MIKSCH accelerates

Miksch GmbH • Reutlinger Str. 5 • 73037 Göppingen • Germany
Tel. +49-(0)7161/6724-0 • Fax +49-(0)7161/14429
E-Mail: miksch@miksch.de • www.miksch.de

Cams

Modules of automation

Cams

MIKSCH accelerates

Production

In the field of drive technology, cam drives form part of the group of asymmetrical translational drives.
They form a universal mechanical element for controlling movement processes in machines and systems of all kinds.
One of their key advantages is that they allow virtually any movement sequences to be carried out on the output element. Each specific motion diagram requires its own cam.
In addition, cams also occupy little space in the machine, thanks to their compact design, and other than the lubrication of the roller lanes, can be considered as maintenance-free.

Rollers or sliding pieces can be used as transmission elements.

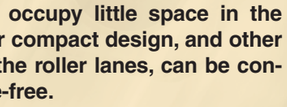
Cams – Production

MIKSCH offers the following cam production options:

Complete production including material (also hardening and grinding)

Milling and grinding of the cam profile (customer provides semi-finished parts)

Our production options

Radial cams			
Radial cams	Ø 5 - 2500 mm	Width < 1mm - 400 mm	
3D cams			
Cylindrical cams	Ø 5 - 1200 mm	Strokes up to 800 mm	
Globoidal cams	Axial distance up to 800 mm	Turret strokes up to 360°	
Transport shafts	Ø 5 - 500 mm	Total length variable, production in parts, pinned during assembly	

Delivery program

The following materials, with appropriate heat and surface treatment of the complete parts or cam profiles, are used in preference by MIKSCH:

Recommended materials (preferred Miksch range)

Cam profile	Materials (*Old designation*)	Application / Advantages
Soft	C45E (Ck45) GG25, GGG60	Cams with low load, inexpensive
Temper-hardened	42CrMo4V	
Nitrided	34CrAlMo7	
Induction-hardened	C45E (Ck45) 42CrMo4V	High loads, long standing times, milling and polishing for simple cams, grinding for complementary and precision cams
Case-hardened	18CrNiMo7-6 (17CrNiMo6) 16MnCr5	
Through-hardened	90MnV8 100Cr6	

Special applications in plastic available on request

Upon request, other materials can of course also be used if you provide them or if the scope of the order permits the purchasing of conventional quantities of materials.

Service - Analysis and optimisation

MIKSCH also offers the analysis and/or optimisation of existing cam drives and cam-linked gear combinations.

MIKSCH documents the results in an informative and illustrative way.

Motion schedule

Motion schedule and motion diagram

The designer creates the single drive's motion schedule based on the machine working schedule and thus roughly specifies its function.
In the motion schedule, the relationships between the drive and output movement are illustrated in a simplified, linear way.
What's more, additional requirements also need to be specified in detail. These include laws of motion, a defined maximum acceleration at a specified rpm and position of the inflection point in a section of movement.
In the motion diagram, the lines are replaced by the actual laws of motion and all further requirements of the motion schedule, insofar as it is possible to do so, are included.

The output element can perform a straight **S-** movement via a ram or an arc-like **Ψ-** motion via a pendulum lever. The strokes **S** or **Ψ** are determined by their preceding sign, based on the mathematically positive or negative direction of motion. The positive direction of numbering for the stroke must be entered in the diagram.

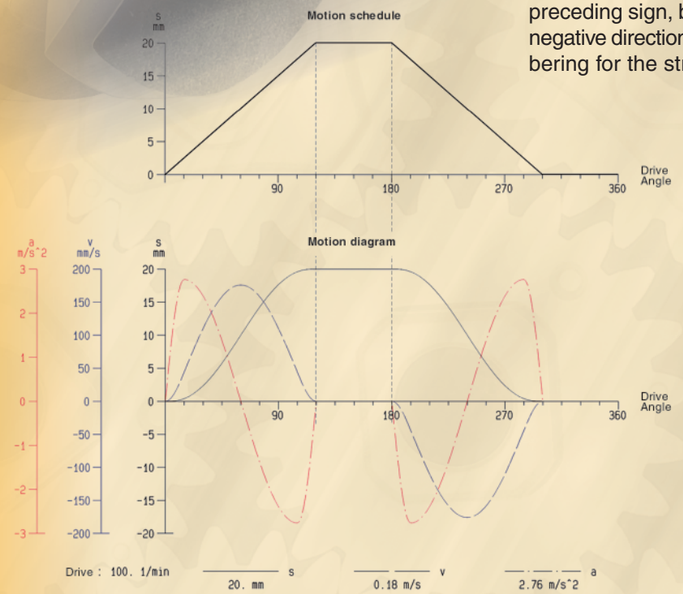


Illustration left: Motion schedule and motion diagram for the same task.

Planning - Ensuring positive motion

A cam drive can only fully carry out its purpose if the roller and the cam are permanently in contact.
This positive motion can be achieved positively and non-positively.
For the non-positive motion, only one cam lane is required. The necessary return forces can be generated using weights, springs, hydraulic or pneumatic systems, etc.
For cams under higher loads, positive motion is often preferred. This requires a second cam flank on rollers. Between the two rollers, if they are precision-manufactured, no spring intermediates are required.

