RV®

Precision Reduction Gear RV™

AGV Drive Unit

RVW®

### RVW® Series

Nabtesco

Nabtesco's technologies supporting society

Contributing to society with our 'Moving it. Stopping it.' technologies

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

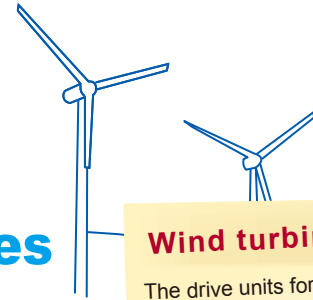**Nabtesco technologies are at work in many areas of our daily lives.**
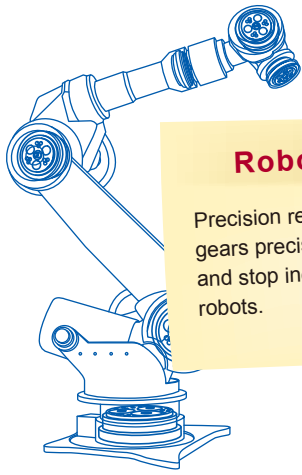
Robots
Precision reduction gears precisely move and stop industrial robots.
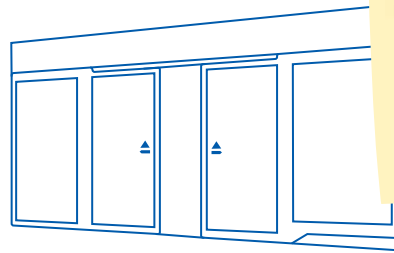
Doors
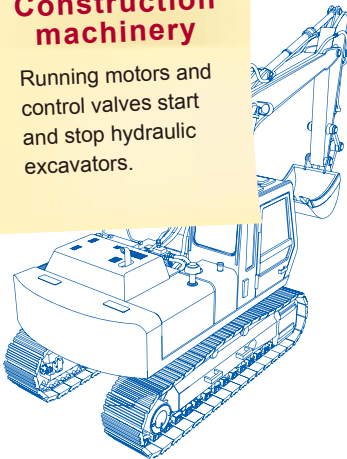Nabtesco technology opens and closes automatic doors in buildings and platform doors at train stations.

Construction machinery
Running motors and control valves start and stop hydraulic excavators.

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

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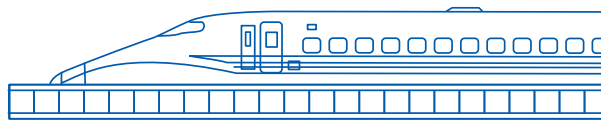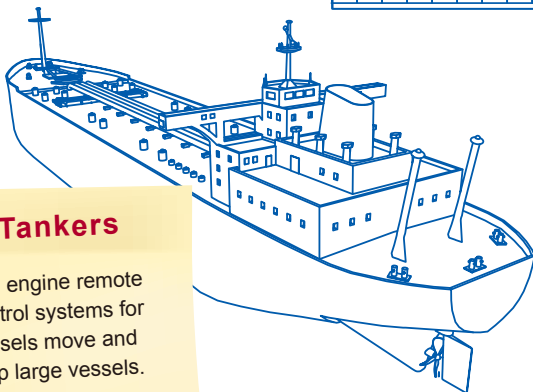Brakes and doors ensure safety and comfort for the world-famous Shinkansen bullet trains.

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

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

CONTENTS

Who is Nabtesco?

The key words for Nabtesco are 'motion control'. We use our strengths in the fields of component and systems technologies to develop highly creative products. Through the Nabtesco Group as a whole, we can also utilize our advantage of expertise to maximum effect in order to further enhance these strengths.

In the air, on land and at sea, we have a 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.

NABCO Ltd.
Established 1925

Teijin Seiki Co., Ltd.
Established 1944

Business Merger in 2003

Motion control

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.

An in-wheel drive unit ideal for large AGVs, combining high load resistance with high reliability

This is achieved by utilizing the high-precision processing technology and assembly techniques of the Precision Reduction Gear RV™, which can be found in industrial robots worldwide.
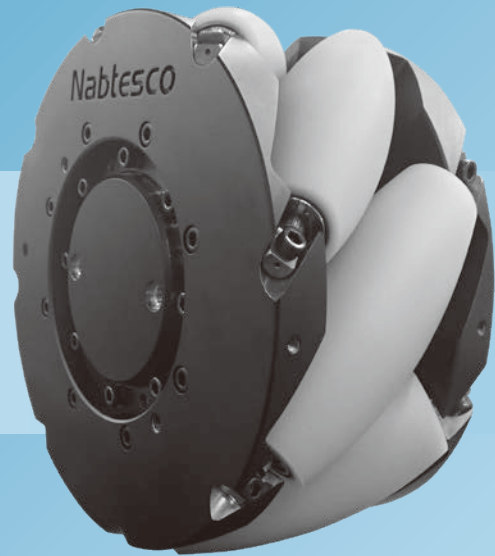
Ideal solution- A Mecanum Wheel AGV Drive Unit

This product integrates a Mecanum wheel and Precision Gear RV™.

*To be arranged by customer

Thrust load

Built-in high-capacity main bearing.
Ideal for supporting the thrust force acting on the Mecanum wheel.
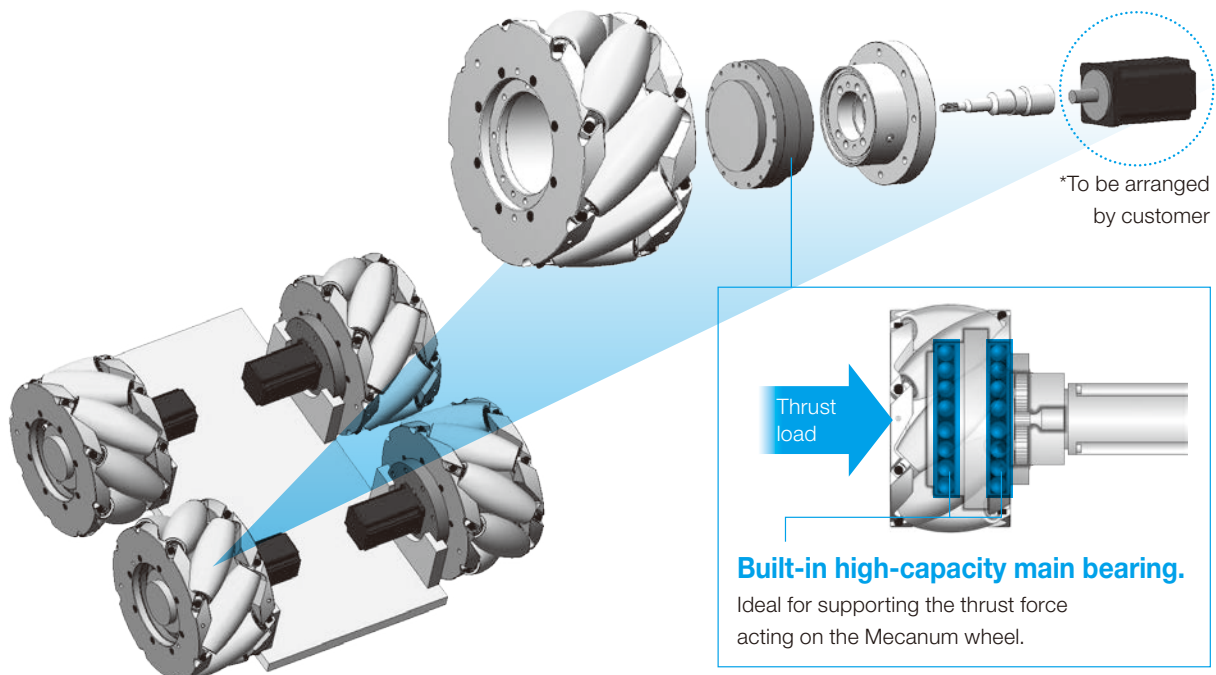
Solving your AGV problems: The RVW® Series!

High Payload

With the Mecanum wheel, heavy objects can be easily transported!

Mecanum wheel suitable for high loads

Example (RVW-10PG)
Loading capacity 500 kgf / Mecanum wheel

1,000 kg
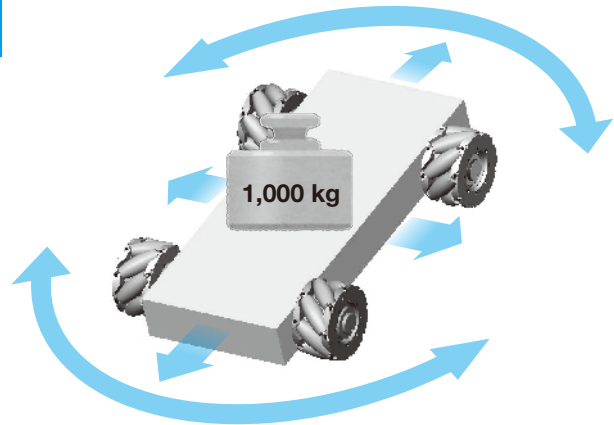
Easy Installation

Mecanum AGV assembly made simple!
A unit product that can easily be incorporated into the frame
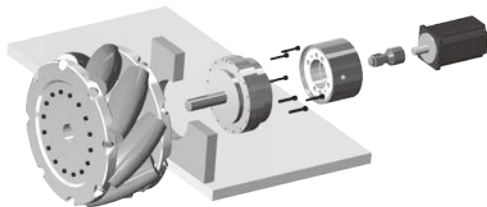
Example: Conventional product
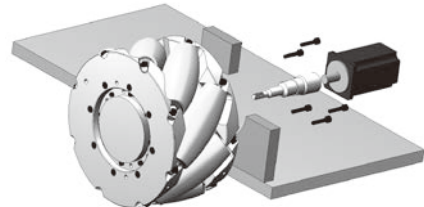
Example: Nabtesco drive unit

Compact

Making compact AGV design possible!
Uses an in-wheel structure.

