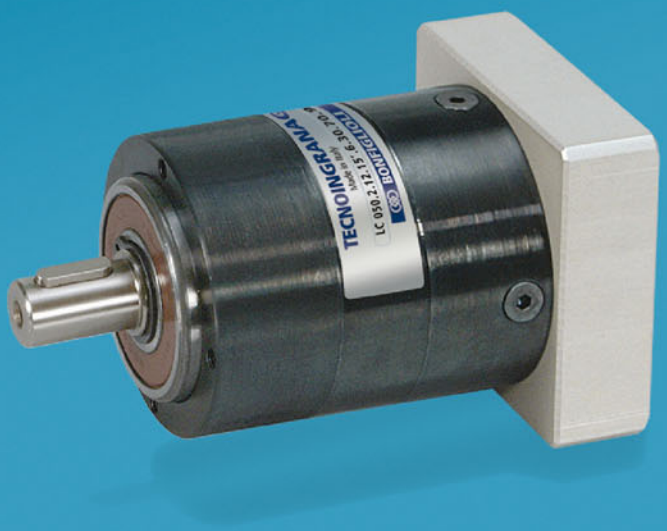
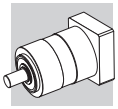
Bonfiglioli
Tecnoingranaggi

LC series

Low-backlash gearboxes



Bonfiglioli
power, control and green solutions



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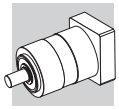
LC 120 16

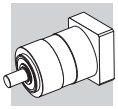
LC 155 18

Revisions

Refer to page 20 for the catalogue revision index.

Visit www.bonfiglioli.com to search for catalogues with up-to-date revisions.





1 GENERAL INFORMATION

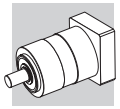
1.1 SYMBOLS, UNITS AND DEFINITIONS

Values depending on the APPLICATION

term	u.m.	definition
A_2	[N]	Thrust force on output shaft
$A_{2\ EQU}$	[N]	Equivalent thrust force applying on output shaft
$A_{2\ MAX}$	[N]	Maximum thrust force applying on output shaft
R_2	[N]	Radial force on output shaft
$R_{2\ EQU}$	[N]	Equivalent radial force applying on output shaft
$R_{2\ MAX}$	[N]	Maximum radial force applying on output shaft
ED	[min]	Loading time
ED%	[%]	Loading time %
$L_{10h\ TARGET}$	[h]	Output shaft bearings' desired basic rating life
$M_{1\ PEAK}$	[Nm]	Maximum input torque (usually motor)
$M_{2(1)}$ ... $M_{2(n)}$	[Nm]	Output torque at each of the time periods t_1 ... t_n
$M_{2\ EQU}$	[Nm]	Equivalent output torque
$M_{2\ MAX}$	[Nm]	Maximum output torque in case of emergency
$M_{T2\ EQU}$	[Nm]	Equivalent tilting moment applying on output shaft
$M_{T2\ MAX}$	[Nm]	Maximum tilting moment applying on output shaft
n_2	[min^{-1}]	Output speed
$n_{2(1)}$ ... $n_{2(n)}$	[min^{-1}]	Output speed based on the time periods t_1 ... t_n
$n_{2\ EQU}$	[min^{-1}]	Equivalent output speed
$n_{2\ MAX}$	[min^{-1}]	Maximum output speed
T	[C°]	Ambient temperature
t_1 ... t_n	[s]	Time periods of motion
t_Σ	[s]	Cycle duration including pause
Z	[1/h]	Cycle number per hour

Values depending on the GEAR DRIVE SELECTION

term	u.m.	definition
$A_{2\ 3\ max}$	[N]	Admissible thrust force on output shaft
$A_2'_{max}$	[N]	Thrust force acting simultaneously with the rated radial force
$R_{1\ max}$	[N]	Admissible radial force at midpoint of input shaft
$R_{2\ 3\ max}$	[N]	Admissible radial force at midpoint of output shaft
C_B	[Nm]	Constant for bearing's lifetime calculation
C_t	$\left[\frac{Nm}{arcmin}\right]$	Torsional stiffness
f_n	—	Speed factor
f_z	—	Cycle factor
f_T	—	Temperature adjusting factor
i	—	Gearbox ratio
J_G	[$kgcm^2$]	Mass moment of inertia of the gearhead
K_n	—	Speed constant
L_{10h}	[h]	Bearings' basic rating life
L_Z	[mm]	Factor for bearing's lifetime calculation
$M_{a\ 2}$	[Nm]	Maximum acceleration output torque
$M_{n\ 2}$	[Nm]	Rated output torque
$M_{p\ 2}$	[Nm]	Emergency stop output torque
$M_{T2\ max}$	[Nm]	Maximum tilting moment applying on output shaft
$n_{1\ max}$	[min^{-1}]	Maximum momentary input speed. The speed the unit can be driven at occasionally and in non-repetitive conditions For cycle duty type S5, it cannot be applied continuously for more than 30 seconds
p	—	Bearing lifetime exponent
η	[%]	Gear efficiency
φ_R	[arcmin]	Reduced backlash is calculated in static conditions and with the application of a torque equal to 2% of the gear unit rated torque
φ_S	[arcmin]	Standard backlash is calculated in static conditions and with the application of a torque equal to 2% of the gear unit rated torque



1.2 SELECTING THE GEAR UNIT

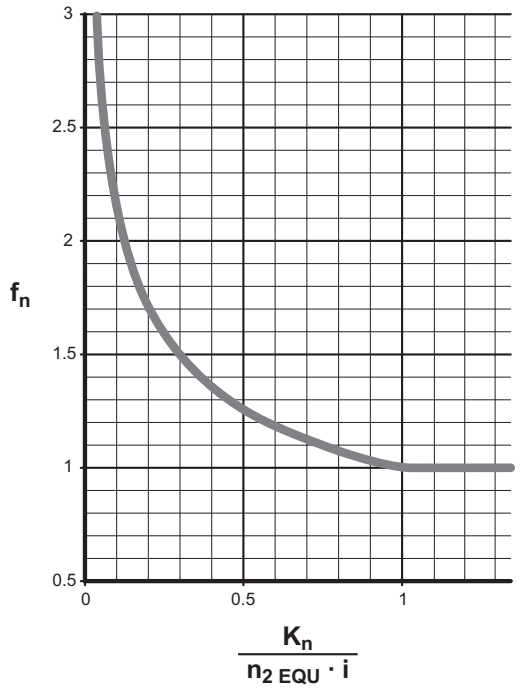
(a)	Ratio	i	—	$i = \frac{n_1}{n_2}$
(b)	Equivalent output torque	$M_{2\,EQU}$	[Nm]	$M_{2\,EQU} = \sqrt[3]{\frac{n_{2(1)} \cdot t_1 \cdot \lvert M_{2(1)} \rvert^3 + \ldots + n_{2(n)} \cdot t_n \cdot \lvert M_{2(n)} \rvert^3}{n_{2(1)} \cdot t_1 + \ldots + n_{2(n)} \cdot t_n}}$
(c)	Equivalent output speed	$n_{2\,EQU}$	[min^{-1}]	$n_{2\,EQU} = \frac{n_{2(1)} \cdot t_1 + n_{2(2)} \cdot t_2 + \ldots + n_{2(n)} \cdot t_n}{t_\Sigma}$
(d)	Speed factor	f_n	—	If $\frac{K_n}{n_{2\,EQU} \cdot i} \geq 1 \Rightarrow f_n = 1$ If $\frac{K_n}{n_{2\,EQU} \cdot i} < 1 \Rightarrow f_n$ = Obtain from diagram
(e)	Loading time % Loading time	ED% ED	[%] [min]	$ED\% = \frac{t_1 + t_2 + \ldots + t_n}{t_\Sigma} \cdot 100$ $ED = t_1 + t_2 + \ldots + t_n$
(f)	Cycle number per hour	Z	[1/h]	$Z = \frac{3600}{t_\Sigma}$
(g)	Cycle factor	f_z	—	see table below
(h)	Temperature adjusting factor	f_T	—	If T ≤ 30°C ⇨ $f_T = 1$ If T > 30°C ⇨ $f_T = 1 + \frac{T° - 30\ C}{100\,°C}$
(i)	Maximum input torque	$M_{1\,PEAK}$	[Nm]	a) maximum possible application torque b) limited motor torque by inverter c) maximum motor torque

Z	f_z
Z ≤ 1000	1.00
1000 < Z ≤ 1500	1.25
1500 < Z ≤ 2500	1.50
2500 < Z ≤ 4000	1.75
4000 < Z ≤ 6000	2.00
Z > 6000	contact us

