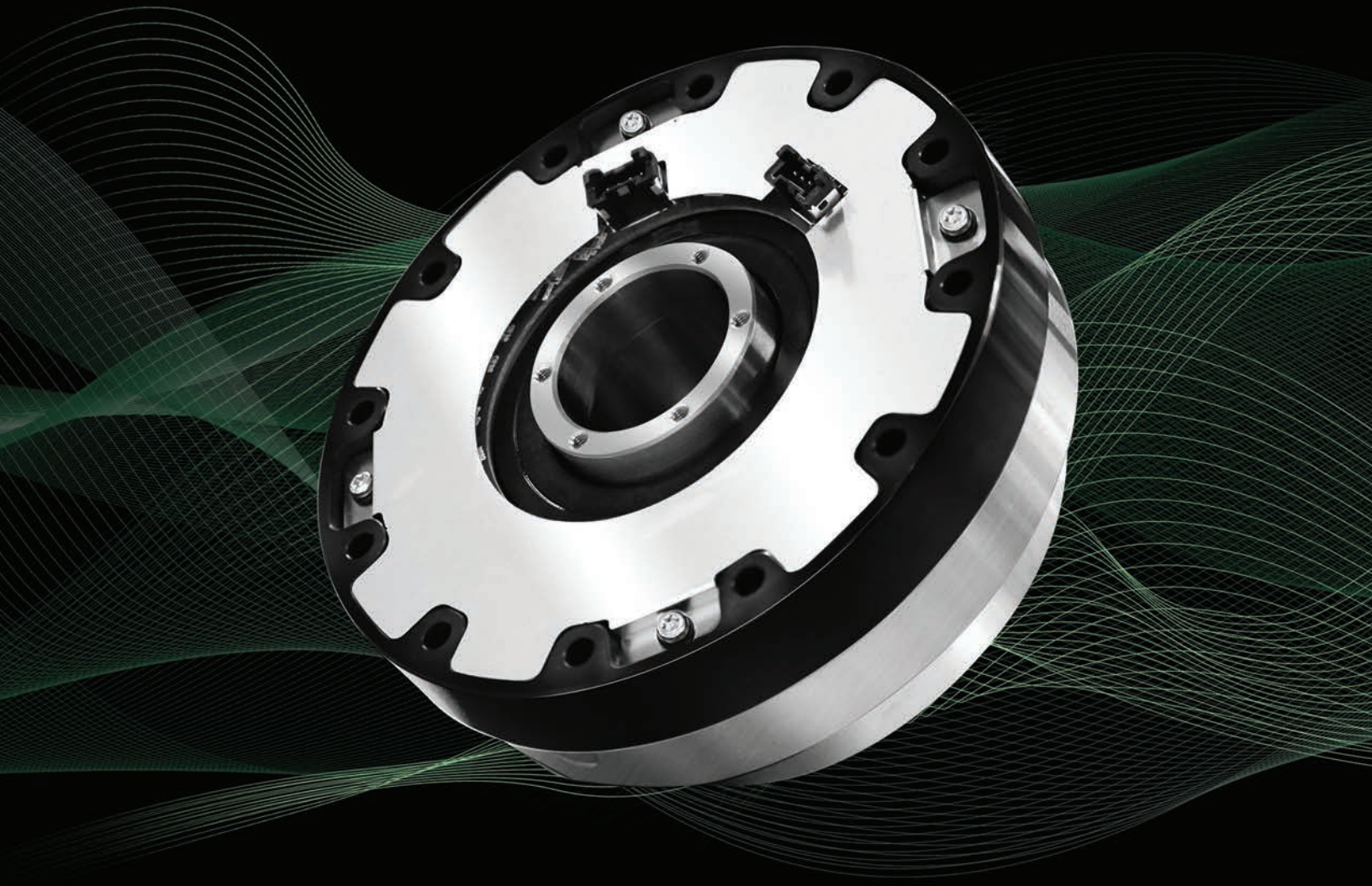
Nidec

Smart-FLEXWAVE

Next Generation Buit-in Multi-Sensor



WP Series

Integrated, Compact and Efficient Design

NIDEC DRIVE TECHNOLOGY CORPORATION

Built-in Multi-Sensor Gearbox

Smart-FLEXWAVE

Built-in Multi-Sensor Gearbox assists in maximizing your manufacturing and automation capabilities. It delivers a streamlined addition to your most demanding applications, saving space with its compact and lightweight design.

01 TORQUE SENSOR

The system's performance is optimized by accurately measuring the output torque from the gearbox.

02 TEMPERATURE SENSOR

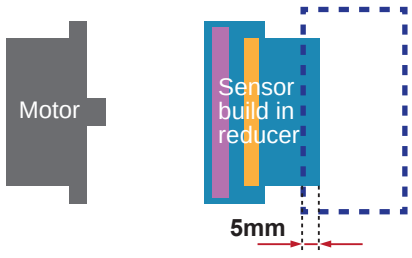
The system's stability is improved by continuously monitoring the gearbox temperature.

