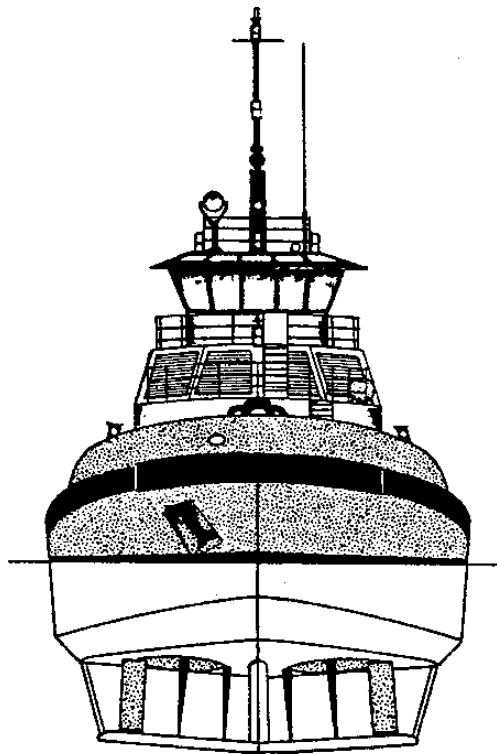


Model Vessels
with
VOITH-SCHNEIDER PROPELLERS



Voith-Schneider Propellers Ready for Operation

Model builders often want to build models of vessels with Voith-Schneider propulsion as operable units in order to be able to utilize the excellent steering characteristics of the Voith-Schneider propeller in the model, too.

The construction of Voith-Schneider propellers as model presupposes some knowledge and care for it to be successful. To facilitate construction of a model to imitate the real thing, and to avoid failures, we have drawn up a number of principles which have to be observed to achieve similarity of the model.

At the very beginning it should be mentioned that an exact reduction in size of the prototype of the Voith-Schneider propeller is ruled out. This idea is soon limited, as the prototype contains control elements which can no longer be reduced in size as desired. On a model scale of approx. 30 to 40, the necessary precision can no longer be achieved in manufacture using customary machines. The design therefore has to be simplified, always on the principle that the function is to be retained. After all, the model is expected to behave in exactly the same way as the full-scale vessel.

In the course of our activities, operable model propellers with a blade orbit diameter of 80 mm for a remote-controlled tractor model have been manufactured in our own workshops. The model propellers have been simplified compared with the prototype, but without impairing operation. The examples given in this description refer to this model.

How does the Voith-Schneider propeller work? How is thrust produced? We wish to answer these questions in a section dedicated to these points.

Operation of the Voith-Schneider Propeller

The VOITH-SCHNEIDER PROPELLER is the ideal propulsion system for all marine vessels that frequently have to manoeuvre in restricted waters and that have to be held in position.

The outstanding features are:

The thrust can be adjusted steplessly according to magnitude and direction without changing the speed.

Control of the thrust is in right-angled coordinates. One direction determines the longitudinal thrust, the other the transverse thrust.

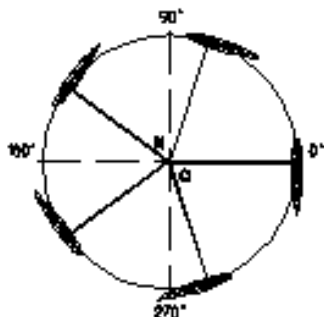


figure 1

Five blades are arranged on a cylindrical rotor casing, which rotates about an approximately vertical axis and is flush with the vessel's hull, so that they project downwards into the water. Links at right angles to the sections of the blade are arranged on the blade journal. These links intersect at the steering centre N. If the steering centre is in the centre O, the sections are in the tangential position and no lifting force and thus no thrust is generated. (fig. 1)

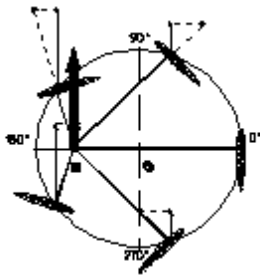


Fig. 2:

If the steering centre N is shifted out of the centre O, the blades perform an oscillating movement during the rotation of the rotor. In the front half of the casing (0 to 180°) lifting forces are created at the tip outward position of the blades from the rotor. In the rear half (180 to 360°) lifting forces occur at the tip inward position of the blades into the rotor (Fig. 2).

Lifting force in the front and rear casing half adds up in the forward direction to thrust. This acts perpendicularly to the connecting line N-O. The components in transverse direction cancel each other out. For there is always a tip inward position of the blades in the rear half of the casing, which is equal to the tip outward position in the front half of the casing.

The propeller thrust acts eccentrically in the steering centre N. The driving torque and the resultant reaction moment are created from the thrust and the eccentricity of the steering centre (section N-O).

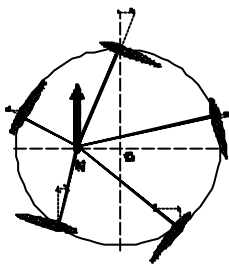


Fig. 3:

If the steering centre N is shifted less far from the centre, and the angle of attack, and hence the thrust, decrease, the direction of thrust is maintained. The distance of the steering centre N from the centre O determines the magnitude of the generated thrust (Fig. 3).

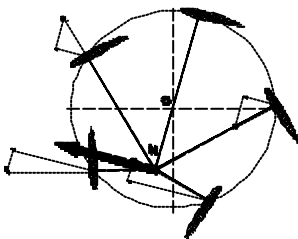


Fig. 4:

If the steering centre N is shifted in another direction, the direction of thrust also changes (Fig. 4).

The blade movement during the rotation of the rotor is generated by the mechanism inside the rotor, called the kinematics. The mode of operation is explained on the basic model of the VOITH-SCHNEIDER PROPELLER. Nowadays the so-called bell-crank lever type kinematics is used, which combines the best mechanical and hydrodynamic characteristics. Our model uses a variation of the basic model.

Similarity of the Model to the Prototype

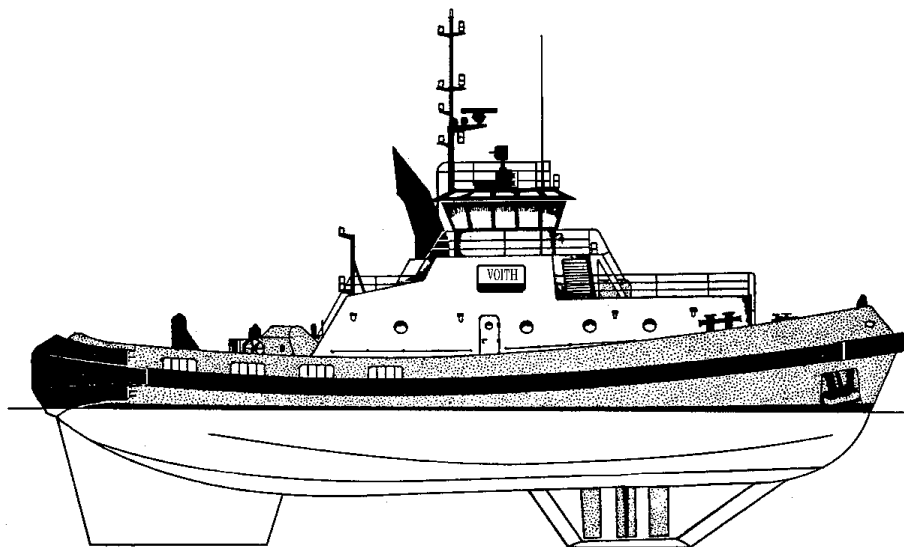
In our similarity investigation we use our VOITH WATER TRACTOR as an example. The model was built for deployment on the West Coast of the United States.

The principal dimensions are:

Length overall	30.48 m
Length in the waterline	29.26 m
Moulded breadth	10.97 m
Total draught	4.11 m
Draught of hull	2.97 m
Displacement	560 t

Engines	2 * 1100 kW
VSP Type propellers	28GII/185
Rotor speed	64.4 /min

Forward bollard pull	343 kN
Open-water speed	12.7 kn



VOITH WATER TRACTOR with 2 Propellers

The vessel is equipped with Size 28GII/180 VOITH-SCHNEIDER PROPELLERS. The indication of size shows that the blade orbit diameter of the propeller is 2800 mm and the blade length 1800 mm. The scale on which our vessel is built as a model depends in our case on this propeller size and our model propeller.

