

Three Generations of Know-How in Gas Safety and Control Technology



Hyperturn 45 equipped with Turbo 5-55: Fully automated bar loading for bars with a diameter of up to 65 mm, whilst the work pieces are finished via sub-spindle by means of the tools in the turret.

Karl DUNGS GmbH & Co.KG

The DUNGS company group is a global player supplying components and systems of gas safety and control technology for heating systems, process heating equipment and gas engines. Founded in 1945 as an electrical installation company, the family company has been building up systematically and developing its business in three generations. Today, the family company with its headquarters in Urbach has around 500 employees. Under managing director Karl Dungs, it has developed into one of the leading international suppliers and generated an annual turnover of around €150 million in 2015.



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Requirement Profile

- Machining, economic production of high-quality precision parts
- Cubic and cylindrical blanks with high component diversity in small to mini batch sizes
- Focus on repeatability
- Solutions for the flexible use of processing machines with different, blank-specific feeding devices



The operating panels designed by Emco for DUNGS facilitate a smooth production process, which is demonstrated by Matthias Hottinger on the Siemens control.

Gas safety and control technology is the core competence of Karl DUNGS GmbH & Co. KG based in Urbach, Baden-Wuerttemberg. Manufacturers of gas engines, heating and process heating systems particularly appreciate the reliability of the products fabricated by DUNGS. Maintaining and expanding the quality leadership within the industry is top priority for the company's management, technology managers and employees of DUNGS. DUNGS manufactures important functional components such as cylindrical solenoid tubes in-house. Klaus Frenz, marketing and communications manager, refers to them as "the solenoid valve's heart." In order to machine these work pieces, DUNGS invested in five modern Emco machines: one Vertical Turn 250 MY vertical lathe and four Hyperturn 45 horizontal turning and milling centres, each of them equipped with different, component-specific work piece feeding devices. Since the commissioning of these processing machines in 2014, the experts for gas safety and control technology have achieved very good results. In the following, Matthias Hottinger, production engineer for machining processes, talks about the specific processing tasks and explains the requirements as well as the details of the production practice.

Quality Leader

"DUNGS is the Mercedes Benz of gas safety and control technology," clarifies Matthias Hottinger at the beginning of his explanations. "The quality leadership and the productive affiliation that is actually lived at the family company have made me a convinced member of the team of about 500 employees," explains the 43-year-old industrial mechanic foreman. Klaus Frenz adds that the premium car metaphor is only partially right: "Some of our process or thermal heating supply systems have been running around the clock without any interruptions for more than 30 years. A lifespan and availability of this magnitude is unlikely to be achieved by any passenger car. And also the use of gas safety and control technology is measured differently. When it comes to the

fail-proof heat supply in hospitals, for instance, the lives of hundreds or thousands of people are concerned, and the reliable process heat supply in case of an aluminium or steel melt is crucial to protect tangible assets worth millions." The competence of providing, supplying, controlling and mixing gases comes naturally to the DUNGS family. "When it comes



Three-part solenoid tubes – The example shows the brazed primary products, finished to precision parts with a Hyperturn 45 machine by drilling, turning and thread-cutting from both the outside and inside.

[Technical data]

