

Crane Hoist Drive with Twin Shafts SHC Series

Rev. Sep. 6. 2002
Sumitomo Heavy Industries, Ltd.
PTC Okayama GB

1. Garbage crane with twin drums

Due to increasing environmental issues, the establishment and upgrading of garbage incineration plants is increasing. Garbage cranes installed in garbage incineration plants have twin drums to manipulate a club bucket (Fig.2).

Therefore, the gearbox requires two output shafts to rotate the twin drums. Fig.3 shows examples of twin shaft arrangements.

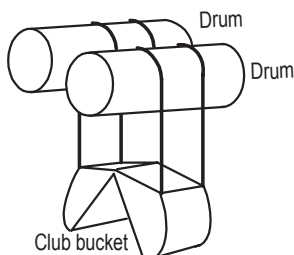


Fig.2 Twin drum for garbage crane

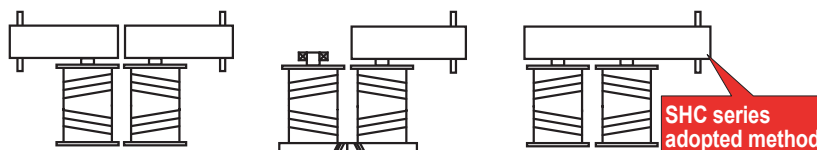


Fig.3 Examples of twin shafts arrangements

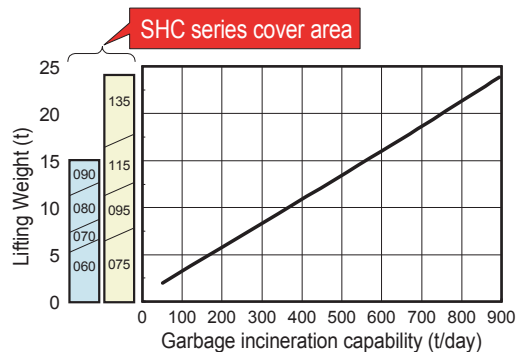


Fig.1 Garbage incineration capability - Lifting weight

To drive the twin drums, the SHC series has two output shafts in the gearbox. Therefore, space reduction and simpler maintenance is achieved.

2. Specifications

SHC Standard Series Line-up

Lifting Weight (ton)	6	8	12	14
Size	SHC060	SHC070	SHC080	SHC090
Center distance of the output shafts	470	530	620	650
Output Torque (kNm)	22	38	57	77

SHC Increased Center Distance Series Line-up

Lifting Weight (ton)	7	12	17	24
Size	SHC075	SHC095	SHC115	SHC135
Center distance of the output shafts	540	680	840	1000
Output Torque (kNm)	27	57	112	207

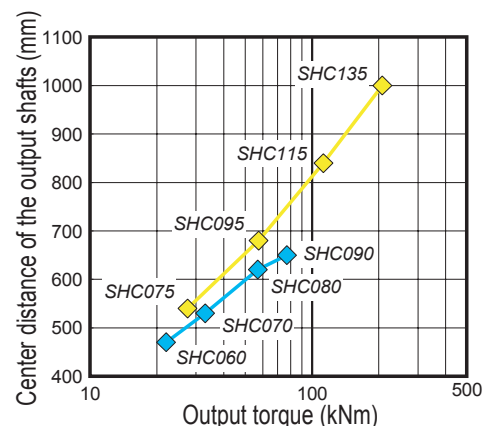


Fig.4 Output torque - Center distance of the output shafts

3. Features

- (1) The first standardized gearbox series dedicated to the garbage incineration industry. By having a standardized series available, inquiries can be dealt with promptly and efficiently.
- (2) Space saving design
Based on PARAMAX® gear design technology, the SHC series is more compact than previous design.
- (3) Optimum center distance of the output shafts for garbage incineration plants
Optimum center distance of two output shafts has been standardized based on our numerous past in this industry.

