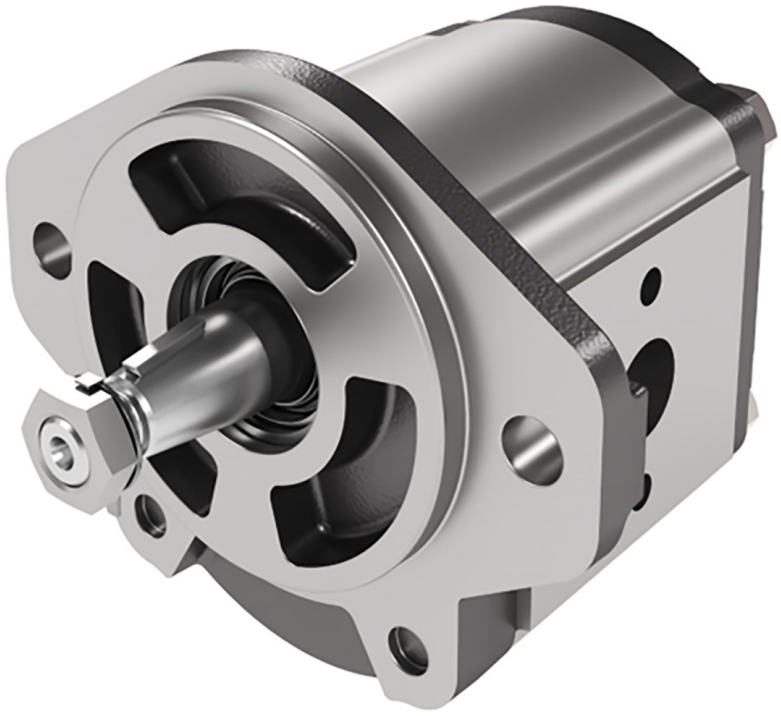
ENGINEERING
TOMORROW

Technical Information

Lumi
Aluminum Gear Motor Group 2



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Revision history

Table of revisions

Date	Changed	Rev
May 2023	First edition	0101

Contents

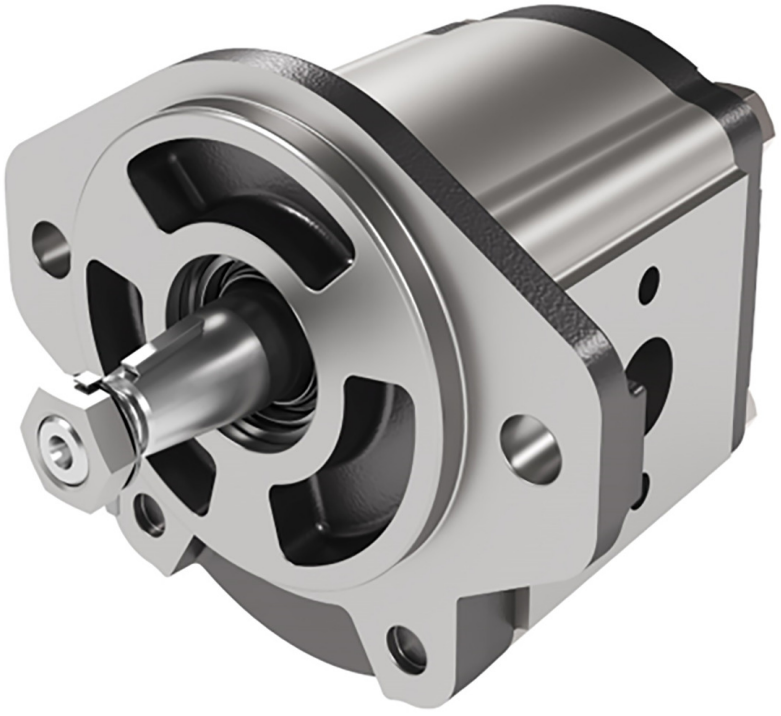
General information

Lumi Gear Motors overview

The Danfoss Lumi gear motors are a range of standard performance fixed displacement hydraulic motors available in Group 2 frame size in bi-directional rotation.

The Lumi gear motor is a floating bushing, pressure balanced design with a high strength extruded aluminum body, cast iron end cover and cast-iron mounting flange to guarantee the ability to work with high back pressure and low system pressure.

Danfoss gear motors are the ideal choice for a wide range of applications due to the range of flexibility, high efficiency, and low starting pressure. Application sectors include on-highway and off-highway hydraulic fan drive systems, turf care, specialty vehicles, municipal, etc.



Features and benefits

- Frame size - Group 2
- Displacements from 8 to 24 cm^3/rev [from 0.50 to 1.46 in^3/rev]
- Rated pressure up to 180 bar [2610 psi]
- Back pressure capability up to 180 bar [2610 psi]
- Speeds up to 4000 min^{-1} (rpm)
- SAE and ISO mounting flanges and shafts
- Available with integrated anti-cavitation-cum-relief valve

General information

Determination of nominal motor size

Based on SI units

$$Q_e = \frac{V_g \cdot n}{1000 \cdot \eta_v}$$

$$M_e = \frac{V_g \cdot \Delta p \cdot \eta_{mh}}{20 \cdot \pi}$$

$$P_e = \frac{M_e \cdot n}{9550} = \frac{Q_e \cdot \Delta p \cdot \eta_t}{600}$$

$$n = \frac{Q_e \cdot 1000 \cdot \eta_v}{V_g}$$

Where:

Q_e	Input flow (l/min)
M_e	Output torque (N•m)
P_e	Output power (kW)
n	Speed (min^{-1})
V_g	Motor displacement per rev. (cm^3/rev)
p_{high}	High pressure (bar)
p_{low}	Low pressure (bar)
Δp	High pressure minus Low pressure (bar)
η_v	Motor volumetric efficiency
η_{mh}	Mechanical-hydraulic efficiency
η_t	Motor total efficiency ($\eta_v \cdot \eta_{mh}$)

Based on US units

$$Q_e = \frac{V_g \cdot n}{231 \cdot \eta_v}$$

$$M_e = \frac{V_g \cdot \Delta p \cdot \eta_{mh}}{2 \cdot \pi}$$

$$P_e = \frac{V_g \cdot n \cdot \Delta p \cdot \eta_t}{396\,000}$$

$$n = \frac{Q_e \cdot 231 \cdot \eta_v}{V_g}$$

Where:

