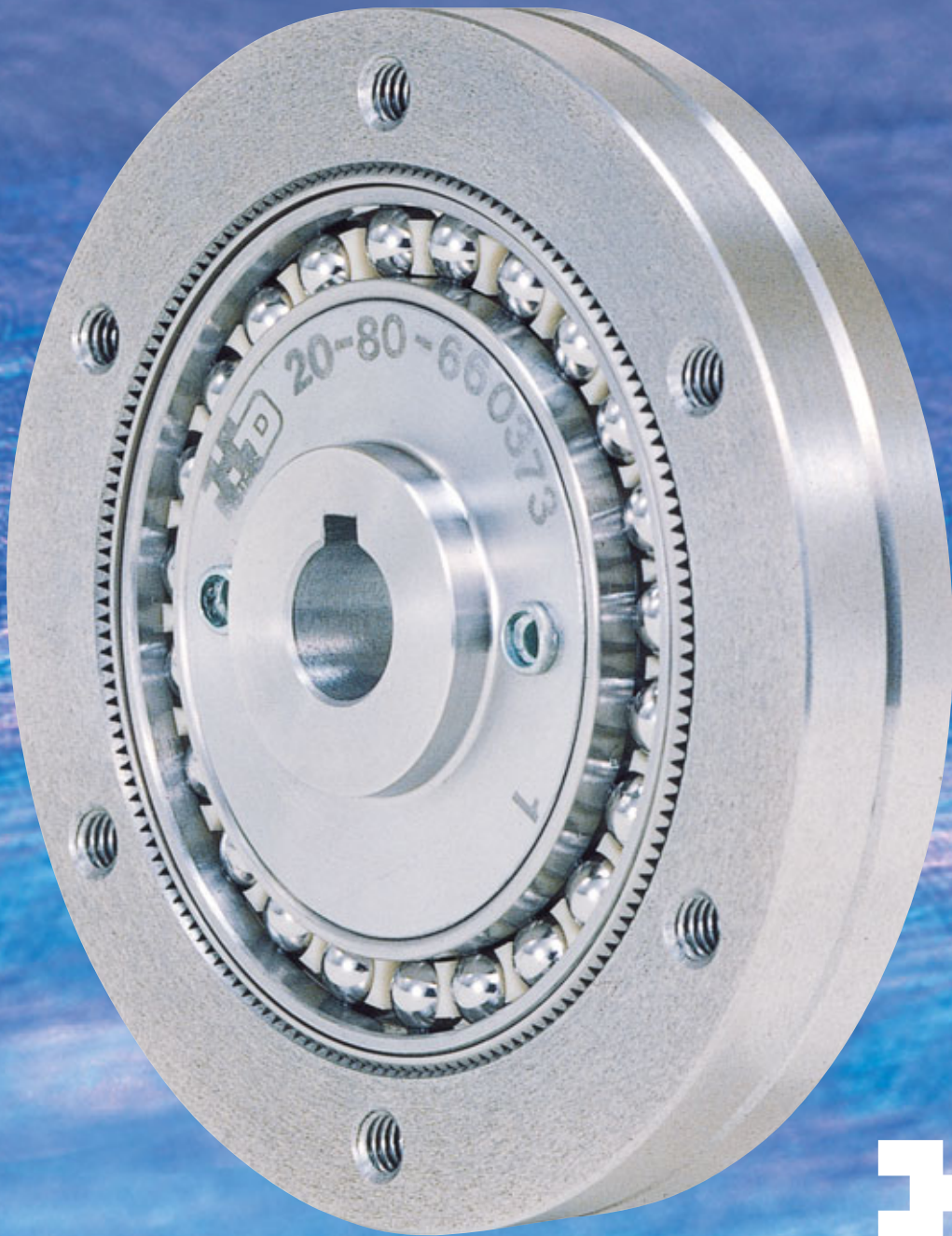


HDUF Gearing



harmonic drive gearing
Precision Gearing & Motion Control

Contents

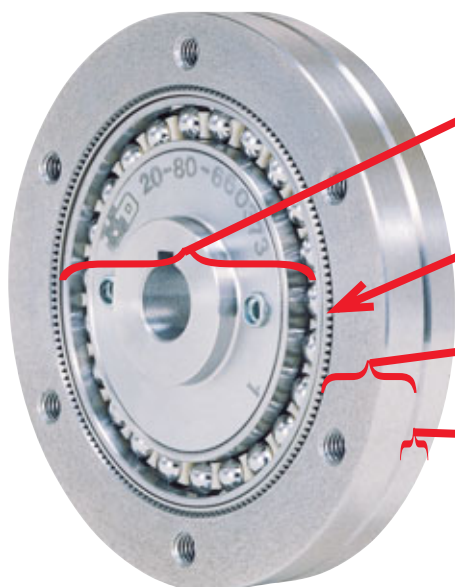
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Compact, High Ratio, In-Line Gearing

Harmonic Drive HDUF “Pancake” type component set offers the designer high ratio, in-line mechanical power transmissions in extremely compact configurations. The component set consists of four elements: the Wave generator, an elliptical bearing assembly; the Flexspline, a non-rigid ring with external teeth; and the Circular Spline and the Dynamic Spline, rigid internal gears.