Long

Short
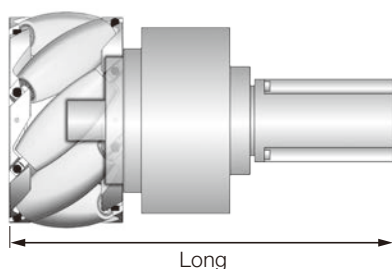
Example: Conventional product
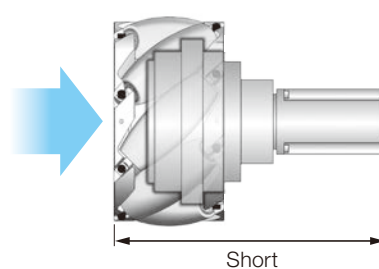
Example: Nabtesco drive unit

Advantages of Mecanum wheel

Travelling in all directions and accurate positioning

Mecanum AGV can travel smoothly in all directions and change direction freely. Moving into narrow spaces and accurate positioning are possible. It is suitable for applications that require transport within less space and accurate positioning.
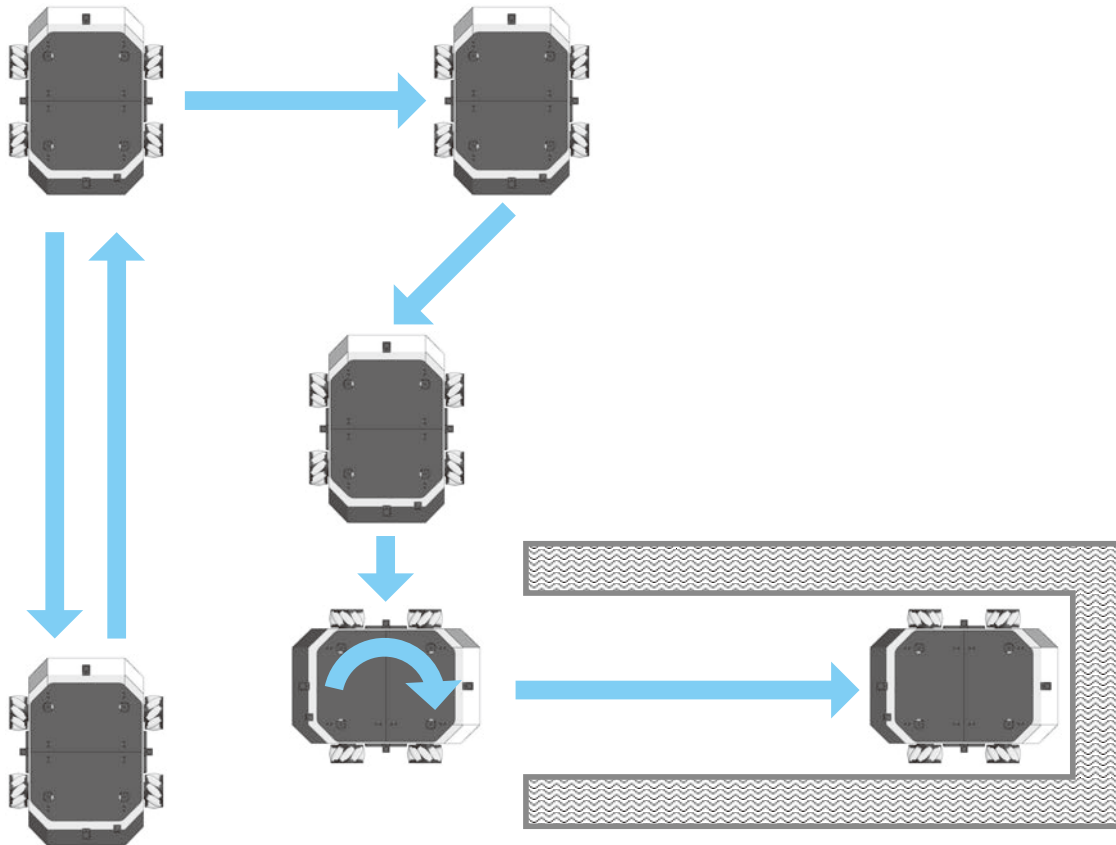
Efficient use of inner space of the AGV

Mecanum wheel AGV can travel in all directions without changing the direction of the wheels. As a result, a large space for placing the batteries and control devices is available around the wheels and the motor allowing for more efficient use of the inner space of the AGV.

Motor   Mecanum wheel

Applications
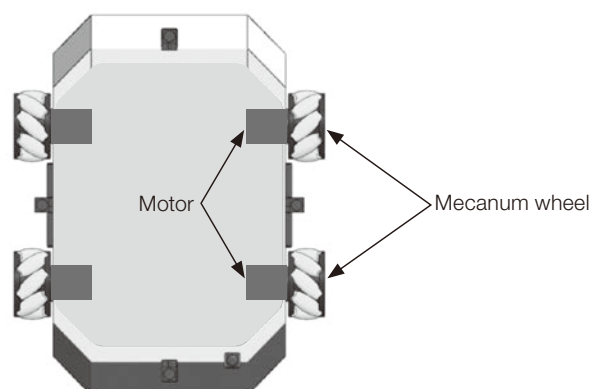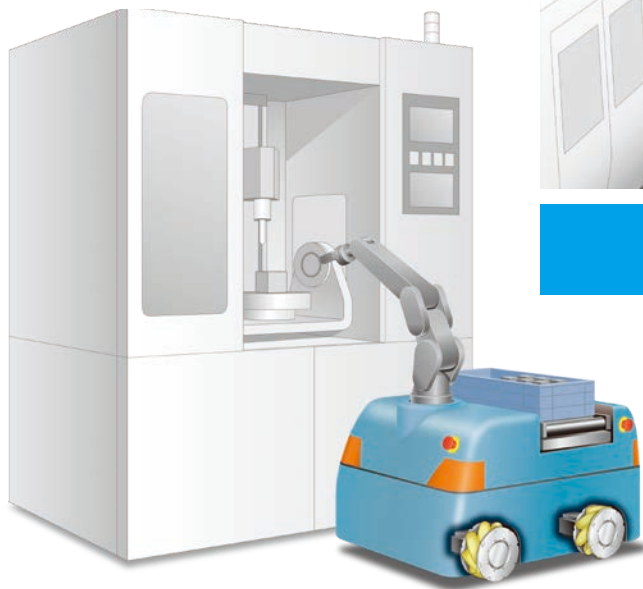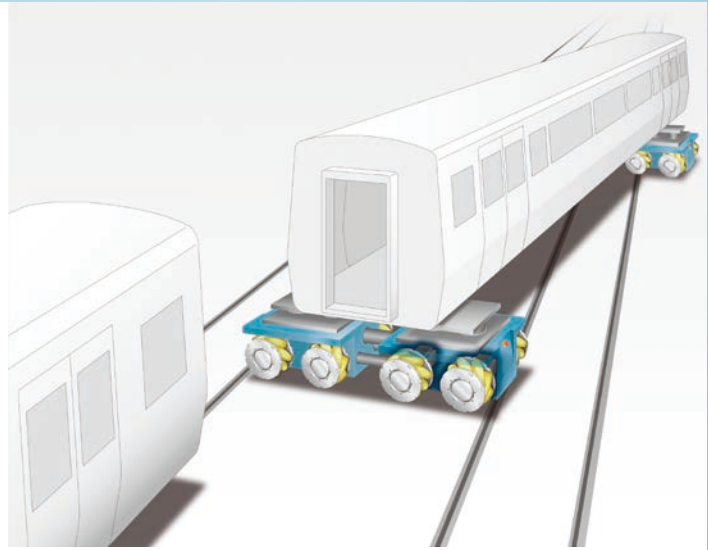
Assembly and maintenance of railroad vehicles

Autonomous mobile robot

Transport of machines during assembly process

All-direction lifter or aerial work platform

Operating principle of Mecanum wheel

Controlling the rotation direction and speed of the four Mecanum wheels makes it possible to move the AGV freely. The relationship between the wheel rotation direction and AGV traveling direction is described by the figures shown below. The following figures show the vehicle status when viewed from the top.