The model scale α is determined by the ratio of the propeller diameter of the vessel to the diameter of the model propeller.

$$\alpha = \text{dia. VSP}_{\text{Vessel}} / \text{dia. VSP}_{\text{Model}}$$

$$\alpha = 2800 / 80 = 35$$

Our model scale is $\alpha = 35$. If one is not bound to an existing model propeller in the selection of the model scale, the model scale is established by the selection of a model size.

$$\alpha = \text{Vessel length} / \text{Model length}$$

$$\text{Model length} = \text{Vessel length} / \alpha$$

If the vessel length is, for example, 30.5 m and the model 0.87 m, the scale of the model is $\alpha = 30.5 / 0.87 = 35$. To maintain model similarity, the breadth of the model must then also be smaller by the scale of the model than the vessel.

$$\begin{aligned} \text{Breadth}_{\text{Model}} &= \text{Breadth}_{\text{Vessel}} / \alpha \\ &= 10.97 / 35 = 0.313 \text{ m} \end{aligned}$$

On a similar model the surfaces of the model are divided from the surfaces of the vessel by the square of the model scale α .

$$\text{Surface}_{\text{Model}} = \text{Surface}_{\text{Vessel}} / \alpha^2$$

The displacement and thus the weight of a model must, if similarity of the construction of the model is to be maintained, be observed. More precisely, the weight of the model is obtained if the weight of the vessel is divided by α^3 .

$$\text{Weight}_{\text{Model}} = \text{Weight}_{\text{Vessel}} / \alpha^3$$

If the length of the vessel is, for example, 30.48 m, and 35 was chosen as the scale of the model, and if the weight of the vessel is 560 t, then in a similar design the model must weigh 13.1 kg.

$$\begin{aligned} \text{Weight}_{\text{Model}} &= 560000 / 35^3 = 560000 / 42875 \\ &= 13.1 \text{ kg} \end{aligned}$$

If the weight of the model of 13.1 kg is exceeded, the model immerses deeper, and our model is no longer similar to the full-scale vessel. If the model weight is less, the similar weight can be created by additional ballast, so that the draught of the vessel and the draught of the model are similar.

If the model conforms to these laws in all dimensions, we speak of geometrical similarity.

In addition, the speed of the model vessel can be adjusted so that the speed of the prototype appears to be similar.

The impression of similar speed is given by a model vessel if the wave pattern during motion in

water, i.e. the bow and stern wave, corresponds to that of the prototype.

The English physicist, Froude, discovered the law by which a similar wave pattern occurs and a process is derived therefrom with which the performances of the full-scale vessel can be determined. This method is used to determine from model tests the achievable speed and power requirement of a full-scale vessel before it is built. There are research centres in Germany located in Hamburg, Duisburg, Berlin, Potsdam and Rostock, in which such model tests are conducted. It should not be left unmentioned in this connection that VOITH Schiffstechnik GmbH & Co. KG, too, has its own research laboratories where marine engineering tests are performed with VOITH-SCHNEIDER PROPELLERS.

After this excursion let us now return to the similarities.

Construction of the model of a Propulsion System

On condition that not only the hull of the vessel but also the propellers are constructed similarly, the speed of the model, the rotational speed of the propellers and also the necessary drive power of the model can be determined in advance when the data of the vessel are available. The speed of the model is similar to that of the vessel when the wave pattern of the model is similar to that of the prototype. This is the case if the so-called "Froude number" of vessel and model is the same.

Froude number F_n :

$$F_n = V / \sqrt{(L \times g)}$$

V Vessel speed m/s
 L Vessel length m
 g Acceleration due to gravity 9.81 m/s²

It follows from this principle that the model speed is:

$$V_{\text{Model}} = V_{\text{Vessel}} / \sqrt{\alpha}$$

Our example:

The vessel speed is 12.7 knots, the model scale is 35.

$$V_{\text{Model}} = 12.7 / \sqrt{35} = 12.7 / 5.92 = 2.15 \text{ knots} \\ = 1.1 \text{ m/s}$$

The speed in seafaring terms is given in knots. For "landlubbers" it should be mentioned that 12.7 knots corresponds to a speed of 6.53 m/s or 23.5 km/h. In the aforementioned example the model must be operated at a speed of 1.1 m/s to generate the same wave pattern as the full-scale vessel at 12.7 knots.

The rotational speed of the propeller, by which we mean the rotational speed of the rotor, the power and the thrust, can also be calculated from the data of the prototype.

Rotational speed:

$$N_{\text{Model}} = N_{\text{Schiff}} \times \sqrt{\alpha} \\ = 64.4 \times \sqrt{35} = 381$$

$$N_{\text{Model}} = 381 / \text{min}$$

The rotational speed of the drive motor of your model can be determined from the gear transmission ratios. In our model propeller there is a transmission ratio of 1:3. The rotational speed at the input shaft must therefore be $3 \times 381 = 1143$.

The power is obtained if you calculate

$$P_{\text{Model}} = P_{\text{Vessel}} / \alpha^{3.5}$$

You will obtain the same result, if you are not among the proud owners of a modern, powerful pocket calculator, by calculating:

$$\begin{aligned} P_{\text{Model}} &= P_{\text{Vessel}} / (\alpha * \alpha * \alpha * \sqrt{\alpha}) \\ &= 1100 \text{ kW} / 353.5 = 0.0043 \text{ kW} = 4.3 \text{ W} \\ &\quad \text{(Performance of one propeller)} \end{aligned}$$

In determining the power requirement of our model we must, however, consider that the mechanical losses of the model propeller will usually be much larger than those of the prototype. Above all, we have a higher friction in the combined bearing seals. In the conversion shown, we have also disregarded scale effects for the propulsion system and the vessel. By an addition of approx. 10% on our calculated power, we take this into account. The consequence of the scale effects is that the thrust achievable in the model is distinctly less than the thrust achieved in the vessel.

Let us remain with our example and apply the calculation to our model.

Our vessel is fitted with a type 28GII/185 propeller. The model scale is 35. The rotor speed was 64.4 revolutions / minute at 1100 kW. The thrust of a propeller was $343 \text{ kN} / 2 = 171.5 \text{ kN}$.

Hence

$$\begin{aligned} N_{\text{Model}} &= 54.4 \times \sqrt{35} &&= 381 / \text{min rotor speed} \\ P_{\text{Model}} &= 1100000 / (35 \times 35 \times 35 \times \sqrt{35}) = 4.3 \text{ watts power} / \text{VSP} \\ &\quad + 10\% \text{ addition} &&= 4.7 \text{ watts/VSP} \\ T_{\text{Model}} &= 171500 / 353 &&= 4 \text{ N thrust} / \text{VSP} \end{aligned}$$

The data apply to the moving vessel. When the vessel is stationary the full power consumption is already achieved at small pitches.

In contrast to the full-scale vessel, on the model we can measure the electrical power consumption very easily when the vessel is stationary using a measuring instrument. We will then, however, measure, in the stationary vessel, virtually double the power consumption and also a greater thrust as compared with the moving vessel.

In all considerations of similarity the time scale must not be forgotten. All time intervals on the model are shorter, with a time factor of $\sqrt{\alpha}$. If the vessel is able to stop from full speed within 45 seconds, on the model this is achieved within just $45 / \sqrt{\alpha} = 14$ seconds. This should be taken into consideration when designing the control system of the model.

As a general rule you should not disregard the fact that the power has to be produced from a

single energy source. In the case of drive by electric motors the energy is taken from the accumulators. The input speed of the model propeller is relatively low. To be able to employ high-speed electric motors we use a two-stage planetary gear unit.

If a propeller has a power consumption of 4.7 watts, taking into consideration the efficiency of the motor and gear unit, the motor has a power consumption of approx. 9.4 watts. 6-volt motors then have a power consumption of $9.4/6 = 1.6$ amps. Verifying measurements show that the efficiencies of the electric motors are in some cases even lower if they are not optimally designed.

Accumulators with an ampere-hour capacity of 9.5 Ah could drive our model for 4 hours under ideal pre-conditions.

This quickly brings about the desire to extend the running time while dispensing with some speed.

Accumulators have a greater weight and increase the weight of our vessel. In addition, we have difficulty in accommodating the larger accumulators in the model.