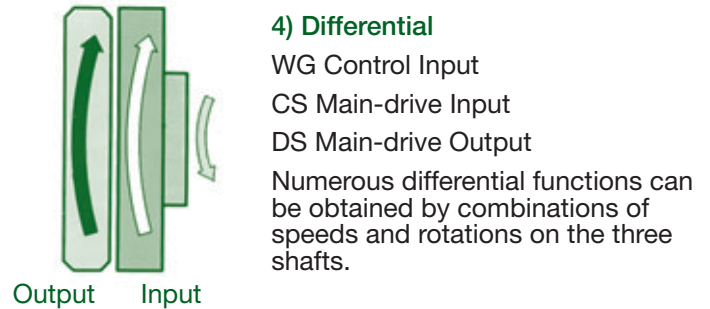
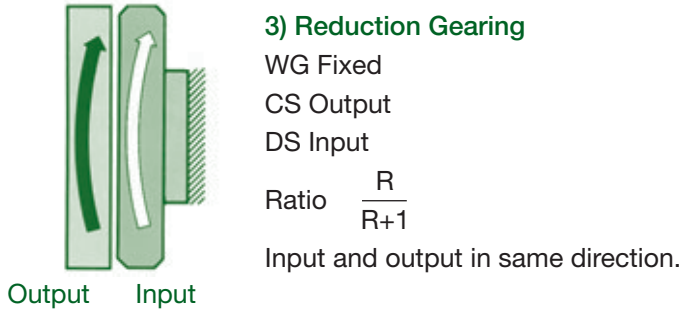
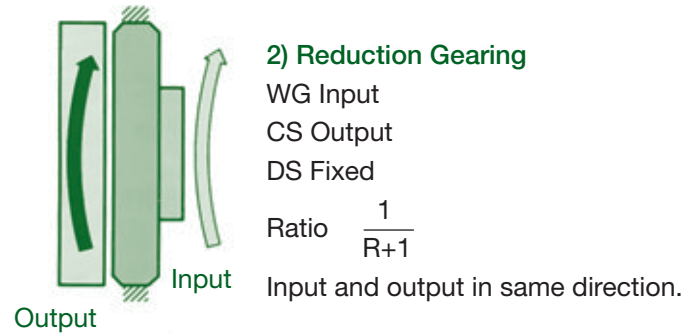
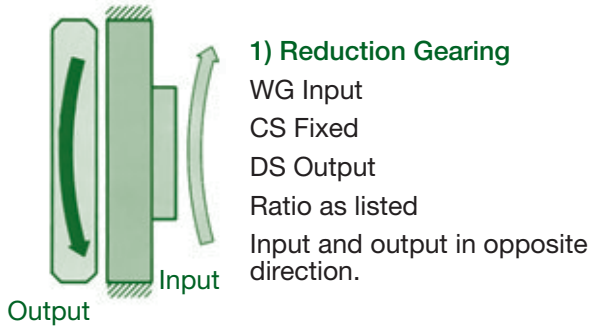
Rotation of the Wave Generator imparts a rotating elliptical shape to the Flexspline causing progressive engagement of its external teeth with the internal teeth of the Circular Spline and the Dynamic Spline. The fixed Circular Spline has two more teeth than the Flexspline, thereby imparting relative rotation to the Flexspline at a reduction ratio corresponding to the difference in the number of teeth. With the same number of teeth, the Dynamic Spline rotates with and at the same speed as the Flexspline.

