

Energy-efficient right-angle gearmotors

Interview with your
SPIROPLAN® experts

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SEW-EURODRIVE has developed an impressive series of new right-angle gear units with a wide range of gear ratios. They are also quiet, energy-efficient, and particularly cost-effective. Gear unit developers Sebastian Hess, Dr. Björn Sievers, and Michael Herberger provide a first-hand explanation of the idea and its mechanical implementation.

Interview

SEW-EURODRIVE is ushering in a new era with its new SPIROPLAN® helical gear units. What sets these gear units apart?

Hess: Our objective when designing and configuring the W..9 gear units was to develop energy-efficient solutions that are particularly cost-effective for users. Our new right-angle gear units normally achieve an efficiency of over 90% in nominal operation.

How can such high levels of efficiency be achieved?

Sievers: It's down to the specific arrangement of the gear stages and the efficiency-optimized design of the SPIROPLAN® right-angle stages on the high-speed side of the gear unit. High gearing efficiencies, especially with large overall gear ratios, make it possible to maintain high gear unit efficiency, too. That and the low load-independent bearing power loss play a key role here.

SEW-EURODRIVE has developed and patented gear units with SPIROPLAN® gearing. What is special about the SPIROPLAN® gearing?

Herberger: SPIROPLAN® gearing benefits from virtually wear-free operation, good misalignment tolerance, and cost-effective manufacture. It can thus be configured specifically to create a very quiet gear stage. As with other right-angle stages – such as hypoid or worm stages – if the stage gear ratio is sufficiently small, the load-dependent gearing efficiency is correspondingly high.

The SEW-EURODRIVE portfolio has included gear units with SPIROPLAN® gearing since the 1990s. How does the new generation of SPIROPLAN® right-angle gear units differ from the previous gear units?

Herberger: The W..9 gear units have a two-stage or three-stage design, depending on the gear ratio. The SPIROPLAN® right-angle stage is configured as the first stage on the high-speed, input side of the gear unit, with a consistently small stage gear ratio and a high load-dependent gearing efficiency. For the gear unit stages after this, we use one or two helical stages from SEW-EURODRIVE's modular system, in principle with a high load-dependent gearing efficiency. That means we can also create three-stage gear unit designs with a large overall gear ratio in the range $i > 200$.



- **Sebastian Hess**, Development of standard gear units, development of new concepts for standard gear units
- **Dr. Björn Sievers**, Gear development, calculation and support
- **Michael Herberger**, Gear development, calculation and support





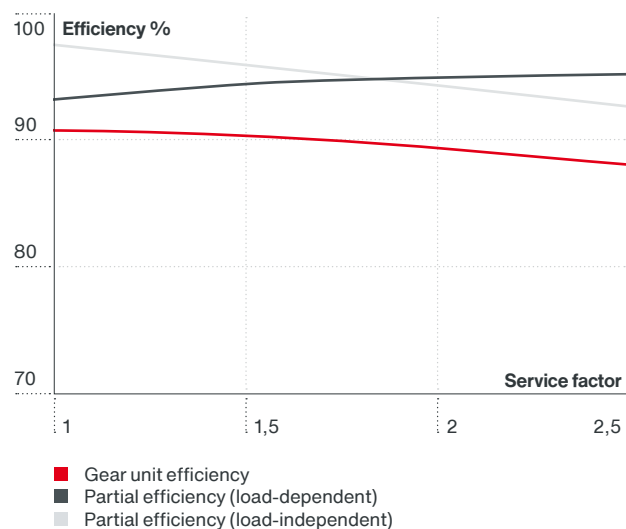
How was it possible to minimize the previously mentioned bearing power loss?

Sievers: This series of gear units benefits from very low load-independent bearing losses compared to other bearing concepts. We have implemented a concept with no need for bearing preloading. What's more, the configuration with the right-angle stage as the first gear unit stage means that, overall, only relatively small axial forces act on the rolling bearings. We have therefore been able to dimension these bearings accordingly and make them correspondingly small. Load-independent losses are particularly important in partial load operation because they become more significant in the power balance as the power throughput decreases.

Can you give us a specific example?

Herberger: The diagram on the right shows the high energy efficiency based on the example of efficiency levels for a WAF49 gear unit with a gear ratio of $i = 200.76$ at an input speed of $n_{\text{input}} = 1500 \text{ min}^{-1}$. The gear unit efficiency is calculated from the product of the two partial efficiencies for the load-dependent and load-independent losses. In this case, the three efficiencies are plotted against the service factor.

The gear unit efficiency in nominal operation is over 90%, which is very high for such a large gear ratio. Compared to other gear unit concepts, the drop in efficiency in partial load operation as the service factor increases is relatively gradual, which results in very good levels of efficiency.



What about the gear unit's thermal properties?

Sievers: Thanks to the high-energy efficiency, less heat is generated in the gear unit. At the design stage, we also made a point of optimizing heat dissipation. Achieving the best possible flow of air from the motor fan in the gear unit housing means the warm is circulated effectively and quickly removed.

How is the SPIROPLAN® W..9 series combined with the motors?

Hess: Another key argument in favor of the new design of the gear unit stages is that the SPIROPLAN® pinion is fitted onto the motor shaft as a cantilevered shaft-mounted pinion, meaning the W..9 right-angle gear units can be combined with all asynchronous motors, synchronous motors, adapters, and input shaft assemblies. We thus use the benefits of SEW-EURODRIVE's modular motor system with our tried-and-tested flange interface. What's more, unlike push-in pinions that are pressed permanently into place, the shaft-hub connection enables non-destructive disconnection.

What sizes are the new SPIROPLAN® right-angle gear units available in?

Sievers: They are available in five sizes with a M_{amax} of 80 Nm to 600 Nm, and we offer gear ratios of around $i = 6$ to over 200. Depending on the size, between 28 and 35 gear ratios are available. Thanks to the fine graduation, the output speed can be precisely adapted to specific requirements.

What are the other advantages for our customers?

Hess: With the W..9 gear unit series, SEW-EURODRIVE is, for the first time, offering all sizes with torques of up to $M_{amax} = 600$ Nm in an aluminum housing. That makes the gear units exceptionally light, which has a positive impact on the machine design, handling, and mobile applications. Lubrication for life means no oil changes need to be scheduled and maintenance costs are kept low.

Overview

Sizes	W..19	W..29	W..39	W..49	W..59
M_{amax} in Nm	80	130	200	400	600
Gear ratio i	5.90 – 167.59	4.68 – 188.47	4.72 – 210.49	7.22 – 200.76	6.76 – 213.21
Motor power with DRN.. (IE3) kW	0.09 – 0.75	0.12 – 1.1	0.12 – 1.5	0.12 – 3.0	0.12 – 4.0

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