03 ANGLE SENSOR

The torque sensor achieves high-accuracy torque measurement by angle compensation.

Built-in Multi Sensor VS External Sensor

Smart-FLEXWAVE

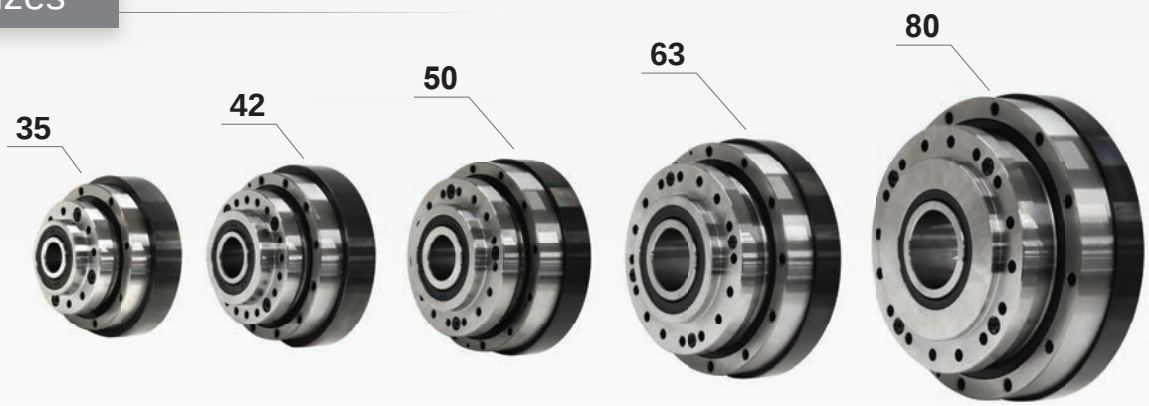


1. Lightweight
2. Space Saving
3. Cost-effective
4. High Rigidity

Conventional Gearbox

1. Heavyweight
2. Large Size
3. Expensive
4. Low Rigidity

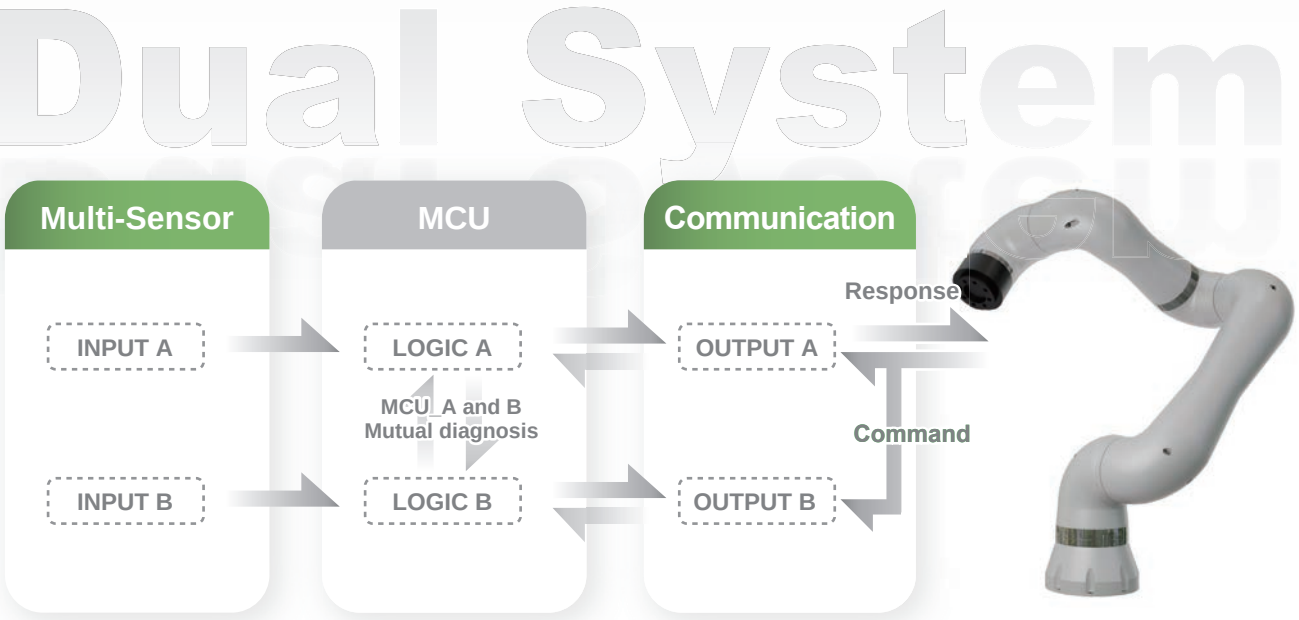
Sizes



Dual System + Collaborative Robots

WP Series

The dual-channel multi-sensor system for collaborative robots ensures high level safety for operator. The multi-drop connection allows for the connection of up to 8 axes with simplified wiring.