The Basic Component Set



- 1) The Wave generator (WG) is a thin raced bearings assembly fitted onto an elliptical plug, and normally is the rotating input member.
- 2) The Flexspline (FS) is a non-rigid ring with external teeth on a slightly smaller pitch diameter than the Circular Spline. It is fitted over and is elastically deflected by the Wave Generator.
- 3) The Circular Spline (CS) is a rigid ring with internal teeth, engaging the teeth of the Flexspline across the major axis of the Wave Generator.
- 4) The Dynamic Spline (DS) is a rigid ring having internal teeth of same number as the Flexspline. It rotates together with the Flexspline and serves as the output member. It is identified by chamfered corners at its outside diameter.

Configurations

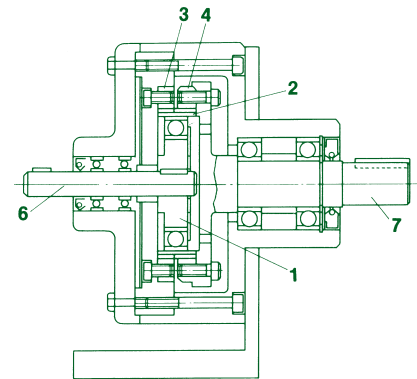
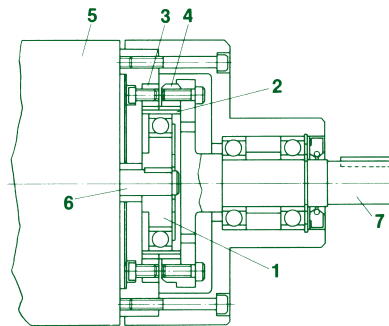


Typical Installation

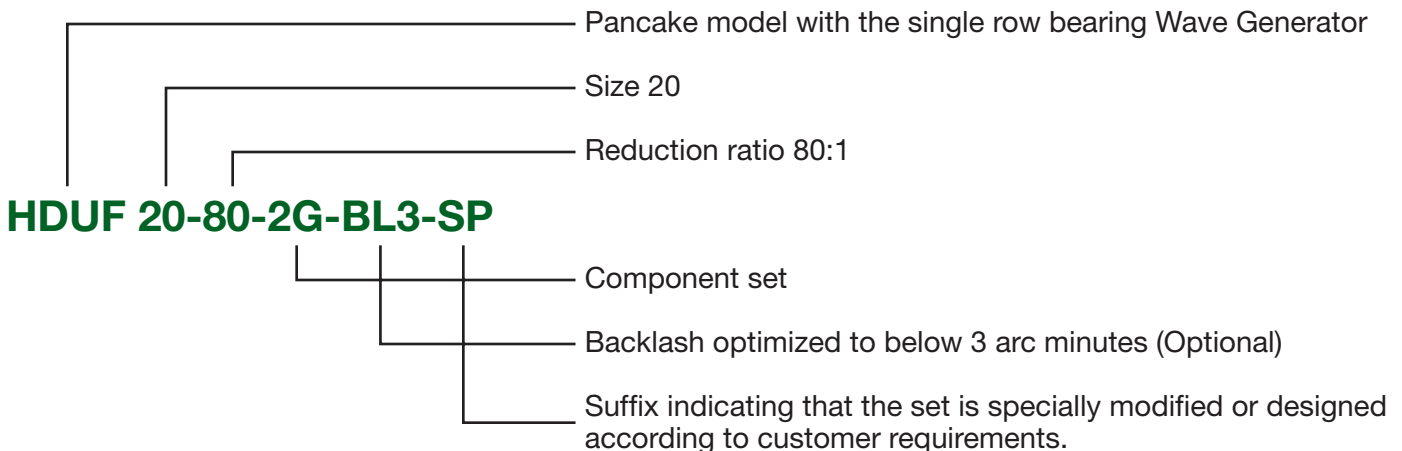
HDUF “pancake” type component sets are easier to use than conventional gearing. All that is required is suitable bearing support for the input and output shaft, and a means of fixing the circular spline against rotation.