Travel forward	Travel backward

Left side surface	Right side surface	Left side surface	Right side surface

Left traverse	Right traverse

Diagonal movement toward front left	Diagonal movement toward front right

Diagonal movement toward rear left	Diagonal movement toward rear right

CCW rotation	CW rotation

Specifications, External Dimensions

RVW – 10P G L A – 35 – 0A 0A

Series name	Frame number		Series code		Torsion code		Specification code		Ratio code		Motor flange code		Input spline (input gear) code	
RVW	Diam. 10 inch	**10P**	Gearhead	**G**	Left torsion	**L**	Standard specification	**A**	10PG	**35**	Standard component	**2-digit value**	Standard component	**2-digit value**
	Diam. 20 inch	**20P**	Wheel	**W**	Right torsion	**R**			20PG	**80**				
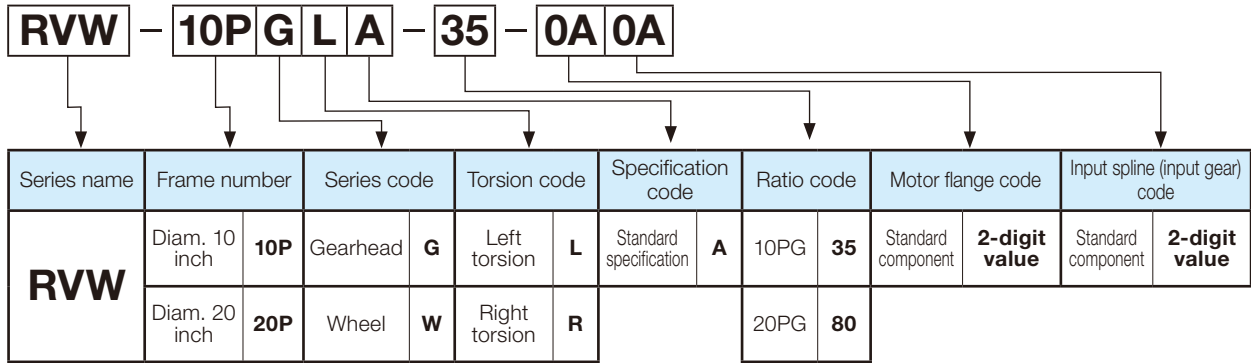
Series code

Two types, gearhead (G) and wheel (W), are available in this product as shown by the series code (G, W).

Gearhead (RVW-10PG)

Wheel (RVW-10PW)

Hexagon socket head cap screw

Serrated lock washer

Wheel

Reduction gear

Motor flange

Input spline (input gear)

Serrated lock washer
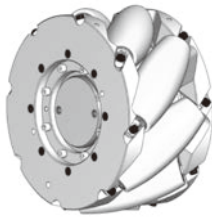
Hexagon socket head cap screw
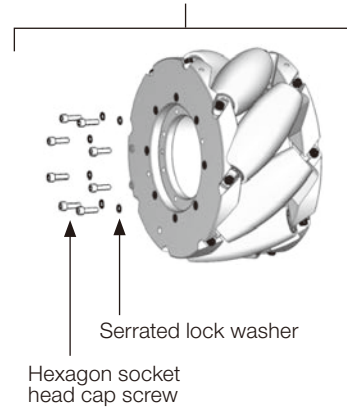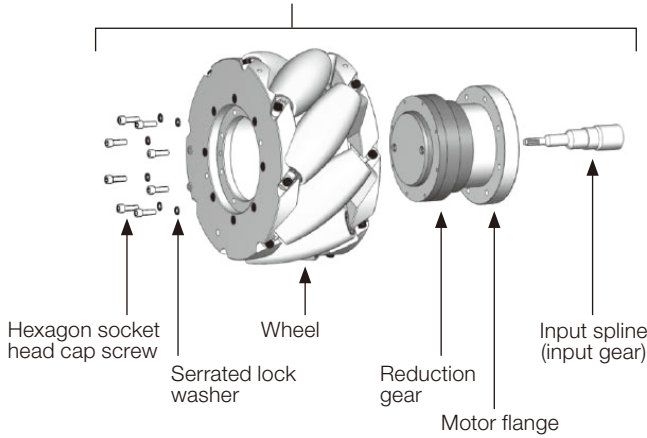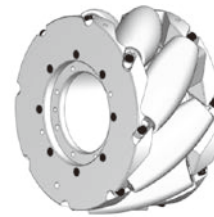
Torsion code

There are two types of barrel orientations, left torsion (L) and right torsion (R), as shown by the torsion code (L, R).

Left torsion (L)
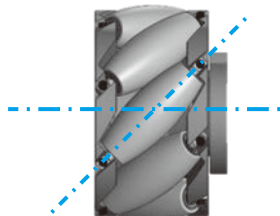
Right torsion (R)
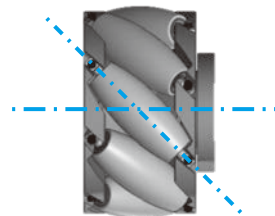
Rating table

Rating Table

Model		RVW-10PG	RVW-20PG
Allowable loading capacity/wheel	kgf	500	2,500
Wheel diameter	mm	254	508
Maximum speed (with allowable loading capacity)	m/min	60 (60)	60[*1] (30)
Maximum output speed	rpm	75.2	37.6
Speed ratio (ratio code)		34.73 (35)	80 (80)
Backlash[*2]	arc.min.	12	12
Lost motion[*2]	arc.min.	12	12
Basic rated torque[*2]	Nm	100	1,225
Allowable acceleration/deceleration torque[*2]	Nm	300	2,000
Rolling resistance coefficient		0.04	0.04
Mass[*3]	kg	35.6	210
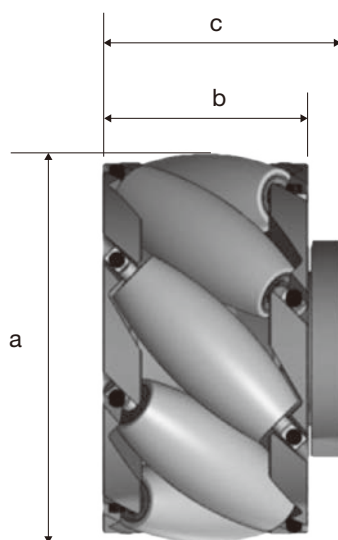
External dimensions

Model		RVW-10PG	RVW-20PG
Wheel diameter (a)	mm	254	508
Wheel thickness (b)	mm	134	278
Total length (c)[*3]	mm	166	308

*1: Speed at a load of 1,250 kgf/wheel or less.
*2: Performance of the reduction gear unit.
*3: Subject to change depending on motor.

RVW-10PGLA 外形寸法図
RVW-10PGLA Dimension Drawing

45°
22.5°

8-M8 深さ18
8-M8 DEPTH18

P.C.D.185

2-M6 深さ10
(吊りタップ)
2-M6 DEPTH10
(FOR HANDLING)

塗装範囲
(塗装色：エポキシ マンセル No.N1.5(黒色))
PAINTING RANGE
PAINTED COLOR : EPOXY MUNSELL No.1.5(BLACK)

R0.5MAX

モータフランジ
MOTOR FLANGE

φ200
φ170h7 -0.040

30°

18

157±1

134

9

(127)
(φ254)

45°
22.5°

Nabtesco

外側の8-M6は取り外し不可。
DO NOT REMOVE
OUTSIDE 8-M6 BOLTS.

P.C.D.115

P.C.D.146

2-M8 深さ10
(吊りタップ)
2-M8 DEPTH10
(FOR HANDLING)

38.5 38.5

2-M6深さ12
(接続タップ)
2-φ6.6 座グリ深さ4
2-M6 DEPTH12
2-φ6.6 SPOT
FACING DEPTH4
(FOR DISASSEMBLY)

8-M6(ホイール固定用)
8-M6
(FOR FIXING WHEEL)

R(PT)1/8六角穴付プラグ
(給油穴用)
R(PT)1/8PLUG
(FOR OIL)

注記
1. 質量には、モータフランジの質量は含まれておりません。
2. モータフランジの形状・寸法・塗装範囲・質量は、モータフランジ図面を参照してください。

NOTE:
1. The mass does not include the mass of the motor flange.
2. Refer to the motor flange drawing for the motor flange shape,
   dimensions, paint range and mass.

速比 Speed Ratio	型式コード Model Code	質量 Mass (kg)	慣性モーメントI Moment of Inertia "I" GD(2/4) 及機換算 The Motor Axis Conversion 4gm(2)
34.73	RVW-10PGLA-35	29.5	1.90x10⁻⁴

Specifications and dimensions are subject to change without notice.

RVW-10PGRA 外形寸法図
RVW-10PGRA Dimension Drawing

45°
22.5°

8-M8 深さ18
8-M8 DEPTH18

P.C.D.185

2-M6 深さ10
(吊りタップ)
2-M6 DEPTH10
(FOR HANDLING)

塗装色：エポキシ マンセル No.1.5（黒色）
PAINTED COLOR：EPOXY MUNSELL No.1.5〈BLACK〉
塗装範囲
PAINTING RANGE

モータフランジ
MOTOR FLANGE
R0.5 MAX

18

157±1

ø200
ø170h7 -0.040 0
30°
1

134

6

(127)
(ø254)

外側の8-M6は取り外し不可。
DO NOT REMOVE
OUTSIDE 8-M6 BOLTS.

P.C.D.115
P.C.D.146

2-M8 深さ10
(吊りタップ)
2-M8 DEPTH10
(FOR HANDLING)

45°
22.5°

38.5 38.5

Nabtesco

2-M6深さ12
2-φ6.6 座ぐり深さ4
(抜きタップ)
2-M6 DEPTH12
2-φ6.6 SPOT
FACING DEPTH4
(FOR DISASSEMBLY)

8-M6(ホイール固定用)
(FOR FIXING WHEEL)

R(PT)1/8六角穴付プラグ
(給排油ポート)
R(PT)1/8PLUG
(FOR OIL)

注記
1. 質量には、モータフランジの質量は含まれておりません。
2. モータフランジの形状・寸法・塗装範囲・質量は、モータフランジ図面を参照してください。

NOTE
1. The mass does not include the mass of the motor flange.
2. Refer to the motor flange drawing for the motor flange shape,
   dimensions, paint range and mass.