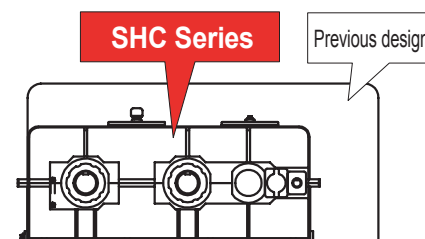
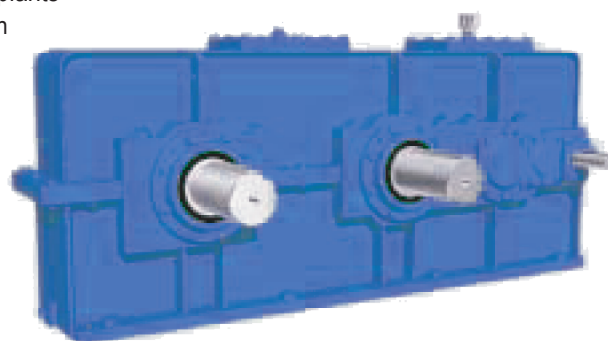


Fig.5 SHC and previous design size comparison

4. Appendix

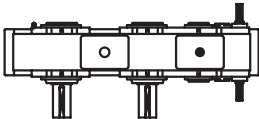
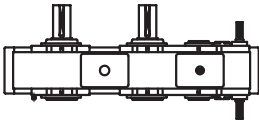
- APP.1 Nomenclature
- APP.2 Selection Procedure
- APP.3 Rating Table
- APP.4 Dimensions

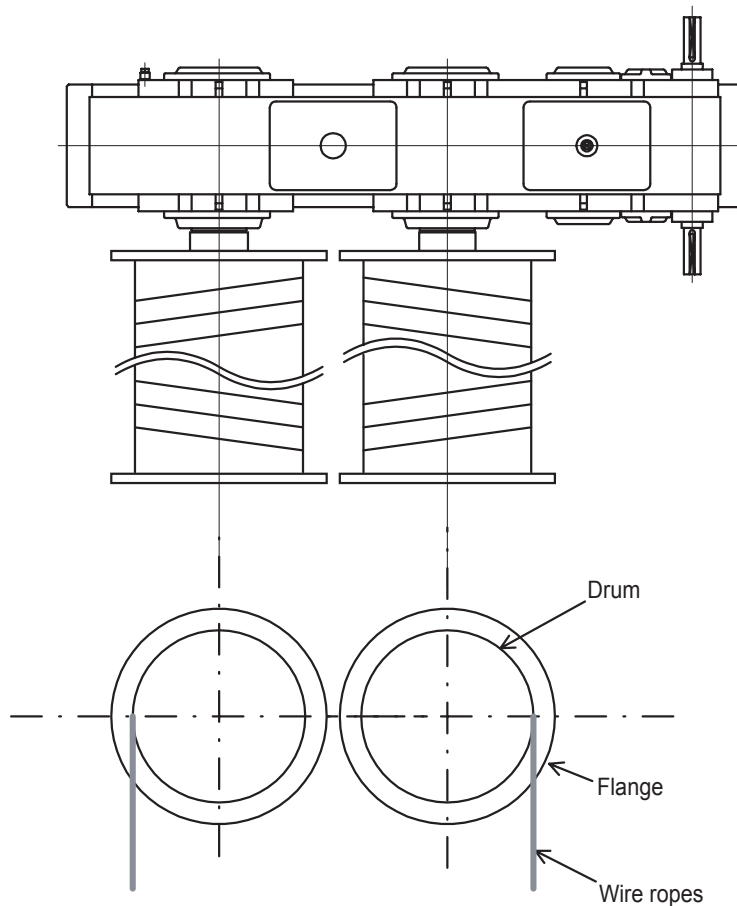


Crane Hoist Drive with Twin Shafts SHC Series

APP.1 Nomenclature

SHC 060 P4 A - BL2 - 36.479

Series	Size		Shaft Position	Number of Stages	Housing Material	Shaft Arrangement	Reduction Ratio
	Standard series	Increased center distance series					
SHC	060	075	P:Parallel	4:Quadruple Reduction	A:Steel Fabricated	 BL2	Refer to APP.3
	070	095				 DR2	
	080	115					
	090	135					



Crane Hoist Drive with Twin Shafts SHC Series

APP.2

(1) Selection Procedure (Standard Series)