The simplicity of HDUF component sets is demonstrated in the typical arrangements shown below.

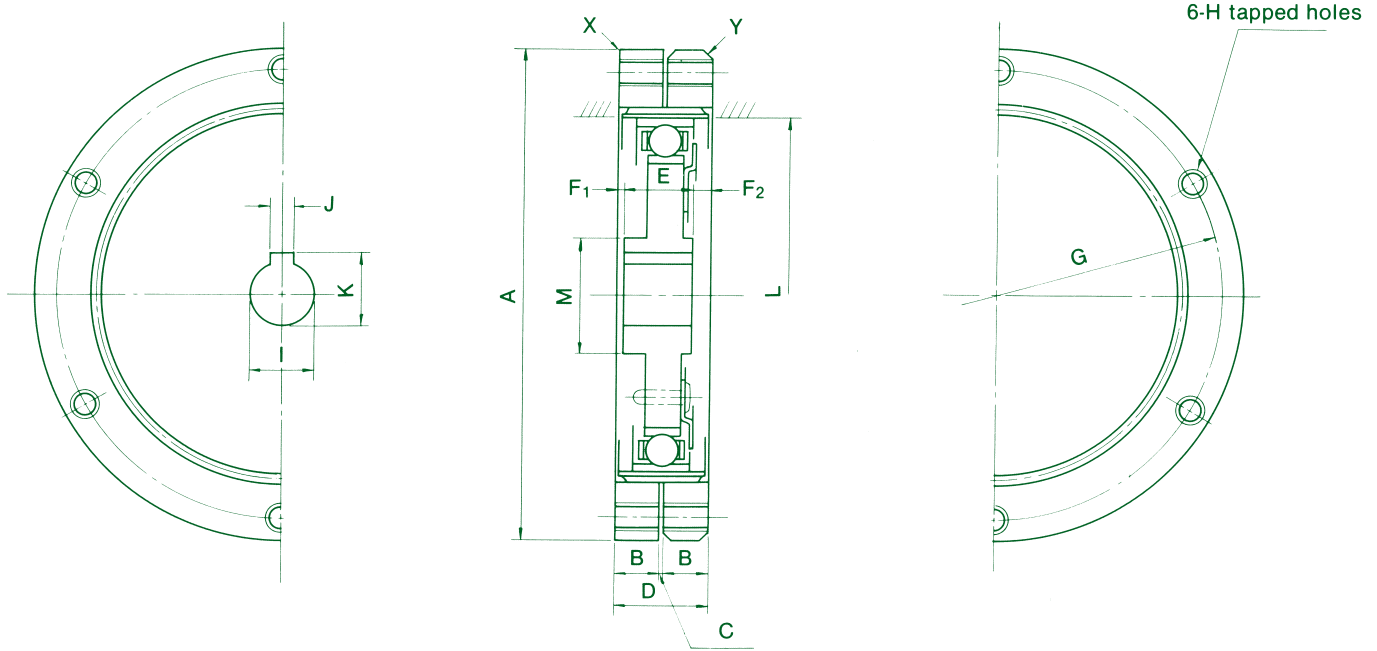
- 1. Wave Generator
- 2. Flexspline
- 3. Circular Spline
- 4. Dynamic Spline
- 5. Motor
- 6. Input Shaft or Motor Shaft
- 7. Output Shaft