速比 Speed Ratio	型式コード Model Code	質量 Mass (kg)	慣性モーメント Moment of Inertia, I (GD²/4) 換算機構質量 The Motor Axis Conversion (kgm²)
34.73	RVW-10PGRA-35	29.5	1.90×10⁻⁴

3RD ANGLE
PROJECTION

モータフランジ寸法図
Motor Flange Dimension

8-M8 通し
8-M8 THRU

詳細図X DETAIL DRAWING X
DETAIL DRAWING X

4-E₂

P.C.D.F

4-E₁

P.C.D.185

詳細図Y DETAIL DRAWING Y
DETAIL DRAWING Y

SECTION Z-Z

詳細図X DETAIL DRAWING X

Figure 1 (Ø170h7)

Figure 2 (Ø169) (Ø170h7) 6

詳細図Y DETAIL DRAWING Y

Figure 3

Figure 4 Ø80

モータ取付部寸法 Dimensions (mm)								質量 Mass (kg)	モータフランジ記号 Motor Flange Code
X	Y	D	E₁	E₂	F	G	H		
Figure 1	Figure 3	Ø80H7 +0.030/0			100	6	7	5.7	0F
Figure 1	Figure 4	Ø95H7 +0.035/0	M6 深さ 11 M6 DEPTH 11	M8 深さ 15 下穴通し M8 DEPTH 15 PILOT HOLE THRU	115	7	8	5.7	0E
Figure 1	Figure 4	Ø110H7 +0.035/0	M8 深さ 15 下穴通し M8 DEPTH 15 PILOT HOLE THRU		145	6	8	5.4	0A
Figure 2	Figure 4					9	8	5.9	0D

注記
1.塗装 塗装色 エポキシ マンセルNo.N1.5（黒色） 塗装範囲部分を ///// に示す。

NOTE
1. ///// area is painted black.

3RD ANGLE PROJECTION

モータフランジ寸法図
Motor Flange Dimension

8-M8 通し
8-M8 THRU

4-E₂

P.C.D.F

4-E₁

P.C.D.185

詳細図X
DETAIL DRAWING X

SECTION Z-Z

詳細図X DETAIL DRAWING X

Figure 1 Ø140 5
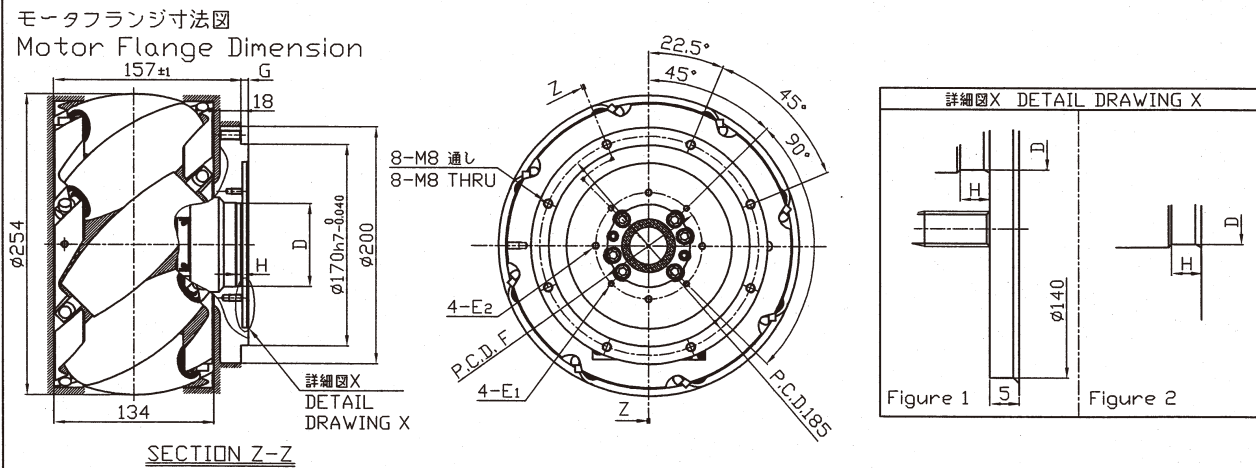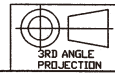
Figure 2

モータ取付部寸法 Dimensions (mm)							質量 Mass (kg)	モータフランジ記号 Motor Flange Code
X	D	E₁	E₂	F	G	H		
Figure 1	Ø70H7 +0.030/0	M5 深さ 9 M5 DEPTH 9	M6 深さ 11 M6 DEPTH 11	90	6	5	5.5	0G
Figure 2		M6 深さ 11 M6 DEPTH 11					5.9	0H

注記
1.塗装 塗装色 エポキシ マンセルNo.N1.5（黒色） 塗装範囲部分を ///// に示す。

NOTE
1. ///// area is painted black.

3RD ANGLE PROJECTION

Please contact us for shapes not listed above.

Straight shaft (without key)
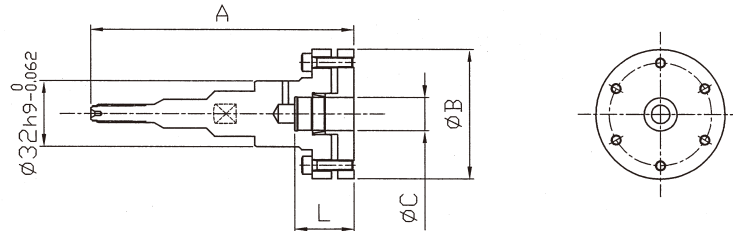
Figure 1

			Input spline dimensions table			
Model code	Shape	A [mm]	ø B [mm]	ø C [mm]		L [mm]	Input spline code
RVW-10PG	Figure 1	130.5	63	14H7	+0.018 0	26	0K
		128.5	63	16H7	+0.018 0	29	0J
		133.5	63	19H7	+0.021 0	34	0H
		130.5	63	19H7	+0.021 0	31	0G
		122.4	63	19H7	+0.021 0	37.9	0F
		123.5	63	22H7	+0.021 0	39	0E
		133.5	63	24H7	+0.021 0	39	0D
		123.5	63	24H7	+0.021 0	39	0A

Straight shaft (with key)

Figure 1

Figure 2
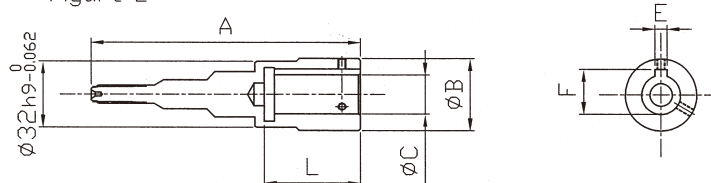
Figure 3

		Input spline dimensions table						
Model code	Shape	A [mm]	ø B [mm]	ø C [mm]		L [mm]	E [mm]	F [mm]	Input spline code
RVW-10PG	Figure 1	128.5	30	14H7	+0.018 0	24	5	16.3	0R
	Figure 2	128.5	32	16H7	+0.018 0	29	5	18.3	0Q
	Figure 3	131.5	35	19H7	+0.021 0	47	6	21.8	0P
		130.5	35	19H7	+0.021 0	31	6	21.8	0N
		122.5	35	19H7	+0.021 0	38	6	21.8	0M
		133.5	40	24H7	+0.021 0	38	8	27.3	0L

Please contact us for shapes not listed above.

RVW-20PGLA 外形寸法図
RVW-20PGLA Dimension Drawing

16-M8(ホイール固定用)
〈FOR FIXING WHEEL〉

4-M12 深さ16
(抜きタップ)
4-M12 DEPTH16
〈FOR DISASSEMBLY〉

2-M12 深さ22
(吊りタップ)
2-M12 DEPTH22
〈FOR HANDLING〉

R(PT)3/8六角穴付プラグ
(給排油ポート)
R(PT)3/8PLUG
〈FOR OIL〉

2-M12 深さ22
2-M12 DEPTH22

2-M12 深さ22
(吊りタップ)
2-M12 DEPTH22
〈FOR HANDLING〉

16-M12 深さ24
16-M12 DEPTH24

モータフランジ
MOTOR FLANGE

モータ取付面
MOTOR MOUNTING SURFACE

塗装範囲
PAINTING RANGE
塗装色：エポキシ マンセル No.1.5〈黒色〉
PAINTED COLOR：EPOXY MUNSELL No.1.5〈BLACK〉

注記
1. 質量には、モータフランジの質量は含まれておりません。
2. モータフランジは使用するモータによって異なります。詳細については弊社までお問合せください。

NOTE
1. The mass does not include the mass of the motor flange.
2. The motor flange varies depending on motor used. Please contact us for detail of motor flange.

Speed Ratio 減比	Mass 質量 (kg)	Model Code 型式コード	The Motor Axis Conversion モータ軸換算 慣性モーメント Moment of Inertia, T (kgㆍ㎡) GㆍD²/4
80	207	RVW-20PGLA-80	7.02×10^{-4}

Specifications and dimensions are subject to change without notice.

