

ILJIN *flix*-DRIVE Strain Wave Gear Leaflet for Gears with short axial length



**MORE CREATIVE,
MORE INNOVATIVE,
WORLD CLASS ILJIN**

ILJIN Company Introduction

ILJIN is a global leader in bearings, wheel bearings and chassis components to automotive and industrial customers world-wide. We also manufacture Strain Wave Gear for these demanding applications. Our Strain Wave Gear meets highest precision and torque requirements. ILJIN can provide optimized designs bespoke to your application needs.

STRENGTHS

Engineering service worldwide

- Engineering centers in Asia, Europe and North America.
- Customized engineering solution tailored to your needs.

Customized design

- Engineered solution to customer's requirements.
- Joint development to customer specification.
- Value added solutions.

High precision & performance

- Optimized tooth profile design.
- Zero backlash.
- High transmission and positioning accuracy.
- Excellent torque transmission capability range.



R&D Motion & Control Center
Design
Testing
Prototyping & small batch production



Bearing ART plant
Testing
Prototyping & large-scale production

flix-DRIVE Performance Specifications (Short Type Gears)

- (1): If Internal Gear is fixed and Flexgear is Output, otherwise Ratio = Nominal Ratio + 1
 (2): If lubricated with ILJIN's recommended grease
 (3): On Demand
 Cup-SB: Applicable for Cup-Flexgear with Standard through Bore
 Cup-EB: Applicable for Cup-Flexgear with Extended through Bore
 Hat-Unit: Applicable for Hat-Flexgear
 T_{OM} is limited for Cup-SB and Cup-EB due to applicable Screw Connection by Flexgear-Flange Bore Pattern.
 Actual value is equal to value given for Hat-Unit.

flix-DRIVE Definitions

Repeatable Start/Stop-Torque T_{RSS} :

Can be provided in application duty cycle short-term, periodically, e.g for Acceleration and Deceleration.
 Can only be exceeded occasionally – see below.

Occasional Momentary Torque T_{OM} :

This is the very maximum torque in the application, that must not occur, periodically, in the usual application duty cycle but only very seldom in unexpected cases, e.g. emergency stops

Average Application Torque T_{AV} :

Torque and Speed is usually changing within the application duty cycle and can be replaced by an equivalent substitute value, that must not exceed the given value

Rated Life Torque T_{RL} :

This is the Reference Torque for Lifetime calculation but not applicable for sizing the gear with regards to the Application load Torque.
 L_{10} at 2000 rpm is 7000h

Ratcheting Torque T_{RT} :

In Case the output is blocked but a high input torque is applied to the Cam shaft, e.g sudden hard limit stop, the teeth engagement might skip. The given value is for info only but not a gear sizing criteria.

Buckling Torque T_{BT} :

While the Cam shaft is blocked but the Output is applied with such Torque, the Flexible Gear might buckle. The given value is for info only but not a gear sizing criteria.

Maximum input speed n_{in-max} :

The gear must not be driven with a higher speed and only short-term, with subsequent idle or low speed to maintain

Average Input speed n_{in-av} :

The application variable speed must not exceed in average the given Value

Size	Nominal Ratio ⁽¹⁾	Repeatable Start/Stop Torque (T_{RSS}) (2)	Average Application Torque (T_{AV}) (2)	Rated Life Torque (T_{RL}) (2)	Occasional Momentary Torque (T_{OM}) (2)			Ratcheting Torque (T_{RT})	Buckling Torque (T_{BT})	Max. Input Speed	Average Input Speed
					Cup-SB	Cup-EB	Hat-Unit				
					[Nm]	[Nm]	[Nm]				
35 (1,4")	50	12	4,8	3,7	24			60	190	8500	3500
	80	16	7,7	5,4	31	35	75				
	100	19	7,7	5,4	31	35	55				
43 (1,7")	50	23	18	11	48			105	330	7300	3500
	80	29	19	15	55	61	140				
	100	37	27	16	55	71	110				
	120	37	27	16	55	71	80				
51 (2,0")	50	39	24	17	69			150	560	6500	3500
	80	51	33	24	76	65	89	245			
	100	57	34	28	76	65	95	180			
	120	60	34	28	76	65	95	165			
64 ⁽³⁾ (2,5")	50	69	38	27	127			315	1000	5600	3500
	80	96	60	44	152	135	n/a	475			
	100	110	75	47	152	135	n/a	350			
	120	117	75	47	152	135	n/a	325			
83 ⁽³⁾ (3,2")	50	151	75	53	268			685	2200	4800	3500
	80	213	117	83	359	331	n/a	980			
	100	233	151	96	359	331	n/a	700			
	120	247	151	96	359	331	n/a	685			