Q_e	Input flow [US gal/min]
M_e	Output torque [lb•in]
P_e	Output power [hp]
n	Speed [rpm]
V_g	Motor displacement per rev. [in^3/rev]
p_{high}	High pressure [psi]
p_{low}	Low pressure [psi]
Δp	High pressure minus Low pressure [psi]
η_v	Motor volumetric efficiency
η_{mh}	Mechanical-hydraulic efficiency
η_t	Motor total efficiency ($\eta_v \cdot \eta_{mh}$)

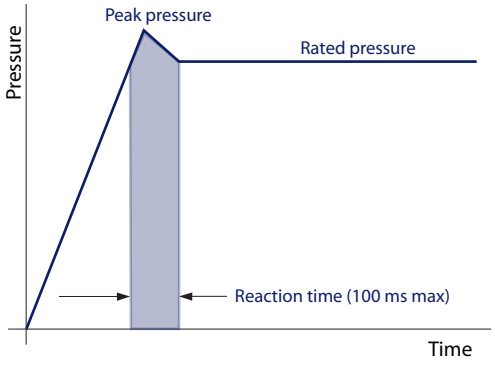
System requirements

Pressure

Peak pressure is the highest intermittent pressure allowed. The relief valve overshoot (reaction time) determines peak pressure. It is assumed to occur for less than 100 ms.

Rated pressure is the average, regularly occurring operating inlet pressure that should yield satisfactory product life. The maximum machine load at the motor shaft determines rated pressure.

The following graph shows peak pressure in relation to rated pressure and reaction time (100 ms maximum).



System pressure is the differential between the inlet and outlet ports. It is a dominant operating variable affecting hydraulic unit life. High system pressure, resulting from high load at the motor shaft, reduces expected life. System pressure must remain at, or below, rated pressure during normal operation to achieve expected life.

Back pressure is the average, regularly occurring operating outlet pressure that should yield satisfactory bidirectional motor life. The hydraulic load demand downstream of the motor determines the back pressure.

Case drain pressure is the regularly occurring case drain line pressure that should yield satisfactory bi-directional motor life. It is recommended to design the case drain piping connecting the case drain direct to the tank in order to keep the case drain pressure as low as possible. The maximum continuous case drain pressure allowed is 10 bar [145 psi] rated and 12 bar [174 psi] as peak.

Speed

Maximum speed is the limit recommended by Danfoss for a particular gear motor when operating at rated pressure. It is the highest speed at which normal life can be expected.

The lower limit of operating speed is the minimum speed. It is the lowest speed at which normal life can be expected. The minimum speed increases as operating system pressure increases.

Hydraulic Fluids

Pressure ratings in this document are determined using petroleum-based hydraulic fluids. Ratings and data are guaranteed when the hydraulic system operates with premium hydraulic fluids without containing oxidation, rust, or foam inhibitors.

These fluids have to work with good thermal and hydrolytic stability to prevent wear, erosion, or corrosion of internal components.

Avoid using fluids with a mixture of two different oils. These fluids may damage the product and decrease lubrication efficiency. For use with other oils, contact your Danfoss representative for approval.

Mixing hydraulic fluids or using contaminated fluids may damage the interior of the product.
Do not mix hydraulic fluids. Use only clean hydraulic fluid.

System requirements

Temperature and viscosity

Temperature and viscosity requirements must be concurrently met. Use of petroleum/mineral-based fluids is highly recommended.

High temperature limits apply at the inlet port of the motors. The motors should operate at or below the maximum continuous temperature. The peak temperature is based on material properties. Do not exceed peak temperature.

Minimum (cold start) temperature relates to the physical properties of component materials.

Cold oil, generally, doesn't affect the durability of motors components. It may affect the ability of oil to flow and transmit power. For this reason, keep the temperature at 16°C [60 °F] above the pour point of the hydraulic fluid.

Temperature limits (with standard NBR seals)

Minimum (cold start)	Maximum continuous	Peak (intermittent)
-20°C [-4°F]	80°C [176°F]	90°C [194°F]

Minimum viscosity occurs only during brief occasions of maximum ambient temperature and severe duty cycle operation.

Maximum viscosity occurs at cold start only. During this condition, limit speeds until the system warms up.

- Size heat exchangers to keep the fluid within these limits
- Test regularly to verify that these temperatures and viscosity limits aren't exceeded
- Keep the fluid viscosity in the recommended viscosity range for maximum unit efficiency and bearing life

Fluid viscosity limits, in mm^2/s [SUS]

Maximum (cold start)	Recommended range	Range for high efficiency	Minimum
1600 [7273]	12-100 [66-456]	20-50 [97-231]	10 [60]

Filtration

Filters

Use a filter that conforms to Class 20/18/13 of ISO 4406 (or better). It may be on the motor outlet (discharge filtration) or inlet (pressure filtration).

Selecting a filter

When selecting a filter, please consider:

- Contaminant ingression rate (determined by factors such as the number of actuators used in the system)
- Generation of contaminants in the system
- Required fluid cleanliness
- Desired maintenance interval
- Filtration requirements of other system components

Measure filter efficiency with a Beta ratio (β_X). β_x ratio is a measure of filter efficiency defined by ISO 4572. It is the ratio of the number of particles greater than a given diameter (in microns) upstream of the filter to the number of these particles downstream of the filter.

- For discharge filtration with controlled reservoir ingression, use a $\beta_{35\text{-}45} = 75$ filter
- For pressure filtration, use a filtration with an efficiency of $\beta_{10} = 75$

The filtration requirements for each system are unique. Evaluate filtration system capacity by monitoring and testing prototypes.

System requirements

Fluid cleanliness level and β_X ratio

Fluid cleanliness level (per ISO 4406)	Class 20/18/13 or better
β_X ratio (discharge filtration)	$\beta_{35\text{-}45} = 75$ and $\beta_{10} = 2$
β_X ratio (pressure or return filtration)	$\beta_{10} = 75$
Recommended inlet screen size	100 – 125 µm [0.004 – 0.005 in]

Reservoir

The **reservoir** provides clean fluid, dissipates heat, removes entrained air, and allows fluid volume changes associated with fluid expansion and cylinder differential volumes. A correctly sized reservoir accommodates maximum volume changes during all system operating modes. It promotes de-aeration of the fluid as it passes through, and accommodates a fluid dwell-time between 60 and 180 seconds, allowing entrained air to escape.