RVW-20PGRA 外形寸法図
RVW-20PGRA Dimension Drawing

3RD ANGLE PROJECTION

2-M12 深さ22
2-M12 DEPTH22

16-M12 深さ24
16-M12 DEPTH24

P.C.D.296

22.5°

18.75

18.75

モータフランジ
MOTOR FLANGE
モータ取付面
MOTOR MOUNTING SURFACE

φ320h7 -0.057 範囲

φ230
φ179

55
26
24
30
2

12(φ320h7範囲)

塗装範囲：エポキシ マンセル
No.1.5(黒色)
PAINTING RANGE
PAINTED COLOR：EPOXY MUNSELL No.1.5〈BLACK〉

2-M12 深さ22
(吊りタップ)
2-M12 DEPTH22
〈FOR HANDLING〉

308±2
278
φ508

12
12

R(PT)3/8六角穴付プラグ
(給排油ポート)
R(PT)3/8PLUG
〈FOR OIL〉

φ204
φ336

18.75

20°
10°
80°

16-M8(ホイール固定用)
〈FOR FIXING WHEEL〉

4-M12 深さ16
(抜きタップ)
4-M12 DEPTH16
〈FOR DISASSEMBLY〉

2-M12 深さ22
(吊りタップ)
2-M12 DEPTH22
〈FOR HANDLING〉

18.75

注記
1. 質量には、モータフランジの質量は含まれておりません。
2. モータフランジは使用するモータによって異なります。詳細については弊社までお問合せください。

NOTE
1. The mass does not include the mass of the motor flange.
2. The motor flange varies depending on motor used. Please contact us for detail of motor flange.

減比 Speed Ratio	型式コード Model Code	質量 Mass (kg)	慣性モーメント Moment of Inertia GD²/4 モータ軸換算 The Motor Axis Conversion (kgm²)
80	RVW-20PGRA-80	207	7.02×10⁻⁴

Specifications and dimensions are subject to change without notice.

— 15 —

モータフランジ寸法図

Motor Flange Dimension

モータ取付部寸法 Dimensions (mm)			質量 Mass (kg)	モータ フランジ記号 Motor Flange Code
D	E	F		
$\varnothing110_{H7}{}^{+0.035}_{0}$	M8 深さ 15 M8 DEPTH 15	145	2.7	0A

注記
1.塗装　塗装色 エポキシ マンセルNo.N1.5〈黒色〉　塗装範囲部分を ///// に示す。
NOTE
1. ///// area is painted black.
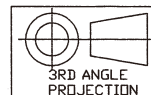
Please contact us for shapes not listed above.

Straight shaft (with key)
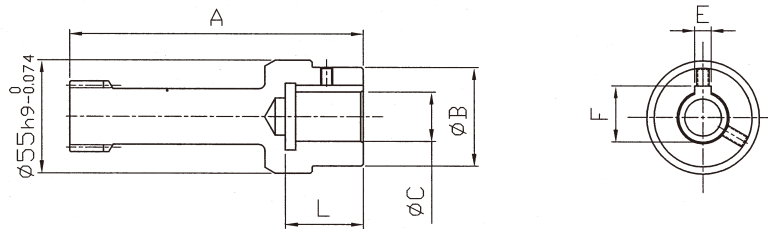
Figure 1

Input gear dimensions table									
Model code	Shape	A [mm]	ø B [mm]	ø C [mm]		L [mm]	E [mm]	F [mm]	Input gear code
RVW-20PG	Figure 1	143.5	48	24H7	+0.021 / 0	38	8	27.3	AN

Please contact us for shapes not listed above.

Selection table

Straight shaft (without key)

Model code
RVW-10PG

Motor flange, input spline selection table									
Motor shaft diameter [mm]	Motor shaft diameter tolerance	Motor shaft length [mm]	Motor mounting pilot diameter [mm]	Motor mounting pilot tolerance	Motor mounting pilot length [mm]	Bolt P.C.D. [mm]	Bolt size	Motor flange code	Input spline code
Ø14	h6	30	Ø70	h7	3	90	M5 or M6	0G	0K
Ø16	h6	40	Ø80	h7	5	100	M6	0F	0J
Ø16	h6	40	Ø110	h7	3.5	145	M8	0A	0J
Ø19	h6	35	Ø70	h7	3	90	M5	0G	0G
Ø19	h6	40	Ø70	h7	3	90	M6	0H	0G
Ø19	h6	40	Ø110	h7	3.5	145	M8	0A	0H
Ø19	h6	55	Ø95	h7	3	115	M8	0E	0F
Ø19	h6	58	Ø110	h7	6	145	M8	0D	0F
Ø22	h6	55	Ø110	h7	6	145	M8	0A	0E
Ø22	h6	58	Ø110	h7	6	145	M8	0D	0E
Ø24	h6	45	Ø95	h7	3	115	M6 or M8	0E	0D
Ø24	h6	55	Ø110	h7	3	145	M8	0A	0A

Straight shaft (with key)

Model code
RVW-10PG

Motor flange, input spline selection table									
Motor shaft diameter [mm]	Motor shaft diameter tolerance	Motor shaft length [mm]	Motor mounting pilot diameter [mm]	Motor mounting pilot tolerance	Motor mounting pilot length [mm]	Bolt P.C.D. [mm]	Bolt size	Motor flange code	Input spline code
Ø14	h6	30	Ø70	h7	3	90	M5 or M6	0G	0R
Ø16	h6	40	Ø80	h7	5	100	M6	0F	0Q
Ø16	h6	40	Ø110	h7	3.5	145	M8	0A	0Q
Ø19	h6	35	Ø70	h7	3	90	M5	0G	0N
Ø19	h6	40	Ø70	h7	3	90	M6	0H	0N
Ø19	h6	40	Ø110	h7	3.5	145	M8	0A	0N
Ø19	h6	55	Ø95	h7	3	115	M8	0E	0P
Ø19	h6	58	Ø110	h7	6	145	M8	0D	0M
Ø24	h6	45	Ø95	h7	3	115	M6 or M8	0E	0L

Straight shaft (with key)

Model code
RVW-20PG

Motor flange, input gear selection table									
Motor shaft diameter [mm]	Motor shaft diameter tolerance	Motor shaft length [mm]	Motor mounting pilot diameter [mm]	Motor mounting pilot tolerance	Motor mounting pilot length [mm]	Bolt P.C.D. [mm]	Bolt size	Motor flange code	Input gear code
Ø24	h6	55	Ø110	h7	3	145	M8	0A	AN

Please contact us for shapes not listed above.

Technical Information

Considering the use of RVW® series

This product is a drive unit for vehicles that can travel in all directions. To exhibit its performance satisfactorily, it is necessary to strictly comply with various restrictions and select an appropriate model. Please read this technical document thoroughly and select and adopt an appropriate model based on the actual operating environment, method, and conditions 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

- Intended use of this product (intended purpose)
  This product was designed and manufactured as a drive unit for mobile industrial vehicles or an autonomous mobile robots (hereafter referred to as a "vehicle"). (The product decelerates the rotation of the motor, amplifies the drive torque necessary to drive the vehicle, and transfers it onto the road surface.) Do not use this product for other purposes.
- 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 energy facilities, space equipment, transportation 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, e.g., the installation of independent safeguards, based on vehicle safety standards specified by JIS, ISO, and others.

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 this product under the following environment:	Do not use this product at the following locations.
· Location where the ambient temperature is between -10°C to 40°C. · Location where the humidity is less than 85% and no condensation occurs. · Location where the altitude is less than 1000 m. · Well-ventilated location	· Location where a lot of dust is collected. · Location where a lot of oil, water, or sand is collected. · Location that can be affected by the direct sunlight · Outdoors that can be directly affected by wind and rain · Location near to areas that contain combustible, explosive, or corrosive gases and flammable materials. · Location where the magnetic fields or vibration occur

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

Maintenance

- The wheel is a consumable part. A vehicle structure that allows replacement of the wheel should be used.
- 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 lubricant replaced earlier as necessary.
  Since the tapped hole for injecting/draining lubricant is used to replace the lubricant, a vehicle structure that allows use of this tapped hole should be used.

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.

Manuals

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

Glossary

Self-propelled industrial vehicle

A self-propelled industrial vehicle that conforms to the following classifications in JIS D 6201:2017.
   1) Classification by drive power - Electric vehicle
   2) Classification by operation type - Pedestrian controlled type or driverless type

Autonomous mobile robot

A robot that can travel autonomously.
Note: Autonomous traveling refers to movement executed by recognizing and understanding the surrounding environment without receiving external supports.

Allowable loading capacity

Maximum radial load that one piece of this product can withstand.

## Maximum speed

Maximum speed of the vehicle.

Lost motion, backlash

When torque is applied to the output shaft while the input shaft is fixed, torsion is generated on the output shaft according to the torque value. The torsion can be shown in the hysteresis curves.
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 width of the hysteresis curve at zero torque is referred to as "backlash".