Table 1: Output Torque and Speed Technical specification

flix-DRIVE Gear Characteristics (Short Type Gears)

Gear Torsional Stiffness K1/K2/K3, Hysteresis Loss, Transmission Accuracy TA, Efficiency

SIZE		35 (1,4")	43 (1,7")	51 (2,0")	64 ⁽³⁾ (2,5")	83 ⁽³⁾ (3,2")	
	T_2 [Nm]	6,9	12	25	48	108	
	T_1 [Nm]	2,0	3,9	7	14	29	
i = 50	> T_2	⁽¹⁾ K_3 [10 ³ Nm/rad]	4,7	12	20	37	84
	$T_1 \dots T_2$	⁽¹⁾ K_2 [10 ³ Nm/rad]	3,7	8,8	13	27	61
	0 ... T_1	⁽¹⁾ K_1 [10 ³ Nm/rad]	2,9	6,7	11	20	47
	Hysteresis Loss [arcmin]		2,5	2,0	2,0	2,0	2,0
i >= 80	> T_2	⁽¹⁾ K_3 [10 ³ Nm/rad]	6,1	13	25	47	110
	$T_1 \dots T_2$	⁽¹⁾ K_2 [10 ³ Nm/rad]	4,4	9,4	17	37	78
	0 ... T_1	⁽¹⁾ K_1 [10 ³ Nm/rad]	4,0	8,4	13	27	61
	Hysteresis Loss [arcmin]		2,0	1,0	1,0	1,0	1,0
Transmission Accuracy TA [arcmin]	⁽²⁾ Max	1,5	1,5	1	1	1	
	⁽²⁾ Typ	0,7...1	0,7...1	0,5...0,8	0,5...0,8	0,5...0,8	
Efficiency Gear Set @ 20°C [%]	@ 1000 rpm	75...76	78...79	78...79	78...79	78...79	
	@ 2000 rpm	70...72	72...74	72...75	72...75	72...75	

Table 2: Gear Characteristics Technical specification

(1) Given Gear Torsional Stiffness K1/K2/K3 is an average on batch level.