Step	Item	Variable	Units	Value	Equations	Example1	Example2	Example3	Example4	
Operating Condition	Lifting Weight	Bucket	F_b	ton	—	-	-	-	-	
		Rated Load	F_t	ton	—	-	-	-	-	
		Total	F	ton	—	$F = F_b + F_t$	6	8	12	14
	Line Speed	V	m/min	—	—	30	40	50	60	
Motor	Type	—	—	—	—	-	-	-	-	
	Rotation Speed	N_m	r/min	—	—	1450	1450	1450	1450	
Wire rope & Drum	Wire rope	Number	n	—	Normally 4 Ropes (2ropes / 1drum)	4	4	4	4	
		Diameter	d	mm	—	※ 1	14	14	18	20
		Fracture Load	S_r	k	—	—	116	116	192	237
		Safety Factor	ν	—	—	$\nu = (S_r \times n) / (F \times 9.81) \geq 5$ ※ 2	7.9	5.9	6.5	6.9
	Minimum Drum Diameter Ratio	E_{min}	—	—	※ 3	21.4	25.5	24.0	23.1	
	Minimum Drum Diameter	D_{min}	mm	—	$D_{min} = E_{min} \times d$	300	356	431	463	
	Drum	Diameter	D	mm	—	$D \geq D_{min}$	320	360	450	480
Diameter Ratio		E	—	—	$E = D / d \geq E_{min}$	22.9	25.7	25.0	24.0	
Flange Height		H	mm	—	—	70	75	75	75	
Flange Diameter		D_f	mm	—	$D_f = D + 2H$	460	510	600	630	
Calculation	Drum Rotation Speed	N_d	r/min	—	$N_d = 1000 \cdot V / (\pi \cdot D)$	29.8	35.4	35.4	39.8	
	Required Reduction Ratio	i_r	—	—	$i_r = N_m / N_d$	48.6	41.0	41.0	36.4	
	Calculated Output Torque	T_r	k m	—	$T_r = 9.81 \cdot F \cdot D / 2000$	9.4	14.1	26.5	33.0	
	Efficiency	η	—	—	$\eta \approx 0.93$ (Gearbox & Rope)	0.93	0.93	0.93	0.93	
	Required Motor Power	P_r	kW	—	$P_r = 0.105 \cdot T_r \cdot N_d / \eta$	31.7	56.4	105.8	148.1	
Motor Selection	Motor Power	P_m	kW	—	$P_m \geq P_r$	37	75	110	150	
	Safety Factor	ν_m	—	—	$\nu_m = P_m / P_r$	1.16	1.32	1.04	1.01	
Service Factor	Required Service Factor	SF_r	—	—	$SF = 1.5$ or 1.75 (common)	1.5	1.5	1.5	1.5	
Gearbox Selection	Selected Size	—	—	—	see APP.3	SHC060	SHC070	SHC080	SHC090	
	Reduction Ratio	i	—	—	—	46.902	41.103	40.471	35.150	
	Mechanical Rating	P	kW	—	see APP.3	72	124	218	336	
	SF	SF	—	—	$SF = P / P_m$	1.94	1.65	1.98	2.24	
	Center Distance of the Output Shafts	L	mm	—	see APP.3	470	530	620	650	
	Drum Rotation Speed	N	r/min	—	$N = N_m / i$	30.9	35.3	35.8	41.3	
	Tolerance Between Drums	S_1	mm	—	$S_1 = L - D_f$	10	20	20	20	
Gearbox Type										

※ 1 (Example) JIS G 3525-1999 6 by 29 filler wire construction 6×Fi(29)

Rope Diameter (mm)	d	12.5	14	16	18	20	22.4	25
Fracture Load (kN)	S_r	92.5	116	152	192	237	297	370

※ 2 By the crane structure standard, safety factor ν is decided by the lifting grade.

The lifting grade of the crane for garbage is "F" grade, safety factor of the wire rope ν should be greater than or equal to 5.