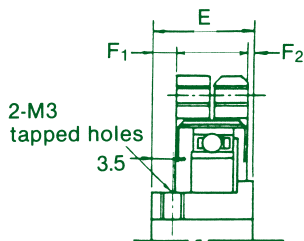
Ordering Information



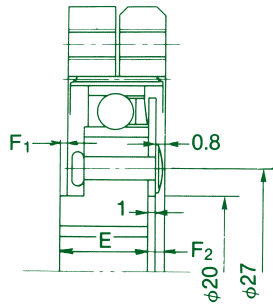
Dimensions



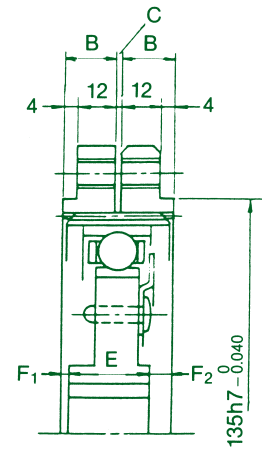
HDUF-14



HDUF-20



HDUF-50



HDUF	A (g7)	B	C	D	E	F1	F1	G	H	I		J (JS9)	K	L	M	N	X	Y	Wt	
										(H7)	Max								lb	kgf
14	50 ^{-0.009} _{-0.034}	5	0.5	10.5	15.0	3.75	0.75	44	M3	6 ^{+0.012} ₀	8	—	—	29	14	—	0.2	1.0	0.2	0.1
20	70 ^{-0.010} _{-0.040}	6	0.5	12.5	11.4	0.95	2.05	60	M4	9 ^{+0.015} ₀	12	3±0.0125	10.4	42	20	—	0.2	1.0	0.2	1.0
25	85 ^{-0.012} _{-0.047}	8	0.5	16.5	12.8	0.35	3.35	75	M5	14 ^{+0.018} ₀	15	5±0.0150	16.3	53	26	0.9	0.2	1.5	1.1	0.5
32	110 ^{-0.012} _{-0.047}	10	0.5	20.5	15.6	0.95	3.95	100	M6	14 ^{+0.018} ₀	15	5±0.0150	16.3	69	26	0.8	0.2	1.5	2.2	1.0
40	135 ^{-0.014} _{-0.054}	13	1	27.0	19.4	1.80	5.80	120	M8	14 ^{+0.018} ₀	20	5±0.0150	16.3	84	32	1.2	0.4	2.0	4.0	1.8
50	170 ^{-0.014} _{-0.054}	16	1	33.0	23.2	2.90	6.90	150	M10	19 ^{+0.021} ₀	20	6±0.0150	21.8	105	32	1.1	0.4	2.0	6.4	2.9

Maximum housing I.D. for Flexspline axial containment is L. The surface hardness in the region where the Flexspline abuts the housing is recommended to be HRC 29–34.

Performance Ratings

HDUF	Ratio	Torque Rating***														Max.** Output Torque	
		Input speed, rpm															
		4000		3500		3000		2500		2000		1000		500		Nm	lb-in
		Nm	lb-in	Nm	lb-in	Nm	lb-in	Nm	lb-in	Nm	lb-in	Nm	lb-in	Nm	lb-in	Nm	lb-in
14	88	3.8	34	4.0	35	4.2	37	4.5	40	5	42	6.2	55	7.7	68	12	104
	100	4.6	40	4.8	42	5.1	45	5.4	48	6	52	7.3	65	9.3	82	15	130
	110	4.6	40	4.8	42	5.1	45	5.4	48	6	52	7.3	65	9.3	82	15	130
20	80			14	120	14	120	15	130	16	147	20	180	20	180	26	230
	100			17	156	18	156	20	174	21	190	24	210	24	210	34	300
	128			20	174	20	174	21	190	23	210	24	210	24	210	43	380
	160			20	174	20	174	21	190	23	210	24	210	24	210	50	440
25	80			26*	230*	26	230	28	250	28	250	29	350	39	350	51	450
	100			29*	256*	33	295	36	320	36	320	49	430	52	460	68	600
	120			29*	256*	33	295	36	320	36	320	49	430	61	540	80	710
	160			29*	256*	33	295	36	320	36	320	49	430	61	540	86	760
32	78			58*	513*	58*	513*	58	510	63	550	75	670	75	670	98	870
	100			59*	522*	59*	522*	75	670	82	730	98	870	98	870	127	1130
	131			59*	522*	59*	522*	75	670	82	730	98	870	117	1040	186	1650
	157			59*	522*	59*	522*	75	670	82	870	98	870	117	1040	215	1910
40	80			117*	1040*	117*	1040*	117*	1040*	117	1040	147	1300	147	1300	196	1940
	100			127*	1125*	127*	1125*	127*	1125*	157	1390	186	1650	186	1650	255	2250
	128			127*	1125*	127*	1125*	127*	1125*	166	1470	206	1820	235	2080	314	2880
	160			127*	1125*	127*	1125*	127*	1125*	166	1470	206	1820	274	2430	353	3120
50	80			215*	1900*	215*	1900*	215*	1900*	215	1900	265	2340	265	2340	353	3120
	100			245*	2170*	245*	2170*	245*	2170*	284	2520	353	3120	353	3120	460	4080
	120			245*	2170*	245*	2170*	245*	2170*	304	2690	382	3380	421	3730	559	4950
	160			245*	2170*	245*	2170*	245*	2170*	304	2690	382	3380	480	4250	666	5900

