SWG Solutions

Application Notes & Handbook

Engineering Data Common

Three Basic Components

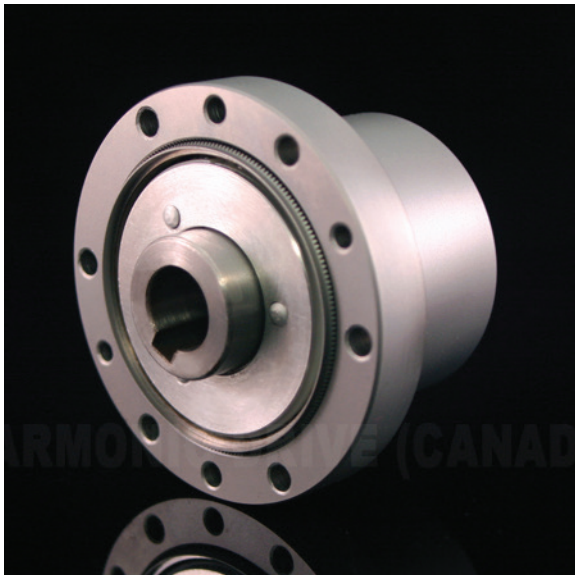
* Flexspline
* Circular Spline
* Wave Generator

Key Advantages

* Low or Zero Backlash
* High Efficiencies
* Simple Support Requirements
* High Single-Stage Rations
* High Torque Output
* Excellent Positional Accurancy and Repeatability
* Design Flexibility
* Long Life and High Reliability

Brief List of Applications

* Aerospace
* Industrial Robots
* Medical Equipment
* Machine Tools
* Measuring and Testing Machines
* Printing Presses
* Semi-Conductor Equipment Manufacturing
* Communiations Equipment
* Terminology
* Woodworking Machine



Ordering Information

HDC - 80 - 100 - 2 - 6 / 6 - (SP)*1

| | | | | | | --- Transmission error: Grade 6 (*2)
| | | | | | --- Backlash: Grade 6 (*3)
| | | | | --- 2 - Three Basic Components 1 - Gearbox
| | | | --- Transmission ratio 100:1
| | | --- Size 80
| | --- Model HDC (Cup Type Components)

*1 --- SP (Special order with custom design)

*2 --- Transmission Error

| --- Grade 6: ± 180 arc sec for industrial grade
| --- Grade 3: ± 90 arc sec for robotics grade
| --- Grade 1: ± 30 arc sec for robotics grade

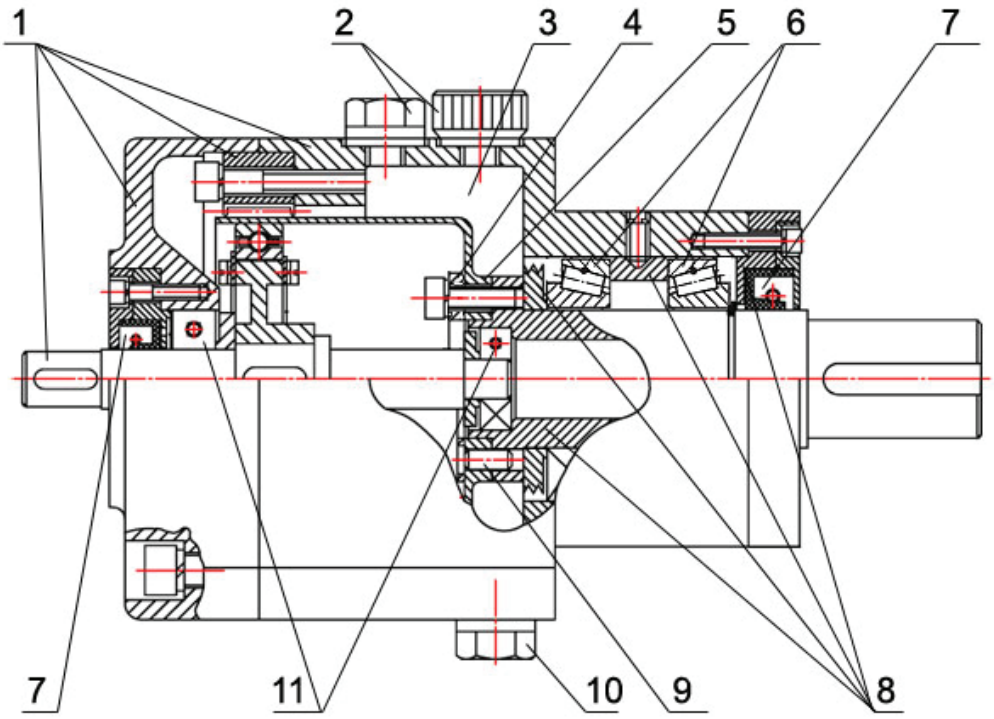
*3 --- Backlash

| --- Grade 6: 6 (±3) arc min for industrial grade
| --- Grade 3: 3 (±1.5) arc min for robotics grade
| --- Grade 1: 1 (±0.5) arc min for robotics grade