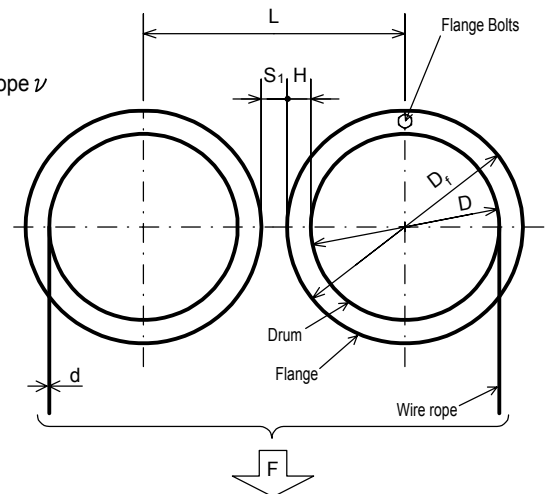
※ 3 Drum diameter ratio E is the ratio of the drum diameter D and rope diameter d ($E=D/d$). According to the crane structure standard, if safety factor of the rope ν equals to 5, drum diameter ratio E should be greater than or equal to 35.5. If ν is greater than 5, the minimum diameter ratio E_{min} will be calculated in following equation.

$$E_{min} = \left[(35.5 - 9) \times \frac{\frac{\sigma_B}{\nu} + 4g}{\frac{\sigma_B}{5} + 4g} + 9 \right] \times \frac{1}{1.25}$$

σ_B : Nominal tensile strength of the wire 1770N/mm² (JIS G3525 B type)
 g : Gravity acceleration 9.81m/s²

Safety factor of the rope (ν) and minimum drum diameter ratio (E_{min})

Rope Safety Factor	ν	5	6	7	8
Minimum Drum Diameter Ratio	E_{min}	35.5	25.3	23.0	21.3



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APP.2

(2) Selection Procedure (Increased Center Distance Series)

Step	Item	Variable	Units	Value	Equations	Example1	Example2	Example3	Example4	
Operating Condition	Lifting Weight	Bucket	F_b	ton	—	—	—	—	—	
		Rated Load	F_t	ton	—	—	—	—	—	
		Total	F	ton	—	$F = F_b + F_t$	7	12	17	24
	Line Speed	V	m/min	—	—	30	50	60	60	
	Motor	Type	—	—	—	—	—	—	—	—
Rotation Speed		N_m	r/min	—	—	1450	1450	1450	1450	
Wire rope & Drum	Wire rope	Number	n	—	—	Normally 4 Ropes (2ropes / 1drum)	4	4	4	4
		Diameter	d	mm	—	※ 1	14	18	22.4	25
		Fracture Load	S_r	kN	—	—	116	192	297	370
		Safety Factor	ν	—	—	$\nu = (S_r \times n) / (F \times 9.81) \geq 5$ ※ 2	6.8	6.5	7.1	6.3
	Minimum Drum Diameter Ratio	E_{min}	—	—	※ 3	23.5	24.0	22.7	24.5	
	Minimum Drum Diameter	D_{min}	mm	—	$D_{min} = E_{min} \times d$	328	431	509	613	
	Drum	Diameter	D	mm	—	$D \geq D_{min}$	350	450	560	710
		Diameter Ratio	E	—	—	$E = D / d \geq E_{min}$	25.0	25.0	25.0	28.4
		Flange Height	H	mm	—	—	80	80	80	80
		Flange Diameter	D_f	mm	—	$D_f = D + 2H$	510	610	720	870
Calculation	Drum Rotation Speed	N_d	r/min	—	$N_d = 1000 \cdot V / (\pi \cdot D)$	27.3	35.4	34.1	26.9	
	Required Reduction Ratio	i_r	—	—	$i_r = N_m / N_d$	53.1	41.0	42.5	53.9	
	Calculated Output Torque	T_r	kN·m	—	$T_r = 9.81 \cdot F \cdot D / 2000$	12.0	26.5	46.7	83.6	
	Efficiency	η	—	—	$\eta \doteq 0.93$ (Gearbox & Rope)	0.93	0.93	0.93	0.93	
	Required Motor Power	P_r	kW	—	$P_r = 0.105 \cdot T_r \cdot N_d / \eta$	37.0	105.8	179.8	253.8	
Motor Selection	Motor Power	P_m	kW	—	$P_m \geq P_r$	37	110	220	320	
	Safety Factor	ν_m	—	—	$\nu_m = P_m / P_r$	1.00	1.03	1.22	1.26	
Service Factor	Required Service Factor	SF_r	—	—	$SF = 1.5$ or 1.75 (common)	1.5	1.5	1.5	1.5	
Gearbox Selection	Selected Size	—	—	—	see APP.3	SHC075	SHC095	SHC115	SHC135	
	Reduction Ratio	i	—	—	see APP.3	54.120	35.769	43.072	55.180	
	Mechanical Rating	P	kW	—	see APP.3	77	242	395	568	
	SF	SF	—	—	$SF = P / P_m$	2.08	2.20	1.79	1.77	
	Center Distance of the Output Shafts	L	mm	—	see APP.3	540	680	840	1000	
	Drum Rotation Speed	N	r/min	—	$N = N_m / i$	26.8	40.5	33.7	26.3	
	Tolerance Between Drums	S_1	mm	—	$S_1 = L - D_f$	30	70	120	130	
	Gearbox Type	—	—	—	see APP.1	—	—	—	—	