■ Hysteresis curve
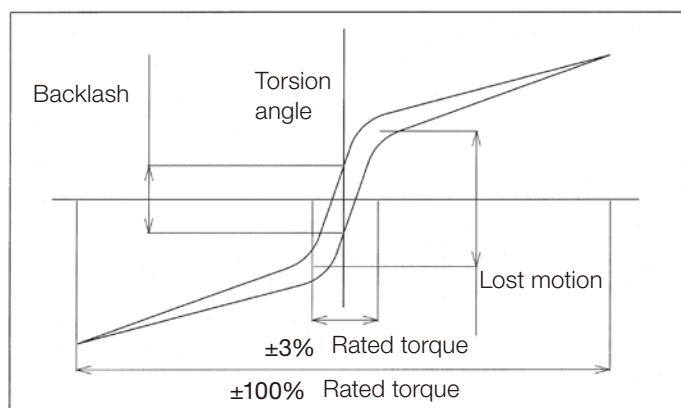
Rolling resistance coefficient

The ratio of the rolling resistance (loss) to the load applied to the wheel is referred to as the "rolling resistance coefficient".
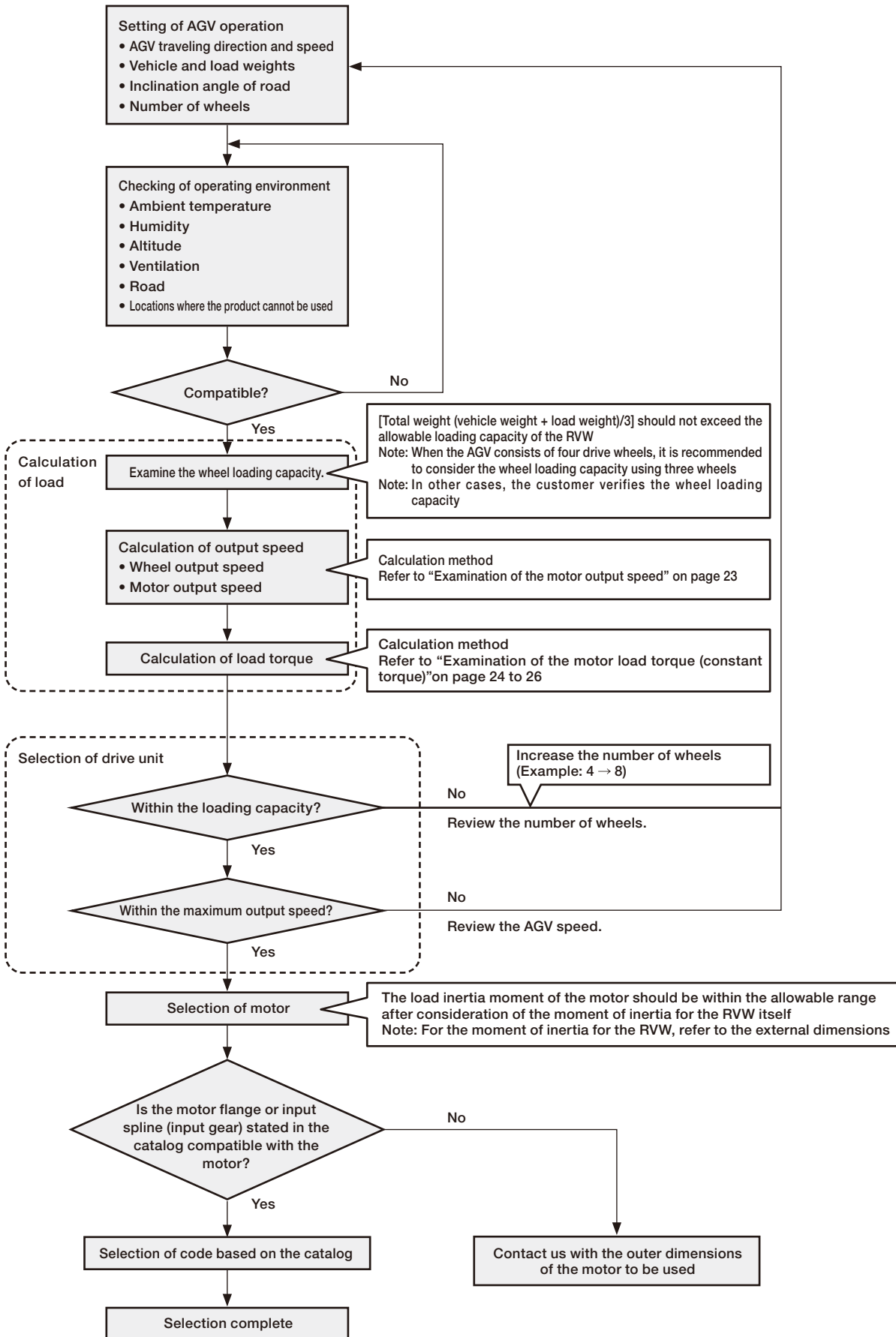
No-load running torque

The torque that is required to run the reduction gear without load is referred to as "no-load running torque".

Total weight

The total of the vehicle weight and load weight.

Product model and motor selection flowchart

Setting of AGV operation
- AGV traveling direction and speed
- Vehicle and load weights
- Inclination angle of road
- Number of wheels

Checking of operating environment
- Ambient temperature
- Humidity
- Altitude
- Ventilation
- Road
- Locations where the product cannot be used

Compatible? → **No**

Yes

Calculation of load

Examine the wheel loading capacity.

[Total weight (vehicle weight + load weight)/3] should not exceed the allowable loading capacity of the RVW
Note: When the AGV consists of four drive wheels, it is recommended to consider the wheel loading capacity using three wheels
Note: In other cases, the customer verifies the wheel loading capacity

Calculation of output speed
- Wheel output speed
- Motor output speed

Calculation method
Refer to "Examination of the motor output speed" on page 23

Calculation of load torque

Calculation method
Refer to "Examination of the motor load torque (constant torque)"on page 24 to 26

Selection of drive unit

Within the loading capacity? → **No**

Increase the number of wheels
(Example: 4 → 8)
Review the number of wheels.

Yes

Within the maximum output speed? → **No**

Review the AGV speed.

Yes

Selection of motor

The load inertia moment of the motor should be within the allowable range after consideration of the moment of inertia for the RVW itself
Note: For the moment of inertia for the RVW, refer to the external dimensions

Is the motor flange or input spline (input gear) stated in the catalog compatible with the motor? → **No**

Contact us with the outer dimensions of the motor to be used

Yes

Selection of code based on the catalog

Selection complete

Product model and motor selection calculation formula

Examination of the motor output speed

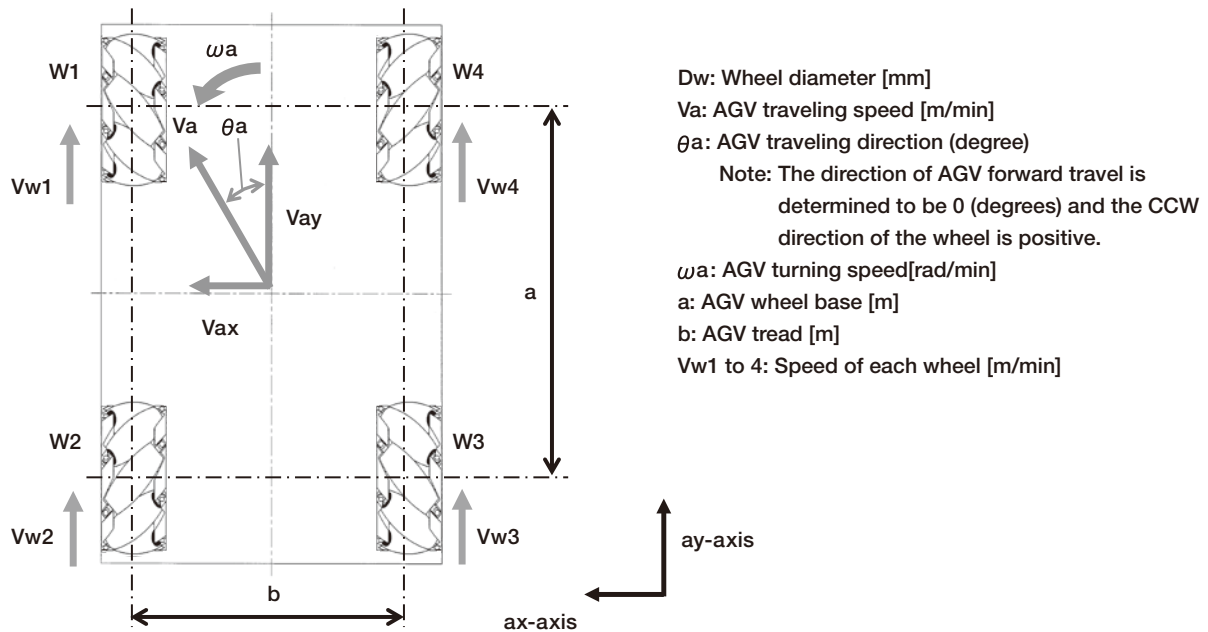Calculate the speed of each wheel from the AGV operation.

Dw: Wheel diameter [mm]
Va: AGV traveling speed [m/min]
θa: AGV traveling direction (degree)
   Note: The direction of AGV forward travel is determined to be 0 (degrees) and the CCW direction of the wheel is positive.
ωa: AGV turning speed[rad/min]
a: AGV wheel base [m]
b: AGV tread [m]
Vw1 to 4: Speed of each wheel [m/min]

Figure: Speed vector of AGV and speed vector of each wheel (the figure shows the vehicle status when viewed from the top)
Note: For the rotation of each wheel and barrel, the rotation direction in which the AGV travels forward is positive.

(1) Calculate the ax-axis and ay-axis components of the AGV speed

Vax=Va×sin θa
Vay=Va×cos θa

(2) Calculate the wheel speeds (Vw1, Vw2, Vw3, and Vw4) from the Vax, Vay, and ωa

Vw1=Vay - Vax - (a+b)/2× ωa
Vw2=Vay + Vax - (a+b)/2× ωa
Vw3=Vay - Vax + (a+b)/2× ωa
Vw4=Vay + Vax + (a+b)/2× ωa

(3) Calculate the wheel output speeds (Nw1, Nw2, Nw3, and Nw4) from the wheel speeds
   Note: If the wheel output speed exceeds the maximum output speed (refer to page 9), review the AGV speed.