Minimum reservoir capacity depends on the volume required to cool and hold the oil from all retracted cylinders, allowing for expansion due to temperature changes. A fluid volume of 1 to 3 times the pump output flow (per minute) is satisfactory. The minimum reservoir capacity is 125% of the fluid volume.

Install the suction line above the bottom of the reservoir to take advantage of gravity separation and prevent large foreign particles from entering the line. Cover the line with a 100-125 micron screen. The pump should be below the lowest expected fluid level.

Put the return-line below the lowest expected fluid level to allow discharge into the reservoir for maximum dwell and efficient deaeration. A baffle (or baffles) between the return and suction lines promotes deaeration and reduces fluid surges.

Line sizing-x

Choose pipe sizes that accommodate minimum fluid velocity to reduce system noise, pressure drops, and overheating. This maximizes system life and performance.

The line velocity should not exceed the values in the table below:

Maximum line speed

Inlet	Outlet	Return
5 m/s [16.4 ft/sec]	2.5 m/s [8.2 ft/sec]	3 m/s [9.8 ft/sec]

Most systems use hydraulic oil containing 10% dissolved air by volume.

Over-aeration (or entrained air) The result of flow line restrictions where dissolved air comes out of solutions or when air leaks into the hydraulic circuit. This fault is caused by inadequate pipe size, sharp bends, or elbow fittings reducing flow.

Avoid over-aeration by following circuit recommendations, rated speed requirements, and placing the appropriately sized reservoir in an adequate location.

Motor shaft connection

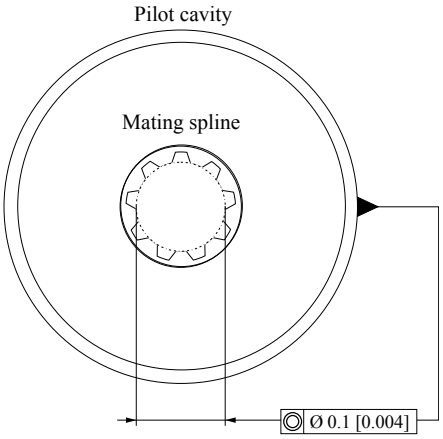
Shaft options for gear motors include tapered, splined, and parallel shafts.

Plug-in drives, with a splined shaft, can impose severe radial loads when the mating spline is rigidly supported. Increasing spline clearance does not alleviate this condition.

Use plug-in drives only if the concentricity between the mating spline and pilot diameter is within 0.1 mm [0.004 in]. Lubricate the drive by flooding with oil. A three-piece coupling minimizes radial or thrust shaft loads.

System requirements

Motor shaft connection



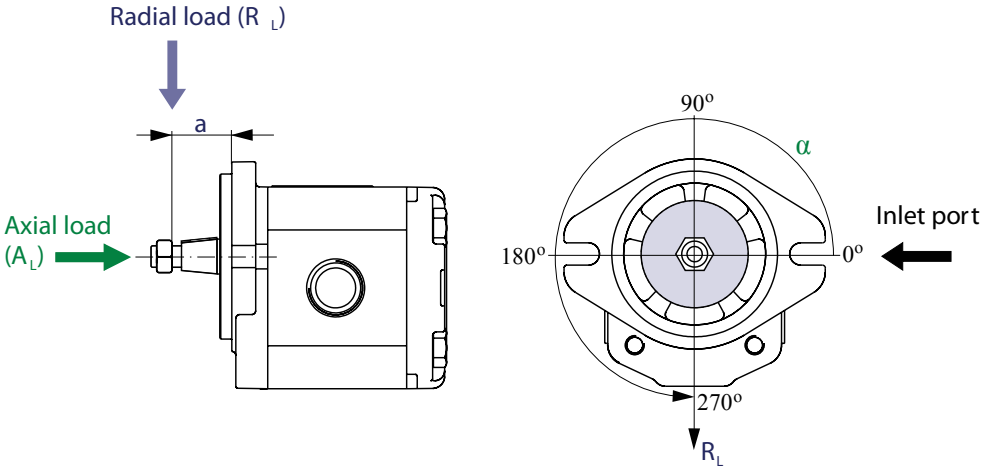
To avoid spline shaft damage, use carburized and hardened steel couplings with 80-82 HRA surface hardness.

System requirements

Motor shaft load data form

Extract this page and send the complete form to your Danfoss representative for an assistance.

Counterclockwise orientation



Application data

Item		Value	Based on SI or US units	
Motor displacement			□ cm^3/rev	□ in^3/rev
Rated system pressure			□ bar	□ psi
Peak pressure				
Motor shaft rotation			□ left	□ right
Motor minimum speed			min^{-1} (rpm)	
Motor maximum speed				
Radial load	**R_1**		□ N	□ lbf
Angular orientation of radial load to inlet port	α		degree	
Axial load	**A_1**		□ N	□ lbf
Distance from flange to radial load	**a**		□ mm	□ in

System requirements

Motor Life

Motor life is a function of speed, system pressure, and other system parameters (such as fluid quality and cleanliness).

All Danfoss gear motors use hydrodynamic journal bearings that have an oil film maintained between the gear/shaft and bearing surfaces at all times. If the oil film is sufficiently sustained through proper system maintenance and operating within recommended limits, long life can be expected.

High pressure impacts motor life. When submitting an application for review, provide machine duty cycle data that includes percentages of time at various loads and speeds.

B_{10} life expectancy number is generally associated with rolling element bearings. It does not exist for hydrodynamic bearings.

Danfoss strongly recommends a prototype testing program to verify operating parameters and their impact on life expectancy before finalizing any system design.