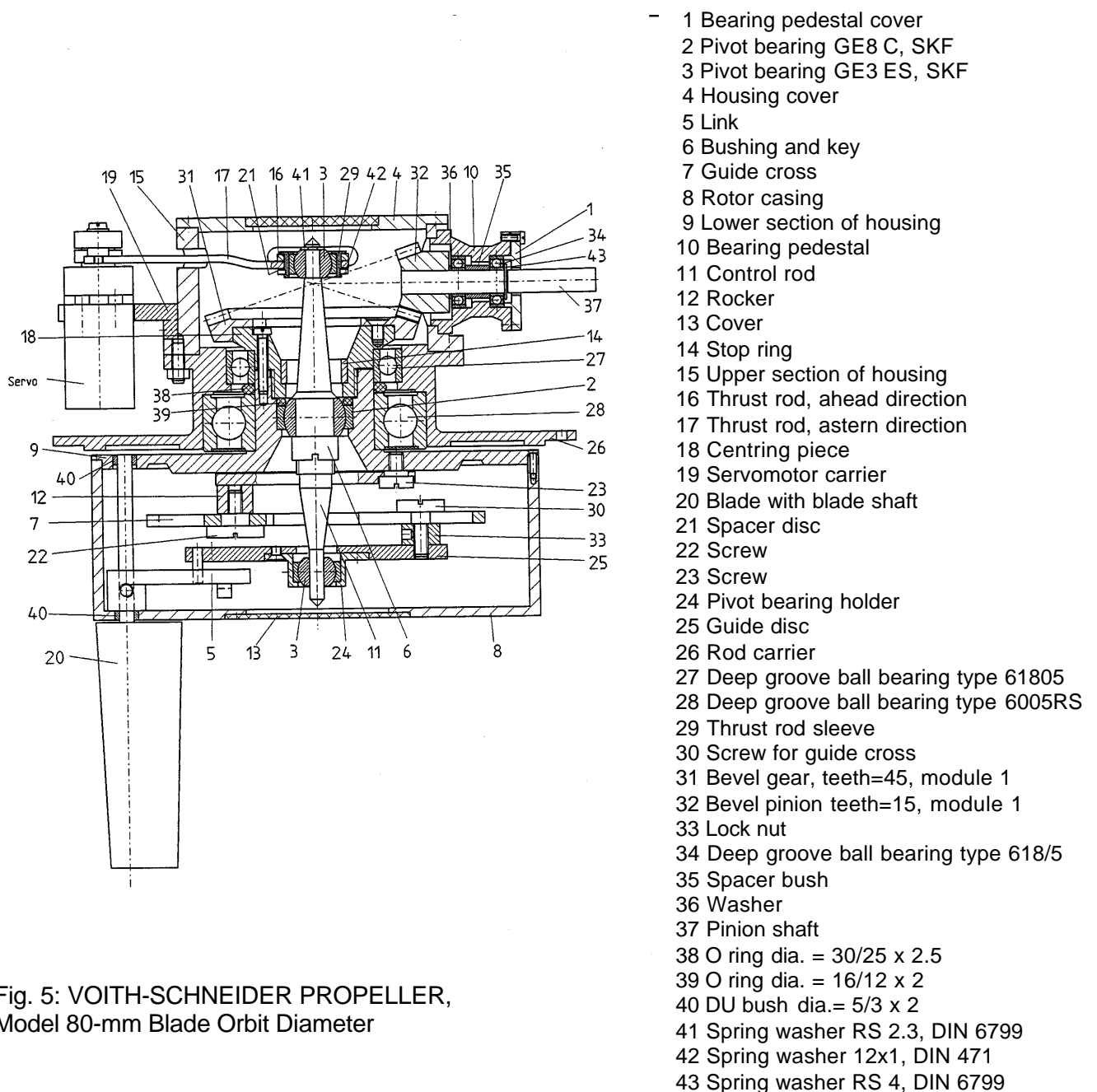
We therefore drive our model at 800 rpm instead of 1143 rpm. The speed decreases from 12.7 knots to approx. 9 knots, the power consumption decreases theoretically to 3.2 watts and the operating time is now 12 hours.

The aforementioned power consumptions are theoretical values. Our experience has shown that the mechanical friction in the propeller model and, above all, in the planetary gear unit, and losses in the electric motor assume significant magnitudes. In the practical part we indicate measured values for this at the model.

VOITH-SCHNEIDER PROPELLER with 80-mm Blade Orbit Diameter

Our model of the VOITH-SCHNEIDER PROPELLER was constructed with a blade orbit diameter of 80 mm and a blade length of 52.8 mm. Two propellers, one rotor of which is left-handed and the other right-handed, drive the model of a VOITH WATER TRACTOR.

Our model is driven by an electric motor horizontally through a planetary gear unit and an incorporated bevel gear unit with the ratio 1:3 (Module 1). The pitch setting, that means the thrust setting, is performed through 2 electric servomotors on the control rod (11). One servomotor controls the longitudinal pitch, the ahead thrust, and the other controls the transverse pitch, the transverse thrust. The lower end of our control rod determines the position of the steering centre N (Figs. 1 to 4). The blade actuating mechanism in the rotor transmits the eccentricity of the control rod into the steering centre N. The servomotors control the control rod at the upper end, the setting of the steering centre is done at the opposite end. This thus results in a reversing of the directions.



The propeller has five blades. The actuating mechanism, the gearing in the rotor which generates the blade movement during rotation, is a simplified version of the bell-crank lever type kinematics. The mode of operation corresponds to that of the full-scale model.

The model propeller can also be inserted in the model so that the water level is above the propeller casing. The antifriction bearings (Item 28) has sealing washers.

Specifications:

Blade orbit diameter:	80 mm
Number of blades:	5
Blade setting:	E = 41.2 mm
Input shaft rotational speed:	1200 /min
Rotor speed	400 /min
Propeller* input power:	10.5 watts
Propeller thrust*:	2.6 N
Servo adjusting force (max.):	0.9 N
Weight:	0.75 kg

* Data for the stationary vessel

We recommend using control rods for the control of the model on the transmitter side, as the faster time control intervals on the model can be mastered better with these. In addition, with these it is easy to limit the control signals so that the eccentricity of the steering centre (11) inside the propeller is not exceeded in any direction. On the propeller prototype the exceeding of the maximum eccentricity is prevented by a special reduction gear unit. Reproduction in the model, however, requires an unachievable precision.

Symmetrical sections are used for the blades. The blades in our model were made from a two-component casting resin. The exact shape of the sections is of less importance in the reproduction of such small models. The enclosed drawing shows the section at the blade root and at the blade end.

All types of prime movers are suitable for the drive system. They must have a constant rotational speed, irrespective of the load. These include, for example, DC direct-wound motors, but not series-wound motors, which are subject to substantial speed fluctuations, depending on the load.

The model propellers are driven in our model at 800 revolutions per minute at the input shaft. For the drive we use motors manufactured by the firm of Graupner, type INDY 05 R, Order No. 1778. As a gear unit we use the planetary gear unit PILE, Order No. 1729. The manufacturer of these gear units is the firm of Marx + Löder, Gemmrigheim/Neckar. The motor speed at 6 volts is 12,000 revolutions per minute. The planetary gear unit has a transmission ratio of 1:15. It is filled with oil. The power requirement of the motors on driving the planetary gear unit (without propeller) was already 1.9 amps! and hardly increased when the propeller was attached. To permit the selection of a suitable motor we have measured the necessary drive power of the model on the input shaft and plotted it in the diagram. In addition, the generated thrust and the necessary cohesion of the servomotor are indicated.

By cohesion is understood the force at the upper control rod in the thrust rod (17), which is necessary in order to adjust or maintain the pitch. The force occurs not only during adjustment but also with set pitch.

.Z.Z7343_1.PIC;12 cm;8,665 cm;Lotus PIC

Fig. 6: Propeller Power Data,
Vessel Stationary

For remote control we use equipment supplied by the firm of GRAUPNER: transmitter FM 4740, Order No. 4740, receiver Superhet C16, Order No. 4067, and servomotors C3311 Order No. 3893.

We have limited the pitch by creating stops at the control rods with a circular disc. Each control rod controls one propeller. Not only can you move AHEAD, ASTERN, but also transversely (athwartships) and turn on the spot.

We can switch the engines on and off with a fifth servo.

Arrangement in the Vessel:

On an arrangement in the Tractor, the rotor of the port propeller is left-handed and that of the starboard propeller right-handed.

When establishing the position of the propeller in the vessel note the model. The distance of the propellers and their position in the vessel determine the behaviour and capacity of the vessel or its model.

If you intend to construct a tractor as a model, use the attached drawing of a protective plate as a basis for your protective plate.