Nw1 = Vw1 / (Dw × π) / 1000
Nw2 = Vw2 / (Dw × π) / 1000
Nw3 = Vw3 / (Dw × π) / 1000
Nw4 = Vw4 / (Dw × π) / 1000
Dw: Wheel diameter (refer to page 9)

(4) Calculate the motor output speeds (Nm1, Nm2, Nm3, and Nm4) from the wheel output speeds
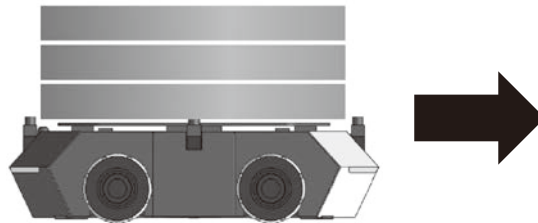
Nm1 = Nw1 × i
Nm2 = Nw2 × i
Nm3 = Nw3 × i
Nm4 = Nw4 × i
i: Speed ratio (refer to page 9)

Note: Examine the motor output speeds from the wheel output speeds calculated on this page.

Examination of the motor load torque (regular)

(1) Calculate the load torque applied to the wheel from the total weight

   Note: At constant speed on flat ground

$$Tw = \frac{W}{4} \times 9.8 \times Crr \times \frac{Dw}{2 \times 1,000} \times C$$

(when the center of gravity of the vehicle and load match the center of the vehicle)

Tw: Wheel torque [N•m]
W: Vehicle weight + load weight [kg]
Crr: Rolling resistance coefficient of the wheel while
      traveling forward/backward
      Refer to page 9
Dw: Wheel diameter [mm]
      Refer to page 9
C: Correction coefficient
   Note: Select the numeric value in accordance with the
         traveling direction

Correction coefficient C	
Travel forward/backward	1
Traverse	2
Diagonal movement	2.5

(2) Add the no-load running torque of the RVW in accordance with the wheel output speed
   Refer to page 27

(3) Convert the wheel torque into the motor shaft torque

$$Tm = (Tw / 0.95 + T_{0(Nm)}) / i$$

Tm: Motor torque [N•m]
$T_{0(Nm)}$: No-load running torque in accordance with the wheel
         output speed [N•m]
         Refer to page 27
i : Speed ratio
   Refer to page 9

Note: Consider the model of the motor from the motor torque value calculated on this page.

Examination of the motor load torque (acceleration/deceleration)

(1) Calculate the load torque applied to the wheel from the total weight and acceleration

Note: During acceleration or deceleration on flat ground
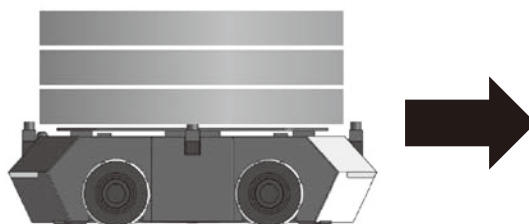
$$Tw = \frac{W}{4} \times (a + 9.8 \times Crr \times C) \times \frac{Dw}{2 \times 1,000}$$

(when the center of gravity of the vehicle and load match the center of the vehicle)

Tw: Wheel torque [N•m]
W: Vehicle weight + load weight [kg]
a: Acceleration [m/s^2] (during acceleration: +, during deceleration: –)
Crr: Rolling resistance coefficient of the wheel while traveling forward/
backward
Refer to page 9
C: Correction coefficient
Note: Select the numeric value in accordance with the traveling
direction
Dw: Wheel diameter [mm]
Refer to page 9

Correction coefficient C	
Travel forward/backward	1
Traverse	2
Diagonal movement	2.5

(2) Add the no-load running torque of the RVW in accordance with the wheel output speed
Refer to page 27

(3) Convert the wheel torque into the motor shaft torque

$$Tm = (Tw / 0.95 + T_{0(Nm)}) / i$$

Tm: Motor torque [N•m]
$T_{0(Nm)}$: No-load running torque in accordance with the wheel
output speed [N•m]
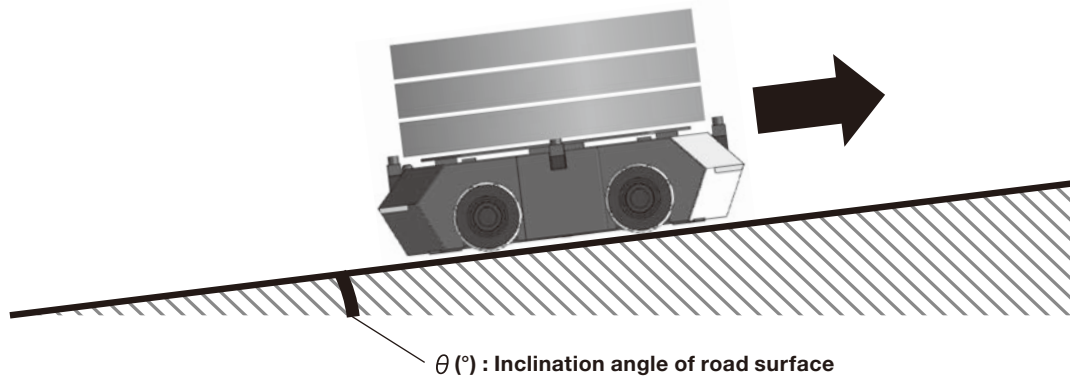Refer to page 27
i : Speed ratio
Refer to page 9

Note: Confirm the acceleration/deceleration characteristics of the selected motor from the motor torque value calculated on this page.
Note: The wheel torque value calculated on this page should not exceed the allowable acceleration/deceleration torque (refer to page 9).

Product model and motor selection calculation formula

Examination of the motor load torque (slope)

(1) Calculate the load torque applied to the wheel using the total weight and inclination angle

   Note: At constant speed on slope (travel forward/backward, or traverse)

θ **(°) : Inclination angle of road surface**

$$Tw = \frac{W}{4} \times 9.8 \times (\, SIN\theta + Crr \times C \times COS\theta \,) \times \frac{Dw}{2 \times 1{,}000}$$

(when the center of gravity of the vehicle and load match the center of the vehicle)

Tw: Wheel torque [N·m]
W: Vehicle weight + load weight [kg]
Crr: Rolling resistance coefficient of the wheel while
     traveling forward/backward
     Refer to page 9
Dw: Wheel diameter [mm]
     Refer to page 9
C: Correction coefficient
   Note: Select the numeric value in accordance with the
         traveling direction

Correction coefficient C	
Travel forward/ backward	1
Traverse	2

Note: Do not perform the diagonal
      movement on a slope due to
      safety reasons.

(2) Add the no-load running torque of the RVW in accordance with the wheel output speed
   Refer to page 27

(3) Convert the wheel torque into the motor shaft torque

   $Tm = (Tw / 0.95 + T_{0(Nm)}) / i$

Tm: Motor torque [N·m]
$T_{0(Nm)}$: No-load running torque in accordance with the wheel
      output speed [N·m]
      Refer to page 27
Nm: Wheel output speed [rpm]
i : Speed ratio
    Refer to page 9

Note: In case the motor torque value calculated on this page exceeds the rated torque of the selected motor, it is recommended
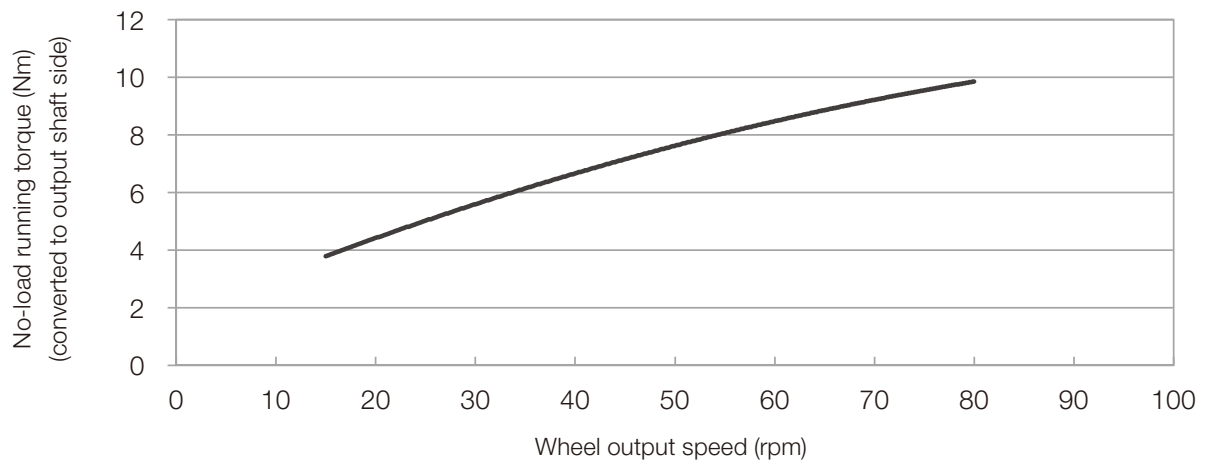   to review the traveling conditions.
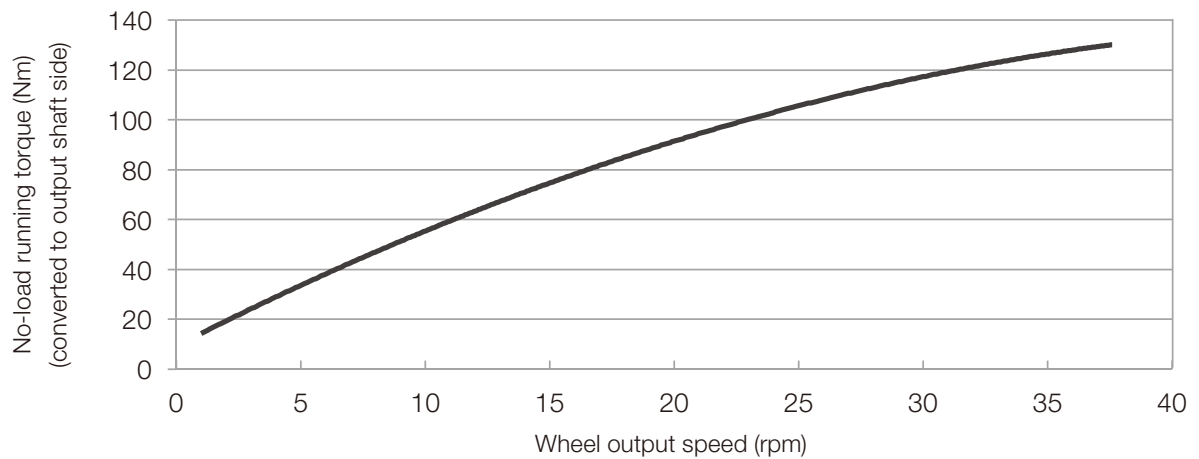
No-load running torque