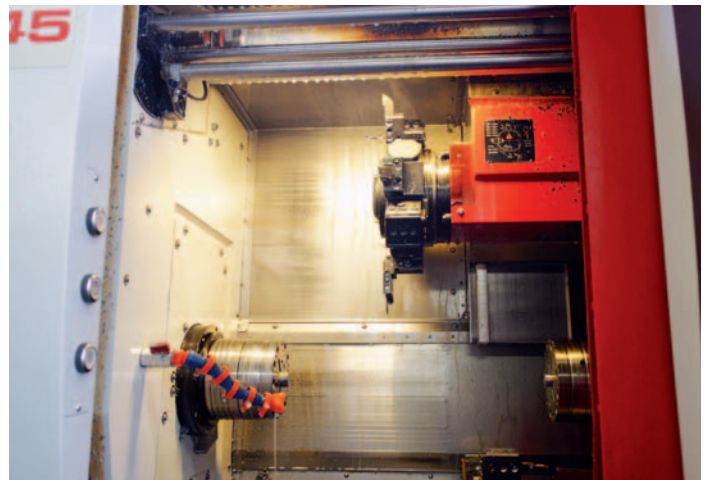
EMCO VERTICAL TURN 250

| Work area | |
|------------------------------|---|
| Chuck size | 250 mm (9.8") |
| Maximum work piece diameter | 250 mm (9.8") |
| Maximum work piece length | 150 mm (5.9") |
| Travel | |
| Travel X / Y / Z axis | 520 / +- 90 / 310 mm (20.5" / +- 3.5" / 12.2") |
| Rapid motion speed X / Y / Z | 60 / 15 / 30 m/min (2362 / 590.5 / 1181"/min) |
| Main spindle | |
| Speed range | 0 – 5000 rpm |
| Drive power | 29 kW (38.9 hp) |
| Torque | 280 Nm (207.2 ft.lbs) |
| Spindle nose / DIN 55026 | A2-6 |

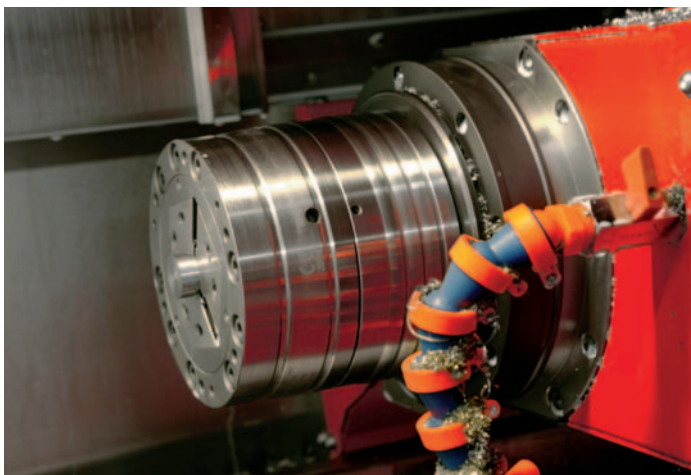
| Tool turret | |
|--|----------------------------|
| Number of tool holders | 12 |
| Tool shaft according VDI (DIN 69880) | VDI40 |
| Driven tools | 12 |
| Speed range | 0 – 4000 rpm |
| Drive power | 8.5 kW (11.4 hp) |
| Torque | 40 Nm (29.50 ft.lbs) |
| Coolant system | |
| Tank volume | 230 litres (60 gal) |
| Coolant pressure standard / optional | 3.7 / 14 bar (50 psi) |
| Dimensions and weight | |
| Overall height | 2360 mm (93") |
| Floor space L x D (w/o chip conveyor and part feeder) | 2240 x 2185 mm 88 x 86" |
| Machine weight | 3800 kg (8380 lb) |



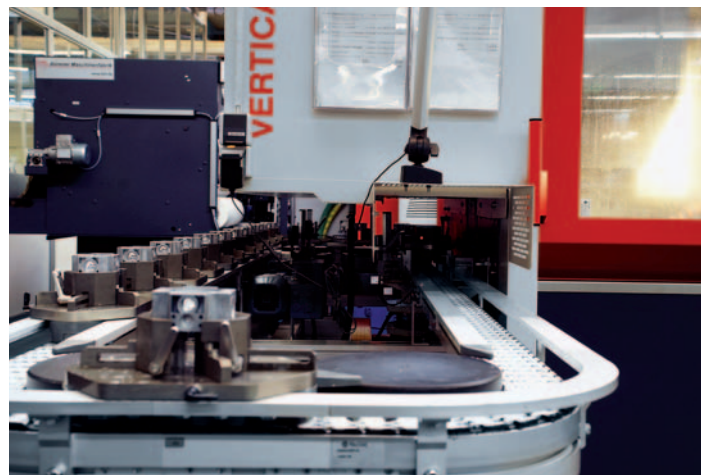
The operating panels designed by Emco for DUNGS facilitate a smooth production process.



View into the clearly arranged Hyperturn 45 machine room with main spindle + sub-spindle and turret.



With regard to speed (up to 7000 rpm) and torque (100 Nm), the sub-spindle resembles the main spindle.



Even small, order-related batch sizes with simultaneous stock-keeping and storage space savings are economically produced by the Vertical Turn 250 MY with its driven tools and X-axis.



