Cam followers

Technicals characteristics

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NADELLA cam followers are designed to run directly on various types of surface such as cams, ramps and slideways.

In order to satisfy the operating conditions imposed on this type of bearing - heavy radial loads usually accompanied by substantial and repeated shocks, the various NADELLA cam followers have these common advantages:

- heavy section outer ring of high strength steel hardened to 58-62 HRC;
- outer ring possessing no oil hole or lubrication groove, thus preventing the introduction of impurities into the bearing and scaling and galling of the bearing track;
- convex outer ring tolerating out-of-parallelism of contact surfaces;
- oil holes situated under the needles enabling lubricant replenishment through the shaft;
- full complement of needles providing maximum dynamic and static load capacities.

Although the use of a convex outer ring is advisable in many cases, cam followers are also available with cylindrical outer ring for special applications or for use as radial bearings.

For the use of cam followers with convex outer ring as bearings, please consult NADELLA Technical Department.

Types of cam follower

Convex outer ring		
without seals	with seals	
	plastic	metal
FG...	FG...EE	FG...EEM
		FGU...MM
FP...		
GC...	GC...EE	GC...EEM
GCR...	GCR...EE	GCR...EEM
		GCU...MM
		GCUR...MM

Cylindrical outer ring		
without seals	with seals	
	plastic	metal
FGL...	FGL...EE	FGL...EEM
FGUL...		FGUL...MM
FPL...		
GCL...	GCL...EE	GCL...EEM
GCRL...	GCRL...EE	GCRL...EEM
		GCUL...MM
		GCURL...MM

To use as follower

Dynamic capacity Cg NADELLA

It is the constant radial load which a follower can support during 1 000 000 revolutions before the first signs of fatigue appear on a ring or rolling element.

This dynamic capacity enables to calculate the life of a cam follower.

Limit loads

Dynamic limit load F

It is the load which should not be exceeded when follower is subject to repeated forces.

Static limit load Fo

It is the maximum strength limit that the follower can exceptionally support.

Operating conditions

Full complement needle followers types GC, FG, FP

These followers are recommended under following conditions:

- Intermediate speeds
- High radial loads
- Oscillating motions.

Full complement roller followers types GCU, FGU (light series)

Their installation is especially recommended for:

- High speeds (increased grease content)
- Limited and intermittent axial loads
- Heavy radial loads.

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Full complement roller followers type FGU (heavy series)

This type differs from the light series in that the outer ring is thicker, hence a larger outer diameter and thus can accept heavier loads.

Cam followers types GCR, GCUR

Derivatives of GC and GCU, this type has an eccentric collar, which is tightly fitted on the stud enabling the mounting position to be adjusted. The position of the stud can vary ± k (see table of dimensions) relative to the centre of the hole in the mating member.

Misalignment tolerances

Followers with a convex outer ring permit displacement in relation to the track surface up to a maximum slope of:
7.0 in 1 000 for FG, GC and GCU.

Tolerances on outer diameter

For all types of follower:
- convex outer ring h9 on dim. De
- cylindrical outer ring h7 on dim. De
- out of roundness: in accordance ISO Standard 492 (class zero according to DIN 620).

Shaft tolerances

For FG and derivatives	Dim. Di
Load fixed in relation to the inner ring	h5
Load rotating in relation to the inner ring	k5

The cylindrical tolerance, defined as the difference in radii of two coaxial cylinders (ISO Standard 1101), should normally be less than a quarter of the manufacturing tolerance. However, for high precision or high speed applications it is advised to restrict this tolerance to one eighth of the manufacturing tolerance.

Where followers are used as bearings, please consult NADELLA Technical Department for shaft and housing tolerances.

Raceway strength

The stress capacity of the raceway on which the follower rotates depends on several factors such as load and speed, possibility of shock and width of follower. In the case of high loads, raceway stress may be calculated approximately by the formula:

$$R \geq 45 \frac{P}{De \times L}$$ where:

R in megapascals 1)	= raceway stress
P in newtons	= applied load on follower
De in mm	= outer diameter of follower
L in mm	= width of follower

1) 1 megapascal (MPa) = 1 newton (N) per mm^2

Advice on assembly

Positioning of the radial lubrication hole

In cases where the follower is subjected to high loads, shock or vibration, the lubrication hole situated under the needles should be positioned outside the loaded zone. The lubrication hole which is not visible on the cam follower with threaded stud is parallel to the screwdriver slot in the head of the stud. (The GC 13 does not possess a lubrication hole.) Where the head of the stud has a hexagonal socket, the position of the lubrication hole is indicated by the marking NA.

Lateral support of FG type followers

Shoulders on the shaft or other parts serving to retain the follower on the faces of the inner ring should have an outer diameter not less than dimensions D_1. Where there is considerable axial load or operation is subject to vibration, this outer diameter should be equal to dimension M.