Designed for Safety Built for Trust

Smart-FLEXWAVE BD model complies with the functional safety standards for industrial equipment as a safety torque sensor and has obtained safety certification from the certification body, TÜV SÜD.

Applicable Standards:
EN ISO 13849-1:2023
IEC 61508: 2010
EN IEC 62061: 2021

Note: The integration of this product into the overall machine system does not ensure compliance with the essential requirements of the functional safety standards.

Model Nomenclature

WP	U	–	35	–	50	-	SRH	-	BD
Series name	Type		Size		Ratio		Shaft code		Sensor code
WP Series	Unit type • Hollow shaft unit • Input shaft unit		35 42 50 63 80		50 80 100 120 160		SRH SRJ		BD

Ratio Matrix Availability

Frame Size	Reduction Ratio				
	50	80	100	120	160
35	■	■	■		
42	■	■	■	■	
50	■	■	■	■	■
63	■	■	■	■	■
80	■	■	■	■	■

Reducer Specifications

Frame	Ratio R*1	Nominal Output Torque *2	Maximum Output Torque *3	Emergency Stop Torque *4	Nominal Input Speed *5	Maximum Input Speed *6	Life *7
		[Nm]	[Nm]	[Nm]	[r/min)	[r/min]	[hours]
35	50	7	23	46	3000	8500	7692
	80	10	30	61			
	100	10	36	70			
42	50	21	44	91	3000	7300	
	80	29	56	113			
	100	31	70	143			
	120	31	70	112			
50	50	33	73	127	3000	6500	
	80	44	96	165			
	100	52	107	191			
	120	52	113	191			
	160	52	120	191			
63	50	51	127	242	3000	5600	
	80	82	178	332			
	100	87	204	369			
	120	87	217	395			
	160	87	229	408			
80	50	99	281	497	3000	4800	
	80	153	395	738			
	100	178	433	841			
	120	178	459	892			
	160	178	484	892			

*1 Reduction ratio is to be calculated by the formula in the previous page, using R value in this table.
*2 The maximum allowable value at the input rotation speed of 2000r/min
*3 The maximum torque when starting and stopping.
*4 The maximum torque when it receives shock.
*5 The maximum average input speed.
*6 The maximum input speed.
*7 The life time at the input rotation speed of 2000 r/min and nominal output torque.

Sensor Data

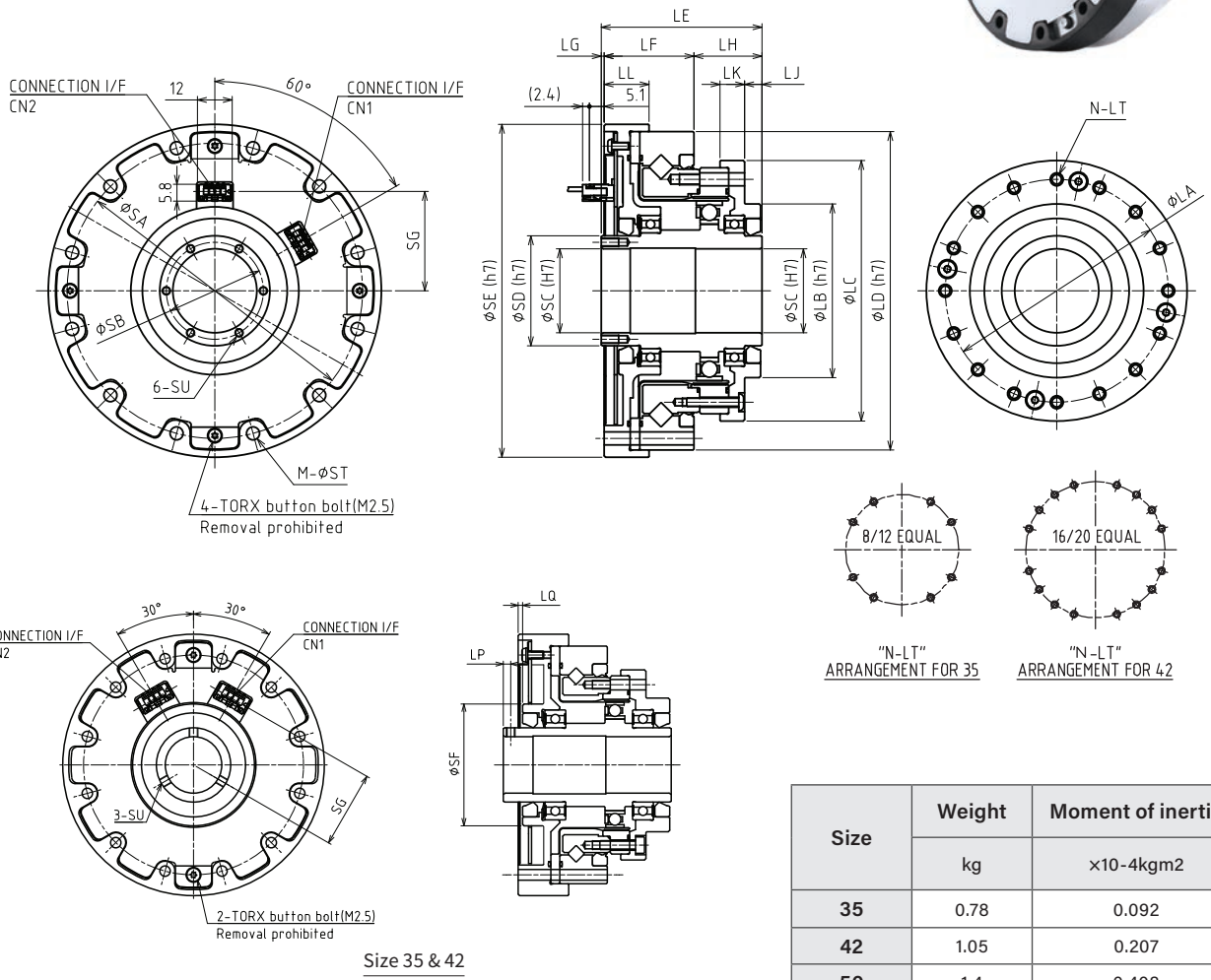
Sensor Type	Features	Description	Notes
Torque Sensor	Rated torque	Equivalent to the maximum allowable torque of the reducer	--
	Limit torque	Equivalent to the emergency stop torque of reducer	--
	Durability	Equivalent to reducer	--
	Measuring range (Full scale)	Determined by the size of the reducer	--
	Non-linearity	±3% FS or less	Range to rated torque
	Hysteresis	3% FS or less	Range to rated torque
	Cross-axis sensitivity	±1% FS or less	Range to allowable moment of reducer
	Temperature compensation	±0.05FS/°C	Use the built-in temperature sensor
	Resolution	12-bit	Range: ±2000 LSB:Determined by the size of the reducer
	Functional safety	PLd (Category 3) /ISO 13849-1 SIL2 /IEC 61508	Certification is expected in 2024
Temperature Sensor	Accuracy	±2°C	T.B.D.
	Measuring range	0°C ~ 80°C	--
	Resolution	0 ~ 800 bit	LSB: 0.1°C
General	Power supply voltage	DC24V+10%/-15%	--
	Consumption current	0.1A or less	T.B.D.
	Communication method	RS-485 Half-duplex (2-wire)	--
	Baud rate	3.0Mbps	--
	Operating temperature limit	0°C ~ 80°C	--

