

BISHOP RACK AND PINION GEAR SETS
FOR OPTIMUM STEERING GEAR PERFORMANCE
FULLY MACHINED RACKS AND PINIONS



 **BISHOP**
Steering Technology Pty Ltd

 **BISHOP**
Steering Technology Inc.

 **MVO GmbH**
Metallverarbeitung Ostalb



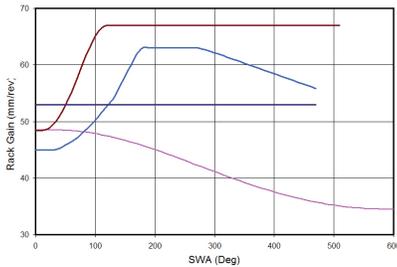
FULLY MACHINED RACKS AND PINIONS

In order to support its world class rack forging process, Bishop Steering Technology Inc. has developed highly sophisticated machining techniques for the production of prototype rack and pinion gear sets.

These prototypes are used by vehicle manufactures in the early stages of vehicle model development. Bishop's ability to supply gear sets of almost unlimited ratio variation with short lead times has greatly assisted many program managers to optimise their steering systems.

In addition to it's expertise in gear design, Bishop invented variable ratio racks. Bishop's understanding of vehicle dynamics requirements allows it to work with the customer's engineers to develop the optimum ratio pattern. These ratios can then be translated into pinion and rack gear profiles using Bishop's in house developed software.

This software allows manufacturing feasibility studies to be carried out at this early design stage.



DESIGN PROCESS

Bishop's design process standard uses automotive design methodologies (TS16949) to cover all the basic design parameters, for example:

- Initial Design
- Verification of Customer Designs
- Identification of Special Characteristics
- DFMEA
- Prototype Control Plans
- Process Verification and Development
- FEA
- Inspection Reports

PINION USAGE	DIN	ISO	JIS	AGMA
Masters	4	4	0	12
	5	5	1	11
Racecar	6	6	2	10
	7	7	3	9
General	8	8	4	8
Automotive	9	9	5	7

MASTER PINIONS

Bishops pinion machining process has been enhanced to enable it to produce pinion teeth to DIN Class 4. Currently these "Master" pinions are only produced for internal gauging requirements.

Bishop uses DIN classification for pinion measurement. The above tables shows approximate equivalents specified by other standards. Note: This table is for guidance only as direct conversions are not possible.



Herringbone Pinion



Closed End Teeth

LOW VOLUME MANUFACTURE

Bishop also produces low volume batches of rack and pinion gear sets, special pinions and racks to enhance existing steering gear performance. These are predominantly supplied to the high performance racing industry. Bishop's sophisticated machining process allows additional features to be designed into the pinion and rack. An example is the ability to close the end of the teeth while maintaining a tooth accuracy of DIN class 6. Additional novel features such as herringbone teeth and other configurations are also available.

FLEXIBLE MANUFACTURING CAPABILITIES

The Bishop developed, sophisticated machining process is suitable for a wide range of materials, from frequently used, commercial material such as SAE1040, 37CrS4, through to exotic steels such as precipitation hardening steel and non ferrous material such as titanium.

COMPONENT HEAT TREATMENT

Induction hardening of racks and pinions is available in house. This process can be set up to supply hardness patterns similar to those used in production.



Bishop can also manufacture inductors to supply the customer with a variety of specific heat treatment patterns.

The precipitation hardening steels are heat treated in a MIL certified oven. This process is used for parts where the customer requires rapid deliveries and/or high performance. Typical uses are short lead time vehicle drivability samples and high strength racing car steering components.

QUALITY ASSURANCE

Quality of the components is assured using industry standard and in house developed techniques.

For the pinion a certified gear measuring machine is used.

The racks are inspected on a specially developed double flank contact rack measurement gage. This measuring technique is based on DIN 3962.

ABOUT BISHOP STEERING

Bishop Steering Technology is a part of the GMH Group, and a world leader in the development of automotive steering systems and their production techniques. As the inventor of variable ratio racks for use with conventional helical pinion, Bishop specializes in the design and supply of leading edge rack and pinion steering technologies. More than 23% of all vehicles produced globally each year contain components based on Bishop technology.

ABOUT VARIABLE RATIO (VR) RACK & PINION STEERING

Bishop is synonymous with VR steering. Arthur Bishop, founder of Bishop Steering Technology, invented VR steering first for aircraft nose wheels, then for motor vehicles and was granted the first variable ratio rack and pinion patent for cars in 1958.

Bishop VR was used in the first variable ratio rack & pinion application to go into production in 1981. Since then VR steering has become increasingly common in a range of motor vehicle applications around the world, ranging from Formula 1 race cars to standard passenger cars through to SUV and light van applications where increased safety is required.



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**Business units of the
GMH Group:**

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Steel Castings Mechanical Engineering

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