According to production planner Matthias Hottinger, the Vertical Turn 250 MY replaces three individual machines, whilst offering the same performance and saving valuable space.

to the quality of our products, we do not tolerate any compromises." The decision in favour of the in-house production of essential, quality-relevant parts requires a huge vertical range of manufacture. Precise thread-cutting from both the inside and outside as well as further demanding processing operations dedicated to functional parts are included in the offer, as are brazing or laser welding to connect iron with non-ferrous metal parts. The semi-finished bar material – which is used to produce parts of the cylindrical solenoid tubes, for instance – is purchased by DUNGS from selected suppliers according to own specifications. Also the pressure die castings for the housings are supplied by a specialised contractor. However, finishing, final assembly and surface treatment are performed by DUNGS itself. "We perform a 100% check, and our products even exceed the standardised specifications applying to the tightness and functional safety," ensures production manager Holger Geywitz.

The Need for Investment

One Emco machine had already been running reliably from 1998 to 2014. By the end of 2012, DUNGS planned to expand its capacity in the area of machining. The experts needed new and efficient processing machines compatible with CAD-CAM systems for tapping, turning, milling, drilling, grinding and spinning of the housings and solenoid tubes. The expansion and investment requirements had to be met under the condition of extremely limited space. Matthias Hottinger mentions further requirements: "For efficiency reasons, loading and unloading of the parts had to be automatable. Our shortage of space moreover dictated a degree of flexibility that needed to be as high as possible. This means that every machine had to be suitable for many contingencies – for multi-process and complete machining as well as for designable variants in the upstream and downstream process steps. Our product range is characterised by many similar components with subtle differences. These must often be processed from identical blanks and in small batch sizes. Despite the defined, considerable

variance, the solutions had to be economically feasible. We expect high availability for our three-shift operation and, above all, maximum precision and repeatability." Hottinger reports that the production planners had checked the offers of several providers. He adds: "Emco fulfils the technical requirements. But our good, decade-long experience with the previous machine of this manufacturer was a crucial criterion for our decision as well. And last but not least, also the good price-performance ratio and service quality played into the decision."

Vertical Lathe: Vertical Turn 250 MY

The vertical pick-up turning machine for chuck parts with a diameter of up to 250 mm performs turning, drilling and milling tasks. With its particularly small footprint of 2.24 x 2.19 m (without chip conveyor and automation) including the integrated, self-loading system, it complies with the space available at DUNGS. The MY version with driven tools, Y-axis and hollow spindle drive focuses all processing operations from the three individual machines used before on one single machine. Thus, the set-up and production times were radically reduced. Small, order-related batch sizes can be produced in a less expensive way, whilst the expenses for stock-keeping as well as the required storage space are reduced at the same time. A pallet conveyor transports the turned parts into the machine. Its special feature: The pallet clamps can be quickly and easily adjusted to the seven different sizes of the gas pressure regulator housings. The inventory lasts for a machine processing time of up to one hour. Feeding, work piece mounting, complete machining and discharge of the finished parts is done fully automatically. In this time, the employee may operate other machines. Matthias Hottinger comments: "We benefit from the improved quality, because there are no longer any machine-related or human error risks. Operation in general has become more comfortable, particularly because Emco designed the operating panel according to our wishes. With the new machines, the entire process runs smoother and

more predictable.” When it comes to the housing parts, the complete machining skills of the Vertical Turn 250 MY are demonstrated on the cubic work pieces. The blanks consist of a die cast aluminium-silicone alloy. An employee loads the work piece carrier pallets manually. She or her colleague from the respective shift is moreover responsible for checking the finished work pieces. The production experts implement additional flexibility with the work piece carrier pallets. They are set up for work pieces in seven different sizes belonging to one parts family. The blanks are just inserted into the work piece carrier pallets. Matthias Hottinger explains: “Once we have loaded 25 of these work piece carrier pallets, they last for an automated feeding procedure of approximately 1 hour. Errors that might occur whilst the parts are automatically fed into the machine are avoided by a light barrier installed directly in front of the entry into the work space. It detects whether a component is available for processing and emits a ready-for-feeding signal.” Since the five-sided housing parts to be processed by DUNGS only vary within defined dimensions, and since they are very similar regarding their shape, the production experts achieve the desired flexibility with their work piece carrier pallet solution. Due to the primarily small batch sizes, but also in order to ensure 100% process control, they consciously supplement the broadly automated production by defined, partly manual processing operations on the sixth side as well as by check operations.