Manufacturing Instructions:

The drawings give instructions on the material to use. For construction of the housing and the rotor, easily cuttable aluminium (AL) should be used. The parts contacting the water are anodised in a metal finishing plant.

Bushes coated with teflon are used for support of the blade axle, and the boreholes are pressed or bonded in. (DU Bush). The ends of the links at the blades must not touch each other even in the event of major eccentricity of the control rod.

The size of the oval cutout in the guide cross (7) of the blade actuating mechanism can be checked by hand by examining the freedom of movement at maximum eccentricity of the control rod during full rotation of the rotor.

In central position of the control rod the blades are adjusted so that the tail end is 41.2 mm from the metacentre. To fix the control rod in the central position you can use the setting aid (see drawing).

The control rod is guided in a pivoted bearing. The transmission of force from the servos and from the blade actuating mechanism in the rotor casing takes place in the same way via a pivot bearing. At the lower pivot bearing make sure that the pin of the control rod is easily slidable in the internal bearing ring.

The input shaft and the rotor are mounted in antifriction bearings. The large bearing is fitted with sealing washers. Pretensioning of the bearings is obtained by an interposed O ring. These parts can be purchased through specialized dealers.

The gearwheels for the bevel gear unit are obtained from firms that manufacture standard parts for the engineering industry, e.g. Bruno Mädler, Stuttgart.

The eccentricity of the control rod is identical with the pitch setting of the propeller. While the pitch is indicated in right-angled coordinates as longitudinal and transverse pitch, the eccentricity is indicated as the distance and direction of the control rod. The maximum eccentricity is limited by the stop ring (14).

The maximum adjustable eccentricity of the control rod amounts to 8.0 mm, measured at the level of the pivot bearing. If the aforementioned version is used as the servo, then the lever arm of the servomotor should be 14.5 mm long for control of the direction of travel. The lever arm of the servomotor for control of the transverse direction is moved, on the other hand, by only 12 mm. This setting corresponds to that of the prototype.

Make sure that your remote control has limitations which prevent the control rod from running against the stop ring. You can limit the deflections by inserting a disc at the control rod of your remote control system, which prevents major deflections.

In accordance with the mode of operation of the VOITH-SCHNEIDER PROPELLER, the servomotor moves the control rod in athwartship direction to control the direction of ahead-astern.

In the arrangement of two propellers, counter-rotating rotors or the propeller are always used. Accordingly, the supports for the servomotors (19) are to be designed mirror-inverted.

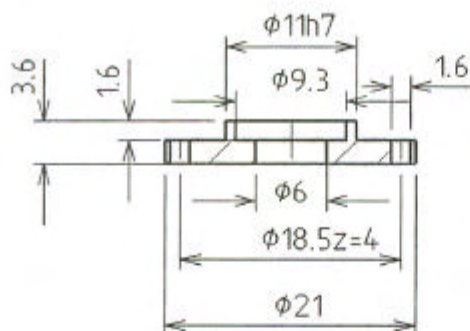
In closing it should be mentioned that an operable Voith-Schneider propeller with a 45-mm blade orbit diameter is marketed by the model construction firm of GRAUPNER. The basic arrangement differs, however, from the propeller presented in this document.

In the meantime a number of descriptions of construction have been published in book form, e.g.:

Der Voith-Schneider Propeller als
Schiffsmodellantrieb
by Kurt Benz
B.-Scholz-Verlag, D 3180 Wolfsburg 1

Der VSP-Antrieb im Schiffsmodell
by Theodor Vieweg
Neckar-Verlag GmbH, 7730 Villingen

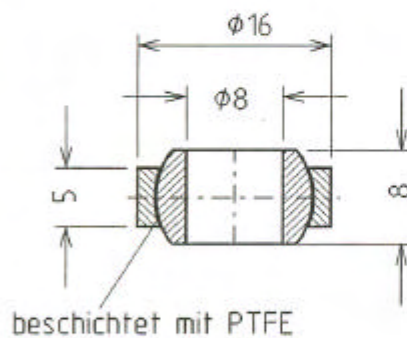
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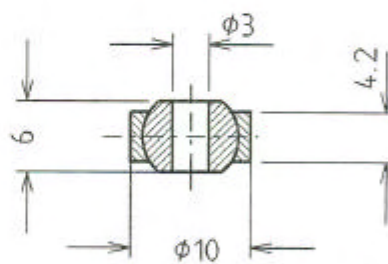
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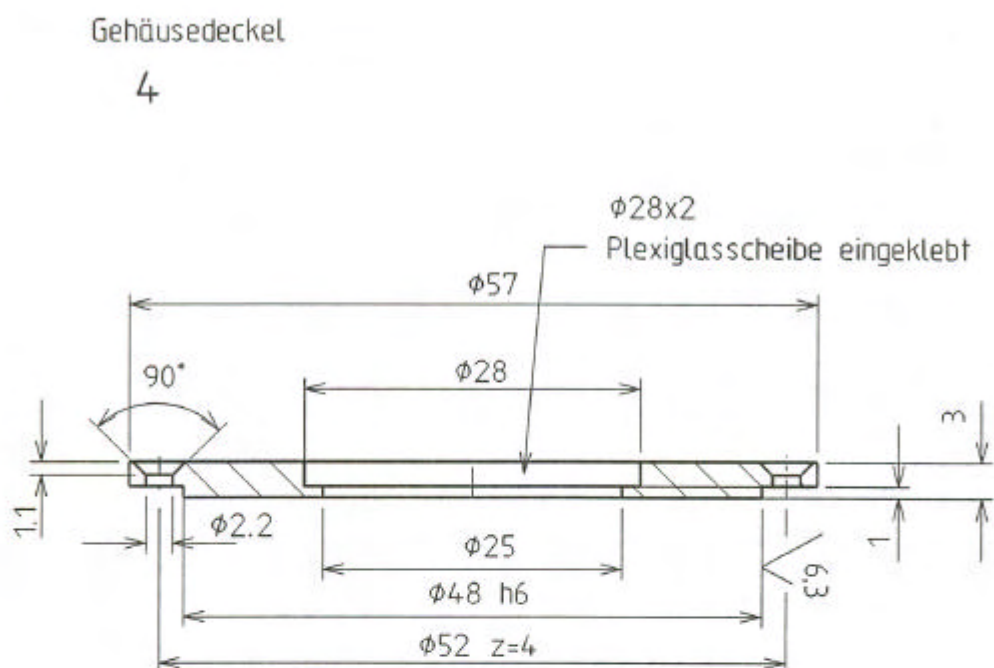
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						1991 Datum Name		Modell-, Gesenk-Nr.		Rohteil-Nr.	
Paßmaß		Abmaße		Paßmaß		Gez. 5.6. Gepr. Abt. fsh Norm		Benennung <h2 style="text-align: center;">Einzelteil 4</h2>			
Freigabevermerk				Konten DIN 6784 Innenkonten $\sqrt{-1.6}$ Außenkonten $\sqrt{-0.2}$		<h2 style="text-align: center;">VOITH</h2> J. M. Voith GmbH, D-89509 Heidenheim Urspr. 2.73-7258 BL1		Zeichnungs-Nr. / Sach-Nr. <h2 style="text-align: center;">2.73-7258</h2>		Blatt 5	
CAD						Ers. f.		Ers. d.			