Sensor Specifications

Frame	Ratio R*1	Rated Load [Nm]	Full Scale [Nm]	LSB [Nm]
35	50	23	± 50	0.025
	80	30		
	100	36		
42	50	44	± 100	0.050
	80	56		
	100	70		
	120	70		
50	50	73	± 150	0.075
	80	96		
	100	107		
	120	113		
	160	120		
63	50	127	± 300	0.150
	80	178		
	100	204		
	120	217		
	160	229		
80	50	281	± 600	0.300
	80	395		
	100	433		
	120	459		
	160	484		

SRH Hollow Shaft Unit

WPU-□-□-SRH-BD



Size 35 & 42

Size	Weight	Moment of inertia
	kg	×10-4kgm2
35	0.78	0.092
42	1.05	0.207
50	1.4	0.408
63	2.1	1.06
80	4.2	2.72

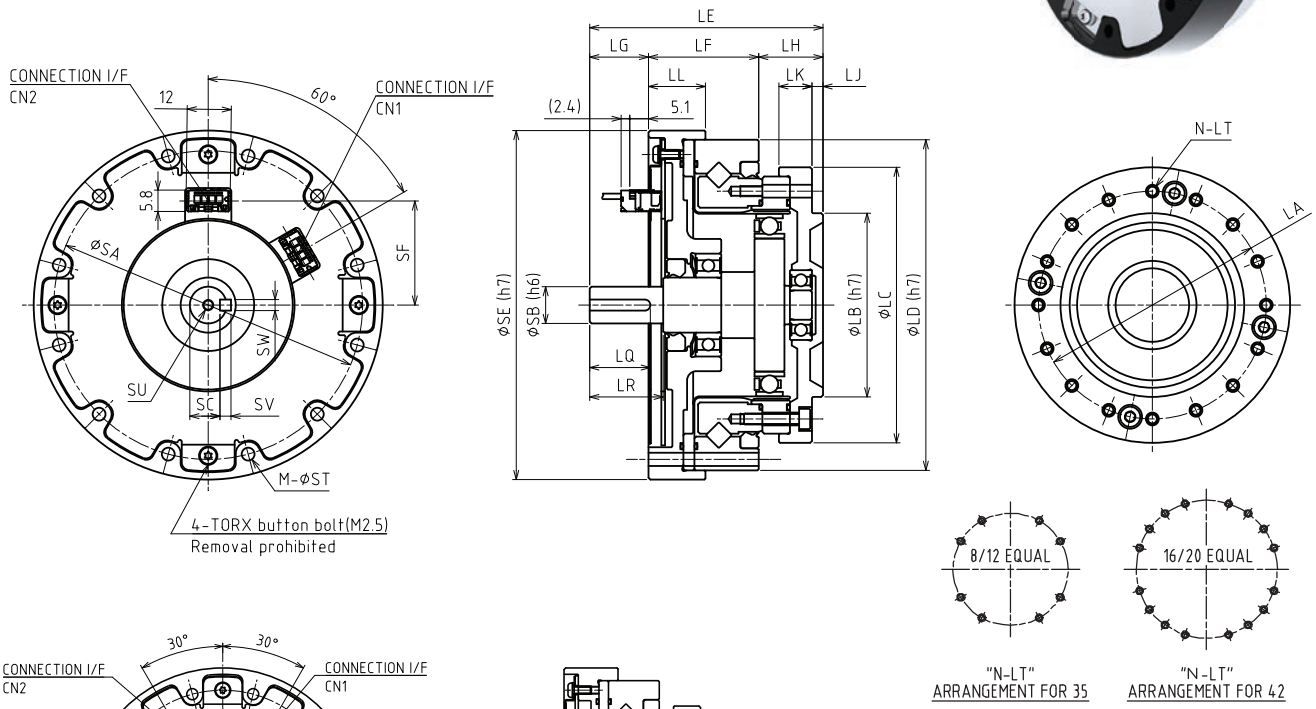
[mm]

