CAM FOLLOWERS

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 58–61.5 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			Cylindrical outer ring		
without seals	with seals		without seals	with seals	
	plastic	metal		plastic	metal
FG...	FG...EE	FG...EEM FGU...MM	FGL...	FGL...EE	FGL...EEM FGUL...MM
FP...			FPL...		
GC...	GC...EE	GC...MM	GCL...	GCL...EE	GCL...EEM
GCR...	GCR...EE	GCR...EEM GCU...MM GCUR...MM	GCRL...	GCRL...EE	GCRL...EEM GCUL...MM GCURL...MM
RNA 11 000B6 RNAB 11 000			RNAL 11 000		

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 torques.

► *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.

► *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.

► *Full complement needle followers type RNA 11 000*

These followers may be used without an inner ring on a hardened shaft. Inner rings can be supplied with inner ring for shaft diameters of 12 mm and above. This type is recommended under the following conditions:
– Intermediate speeds,
– High radial loads,
– Oscillating motions.

MISALIGNMENT TOLERANCES

Followers with a convex outer ring permit displacement in relation to the track surface up to a maximum slope of:

1.5 in 1 000 for RNA 11 000 B6
15.0 in 1 000 for RNAB 11 000
7.0 in 1 000 for FG, GC and GCR.

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 RNA 11 000 fitted with inner ring, FG and derivatives	Dim. Di
Load fixed in relation to the inner ring	h5
Load rotating in relation to the inner ring	k5
For RNA 11 000 without inner ring	Dim. Ci h5

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

RIGIDITY CONCEPT

The design of NADELLA full complement needle or roller followers provides applications with the high degree of rigidity necessary for precise motion.

This is essentially due to the rigidity of the stud and the rolling elements, to the bending under load of the outer ring, to the rigid contact between the outer ring and the cam, and above all to the thickness of the outer ring.

Owing to their inner design, the full complement followers types GC, FG... limit the load on the rolling elements and consequently the load on the outer ring.

For K values, please see table of dimensions.

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 D1. 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 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	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 fitted 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

Type RNA 11 000 followers are supplied with a coating of protective grease compatible with a lithium base grease.

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 RNA 11 000	Protective grease	according to lubricant used for operation (see section on lubrication)
Followers without seals type FG (FGL), 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 [1] limits permitted by lithium soap grease

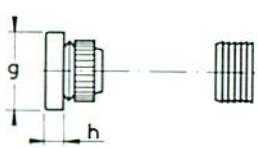
► At temperatures of 150°C and above, cam followers must be specially heat treated and calculation of life should take account of reduced load capacity (see page 12).

► 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 Follower no.	NUTS Reference	NUTS h mm	GREASE NIPPLES Ref.	GREASE NIPPLES g mm	GREASE NIPPLES h mm	PLUGS Ref.	PLUGS ⌀ 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	3.2					
15	Hm 6 x 1.0	3.2					
16	Hm 6 x 1.0	3.2					
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.
For followers of De 30 and 32 mm with hexagonal socket: grease nipple GN 4 and plug OB 4.

YOUR CAM FOLLOWER

Improved cam follower design for better performance

This is what NADELLA strives for with its "made to measure" cam followers which it manufactures when the quantities involved are sufficient to justify series production.

THE FOLLOWING MAY BE MODIFIED TO SUIT REQUIREMENTS:

A a. The stud
b. The types of mounting used
c. Lubrication method

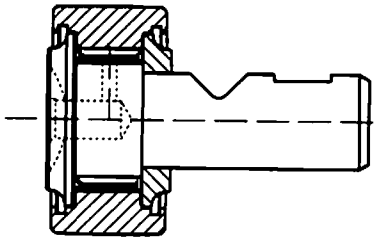
B a. Cam follower design
b. The shape of the outer ring

A 1. Milled mounting points on stud
2. Threads cut along entire stud length
3. Clip mounting in blind hole
4. Sealed with smooth, threadless stud
5. With tapped hole for central lubrication
6. With tapped hole for central lubrication
7. Blocking flats or square
8. Hex-socket, long stud, special threading
9. Hexagonal or square blocking head

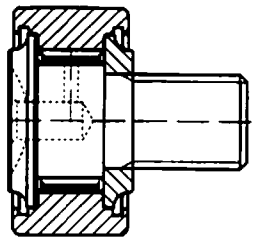
B 10. Cam follower with thrust bearings for high axial loads
11. Simplified, non sealed cam follower
12. With eccentric collar and blocking square
13. Double ring cam follower
14. Cam follower with polyurethane collar
15. Specially shaped outer ring
16. Cam follower with half-circle, vee or other type groove
17. Cam follower with long outer ring

A given cam follower may comprise several modifications

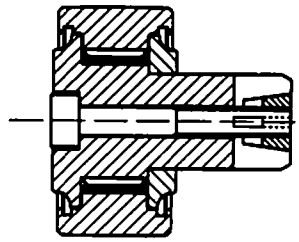
Examples:	GC	53584	5	and/or 6 + 7
	GCR	53584	12 + 7 + 5	and/or 6
	GC	53830	7 + 5	and/or 6



