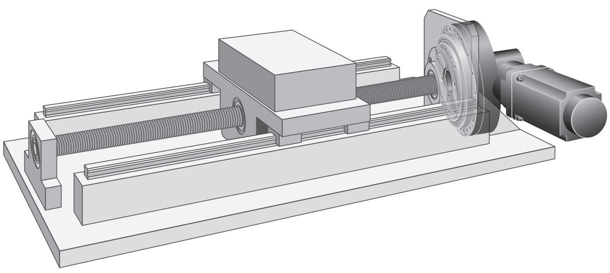
■ Glass Substrate/ Wafer Rotation and Positioning



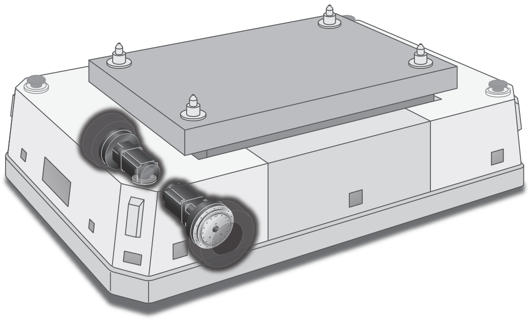
■ Palletizing Robots



■ Ball Screw Drive



■ AGV Drive



Principle of Operation

1. Rotation of the servomotor is transmitted through the input gear to the spur gears, and the speed is reduced according to the gear ratio between the input gear and the spur gears. <Fig. 1>
Note: For the hollow shaft series, the rotation of the servomotor is transmitted from the input gear through the center gear to the spur gears.

2. Since the crankshafts are directly connected to the spur gears, they have the same rotational speed as the spur gears. <Fig. 1>

3. Two RV gears are mounted around the needle bearings on the eccentric section of the crankshaft. (In order to balance the equal amount of force, two RV gears are mounted.) <Fig. 2>

4. When the crankshafts rotate, the two RV gears mounted on the eccentric sections also revolve eccentrically around the input axis (crank movement). <Fig. 2>

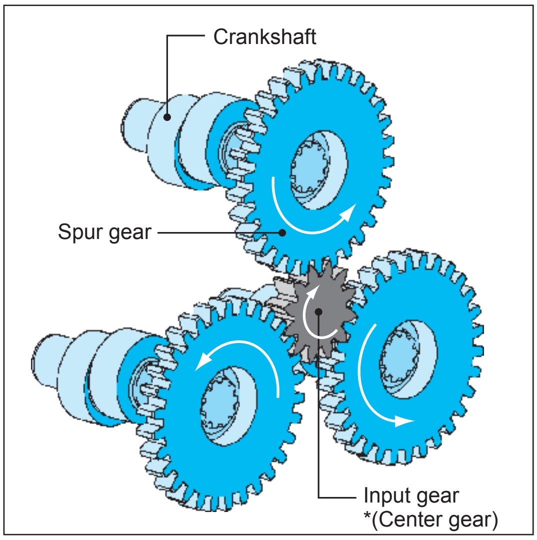
5. Pins are arrayed in a constant pitch in the grooves inside the case. The number of pins is just one larger than the number of RV gear teeth. <Fig. 3>

6. As the crankshafts revolve one complete rotation, the RV gears revolve eccentrically one pitch of a pin (crank movement), with all the RV teeth in contact with all of the pins. As a result, 1 RV gear tooth moves in the opposite direction of the crankshaft rotation. <Fig. 3>

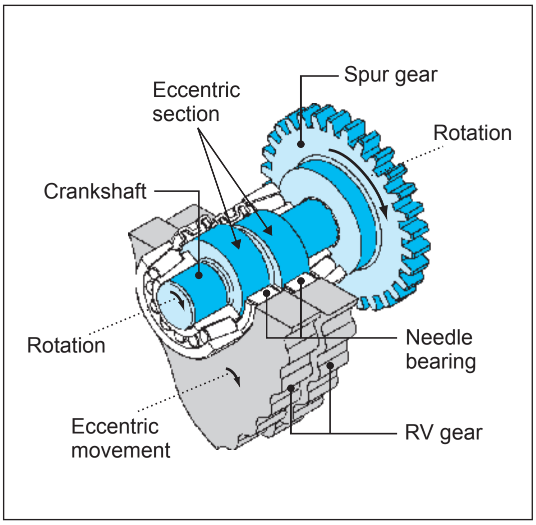
7. The rotation is then output to the shaft (output shaft) via the crankshaft so that the crankshaft rotation speed can be reduced in proportion to the number of pins. <Fig. 3>

8. The total reduction ratio is the product of the first reduction ratio multiplied by the second reduction ratio.
Note: For the hollow shaft series, the rotation of the servomotor is transmitted from the input gear through the center gear to the spur gears.

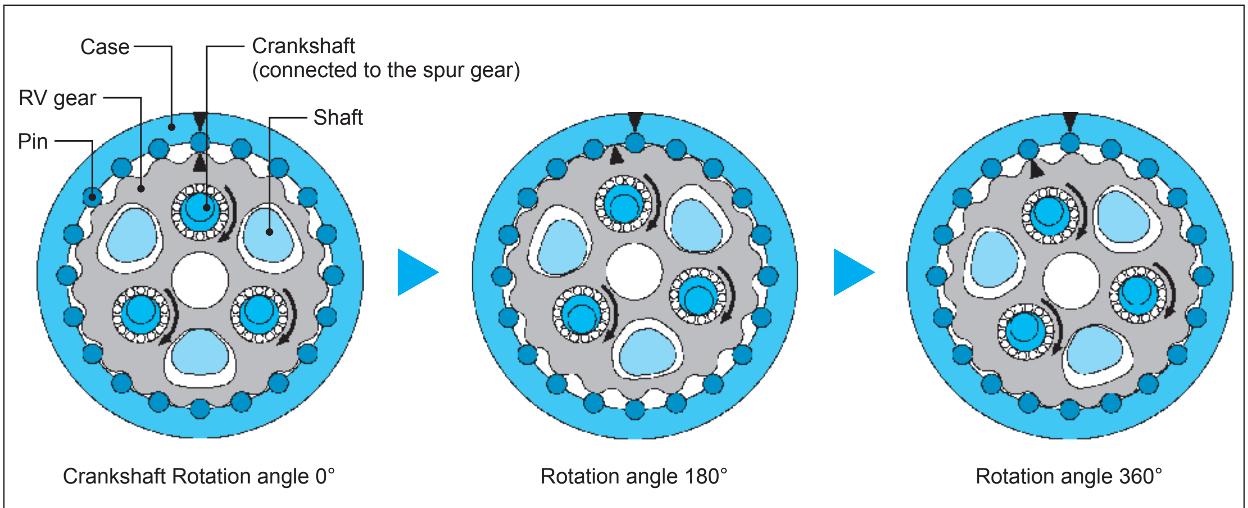
■ Fig. 1. First reduction section



■ Fig. 2. Crankshaft section



■ Fig. 3. Second reduction section

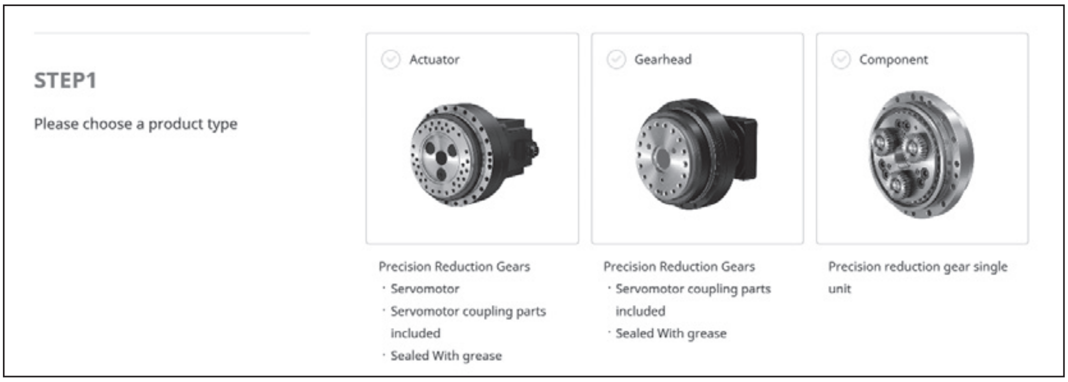


http://precision.nabtesco.com/

1. Product Selection

● Select "Simple Product Selection" from "Product Selection".

You can designate the applicable model by simply clicking on the items in a sequence of five steps according to the product type and the motor for use.
The motor can be selected in accordance with the watt value or from the series of the manufacturer of the motor for use.

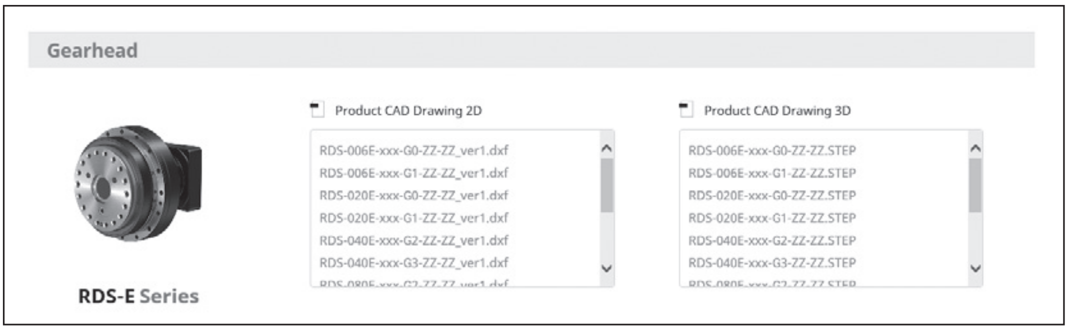


▶When you select the specified motor from the manufacturer, the display also shows the codes of the motor flange and the bushing that are applicable to the motor.

2. CAD Data Download

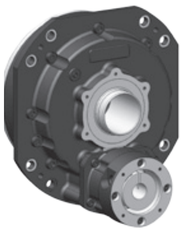
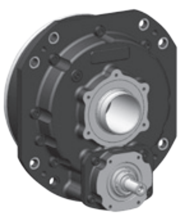
You may also download CAD data, either 3D CAD (STEP file) or 2D CAD (DXF file).

Note: Free membership registration is required to download the CAD data.

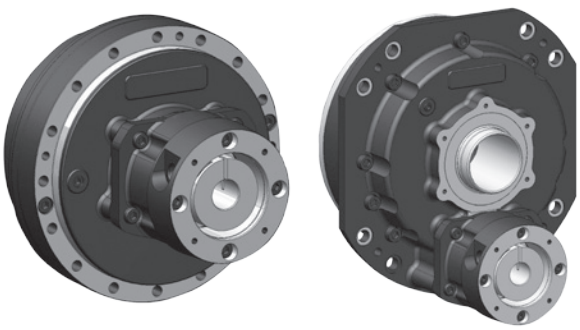


Note: The above website displays are only images from the current site.

Overview of Features (listed by input type)

Input type	Reduction gear configuration	Product	Product features	Corresponding speed ratio	Allowable acceleration/ deceleration torque (Nm)	Items not included	External dimensions
Straight input type	Solid series		● The total length in the axial direction has been reduced by up to 15% as compared to the previous series.	31 to 258	117 to 7,840	Servomotor	P.16 ▼ P.27
	Hollow shaft series						P.28 ▼ P.39
Right angle input type	Solid series		● Equipment can be more compact ● Can be installed in confined space ● Table can be made shorter	31 to 258	117 to 7,840	Servomotor	P.44 ▼ P.55
	Hollow shaft series						P.56 ▼ P.67
Pulley input type	Solid series		● Belt input is possible ● Motor can be installed anywhere ● Speed ratio can be changed using pulley	57 to 157	412 to 7,840	Servomotor pulley	P.71 ▼ P.75
	Hollow shaft series						P.76 ▼ P.81

Straight Input Type



Straight Input Type Product Code / Configuration Diagram

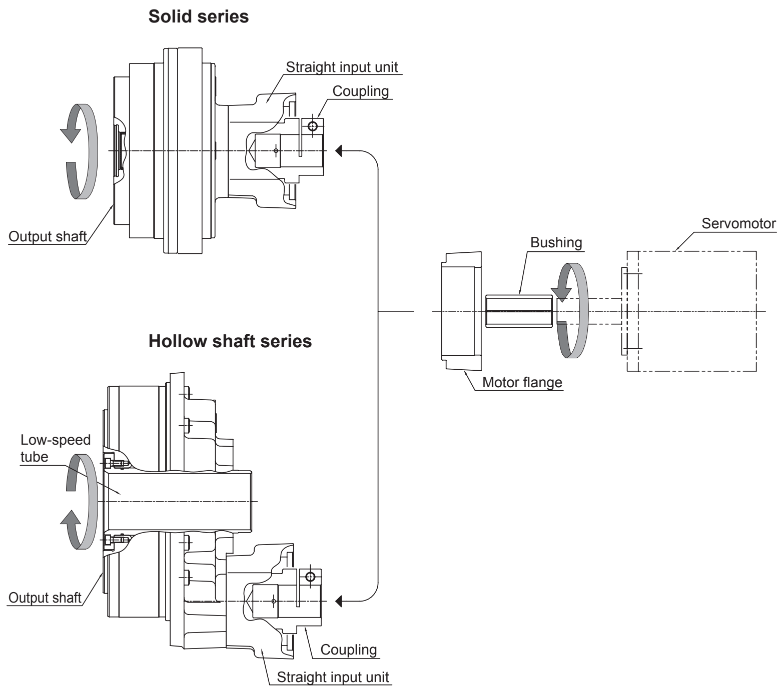
Product code

RD S – 040 E – 153 – G2 – CF – 1E

Model Code			Ratio Code	Input unit code	Motor flange code	Bushing code
Straight Input code	Torque code	Series code				
S	006	E: Solid series	031, 043, 054, 079, 103	G0 : Corresponding motor shaft diameter Ø8 to 14 G1 : Corresponding motor shaft diameter Ø14 to 24	2-alphabetic character code ZZ: None (The code will differ depending on motor to be mounted.)	2-letter code of a numeric and an alphabetic characters ZZ: None (The code will differ depending on motor to be mounted.)
	020		041, 057, 081, 105, 121, 161	G0 : Corresponding motor shaft diameter Ø8 to 14 G1 : Corresponding motor shaft diameter Ø14 to 24		
	040		041, 057, 081, 105, 121, 153	G2 : Corresponding motor shaft diameter Ø14 to 24 G3 : Corresponding motor shaft diameter Ø25 to 35		
	080		041, 057, 081, 101, 121, 153	G2 : Corresponding motor shaft diameter Ø14 to 24 G3 : Corresponding motor shaft diameter Ø25 to 35		
	160		066, 081, 101, 121, 145, 171	G4 : Corresponding motor shaft diameter Ø19 to 28 G5 : Corresponding motor shaft diameter Ø32 to 42		
	320		066, 081, 101, 121, 141, 185	G4 : Corresponding motor shaft diameter Ø19 to 28 G5 : Corresponding motor shaft diameter Ø32 to 42		
	010	C: Hollow shaft series	081, 108, 153, 189, 243	G0 : Corresponding motor shaft diameter Ø8 to 14 G1 : Corresponding motor shaft diameter Ø14 to 24		
	027		100, 142, 184, 233	G0 : Corresponding motor shaft diameter Ø8 to 14 G1 : Corresponding motor shaft diameter Ø14 to 24		
	050		109, 153, 196, 240	G2 : Corresponding motor shaft diameter Ø14 to 24 G3 : Corresponding motor shaft diameter Ø25 to 35		
	100		101, 150, 210, 258	G2 : Corresponding motor shaft diameter Ø14 to 24 G3 : Corresponding motor shaft diameter Ø25 to 35		
	200		106, 156, 206, 245	G4 : Corresponding motor shaft diameter Ø19 to 28 G5 : Corresponding motor shaft diameter Ø32 to 42		
	320		115, 157, 207, 253	G4 : Corresponding motor shaft diameter Ø19 to 28 G5 : Corresponding motor shaft diameter Ø32 to 42		

Note: For selection of motor flange and bushing, see the selection tables on pages 83 – 85 or visit the Nabtesco website (URL : http://precision.nabtesco.com/).