Specifications

Lumi Group 2 gear motor technical data

Displacement	**cm^3/rev [in^3/rev]**	**8.2 [0.50]**	**9.5 [0.58]**	**11.0 [0.67]**	**12.3 [0.75]**	**16.5 [1.01]**	**18.0 [1.10]**	**20.0 [1.22]**	**24.0 [1.46]**
Peak pressure	bar [psi]	210 [3046]	210 [3046]	210 [3046]	210 [3046]	210 [3046]	210 [3046]	210 [3046]	210 [3046]
Rated pressure	bar [psi]	180 [2610]	180 [2610]	180 [2610]	180 [2610]	180 [2610]	180 [2610]	180 [2610]	180 [2610]
Outlet back pressure	bar [psi]	180 [2610]	180 [2610]	180 [2610]	180 [2610]	180 [2610]	180 [2610]	180 [2610]	180 [2610]
Speed	Min speed rpm	1000	1000	700	700	700	700	700	700
	Max speed rpm	4000	4000	4000	4000	3500	3000	3000	3000
Shafts	9T, 11T Straight keyed Ø15.85 mm[1], Ø17 mm, Ø19 mm 1:8 Taper (Ø16.7 mm)								
Front mount	SAE A- 2 Bolt, European Rectangular 4 Bolt								
Ports	SAE, ISO, European flanged, German flanged, BSPP								
Valves	Integral Anti Cavitation, Pressure Relief valve								

[1] Not available with 24cc

The rated and peak pressures shown above are for motors with flanged ports only. When threaded ports are required, a lower rated performance must be considered. To verify the compliance of a high pressure application where threaded ports are required, see your Danfoss representative.

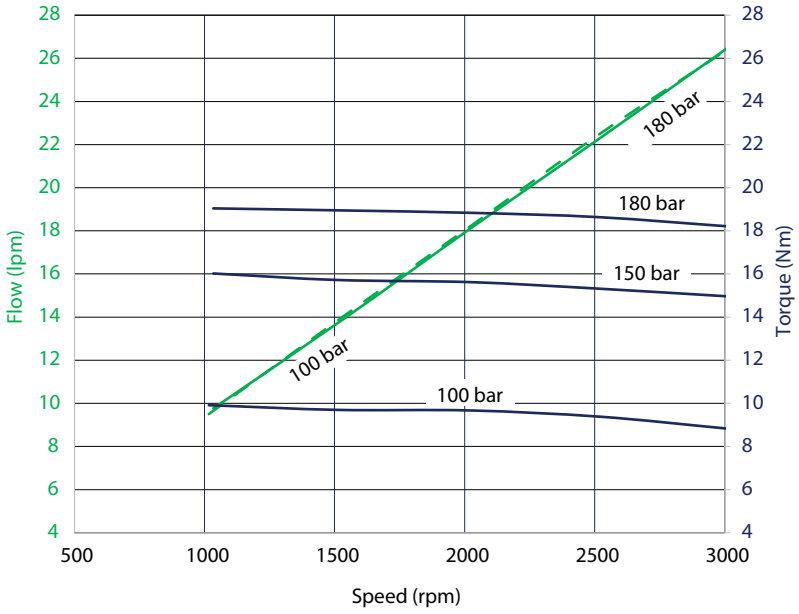
Specifications

Lumi Group 2 gear motor performance

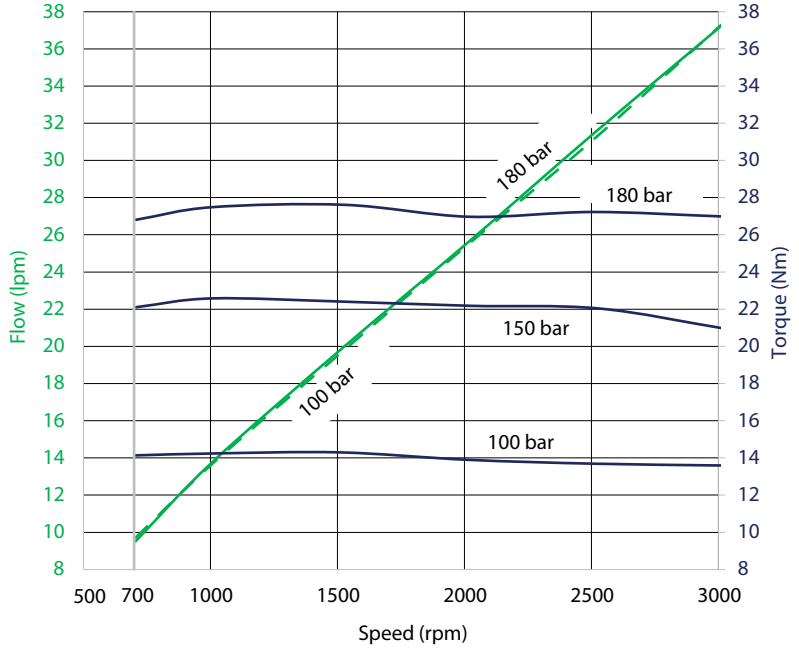
The following graphs provide typical inlet flow and output torque for Lumi Group 2 motors at various working pressures.

Data was measured using ISO VG32 petroleum /mineral based fluid at 50 °C [122 °F] (viscosity = 25 mm^2/s [120 SUS]).