HDUF	Max. Input Speed, rpm		Moment of Inertia J		Backlash arc min.****	
	Oil Lub	Grease SK-1	kg-cm ²	lb-in ²	Optimized	Non-Opt.
14	6000	3600	0.033	0.011	3	32
20	6000	3600	0.14	0.048	3	32
25	5000	3600	0.36	0.12	3	30
32	4500	3600	1.3	0.44	3	24
40	4500	3300	3.4	1.2	3	24
50	3500	3000	9.9	3.4	3	23

* Thermal limited—50% duty cycle with on time not exceeding 15 minutes.
 ** This torque is not to be exceeded under any circumstances.
 *** Rating at input speed below 500 rpm is same as for 500 rpm.
 **** Backlash measured at output with the input locked, maximum value.

Lubrication

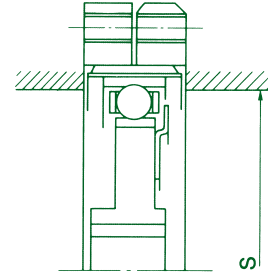
Oil lubrication ratings are based on Molub Alloy gear Oil No. 80. See table for recommended oil level and volume for horizontal shaft mounting.

For vertical mounting the recommended level is at the wave generator bearing ball centerline or midpoint of the drive.

HDUF		14	20	25	32	40	50
Oil Level Below Drive Centerline	mm	7.6	12.7	15.2	17.8	23.0	30.5
Minimum Oil Volume	cc	50	50	100	150	250	500
	fl-oz	1.5	1.5	3	5	8	16

Grease lubricated ratings are based on Harmonic Grease HC-1, which has been specially developed for Harmonic Drive lubrication. Alternate lubricants include Molub Alloy Grease No. 2, Shell Alvania EP 1 and their equivalents.

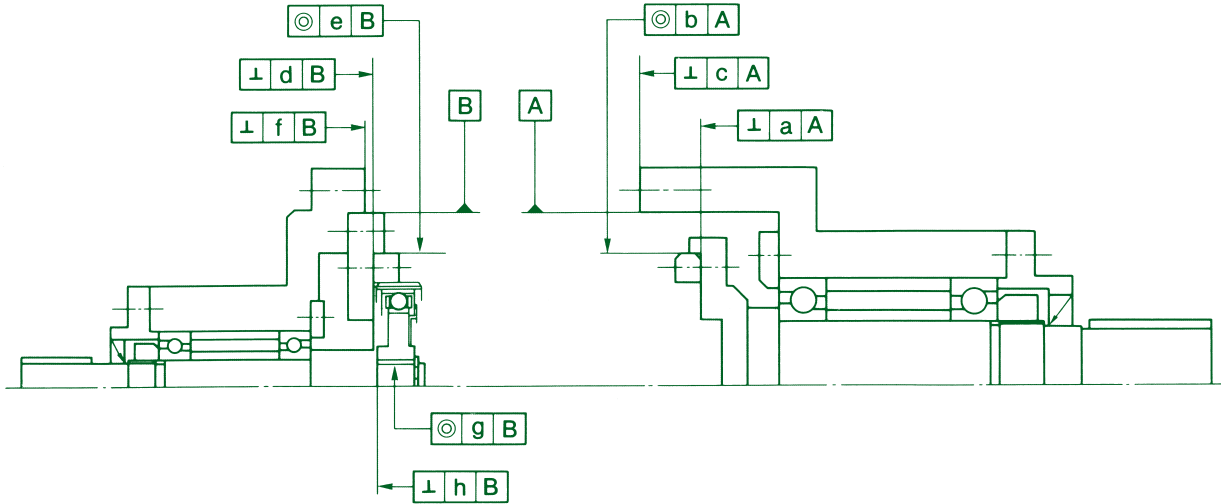
For retention of grease within the tooth mesh area and the ball bearing, it is recommended that the L dimension (see HDUF Dimensions, page 4) be extended further inward to at least S.