Configuration diagram



Rating Table Straight Input Type

Solid series

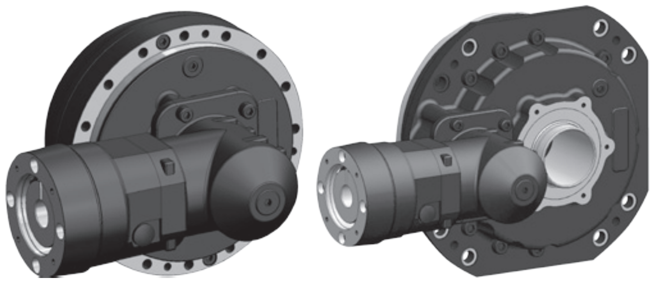
Model Code	Ratio code (Reduction ratio value)	T_0 Rated Torque (Nm)	N_0 Rated Output Speed (rpm)	K Life Rating (h)	T_{S1} Allowable Startup/Stop Torque (Nm)	T_{S2} Momentary maximum allowable torque (Nm)	N_{in} Allowable Input Speed (Note 2) (rpm)	N_S Allowable Output Speed (Note 2) (rpm)	N_{To} Reference value to output speed during continuous operation at rated torque (rpm)	Backlash (arc.min.)	Lost motion (arc.min.)	Start-up Efficiency (%)	M_0 Allowable moment (Note 3) (Nm)	Wr Allowable radial load (Note 8) (N)	External Dimensions
RDS-006E	031 (31)	58	30	6,000	117	294	3,500	100	100	1.5	1.5	70	196	2,170	Input Unit Code : G0 ——P.16 Input Unit Code : G1 ——P.17
	043 (43)							81	76						
	054 (53.5)							65	63						
	079 (79)							44	44						
	103 (103)							34	34						
RDS-020E	041 (41)	167	15	6,000	412	833	3,500	75	75	1.0	1.0	75	882	7,785	Input Unit Code : G0 ——P.18 Input Unit Code : G1 ——P.19
	057 (57)							61	56						
	081 (81)							43	42						
	105 (105)							33	33						
	121 (121)							29	29						
	161 (161)							22	22						
RDS-040E	041 (41)	412	15	6,000	1,029	2,058	3,000	70	37	1.0	1.0	70	1,666	11,529	Input Unit Code : G2 ——P.20 Input Unit Code : G3 ——P.21
	057 (57)							53	35						
	081 (81)							37	34						
	105 (105)							29	29						
	121 (121)							25	25						
	153 (153)							20	20						
RDS-080E	041 (41)	784	15	6,000	1,960	3,920	3,000	70	34	1.0	1.0	75	2,156	13,146	Input Unit Code : G2 ——P.22 Input Unit Code : B3 ——P.23
	057 (57)							53	31						
	081 (81)							37	29						
	101 (101)							30	28						
	121 (121)							25	25						
	153 (153)							20	20						
RDS-160E	066 (66)	1,568	15	6,000	3,920	7,840	2,000	30	20	1.0	1.0	75	3,920	18,666	Input Unit Code : G4 ——P.24 Input Unit Code : G5 ——P.25
	081 (81)							25	18						
	101 (101)							20	16						
	121 (121)							17	15						
	145 (145)							14	14						
	171 (171)							12	12						
RDS-320E	066 (66)	3,136	15	6,000	7,840	15,680	2,000	30	15	1.0	1.0	80	7,056	28,066	Input Unit Code : G4 ——P.26 Input Unit Code : G5 ——P.27
	081 (81)							25	12						
	101 (101)							20	9						
	121 (121)							17	7						
	141 (141)							14	6						
	185 (185)							11	4						

Hollow shaft series

Model Code	Ratio code (Reduction ratio value)	T_0 Rated Torque (Nm)	N_0 Rated Output Speed (rpm)	K Life Rating (h)	T_{S1} Allowable Startup/Stop Torque (Nm)	T_{S2} Momentary maximum allowable torque (Nm)	N_{in} Allowable Input Speed (Note 2) (rpm)	N_S Allowable Output Speed (Note 2) (rpm)	N_{To} Reference value to output speed during continuous operation at rated torque (rpm)	Backlash (arc.min.)	Lost motion (arc.min.)	Start-up Efficiency (%)	M_0 Allowable moment (Note 3) (Nm)	Wr Allowable radial load (Note 8) (N)	External Dimensions
RDS-010C	081 (81)	98	15	6,000	245	490	3,500	43	43	1.0	1.0	65	686	5,755	Input Unit Code : G0 ———P.28 Input Unit Code : G1 ———P.29
	108 (108)							32	32						
	153 (153)							23	23						
	189 (189)							19	19						
	243 (243)							14	14						
RDS-027C	100 (99.82)	265	15	6,000	662	1,323	3,500	35	35	1.0	1.0	70	980	6,533	Input Unit Code : G0 ———P.30 Input Unit Code : G1 ———P.31
	142 (141.68)							25	25						
	184 (184)							19	19						
	233 (233.45)							15	15						
RDS-050C	109 (109)	490	15	6,000	1,225	2,450	3,000	28	28	1.0	1.0	70	1,764	9,418	Input Unit Code : G2 ———P.32 Input Unit Code : G3 ———P.33
	153 (152.6)							20	20						
	196 (196.2)							15	15						
	240 (239.8)							13	13						
RDS-100C	101 (100.5)	980	15	6,000	2,450	4,900	3,000	30	20	1.0	1.0	80	2,450	11,802	Input Unit Code : G2 ———P.34 Input Unit Code : G3 ———P.35
	150 (150)							20	17						
	210 (210)							14	14						
	258 (258)							12	12						
RDS-200C	106 (105.83)	1,960	15	6,000	4,900	9,800	2,000	19	16	1.0	1.0	80	8,820	31,455	Input Unit Code : G4 ———P.36 Input Unit Code : G5 ———P.37
	156 (155.96)							13	12						
	206 (206.09)							10	10						
	245 (245.08)							8	8						
RDS-320C	115 (115)	3,136	15	6,000	7,840	15,680	2,000	17	17	1.0	1.0	80	20,580	57,103	Input Unit Code : G4 ———P.38 Input Unit Code : G5 ———P.39
	157 (157)							13	13						
	207 (207)							10	10						
	253 (253)							8	8						

Notes:
1. The rating table shows the specification values including the entry fields for reduction gear values.
2. The allowable speed may be limited by heat depending on the operating rate. Make sure the surface temperature of the reduction gear does not exceed 60°C during use.
3. The allowable moment will differ depending on the thrust load. Check the allowable moment diagram (p.120).
4. For the moment of inertia of the reduction gears, refer to the external dimension drawings for the reduction gear.
5. For the moment rigidity and torsional rigidity, refer to the calculation of tilt angle and the torsion angle (p.126).
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 the "Glossary" (p.110) and the "Product selection flowchart" (p.111).
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.
8. When the radial load is applied within dimension b (see page 126), use the reduction gear within the allowable radial load.

Right Angle Input Type



Right Angle Input Type Code Description / Configuration Diagram

Product code

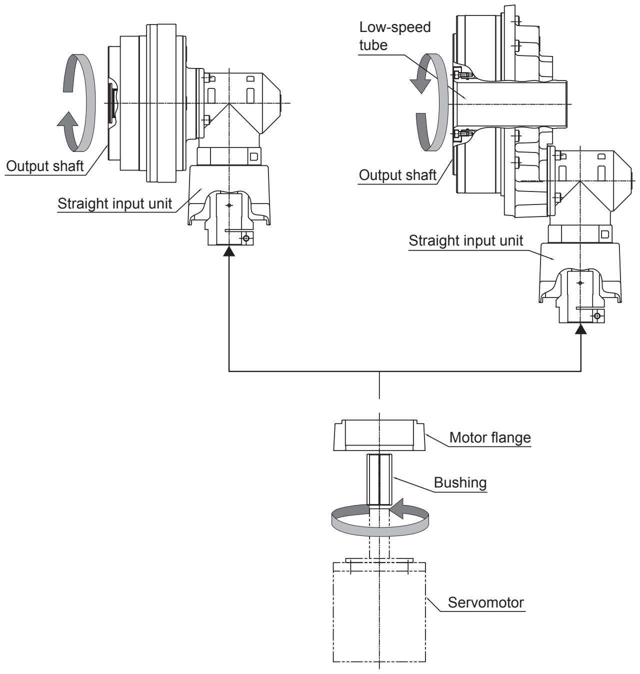
RD R – 080 E – 041 – H3 – GD – ZZ

Model Code: Right angle input code	Model Code: Torque code	Model Code: Series code	Ratio Code	Input unit code	Motor flange code	Bushing code
R	006	E: Solid series	031, 043, 054, 079, 103	H0 : Corresponding motor shaft diameter Ø8 to 14 H1 : Corresponding motor shaft diameter Ø14 to 24	2-alphabetic character code (The code will differ depending on motor to be mounted.)	2-letter code of a numeric and an alphabetic characters ZZ: None (The code will differ depending on motor to be mounted.)
	020		041, 057, 081, 105, 121, 161	H0 : Corresponding motor shaft diameter Ø8 to 14 H1 : Corresponding motor shaft diameter Ø14 to 24		
	040		041, 057, 081, 105, 121, 153	H2 : Corresponding motor shaft diameter Ø14 to 24 H3 : Corresponding motor shaft diameter Ø25 to 35		
	080		041, 057, 081, 101, 121, 153	H2 : Corresponding motor shaft diameter Ø14 to 24 H3 : Corresponding motor shaft diameter Ø25 to 35		
	160		066, 081, 101, 121, 145, 171	H4 : Corresponding motor shaft diameter Ø19 to 28 H5 : Corresponding motor shaft diameter Ø32 to 42		
	320		066, 081, 101, 121, 141, 185	H4 : Corresponding motor shaft diameter Ø19 to 28 H5 : Corresponding motor shaft diameter Ø32 to 42		
	010	C: Hollow shaft series	081, 108, 153, 189, 243	H0 : Corresponding motor shaft diameter Ø8 to 14 H1 : Corresponding motor shaft diameter Ø14 to 24		
	027		100, 142, 184, 233	H0 : Corresponding motor shaft diameter Ø8 to 14 H1 : Corresponding motor shaft diameter Ø14 to 24		
	050		109, 153, 196, 240	H2 : Corresponding motor shaft diameter Ø14 to 24 H3 : Corresponding motor shaft diameter Ø25 to 35		
	100		101, 150, 210, 258	H2 : Corresponding motor shaft diameter Ø14 to 24 H3 : Corresponding motor shaft diameter Ø25 to 35		
	200		106, 156, 206, 245	H4 : Corresponding motor shaft diameter Ø19 to 28 H5 : Corresponding motor shaft diameter Ø32 to 42		
	320		115, 157, 207, 253	H4 : Corresponding motor shaft diameter Ø19 to 28 H5 : Corresponding motor shaft diameter Ø32 to 42		

Note: For selection of motor flange and bushing, see the selection tables on pages 83 – 85 or visit the Nabtesco website (URL : http://precision.nabtesco.com/).

Configuration diagram

Solid series **Hollow shaft series**



Rating Table Right angle input type

Solid series

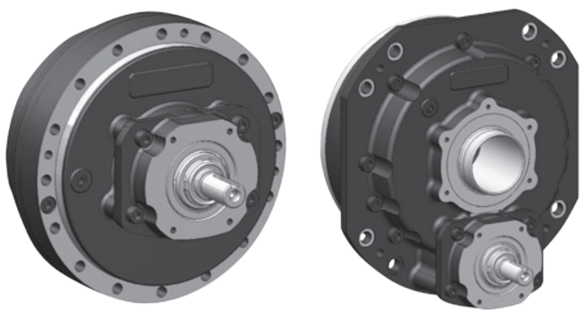
Model Code	Ratio code (Reduction ratio value)	Reduction Gear T_0 Rated Torque (Nm)	N_0 Rated Output Speed (rpm)	K Life Rating (h)	T_{S1} Allowable Startup/Stop Torque (Nm)	T_{S2} Momentary maximum allowable torque (Nm)	N_{In} Allowable Input Speed (Note 2) (rpm)	N_S Allowable Output Speed (Note 2) (rpm)	N_{To} Reference value to output speed during continuous operation at rated torque (rpm)	Backlash (arc.min.)	Lost motion (arc.min.)	Start-up Efficiency (%)	M_0 Allowable moment (Note 3) (Nm)	Wr Allowable radial load (Note 8) (N)	External Dimensions
RDR-006E	031 (31)	58	30	6,000	117	294	3,500	100	100	2.0	2.0	70	196	2,170	Input Unit Code : H0 ——P.44 Input Unit Code : H1 ——P.45
	043 (43)							81	76						
	054 (53.5)							65	63						
	079 (79)							44	44						
	103 (103)							34	34						
RDR-020E	041 (41)	108	15	6,000	271	543	3,500	75	55	1.5	1.5	75	882	7,785	Input Unit Code : H0 ——P.46 Input Unit Code : H1 ——P.47
	057 (57)	151			378	755		61	44						
	081 (81)	167			412	833		43	35						
	105 (105)							33	30						
	121 (121)							29	28						
	161 (161)							22	22						
RDR-040E	041 (41)	400	15	6,000	1,000	2,000	3,000	70	32	1.5	1.5	70	1,666	11,529	Input Unit Code : H2 ——P.48 Input Unit Code : H3 ——P.49
	057 (57)	412			1,029	2,058		53	30						
	081 (81)							37	28						
	105 (105)							29	27						
	121 (121)							25	25						
	153 (153)							20	20						
RDR-080E	041 (41)	400	15	6,000	1,000	2,000	3,000	70	35	1.5	1.5	75	2,156	13,146	Input Unit Code : H2 ——P.50 Input Unit Code : H3 ——P.51
	057 (57)	556			1,390	2,781		53	31						
	081 (81)	784			1,960	3,920		37	29						
	101 (101)							30	27						
	121 (121)							25	25						
	153 (153)							20	20						
RDR-160E	066 (66)	1,568	15	6,000	3,920	7,840	2,000	30	20	1.5	1.5	75	3,920	18,666	Input Unit Code : H4 ——P.52 Input Unit Code : H5 ——P.53
	081 (81)							25	18						
	101 (101)							20	16						
	121 (121)							17	14						
	145 (145)							14	13						
	171 (171)							12	12						
RDR-320E	066 (66)	1,800	15	6,000	4,503	9,002	2,000	30	14	1.5	1.5	80	7,056	28,066	Input Unit Code : H4 ——P.54 Input Unit Code : H5 ——P.55
	081 (81)	2,209			5,527	11,048		25	9						
	101 (101)	2,755			6,892	13,776		20	7						
	121 (121)	3,136			7,840	15,680		17	6						
	141 (141)							14	5						
	185 (185)							11	4						

Hollow shaft series

Model Code	Ratio code (Reduction ratio value)	T_0 Rated Torque (Nm)	N_0 Rated Output Speed (rpm)	K Life Rating (h)	T_{S1} Allowable Startup/Stop Torque (Nm)	T_{S2} Momentary maximum allowable torque (Nm)	N_{in} Allowable Input Speed (Note 2) (rpm)	N_S Allowable Output Speed (Note 2) (rpm)	N_{To} Reference value to output speed during continuous operation at rated torque (rpm)	Backlash (arc.min.)	Lost motion (arc.min.)	Start-up Efficiency (%)	M_0 Allowable moment (Note 3) (Nm)	Wr Allowable radial load (Note 8) (N)	External Dimensions
RDR-010C	081 (81)	98	15	6,000	245	490	3,500	43	39	1.5	1.5	65	686	5,755	Input Unit Code : H0 ——P.56 Input Unit Code : H1 ——P.57
	108 (108)							32	31						
	153 (153)							23	23						
	189 (189)							19	20						
	243 (243)							14	14						
RDR-027C	100 (99.82)	265	15	6,000	662	1,323	3,500	35	23	1.5	1.5	70	980	6,533	Input Unit Code : H0 ——P.58 Input Unit Code : H1 ——P.59
	142 (141.68)							25	18						
	184 (184)							19	15						
	233 (233.45)							15	14						
RDR-050C	109 (109)	490	15	6,000	1,225	2,450	3,000	28	28	1.5	1.5	70	1,764	9,418	Input Unit Code : H2 ——P.60 Input Unit Code : H3 ——P.61
	153 (152.6)							20	20						
	196 (196.2)							15	15						
	240 (239.8)							13	13						
RDR-100C	101 (100.5)	980	15	6,000	2,450	4,900	3,000	30	19	1.5	1.5	80	2,450	11,802	Input Unit Code : H2 ——P.62 Input Unit Code : H3 ——P.63
	150 (150)							20	17						
	210 (210)							14	14						
	258 (258)							12	12						
RDR-200C	106 (105.83)	1,960	15	6,000	4,900	9,800	2,000	19	11	1.5	1.5	80	8,820	31,455	Input Unit Code : H4 ——P.64 Input Unit Code : H5 ——P.65
	156 (155.96)							13	8						
	206 (206.09)							10	6						
	245 (245.08)							8	5						
RDR-320C	115 (115)	3,136	15	6,000	7,840	15,680	2,000	17	14	1.5	1.5	80	20,580	57,103	Input Unit Code : H4 ——P.66 Input Unit Code : H5 ——P.67
	157 (157)							13	11						
	207 (207)							10	7						
	253 (253)							8	8						

Notes:
1. The rating table shows the specification values including the entry fields for reduction gear values.
2. The allowable speed may be limited by heat depending on the operating rate. Make sure the surface temperature of the reduction gear does not exceed 60°C during use.
3. The allowable moment will differ depending on the thrust load. Check the allowable moment diagram (p.120).
4. For the moment of inertia of the reduction gears, refer to the external dimension drawings for the reduction gear.
5. For the moment rigidity and torsional rigidity, refer to the calculation of tilt angle and the torsion angle (p.126).
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 the “Glossary” (p.110) and the “Product selection flowchart” (p.111).
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.
8. When the radial load is applied within dimension b (see page 126), use the reduction gear within the allowable radial load.