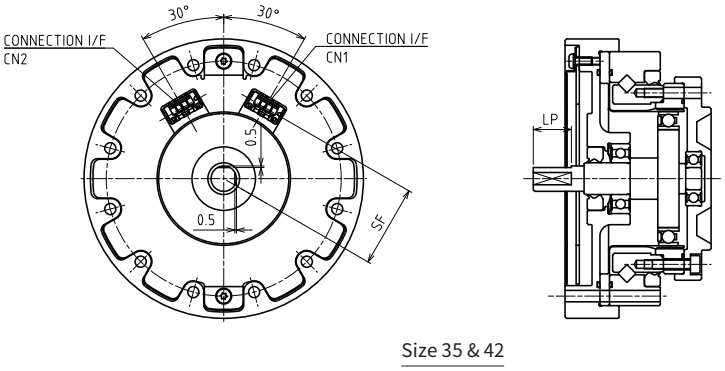
Size	LA	LB	LC	LD	LE	LF	LG	LH	LJ	LK	LL	LP	LQ
35	44	36	54	70	52.5	27.5	5	20	7.5	8	16	2.5	1.5
42	54	45	64	80	56.5	30	5	21.5	8.5	8.5	17	2.5	1.5
50	62	50	75	90	51.5	30	0	21.5	7	9	15.5	-	-
63	77	60	90	110	55.5	31	1	23.5	6	8.5	15.5	-	-
80	100	85	115	142	65.5	37	2	26.5	5	9.5	17	-	-

Size	SA	SB	SC	SD	SE	SF	SG	M	ST	SU	N	LT
35	64	-	14	20	78	36	21.6	8	3.5	M3	8	M3× 5, Ø3.5× 11.5
42	74	-	19	25	88	41	25.8	12	3.5	M3	16	M3× 6, Ø3.5× 12
50	84	25.5	21	30	95	-	28.3	12	3.5	M3×6	16	M3× 6, Ø3.5× 13.5
63	102	33.5	29	38	115	-	34.3	12	4.5	M3×6	16	M4× 7, Ø4.5× 15.5
80	132	40.5	36	45	147	-	42.9	12	5.5	M3×6	16	M5× 8, Ø5.5× 20.5

SRJ Input Shaft Unit

WPU-□-□-SRJ-BD





Size 35 & 42

Size	Weight	Moment of inertia
	kg	×10-4kgm2
35	0.71	0.027
42	0.96	0.067
50	1.4	0.155
63	2.1	0.382
80	4.1	1.28

[mm]

Size	LA	LB	LC	LD	LE	LF	LG	LH	LJ	LK	LL	LP	LQ	LR
35	44	36	54	70	50.5	27.5	8	15	2.5	8	16	11	-	-
42	54	45	64	80	56	30	10	16	3	8.5	17	12	-	-
50	62	50	75	90	63.5	30	16	17.5	3	9	15.5	-	16.5	20
63	77	60	90	110	72.5	31	21	20.5	3	8.5	15.5	-	22.5	25
80	100	85	115	142	84.5	37	21	26.5	5	9.5	17	-	22.5	25