K_n - speed constant

i	LC 050	LC 070	LC 090	LC 120	LC 155
3	1671	1392	2900	2500	1340
4	2200	1584	2500	2100	876
5	2901	2047	2700	2300	957
7	3700	3032	3500	3000	1229
9	4000	3300	2900	2500	3000
10		4000	4000	3500	2500
12	3300	3300	2900	2500	2100
15	3300	3500	2900	2500	2100
16	3500	3500	3100	2800	3000
20	3500	3700	3200	3000	3000
25	3500	4000	3200	3000	3000
28	3500	3700	3500	3000	3000
30		4000	4000	3500	3000
35	3700	4000	3500	3000	3000
36	4000				
40		4000	4000	3500	3000
45	4000				
50		4000	4000	3500	3000
70		4000	4000	3500	3000
81	4000				
100		4000	4000	3500	3000

f_n - speed factor

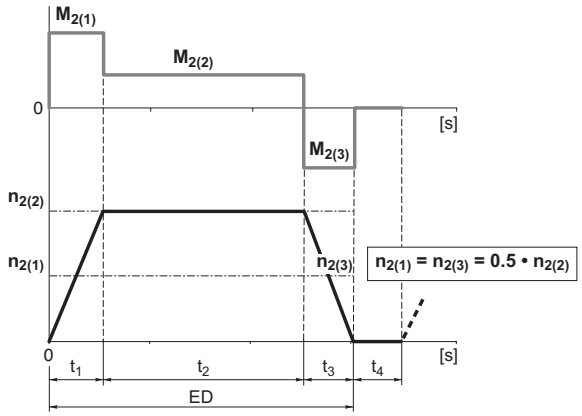


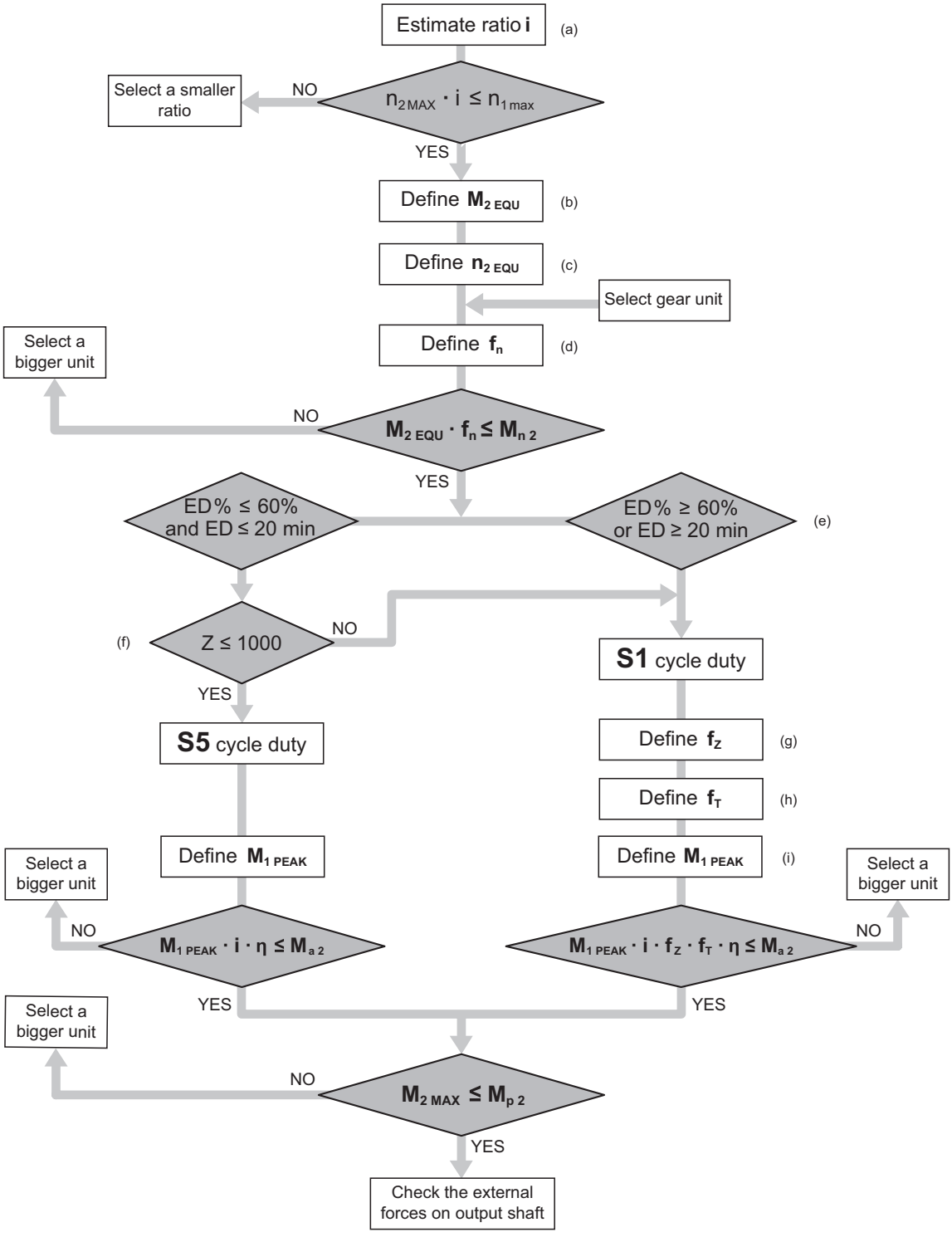
Load diagram

M_2: Output torque

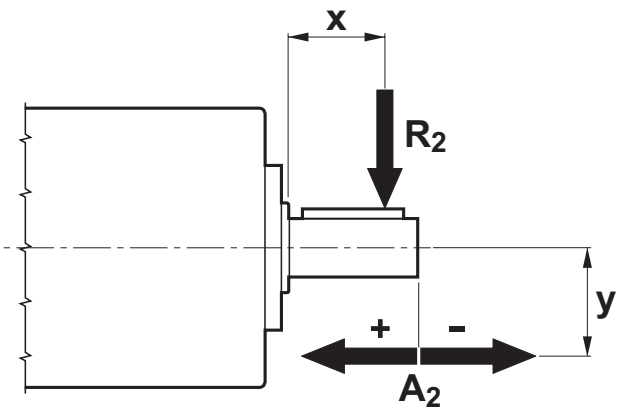
Speed diagram

n_2: Output speed



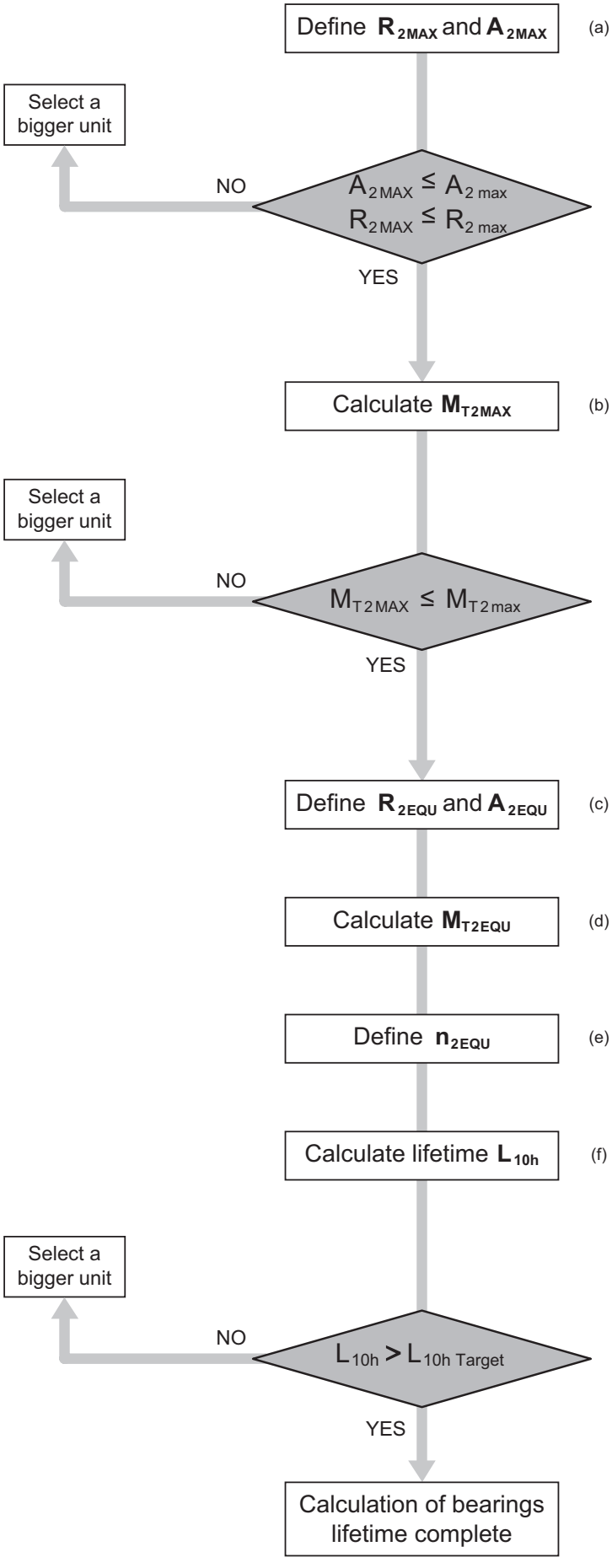


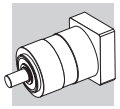
1.3 SERVICE LIFE OF BEARINGS



(a)	Maximum radial force applying on output shaft	$R_{2\,MAX}$	[N]	Please consider the specific conditions (e.g. belt drives under acceleration torque)
	Maximum axial force applying on output shaft	$A_{2\,MAX}$	[N]	
(b)	Maximum tilting moment applying on output shaft	$M_{T\,2\,MAX}$	[Nm]	$M_{T2MAX} = \frac{R_{2\,MAX} \cdot (x + L_Z) \pm A_{2\,MAX} \cdot y}{1000}$
(c)	Equivalent forces applying on output shaft	$R_{2\,EQU}$	[N]	$R_{2EQU} = \sqrt[3]{\frac{n_{2(1)} \cdot t_1 \cdot \lvert R_{2(1)} \rvert^3 + \ldots + n_{2(n)} \cdot t_n \cdot \lvert R_{2(n)} \rvert^3}{n_{2(1)} \cdot t_1 + \ldots + n_{2(n)} \cdot t_n}}$
		$A_{2\,EQU}$	[N]	$A_{2EQU} = \sqrt[3]{\frac{n_{2(1)} \cdot t_1 \cdot \lvert A_{2(1)} \rvert^3 + \ldots + n_{2(n)} \cdot t_n \cdot \lvert A_{2(n)} \rvert^3}{n_{2(1)} \cdot t_1 + \ldots + n_{2(n)} \cdot t_n}}$
(d)	Equivalent tilting moment applying on output shaft	$M_{T\,2\,EQU}$	[Nm]	$M_{T2EQU} = \frac{R_{2\,EQU} \cdot (x + L_Z) + A_{2\,EQU} \cdot y}{1000}$
(e)	Equivalent output speed	$n_{2\,EQU}$	[min^{-1}]	$n_{2EQU} = \frac{n_{2(1)} \cdot t_1 + n_{2(2)} \cdot t_2 + \ldots + n_{2(n)} \cdot t_n}{t_1 + t_2 + \ldots + t_n}$
(f)	Bearings' basic rating life	L_{10h}	[h]	$L_{10h} = \frac{16666}{n_{2EQU}} \cdot \left(\frac{C_B}{M_{T2EQU}} \right)^p$

		LC 050	LC 070	LC 090	LC 120	LC 155
L_Z	[mm]	22	28	30	39	46
$M_{T\,2\,max}$	[Nm]	15	54	105	238	522
C_B	[Nm]	106	280	298	813	1588
p	—	3	3	3	3	3


Define R_{2MAX} and A_{2MAX}
(a)
Select a bigger unit
NO
$A_{2\,MAX} \leq A_{2\,max}$
$R_{2\,MAX} \leq R_{2\,max}$
YES
Calculate M_{T2MAX}
(b)
Select a bigger unit
NO
$M_{T\,2\,MAX} \leq M_{T\,2\,max}$
YES
Define R_{2EQU} and A_{2EQU}
(c)
Calculate M_{T2EQU}
(d)
Define n_{2EQU}
(e)