25 ✓

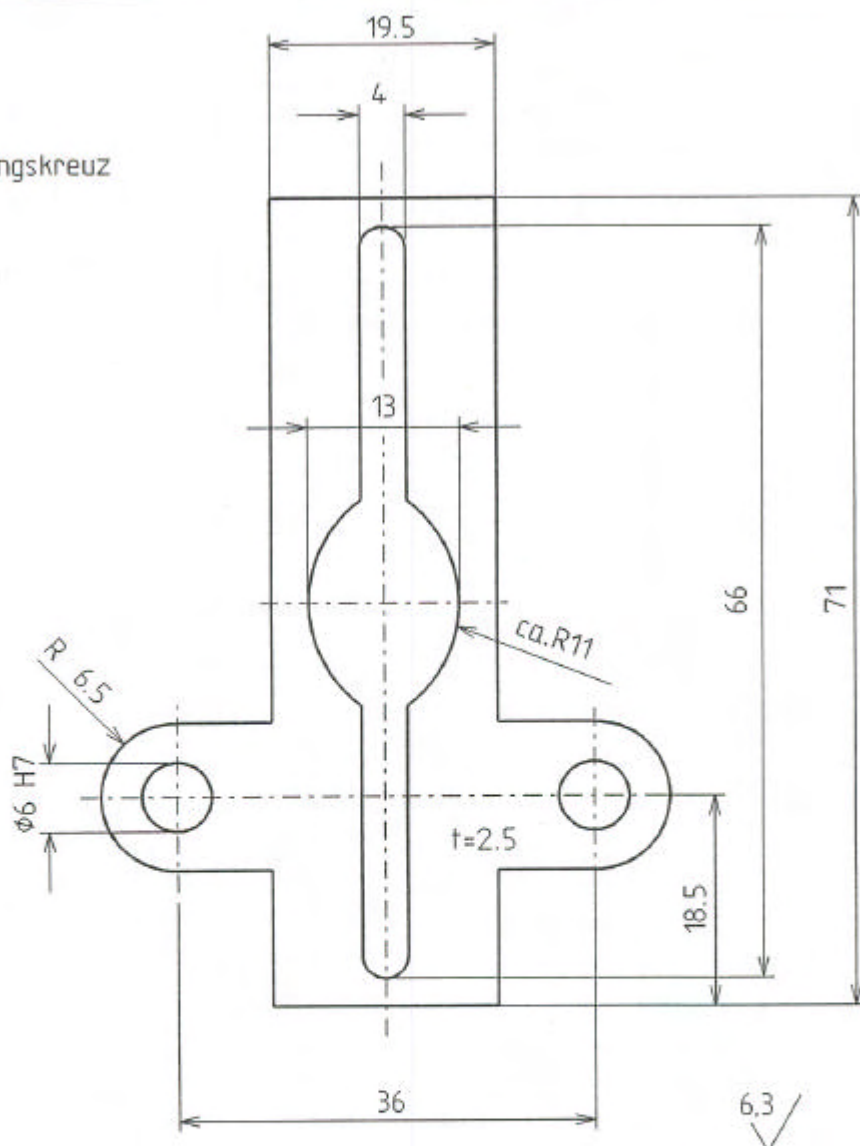
						<h1 style="text-align: center;">MINI 80</h1>		Prüferforderungen in Zeichnungen nach DIN 1631 VN		Datum Ges.	
Änd. korrigiert Änderungs-Nr. Ass. Nr. Datum Name						Allg. Toleranzen DIN 7768 - mB für Schweißstelle R_a in μm DIN 8570 - BE 1991 Datum Name		Bestell- und Liefervorschrift Maßstab im Orig. 2:1 Masse (Gewicht)		Kp	
3H7 +0.010 0						Werkstoff/Werkstoff-Nr. CuZn (Ms)		Modell-, Gesenk-Nr. Rohteil-Nr.		Blatt 6	
Paßmaß Abmaß Paßmaß Abmaß Freigabevermerk						Gepr. 5.6. Abt. fsh Ges.		Benennung Einzelteil 5		Zeichnungs-Nr. / Sach-Nr. 2.73-7258	
CAD Kanten DIN 6764 Innenkanten ± 0.1 Außenkanten ± 0.2						VOITH J. M. Voith GmbH D-89509 Heidenheim Urspr. 2.73-7258 BL.1		Zeichnung auch in BEARBEITUNG ERS. r. ERS. d.		Blatt 6	

25 ✓

						MINI 80		Prüfverfahren in Zeichnungen nach VN 1631		Datum	
								VN		Ges.	
						Allg. Toleranzen DIN 7168 - mB für Schweißteile DIN 8570 - BE 1991		Bestell- und Liefervorschrift		Masse / Gewicht	
								Maßstab im Orig. 2:1			
Änd.	Konst. vor	Änderungs-Nr.	Änd. tag	Datum	Name	R _a in µm DIN ISO 1302		Werkstoff / werkstoff-Nr. CuZn (Ms)			
						Datum Name		Modell-, Gesenk-Nr.		Rohteil-Nr.	
						Gez. 5.6. Gepr. Abt. tsh Ges. Norm		Benennung			
Paßmaß		Abmaß		Paßmaß		Abmaß		Einzelteil 6			
Freigabevermerk											
		Kanten DIN 6784 Innenkanten 1-1.6 Außenkanten 1-0.2				VOITH J. M. Voith GmbH D-89509 Heidenheim Urspr. 2.73-7258 BL1		Zeichnungs-Nr. / Sach-Nr. ZEICHNUNG 2.73-7258 nach der BEARBEITUNG		Blatt 7	
CAD								Efs. 1		Efs. 2	

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7 Führungskreuz

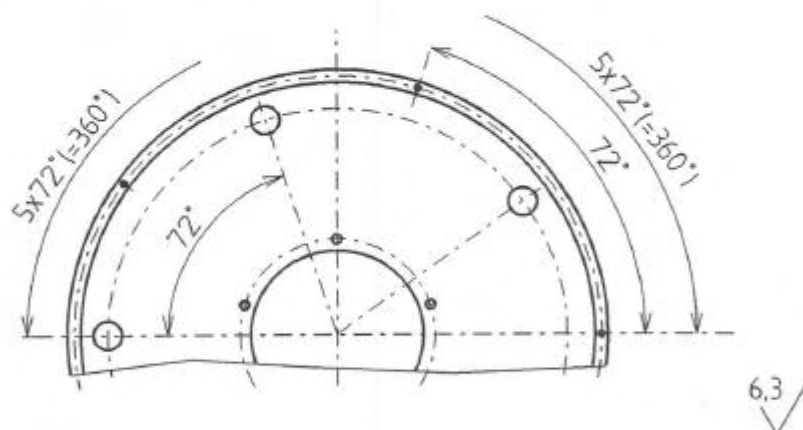


				MINI 80		Prüfbedingungen in Zeichnungen nach VN 1631	
						VN	
						Datum	
						Ges.	
				Bestell- und Liefervorschrift			
				Maßstab im Orig. 2:1		Masse (Gewicht) Kg	
				Werkstoff/Werkstoff-Nr.		CuZn (Ms)	
				Modell-, Gesenk-Nr.		Rohrteil-Nr.	
				Benennung		Einzelteil 7	
				Zeichnungs-Nr. / Sach-Nr.		2.73-7258	
				ZEICHNUNG		8	
				auch in BEARBEITUNG		BL	
				Ers. f.		Ers. d.	
				Ers. f.		Ers. d.	

Änd.	Korrek- tur	Änderungs-Nr.	Änd. datum	Datum	Name
Allg. Toleranzen					
DIN 7168 - m8 für Schweißteile					
R _a in µm					
DIN 8570 - BE DIN ISO 1302					
1991 Datum Name					
Gez. 5.6.					
Gepr.					
Abt. tsh					
Norm					
VOITH					
J. M. Voith GmbH D-89509 Heidenheim					
Urspr. 2.73-7258 BL1					