Lumi GD5M8 performance

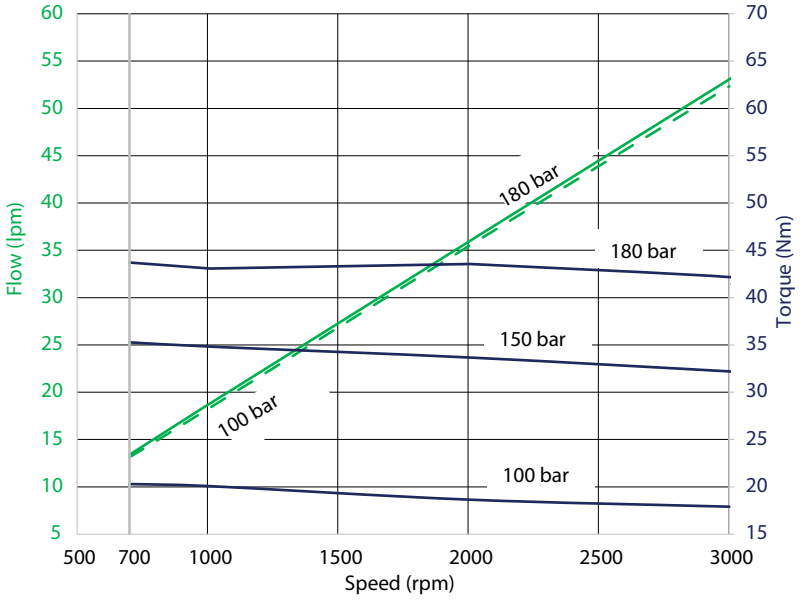


Lumi GD5M11 performance

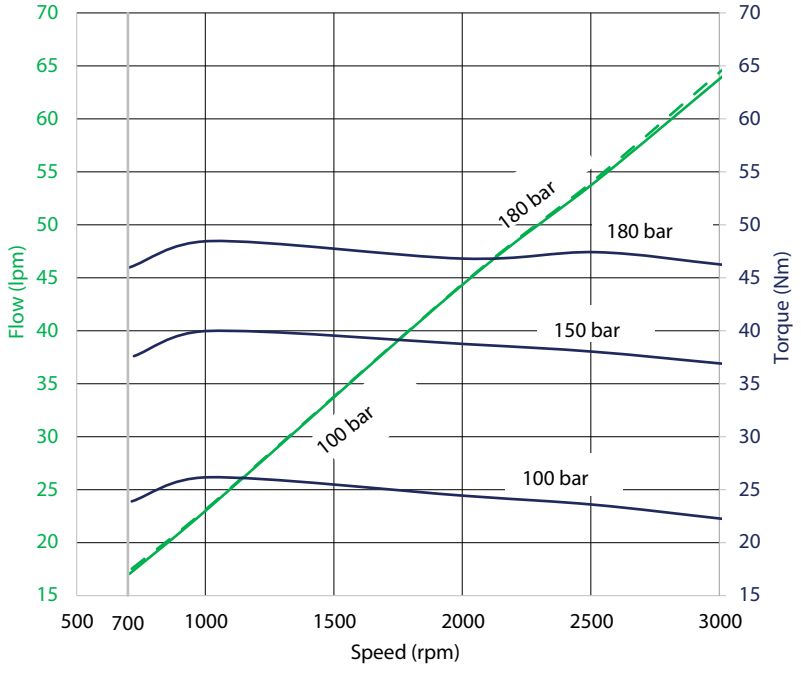


Specifications

Lumi GD5M16 performance



Lumi GD5M20 performance

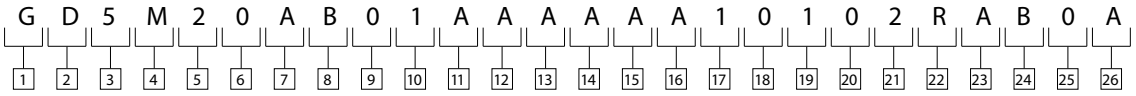


Lumi Group 2 gear motor model code

The following 26-digit coding system has been developed to identify standard configuration options for the External Gear Motor.

Use this model code to specify a motor with the desired features. All 26 digits of the code must be present to release a new product number for ordering.

Before placing the order, please contact your Danfoss representative.



Product, size, type, displacement options (position 1-6)

Product (position 1, 2)

Code	Description
GD	External gear

Size (position 3)

5	Frame size

Unit type (position 4)

M	Motor

Displacement (position 5, 6)

08	8.2 cm^3/rev [0.50 in^3/rev]
09	9.5 cm^3/rev [0.58 in^3/rev]
11	11.0 cm^3/rev [0.67 in^3/rev]
12	12.3 cm^3/rev [0.70 in^3/rev]
16	16.5 cm^3/rev [1.00 in^3/rev]
18	18.0 cm^3/rev [1.09 in^3/rev]
20	20.0 cm^3/rev [1.22 in^3/rev]
24	24.0 cm^3/rev [1.46 in^3/rev]

Mounting and output shaft options (position 7-10)

Mounting description (position 7, 8)

Code	Description
AB	SAE-A 2 bolts, pilot Ø82.50, Ø14.0 holes on 106.4 pcd
AC	SAE-A 2 bolts, pilot Ø82.50, Ø11.0 holes on 106.4 pcd
AD	European 4 bolts, pilot Ø50.0, Ø9.0 holes on 71.4 x 96.1 dist
AE	European 4 bolts, pilot Ø54.0, Ø7.5 holes on 71.4 x 96.1 dist
AF	European 4 bolts, pilot Ø36.4, Ø7.0 holes on 71.4 x 96.1 dist
AG	German 4 bolts, pilot Ø80.0, Ø9.0 holes on 72 x 100 dist

Output shaft description (position 9, 10)

01	Straight Ø15.88-L 34.8-Key4.76x19
02	Taper 1:8 on Ø16.66-7/16-20 UNF-2A-L 39.7-Woodruff Key 3

Lumi Group 2 gear motor model code

Output shaft description (position 9, 10) (continued)

03	Straight Ø19.05-L 31.0-Key 4.76x19
04	Straight Ø15.88-L 31.8-Key 4x14.27
05	Spline SAE J498-11T-16/32-min spline 20.0
06	Spline SAE J498-9T-16/32-min spline 20.0
07	Straight Ø17.46-L 31.8-Key 4.76x19
08	Taper 1:8 on Ø17.46-M12x1.5-L 40.5-Woodruff Key 4

Inlet/outlet port, case drain, relief valve options (position 11-19)

Inlet/outlet ports (position 11, 12, 13, 14)

Code	Description
AA	SAE #10-7/8-14
AB	SAE #12-1 1/16-12
AD	SAE #8-3/4-16
AF	BSP 3/4
AG	BSP 1/2
AH	BSP 3/8
AJ	M22X1.5-ISO6149
AK	M18X1.5-ISO6149
AL	M27X2.0-ISO6149
AM	European flanged-4 bolt-M8X1.25-Ø19 holes on 40 PCD
AN	European flanged-4 bolt-M6X1-Ø14 holes on 30.2 PCD
AP	German flanged-4 bolt-M6X1-Ø15 holes on 35 PCD
AR	German flanged-4 bolt-M6X1-Ø20 holes on 40 PCD
AS	German flanged-4 bolt-M6X1-Ø19 holes on 40 PCD