Strain Wave Gearing

Design Guidelines

Cup Style Components Design Sample:



The relative perpendicularity and concentricity of the three basic Strain Wave Gearing components have an important influence on accuracy and service life. Pay attention on the following points:

1) Input shaft, Circular spline and housing must be concentric.
2) Oil input and assembly check.
3) Air vent depending on the application.
4) A clamping ring with corner radius increases torque transmission capacity and prevents damage to Flexspline diaphragm.
5) The Flexspline pilot diameter must be concentric to Circular Spline.
6) Pre-loaded and backlash-free double bearing support for output shaft.
7) A radial shaft seal for oil lubrication.
8) Axial location of Flexspline.
9) Flexspline and Circular Spline must be located in parallel and perpendicular to the Output Shaft.
10) Oil drain
11) Double bearing support for Input Shaft.

Three Basic Components

* Flexspline
* Circular Spline
* Wave Generator

Key Advantages

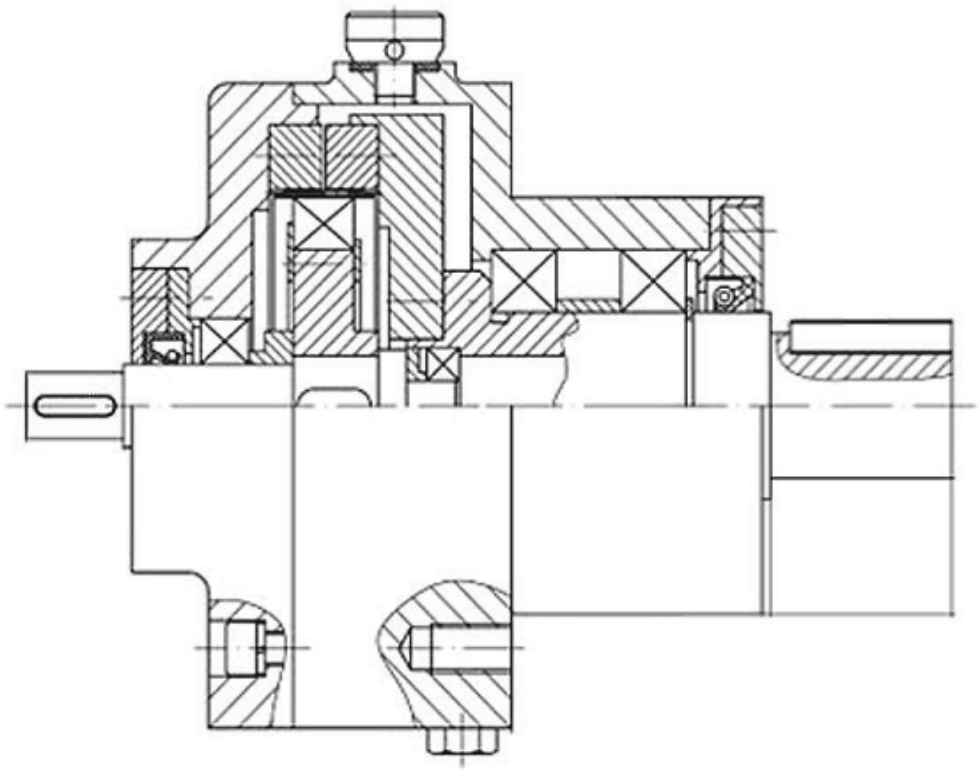
* Low or Zero Backlash
* High Efficiencies
* Simple Support Requirements
* High Single-Stage Rations
* High Torque Output
* Excellent Positional Accurancy and Repeatability
* Design Flexibility
* Long Life and High Reliability

Brief List of Applications

* Aerospace
* Industrial Robots
* Medical Equipment
* Machine Tools
* Measuring and Testing Machines
* Printing Presses
* Semi-Conductor Equipment Manufacturing
* Communiations Equipment
* Terminology
* Woodworking Machine

Strain Wave Gearing

Pancake Style Components Design Sample:



Three Basic Components

* Flexspline
* Circular Spline
* Wave Generator

Key Advantages

* Low or Zero Backlash
* High Efficiencies
* Simple Support Requirements
* High Single-Stage Rations
* High Torque Output
* Excellent Positional Accurancy and Repeatability
* Design Flexibility
* Long Life and High Reliability