HDUF	14	20	25	32	40	50
S	26	38	48	63	76	95

Installation

The Dynamic Spline is distinguished by its chamfered outer edge. HDUF Component Sets may be operated in any attitude. Recommended installed relationships are shown below:



Housing Tolerance

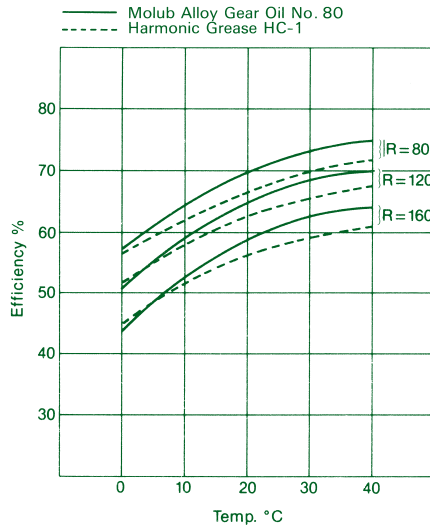
HDUF	a	b	c	d	e	f	g	h
14	0.013	0.015	0.016	0.013	0.015	0.016	0.011	0.007
20	0.017	0.016	0.020	0.017	0.016	0.020	0.013	0.010
25	0.024	0.016	0.029	0.024	0.016	0.029	0.016	0.012
32	0.026	0.017	0.031	0.026	0.017	0.031	0.016	0.012
40	0.026	0.019	0.031	0.026	0.019	0.031	0.017	0.012
50	0.028	0.024	0.034	0.028	0.024	0.034	0.021	0.015

Efficiency

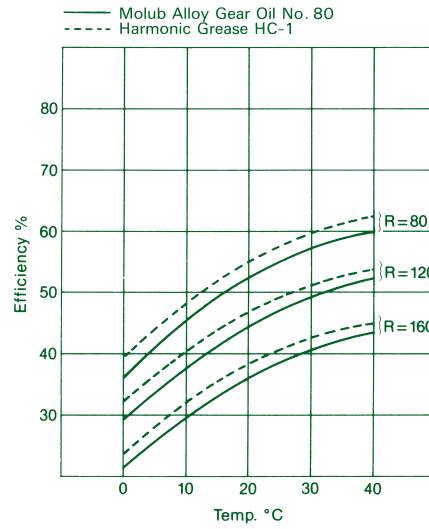
Efficiency varies depending on input speed, ratio, load level, temperature, and type of lubrication. The effects of these factors are illustrated in the curves shown below.

HDUF Efficiency vs. Ratio, Temperature, and Lubricant (At Rated Torque)