Variants of a Horizontal High-Performance CNC Turning and Milling Centre: Hyperturn 45

The developers designed the compact Hyperturn 45 for the flexible and complete processing of complex work pieces with a diameter of up to 300 mm and a maximum length of 480 mm. The versions equipped with bar loader have been designed for semi-finished bar products with a diameter of up to 48 mm. Important features include the efficient main and sub-spindle and two twelve-fold tool turrets with twelve driven tools each. Its milling spindle with direct drive, the stable Y-axis with a particularly long travel of 70 mm, and roller guides in all linear axes also contribute to the high processing quality. Hyperturn 45 machines work with up-to-date Siemens control and drive technology. They ensure easy programme configurations on both the machine and the PC and allow simulating the processes in the virtual machine. And they facilitate the safe handling of the machine with a familiar operational sequence for the operator. Matthias Hottinger says: “We actively use the possibility of virtually simulating our production tasks via the Siemens control. The esprit software is a useful tool for that. We develop new programmes on the PC and test them, while real production continues without any interruptions. The finished programmes that have been tested in the virtual room are then brought to the machine. Tool changes and the resulting set-up times become superfluous. Except for the Hyperturn 45 machines with bar loading magazine, the revolvers equipped with 12 stations each are sufficient for all tools needed in our everyday complete processing practice. This means that there is no need for additional tool magazines.” Digital networking via intranet is also possible. In case of DUNGS, however, having only one location for the time being, it is not yet necessary. Hence, the production experts transmit the data via a USB interface.

The Feed System is Determined by the Blanks

The high flexibility of the Hyperturn 45 machines used at DUNGS is also achieved by the blank-specific feeding systems. Two of these four horizontal turning centres for complete processing are equipped with bar loaders and one each with swivel and/or pallet loader. The two identical Hyperturn 45 machines equipped with the Turbo 55-5 bar loader are used to produce turned parts. To ensure economic production, they use the main and sub-spindle as well as the tools in the turret. Driven tools are available as an option. Different clamping accessories ensure sufficient variance in the machining

processes. One of the other Hyperturn 45 machines is equipped with a swivel loader. This is where the solenoid tubes requiring sophisticated processing are produced. They are assembled as a cylinder in three parts. Rear and front are made of magnetisable steel, whilst the centre part consists of non-magnetisable steel. By MIG brazing with a non-magnetic material, the joining experts at DUNGS have connected them to create a longer steel cylinder. Thus, this component triggers the quick opening and closing of the valve that regulates the gas flow. The swivel loader conveys the prepared parts into the machine. Within approximately two minutes, it performs several processing steps: The brazed three-part full material is drilled out to form a sleeve, which is followed by inside and outside turning and thread-cutting and finally by rotating. “Thanks to its excellent thermal stability, the Hyperturn 45 has no trouble coping with the forces generated during the removal of the large chip volume,” says Matthias Hottinger. He adds: “Using the Hyperturn 45 for producing this thin-walled hollow part, we are perfectly able to master this process in a reproducible and safe manner. However, the precision potentials have meanwhile been exhausted. We are currently working on a new welding solution. Apart from the advantage of even higher, reproducible precision, it will also offer the benefit of significantly lowering material loss, because it will be a solution with semi-finished bar material. The intermediate results of this development have already been tested successfully. And the necessary high-precision turned parts are produced with our Emco processing machines.”

Conclusion and Perspective

Matthias Hottinger and his team colleagues know that choosing Emco was the right decision: “Emco machines meet all expectations placed on precision and flexibility. When it comes to the reliability and service quality, we even think that they have been exceeded,” as he says and adds: “On-schedule delivery as well as the quick procurement and provision of parts are a matter of course. In the evening of the delivery day, three Emco employees arrived, and three days later our production was already running. With comparatively little instruction or training effort, our colleagues could start with their productive work. In the beginning, we still needed information input – and it was always provided very fast. The Emco application engineers supported us, especially in the development of programmes. The included basic programmes and the esprit software was really helpful. Also the set-up can be displayed well.” When it comes to the future of processing technology, the production planner sees intelligent automation in addition to further increased variety and flexibility: “Turning/grinding combinations will be more important, and I think there will be more overlapping production processes.” His recommendation for the users of processing technology: “Each user facing an investment decision should make sure somebody demonstrates the function of the desired machines on own work pieces – and, if possible, also in everyday business practice.”