Size	SA	SB	SC	SE	SF	SV	SW	M	ST	SU	N	LT
35	64	6	-	78	21.6	-	-	8	3.5	-	8	M3× 5, Ø3.5× 11.5
42	74	8	-	88	25.8	-	-	12	3.5	-	16	M3× 6, Ø3.5× 12
50	84	10	8.2	95	28.3	3	3	12	3.5	M3×6	16	M3× 6, Ø3.5× 13.5
63	102	14	11	115	34.3	5	5	12	4.5	M5×10	16	M4× 7, Ø4.5× 15.5
80	132	14	11	147	42.9	5	5	12	5.5	M5× 10	16	M5× 8, Ø5.5× 20.5

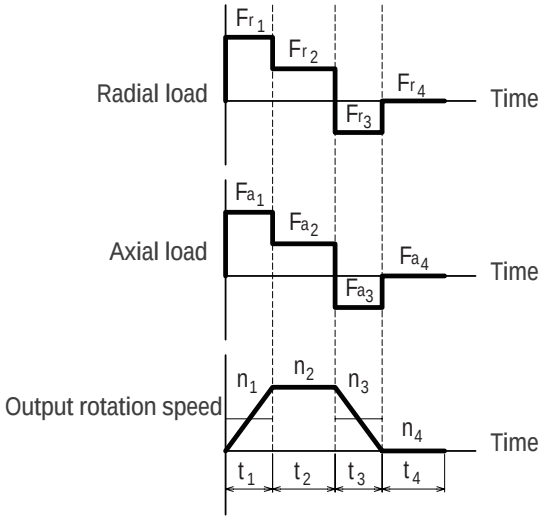
Life Estimation (Main Bearing)

Main bearing specification (Cross roller bearing)

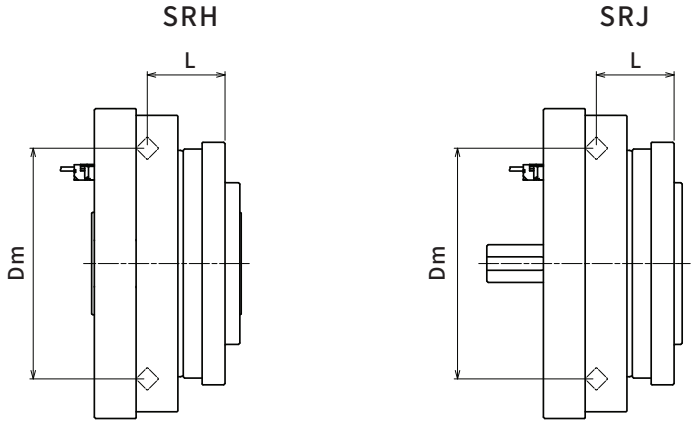
Series	Size	Pitch Circle Diameter of the Bearing Rollers	Offset	Basic Dynamic Load Rating	Basic Static Load Rating	Allowable Moment	Moment Rigidity
		Dm	L	C	Co	Mal	Km
		m	m	N	N	Nm	×10⁴ Nm/rad
WPU-□-□-SRH WPU-□-□-SRJ	35	0.0500	0.0217	5800	8600	74	8.5
	42	0.0600	0.0239	10400	16300	124	15.4
	50	0.0700	0.0255	14600	22000	187	25.2
	63	0.0850	0.0296	21800	35800	258	39.2
	80	0.111	0.0364	38200	65400	580	100

Life span for the main bearing

Operation cycle example



External load



Life Estimation (Main Bearing)

Calculation formula for the largest working moment

Peak working moment	**Mm**	**Nm**	$Mm = Frm \cdot (Lr + L) + Fam \cdot La$
Peak radial load	**Frm**	**N**	Frm = maximum value of $Fr_1, Fr_2, \cdots Fr_n$
Peak axial load	**Fam**	**N**	Fam = maximum value of $Fa_1, Fa_2, \cdots Fa_n$

Please make sure the peak working moment is below the maximum allowable moment.

Calculation formula for the Average radial load, Axial load, Average output rotation speed, Average working moment

Average radial load	**Fra**	**N**	$Fra = \sqrt[10/3]{\dfrac{n_1 \cdot t_1 \cdot \lvert Fr\rvert^{10/3} + n_2 \cdot t_2 \cdot \lvert Fr_2\rvert^{10/3} + \cdots + n_n \cdot t_n \cdot \lvert Fr_n\rvert^{10/3}}{n_1 \cdot t_1 + n_2 \cdot t_2 + \cdots + n_n \cdot t_n}}$
Axial load	**Faa**	**N**	$Faa = \sqrt[10/3]{\dfrac{n_1 \cdot t_1 \cdot \lvert Fa_1\rvert^{10/3} + n_2 \cdot t_2 \cdot \lvert Fa_2\rvert^{10/3} + \cdots + n_n \cdot t_n \cdot \lvert Fa_n\rvert^{10/3}}{n_1 \cdot t_1 + n_2 \cdot t_2 + \cdots + n_n \cdot t_n}}$
Average output rotation speed	**nao**	**r/min**	$nao = \dfrac{n_1 \cdot t_1 + n_2 \cdot t_2 \cdots n_n \cdot t_n}{t_1 + t_2 + \cdots + t_n}$
Average working moment	**Ma**	**Nm**	$Ma = Fra \cdot (Lr + L) + Faa \cdot La$