Mounting cam followers with threaded studs type GC, GCR, and derivatives

The stud should fit easily into the hole in the mating member having a bore of tolerance H7. To ensure contact over the entire surface area of the yoke, the supporting face of the mating member should have a diameter of at least equal to dimension M. The locking

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torque applied to the nuts, as shown in the table of dimensions, is calculated to provide effective fixing of the followers.

Accessories for followers GC and GCR

Cam followers GC and GCR with threaded studs are supplied with the parts:

Type GC, GCU	Type GCR
two nuts	one nut
	one lock washer
	one flat washer
one grease nipple for followers up to De = 28 mm (except GC 10 to 15)	
one grease nipple and one plug for followers from De = 30 mm	

The stud of GC 10 to 15 has no axial hole. The stud of types GC and GCR up to De = 28 mm inclusive has a single threaded hole at its top end for a grease nipple. If this grease nipple is not used, an additional plug can be supplied on request as a substitute.

From De = 30 mm upwards the stud of the followers has a hole at each end for a grease nipple. Having filled the grease nipple into one of the holes, the other should be blanked by means of the plug supplied. If greasing is effected by means of the hole at right angles to the stud, the arrangement described still applies as the grease nipple will act as a plug in this case. However, if obstruction results from the protruding head of the grease nipple, this can be replaced by a second plug available on request.

Cam followers with threaded stud types GC and GCR have a screwdriver slot at the top end. From D = 30 mm up to 52 mm, these types may either have a screwdriver slot or a hexagonal socket at the discretion of NADELLA, unless a specific type is requested.

Lubrication - operating temperature

Types FG, GC, GCR and derivatives with or without seals are supplied with a coating of lithium soap grease permitting operation in temperatures from -20 to +120°C. On request, these followers can be supplied without grease (but protected) in case where lubrication is to be effected by oil or a special lubricant.

Type of follower	Lubrication	Operating temperature
Followers without seals type FG (FG L), GC (GCL) and GCR (GCRL)	Lithium soap grease	-20 to +120°C limits permitted by lithium soap grease
Followers with plastic seals EE		-20 to +100°C limits permitted by plastic seals
Followers with metal seals EEM		-20 to +120°C limits permitted by by lithium soap grease

At temperatures of 150°C and above, cam followers must be specially heat treated and calculation of life should take account of reduced load capacity.

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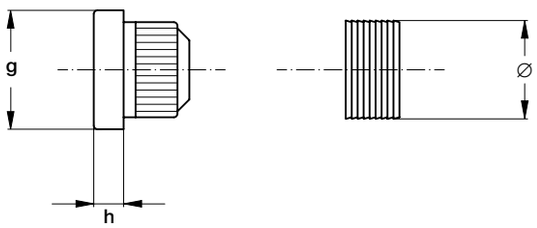
Use of a special grease for high temperatures may reduce the limiting speeds shown in the tables of dimentions.

1) The metal seal...EEM enables operation up to 200°c with a suitable lubricant.



Accessory details for followers GC and GCR

The nuts, grease nipples and plugs provided with GC and GCR type followers can be supplied separately. The references and principal dimensions of these accessories are shown in the table below:

For	NUTS		GREASE NIPPLES			PLUGS	
Follower no.	Reference	h (mm)	Ref.	g (mm)	h (mm)	Ref.	Ø (mm)
10	Hm 4 x 0.7	2.2					
11	Hm 4 x 0.7	2.2					
12	Hm 5 x 0.8	2.7					
13	Hm 5 x 0.8	2.7					
14	Hm 6 x 1.0	3					
15	Hm 6 x 1.0	3					
16	Hm 6 x 1.0	3					
19	Hm 8 x 1.25	4					
22	Hm 10 x 1.25*	5	GN 4	6	2.5 to 3 mm max.	OB 4	4
24	Hm 10 x 1.25*	5					
26	Hm 10 x 1.25*	5					
28	Hm 10 x 1.25*	5					
30	Hm 12 x 1.5*	6	**			**	
32	Hm 12 x 1.5*	6	**			**	
35	Hm 16 x 1.5	8					
40	Hm 18 x 1.5	9	GN 6	8		OB 6	6
47	Hm 20 x 1.5	10					
52	Hm 20 x 1.5	10					
62	Hm 24 x 1.5	12					
72	Hm 24 x 1.5	12					
80	Hm 30 x 1.5	15	GN 8	10		OB 8	8
85	Hm 30 x 1.5	15					
90	Hm 30 x 1.5	15					

* These threads may be supplied with the old pitch of 1 mm.

** For followers of De 30 and 32 mm with screwdriver slot: grease nipple GN 6 and plug OB 6.
De 30 and 32 mm with hexagonal socket: grease nipple GN 4 and plug OB 4.