On item level we guarantee 80 % of given values

(2) Better Transmission Accuracy can be offered, please contact

(3) On Demand

flix-DRIVE Definitions

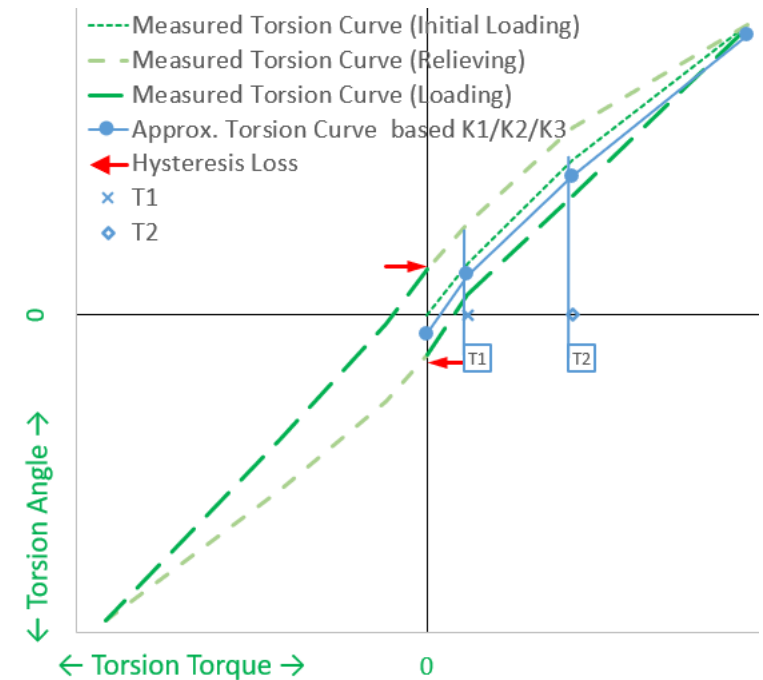


Figure 1: Definition of Torsional stiffness and Hysteresis Loss

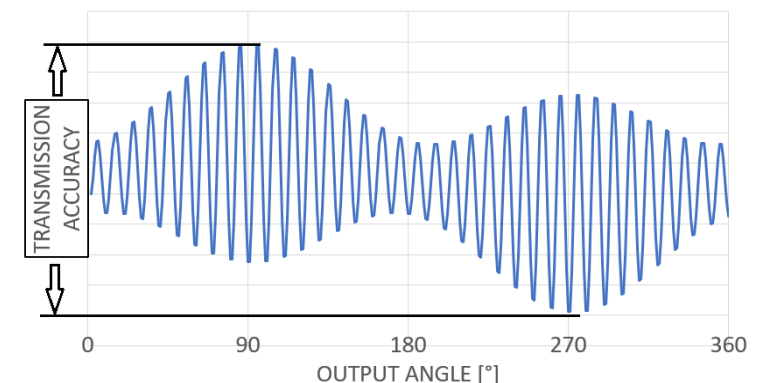


Figure 2: Definition of Transmission accuracy TA

ILJIN's Short Cup-Type Strain Wave Gear Set

Drop-in Replacement for popular Market Standard

fliX-DRIVE

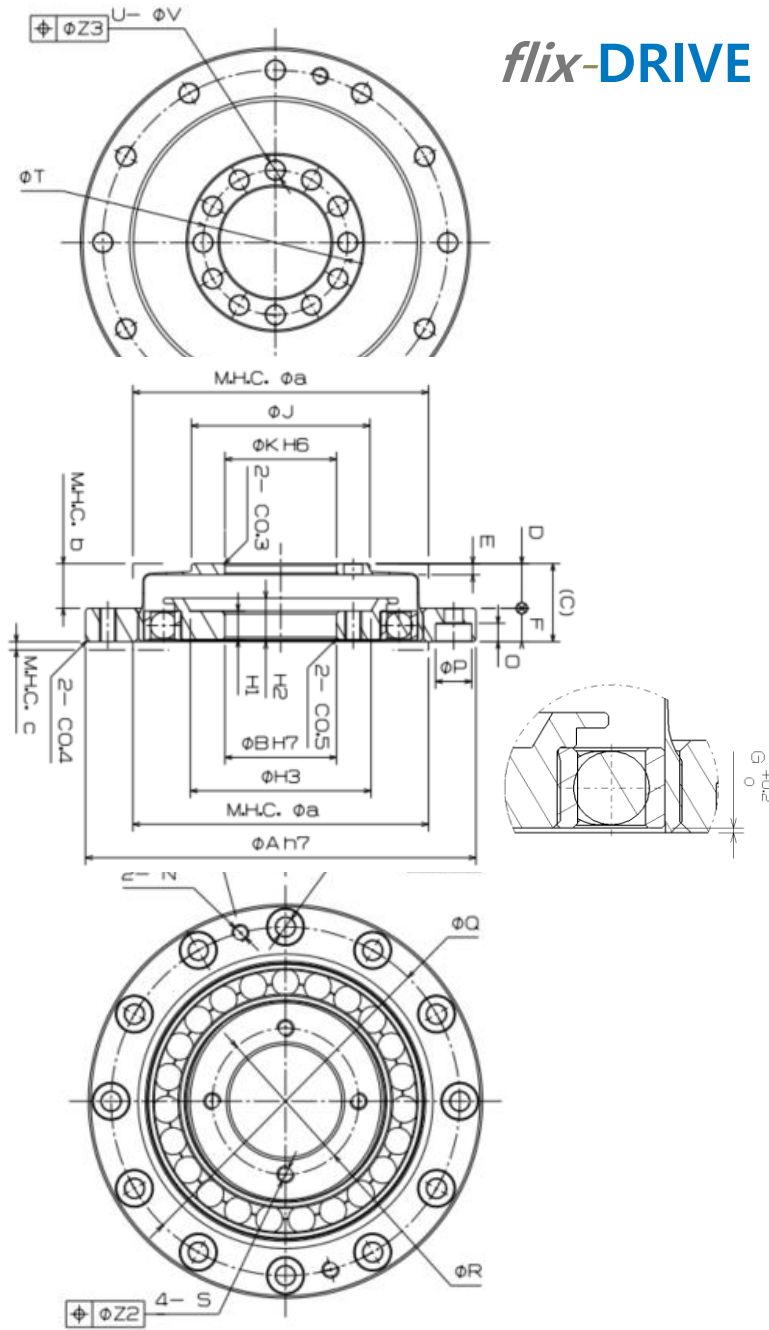


Figure 3: Design overview of Short Cup SWG

SIZE	35 (1,4")	43 (1,7")	51 (2,0")	64 ⁽³⁾ (2,5")	83 ⁽³⁾ (3,2")
ØA h7	50	60	70	85	110
ØB H7	11	15	20	24	32
(C)	11	12,5	14	17	22
D	6.5 ^{+0.2}	7.5 ^{+0.2}	8.5 ^{+0.3}	10 ^{+0.3}	13 ^{+0.3}
E	1,4	1,7	2	2	2,5
F	4,5	5	6	7	9
ØG ^{+0.2}	0,3	0,3	0,3	0,4	0,5
H1	4 ^{-0.1}	5 ^{-0.1}	5.2 ^{-0.1}	6.35 ^{-0.1}	8.6 ^{-0.1}
H2	5.7 ^{-0.1}	6.5 ^{-0.1}	7.5 ^{-0.1}	TBD	TBD
ØH3	21	24,9	32.4	TBD	TBD
ØJ	23	27,2	32	40	52
ØK H6 (SB/EB)	11 / 11	11 / 11	16 / 20	20 / 24	30 / 32
L	6	8	12	12	12
ØM	3,4	3,4	3,4	3,4	4,5
N	M3	M3	M3	M3	M4
O	-	-	3,3	3,3	4,4
ØP	-	-	6,5	6,5	8
ØQ	44	54	62	75	100
ØR	17	21	26	30	40
S	M3	M3	M3	M3	M4
ØT (SB/EB)	17 / 17	19,5 / 19,5	24 / 26	30 / 32	41 / 42
U (SB/EB)	9 / 9	8 / 8	9 / 12	9 / 12	11 / 14
ØV (SB/EB)	3,4 / 3,4	4,5 / 4,5	4,5 / 3,4	5,5 / 4,5	6,6 / 5,5
ØZ1	0,2	0,2	0,2	0,2	0,25
ØZ2	0,25	0,25	0,2	0,2	0,25
ØZ3 (SB/EB)	0,2 / 0,2	0,25 / 0,25	0,25 / 0,2	0,25 / 0,25	0,3 / 0,25
MHC	Øa	38	45	53	66
	b	6,5	7,5	8	10
	c	1	1	1,5	1,5
Mass [kg] (*)	0,06	0,1	0,15	0,25	0,52
Inertia Cam Shaft [kgmm²] (*)	~2	~6	~9	~30	~110

(*) Mass / Inertia for Reference, pending final design

(3) On Demand

SB: Cup-Flexgear with Standard through Bore

EB: Cup-Flexgear with Extended through Bore

flix-DRIVE Strain Wave Gear Assessment

**Below Conditions shall be met
for suitable Gear selection**

Assessment 1: $T_{RSS} \geq T_{A_max}$

Assessment 2: $n_{in_max} \geq i * n_{A_max}$