Calculation formula for the Loading factor, Equivalent radial load

Loading factor	**Xc, Yc**	**-**	$\dfrac{Faa}{Fra + 2Ma / Dm} \leqq 1.5$ *in the case of, Xc = 1.0, Yc = 0.45*
			$\dfrac{Faa}{Fra + 2Ma / Dm} > 1.5$ *in the case of, Xc = 0.67, Yc = 0.67*
Equivalent radial load	**Pc**	**N**	$Pc = Xc \cdot (Fra + 2Ma/Dm) + Yc \cdot Faa$

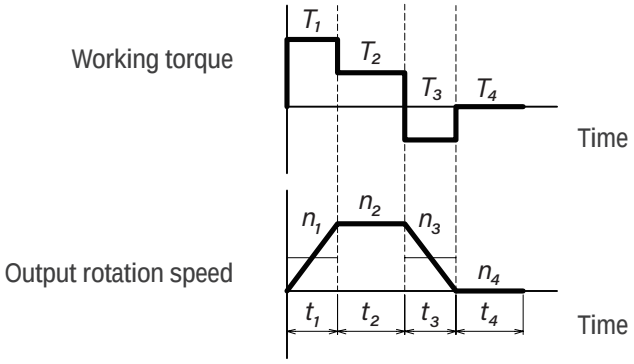
Life span for the main bearing

Life span for the main bearing	**Lhc**	**h**	$Lhc = \dfrac{10^6}{60 \cdot nao} \cdot \left(\dfrac{C}{fw \cdot Pc}\right)^{\frac{10}{3}}$
Impact factor	**f w**	**-**	*1.0: no shock*
			1.2: with some shock
			1.5: with shock and vibration

Life Estimation (Elastic Bearing)

Life span for the elastic bearing

Operation cycle example



Calculation formula for output torque

Average output torque	**Tao**	**Nm**	$Tao = \sqrt[3]{\frac{n_1 \cdot t_1 \cdot \lvert T_1 \rvert^3 + n_2 \cdot t_2 \cdot \lvert T_2 \rvert^3 + \cdots + n_n \cdot t_n \cdot \lvert T_n \rvert^3}{n_1 \cdot t_1 + n_2 \cdot t_2 \cdots n_n \cdot t_n}}$
Peak output torque value	**Tmo**	**Nm**	Tmo = maximum value of $T_1, T_2, \cdots T_n$

Please make sure the peak output torque is below the maximum output torque in the specification table.

Calculation formula for input speed

Average output rotation speed	**nao**	**r/min**	$nao = \frac{n_1 \cdot t_1 + n_2 \cdot t_2 \cdots n_n \cdot t_n}{t_1 + t_2 + \cdots + t_n}$
Peak output rotation speed	**nmo**	**r/min**	nmo = maximum value of $n_1, n_2, \cdots n_n$
Average input speed	**nai**	**r/min**	$nai = nao \times R$ (R = ratio)
Peak input speed value	**nmi**	**r/min**	$nmi = nmo \times R$ (R = ratio)

Please make sure the peak input speed value is below the maximum input speed in the specification table.

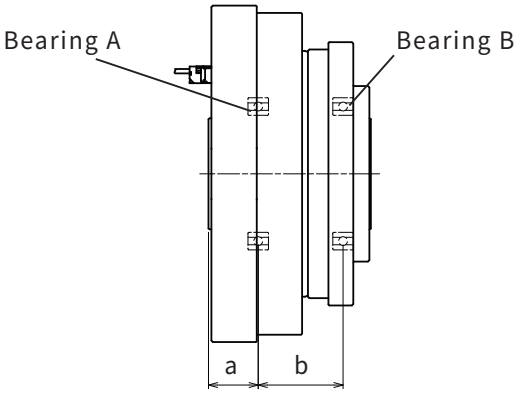
Calculation formula for life span

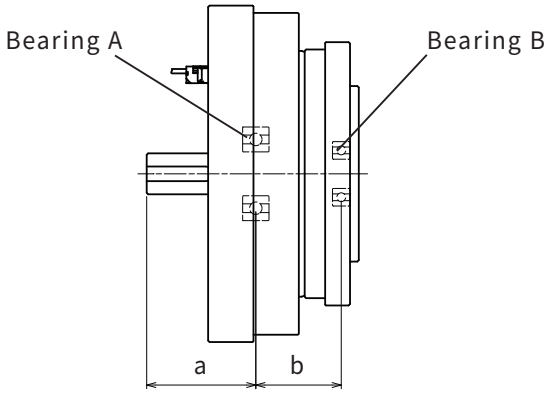
Part life span for the elastic bearing	**Lhe**	**h**	$Lhe = 10000 \times \left(\frac{Tar}{Tao}\right)^3 \times \left(\frac{nar}{nai}\right)$
Rating torque	**Tar**	**Nm**	*Nominal output torque in the specification table*
Rating input rotation speed	**nar**	**r/min**	*2000 r/min*