Case drain and location (position 15, 16)

00	None
AA	SAE #6-9/16-18-rear
AB	BSP ¼-rear
AC	SAE #4-7/16-20-rear
AD	No drain (internal)- SAE#6-9/16-18-rear(optional)

Relief valve (position 17)

0	None
1	Relief valve

Relief valve setting (position 18, 19)

00	None
01	160 bar [2320 psi]
02	115 bar [1668 psi]
03	200 bar [2900 psi]

Lumi Group 2 gear motor model code

Special features, rotation, design specification options (position 20-26)

Special features (position 20, 21)

Code	Description
00	None
01	anti-cavitation-cum-relief valve

Rotation (position 22)

B	Bi-directional
L	Counterclockwise
R	Clockwise

Paint and packaging (position 23, 24)

AA	None
AB	Epoxy coated primer black

Customer identification (position 25)

0	None

Design code (position 26)

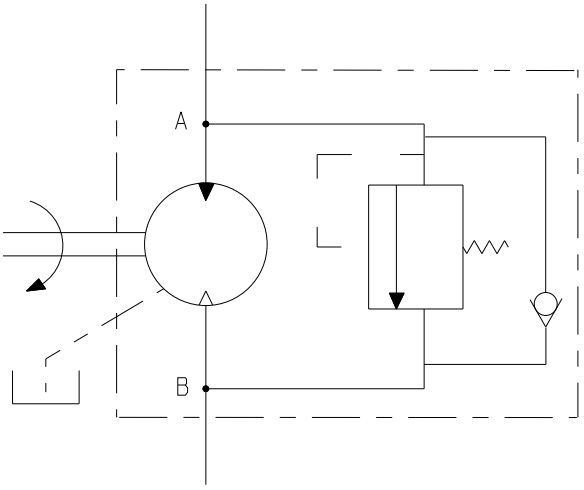
A	First

Anti-cavitation-cum-relief valve

Danfoss offers the Lumi Group 2 motors with an optional integral anti-cavitation-cum-relief valve in the rear cover.

The integral relief valve is drained internally and directs all the flow from the motor inlet to the outlet when the inlet pressure reaches the valve setting. The anti-cavitation check valve directs the internal flow from the motor outlet to the inlet, when the outlet pressure gets higher than the inlet pressure.

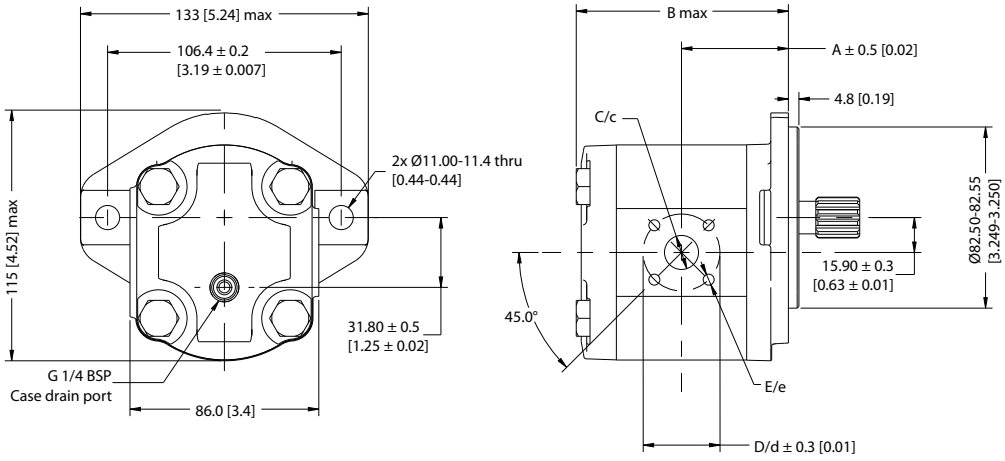
Schematic



Lumi Group 2 gear motor installation

Use the following illustration and table to determine the gear motor's installation dimensions.

Dimensions in mm [in]



Dimensions reference

Type/ Displacement	A	B	C/c	D/d	E/e
08	46.4 [1.83]	96 [3.78]	15 [0.591]	35 [1.38]	M6 X 1P- 6H ↧ 13[0.51] MIN FULL THDS
09	47.5 [1.87]	98 [3.86]			
11	48.7 [1.92]	100 [3.94]			
12	49.5 [1.95]	101 [3.98]			
16	52.6 [2.07]	106 [4.17]			
18	53.8 [2.12]	108 [4.25]	20 [0.79]	40 [1.58]	
20	55.4 [2.18]	114 [4.49]			
24	58.5 [2.30]	120 [4.72]			

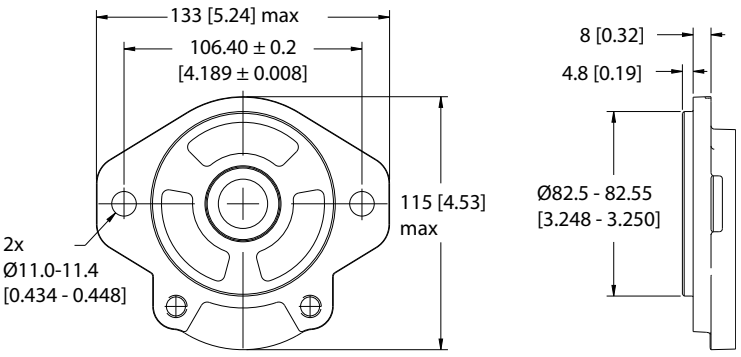
Dimensions

Mounting flange

SAE "A" 2 bolt mounting flange dimensions

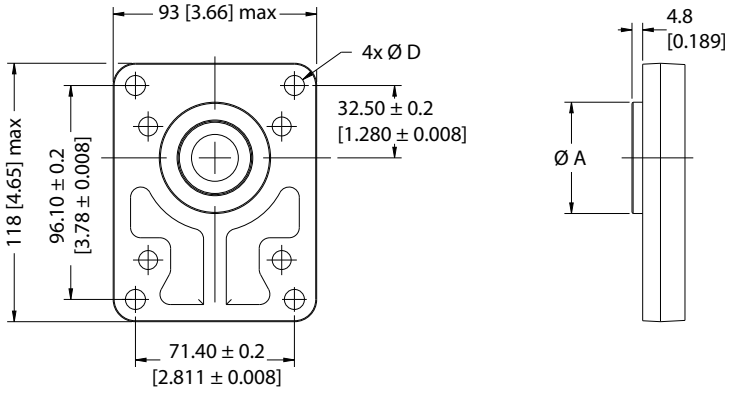
Dimensions in mm [in].