※ 1 (Example) JIS G 3525-1999 6 by 29 filler wire construction 6×Fi(29)

Rope Diameter (mm)	d	12.5	14	16	18	20	22.4	25
Fracture Load (kN)	S_r	92.5	116	152	192	237	297	370

※ 2 By the crane structure standard, safety factor ν is decided by the lifting grade.

The lifting grade of the crane for garbage is "F" grade, safety factor of the wire rope ν should be greater than or equal to 5.

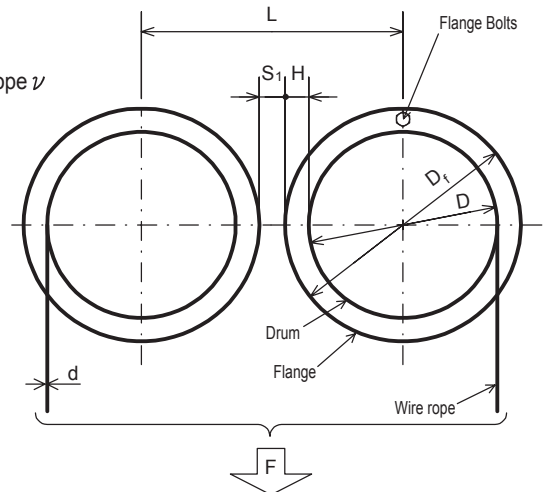
※ 3 Drum diameter ratio E is the ratio of the drum diameter D and rope diameter d ($E=D/d$). According to the crane structure standard, if safety factor of the rope ν equals to 5, drum diameter ratio E should be greater than or equal to 35.5. If ν is greater than 5, the minimum diameter ratio E_{min} will be calculated in following equation.

$$E_{min} = \left[(35.5 - 9) \times \frac{\frac{\sigma_B}{\nu} + 4g}{\frac{\sigma_B}{5} + 4g} + 9 \right] \times \frac{1}{1.25}$$

σ_B : Nominal tensile strength of the wire 1770N/mm² (JIS G3525 B type)
 g : Gravity acceleration 9.81m/s²

Safety factor of the rope (ν) and minimum drum diameter ratio (E_{min})

Rope Safety Factor	ν	5	6	7	8
Minimum Drum Diameter Ratio	E_{min}	35.5	25.3	23.0	21.3

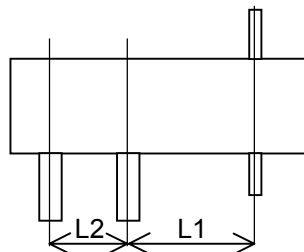


Crane Hoist Drive with Twin Shafts SHC Series

APP.3

(1) Rating Table (Standard Series)

Lifting Weight	Type	Center Distance		Reduction Ratio	Gear Rating (kW) SF=1.0		
		L1	L2		750r/min	1000r/min	1500r/min
~ 6t	SHC060P4A	536	470	57.455	30	41	61
				53.864	32	43	65
				46.902	37	50	74
				43.971	40	53	79
				36.479	48	64	95
				34.199	51	68	102
				32.193	54	72	108
				26.097	67	89	133
				24.566	71	94	141
				21.046	83	110	164
				19.811	88	117	174
~ 8t	SHC070P4A	614	530	62.729	42	56	84
				56.138	47	63	94
				50.351	53	70	105
				45.827	58	77	115
				41.103	64	86	128
				35.643	74	99	147
				31.365	84	112	167
				28.751	92	122	182
				25.053	105	140	208
				22.965	115	152	227
				19.486	135	179	266
~ 12t	SHC080P4A	719	620	65.765	70	93	140
				58.028	78	104	155
				50.588	91	121	181
				45.561	100	132	197
				40.471	114	151	225
				36.966	122	162	241
				31.702	145	192	287
				29.139	157	209	311
				24.317	188	250	372
				22.351	204	271	404
				19.775	231	306	455
~ 14t	SHC090P4A	792	650	64.807	96	128	191
				55.026	113	150	224
				50.298	123	164	245
				44.444	139	185	276
				40.171	154	205	305
				35.150	176	234	348
				31.905	193	257	383
				28.837	214	284	423
				25.068	245	326	485
				22.381	274	364	542
				19.456	315	418	621