Calculate lifetime L_{10h}
(f)
Select a bigger unit
NO
$L_{10h} > L_{10h\ Target}$
YES
Calculation of bearings lifetime complete



2 FEATURES OF LC SERIES

Planetary gear units of the LC series belong to a range of low backlash drives very broad and complete as far as transmissible torque, gear ratios and circumferential backlash.
All units are generously proportioned to run quietly and provide a long service life without maintenance requirements.
Motor mounting is an operation that can be easily conducted without the need of any particular tooling, other than that usually available in a normally equipped workshop.

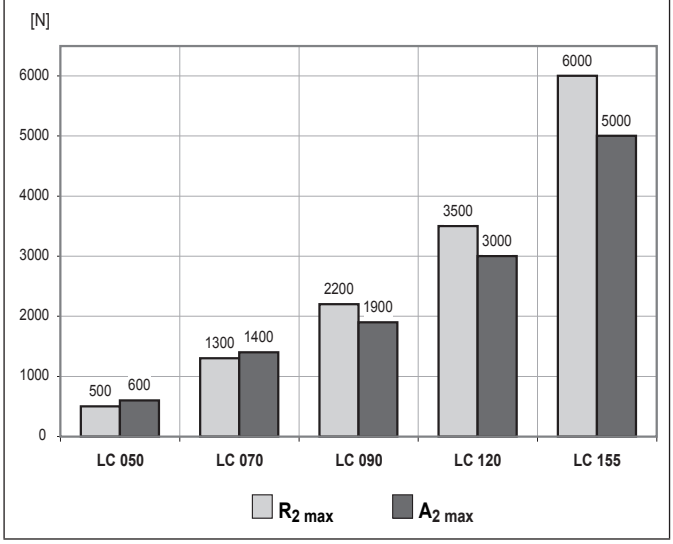
- Available with either standard (STD) or reduced (LOW) backlash
  single reduction gearheads: φ_S = 12' ; φ_R = 6'
  double reduction gearheads: φ_S = 15' ; φ_R = 8'
- Ratio i = 10 available for single-reduction units (i = 9 for frame size LC 050 alone)
- Rigid ball bearings, suitably rated for an average service life of 20,000 hours under nominal operating conditions
- Degree of protection IP64
- Oil seals from Viton® compound as standard
- Max. noise level $L_P \leq 70$ dB(A) @ $n_1 = 3000$ min^{-1}
- Wide range of adapter flanges matching the most popular brands of motors
- Units are factory filled with synthetic grease to NLGI consistency class 00, suitable for installation in any mounting position and at ambient temperature within the range 0°C...40°C.
  In the absence of contamination the lubricant does not require periodical changes.

Distribution of nominal torque M_{n2} [Nm]

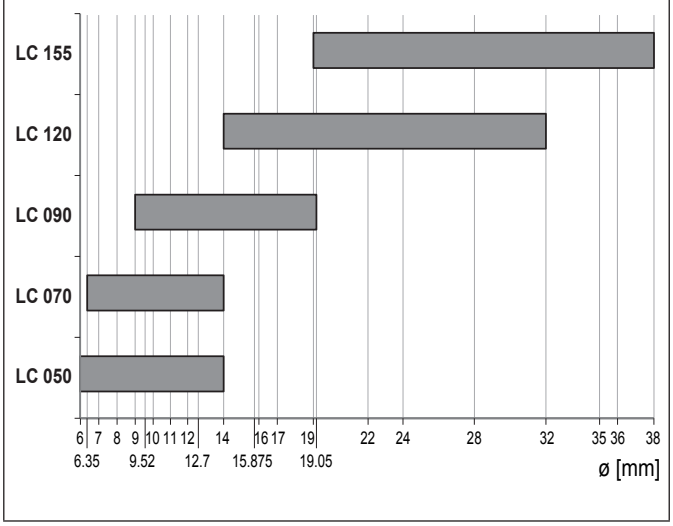
[i]	3	4	5	7	9	10	12	15	16	20	25	28	30	35	36	40	45	50	70	81	100
LC 050	10	12	12	12	10	–	12	12	12	12	12	12	–	12	12	–	12	–	–	10	–
LC 070	18	25	25	25	18	18	25	25	25	25	25	25	18	25	–	25	–	25	25	–	18
LC 090	37	43	43	43	37	37	43	43	43	43	43	43	37	43	–	43	–	43	43	–	37
LC 120	95	110	110	110	95	95	110	110	110	110	110	110	95	110	–	110	–	110	110	–	95
LC 155	250	300	300	300	250	230	300	300	300	300	300	300	250	300	–	300	–	300	300	–	230

double reduction gearheads

Output shaft max. loading capacity



Available motor shaft bores



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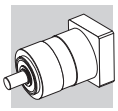


3 ORDERING CODE

LC **120** **1** **3** **STD** **70D** **CD** **19** **KE**

OUTPUT SHAFT CONFIGURATION
- **KE** keyed shaft
- **KL** smooth keyless shaft

INPUT SHAFT BORE

MOTOR COUPLING
- **CD** clamping device

INPUT SECTION
- **25 ... 130** motor adapter
- **FM** without motor adapter

BACKLASH

	1 reduction	2 reductions
STD	φ_S = 12'	φ_S = 15'
LOW	φ_R = 6'	φ_R = 8'