Code - AC



European rectangular 4 bolt mounting flange dimensions

Dimensions in mm [in].



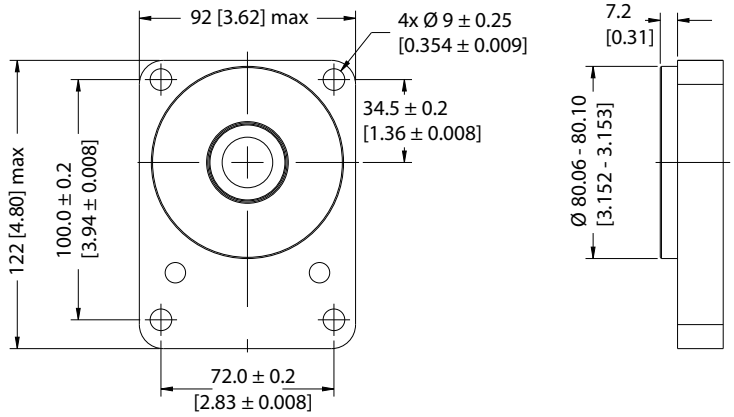
Code	A	D
AD	50 [1.968]	9.0 [0.354]
AE	54 [2.125]	7.5 [0.295]
AF	36.47 [1.435]	7.0 [0.275]

Dimensions

German rectangular 4 bolt mounting flange dimensions

Dimensions in mm [in].

Code - AG



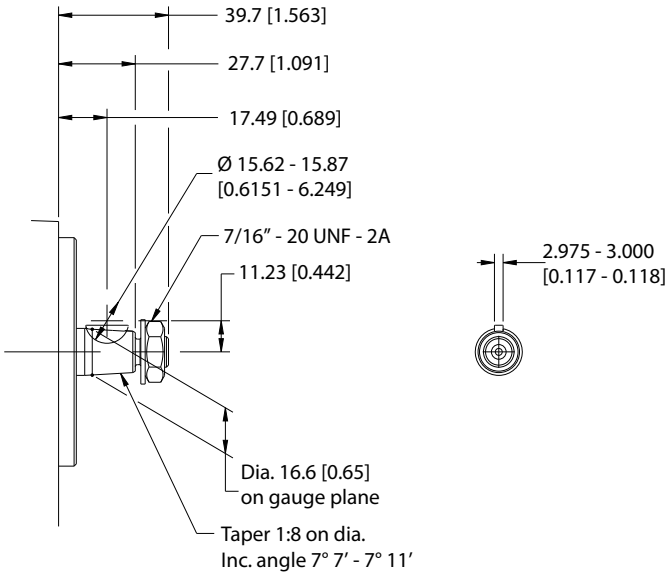
Dimensions

Input shaft

Taper 1:8 input shaft dimensions

Dimensions in mm [in].

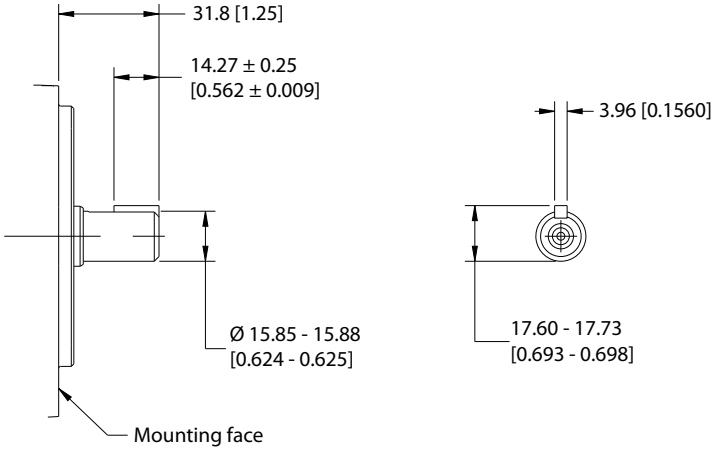
Code - 02 (max allowable torque 150 N·m)



Straight keyed input shaft with Ø15.88 dimensions

Dimensions in mm [in].

Code - 04 (maximum allowable torque 80 N·m)

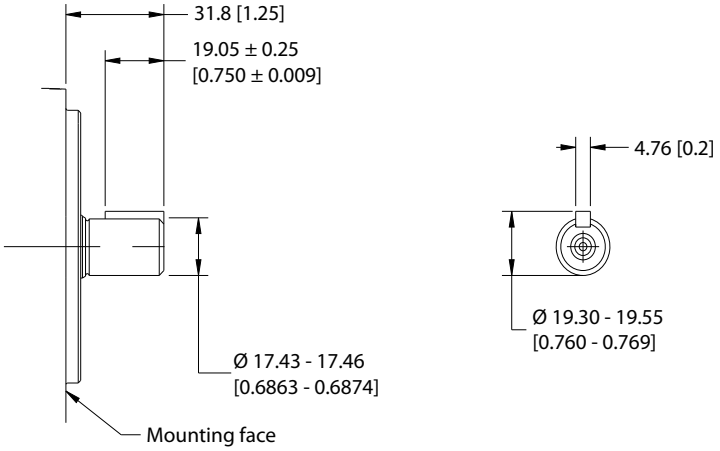


Dimensions

Straight keyed input shaft with Ø17.46 dimensions

Dimensions in mm [in].