Freigabevermerk	
Konten DIN 6704	+16
Innenkonten	-0.2
Außenkonten	

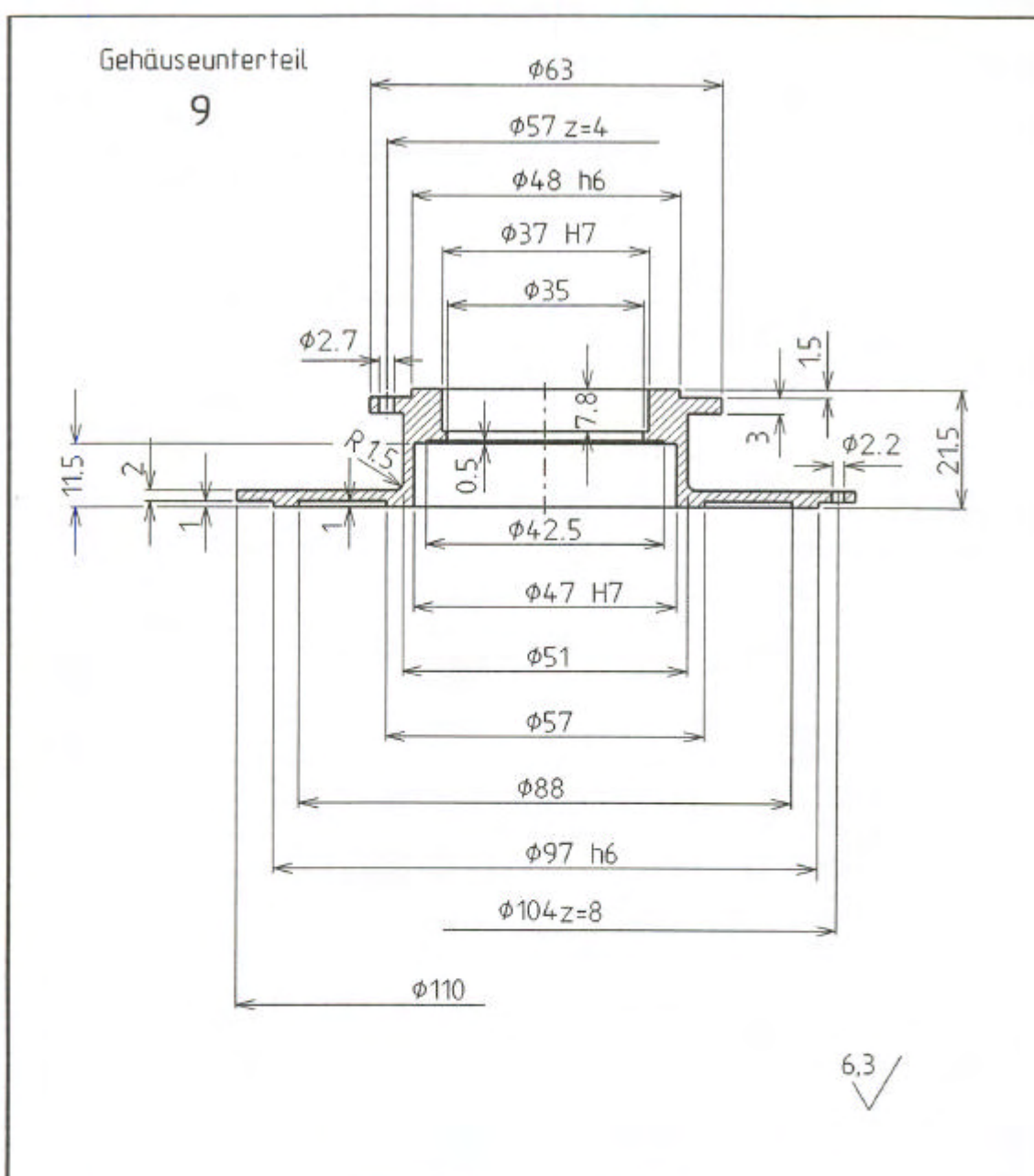
CAD





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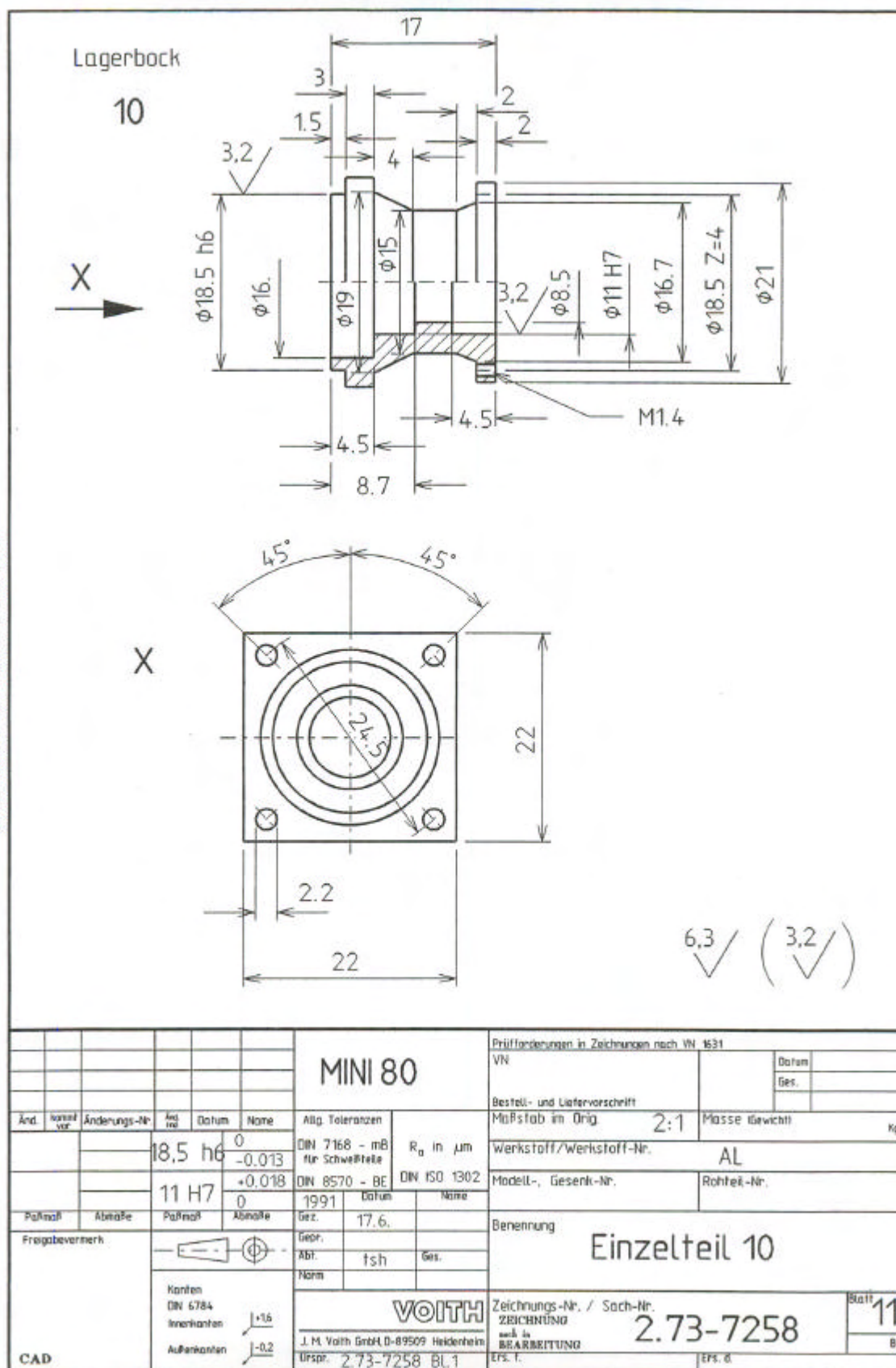
						MINI 80		Prüfbedingungen in Zeichnungen nach VN 1631		Datum	
								VN		Ges.	
Änd.	Kompl. vor	Änderungs-Nr.	Äug. nr.	Datum	Name	Allg. Toleranzen		Bestell- und Lieferanschrift		Maßstab im Orig.	
		89.5H7	+0.035 0			DIN 7168 - m8 für Schweißteile		R _a in µm		1:1	
						DIN B570 - BE		DIN ISO 1302		Masse/Gewicht	
5H7	+0.012 0	39H7	+0.025 0			1991		Dateum		Kg	
Paßmaß	Abmaße	Paßmaß	Abmaße			Ges. 5.6		Modell-, Gesenk-Nr.		Rohrtell.-Nr.	
Freigabevermerk								Benennung			
						Gepr.				Einzelteil 8	
						Abt. tsh		Ges.			
						Name					
						Kanten DIN 6784 Innenkanten		Zeichnungs-Nr. / Sach-Nr. ZEICHNUNG 2.73-7258 in BEARBEITUNG		Blatt 9	
						Außenkanten		Ers. 1		Ers. d	
CAD						J. H. Voith GmbH D-89509 Heidenheim Urspr. 2.73-7258 BL1					