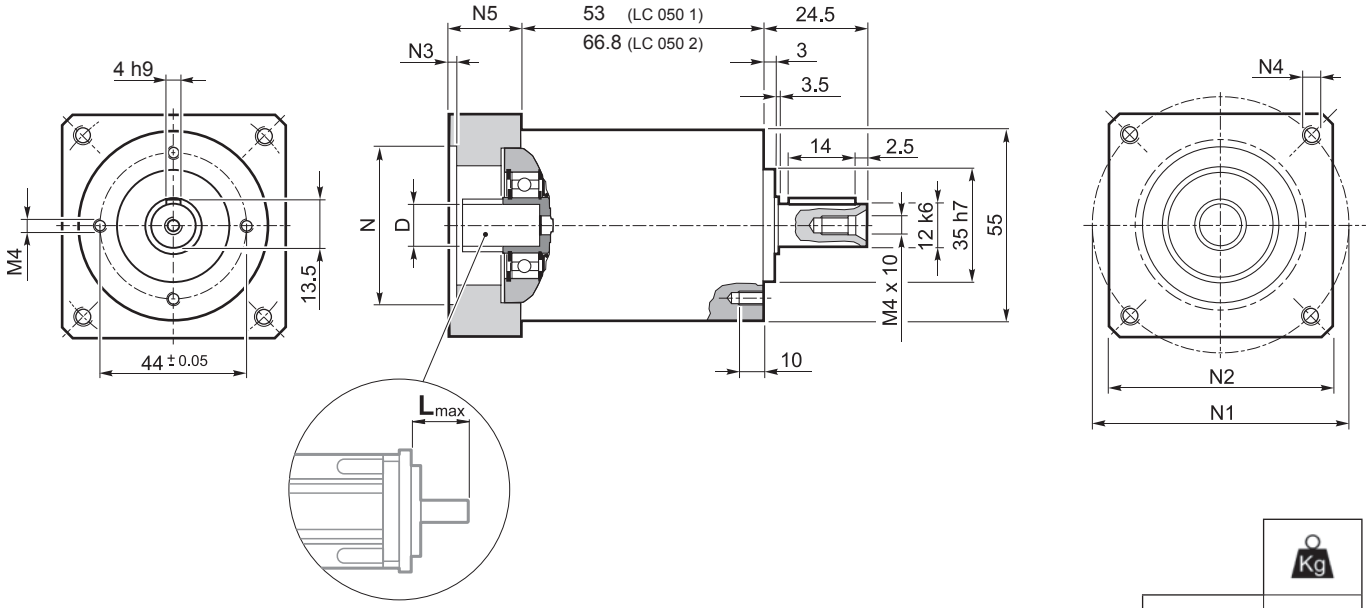
GEAR RATIO

REDUCTIONS
- **1** **2**

FRAME SIZE
- **050** **070** **090** **120** **155**

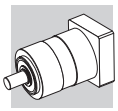
SERIES
- **LC**

4 DIMENSIONS AND TECHNICAL SPECIFICATIONS

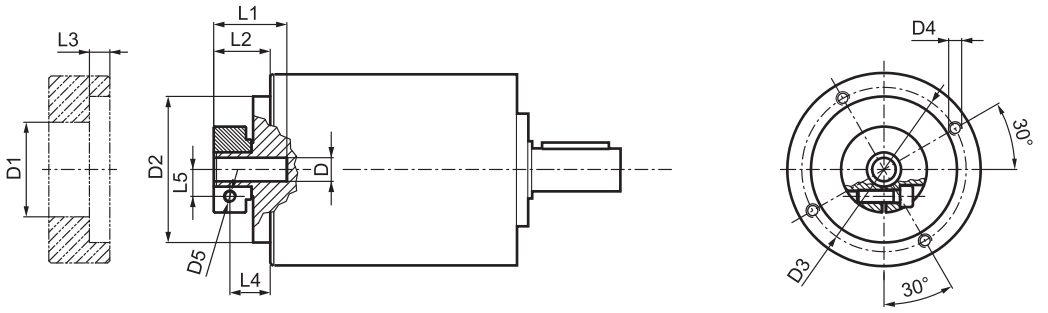


	Kg
LC 050 1	1.1
LC 050 2	1.3

	D											N	N1		N2	N3	N4	N5	L_{max}
													min	max					
25AH	6	6.35	7	8	9	9.52	–	–	–	–	–	25	36	48					
26AH	6	6.35	7	8	9	9.52	–	–	–	–	–	26	36	48					
28AH	6	6.35	7	8	9	9.52	–	–	–	–	–	28	36	48					
30AH	6	6.35	7	8	9	9.52	–	–	–	–	–	30	36	48					
32AH	6	6.35	7	8	9	9.52	–	–	–	–	–	32	38	48	55	3.5	4.5	25	25
34AH	6	6.35	7	8	9	9.52	–	–	–	–	–	34	40	48					
36AH	6	6.35	7	8	9	9.52	–	–	–	–	–	36	42	48					
38AH	6	6.35	7	8	9	9.52	–	–	–	–	–	38	44	48					
40AH	6	6.35	7	8	9	9.52	–	–	–	–	–	40	46	48					
38B	6	6.35	7	8	9	9.52	10	11	12	12.7	–	38.1	66.6		60	3	M4x10	18	25
40B	6	6.35	7	8	9	9.52	10	11	12	12.7	–	40	63		60	3	M4x10	18	25
50A	6	6.35	7	8	9	9.52	10	11	12	12.7	–	50	60		60	3	M4x10	18	25
50B	6	6.35	7	8	9	9.52	10	11	12	12.7	14	50	65		60	3	M5x12	23	30
50BH	6	6.35	7	8	9	9.52	10	11	12	12.7	14	50	65		60	4	5.5	23	30
50C	6	6.35	7	8	9	9.52	10	11	12	12.7	14	50	70		60	3	M4x10	23	30
50MH	6	6.35	7	8	9	9.52	10	11	12	12.7	–	50	65		55	4	5.5	16	23
60A	6	6.35	7	8	9	9.52	10	11	12	12.7	–	60	75		63	3	M5x12	18	25
60AH	6	6.35	7	8	9	9.52	10	11	12	12.7	–	60	75		65	3	5.5	18	25
60A1	6	6.35	7	8	9	9.52	10	11	12	12.7	14	60	75		63	3	M5x12	23	30
60AH1	6	6.35	7	8	9	9.52	10	11	12	12.7	14	60	75		65	3	5.5	23	30
60B	6	6.35	7	8	9	9.52	10	11	12	12.7	14	60	85		75	3	M5x12	23	30
60C	6	6.35	7	8	9	9.52	10	11	12	12.7	14	60	90		75	3	M5x12	23	30
70A	6	6.35	7	8	9	9.52	10	11	12	12.7	14	70	85		75	3	M6x15	23	30
70B	6	6.35	7	8	9	9.52	10	11	12	12.7	14	70	90		75	3	M5x12	23	30
73A	6	6.35	7	8	9	9.52	10	11	12	12.7	14	73	98.4		85	3	M5x12	25	32
80A	6	6.35	7	8	9	9.52	10	11	12	12.7	14	80	100		85	3	M6x15	23	30

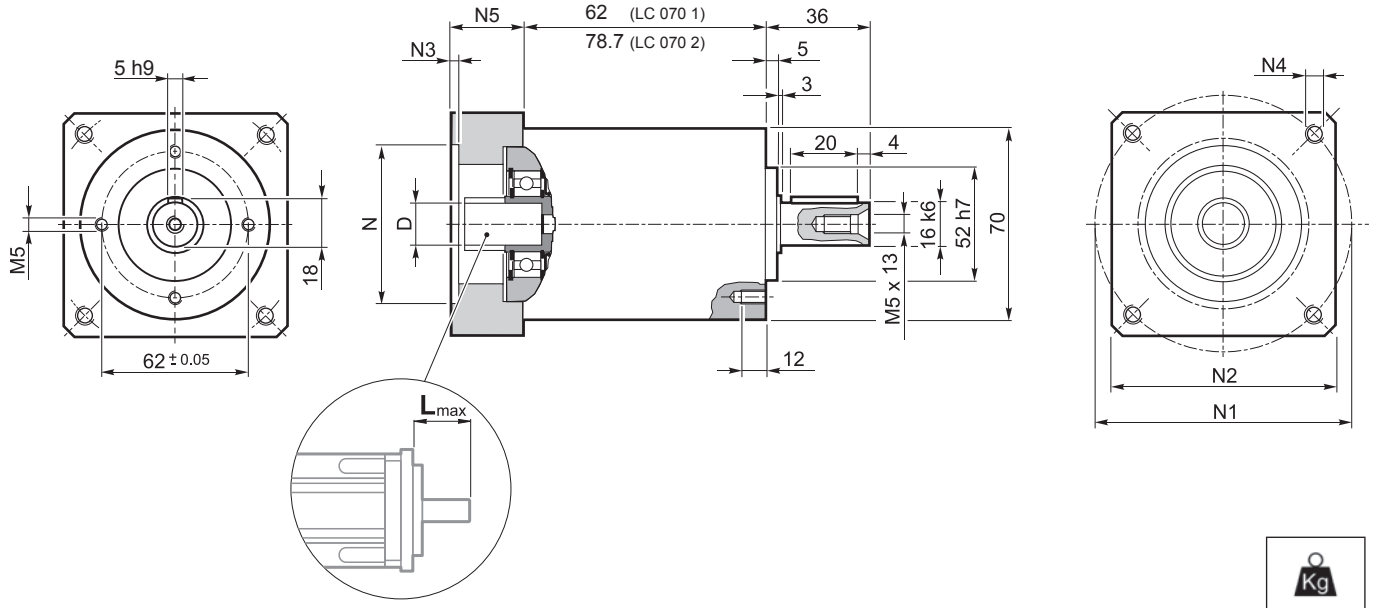


FM



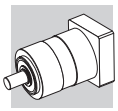
D				D1	D2	D3	D4	D5	L1	L2	L3	L4	L5
6	6.35	7		32.5	50	42.5	M4x8	M4	21.7	13.2	3	8.2	8
8	9	9.52	10	32.5	50	42.5	M4x8	M4	21.7	13.2	3	8.2	9
11	12	12.7		35.5	50	42.5	M4x8	M4	22	13.5	3	8.5	11
14				35.5	50	42.5	M4x8	M4	25	17	3	10.2	11.5