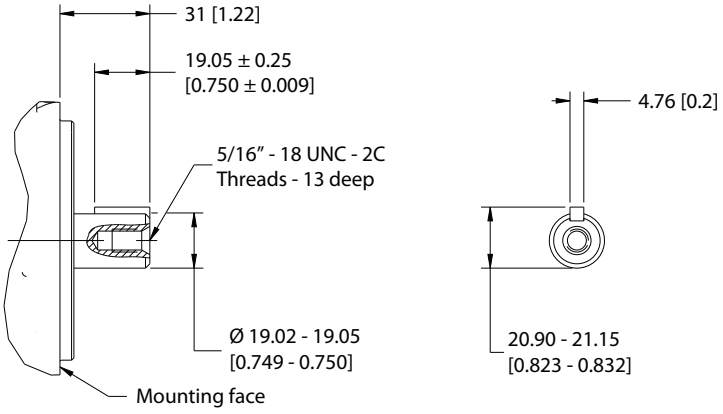
Code - 07 (maximum allowable torque 115 N·m)



Straight keyed shaft with Ø19.05 dimensions

Dimensions in mm [in].

Code - 03 (maximum allowable torque 125 N·m)

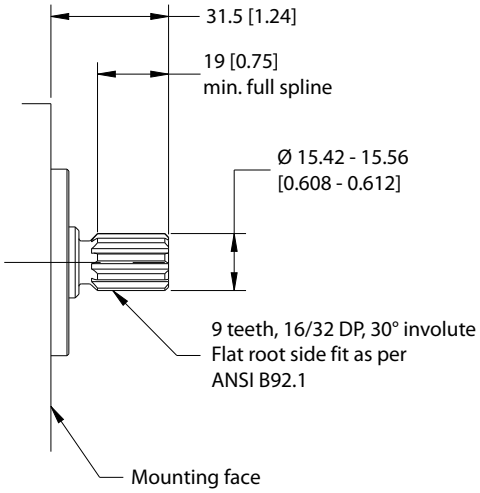


Dimensions

9 teeth shaft dimensions

Dimensions in mm [in].

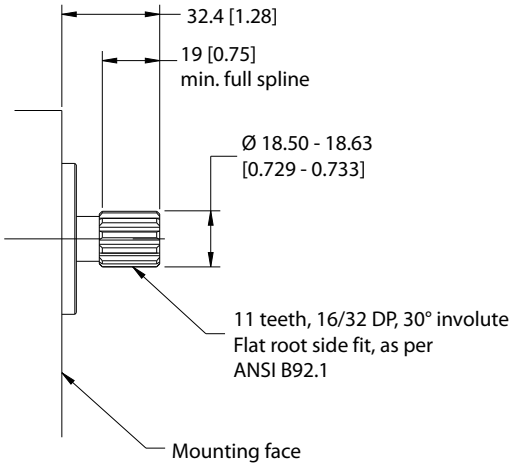
Code - 06 (maximum allowable torque 90 N·m)



11 teeth shaft dimensions

Dimensions in mm [in].

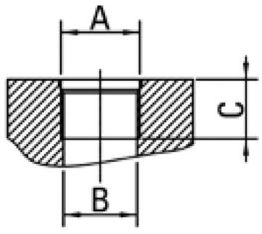
Code - 05 (maximum allowable torque 150 N·m)



Dimensions

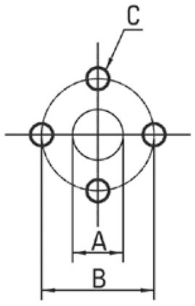
Ports

SAE straight thread O-ring ports dimensions (Pmax ≤ 210 bar)



Code	SAE number	A (thread size)	ØB mm [in]	C mm [in]
AD	8	0.750-16 UNF-2B	17.5 [0.69]	14.3 [0.56]
AA	10	0.875-14 UNF-2B	20.5 [0.81]	16.7 [0.66]
AB	12	1.0625-12 UN-2B	24.9 [0.98]	19.1 [0.75]

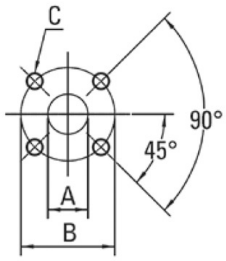
European flanged ports - 4 bolts dimensions



Code	Nominal size	Ø A mm [in]	B mm [in]	C thread	C thread depth mm [in]
AN	14	14.0 [0.55]	30.0 [1.18]	M6	13 [0.51]
AM	19	19,0 [0.75]	40.0 [1.57]	M8	13 [0.51]

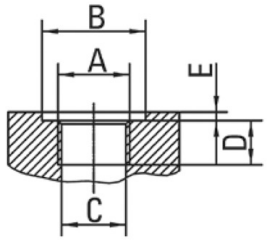
Dimensions

German flanged ports - 4 bolts dimensions



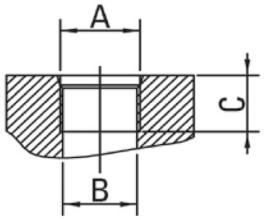
Code	Nominal size	Ø A mm [in]	B mm [in]	C thread	C thread depth mm [in]
AP	15	15.0 [0.59]	35.0 [1.38]	M6	13 [0.51]
AS	19	19.0 [0.75]	40.0 [1.57]	M6	13 [0.51]
AR	20	20.0 [0.79]	40.0 [1.57]	M6	13 [0.51]
BE	13.5	13.5 [0.53]	30.0 [1.18]	M6	13 [0.51]
BF	20	20.0 [0.79]	40.0 [1.57]	M6	13 [0.51]

BSPP straight thread ports dimensions (Pmax ≤ 210 bar)



Code	Nominal size	A	Ø B mm [in]	Ø C mm [in]	D mm [in]	E mm [in]
AF	3/4"	G 3/4"	42.0 [1.65]	24.5 [0.96]	16.0 [0.63]	1.5 [0.06]
AG	1/2"	G 1/2"	33.0 [1.30]	19.0 [0.75]	15.3 [0.60]	1.5 [0.06]
AH	3/8"	G 3/8"	27.0 [1.06]	15.3 [0.60]	12.2 [0.48]	1.5 [0.06]
BB	1"	G 1"	47 [1.85]	30.75 [1.21]	19.1 [0.75]	1.5 [0.06]

Metric straight thread ports (ISO 6149) dimensions (Pmax ≤ 210 bar)



Code	A thread size	Ø B mm [in]	C mm [in]
AJ	M22 x 1.5	20.5 [0.81]	13.5 [0.53]
AK	M18 x 1.5	15.5 [0.65]	12.5 [0.49]
AL	M27 x 2.0	25.0 [0.98]	17.0 [0.67]

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