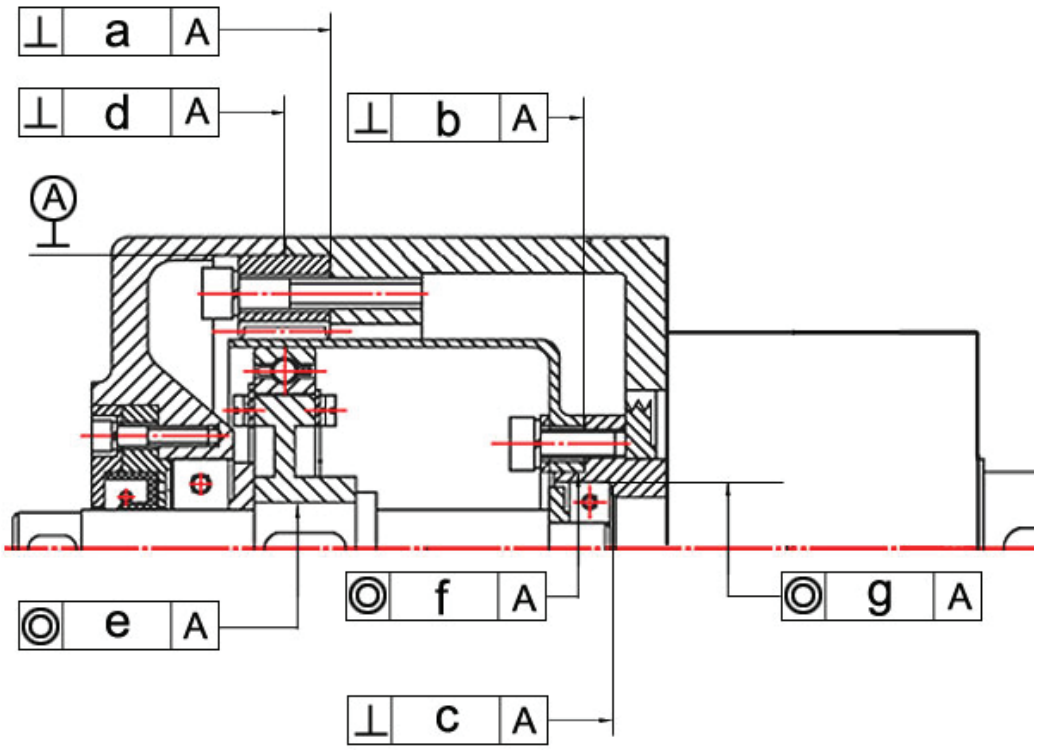
Brief List of Applications

* Aerospace
* Industrial Robots
* Medical Equipment
* Machine Tools
* Measuring and Testing Machines
* Printing Presses
* Semi-Conductor Equipment Manufacturing
* Communiations Equipment
* Terminology
* Woodworking Machine

Strain Wave Gearing

Assembly Tolerances

Cup Style Components Assembly Tolerances:



For Industrial Grade Strain Wave Gearing

Dimensions: (mm)

Size	a	b	c	d	e	f	g
50	0.020	0.025	0.020	0.025	0.020	0.020	0.015
60	0.020	0.025	0.020	0.025	0.020	0.025	0.015
80	0.025	0.030	0.025	0.030	0.025	0.025	0.020
100	0.025	0.030	0.025	0.030	0.025	0.030	0.020
120	0.030	0.030	0.025	0.035	0.025	0.035	0.020

Three Basic Components

* Flexspline
* Circular Spline
* Wave Generator

Key Advantages

* Low or Zero Backlash
* High Efficiencies
* Simple Support Requirements
* High Single-Stage Rations
* High Torque Output
* Excellent Positional Accurancy and Repeatability
* Design Flexibility
* Long Life and High Reliability

Brief List of Applications

* Aerospace
* Industrial Robots
* Medical Equipment
* Machine Tools
* Measuring and Testing Machines
* Printing Presses
* Semi-Conductor Equipment Manufacturing
* Communiations Equipment
* Terminology
* Woodworking Machine

Strain Wave Gearing

Three Basic Components

* Flexspline
* Circular Spline
* Wave Generator

Key Advantages

* Low or Zero Backlash
* High Efficiencies
* Simple Support Requirements
* High Single-Stage Rations
* High Torque Output
* Excellent Positional Accurancy and Repeatability
* Design Flexibility
* Long Life and High Reliability