Maximum Load at Input Shaft

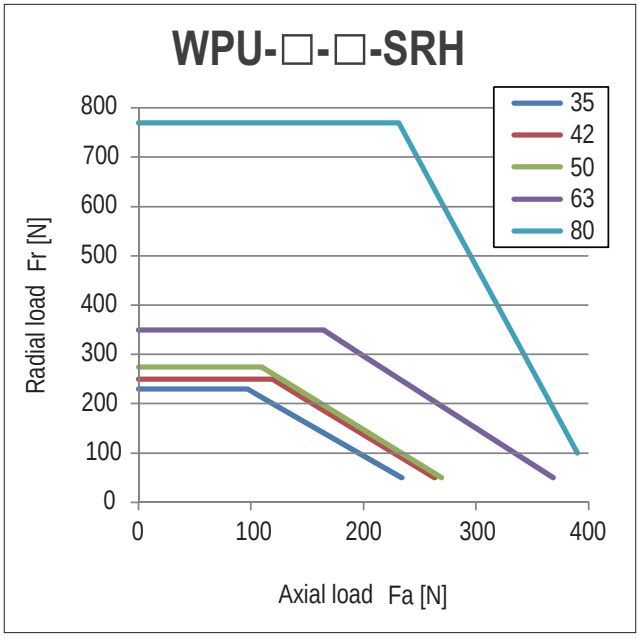
Bearing specification (Open type, Unit)

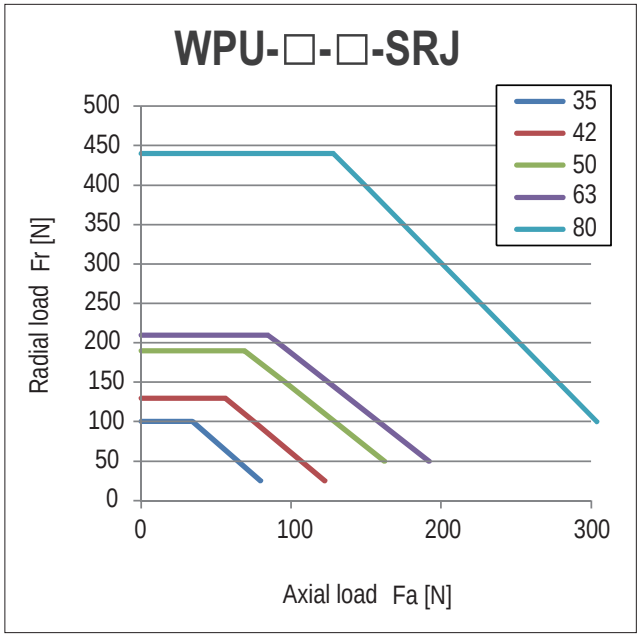
Series	Size	A Bearing A		B Bearing B		a	b
		Basic Dynamic Load Rating	Basic Static Load Rating	Basic Dynamic Load Rating	Basic Static Load Rating		
		C	Co	C	Co		
		N	N	N	N	mm	mm
WPU-□-□-SRH	35	4000	2470	4000	2470	16.5	26.5
	42	4300	2950	4300	2950	17.5	29.5
	50	4500	3450	4500	3450	16	26
	63	4900	4350	4900	4350	17	29
	80	14100	10900	5350	5250	20	35.5
WPU-□-□-SRJ	35	2240	910	1080	430	24.5	21
	42	2700	1270	1610	710	27.5	23
	50	4350	2260	2240	910	32.3	25.2
	63	5600	2830	2700	1270	37.3	29.2
	80	9400	5000	4350	2260	39.4	38.1





Maximum load (Average input rotation speed : 2000r/min, Life span : 10000h)



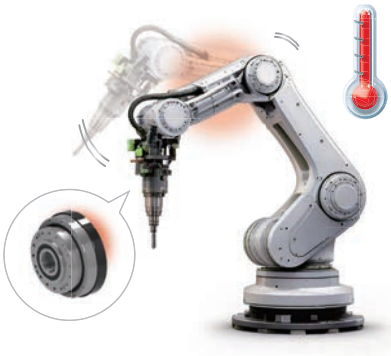


Application

Collision detection / Overall monitoring

Monitoring torque for screw tightening

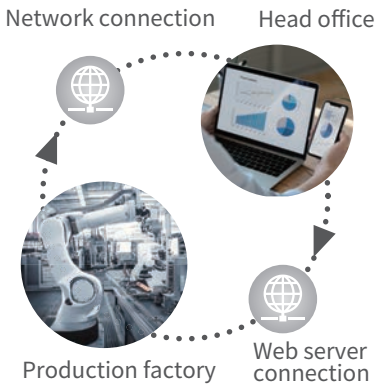
Arm heat effect compensation / Overheat monitoring



Robot stop position / Angle monitoring

∗ Please consult with us.

Network monitoring system



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