Pulley input type



Pulley Input Type Code Description / Configuration Diagram

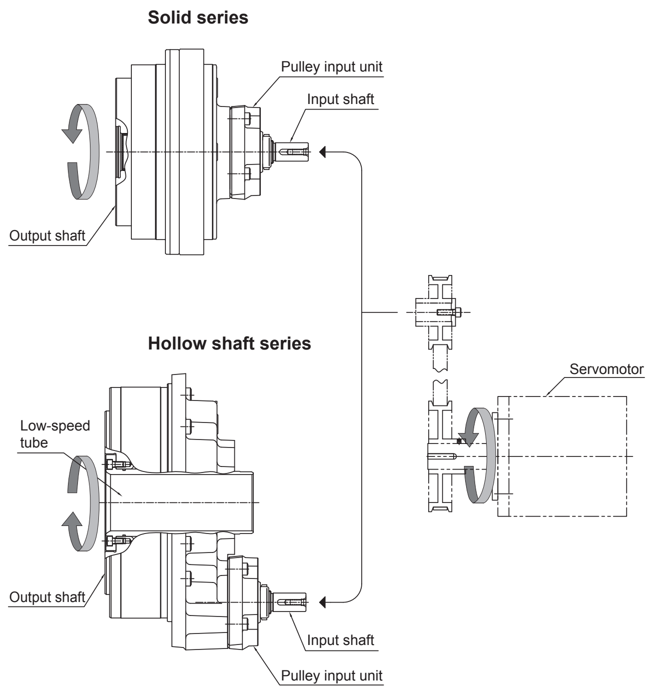
Product code

RD P – 050 C – 109 – F3 – ZZ – ZZ

Model Code			Ratio Code	Input unit code	Motor flange code	Bushing code
Pulley input code	Torque code	Series code				
P	020	E: Solid series	081	F0	ZZ: No motor flange (The pulley input type does not come with a motor flange.)	ZZ: No bushing (The pulley input type does not come with a bushing.)
	040		057	F3		
	080		081	F4		
	160		066	F6		
	320		081	F7		
	010	C: Hollow shaft series	108	F1		
	027		100	F2		
	050		109	F3		
	100		101	F5		
	200		106	F8		
	320		157	F9		

The input unit code for the pulley input type is one code for each model number.

Configuration diagram



Rating Table Pulley input type

Solid series

Model Code	Ratio code (Reduction ratio value)	Reduction Gear													Input shaft			External Dimensions
		T_0 Rated Torque	N_0 Rated Output Speed	K Life Rating	T_{S1} Allowable Startup/Stop Torque	T_{S2} Momentary maximum allowable torque	N_{in} Allowable Input Speed (Note 2)	N_S Allowable Output Speed (Note 2)	N_{To} Reference value to output speed during continuous operation at rated torque	Back-lash	Lost motion	Start-up Efficiency	M_O Allowable moment (Note 3)	Wr Allowable radial load (Note 8)	M_{Oin} Rated moment	M_{Sin} Allowable moment	β dimen-sions	
		(Nm)	(rpm)	(h)	(Nm)	(Nm)	(rpm)	(rpm)	(rpm)	(arc.min.)	(arc.min.)	(%)	(Nm)	(N)	(Nm)	(Nm)	(mm)	
RDP-020E	081 (81)	167	15	6,000	412	833	3,500	43	43	1.0	1.0	75	882	7,785	38	38	58	Input Unit Code : F0 ——P.71
RDP-040E	057 (57)	412			1,029	2,058	3,000	53	25			80	1,666	11,529	78	122	73.8	Input Unit Code : F3 ——P.72
RDP-080E	081 (81)	784			1,960	3,920		37	24			80	2,156	13,146		133		Input Unit Code : F4 ——P.73
RDP-160E	066 (66)	1,568			3,920	7,840	2,000	30	15			80	3,920	18,666	158	295	86.6	Input Unit Code : F6 ——P.74
RDP-320E	081 (81)	3,136			7,840	15,680		25	12			85	7,056	28,066		417		Input Unit Code : F7 ——P.75

Hollow shaft series

Model Code	Ratio code (Reduction ratio value)	Reduction Gear													Input shaft			External Dimensions
		T_0 Rated Torque	N_0 Rated Output Speed	K Life Rating	T_{S1} Allowable Startup/Stop Torque	T_{S2} Momentary maximum allowable torque	N_{in} Allowable Input Speed (Note 2)	N_S Allowable Output Speed (Note 2)	N_{To} Reference value to output speed during continuous operation at rated torque	Back-lash	Lost motion	Start-up Efficiency	M_O Allowable moment (Note 3)	Wr Allowable radial load (Note 8)	M_{Oin} Rated moment	M_{Sin} Allowable moment	β dimen-sions	
		(Nm)	(rpm)	(h)	(Nm)	(Nm)	(rpm)	(rpm)	(rpm)	(arc.min.)	(arc.min.)	(%)	(Nm)	(N)	(Nm)	(Nm)	(mm)	
RDP-010C	108 (108)	98	15	6,000	245	490	3,500	32	32	1.0	1.0	75	686	5,755	38	38	58	Input Unit Code : F1 ——P.76
RDP-027C	100 (99.82)	265			662	1,323		35	28			75	980	6,533		40		Input Unit Code : F2 ——P.77
RDP-050C	109 (109)	490			1,225	2,450	3,000	28	23			80	1,764	9,418	78	90	73.8	Input Unit Code : F3 ——P.78
RDP-100C	101 (100.5)	980			2,450	4,900		30	18			80	2,450	11,802		134		Input Unit Code : F5 ——P.79
RDP-200C	106 (105.83)	1,960			4,900	9,800	2,000	19	14			80	8,820	31,455	158	230	86.6	Input Unit Code : F8 ——P.80
RDP-320C	157 (157)	3,136			7,840	15,680		13	13			85	20,580	57,103		215		Input Unit Code : F9 ——P.81

Notes:
1. The rating table shows the specification values including the entry fields for reduction gear values.
2. The allowable speed may be limited by heat depending on the operating rate. Make sure the surface temperature of the reduction gear does not exceed 60°C during use.
3. The allowable moment will differ depending on the thrust load. Check the allowable moment diagram (p.120).
4. For the moment of inertia of the reduction gears, refer to the external dimension drawings for the reduction gear.
5. For the moment rigidity and torsional rigidity, refer to the calculation of tilt angle and the torsion angle (p.126).
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 the “Glossary” (p.110) and the “Product selection flowchart” (p.111).
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.
8. When the radial load is applied within dimension b (see page 126), use the reduction gear within the allowable radial load.

Motor Flange / Bushing

Selection Table of Motor Flange / Bushing Code-1

Select the motor flange code and bushing code based on the dimension of the motor to be used. Applicable model code: RD□-006E, 020E, 010C, 027C

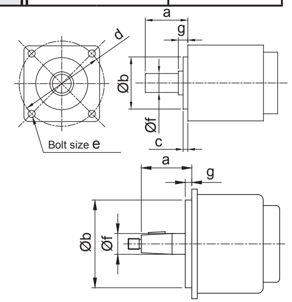
Supported motor shaft diameter: Ø8 to Ø14

Model Code	Input unit code
Reduction gear (straight input type)	
RDS-006E	G0
RDS-020E	
RDS-010C	
RDS-027C	
Reduction gear (right angle input type)	
RDR-006E	H0
RDR-020E	
RDR-010C	
RDR-027C	

Motor flange								
Motor flange code	Motor shaft length (mm) a		Motor mounting pilot diameter (mm) Øb	Motor mounting pilot tolerance	Motor mounting pilot length (mm) c (*)	Bolt P.C.D. d	Bolt size e	Stepped part max length (mm) g
	Min.	Max.						
AA	23	30	30	h7	3	46	M4	3.5
AB	23	31	50	h7	5	60	M4	4
AC	23	31	50	h7	5	70	M4	4
AD	23	31	50	h7	5	70	M5	4
AE	24	32	70	h7	6	90	M5	5
AF	23	31	70	h7	6	90	M6	4
AG	30	38	80	h7	6	100	M6	11
AH	23	31	80	h7	6	100	M6	4
AJ	30	38	95	h7	6	115	M8	11
AK	35	43	115	h7	6	165	M8	16
AL	32	40	80	h7	6	100	M6	13
AM	25	32	30	h7	3	46	M4	5.5
AN	26	34	70	h7	6	90	M6	7
AP	25	33	50	h7	5	60	M4	6
AQ	23	30	60	h7	6	75	M5	3
AR	23	30	40	h7	–	63	M5	3.5

* The motor mounting pilot length indicates the maximum value of the capable range.

Bushing		
Bushing code	Motor shaft diameter(mm) Øf	Motor shaft tolerance
0A	8	h6
0B	9	h6
0C	10	h6
0D	11	h6
0E	9	k6
0F	11	k6
ZZ	14	h6



Supported motor shaft diameter: Ø14 to Ø24

Model Code	Input unit code
Reduction gear (straight input type)	
RDS-006E	G1
RDS-020E	
RDS-010C	
RDS-027C	
Reduction gear (right angle input type)	
RDR-006E	H1
RDR-020E	
RDR-010C	
RDR-027C	

Motor flange								
Motor flange code	Motor shaft length (mm) a		Motor mounting pilot diameter (mm) Øb	Motor mounting pilot tolerance	Motor mounting pilot length (mm) c (*1)	Bolt P.C.D. d	Bolt size e	Stepped part max length (mm) g
	Min.	Max.						
CA	28	55	50	h7	6	70	M5	6.5
CB	28	55	70	h7	5.5	90	M5	6.5
CC	28	55	70	h7	5.5	90	M6	6.5
CD	30	57	80	h7	6	100	M6	8.5
CE	30	57	95	h7	6	115	M6	8.5
CF	30	57	95	h7	6	115	M8	8.5
CG	32	59	110	h7	7	135	M8	10.5
CH	32	59	110	h7	7	145	M8	10.5
CJ	47	74	110	h7	7	145	M8	25.5
CK	32	59	114.3	h7	5	200	M12	10.5
CL	32	59	115	h7	6	165	M8	10.5
CM	32	59	130	h7	6	165	M10	10.5
CN	32	59	200	h7	5	235	M12	10.5
CP	37	64	80	h7	6	100	M6	15.5
CQ	35	62	95	h7	6	115	M8	13.5
CR	40	67	110	h7	7	145	M8	18.5
CT	32	59	110	h7	7	130	M8	10.5
CU	28	55	60	h7	–	75	M5	6.5

Bushing		
Bushing code	Motor shaft diameter(mm) Øf	Motor shaft tolerance
1B	15	h6
1C	16	h6
1D	17	h6
1E	19	h6
1F	22	h6
1G	14	k6
1H	19	k6
1J	16	k6
ZZ	24	h6
6A *2	11	+0.1/0 Taper1/10
6B *3	14	
6C *4	16	

*1 The motor mounting pilot length indicates the maximum value of the capable range.
*2 Select a motor flange based on a motor shaft length of 37 mm.
*3 Select a motor flange based on a motor shaft length of 44 mm.
*4 Select a motor flange based on a motor shaft length of 58 mm.

Selection Table of Motor Flange / Bushing Code-2

Select the motor flange code and bushing code based on the dimension of the motor to be used.Applicable model code: RD□-040E,080E,050C,100C

Supported motor shaft diameter: Ø14 to Ø24

Model Code	Input unit code
Reduction gear (straight input type)	
RDS-040E	G2
RDS-080E	
RDS-050C	
RDS-100C	
Reduction gear (right angle input type)	
RDR-040E	H2
RDR-080E	
RDR-050C	
RDR-100C	

Motor flange								
Motor flange code	Motor shaft length (mm) a		Motor mounting pilot diameter (mm) Øb	Motor mounting pilot tolerance	Motor mounting pilot length (mm) c (*1)	Bolt P.C.D. d	Bolt size e	Stepped part max length (mm) g
	Min.	Max.						
CA	34	55	50	h7	6	70	M5	5
CB	34	55	70	h7	5.5	90	M5	5
CC	34	55	70	h7	5.5	90	M6	5
CD	36	57	80	h7	6	100	M6	7
CE	36	57	95	h7	6	115	M6	7
CF	36	57	95	h7	6	115	M8	7
CG	38	59	110	h7	7	135	M8	9
CH	38	59	110	h7	7	145	M8	9
CJ	53	74	110	h7	7	145	M8	24
CK	38	59	114.3	h7	5	200	M12	9
CL	38	59	115	h7	6	165	M8	9
CM	38	59	130	h7	6	165	M10	9
CN	38	59	200	h7	5	235	M12	9
CP	43	64	80	h7	6	100	M6	14
CQ	41	62	95	h7	6	115	M8	12
CR	46	67	110	h7	7	145	M8	17
CT	38	59	110	h7	7	130	M8	9

Bushing		
Bushing code	Motor shaft diameter(mm) Øf	Motor shaft tolerance
1A	14	h6
1B	15	h6
1C	16	h6
1D	17	h6
1E	19	h6
1F	22	h6
1G	14	k6
1H	19	k6
1J	16	k6
ZZ	24	h6
6A *2	11	+0.1/0 Taper1/10
6B *3	14	
6C *4	16	

*1 The motor mounting pilot length indicates the maximum value of the capable range.
*2 Select a motor flange based on a motor shaft length of 37 mm.
*3 Select a motor flange based on a motor shaft length of 44 mm.
*4 Select a motor flange based on a motor shaft length of 58 mm.

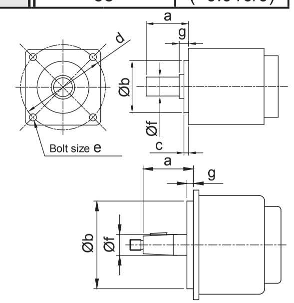
Supported motor shaft diameter: Ø25 to Ø35

Model Code	Input unit code
Reduction gear (straight input type)	
RDS-040E	G3
RDS-080E	
RDS-050C	
RDS-100C	
Reduction gear (right angle input type)	
RDR-040E	H3
RDR-080E	
RDR-050C	
RDR-100C	

Motor flange								
Motor flange code	Motor shaft length (mm) a		Motor mounting pilot diameter (mm) Øb	Motor mounting pilot tolerance	Motor mounting pilot length (mm) c (*)	Bolt P.C.D. d	Bolt size e	Stepped part max length (mm) g
	Min.	Max.						
GA	36	81	95	h7	8	115	M8	7
GB	38	83	110	h7	7	135	M8	9
GC	38	83	110	h7	7	145	M8	9
GD	38	83	114.3	h7	5	200	M12	9
GE	38	83	130	h7	6	165	M10	9
GF	38	83	200	h7	6	235	M12	9
GG	48	93	110	h7	7	145	M8	19
GH	48	93	114.3	h7	5	200	M12	19
GJ	43	88	110	h7	7	145	M8	14
GK	38	83	110	h7	7	130	M8	9

Bushing		
Bushing code	Motor shaft diameter(mm) Øf	Motor shaft tolerance
3A	25	h6
3B	28	h6
3C	28	k6
3D	32	k6
3E	32	h6
ZZ	35	(+0.010/0)

* The motor mounting pilot length indicates the maximum value of the capable range.



Selection Table of Motor Flange / Bushing Code-3

Select the motor flange code and bushing code based on the dimension of the motor to be used.
Applicable model code: RD□-160E,320E,200C,320C

Supported motor shaft diameter: Ø19 to Ø28

Model Code	Input unit code
Reduction gear (straight input type)	
RDS-160E	G4
RDS-320E	
RDS-200C	
RDS-320C	
Reduction gear (right angle input type)	
RDR-160E	H4
RDR-320E	
RDR-200C	
RDR-320C	

Motor flange								
Motor flange code	Motor shaft length (mm) a		Motor mounting pilot diameter (mm) Øb	Motor mounting pilot tolerance	Motor mounting pilot length (mm) c (*1)	Bolt P.C.D. d	Bolt size e	Stepped part max length (mm) g
	Min.	Max.						
GA	36	71	95	h7	8	115	M8	7
GB	38	73	110	h7	7	135	M8	9
GC	38	73	110	h7	7	145	M8	9
GD	38	73	114.3	h7	5	200	M12	9
GE	38	73	130	h7	6	165	M10	9
GF	38	73	200	h7	6	235	M12	9
GG	48	83	110	h7	7	145	M8	19
GH	48	83	114.3	h7	5	200	M12	19
GJ	43	78	110	h7	7	145	M8	14

*1 The motor mounting pilot length indicates the maximum value of the capable range.
*2 Select a motor flange based on a motor shaft length of 58 mm.