Brief List of Applications

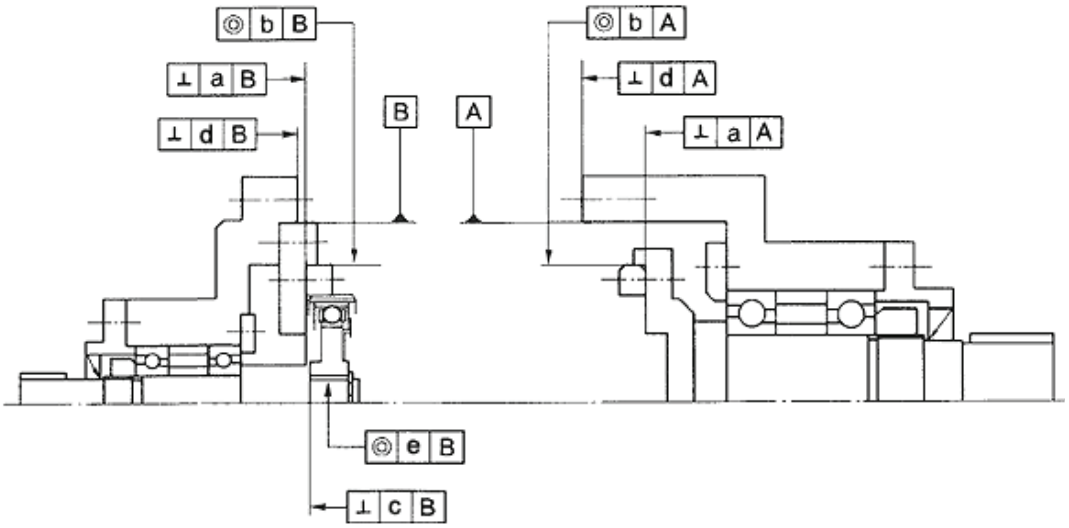
* Aerospace
* Industrial Robots
* Medical Equipment
* Machine Tools
* Measuring and Testing Machines
* Printing Presses
* Semi-Conductor Equipment Manufacturing
* Communiations Equipment
* Terminology
* Woodworking Machine

For Robotics Grade Strain Wave Gearing

Dimensions: (mm)

Size	a	b	c	d	e	f	g
50	0.010	0.015	0.012	0.015	0.012	0.012	0.010
60	0.010	0.015	0.012	0.015	0.012	0.015	0.010
80	0.012	0.020	0.015	0.020	0.012	0.015	0.012
100	0.012	0.025	0.015	0.020	0.012	0.020	0.012
120	0.015	0.025	0.015	0.025	0.015	0.020	0.012

Pancake Style Components Assembly Tolerances:



For Industrial Grade Strain Wave Gearing

Dimensions: (mm)

Size	a	b	c	d	e	f	g
50	0.020	0.020	0.020	0.025	0.020	0.020	0.015
60	0.020	0.025	0.020	0.025	0.020	0.025	0.015
80	0.025	0.025	0.025	0.030	0.025	0.025	0.020
100	0.025	0.030	0.025	0.030	0.025	0.030	0.020
120	0.030	0.035	0.025	0.035	0.025	0.035	0.020

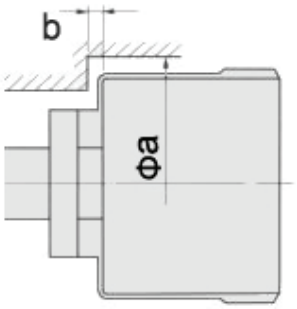
Strain Wave Gearing

For Robotics Grade Strain Wave Gearing

Dimensions: (mm)

Size	a	b	c	d	e	f	g
50	0.010	0.012	0.012	0.015	0.012	0.020	0.015
60	0.010	0.015	0.012	0.015	0.012	0.025	0.015
80	0.012	0.015	0.015	0.020	0.012	0.025	0.020
100	0.012	0.020	0.015	0.020	0.012	0.030	0.020
120	0.015	0.020	0.015	0.025	0.015	0.035	0.020

Minimum Casing Clearance



In order to allow deflective motion of the Flexspline, a certain amount of clearance must be provided between the inner walls of the casing and the Flexspline, as illustrated. In the case of oil lubrication, larger clearances are recommended to provide a sufficient amount of lubricant.