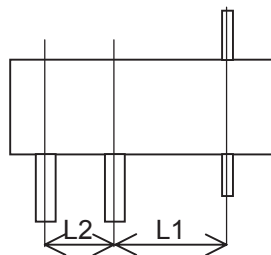


Crane Hoist Drive with Twin Shafts SHC Series

APP.3

(2) Rating Table (Increased Center Distance Series)

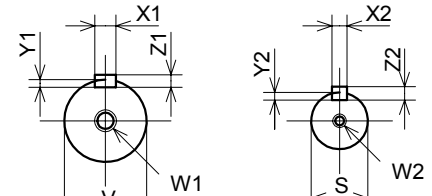
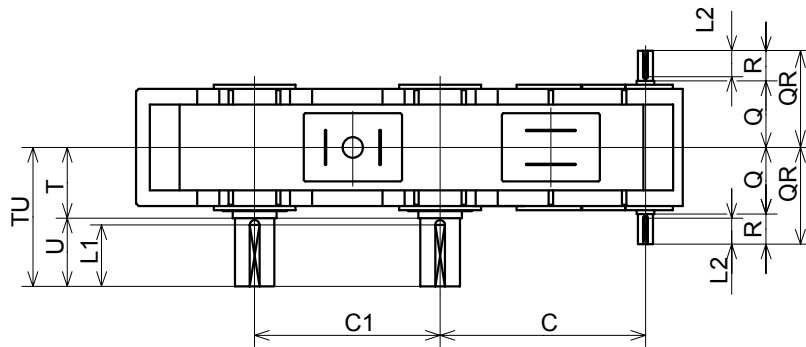
Lifting Weight	Type	Center Distance		Reduction Ratio	Gear Rating (kW) SF=1.0		
		L1	L2		750r/min	1000r/min	1500r/min
~ 7t	SHC075P4A	579	540	57.728	37	49	74
				54.120	40	53	80
				47.125	45	61	90
				44.18	49	65	97
				36.653	58	78	115
				34.362	63	83	124
				32.346	67	89	132
				26.221	91	121	180
				24.682	97	128	190
				21.146	111	147	218
~ 12t	SHC095P4A	753	680	19.905	116	154	228
				51.667	88	117	175
				45.091	101	134	200
				41.333	110	146	217
				35.769	127	168	251
				32.378	140	186	276
				28.615	158	210	312
				26.331	171	227	338
				21.949	205	272	404
				20.197	222	295	439
~ 17t	SHC115P4A	893	840	47.437	169	224	333
				43.072	207	275	409
				38.917	218	290	430
				35.805	237	314	466
				30.205	293	389	579
				28.132	300	397	589
				25.063	336	445	659
				21.834	404	535	795
				19.452	452	599	889
				~ 24t	SHC135P4A	1126	1000
48.983	334	444	661				
44.771	365	485	722				
40.387	405	537	799				
34.998	466	618	919				
32.769	497	659	980				
28.396	572	758	1127				
25.795	629	833	1238				
21.893	738	978	1452				
19.887	811	1074	1594				