[Technical data]

EMCOgroup

Designed for your profit

HYPERTURN 45

| Working area | |
|---|---|
| Swing over bed | Ø 430 mm (16.9") |
| Swing over cross slide | Ø 300 mm (11.8") |
| Distance from main spindle to counter spindle | 720 mm (28.3") |
| Max. turning diameter | Ø 300 mm (11.8") |
| Max. part length | 480 mm (18.9") |
| Max. bar capacity | Ø 45 (51) mm (1.8"(2.0")) |
| Travel | |
| Slide travel in X / X2 | 160 / 150 mm (6.3" / 5.9") |
| Slide travel in Z / Z2 / Z3 | 510 / 510 / 510 mm (20.1 / 20.1 / 20.1") |
| Travel in Y | +40 / -30 mm (+1.6" / -1.2") |
| Main spindle | |
| Speed range | 0 – 7000 rpm |
| Max. torque on the spindle | 100 Nm (73.7 ft·lbs) |
| Spindle nose DIN 55026 | A2-5 |
| Spindle bearing (inner diameter at front) | Ø 85 mm (3.3") |
| Spindle bore | Ø 53 mm (2.1") |
| Counter spindle | |
| Speed range | 0 – 7000 rpm |
| Max. torque on the spindle | 100 Nm (73.7 ft·lbs) |
| Spindle nose DIN 55026 | A2-5 |
| Spindle bearing (inner diameter at front) | Ø 85 mm (3.3") |
| Spindle bore | Ø 53 mm (2.1") |
| C axis | |
| Resolution | 0.001° |
| Rapid motion speed | 1000 rpm |
| Spindle indexing (disc brake) | 0.01° |
| Drive power | |
| Main spindle | 15 kW (20.1 hp) |
| Counter spindle | 15 kW (20.1 hp) |
| Tool turrets 1+2 | |
| Number of tool positions | 2 x 12 |
| Tool holding shaft in accordance with VDI (DIN 69880) | VDI 25 |
| Tool cross section for square tools | 16 x 16 mm (0.6" x 0.6") |

| Tool turrets 1+2 | |
|---|---|
| Shank diameter for boring bars | Ø 25 mm (1.0") |
| Revolver switch time | 0.2 sec |
| Driven tools 1+2 | |
| Speed range | 0 – 6000 rpm |
| Torque | 16 Nm (11.9 ft·lbs) |
| Drive performance | 4 kW (5.3 hp) |
| Number of driven tools | 2 x 12 |
| Feed drives | |
| Rapid motion speed X / Y / Z | 30 / 15 / 45 m/min 1181 / 590.5 / 1771 ipm |
| Feed force in the X axes / Y axis | 4000 N (900 lbs) |
| Feed force in the Z axis | 5000 N (1124 lbs) |
| Feed force in the Z axis counter spindle | 6000 N (1350 lbs) |
| Position variation Ps (VDI 3441) X / Y / Z | 3 / 3 / 3 µm |
| Coolant system | |
| Tank volume | 300 l (80 gal) |
| Pump power standard | 0.62 (1.1) kW (0.82(1.46 hp)) |
| Pump capacity at 3.5 bar / 1 bar | 12.5 / 58 l/min (3.3 / 15.3 gal/min) |
| Pump capacity at 10 bar / 5 bar (optional) | 15 / 40 l/min (3.9 / 10.4 gal/min) |
| Power consumption | |
| Connected load | 30 kVA |
| Supply pressure | 6 bar (87.0 PSI) |
| Dimensions/weight | |
| Height of center above floor | 1126 mm (44.3") |
| Machine height | 1985 mm (78.1") |
| Space occupied B x T (not including chip conveyor and coolant) | 2650 x 1950 mm (104.3 x 76.8") |
| Total weight of machine | 4200 kg (9259.4 lb) |
| Safety devices | |
| | CE compliant |

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