Dimensions: (mm)

Size	50	60	80	100	120
Øa (diameter)	Ø54	Ø66	Ø84	Ø104	Ø130
b	2	2	3	3	4

Three Basic Components

* Flexspline
* Circular Spline
* Wave Generator

Key Advantages

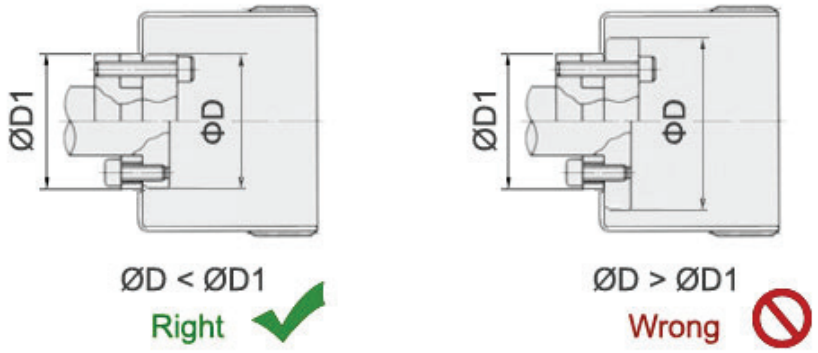
* Low or Zero Backlash
* High Efficiencies
* Simple Support Requirements
* High Single-Stage Rations
* High Torque Output
* Excellent Positional Accurancy and Repeatability
* Design Flexibility
* Long Life and High Reliability

Brief List of Applications

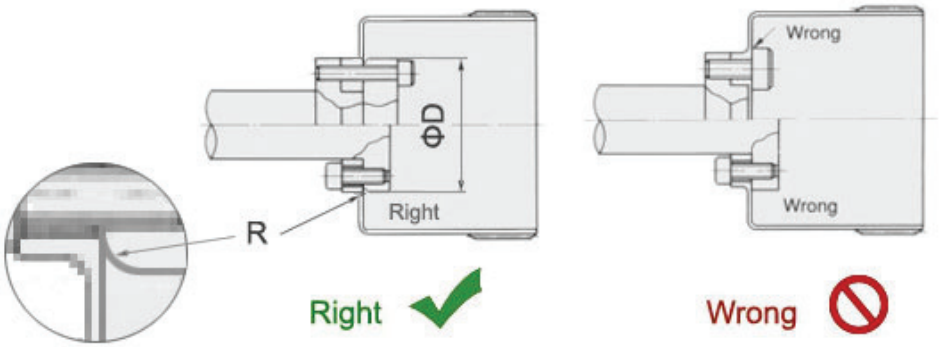
* Aerospace
* Industrial Robots
* Medical Equipment
* Machine Tools
* Measuring and Testing Machines
* Printing Presses
* Semi-Conductor Equipment Manufacturing
* Communiations Equipment
* Terminology
* Woodworking Machine

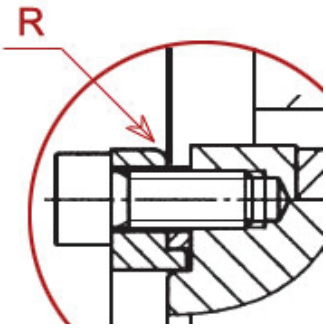
Strain Wave Gearing

Flexspline Mounting



A clamp ring must be used as part of the assembly to attach the Flexspline to the output shaft. The outside diameter of the clamp ring must be less than the diameter of the Flexspline's mounting boss. The outer diameter of the contact surface must have a radius to protect the Flexspline diaphragm from damage.





Three Basic Components

* Flexspline
* Circular Spline
* Wave Generator

Key Advantages

* Low or Zero Backlash
* High Efficiencies
* Simple Support Requirements
* High Single-Stage Rations
* High Torque Output
* Excellent Positional Accurancy and Repeatability
* Design Flexibility
* Long Life and High Reliability

Brief List of Applications

* Aerospace
* Industrial Robots
* Medical Equipment
* Machine Tools
* Measuring and Testing Machines
* Printing Presses
* Semi-Conductor Equipment Manufacturing
* Communiations Equipment
* Terminology
* Woodworking Machine

Strain Wave Gearing

Care must be taken that the heads of clamping bolts, nuts, washers, or clamp rings are kept within the diameter of the Flexspline hub, otherwise local flexing of the Flexspline will be hampered and eventual failure will result. The corner of the clamp ring must be rounded to allow local flexing.

Dimensions: (mm)

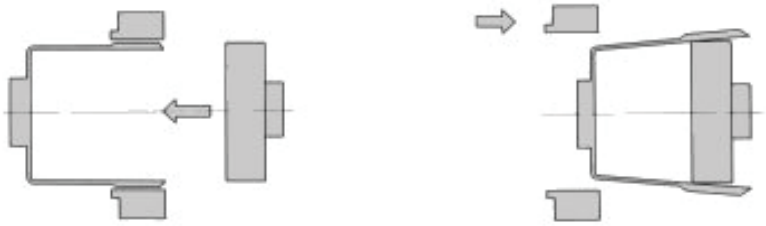
Size	50	60	80	100	120
ØD (Max. clamp ring diameter)	Ø32	Ø40	Ø52	Ø64	Ø80
R (Corner radius)	1	1	1.5	1.5	2

The Flexspline is rotationally connected to an output shaft by clamping bolts. The total clamping force required are shown below.