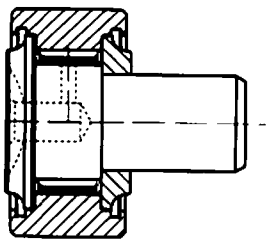
1



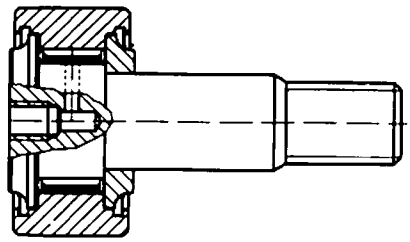
2



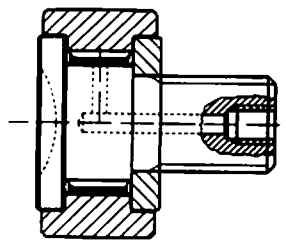
3



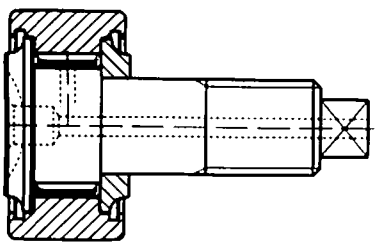
4



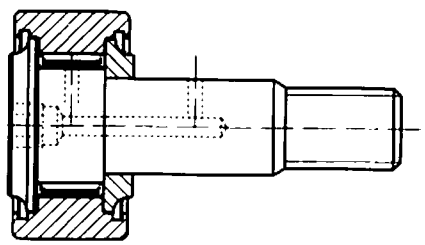
5



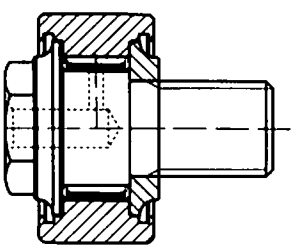
6



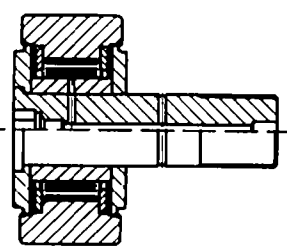
7



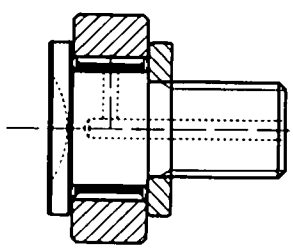
8



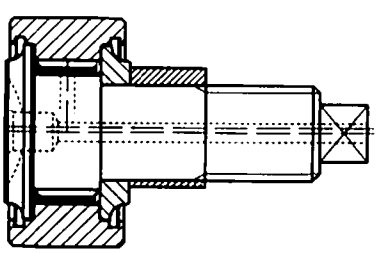
9



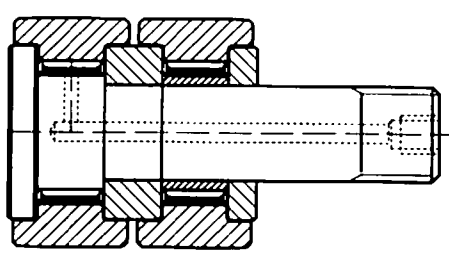
10



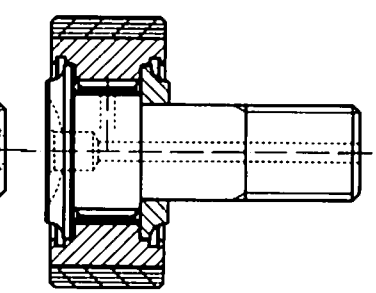
11



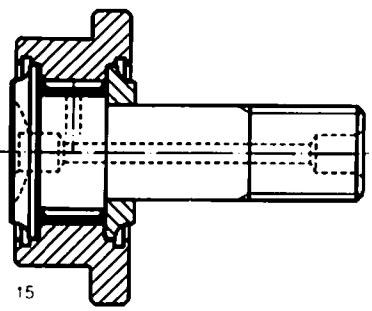
12



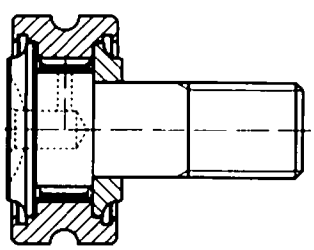
13



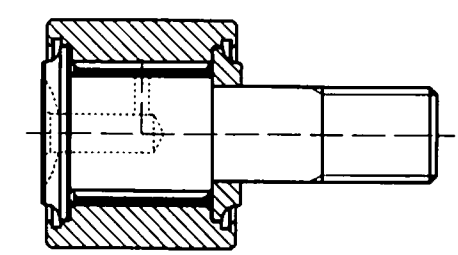
14



15



16



17