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

[Measurement conditions]
Case temperature: 30°C
Lubricant: Oil
　　　　BONNOC AX68

Reduction gear used in the RVW-10PG

Reduction gear used in the RVW-20PG

Design points
Engineering notes

Installation of the gearhead and wheel

When installing the gear head and wheel, use hexagon socket head cap screws and tighten them at the tightening torque shown below in order to satisfy the allowable acceleration/deceleration torque, which is noted in the rating table. The use of the Belleville spring washer is recommended to prevent the bolt from loosening and protect the bolt seat surface from flaws.

• Hexagon socket head cap screw
<Bolt tightening torque and tightening force>

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

Note: 1. The tightening torque values listed are for steel or cast iron material.
2. If softer material, such as aluminum or stainless steel, is used, limit the tightening torque. Also pay attention to the system requirements of the transmission torque.

<Calculation of allowable transmission torque of bolts>

$$T = F \times \mu \times \frac{D}{2 \times 1,000} \times n$$

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

• Serrated lock washer for hexagon socket head cap screw
Name: Belleville spring washer (made by Heiwa Hatsujyo Industry Co., Ltd.)
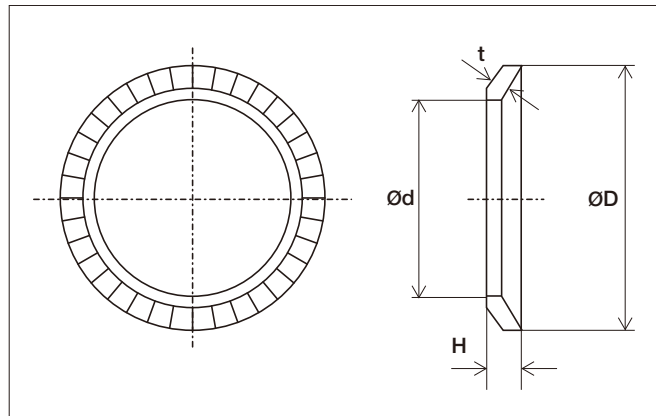Corporation symbol: CDW-H
CDW-L (Only for M5)
Material: S50C to S70C
Hardness: HRC40 to 48

(Unit: mm)

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

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

Lubrication

Lubricant

The standard lubricant of the RVW series AGV drive unit is oil.

In order to take advantage of the performance of this product, use the Nabtesco-specified lubricant.

Using other types of lubricant may cause deterioration of performance and premature damage.

Do not mix the Nabtesco-specified lubricant with other lubricants.

Mixing with other lubricants may cause deterioration of performance, generation of abnormal noise, and premature damage.

Brand specified by Nabtesco		Operating temperature range (ambient temperature)
JXTG Nippon Oil & Energy Corporation	BONNOC AX68	-10 to 40°C

Amount of lubricant

The RVW series AGV drive unit is not filled with lubricant when shipped from Nabtesco. The customer should prepare the lubricant specified by Nabtesco beforehand. In addition, be sure to design the system so that it can be filled with an appropriate amount of the lubricant specified by Nabtesco.

(When using the pneumatic pressure for filling the lubricant, set the set pressure to 0.03 MPa or less.)

Model	RVW-10PG	RVW-20PG
Required amount	153cc	894cc

- Regular amount of lubricant for the number of gearheads is needed.
- Check the regular amount of lubricant for products other than those stated in the catalog, referring to the individual outer dimensions.

Lubricant replacement time

During proper operation of the reduction gear, the standard lubricant replacement time due to lubricant degradation is 20,000 hours.

When operation involves a reduction gear surface temperature above 40°C (the ⬚ area in the following diagram), the state of the lubricant should be checked in advance and the lubricant replaced as early as necessary.

Engineering notes
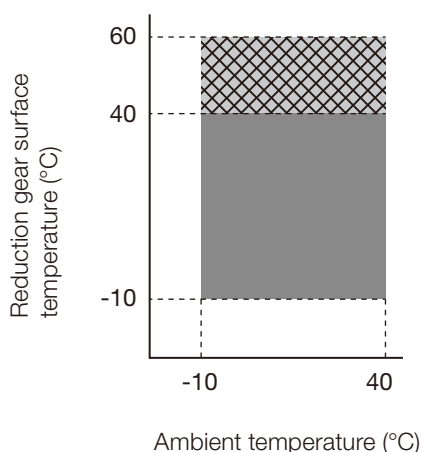
Allowable loading capacity

- Do not use the RVW such that its allowable loading capacity per wheel is exceeded.
- To prevent an excessive concentrated load to one wheel, take the vehicle center of gravity and load center of gravity into consideration.
- When the vehicle consists of the drive wheels at four locations, it is recommended that the total weight is kept to less than three times the loading capacity by taking variations in load distribution due to road surface conditions (swell, level difference, or groove) into consideration.
- Take appropriate measures so that the load does not exceed the allowable loading capacity of the wheel due to an impact caused when loading the vehicle.

Road surface

- The road should have a flat concrete surface that is free from foreign objects (dust, sand, water, or oil), level differences, grooves, or significant concave or convex areas.
- When the vehicle goes over a level difference or groove unavoidably, it should travel forward or backward. Use the vehicle after taking appropriate measures into consideration beforehand.
  In addition, it is recommended to install an appropriate foreign object removal mechanism in the vehicle so that no foreign objects on the road surface become entangled.
- The strength of the road surface should be verified using the actual vehicle beforehand. Reinforce the road surface or restrict the load weight as necessary.

Vehicle behavior

- The wheels may slip due to road surface conditions (oil, water, or inclination) or sudden acceleration or deceleration of the vehicle.
  In addition, when there are wheels that idle due to a level difference, it may affect the vehicle behavior, for example, the vehicle does not travel in the specified direction. In particular, when the vehicle performs a diagonal movement on a slope, its behavior may become unstable due to road surface conditions. Avoid such movement due to safety concerns.
- Maintain a sufficient distance so that the vehicle does not hit a person or an object or take appropriate safety measures so that a person does not approach the vehicle even when wheels slip or idle.
- To make the vehicle behavior stable, it is recommended to install a suspension mechanism so that four wheels are always in contact with a road surface.
- Take appropriate safety measures to prevent load drop or collapse when the vehicle behavior is disturbed.

Stopping on slope

- Avoid stopping on a slope.
  If a vehicle must be stopped on a slope unavoidably, add a function to maintain the position such as an external brake.

Failure during traveling

- If a power failure such as a voltage drop occurs while the vehicle is traveling, the vehicle may not stop completely due to inertial force.
  Therefore, use a motor with a brake to stop the vehicle using the brake immediately if any failure occurs.

Entanglement in wheel

- To prevent entanglement in a rotating wheel while the vehicle is traveling, install a protective cover (wheel cover) on the vehicle.

Installation of this product

- Install this product in the vehicle so that the wheel is perpendicular to the road surface as much as possible. If the wheel/road contact status is poor, the vehicle behavior may become unstable or the wheel may be damaged.

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 "Gearbox investigation request form" from our Website. Fill in the necessary information, and contact us via the agent where you bought the device.

[URL]: **https://precision.nabtesco.com/ja/download/sheet/**

The trouble started immediately after installation of this product

Check column	Item
	Make sure the product's drive section (the motor side or the Mecanum wheel) is not interfering with another component.
	Make sure a load greater than the expected level (allowable loading capacity or maximum speed) is not applied.
	Make sure the required number of bolts is 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 spline (input gear) is appropriately installed on the motor.
	Make sure there is no damage to the surface of the input spline (input gear) teeth.
	Make sure the barrel orientation is correct.
	Make sure four wheels are on the ground.

The trouble started during vehicle operation

Check column	Item
	Make sure this product has not been in operation longer than the calculated service life.
	Make sure the surface temperature of this product 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 a load greater than the expected level (allowable loading capacity or maximum speed) is not applied.
	Make sure the drive section of this product 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.
	Make sure the barrel is not worn out, cracked, or damaged.
	Make sure the wheel is not contaminated.
	Make sure no abnormal noise or rattle occurs in the bearing.
	Make sure no abnormal noise is generated during rotation of the wheel.

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.

   Notwithstanding the foregoing, a defect of the wheel is not covered by the warranty unless Nabtesco confirms that this defect was caused due to Nabtesco's design or manufacture, since the wheel is a consumable part.

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.

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