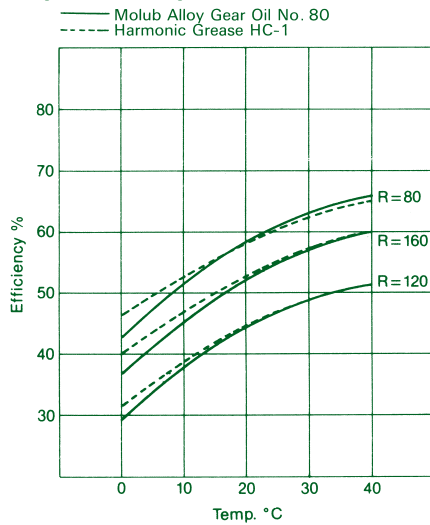
Input Speed 500 rpm



Input Speed 3400 rpm



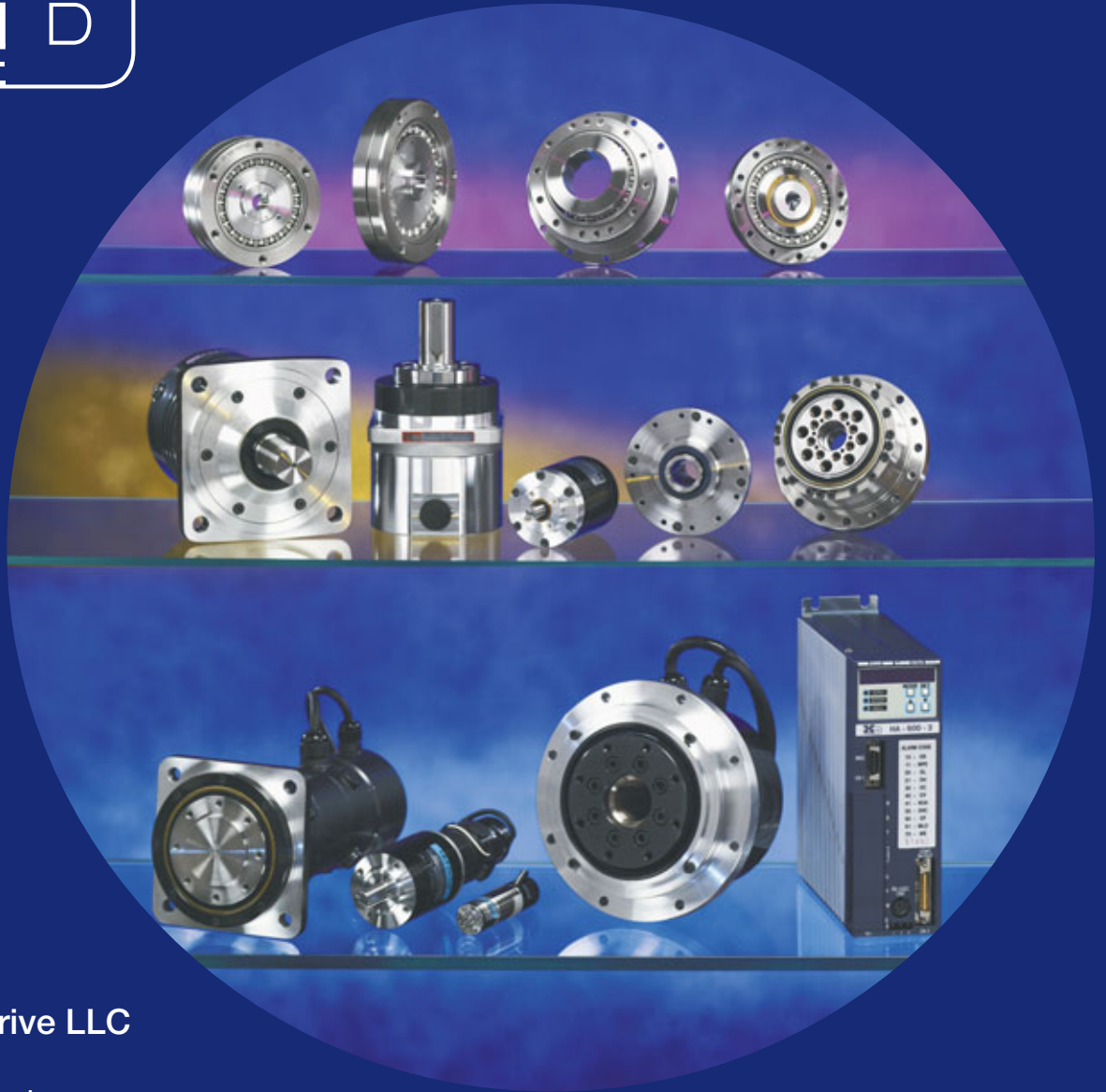
Input Speed 1700 rpm



No-Load Running Torque, Starting Torque, and Backdriving Torque

HDUF		14	20	25	32	40	50
NL Running Torque @ 1500 rpm	Ncm	3~8	5~11	6~30	15~40	20~65	60~150
	oz-in	4~11	7~15	8~42	20~56	28~90	83~210
Starting Torque	Ncm	0.5~3	0.8~4	2~7	3~10	5~30	10~60
	oz-in	0.7~4	1~6	3~10	4~14	7~42	14~83
Backdriving Torque	Nm	0.8~7	2~10	3~38	4~40	8~60	20~110
	lb-in	6~60	17~87	26~330	35~350	70~520	170~950

Values quoted are based on actual tests with the component sets assembled in housings, and takes into consideration friction resistance of oils seals, and churning of oil.



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