i	$M_{n\,2}$ [Nm]	$M_{a\,2}$ [Nm]	$M_{p\,2}$ [Nm]	$n_{1\,max}$ [min^{-1}]	φ_S [arcmin]	φ_R [arcmin]	C_t [Nm/arcmin]	$R_{2\,max}$ [N]	$A_{2\,max}$ [N]	η %	J_G [kgcm^2] D 6 ... 9.52	J_G [kgcm^2] D 10 ... 14
LC 050 1_ 3	10	16	28	4000	12’	6’	0.9	500	600	97	0.07	0.10
LC 050 1_ 4	12	20	30	5000	12’	6’	0.9	500	600	97	0.06	0.08
LC 050 1_ 5	12	20	30	5000	12’	6’	0.9	500	600	97	0.05	0.07
LC 050 1_ 7	12	20	30	5000	12’	6’	0.9	500	600	97	0.04	0.06
LC 050 1_ 9	10	16	28	6000	12’	6’	0.9	500	600	97	0.04	0.06
LC 050 2_ 12	12	20	30	4000	15’	8’	0.75	500	600	94	0.07	0.09
LC 050 2_ 15	12	20	30	4000	15’	8’	0.75	500	600	94	0.07	0.09
LC 050 2_ 16	12	20	30	5000	15’	8’	0.75	500	600	94	0.05	0.07
LC 050 2_ 20	12	20	30	5000	15’	8’	0.75	500	600	94	0.05	0.07
LC 050 2_ 25	12	20	30	5000	15’	8’	0.75	500	600	94	0.05	0.07
LC 050 2_ 28	12	20	30	5000	15’	8’	0.75	500	600	94	0.04	0.06
LC 050 2_ 35	12	20	30	5000	15’	8’	0.75	500	600	94	0.04	0.06
LC 050 2_ 36	12	20	30	6000	15’	8’	0.75	500	600	94	0.04	0.06
LC 050 2_ 45	12	20	30	6000	15’	8’	0.75	500	600	94	0.04	0.06
LC 050 2_ 81	10	16	28	6000	15’	8’	0.75	500	600	94	0.04	0.06

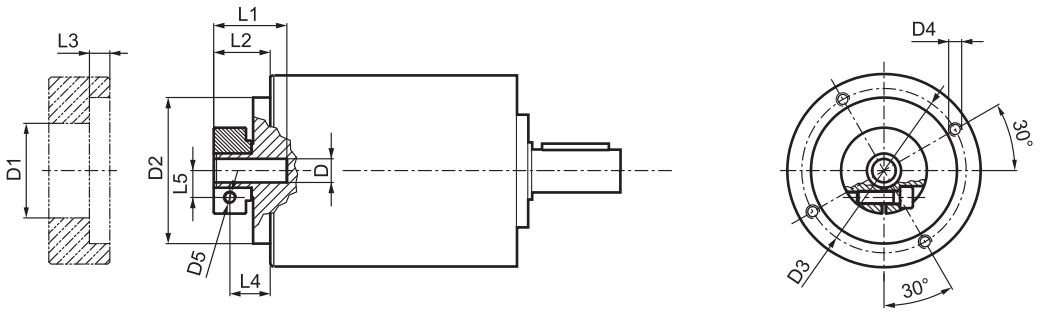


	Kg
LC 070 1	2.0
LC 070 2	2.3

	D										N	N1		N2	N3	N4	N5	L_{max}
												min	max					
25AH	6.35	7	8	9	9.52	–	–	–	–	–	25	39	56					
26AH	6.35	7	8	9	9.52	–	–	–	–	–	26	39	56					
28AH	6.35	7	8	9	9.52	–	–	–	–	–	28	39	56					
30AH	6.35	7	8	9	9.52	–	–	–	–	–	30	39	56					
32AH	6.35	7	8	9	9.52	–	–	–	–	–	32	39	56	65	3.5	4.5	25	25
34AH	6.35	7	8	9	9.52	–	–	–	–	–	34	40	56					
36AH	6.35	7	8	9	9.52	–	–	–	–	–	36	42	56					
39AH	6.35	7	8	9	9.52	–	–	–	–	–	39	45	56					
40AH	6.35	7	8	9	9.52	–	–	–	–	–	40	46	56					
38B	6.35	7	8	9	9.52	10	11	12	12.7	–	38.1	66.6		60	3	M4x10	18	25
40B	6.35	7	8	9	9.52	10	11	12	12.7	–	40	63		60	3	M4x10	18	25
50A	6.35	7	8	9	9.52	10	11	12	12.7	–	50	60		60	3	M4x10	18	25
50B	6.35	7	8	9	9.52	10	11	12	12.7	14	50	65		60	3	M5x12	23	30
50BH	6.35	7	8	9	9.52	10	11	12	12.7	14	50	65		65	3	5.5	25	32
50C	6.35	7	8	9	9.52	10	11	12	12.7	14	50	70		60	3	M4x10	23	30
55MH	6.35	7	8	9	9.52	10	11	12	12.7	–	55	80		65	2	5.5	16	23
60A	6.35	7	8	9	9.52	10	11	12	12.7	–	60	75		63	3	M5x12	18	25
60A1	6.35	7	8	9	9.52	10	11	12	12.7	14	60	75		63	3	M5x12	23	30
60B	6.35	7	8	9	9.52	10	11	12	12.7	14	60	85		75	3	M5x12	23	30
60C	6.35	7	8	9	9.52	10	11	12	12.7	14	60	90		75	3	M5x12	23	30
70A	6.35	7	8	9	9.52	10	11	12	12.7	14	70	85		75	3	M6x15	23	30
70B	6.35	7	8	9	9.52	10	11	12	12.7	14	70	90		75	3	M5x12	23	30
73A	6.35	7	8	9	9.52	10	11	12	12.7	14	73	98.4		85	3	M5x12	25	32
80A	6.35	7	8	9	9.52	10	11	12	12.7	14	80	100		85	3	M6x15	23	30

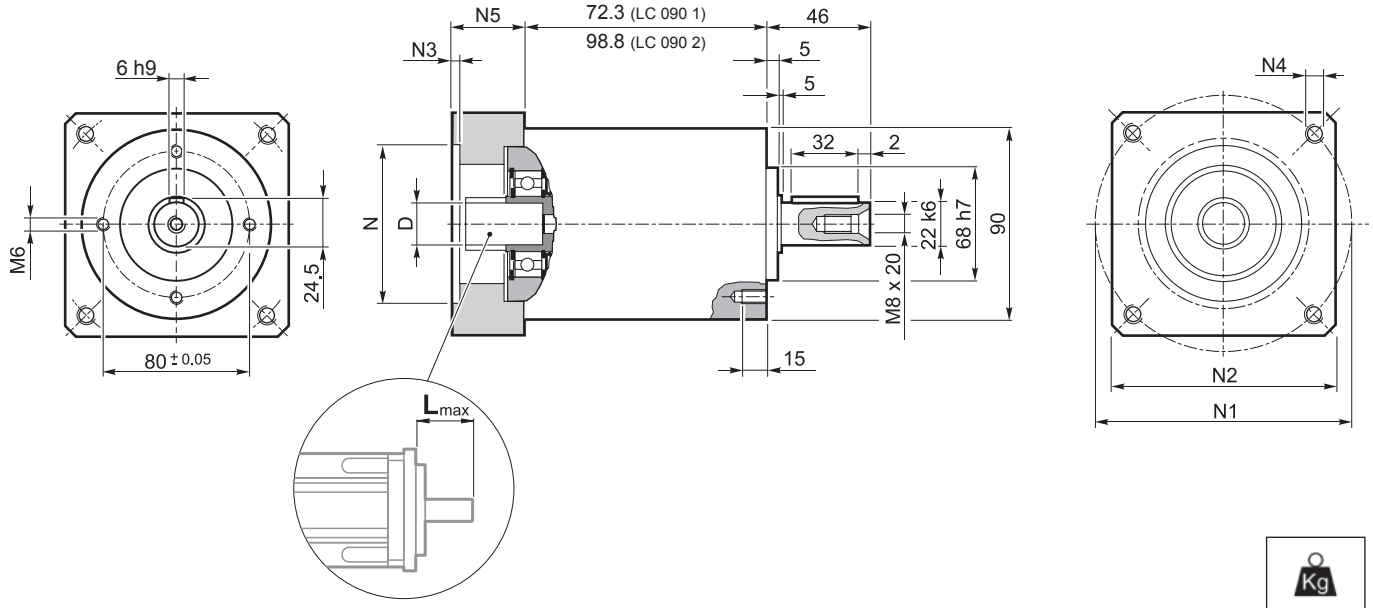


FM



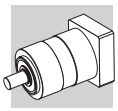
D				D1	D2	D3	D4	D5	L1	L2	L3	L4	L5
6.35	7			32.5	50	42.5	M4x8	M4	21.7	13.2	3	8.2	8
8	9	9.52	10	32.5	50	42.5	M4x8	M4	21.7	13.2	3	8.2	9
11	12	12.7		35.5	50	42.5	M4x8	M4	22	13.5	3	8.5	11
14				35.5	50	42.5	M4x8	M4	25	17	3	10.2	11.5