Dimensions: (mm)

Size	50	60	80	100	120
No. of bolts	6	6	6	6	6
Size of bolts	M4	M5	M6	M8	M12
Clamp torque/bolt (N.m)	4.2	8.5	14.5	35.5	80

• Assembly Sequence



Strain Wave Gearing

Three Basic Components

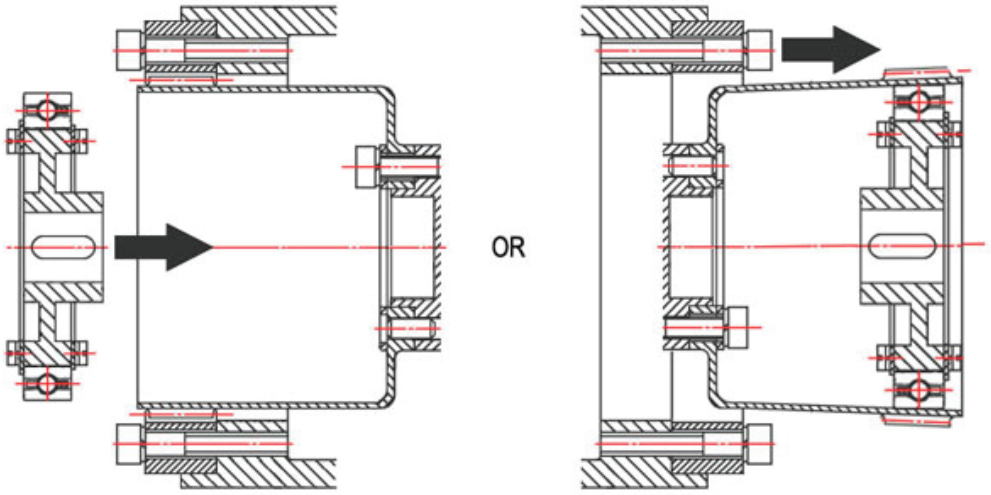
* Flexspline
* Circular Spline
* Wave Generator

Key Advantages

* Low or Zero Backlash
* High Efficiencies
* Simple Support Requirements
* High Single-Stage Rations
* High Torque Output
* Excellent Positional Accurancy and Repeatability
* Design Flexibility
* Long Life and High Reliability

Brief List of Applications

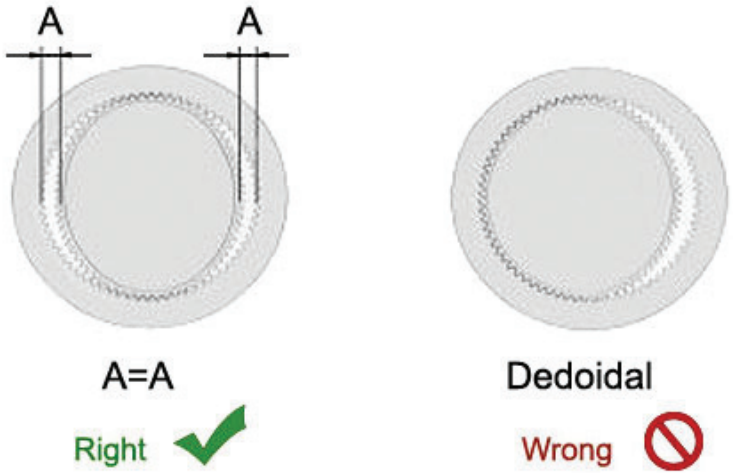
* Aerospace
* Industrial Robots
* Medical Equipment
* Machine Tools
* Measuring and Testing Machines
* Printing Presses
* Semi-Conductor Equipment Manufacturing
* Communiations Equipment
* Terminology
* Woodworking Machine



It is essential that the teeth of the Circular Spline and the Flexspline mesh concentrically for proper function. An eccentric toothmesh called dedoidal will result in noise, vibration, and early failure.

An incorrect assembly may be checked in one of four ways:

1) By visual observation, if the toothmesh is exposed.
2) By rotating the input shaft by hand, if it's a blind assembly. Uneven rotation suggests dedoidal toothmesh.
3) By unusually high motor currency, If the Wave Generator is connected to a motor.
4) By inserting a dial gauge from an access hole near the Circular Spline on the side of the Flexspline, a quasi-sinusoidal curve during one revolution of the Flexspline indicates a concentric assembly.