Assessment 3: $T_{OM} \geq T_{A_except}$

Assessment 4:

$$T_{AV} \geq T_{A_av} \quad ; \quad T_{A_av} = \sqrt[3]{\frac{\sum(\varphi_x * |T_x|^3)}{\sum \varphi_x}}$$

Assessment 5:

$$n_{in_av} \geq i * n_{A_av} \quad ; \quad n_{A_av} = \frac{\sum(nx + tx)}{\sum t_x + t_{idle}}$$

Assessment 6:

$$L_{10} = 7000hrs * \left(\frac{T_{RL}}{T_{A_av}}\right)^3 * \frac{2000}{n_{in_av}}$$

Assessment 7:

$$n_{out_dom} \neq \frac{60 * f_{res}}{i} = \frac{30}{i * \pi} \sqrt{\frac{K_x}{J_{A_Load}}}$$

T_{RSS} : Repeatable Start-Stop-Torque (Table 1)

T_{A_max} : max. Torque in Application's Load cycle, periodically

n_{in_max} : max. Gear Input Speed (Table 1)

n_{A_max} : max. Speed in Application

i : Gear Ratio

T_{OM} : Occasional Momentary Torque (Table 1)

T_{A_except} : max. Torque in Application in exceptional Cases,
must not occur, periodically.

T_{AV} : Average Torque (Table 1)

T_{A_av} : Applications Load Cycle Average Torque

φ_x, T_x : φ_x is Output Angle Range within an Application Cycle where
the related Torque T_x is constant or
can be replaced with a reasonable "constant" substitute Value

$\sum \varphi_x$: to be calculated from all the total sum of output angle within a load cycle,
absolute values for positive(forward) and negative(backward) Speed

n_{in_av} : Average Input Speed (Table 1)

n_{A_av} : Average Speed in Application

n_x, t_x, t_{idle} : n_x is constant during t_x or can be replaced with a reasonable
"constant" substitute Value, for $t_{idle} \rightarrow n=0$

L_{10} : calculated Service Life with application load cycle.
Max 10% of a batch of identical Gears would fail before

T_{RL} : Rated Life Torque (Table 1)

n_{out_dom} : Dominant application output speed,
must not match with the Application Natural Frequency

K_x : either $K_{1/2/3}$ (Table 2), depending the load applied @ N_{out_dom}

J_{A_Load} : Application's Load Inertia



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