i	$M_{n\,2}$ [Nm]	$M_{a\,2}$ [Nm]	$M_{p\,2}$ [Nm]	$n_{1\,max}$ [min^{-1}]	φ_S [arcmin]	φ_R [arcmin]	C_t [Nm/arcmin]	$R_{2\,max}$ [N]	$A_{2\,max}$ [N]	η %	J_G [kgcm^2] D 6.35 ... 9.52	J_G [kgcm^2] D 10 ... 14
LC 070 1_ 3	18	30	60	4000	12’	6’	3	1300	1400	97	0.12	0.14
LC 070 1_ 4	25	35	70	5000	12’	6’	3	1300	1400	97	0.08	0.10
LC 070 1_ 5	25	35	70	5000	12’	6’	3	1300	1400	97	0.06	0.09
LC 070 1_ 7	25	35	70	5000	12’	6’	3	1300	1400	97	0.05	0.07
LC 070 1_ 10	18	30	60	6000	12’	6’	3	1300	1400	97	0.04	0.06
LC 070 2_ 9	18	30	60	4000	15’	8’	2.5	1300	1400	94	0.11	0.13
LC 070 2_ 12	25	35	70	4000	15’	8’	2.5	1300	1400	94	0.10	0.13
LC 070 2_ 15	25	35	70	4000	15’	8’	2.5	1300	1400	94	0.10	0.12
LC 070 2_ 16	25	35	70	5000	15’	8’	2.5	1300	1400	94	0.07	0.09
LC 070 2_ 20	25	35	70	5000	15’	8’	2.5	1300	1400	94	0.06	0.08
LC 070 2_ 25	25	35	70	5000	15’	8’	2.5	1300	1400	94	0.06	0.08
LC 070 2_ 28	25	35	70	5000	15’	8’	2.5	1300	1400	94	0.05	0.07
LC 070 2_ 30	18	30	60	6000	15’	8’	2.5	1300	1400	94	0.04	0.06
LC 070 2_ 35	25	35	70	5000	15’	8’	2.5	1300	1400	94	0.05	0.07
LC 070 2_ 40	25	35	70	6000	15’	8’	2.5	1300	1400	94	0.04	0.06
LC 070 2_ 50	25	35	70	6000	15’	8’	2.5	1300	1400	94	0.04	0.06
LC 070 2_ 70	25	35	70	6000	15’	8’	2.5	1300	1400	94	0.04	0.06
LC 070 2_ 100	18	30	60	6000	15’	8’	2.5	1300	1400	94	0.04	0.06

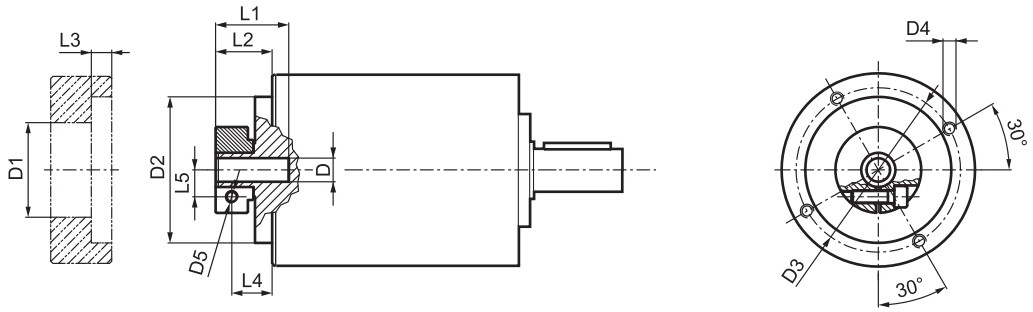


	Kg
LC 090 1	4.2
LC 090 2	5.3

	D											N	N1	N2	N3	N4	N5	L_{max}
40B1	9	9.52	11	12	12.7	14	–	–	–	–	–	40	63	80	4	M4x10	34	40
45A	9	9.52	11	12	12.7	–	–	–	–	–	–	45	63	80	4	M4x10	34	40
50B1	9	9.52	11	12	12.7	14	–	–	–	–	–	50	65	80	4	M5x16	34	40
50BH1	9	9.52	11	12	12.7	14	–	–	–	–	–	50	65	80	4	5.5	34	40
50C1	9	9.52	11	12	12.7	14	–	–	–	–	–	50	70	80	4	M4x10	34	40
50D	9	9.52	11	12	12.7	14	–	–	–	–	–	50	95	80	4	M6x10	34	40
55A	9	9.52	11	12	12.7	14	15.875	16	17	19	19.05	55.5	125.7	105	4	M6x16	34	40
60A2	9	9.52	11	12	12.7	14	–	–	–	–	–	60	75	80	4	M5x16	34	40
60AH2	9	9.52	11	12	12.7	14	–	–	–	–	–	60	75	90	4	5.5	34	40
60B1	9	9.52	11	12	12.7	14	15.875	16	–	–	–	60	85	80	4	M5x16	34	40
60C1	9	9.52	11	12	12.7	14	15.875	16	–	–	–	60	90	80	4	M5x16	34	40
70A1	9	9.52	11	12	12.7	14	15.875	16	17	19	19.05	70	85	80	4	M6x20	34	40
70AH1	9	9.52	11	12	12.7	14	15.875	16	17	19	19.05	70	85	90	4	6.5	34	40
70B1	9	9.52	11	12	12.7	14	15.875	16	17	19	19.05	70	90	80	4	M5x16	34	40
73A1	9	9.52	11	12	12.7	14	–	–	–	–	–	73	98.4	85	4	M5x16	34	40
80A1	9	9.52	11	12	12.7	14	15.875	16	17	19	19.05	80	100	90	4	M6x16	34	40
95A	9	9.52	11	12	12.7	14	15.875	16	17	19	19.05	95	115	100	4	M8x20	34	40
95B	9	9.52	11	12	12.7	14	15.875	16	17	19	19.05	95	130	115	4	M8x20	34	40
110A	9	9.52	11	12	12.7	14	15.875	16	17	19	19.05	110	130	115	4	M8x20	34	40
110B	9	9.52	11	12	12.7	14	15.875	16	17	19	19.05	110	145	120	6.5	M8x20	44	50
110B1	9	9.52	11	12	12.7	14	15.875	16	17	19	19.05	110	145	120	6.5	M8x20	54	60

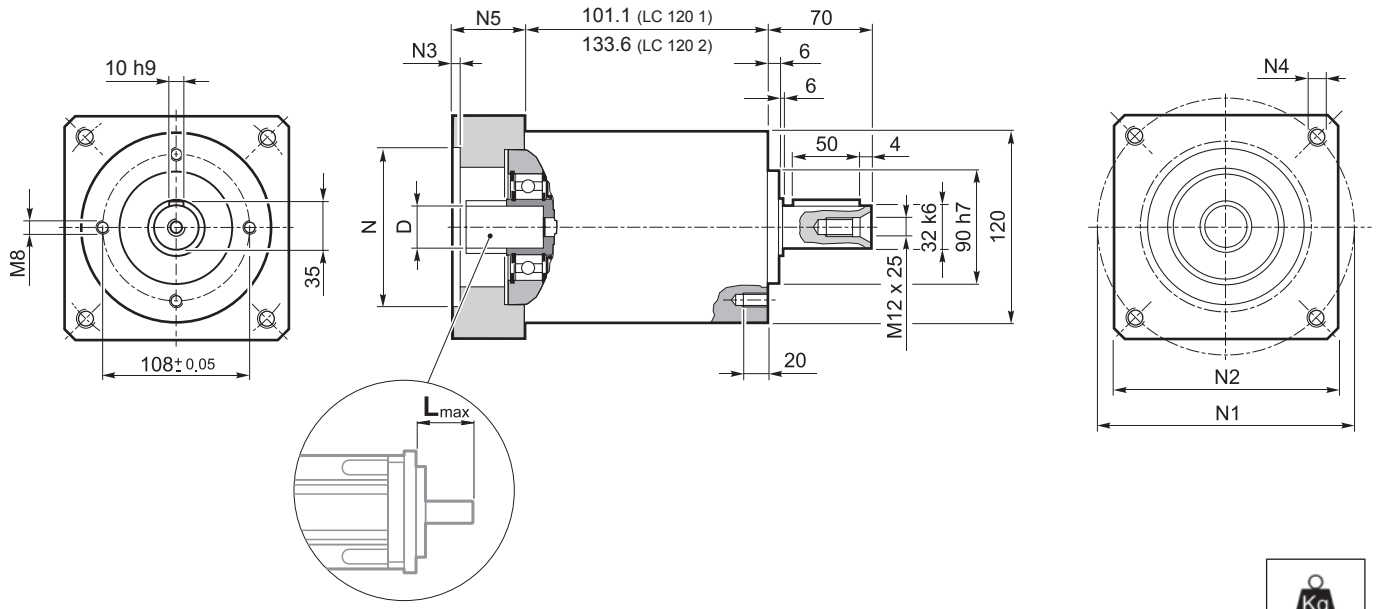


FM



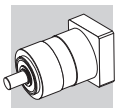
D				D1	D2	D3	D4	D5	L1	L2	L3	L4	L5
9	9.52			38	68	76.5	M6x10	M6	34	26.8	9.5	18.8	10.5
11	12	12.7		43	68	76.5	M6x10	M6	34	26.8	9.5	18.8	12.5
14	15.875	16	17	48	68	76.5	M6x10	M6	34	26.8	9.5	18.8	14.5
19	19.05			51	68	76.5	M6x10	M6	34	26.8	9.5	18.8	16.5