Bushing		
Bushing code	Motor shaft diameter(mm) Øf	Motor shaft tolerance
2A	19	h6
2B	22	h6
2C	24	h6
2D	19	k6
2E	24	k6
ZZ	28	h6
7A *2	16	+0.1/0 Taper1/10

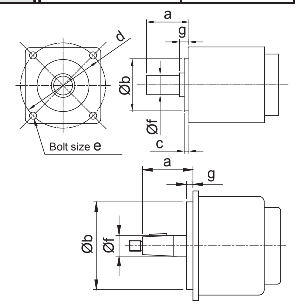
Supported motor shaft diameter: Ø32 to Ø42

Model Code	Input unit code
Reduction gear (straight input type)	
RDS-160E	G5
RDS-320E	
RDS-200C	
RDS-320C	
Reduction gear (right angle input type)	
RDR-160E	H5
RDR-320E	
RDR-200C	
RDR-320C	

Motor flange								
Motor flange code	Motor shaft length (mm) a		Motor mounting pilot diameter (mm) Øb	Motor mounting pilot tolerance	Motor mounting pilot length (mm) c (*1)	Bolt P.C.D. d	Bolt size e	Stepped part max length (mm) g
	Min.	Max.						
JA	56	86	110	h7	7	145	M8	7
JB	54	84	114.3	h7	5	200	M12	5
JC	85	115	114.3	h7	5	200	M12	36
JD	57	87	180	h7	5	215	M12	8
JE	54	84	200	h7	5	235	M12	5
JF	87	117	200	h7	5	235	M12	38
JG	59	89	114.3	h7	5	200	M12	10
JH	54	84	130	h7	10	165	M10	5

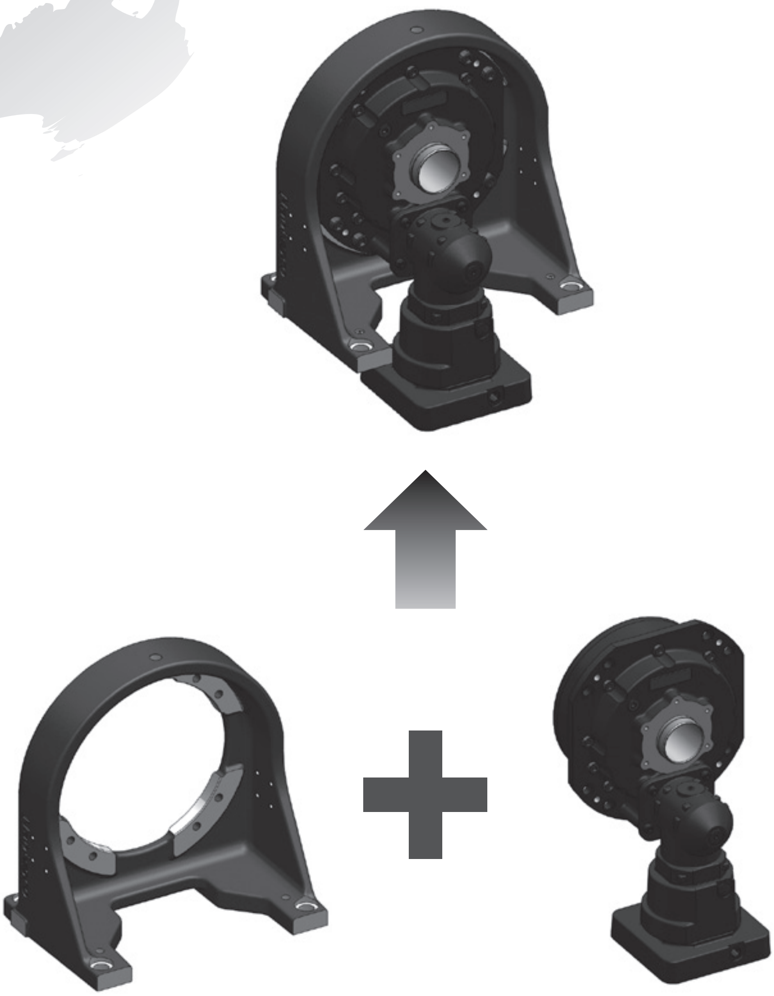
*1 The motor mounting pilot length indicates the maximum value of the capable range.
*2 Select a motor flange based on a motor shaft length of 102 mm.

Bushing		
Bushing code	Motor shaft diameter(mm) Øf	Motor shaft tolerance
4A	32	h6
4B	35	(+0.010/0)
4C	38	k6
4D	32	k6
4E	38	h6
4F	35	h6
ZZ	42	h6
9A *2	32	+0.1/0 Taper1/10



Option: Base Flange

An optional base flange is available. This allows the RD2 to be easily installed in the equipment and enhances the usability.



Base flange

RD2 series

Base Flange Code Description / Configuration Diagram

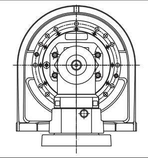
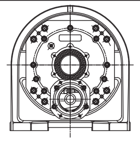
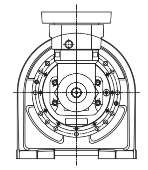
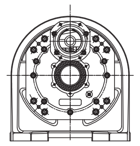
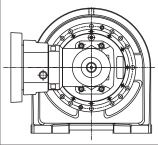
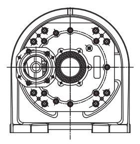
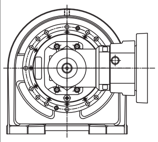
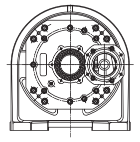
Product code

For details about the codes, refer to pages 13, 41, and 69.

RD S – 100 C – 258 – G2 – CF – 1E – D

* Model Code			Base flange code
Input type code	Torque code	Series code	
S	160	E	P・D
	100	C	P・D U・L・R
R	160	E	
	100	C	
P	160	E	P・D
	100	C	P・D U・L・R

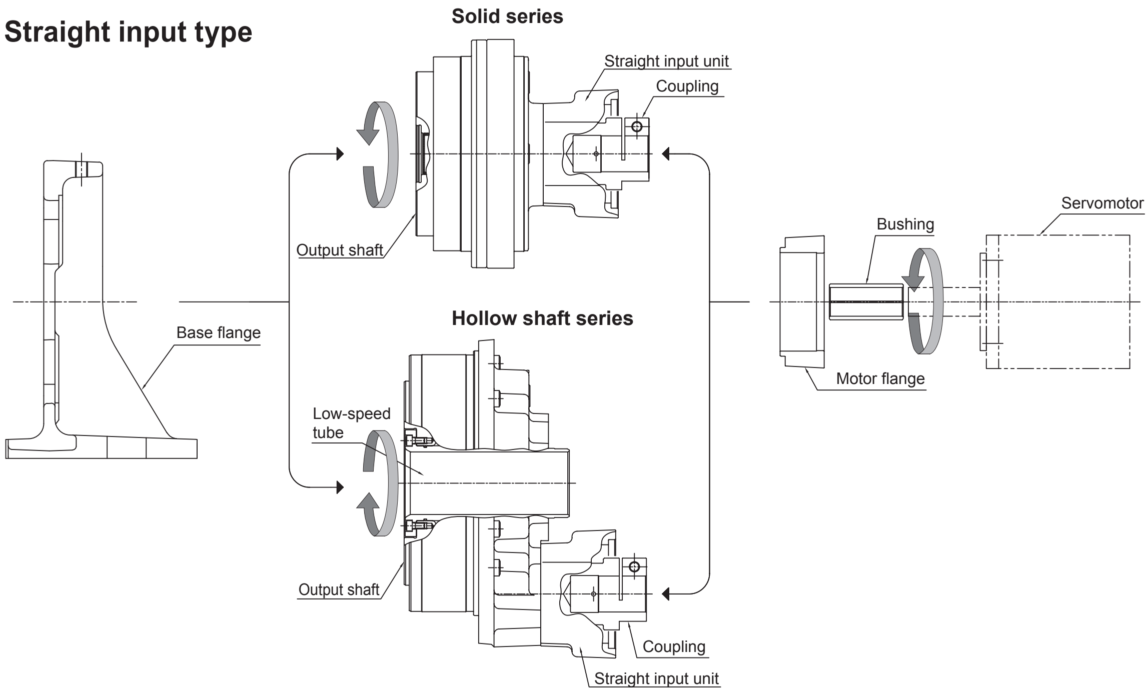
* Applicable model codes are only those listed above.

Base flange code	Base flange assembly status	Assembly drawing	
		RDR-160E	RDS-100C
P	Base flange attached.	-	
D	Downward input or Center input (RDS-160E, RDP-160E)		
U	Upward input		
L	Leftward input		
R	Rightward input		

Select codes in accordance with the presence or mounting direction of the base flange.

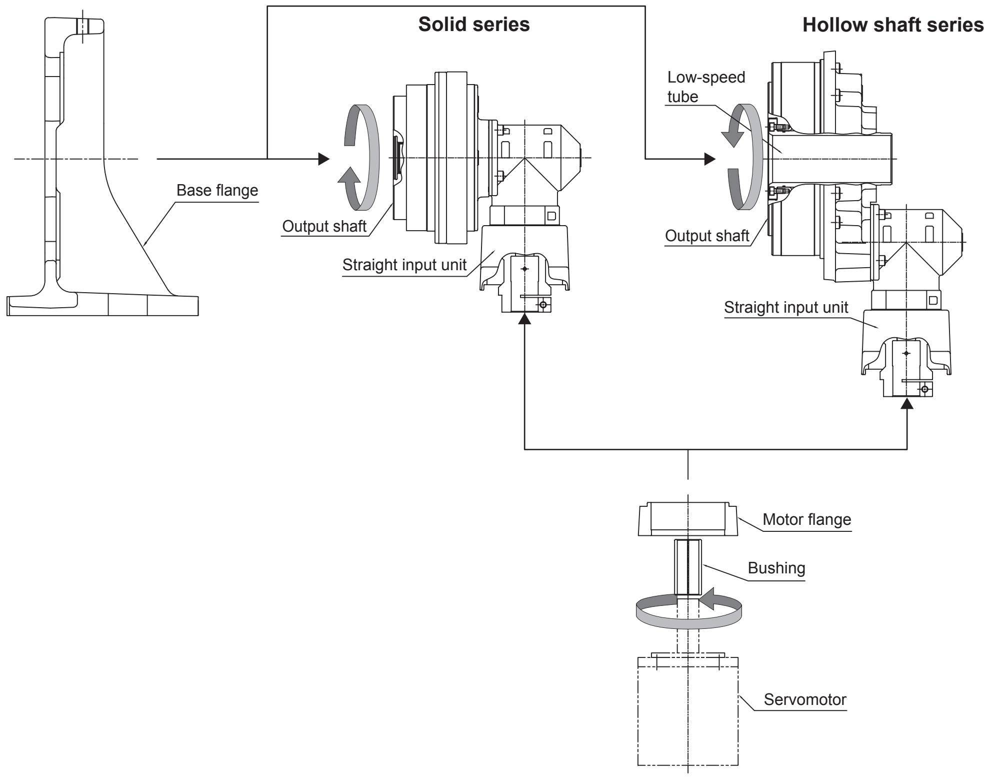
Configuration diagram

Straight input type

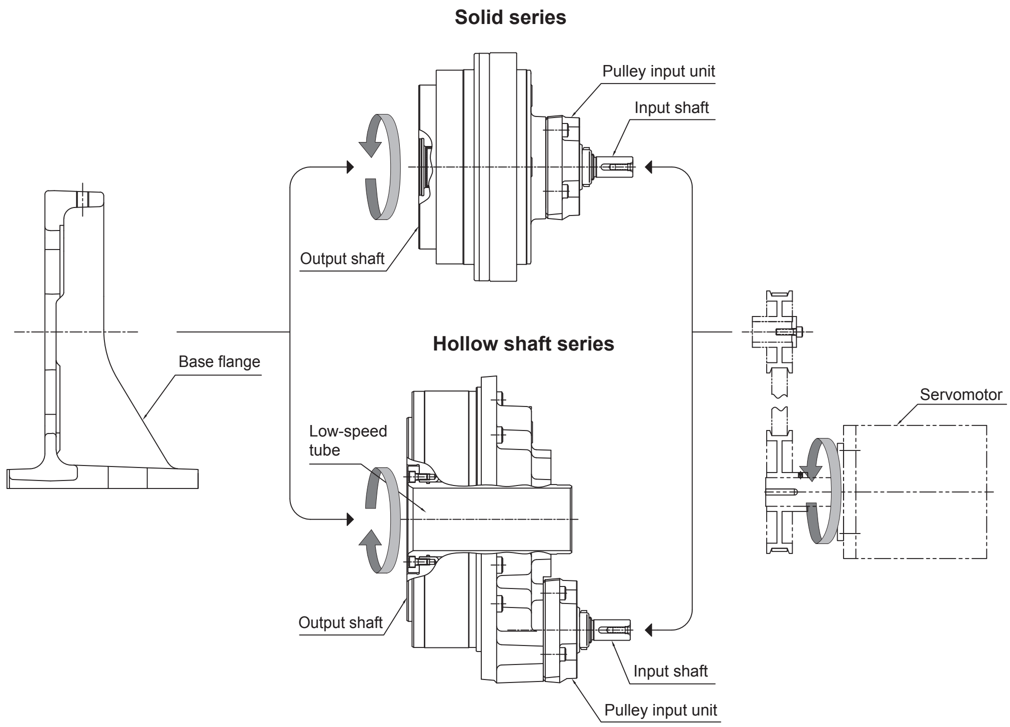


Configuration diagram

Right angle input type



Pulley input type



Technical Information

Considering the use of RD2 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 between -10°C and 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. ·Location that is heated due to heat transfer and radiation from peripherals and direct sun. ·Location where the performance of the servomotor can be affected by magnetic fields or vibration.

Note 1: If the required installation environment cannot be established, contact our customer representative in advance.
Note 2: When using the reduction gear under special conditions (clean room, equipment for food, concentrated alkali, high-pressure steam, etc.), contact our customer representative 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

Life rating

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

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.

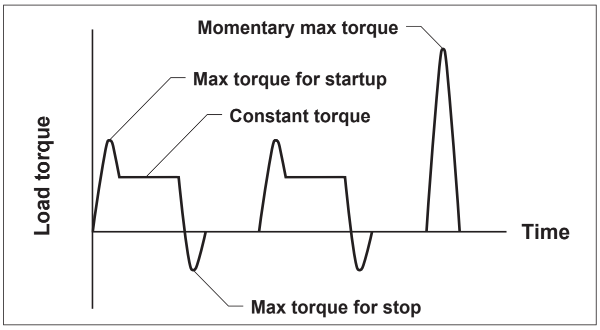
In such a situation, the allowable torque during acceleration/deceleration is referred to as “allowable acceleration/deceleration torque”.

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 input speed

The allowable value of the input speed is referred to as “allowable input speed”.

Note: The reduction gear temperature may increase significantly even when the speed is under the allowable speed depending on the speed ratio. In such a case, use the reduction gear at the speed so that the gear temperature is 60°C or lower.

Allowable output speed

The allowable value of the output speed is referred to as “allowable output speed”.

Note: The reduction gear temperature may exceed 60°C even when the speed is under the allowable output speed depending on the specification conditions (duty, ambient temperature). In such a case, use the reduction gear at the speed so that the gear temperature is 60°C or lower.

Allowable output speed reference value

This is a reference value of the output speed at which the temperature increase of the reduction gear is 40°C or lower when the rated torque is applied to the reduction gear and the gear is operated continuously in one direction.

Note: Maintain the environment and operation conditions so that the temperature of the reduction gear is 60ºC or lower.

Torsional rigidity, lost motion, backlash

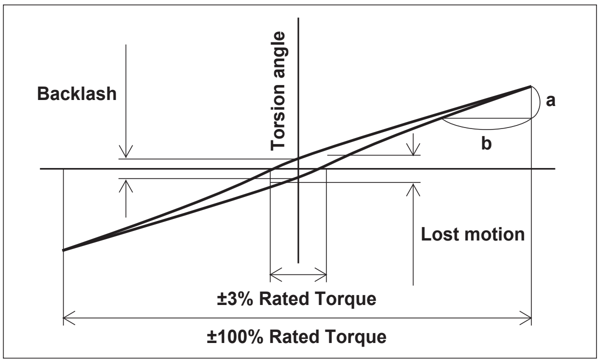
When a torque is applied to the output shaft while the input shaft is fixed, torsion is generated according to the torque value. The torsion can be shown in the hysteresis curves.

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.”