Laws of motion

The motion diagram is divided up into several sections of movement that are described mathematically by laws of motion (transfer functions). Because of their large number, there is however no universal law of motion that can be used for all motion tasks. The best solution has to be selected from the existing laws of motion for the task in hand.

Essential for quiet, gentle running are the use of shock and pulse-free laws of motion and transfers from motion phase to motion phase.

On your behalf, MIKSCH will determine the relevant framework conditions and inflexion points.

We can also refer to the VDI Guideline 2143 "Motion rules for cam mechanisms".

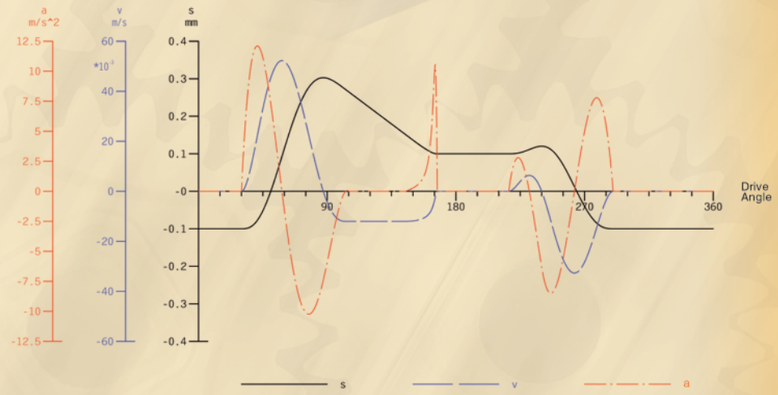
Explanation:

Shock: Final jump in the speed function.

Pulse: Final jump in the acceleration function.

Framework conditions: Shock and pulse-dependent laws of motion can be applied successfully if the peripheral values of the neighbouring motion sector demonstrate the same value.

Point of inflection: Angle of input at which the acceleration on the output element changes sign. Various reasons can sometimes make it necessary to shift the point of inflection from the central position.



s = **s**traight line
v = **v**elocity
a = **a**cceleration

Checklist

Troubleshooting checklist in cam gears

Poorly-running cam gears or premature wear is caused by one single factor in only the most unusual of cases. Examples of such factors include the cam production. In most cases, a combination of several causes is the root of the problem. The following checklist will provide you with assistance when dimensioning and troubleshooting.

1. Motion diagram
- 1.1 Have the best laws of motion for the task been chosen?
- 1.2 Shock and pulse-free transfers to neighbouring motion sections?
- 1.3 Favourable stroke and angle of cam rotation selected? Effects in the analysis of the drive in the form of unfavourable pressure angle, radii of curvature, compressive stress, etc.

2. Main dimensions determined based on gear technology requirements?
- 2.1 Compressive stress corresponds to the material pairing of roller / cam body?
- 2.2 Pressure angle $\alpha < 40°$?
- 2.3 Radius of curvature of the roller midpoint guide $\varrho : R_{Roller} \leq 0{,}7 \times \varrho$ min?

3. Cam bodies
- 3.1 Is production computer-assisted on modern NC milling or grinding machines?
- 3.2 Material and heat treatment are appropriate for the case in hand?
- 3.3 Cam guide width > roller width?

4. Roller is appropriate for the case in hand in terms of diameter and construction?

5. Positive motion ensured?
- 5.1 Non-positive motion: return force matches requirements?
- 5.2 Positive motion: frame length or roller pitch set free of play?

6. Frame and output links designed to be torsion-resistant?
- 6.1 Design with as much rigidity as possible?
- 6.2 Play in participating roller and rotating links minimal?
- 6.3 Chain / toothed gear drives have an inelastic retightening device?
- 6.4 Straight output: sufficient length of the ram guide?
- 6.5 Overhung bearing of the cam avoided?
- 6.6 In the event of extraneous oscillations, have oscillation dampers been installed in the machine?

7. Rigid drive?

8. Lubricant present in the cam link?

Terms

Explanation of frequently-used terms

φ – Angle of cam rotation:
The angle of the cam's rotation. Each angle of rotation φ has an output stroke **S** or angle of output rotation Ψ uniquely assigned to it.

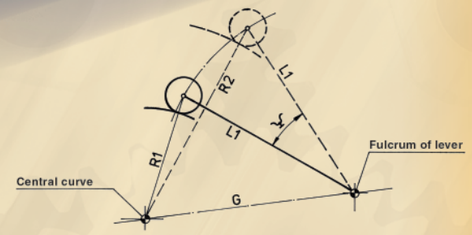
α – Pressure angle:
The pressure angle α tells us something about the gear's transmission quality. It is comparable with the slope angle of a thread.

μ – Angle of transmission:
The angle of transmission μ is the opposite angle to the pressure angle α.

ϱ – Angle of curvature of the roller midpoint guide:
This influences the Hertz pressure on the cam. Small, convex radii of curvature increase the pressure.

Determining sizes on the cam gear

As described above, the strokes of the output link for cams with arc-shaped output motion are to be specified in degrees.
If wished, MIKSCH can convert the strokes specified in cam radii into degrees.



Disk cams with pendular lever output

You can find more information on cams on the Internet at ***www.miksch.de***