i	$M_{n\,2}$ [Nm]	$M_{a\,2}$ [Nm]	$M_{p\,2}$ [Nm]	$n_{1\,max}$ [min^{-1}]	φ_S [arcmin]	φ_R [arcmin]	C_t [Nm/arcmin]	$R_{2\,max}$ [N]	$A_{2\,max}$ [N]	η %	J_G [kgcm^2] D 9 ... 12.7	J_G [kgcm^2] D 14 ... 19.05
LC 090 1_ 3	37	70	150	3500	12’	6’	7	2200	1900	97	0.62	0.77
LC 090 1_ 4	43	80	160	4500	12’	6’	7	2200	1900	97	0.41	0.55
LC 090 1_ 5	43	80	160	4500	12’	6’	7	2200	1900	97	0.33	0.47
LC 090 1_ 7	43	80	160	4500	12’	6’	7	2200	1900	97	0.26	0.40
LC 090 1_ 10	37	70	150	6000	12’	6’	7	2200	1900	97	0.21	0.35
LC 090 2_ 9	37	70	150	3500	15’	8’	5.9	2200	1900	94	0.47	0.61
LC 090 2_ 12	43	80	160	3500	15’	8’	5.9	2200	1900	94	0.44	0.58
LC 090 2_ 15	43	80	160	3500	15’	8’	5.9	2200	1900	94	0.43	0.57
LC 090 2_ 16	43	80	160	4500	15’	8’	5.9	2200	1900	94	0.31	0.45
LC 090 2_ 20	43	80	160	4500	15’	8’	5.9	2200	1900	94	0.26	0.40
LC 090 2_ 25	43	80	160	4500	15’	8’	5.9	2200	1900	94	0.26	0.40
LC 090 2_ 28	43	80	160	4500	15’	8’	5.9	2200	1900	94	0.22	0.36
LC 090 2_ 30	37	70	150	6000	15’	8’	5.9	2200	1900	94	0.20	0.34
LC 090 2_ 35	43	80	160	4500	15’	8’	5.9	2200	1900	94	0.22	0.36
LC 090 2_ 40	43	80	160	6000	15’	8’	5.9	2200	1900	94	0.20	0.34
LC 090 2_ 50	43	80	160	6000	15’	8’	5.9	2200	1900	94	0.20	0.34
LC 090 2_ 70	43	80	160	6000	15’	8’	5.9	2200	1900	94	0.20	0.34
LC 090 2_ 100	37	70	150	6000	15’	8’	5.9	2200	1900	94	0.19	0.34

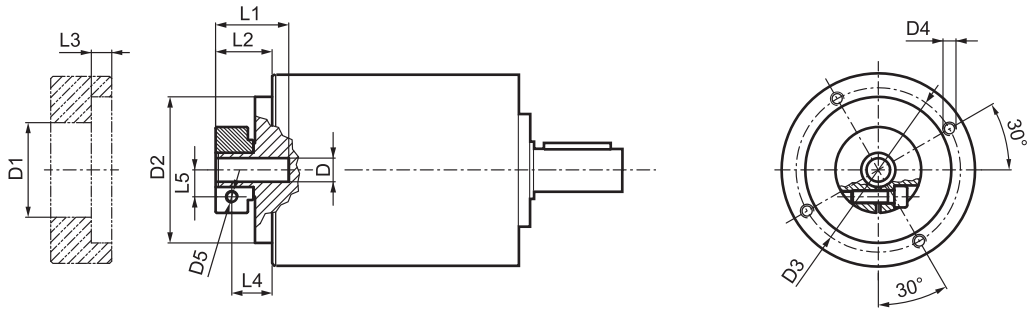


	Kg
LC 120 1	9.6
LC 120 2	12.1

	D									N	N1	N2	N3	N4	N5	L_{max}
50D	14	15	15.875	16	19	–	–	–	–	50	95	100	5	M6x14	28	40
55A	14	15	15.875	16	19	–	–	–	–	55.5	125.7	105	5	M6x16	28	40
60A2	14	15	15.875	16	19	–	–	–	–	60	75	100	5	M5x14	28	40
60AH2	14	15	15.875	16	19	–	–	–	–	60	75	100	5	6.5	33	40
60B1	14	15	15.875	16	19	–	–	–	–	60	85	100	6.5	M5x14	28	40
70A1	14	15	15.875	16	19	–	–	–	–	70	85	100	5	M6x14	28	40
70AH1	14	15	15.875	16	19	–	–	–	–	70	85	100	5	6	33	40
70B1	14	15	15.875	16	19	–	–	–	–	70	90	100	5	M5x12	28	40
80A1	14	15	15.875	16	19	–	–	–	–	80	100	100	5	M6x16	28	40
80AH1	14	15	15.875	16	19	–	–	–	–	80	100	100	5	6.5	28	40
95A	14	15	15.875	16	19	–	–	–	–	95	115	100	5	M8x18	28	40
95A1	14	15	15.875	16	19	22	24	–	–	95	115	100	5	M8x18	38	50
95B	14	15	15.875	16	19	–	–	–	–	95	130	115	5	M8x18	28	40
110A	14	15	15.875	16	19	–	–	–	–	110	130	115	5	M8x18	28	40
110A1	14	15	15.875	16	19	22	24	–	–	110	130	115	6.5	M8x20	38	50
110B	14	15	15.875	16	19	22	24	–	–	110	145	120	6.5	M8x20	38	50
110B1	14	15	15.875	16	19	22	24	28	–	110	145	120	6.5	M8x20	48	60
130A	14	15	15.875	16	19	22	24	–	–	130	165	140	6.5	M10x20	38	50
130A1	14	15	15.875	16	19	22	24	28	32	130	165	140	6.5	M10x25	48	60

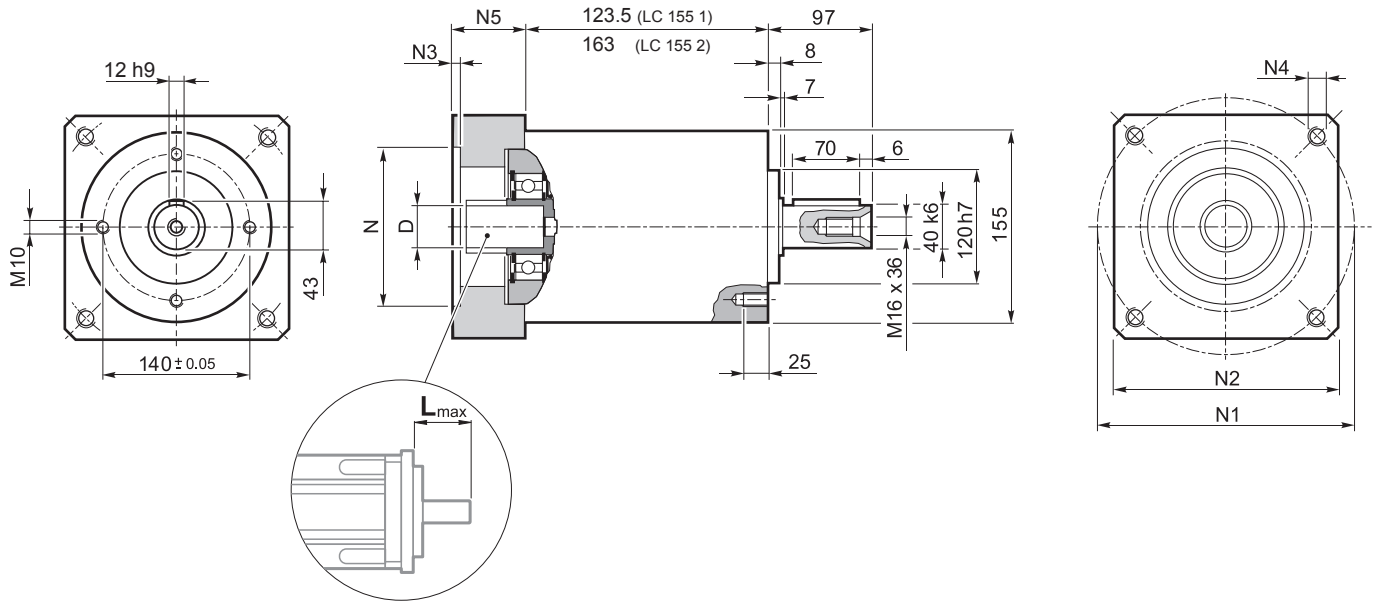


FM



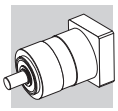
D				D1	D2	D3	D4	D5	L1	L2	L3	L4	L5
14	15	15.875	16	48	90	98	M6x15	M6	33.5	20	7.6	12.5	14.5
19				51	90	98	M6x15	M6	33.5	20	7.6	12.5	16.5
22	24			56.5	90	98	M6x15	M6	36.5	23	7.6	14	19
28				67	90	98	M6x15	M8	36.5	23	7.6	14	22.5
32				71	90	98	M6x15	M8	38	24.5	7.6	15.5	24.5