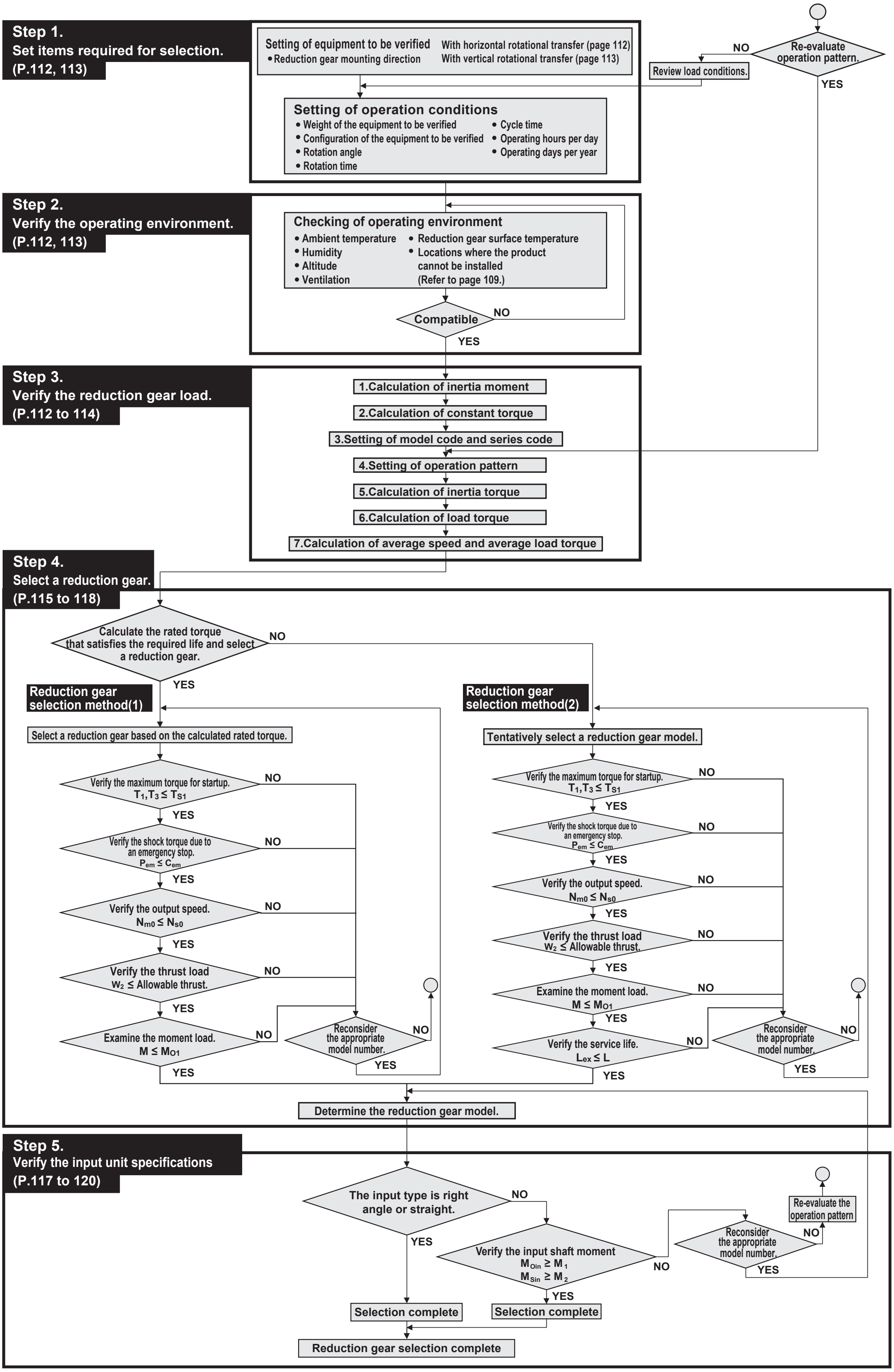
Input shaft rated moment

This is the moment load that satisfies the life rating. The moment to be applied normally must be less than the rated moment.

Input shaft allowable moment

This is the allowable value of the load that can be applied for startup and stop.

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 119)

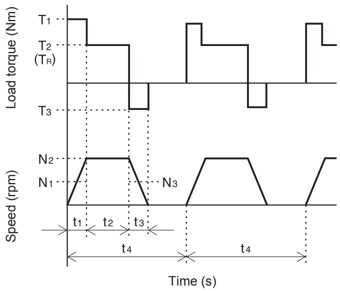
When the reduction gear selection is completed, select a motor flange and bushing. (Refer to pages 83 to 85.)

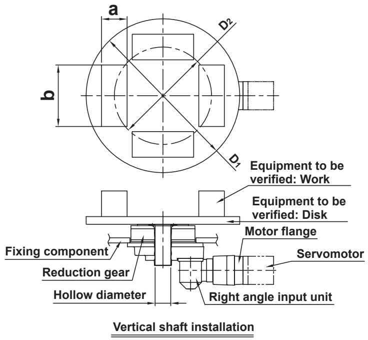
Model code selection examples (With horizontal shaft installed)

With horizontal rotational transfer

Step 1. Set the items required for selection.

Setting item	Setting
Presence of hollow in the output surface of the reduction gear	Hollow (C type)
Reduction gear mounting direction	Vertical shaft installation
Equipment weight to be examined	
W_A ———— Disk weight (kg)	450
W_B ———— Work weight (kg)	100 x 4 pieces
Equipment configuration to be examined	
D_1 ———— Disk: D dimension (mm)	1,200
a ———— Work piece: a dimension (mm)	200
b ———— Work piece: b dimension (mm)	400
D_2 ———— Work piece: P.C.D. (mm)	800
Operation conditions	
θ ———— Rotation angle (°)*1	180
$[t_1+t_2+t_3]$ ———— Rotation time (sec)	2.5
$[t_4]$ ———— Cycle time (sec)	20
Q_1 ———— Equipment operation hours per day (hours/day)	12
Q_2 ———— Equipment operation days per year (days/year)	365

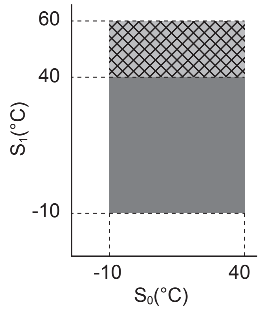




*1. When the range of the rotation angle is small (10 degrees or less), the rating life of the reduction gear may be reduced due to poor lubrication or the internal parts being subject to a concentrated load.

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. 109 for values other than those listed above.

Step 3-1. Examine the reduction gear load

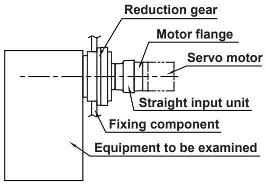
Setting item		Calculation formula	Selection examples
(1)	Calculate the inertia moment based the calculation formula on page 129.		
I_R	Load inertia moment (kgm²)	$I_{R1}=\dfrac{W_A\times\left(\dfrac{D_1}{2\times1{,}000}\right)^2}{2}$ $I_{R2}=\left[\dfrac{W_B}{12}\left\{\left(\dfrac{a}{1{,}000}\right)^2+\left(\dfrac{b}{1{,}000}\right)^2\right\}+W_B\times\left(\dfrac{D_2}{2\times1{,}000}\right)^2\right]\times n$ I_{R1} = Disk inertia moment I_{R2} = Work inertia $I_R = I_{R1} + I_{R2}$ n = Number of workpieces	$I_{R1}=\dfrac{450\times\left(\dfrac{1{,}200}{2\times1{,}000}\right)^2}{2}$ $=81\,(kgm^2)$ $I_{R2}=\left[\dfrac{100}{12}\left\{\left(\dfrac{200}{1{,}000}\right)^2+\left(\dfrac{400}{1{,}000}\right)^2\right\}+100\times\left(\dfrac{800}{2\times1{,}000}\right)^2\right]\times4$ $=70.7\,(kgm^2)$ $I_R = 81+70.7$ $=151.7\,(kgm^2)$
(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 RD2 reduction gear. D_{in} = Rolling diameter: Use the pilot diameter which is almost equivalent to the rolling diameter in this selection calculation. * If the reduction gear model is not determined, select the following pilot diameter: Solid series = 284 (mm) – Maximum pilot diameter Hollow shaft series = 440 (mm) – Maximum pilot diameter	$T_R=(450+100\times4)\times9.8\times\dfrac{440}{2\times1{,}000}\times0.015$ $=27.5\,(Nm)$

Step 3-2: Proceed to p. 114.

Model code selection examples (With vertical shaft installed)

With vertical rotational transfer

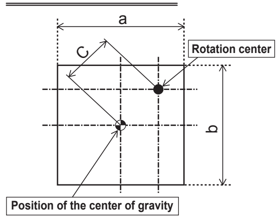
Step 1. Set the items required for selection.

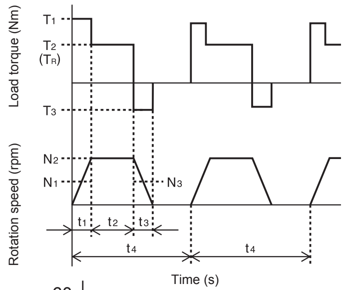


Setting item	Setting
Presence of hollow in the output surface of the reduction gear	Without hollow (Solid series)
Reduction gear mounting direction	Horizontal shaft installation
Equipment weight to be examined	
W_C ———— Mounted work weight (kg)	490
Equipment configuration to be examined	
a ———— a dimension (mm)	500
b ———— b dimension (mm)	500
c ———— C dimension (mm)	320
Operation conditions	
θ ———— Rotation angle (°)*1	90
$[t_1+t_2+t_3]$ ———— Rotation time (sec)	1.5
$[t_4]$ ———— Cycle time (sec)	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.

Horizontal shaft installation

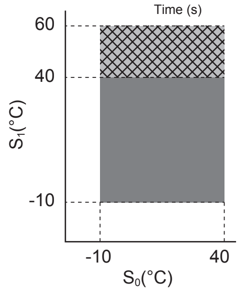




Step 2. Verify the operating environment.

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. 109 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 129.**		
I_R	Load inertia moment (kgm^2)	$I_R = \frac{W_C}{12} \times \left\{\left(\frac{a}{1{,}000}\right)^2 + \left(\frac{b}{1{,}000}\right)^2\right\} + W_C \times \left(\frac{C}{1{,}000}\right)^2$	$I_R = \frac{490}{12} \times \left\{\left(\frac{500}{1{,}000}\right)^2 + \left(\frac{500}{1{,}000}\right)^2\right\} + 490 \times \left(\frac{320}{1{,}000}\right)^2 = 70.6\ (kgm^2)$
(2)	**Examine the constant torque.**		
T_R	Constant torque (Nm)	$T_R = W_C \times 9.8 \times \frac{C}{1{,}000}$	$T_R = 490 \times 9.8 \times \frac{320}{1{,}000} = 1{,}537\ (Nm)$

Step 3-2: Proceed to p. 114. (Refer to “With horizontal rotational 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 model code and series code.		
Setting of model code (input type) RDS —— Straight input type RDR —— Right angle input type RDP —— Pulley input type Setting of series code Solid series or hallow shaft series		Set the model code (input type) and series code (presence of the hollow section on the reduction gear output surface) according to the usage and application. As an example, the RDR (right angle input type) and hollow shaft series are set.
(4) Set the acceleration/deceleration time, constant-speed operation time, and output speed.		
t_1 —— Acceleration time (sec) t_2 —— Constant-speed operation time (sec) t_3 —— Deceleration time (sec) N_2 —— Constant speed (rpm)	• 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. $t_1 = t_3 = \text{Rotation time}\,[t_1+t_2+t_3] - \dfrac{\theta}{\left(\dfrac{N_2}{60}\times 360\right)}$ $t_2 = \text{Rotation time}\,[t_1+t_2+t_3] - (t_1+t_3)$ 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. $t_1 = t_3 = 2.5 - \dfrac{180}{\left(\dfrac{15}{60}\times 360\right)} = 0.5\,(\text{sec})$ $t_2 = 2.5 - (0.5 + 0.5) = 1.5\,(\text{sec})$ $\therefore t_1 = t_3 = 0.5\,(\text{sec})$ $t_2 = 1.5\,(\text{sec})$ $N_2 = 15\,(\text{rpm})$
N_1 —— Average speed for startup (rpm)	$N_1 = \dfrac{N_2}{2}$	$N_1 = \dfrac{15}{2} = 7.5\,(\text{rpm})$
N_3 —— Average speed for stop (rpm)	$N_3 = \dfrac{N_2}{2}$	$N_3 = \dfrac{15}{2} = 7.5\,(\text{rpm})$
(5) Calculate the inertia torque for acceleration/deceleration.		
T_A —— Inertia torque for acceleration (Nm)	$T_A = \left\{\dfrac{I_R\times(N_2-0)}{t_1}\right\}\times\dfrac{2\pi}{60}$	$T_A = \left\{\dfrac{151.7\times(15-0)}{0.5}\right\}\times\dfrac{2\pi}{60}$ $= 476.6\,(\text{Nm})$
T_D —— Inertia torque for deceleration (Nm)	$T_D = \left\{\dfrac{I_R\times(0-N_2)}{t_3}\right\}\times\dfrac{2\pi}{60}$	$T_D = \left\{\dfrac{151.7\times(0-15)}{0.5}\right\}\times\dfrac{2\pi}{60}$ $= -476.6\,(\text{Nm})$
(6) 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 (page 112) With vertical rotational transfer (page 113)	$T_1 = \lvert 476.6 + 27.5 \rvert$ $= 504.1\,(\text{Nm})$
T_2 —— Constant maximum torque (Nm)	$T_2 = \lvert T_R \rvert$	$T_2 = 27.5\,(\text{Nm})$
T_3 —— Maximum torque for stop (Nm)	$T_3 = \lvert T_D + T_R \rvert$ T_R : Constant torque With horizontal rotational transfer (page 112) With vertical rotational transfer (page 113)	$T_3 = \lvert -476.6 + 27.5 \rvert$ $= 449.1\,(\text{Nm})$
(7) -1 Calculate the average speed.		
N_m —— Average speed (rpm)	$N_m = \dfrac{t_1\times N_1 + t_2\times N_2 + t_3\times N_3}{t_1+t_2+t_3}$	$N_m = \dfrac{0.5\times7.5+1.5\times15+0.5\times7.5}{0.5+1.5+0.5}$ $= 12\,(\text{rpm})$
(7) -2 Calculate the average load torque.		
T_m —— Average load torque (Nm)	$T_m = \sqrt[\frac{10}{3}]{\dfrac{t_1\times N_1\times T_1^{\frac{10}{3}} + t_2\times N_2\times T_2^{\frac{10}{3}} + t_3\times N_3\times T_3^{\frac{10}{3}}}{t_1\times N_1 + t_2\times N_2 + t_3\times N_3}}$	$T_m = \sqrt[\frac{10}{3}]{\dfrac{0.5\times7.5\times504.1^{\frac{10}{3}}+1.5\times15\times27.5^{\frac{10}{3}}+0.5\times7.5\times449.1^{\frac{10}{3}}}{0.5\times7.5+1.5\times15+0.5\times7.5}}$ $=315.7\,(\text{Nm})$

Go to Page 115 if the reduction gear model is verified based on the required life.
Go to Page 117 if the service life is verified based on the reduction gear model.

Model code selection examples

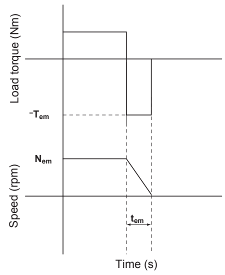
Step 4. Select a reduction gear

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

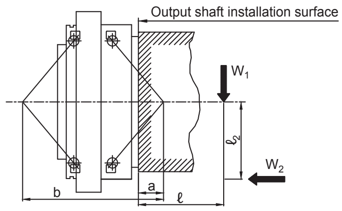
Setting/verification item	Calculation formula	Selection examples (With horizontal rotational transfer)
(1) Calculate the rated torque for the reduction gear that satisfies the required life.		
L_{ex} —— Required life (year)	Based on the operation conditions	5 years
Q_{1cy} —— Number of cycles per day (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)	$L_{hour} = Q_4 \times L_{ex}$	$L_{hour} = 548 \times 5$ $= 2,740$ (h)
T_O' —— Reduction gear rated torque that satisfies the required life (Nm)	$T_O' = T_m \times \left(\frac{10}{3}\right)\sqrt{\frac{L_{hour}}{K} \times \frac{N_m}{N_0}}$ K : Reduction gear rated life (h) N_0 : Reduction gear rated torque (Nm)	$T_O' = 315.7 \times \left(\frac{10}{3}\right)\sqrt{\frac{2,740}{6,000} \times \frac{12}{15}}$ $= 233.5$ (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 $[T_0]$: Straight input type: See the rating table on pages 14 and 15. Right angle input type: See the rating table on pages 42 and 43. Pulley input type: See the rating table on page 70.	RDR-027C that meets the following condition is tentatively selected: $[T_0]$ 265 (Nm) ≥ $[T_0']$ 233.5 (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 $[T_{s1}]$: Straight input type: See the rating table on pages 14 and 15. Right angle input type: See the rating table on pages 42 and 43. Pulley input type: See the rating table on page 70. *2 $[T_1]$ and $[T_3]$: Refer to page 114	$[T_{s1}]$ 662 (Nm) ≥ $[T_1]$ 504.1 (Nm) $[T_3]$ 449.1 (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 (100% duty ratio) $[N_{s0}]$*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 (40% duty ratio) $[N_{S1}]$*1. Note: The value of $[N_{S0}]$ is the speed at which the case temperature is balanced at 60ºC for 30 minutes. *1 $[N_{S0}]$: Straight input type: See the rating table on pages 14 and 15. Right angle input type: See the rating table on pages 42 and 43. Pulley input type: See the rating table on page 70.	$[N_{s0}]$ 15 (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 x 5 = 60 (times)
T_{em} —— Shock torque due to an emergency stop (Nm)	 Shock torque due to an emergency stop $[T_{em}]$ 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, $[T_{em}]$ = 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)		For example, $[t_{em}]$ = 0.05 (s)
Z_4 —— Number of pins for reduction gear	(see pin table)	Number of pins for RDR-27C: 52

Model	Number of pins Z_4	Model	Number of pins Z_4
RD□-6E	40	RD□-10C	52
RD□-20E		RD□-27C	
RD□-40E		RD□-50C	
RD□-80E		RD□-100C	
RD□-160E		RD□-200C	56
RD□-320E		RD□-320C	60

Setting/verification item	Calculation formula	Selection examples (With horizontal rotational transfer)
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 Straight input type: See the rating table on pages 14 and 15. Right angle input type: See the rating table on pages 42 and 43. Pulley input type: See the rating table on page 70.	$C_{em} = \dfrac{775 \times \left(\dfrac{1,323}{500}\right)^{\frac{10}{3}}}{52 \times \dfrac{15}{60} \times 0.05}$ = 30,550 (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.	$[C_{em}]$ 30,550 ≥ $[P_{em}]$ 60 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, $W_2 = W_A + W_B$ = (450+100×4)×9.8 = 8,330 (N) Note W_A, W_B : Refer to page 112.
$ℓ_2$ —— 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)	$M = \dfrac{W_1 \times (ℓ + b - a) + W_2 \times ℓ_2}{1,000}$ a,b: Refer to the calculation of the tilt angle on page 126.	RDR-27C As dimension a = 38 (mm) and dimension b = 150 (mm): $M = \dfrac{0 \times (0 + 150 - 38) + 8,330 \times 0}{1,000}$ = 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 120. When radial load W_1 is applied within dimension b, use the reduction gear within the allowable radial load. Wr: Allowable radial load Straight input type: See the rating table on pages 14 and 15. Right angle input type: See the rating table on pages 42 and 43. Pulley input type: See the rating table on page 70. If the tentatively selected reduction gear is outside of the specifications, change the reduction gear model.	For this example, Thrust load $[W_2]$ =8,330 (N) Moment load [M] = 0 (Nm) As the above values are within the range in the allowable moment diagram, the tentatively selected model should be no problem.
(7)	**Verify the input unit specifications (page 119). (Verification is not required when the input type is right angle or straight.)**	

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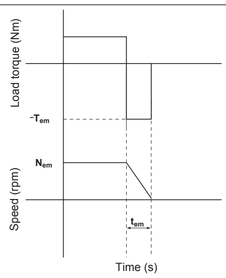
Select the reduction gear model that satisfies all the conditions of the above verification items. The actual reduction ratio is determined based on the motor speed, input torque, and inertia moment. Check with the motor manufacturer.	Based on the above verification result, RDR-27C is selected.