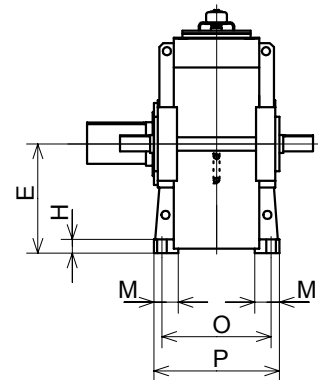
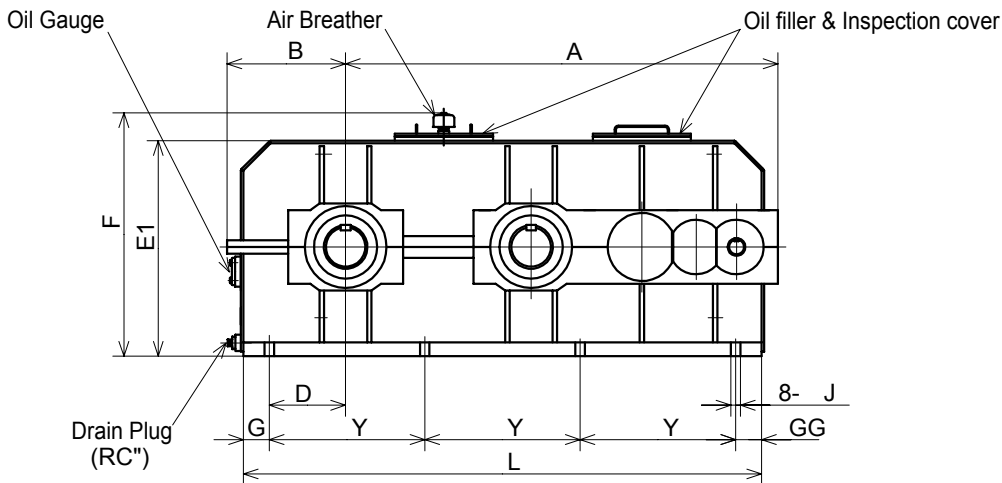
Crane Hoist Drive with Twin Shafts SHC Series

APP.4

(1) Dimensions (Standard Series)



Key and keyways are based on ISO R773-1969 Close keys
(JIS B 1301-1996 Parallel key in fastening type)



(Units : mm)

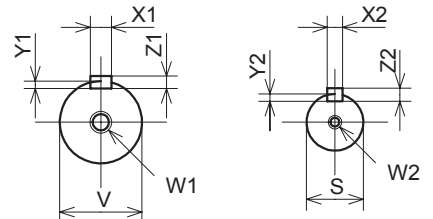
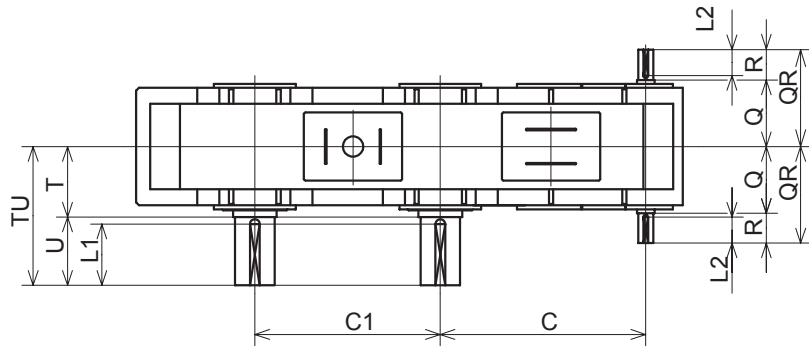
SIZE	A	B	C	C1	D	E	E1	F	G	GG	H	J	L	M	O	P	Y	RC	Weight kg	Oil Q'ty L
SHC060P4A	1130	320	536	470	195	285	550	657	65	65	25	28	1330	90	290	345	400	1"	820	45
SHC070P4A	1270	350	614	530	215	315	610	717	75	75	27	35	1500	105	340	410	450	1 1/4"	1050	65
SHC080P4A	1475	400	719	620	260	370	710	817	80	85	33	42	1755	115	380	460	530	1 1/4"	1600	85
SHC090P4A	1600	425	792	650	260	390	750	857	90	90	37	42	1875	115	400	480	565	1 1/4"	2400	175

SIZE	Slow Speed Shaft									Slow Speed Shaft								
	QR	Q	R	S	W2/Depth	Key				TU	T	U	V	W1/Depth	Key			
						X2	Y2	Z2	L2						X1	Y1	Z1	L1
SHC060P4A	304	194	110	40k6	M16/36	12	5	8	95	411	201	210	110m6	M24/50	28	10	16	190
SHC070P4A	329	219	110	50k6	M16/36	14	5.5	9	95	440	230	210	125m6	M24/50	32	11	18	185
SHC080P4A	354	244	110	55m6	M20/42	16	6	10	95	509	259	250	145m6	M30/60	36	12	20	225
SHC090P4A	405	265	140	65m6	M20/42	18	7	11	125	582	282	300	165m6	M30/60	40	13	22	275