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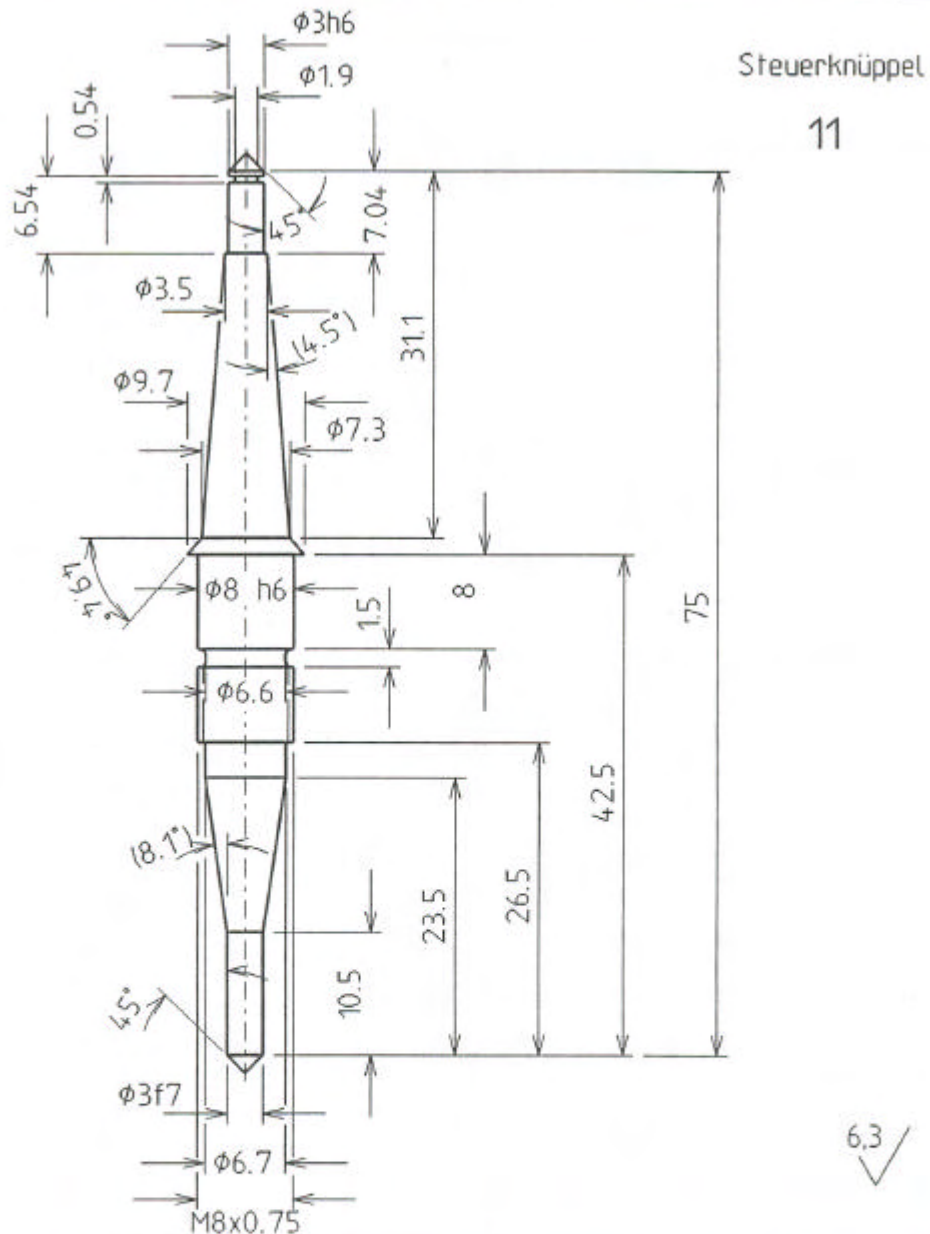


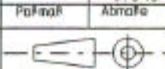
						MINI 80			Prüfbedingungen in Zeichnungen nach VDI 1631				
									VN		Datum		
											Ges.		
						Bestell- und Liefervorschrift							
Änd.	Kommt vor	Änderungs-Nr.	Änd. von	Datum	Name	Allg. Toleranzen		Maßstab im Orig.		1:1	Masse (Gewicht)	Kg	
97h6	0	47H7	+0.025			DIN 7168 - mB für Schweißteile		R _a in µm		Werkstoff/Werkstoff-Nr.			
	-0.022		0							AL			
48h6	0	37H7	+0.025			DIN 8570 - BE		DIN ISO 1302		Modell-, Gesenk-Nr.			
	-0.016		0			1991		Datum	Name	Rohrteil-Nr.			
Polmaß	Abmaße	Polmaß	Abmaße			Gez.	17.6.			Benennung			
Freigabevermerk						Gepr.		Einzelteil 9					
						Abt.							
						tsh							
						Norm							
CAD									Zeichnungs-Nr. / Sach-Nr.				Blatt
									2.73-7258				10
									Ers. 1.				Ers. 2.

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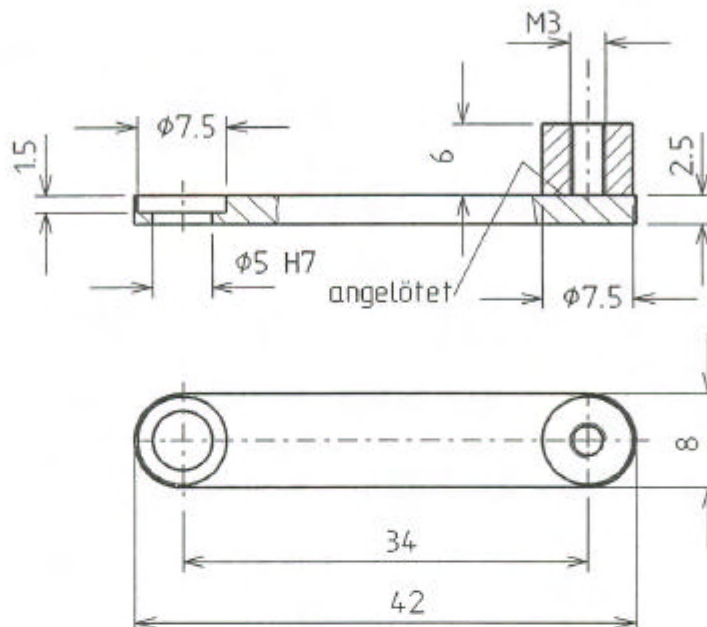


						MINI 80			Prüfänderungen in Zeichnungen nach VN 1531		
									VN	Datum	
										Ges.	
Änd.	Konst. vor	Änderungs-Nr.	Änd. Nr.	Datum	Name	Allg. Toleranzen			Bestell- und Liefervorschrift		
						Maßstab im Orig. 2:1			Masse (Gewicht)		Kg
			3h6	0		DIN 7168 - mB für Schweißteile			Werkstoff/Werkstoff-Nr.		CuZn
				-0.006		R _a in µm					
				-0.006		DIN 8570 - BE			Modell-, Gesenk-Nr.		Rohrteil-Nr.
8h6	0		3f7	-0.006		DIN ISO 1302					
	-0.009			-0.016		1991	Datum	Name			
Paßmaß	Abmaß	Paßmaß	Abmaß			Gez.	21.6.		Benennung		
Freigabevermerk								Einzelteil 11			
					Gepr.						
					Abf. fsh						Ges.
					Norm						
					Kanten DIN 6784 Innenkanten Außenkanten						
					+1.6 -0.2						
					VOITH			Zeichnungs-Nr. / Sach-Nr.			Blatt 12
					J. H. Voith GmbH D-89509 Heidenheim			2.73-7258			
					Urspr. 2.73-7258 BL 1			nach der BEARBEITUNG			
					Ers. 1.			Ers. d.			
CAD											

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Schwinge 2x

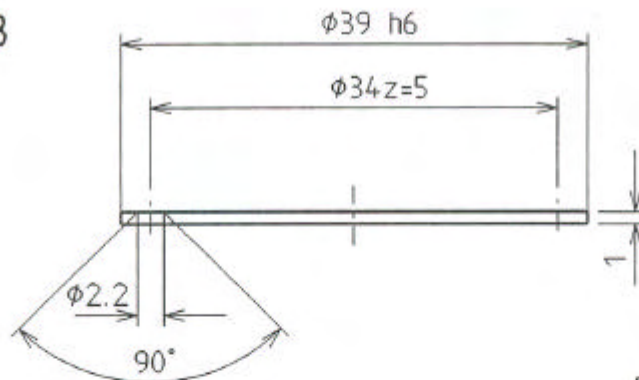
12

[illegible]