Impose a limitation on the motor torque value according to the momentary maximum allowable torque of the selected reduction gear (see page 119).

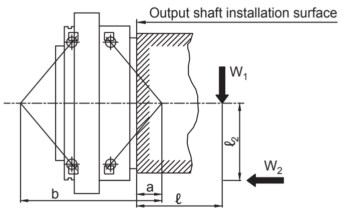
Model code selection examples

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)
(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 RDR-027C.
(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}]: Straight input type: See the rating table on pages 14 and 15. Right angle input type: See the rating table on pages 42 and 43. Pulley input type: See the rating table on page 70. *2 [T_1] and [T_3]: Refer to page 114	[T_{s1}] 662 (Nm) ≥ [T_1] 497.84 (Nm) [T_3] 455.36 (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 (100% duty ratio) [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 (40% duty ratio) [N_{S1}]*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}]: Straight input type: See the rating table on pages 14 and 15. Right angle input type: See the rating table on pages 42 and 43. Pulley input type: See the rating table on page 70.	[N_{s0}] 15 (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 x 5 = 60 (times)
T_{em} —— Shock torque due to an emergency stop (Nm)	 Shock torque due to an emergency stop [T_{em}] 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}] = 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)		For example, [t_{em}] = 0.05 (s)
Z_4 —— Number of pins for reduction gear	Model / Number of pins Z_4: RD□-6E, RD□-20E, RD□-40E, RD□-80E, RD□-160E, RD□-320E: 40 RD□-10C, RD□-27C, RD□-50C, RD□-100C: 52 RD□-200C: 56 RD□-320C: 60	Number of pins for RDR-27C: 52
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 Straight input type: See the rating table on pages 14 and 15. Right angle input type: See the rating table on pages 42 and 43. Pulley input type: See the rating table on page 70.	$C_{em} = \frac{775 \times \left(\frac{1,323}{500}\right)^{\frac{10}{3}}}{52 \times \frac{15}{60} \times 0.05} = 30,550$ (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}] 30,550 ≥ [P_{em}] 60 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 ——— 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, $W_2 = W_A + W_B = (450+100\times4)\times9.8$ $= 8,330$ (N) Note W_A, W_B : Refer to page 112.
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)	$M = \frac{W_1 \times (\ell + b - a) + W_2 \times \ell_2}{1,000}$ a,b: Refer to the calculation of the tilt angle on page 126.	RDR-27C As dimension a = 38 (mm) and dimension b = 150 (mm): $M = \frac{0 \times (0+150-38) + 8,330 \times 0}{1,000}$ $= 0$ (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 120. When radial load W_1 is applied within dimension b, use the reduction gear within the allowable radial load. Wr: Allowable radial load Straight input type: See the rating table on pages 14 and 15. Right angle input type: See the rating table on pages 42 and 43. Pulley input type: See the rating table on page 70. If the tentatively selected reduction gear is outside of the specifications, change the reduction gear model.	For this example, Thrust load [W_2] =8,330 (N) Moment load [M] = 0 (Nm) 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)	$L_h = 6,000 \times \frac{N_0}{N_m} \times \left(\frac{T_0}{T_m}\right)^{\frac{10}{3}}$	$L_h = 6,000 \times \frac{15}{12} \times \left(\frac{265}{315.7}\right)^{\frac{10}{3}}$ $= 4,184.4$ (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)	$Q_3 = \frac{Q_1 \times (t_1 + t_2 + t_3)}{60 \times 60}$	$Q_3 = \frac{2,160 \times (0.5+1.5+0.5)}{60 \times 60} = 1.5$ (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)	$L_{year} = \frac{L_h}{Q_4}$	$L_{year} = \frac{4,180}{548} = 7.6$ (year)
L_{ex} ——— Required life (year)	Based on the operation conditions	5 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}] 5 (year) ≤ [L_{year}] 7.6 (year) According to the above condition, the tentatively selected model should be no problem.
(7) Verify the input unit specifications (page 119). (Verification is not required when the input type is right angle or straight.)		

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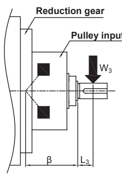
Select the reduction gear model that satisfies all the conditions of the above verification items. The actual reduction ratio is determined based on the motor speed, input torque,and inertia moment. Check with the motor manufacturer.	Based on the above verification result, RDR-27C is selected.

Impose a limitation on the motor torque value according to the momentary maximum allowable torque of the selected reduction gear (see page 119).

Model code selection examples

Step 5. Verify the input unit specifications (calculation method of pulley input unit specifications)

* Examine only when selecting a pulley input unit.

Setting item	Calculation formula	Selection examples
Calculate the moment load for the input shaft.		
M_1 —— Input shaft load moment to be applied during normal operation (Nm)	 $M_1 = W_3 \times \left(\frac{\beta + L_3}{1{,}000}\right)$ β = Refer to the rating table on Page 70. W3 =Radial load (N) applied to the input shaft L3 =Distance to the point of radial load application (mm)	When RDP-027C-100 is selected $W_3 = 150$ (N) $\beta = 58$ (mm) $L_3 = 10$ (mm) $M_1 = 150 \times \left(\frac{58+10}{1{,}000}\right) = 10.2$ (Nm)
M_2 —— Input shaft load moment to be applied at startup and stop (Nm)	$M_2 = \dfrac{\left(\dfrac{\text{Maximum output torque for startup (Nm)}}{\text{Actual reduction ratio} \times \frac{\text{Efficiency (\%)}}{100}}\right)}{\dfrac{\text{Pulley pitch diameter (mm)}}{2 \times 10^3}} \times \left(\frac{\beta + L_3}{1{,}000}\right)$ β = Refer to the rating table on Page 70.	When the maximum torque for startup is 600 Nm at the output stage and the pulley pitch diameter is 50 mm $M_2 = \dfrac{\left(\dfrac{600}{99.82 \times 0.75}\right)}{\left(\dfrac{50}{2 \times 1{,}000}\right)} \times \left(\frac{58+10}{1{,}000}\right)$ $= 21.8$ (Nm)
Select a pulley input unit based on the moment load of the input shaft.		
Determination of the input shaft	$M_{0in} \geq M_1$ $M_{Sin} \geq M_2$ * M_{0in}, M_{Sin} = Refer to the rating table on Page 70. Select an input unit that meets the above conditions.	If RDP-027C-100 is selected, M_{0in} = 38 (Nm) and M_{Sin} = 40 (Nm) and the there is no problem with the pulley input shaft.

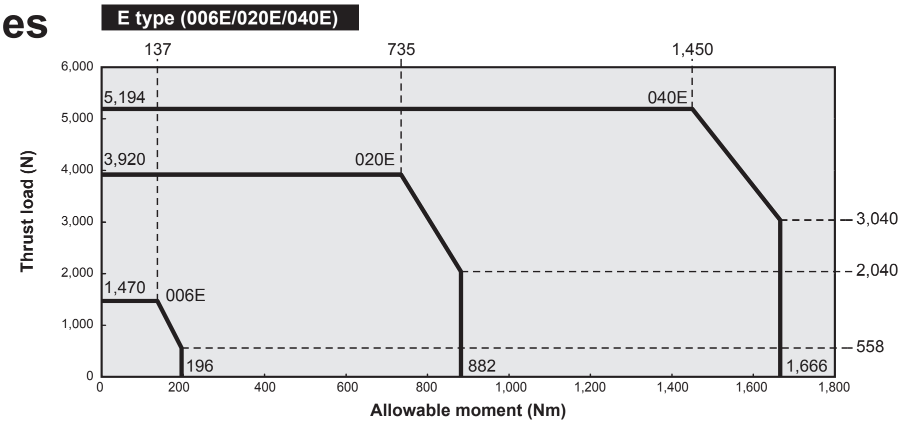
Limitation on the motor torque

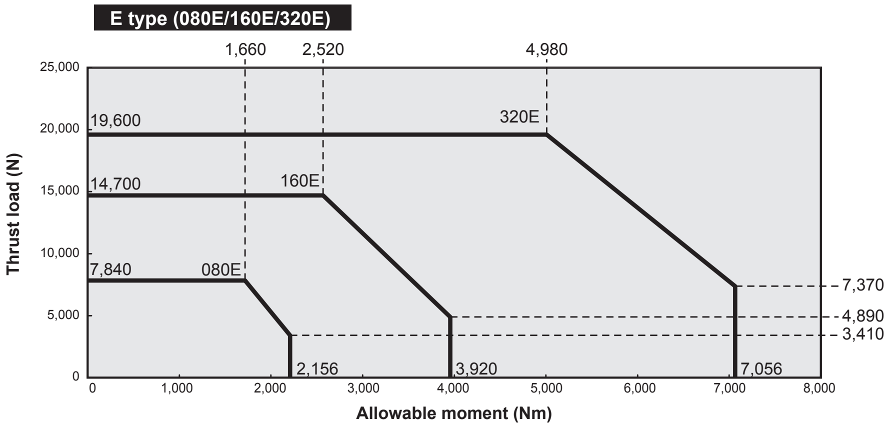
A limitation is imposed on the motor torque value so that the shock torque applied to the reduction gear does not exceed the momentary maximum allowable torque.

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} = 10 (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: Speed ratio η : Startup efficiency (%) Straight input type: See the rating table on pages 14 and 15. Right angle input type: See the rating table on pages 42 and 43. Pulley input type: See the rating table on page 70.	For example, calculate the maximum torque generated at the output shaft for the reduction gear based on the specifications when RDS-027C-233.45 was selected. $T_{M1out} = 10 \times 233.45 \times \frac{100}{70}$ $= 3{,}335$ (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)	$T_{M2out} = T_{M1} \times R \times \frac{\eta}{100}$	$T_{M2out} = 10 \times 233.45 \times \frac{70}{100}$ $= 1{,}634$ (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}]: Straight input type: See the rating table on pages 14 and 15. Right angle input type: See the rating table on pages 42 and 43. Pulley input type: See the rating table on page 70.	[T_{S2}] 1,323 (Nm) ≤ [T_{M1OUT}] 3,335 (Nm) and [T_{M2OUT}] 1,634 (Nm) According to the above condition, the torque limit is set for the motor.
Select a motor flange and bushing.		
When the reduction gear selection is completed, select a motor flange and bushing. (Refer to pages 83 to 85.) URL : http://precision.nabtesco.com/		

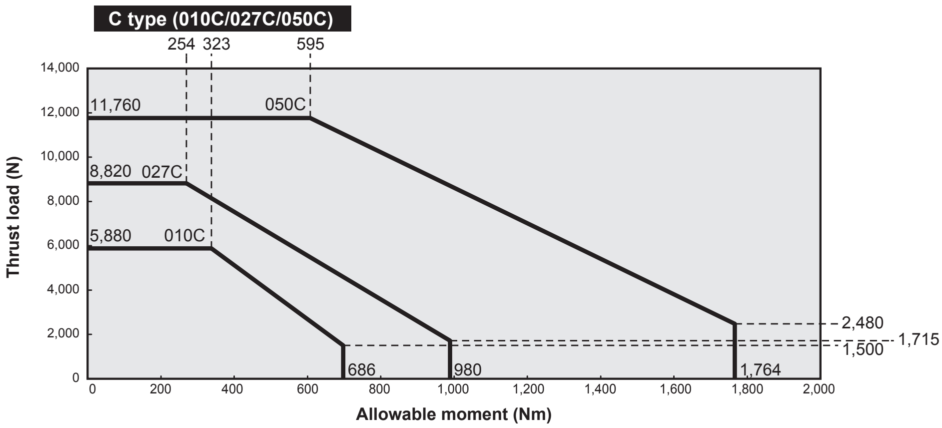
Allowable Moment Diagram

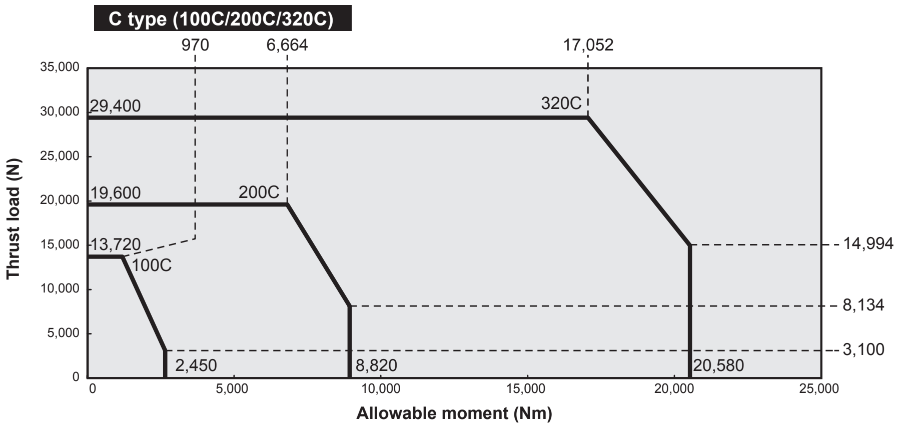
Solid series RD□-E





Hollow shaft series RD□-C





No-load Running Torque (straight input type)

Use the following formula to calculate the no-load running torque converted to the motor shaft.

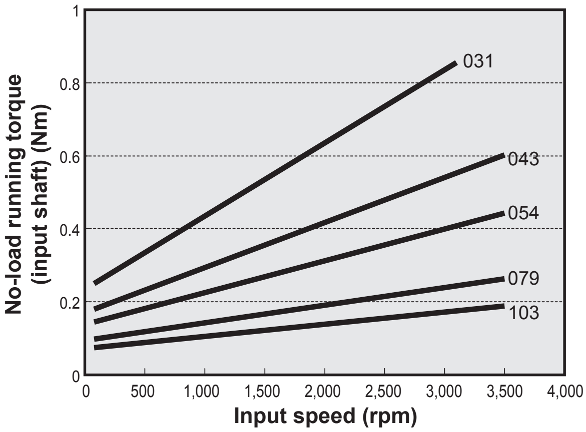
$$\text{No-load running torque converted to the motor shaft (Nm)} = \frac{\text{Torque converted into the output shaft (Nm)}}{R} \quad \text{(R: speed ratio value)}$$

[Measurement conditions]
Case temperature: 30 (ºC)
Lubricant: Grease (RV GREASE LB00)

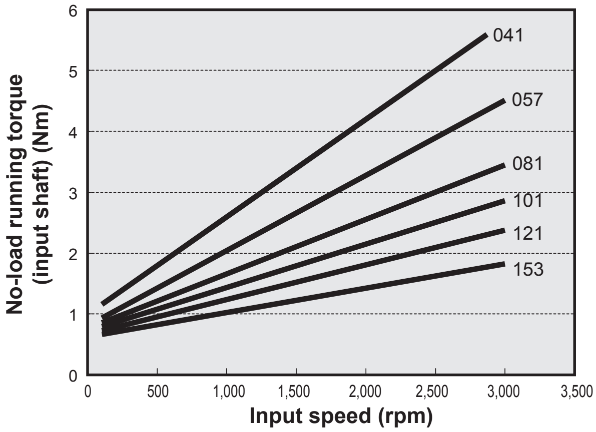
Note: The values in the following graphs are for the reduction gear alone, and indicate the average values after the break-in period.