i	M_{n2}	M_{a2}	M_{p2}	$n_{1\,max}$	φ_S	φ_R	C_t	$R_{2\,max}$	$A_{2\,max}$	η	J_G [kgcm²] D		
	[Nm]	[Nm]	[Nm]	[min⁻¹]	[arcmin]		[Nm/arcmin]	[N]	[N]	%	14 ... 19	22 ; 24	28 ; 32
LC 120 1_ 3	95	160	300	3500	12'	6'	22	3500	3000	97	2.17	2.77	3.13
LC 120 1_ 4	110	190	360	4500	12'	6'	22	3500	3000	97	1.30	1.89	2.26
LC 120 1_ 5	110	190	360	4500	12'	6'	22	3500	3000	97	0.96	1.56	1.92
LC 120 1_ 7	110	190	360	4500	12'	6'	22	3500	3000	97	0.66	1.26	1.62
LC 120 1_ 10	95	160	300	5000	12'	6'	22	3500	3000	97	0.49	1.09	1.45
LC 120 2_ 9	95	160	300	3500	15'	8'	20.5	3500	3000	94	1.61	2.20	2.57
LC 120 2_ 12	110	190	360	3500	15'	8'	20.5	3500	3000	94	1.51	2.10	2.47
LC 120 2_ 15	110	190	360	3500	15'	8'	20.5	3500	3000	94	1.47	2.06	2.43
LC 120 2_ 16	110	190	360	4500	15'	8'	20.5	3500	3000	94	0.92	1.52	1.88
LC 120 2_ 20	110	190	360	4500	15'	8'	20.5	3500	3000	94	0.90	1.50	1.86
LC 120 2_ 25	110	190	360	4500	15'	8'	20.5	3500	3000	94	0.71	1.30	1.67
LC 120 2_ 28	110	190	360	4500	15'	8'	20.5	3500	3000	94	0.54	1.13	1.50
LC 120 2_ 30	95	160	300	5000	15'	8'	20.5	3500	3000	94	0.44	1.04	1.40
LC 120 2_ 35	110	190	360	4500	15'	8'	20.5	3500	3000	94	0.53	1.13	1.49
LC 120 2_ 40	110	190	360	5000	15'	8'	20.5	3500	3000	94	0.43	1.03	1.39
LC 120 2_ 50	110	190	360	5000	15'	8'	20.5	3500	3000	94	0.43	1.02	1.39
LC 120 2_ 70	110	190	360	5000	15'	8'	20.5	3500	3000	94	0.42	1.02	1.38
LC 120 2_ 100	95	160	300	5000	15'	8'	20.5	3500	3000	94	0.42	1.02	1.38

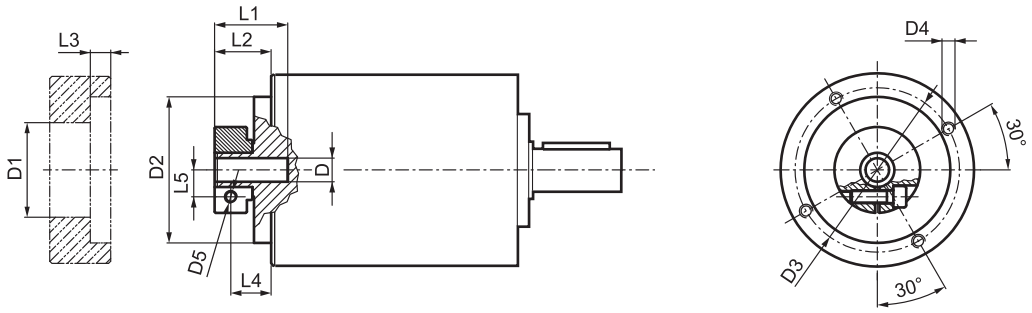


	Kg
LC 155 1	19.3
LC 155 2	24.3

	D							N	N1	N2	N3	N4	N5	L_{max}
55A1	19	–	–	–	–	–	–	55.5	125.7	130	4	M6x15	39.5	50
80A2	19	–	–	–	–	–	–	80	100	130	4	M6x15	39.5	50
95A1	19	22	24	–	–	–	–	95	115	130	4	M8x20	39.5	50
110A1	19	22	24	–	–	–	–	110	130	130	4	M8x20	39.5	50
110B1	19	22	24	–	–	–	–	110	145	130	6.5	M8x20	49.5	60
114A	19	22	24	28	32	35	38	114.3	200	170	5.5	M12x25	69.5	80
130A	19	22	24	–	–	–	–	130	165	140	4	M10x20	39.5	50
130A1	19	22	24	28	32	–	–	130	165	140	4	M10x20	49.5	60
180A	19	22	24	28	32	–	–	180	215	190	5.5	M14x25	49.5	60
180A1	19	22	24	28	32	35	38	180	215	190	5.5	M14x25	69.5	80

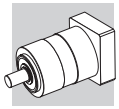


FM



D	D1	D2	D3	D4	D5	L1	L2	L3	L4	L5
19	51	113	125.5	M8x15	M6	40	27.5	6	20	16.5
22 24	56.5	113	125.5	M8x15	M6	41	28.5	6	19.5	19
28	67	113	125.5	M8x15	M8	41	28.5	6	19.5	22.5
32	71	113	125.5	M8x15	M8	41	28.5	6	18.5	24.5
35	73	113	125.5	M8x15	M8	50	37.5	11.25	26	26
38	77.5	113	125.5	M8x15	M8	50	37.5	11.25	26	28

i	$M_{n\,2}$ [Nm]	$M_{a\,2}$ [Nm]	$M_{p\,2}$ [Nm]	$n_{1\,max}$ [min^{-1}]	φ_S [arcmin]	φ_R [arcmin]	C_t [Nm/arcmin]	$R_{2\,max}$ [N]	$A_{2\,max}$ [N]	η %	J_G [kgcm^2] D 19	22 ; 24	28 ; 32	35 ; 38
LC 155 1 _ 3	250	380	600	3600	12’	6’	43.0	6000	5000	97	7.99	8.19	8.54	9.90
LC 155 1 _ 4	300	450	700	3600	12’	6’	43.0	6000	5000	97	4.66	4.87	5.23	6.57
LC 155 1 _ 5	300	450	900	3600	12’	6’	43.0	6000	5000	97	3.32	3.53	3.88	5.23
LC 155 1 _ 7	300	450	900	3600	12’	6’	43.0	6000	5000	97	2.14	2.35	2.70	4.05
LC 155 1 _ 10	230	350	750	3600	12’	6’	43.0	6000	5000	97	1.45	1.66	2.01	3.36
LC 155 2 _ 9	250	380	600	3600	15’	8’	37.5	6000	5000	94	5.30	5.51	5.86	7.21
LC 155 2 _ 12	300	450	700	3600	15’	8’	37.5	6000	5000	94	4.93	5.14	5.49	6.84
LC 155 2 _ 15	300	450	900	3600	15’	8’	37.5	6000	5000	94	4.79	4.99	5.34	6.70
LC 155 2 _ 16	300	450	700	3600	15’	8’	37.5	6000	5000	94	2.97	3.18	3.53	4.88
LC 155 2 _ 20	300	450	900	3600	15’	8’	37.5	6000	5000	94	2.23	2.44	2.79	4.14
LC 155 2 _ 25	300	450	900	3600	15’	8’	37.5	6000	5000	94	2.18	2.39	2.74	4.09
LC 155 2 _ 28	300	450	900	3600	15’	8’	37.5	6000	5000	94	1.58	1.79	2.14	3.49
LC 155 2 _ 30	250	380	600	3600	15’	8’	37.5	6000	5000	94	1.23	1.44	1.79	3.14
LC 155 2 _ 35	300	450	900	3600	15’	8’	37.5	6000	5000	94	1.55	1.76	2.11	3.46
LC 155 2 _ 40	300	450	700	3600	15’	8’	37.5	6000	5000	94	1.20	1.41	1.76	3.11
LC 155 2 _ 50	300	450	900	3600	15’	8’	37.5	6000	5000	94	1.19	1.39	1.74	3.10
LC 155 2 _ 70	300	450	900	3600	15’	8’	37.5	6000	5000	94	1.17	1.38	1.73	3.08
LC 155 2 _ 100	230	350	750	3600	15’	8’	37.5	6000	5000	94	1.17	1.38	1.73	3.08



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