Strain Wave Gearing

Lubrication

Size	Amblent temperature		
	0 ~ +55	-40 ~ +55	-50 ~ +100
25	HDG-LO (Strain Wave Gearing semifluid grease #0)		
32			
40			
50			
60			
80	32 HDL (HD. Lube)	32HDL.L (Low temp. HD Lube)	4109 (Synthetic oil)
100			
120			

Oil Change
The first oil change should be performed after 100 hours of operation. The need to perform subsequent oil changes will depend on operating conditions, but should take place at intervals of approximately 1000 running hours.

Grease Change
When operating at rated torque, change grease after about 1000 running hours. Light-duty operation may permit longer service intervals. To change grease, Completely disassemble and clean units before regreasing. Apply grease generously inside the Flexspline, the Wave Generator bearing, the input coupling, and the teeth of the Circular Spline and the Flexspline.

Oil Temperature
The Max. permissible temperature rise is 60°C, as oil loses its lubricating capability quickly above this limit.

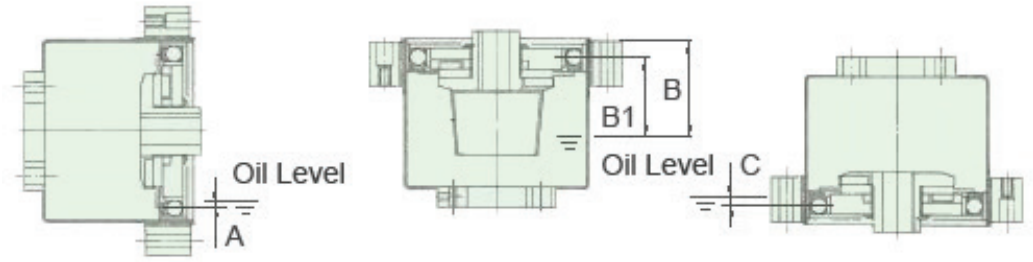
Service Instructions
1) Semi-fluid grease is used for SWG-C-25 to SWG-C-60. They were pre-lubricated with the grease prior to packaging in the factory.
2) For SWG-C-80 to SWG-C-120, oil lubrication is used. (If input speed is less than 2000rpm, grease lubrication may be used as well, but the requirement must be declared when ordering).
3) All oil-lubricated reducers are delivered with dry case. Before operating, users have to fill in suitable oil themselves. For this purpose, a plug and an air-vent are provided on the top of the case. the oil used must be clean and free from impurities. Oil level needed is indicated by the middle-line in the oil indicator, i.e. to keep the oil surface 2 mm higher than the center of the ball lowest in position in the flexible ball bearing.
4) The air-vent must always be on the vertical up position.

Three Basic Components
* Flexspline
* Circular Spline
* Wave Generator

Key Advantages
* Low or Zero Backlash
* High Efficiencies
* Simple Support Requirements
* High Single-Stage Rations
* High Torque Output
* Excellent Positional Accurancy and Repeatability
* Design Flexibility
* Long Life and High Reliability

Brief List of Applications
* Aerospace
* Industrial Robots
* Medical Equipment
* Machine Tools
* Measuring and Testing Machines
* Printing Presses
* Semi-Conductor Equipment Manufacturing
* Communiations Equipment
* Terminology
* Woodworking Machine

Minimum Oil Volume



Dimensions: (mm)

Size	Horizontal A (mm)	Vertical with WG up		Vertical with WG down C (mm)
		B1 (mm)	B (mm)	
50	2	20	26	2
60	2	22	29	2
80	4	28	37	4
100	4	35	47	4
120	6	45	59	6

Vertical Installations

In vertical installations with the input shaft down, the oil level is set at the centerline of the Wave Generator bearing balls.
If the input shaft is on top, a “lift cone” should be provided. This serves to pump oil onto the Wave generator, tooth mesh region, and coupling. For the lift cone to be effective, a minimum input speed of 960 rpm must be maintained, as lower speeds do not generate enough liftforce. For lower input speeds, either fill oil up to the middle of the Wave Generator bearing or use grease lubrication. Note that lube holes are provided on the boss of the Flexspline to facilitate the flow of oil inside the Flexspline cup. The lube holes serve as breathers if the component set is used with input down.
When the Strain Wave Gearing unit is to be used vertically with the Wave Generator placed at the bottom, special consideration must be given. If the Wave Generator assembly is completely submerged in oil, the heat generation caused by churning would be substantial and a loss of efficiency would result. It is recommended that the oil level be maintained in such a way that approximately one half of the Wave Generator bearing is submerged.
To assure a sufficient amount of lubricant it may be necessary to extend the bottom area of the housing or to provide an external oil reservoir. A forced lubrication system may also be considered.