Solid series

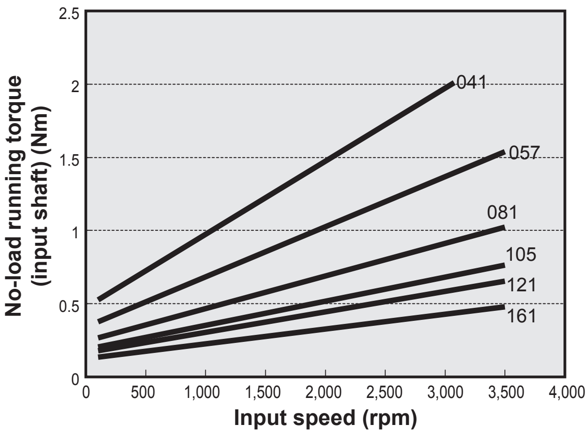
RDS-006E



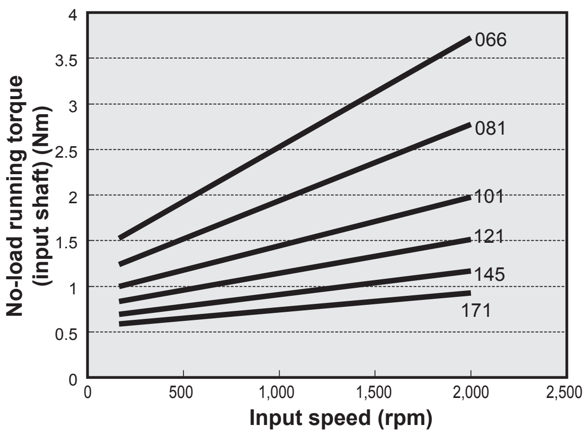
RDS-080E



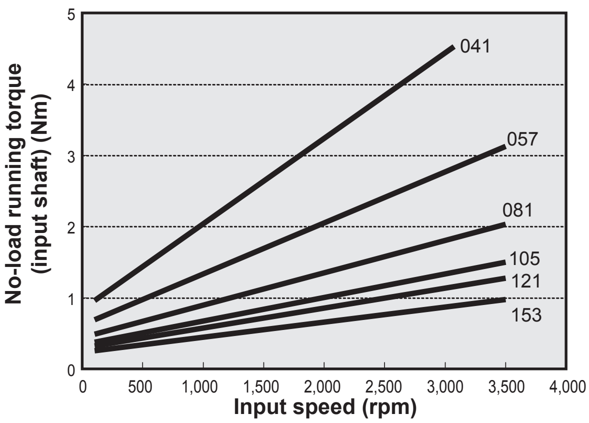
RDS-020E



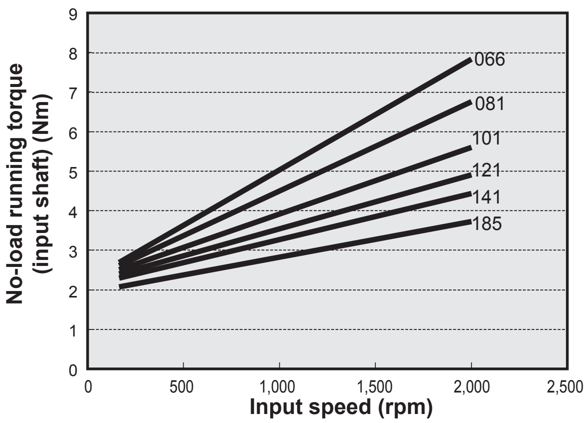
RDS-160E



RDS-040E



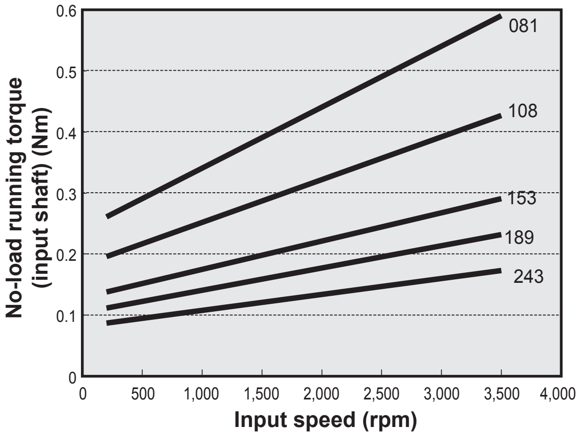
RDS-320E



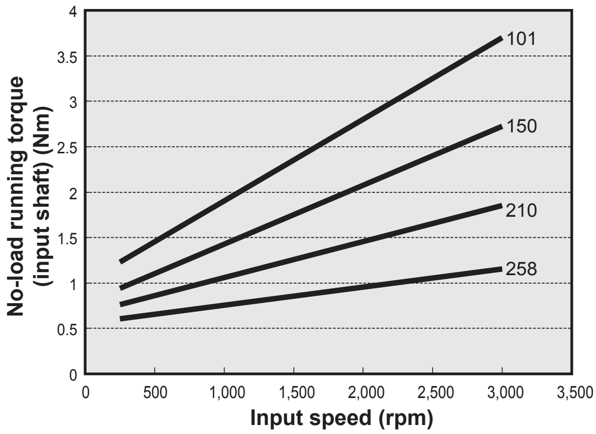
No-load Running Torque (straight input type)

Hollow shaft series

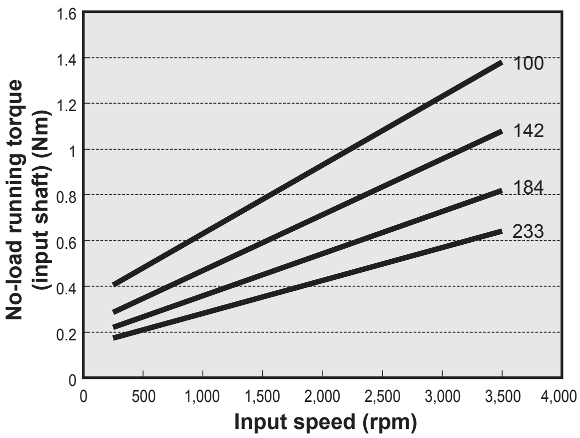
RDS-010C



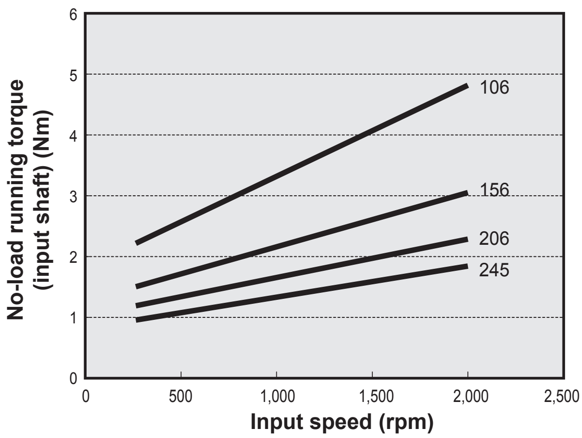
RDS-100C



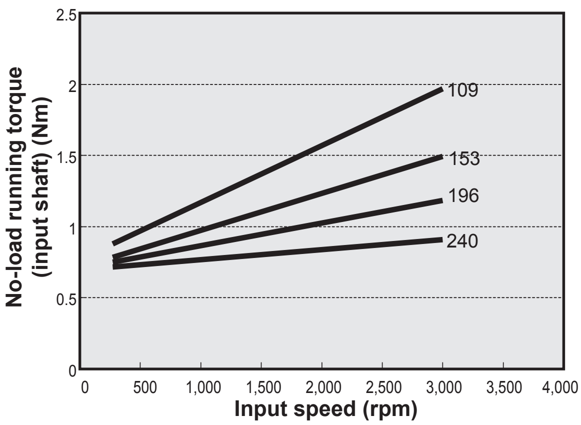
RDS-027C



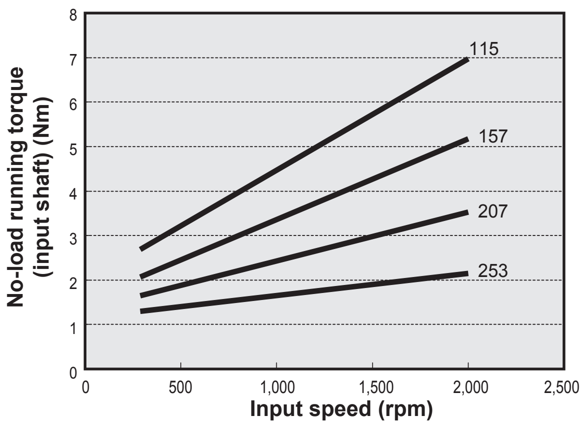
RDS-200C



RDS-050C



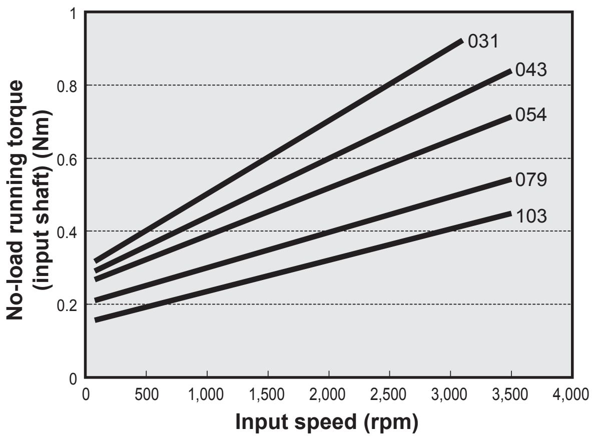
RDS-320C



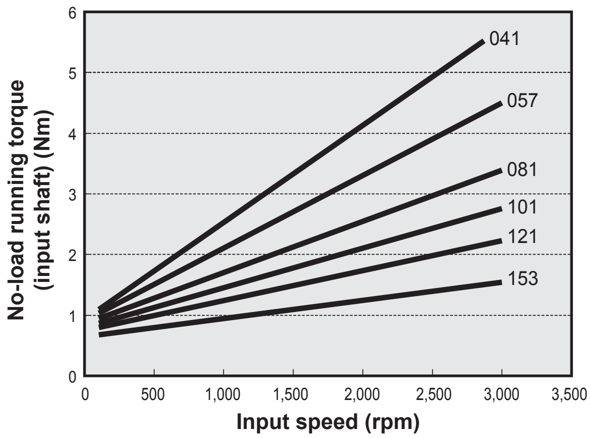
No-load Running Torque (Right angle input type)

Solid series

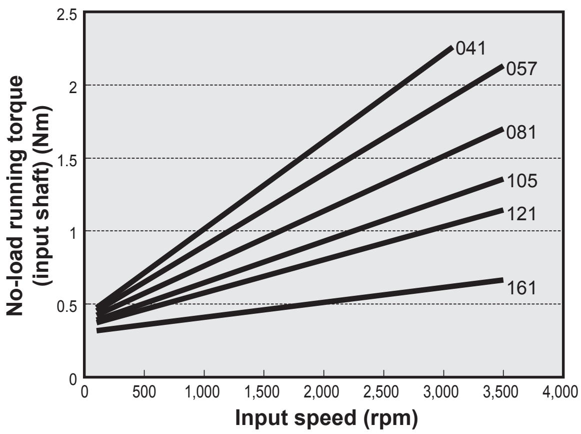
RDR-006E



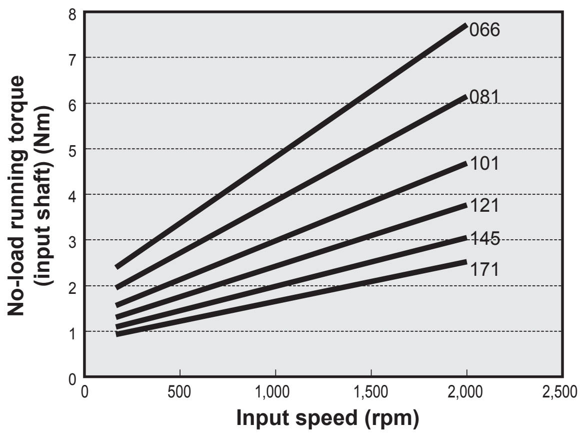
RDR-080E



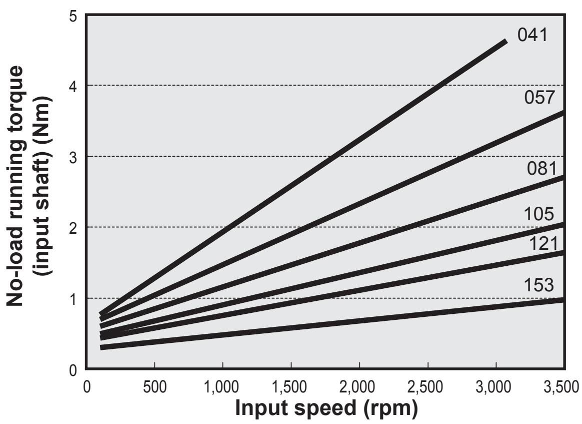
RDR-020E



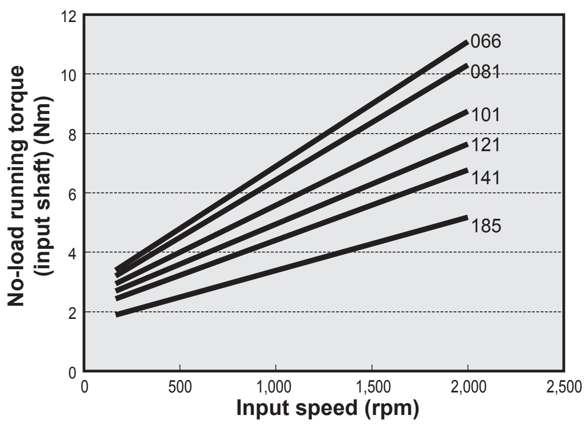
RDR-160E



RDR-040E



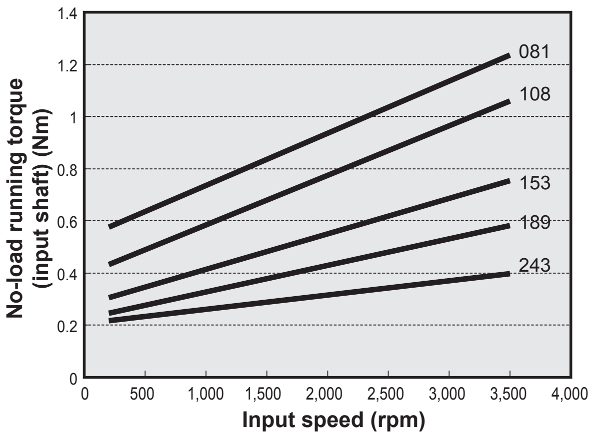
RDR-320E



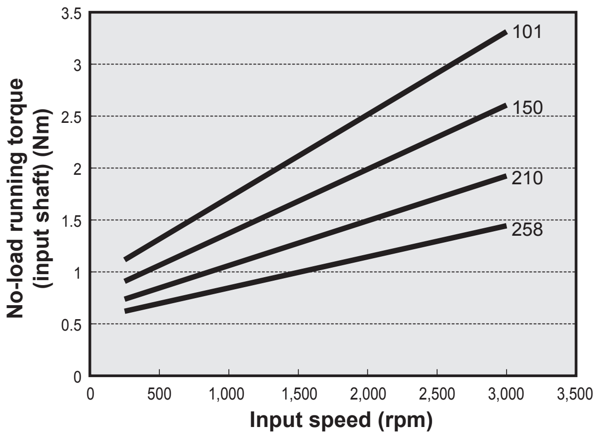
No-load Running Torque (Right angle input type)