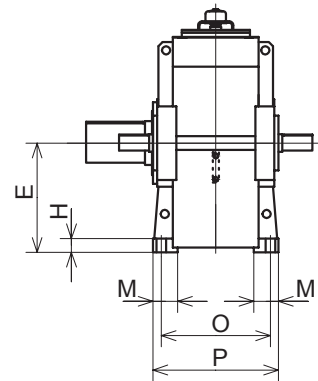
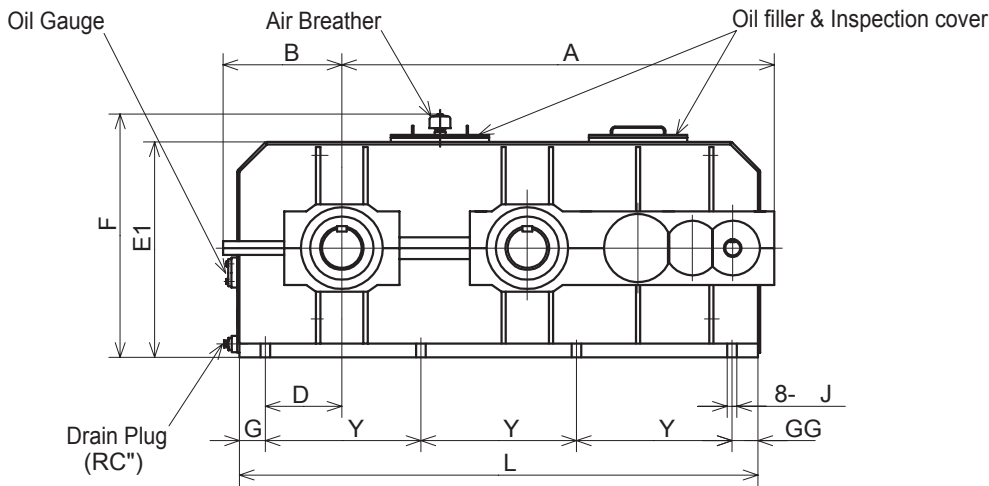
Crane Hoist Drive with Twin Shafts SHC Series

APP.4

(2) Dimensions (Increased Center Distance Series)



Slow Speed Shaft High Speed Shaft
Key and keyways are based on ISO R773-1969 Close keys (JIS B 1301-1996 Parallel key in fastening type)



(Units : mm)

SIZE	A	B	C	C1	D	E	E1	F	G	GG	H	J	L	M	O	P	Y	RC	Weight kg	Oil Q'ty L
SHC075P4A	1250	340	579	540	205	320	620	750	95	95	40	28	1510	80	340	400	440	1"	1200	75
SHC095P4A	1585	435	753	680	280	400	780	890	95	95	50	35	1900	90	400	460	570	1 1/4"	2100	140
SHC115P4A	1950	550	893	840	365	485	945	1080	110	110	50	35	2350	100	420	500	710	1 1/4"	3400	210
SHC135P4A	2355	605	1126	1000	415	575	1120	1220	130	130	50	35	2840	120	580	660	860	1 1/4"	6500	410

SIZE	Slow Speed Shaft									Slow Speed Shaft								
	QR	Q	R	S	W2/Depth	Key				TU	T	U	V	W1/Depth	Key			
						X2	Y2	Z2	L2						X1	Y1	Z1	L1
SHC075P4A	331	221	110	40k6	M16/36	12	5	8	95	438	228	210	110m6	M24/50	28	10	16	190
SHC095P4A	354	244	110	55m6	M20/42	16	6	10	95	509	259	250	145m6	M30/60	36	12	20	225
SHC115P4A	415	275	140	70m6	M20/42	20	7.5	12	125	592	292	300	165m6	M30/60	40	13	22	275
SHC135P4A	515	375	140	75m6	M20/42	20	7.5	12	125	740	390	350	200m6	M30/60	45	15	25	320