Strain Wave Gearing

Three Basic Components

* Flexspline
* Circular Spline
* Wave Generator

Key Advantages

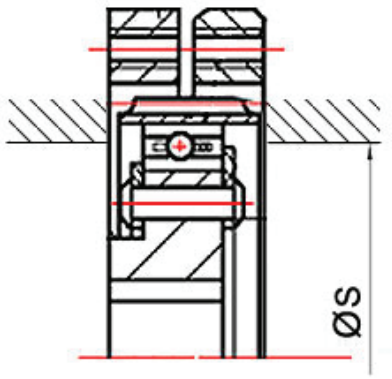
* Low or Zero Backlash
* High Efficiencies
* Simple Support Requirements
* High Single-Stage Rations
* High Torque Output
* Excellent Positional Accurancy and Repeatability
* Design Flexibility
* Long Life and High Reliability

Brief List of Applications

* Aerospace
* Industrial Robots
* Medical Equipment
* Machine Tools
* Measuring and Testing Machines
* Printing Presses
* Semi-Conductor Equipment Manufacturing
* Communiations Equipment
* Terminology
* Woodworking Machine

HDF Grease lubricated ratings

For retention of grease within the tooth mesh areaand the ball bearing, it is recommended that the housing at least S dimension.



Dimensions: (mm)

Size	25	32	40	50	60	80	100	120
ØS (diameter)	Ø24	Ø31	Ø39	Ø47	Ø57	Ø75	Ø95	Ø115

Strain Wave Gearing

Three Basic Components

* Flexspline
* Circular Spline
* Wave Generator

Key Advantages

* Low or Zero Backlash
* High Efficiencies
* Simple Support Requirements
* High Single-Stage Rations
* High Torque Output
* Excellent Positional Accurancy and Repeatability
* Design Flexibility
* Long Life and High Reliability

Brief List of Applications

* Aerospace
* Industrial Robots
* Medical Equipment
* Machine Tools
* Measuring and Testing Machines
* Printing Presses
* Semi-Conductor Equipment Manufacturing
* Communiations Equipment
* Terminology
* Woodworking Machine

Transmission Error

Transmission error is defined as the difference between the output shaft's actual position and its theoretical output position. This is measured in a unidirectional rotation.

The alllowable values are: **Grade 6** / **Grade 3** / **Grade 1**

Grade 6 : ± 180 arc sec for industrial grade
Grade 3 : ± 90 arc sec for robotics grade
Grade 1 : ± 30 arc sec for robotics grade

Backlash (Lost Motion)

Lost Motion is defined as the lag of the output shaft's rotational angle when the input shafts position is altered, under no-load conditions.

The alllowable values are: **Grade 6** / **Grade 3** / **Grade 1**

Grade 6 : 6 (±3) arc min for industrial grade
Grade 3 : 3 (±1.5) arc min for robotics grade
Grade 1 : 1 (±0.5) arc min for robotics grade

No-Load Static Starting Torque

Size	Starting Torque (g-cm)
25	30 ~ 80
32	45 ~ 160
40	60 ~ 200
50	80 ~ 300
60	120 ~ 500
80	200 ~ 800
100	400 ~ 1250
120	650 ~ 1800

Strain Wave Gearing

About SWG Solutions

We are specialized in Strain Wave Gearing products. Our advanced manufacturing capabilities provide high quality and precision for your requirements.

Our customers represent the electronics, automotive, industrial, medical and food industries. We offer our customers high quality products with exceptional customer services.

We believe in satisfying our customers and respond quickly to their needs with prompt, effective and global solutions. With us you will deal with a highly specialized and professional experts.

SWG Solutions provide standard Strain Wave Gearing components and gearheads, and also provide custom design Strain Wave Gearing systems.

Three Basic Components

* Flexspline
* Circular Spline
* Wave Generator

Key Advantages

* Low or Zero Backlash
* High Efficiencies
* Simple Support Requirements
* High Single-Stage Rations
* High Torque Output
* Excellent Positional Accurancy and Repeatability
* Design Flexibility
* Long Life and High Reliability

Brief List of Applications

* Aerospace
* Industrial Robots
* Medical Equipment
* Machine Tools
* Measuring and Testing Machines
* Printing Presses
* Semi-Conductor Equipment Manufacturing
* Communiations Equipment
* Terminology
* Woodworking Machine

SWG Solutions

89 Fawndale Cres.
Toronto, ON, M1W 2X3 Canada
Phone 647-294-8847
Web: www.swgearing.com
Email: info@swgearing.com