Hollow shaft series

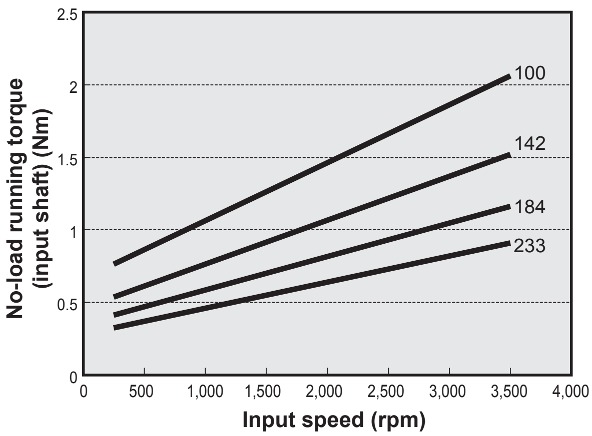
RDR-010C



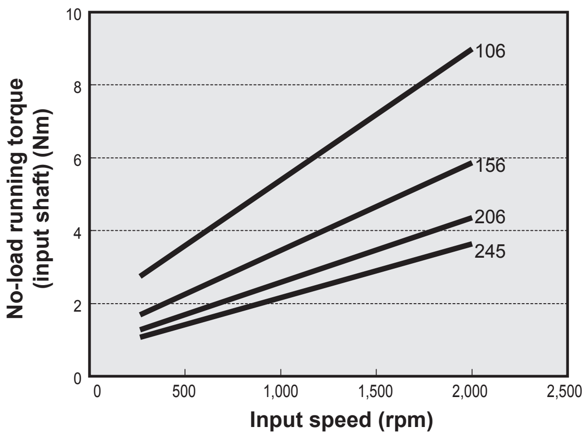
RDR-100C



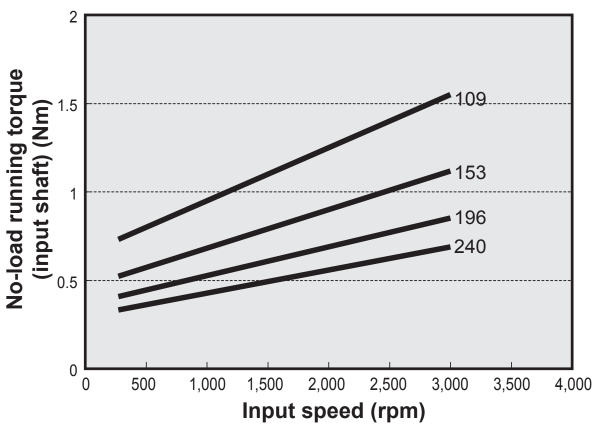
RDR-027C



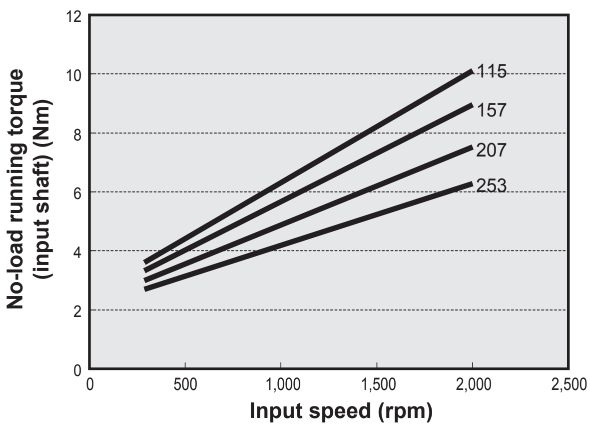
RDR-200C



RDR-050C

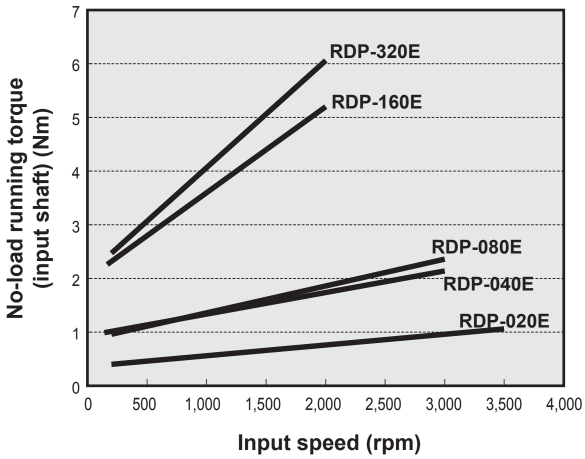


RDR-320C

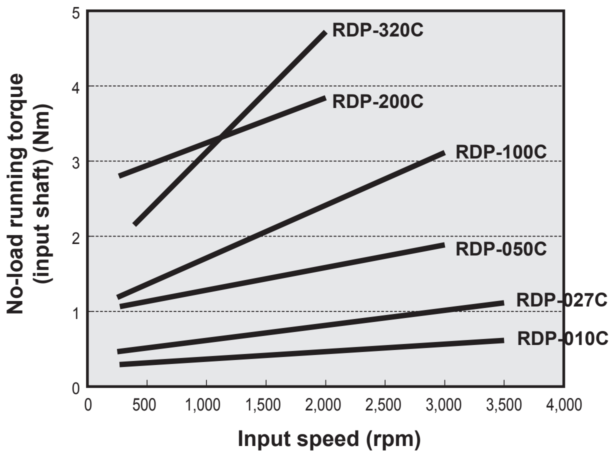


No-load Running Torque (Pulley input type)

Solid series



Hollow shaft series



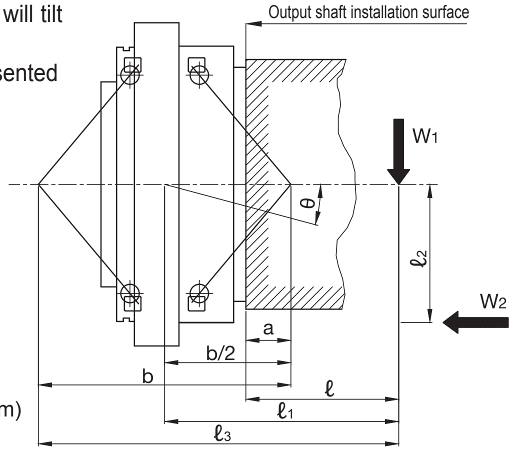
Calculation of Tilt Angle and Torsion Angle

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 : $\ell + \frac{b}{2} - a$
- ℓ : Distance from the output shaft installation surface to the point of load application (mm)



Model code	Moment rigidity Typical Value (Nm/arc.min.)	Dimensions (mm)	
		a	b
RD□-006E	117	12.5	90.3
RD□-020E	372	20.1	113.3
RD□-040E	931	29.9	144.5
RD□-080E	1,176	27.9	164.0
RD□-160E	2,940	42.7	210.0
RD□-320E	4,900	48.4	251.4

Model code	Moment rigidity Typical Value (Nm/arc.min.)	Dimensions (mm)	
		a	b
RD□-010C	421	28.0	119.2
RD□-027C	1,068	38.0	150.0
RD□-050C	1,960	50.5	187.3
RD□-100C	2,813	58.7	207.6
RD□-200C	9,800	76.0	280.4
RD□-320C	12,740	114.5	360.4

Calculation of torsion angle

Calculate the torsion angle when the torque is applied in a single direction, using an example of RD□-160E.

1) When the load torque is 30 Nm··················Torsion angle (ST_1)
   ● When the load torque is 3% or less of the rated torque

$$ST_1 = \frac{30}{47} \times \frac{1\ (\text{arc.min.})}{2} = 0.32\text{arc.min. or less}$$

2) When the load torque is 1,300 Nm Torsion angle (ST_2)
   ● When the load torque is more than 3% of the rated torque

$$ST_2 = \frac{1}{2} + \frac{1{,}300 - 47.0}{392} = 3.70\text{arc.min.}$$

Note: 1. The torsion angles that are calculated above are for a single reduction gear.

Model code	Torsion rigidity Typical Value Nm/arc.min.	Lost motion		Backlash arc.min.
		Lost motion arc.min.	Measured torque Nm	
RD□-006E	20	For RDS 1.5 For RDR 2.0	± 1.76	For RDS 1.5 For RDR 2.0
RD□-020E	49	For RDS or RDP 1.0 For RDR 1.5	± 5.00	For RDS or RDP 1.0 For RDR 1.5
RD□-040E	108		± 12.3	
RD□-080E	196		± 23.5	
RD□-160E	392		± 47.0	
RD□-320E	980		± 94.0	

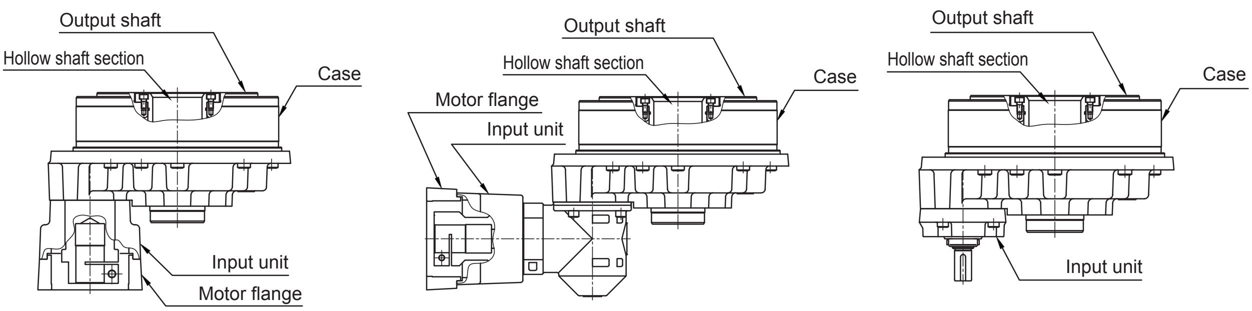
Model code	Torsion rigidity Typical Value Nm/arc.min.	Lost motion		Backlash arc.min.
		Lost motion arc.min.	Measured torque Nm	
RD□-010C	47	For RDS or RDP 1.0 For RDR 1.5	± 2.94	For RDS or RDP 1.0 For RDR 1.5
RD□-027C	147		± 7.94	
RD□-050C	255		± 14.7	
RD□-100C	510		± 29.4	
RD□-200C	980		± 58.8	
RD□-320C	1,960		± 94.1	

Engineering Notes-1

Installation direction of RD2 Series

If you use the hollow shaft types installed vertically with the shaft facing upward (as shown in the figures below), contact our customer representative in advance.

Note1: For the solid type, the installation direction shown in the figures below can be used.
2: If you are using the previous RD series and wish to use the RD2 series with the same conditions, the installation direction shown in the figures below can be used.
3: If the reduction gear is used under operating conditions where the surface temperature of the reduction gear exceeds 40˚C, the installation direction shown in the figures below can be used.



Straight input type　　Right angle input type　　Pulley input type

Vertical shaft installation (with shaft facing upward)

Lubrication

- The standard lubricant for RD2 Series is grease.
  RD2 Series are pre-lubricated with our recommended RV GREASE LB00 grease when shipped.
  When this product is operated while it is filled with an appropriate amount of lubricant, the standard lubricant replacement time due to lubricant degradation is 20,000 hours. However, if RD2 Series are operated under unfavorable conditions (that may deteriorate the lubricant more quickly or that cause gear surface temperatures above 40°C), the state of lubricant degradation should be checked and the lubricant replaced earlier as necessary.

<Nabtesco-specified lubricant>

Brand	RV GREASE LB00
Manufacturer	Nabtesco
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 for 30 minutes or more (until the surface temperature of the RD2 body reaches around 50°C).

Engineering Notes-2

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 hexagonal socket head cap screw and tighten to the torque, as specified below, in order to satisfy the momentary maximum allowable torque, which is noted in the rating table.
Employment of the Belleville spring washer is recommended to prevent the bolt from loosening and protect the bolt seat surface from flaws.

<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 6 g
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	
M20 × 0.5	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 pay attention to the system requirements of the transmission torque and the allowable moment.

<Calculation of allowable transmission torque of bolts>

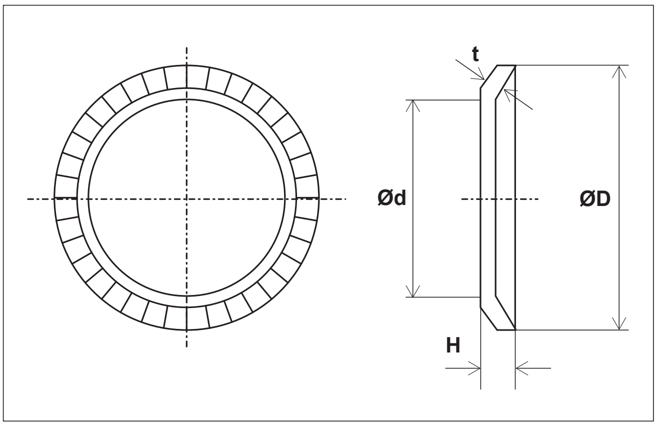
$$T = F \times \frac{D}{2} \times \mu \times n \times 10^{-3}$$	T	Allowable transmission torque by tightening bolt (Nm)
	F	Bolt tightening force (N)
	D	Bolt mounting P.C.D. (mm)
	μ	Friction factor μ=0.15: When lubricant remains on the mating face. μ=0.20: When lubricant is removed from the mating face.
	n	Number of bolts (pcs.)

<Serrated lock washer for hexagonal 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: HRC 40 to 48

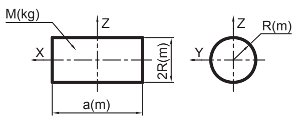
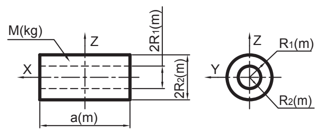
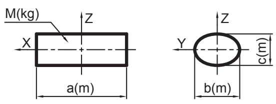
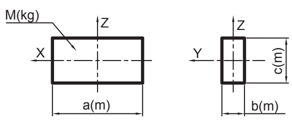
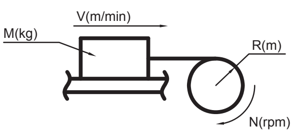
(Unit: mm)

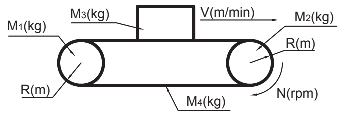
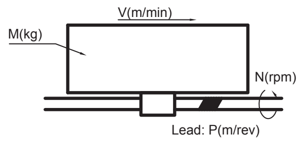
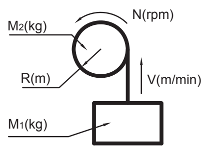
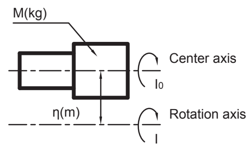
Nominal size	ID and OD of Belleville spring washer		t	H
	Ød	ØD		
5	5.25	8.5	0.6	0.85
6	6.4	10	1.0	1.25
8	8.4	13	1.2	1.55
10	10.6	16	1.5	1.9
12	12.6	18	1.8	2.2
16	16.9	24	2.3	2.8
20	20.9	30	2.8	3.55



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

Inertia Moment Calculation Formula

Shape	I(kg, m²)
1. Cylinder solid 	$I_x = \frac{1}{2}MR^2$ $I_y = \frac{1}{4}M\left(R^2+\frac{R^2}{3}\right)$ $I_z = I_y$
2. Cylinder hollow 	$I_x = \frac{1}{2}M\left(R_1^2+R_2^2\right)$ $I_y = \frac{1}{4}M\left\{\left(R_1^2+R_2^2\right)+\frac{a^2}{3}\right\}$ $I_z = I_y$
3. Oval cross section 	$I_x = \frac{1}{16}M\left(b^2+c^2\right)$ $I_y = \frac{1}{4}M\left(\frac{c^2}{4}+\frac{a^2}{3}\right)$ $I_z = \frac{1}{4}M\left(\frac{b^2}{4}+\frac{a^2}{3}\right)$
4. Rectangle 	$I_x = \frac{1}{12}M\left(b^2+c^2\right)$ $I_y = \frac{1}{12}M\left(a^2+c^2\right)$ $I_z = \frac{1}{12}M\left(a^2+b^2\right)$
5. General application 	$I = \frac{M}{4}\left(\frac{V}{\pi\times N}\right)^2 = MR^2$

Shape	I(kg, m²)
6. Horizontal movement by conveyor 	$I = \left(\frac{M_1+M_2}{2}+M_3+M_4\right)\times R^2$
7. Horizontal movement by lead screw 	$I = \frac{M}{4}\left(\frac{V}{\pi\times N}\right)^2 = \frac{M}{4}\left(\frac{P}{\pi}\right)^2$
8. Up/down movement by hoist 	$I = M_1R^2 + \frac{1}{2}M_2R^2$
9. Parallel axis theorem 	$I = I_0 + M\eta^2$ 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

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 Customer Support 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:

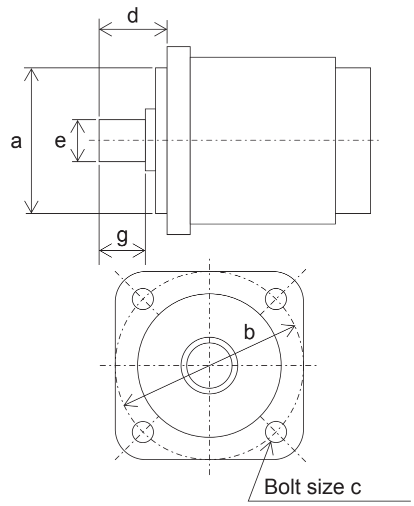
Name: E-mail:

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

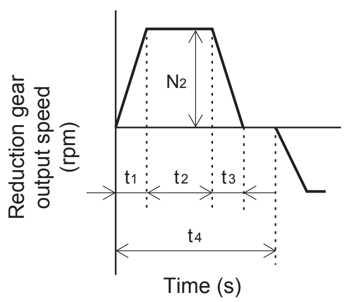


Motor model		
P	Motor rated output (KW)	
T_{M0}	Motor rated torque (Nm)	
T_{M1}	Motor momentary maximum torque (Nm)	
N_{M0}	Motor rated speed (rpm)	

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)	

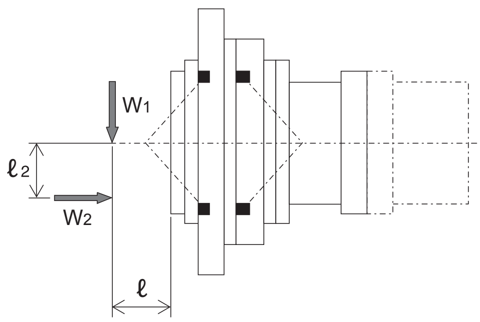
Please inform us of whether a key is attached or not, and when it is attached, also inform us of its dimensions.

◆ 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	Thrust load (N)	
ℓ_2	Distance to the point of thrust load application (mm)	

MEMO

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. 010

Nabtesco
Nabtesco Corporation

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