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Deckel

13

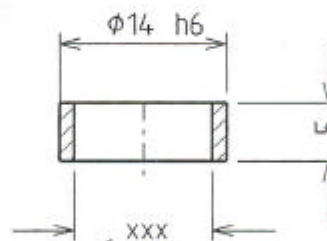


Plexiglas

6,3 ✓

Begrenzungsring

14



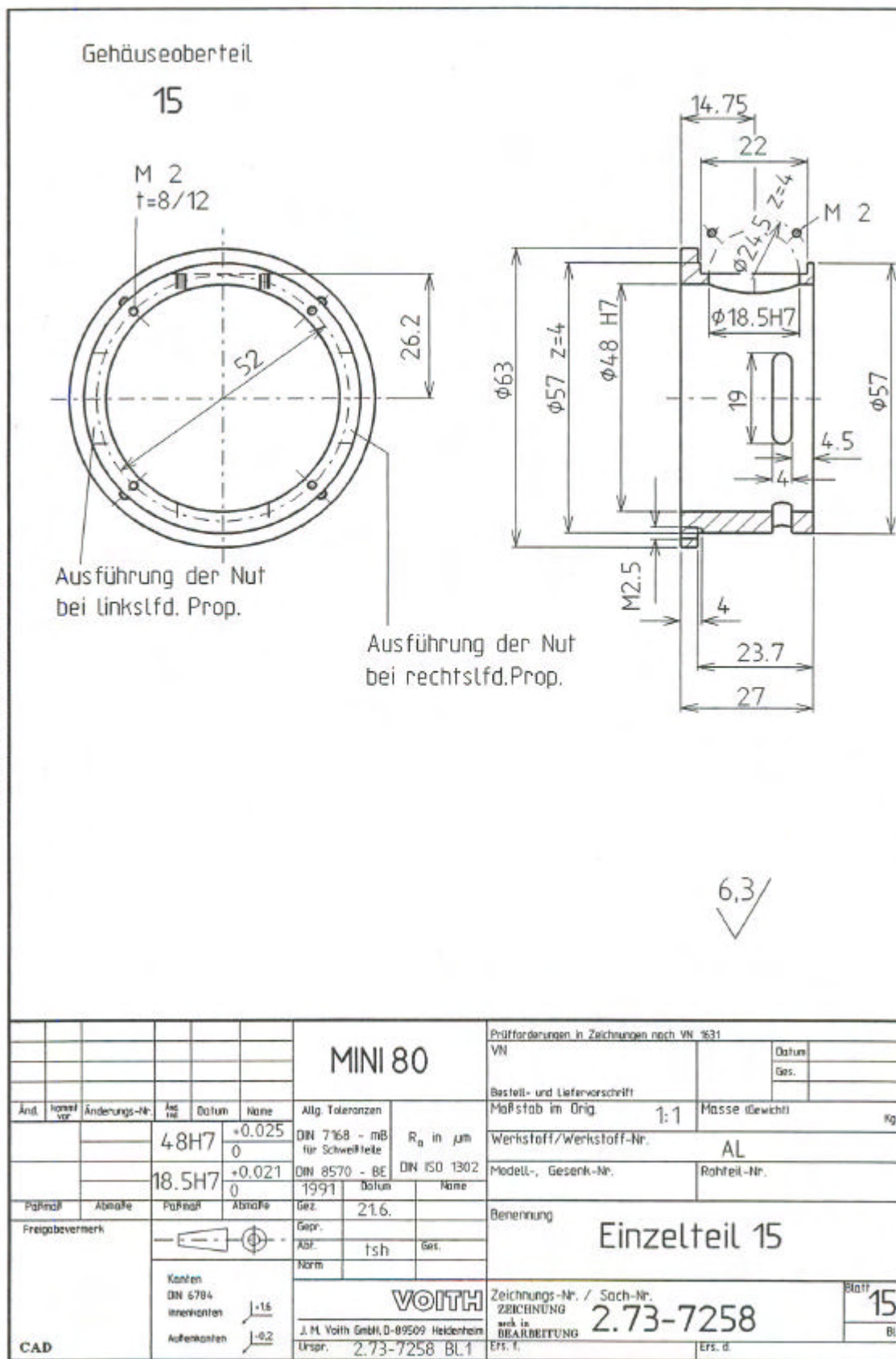
ϕ wird bei Justierung ermittelt
 (theor. $\phi 11,5$)

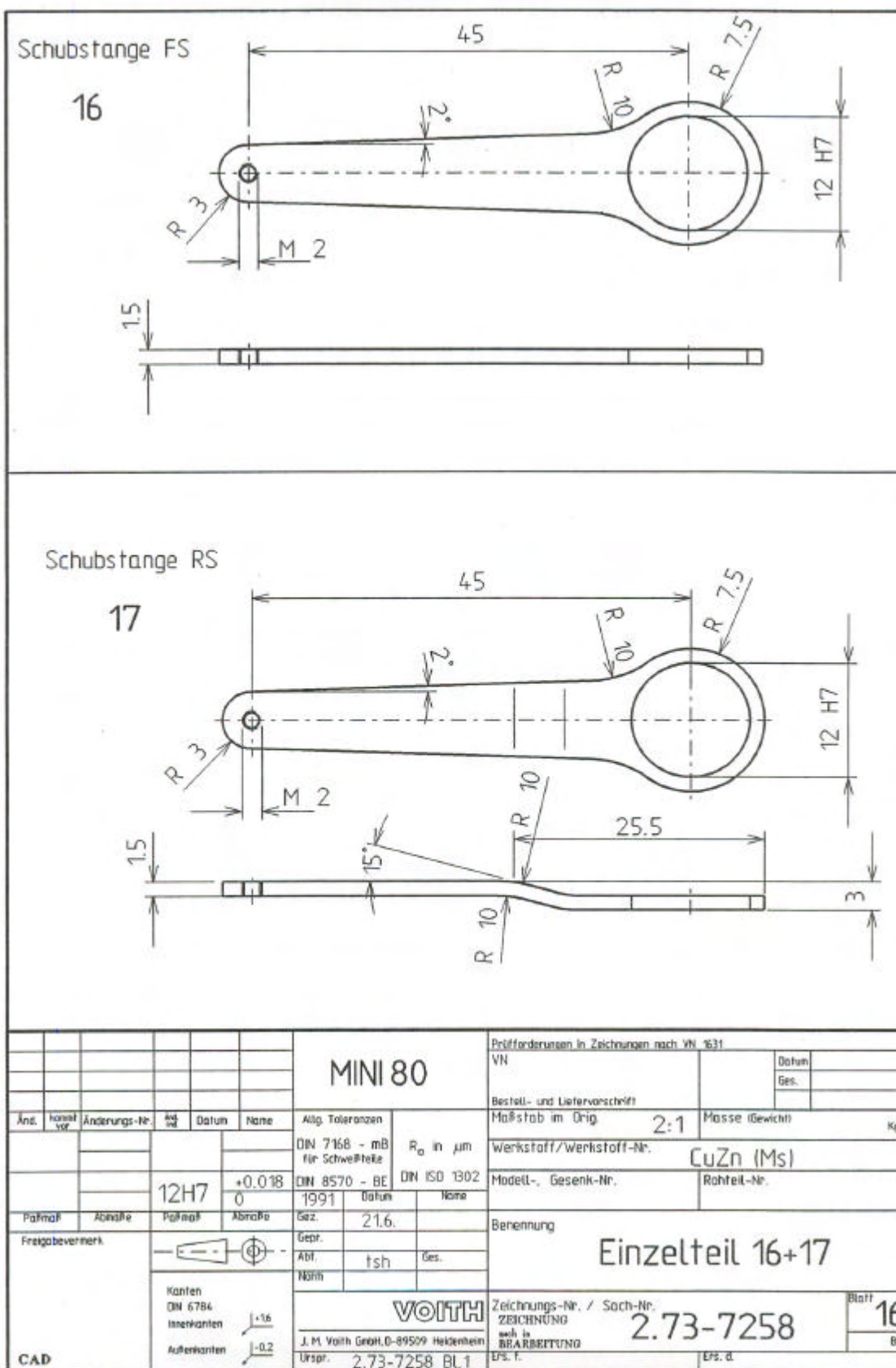
CuZn (Ms)

6,3 ✓

				MINI 80				Prüfbedingungen in Zeichnungen nach VN 1631			
								VN		Datum	
								Bestell- und Liefervorschrift		Ges.	
Änd. kann vor				Änderungs-Nr.		Änd. Datum		Maßstab im Orig. M2:1		Masse (Gewicht) kg	
39h6				0		-0,016		Allg. Toleranzen		R _a in µm	
14h6				0		-0,011		DIN 7168 - m8 für Schnellfeste		DIN ISO 1302	
Paßmaß				Abmaß		Paßmaß		1991		Datum	
Freigabevermerk				Gepr.		21.6.		Modell-, Gesenk-Nr.		Rohteil-Nr.	
Kanten DIN 6784				Abt.		fsh		Benennung		Einzelteil 13+14	
Innenkanten				Norm				Zeichnungs-Nr. / Sach-Nr.		Blatt 14	
Außenkanten				VOITH				2.73-7258		B1	
CAD				J. M. Voith GmbH, D-89509 Heidenheim		Urspr. 2.73-7258 Bl. 1		Ers. T.		Ers. d.	

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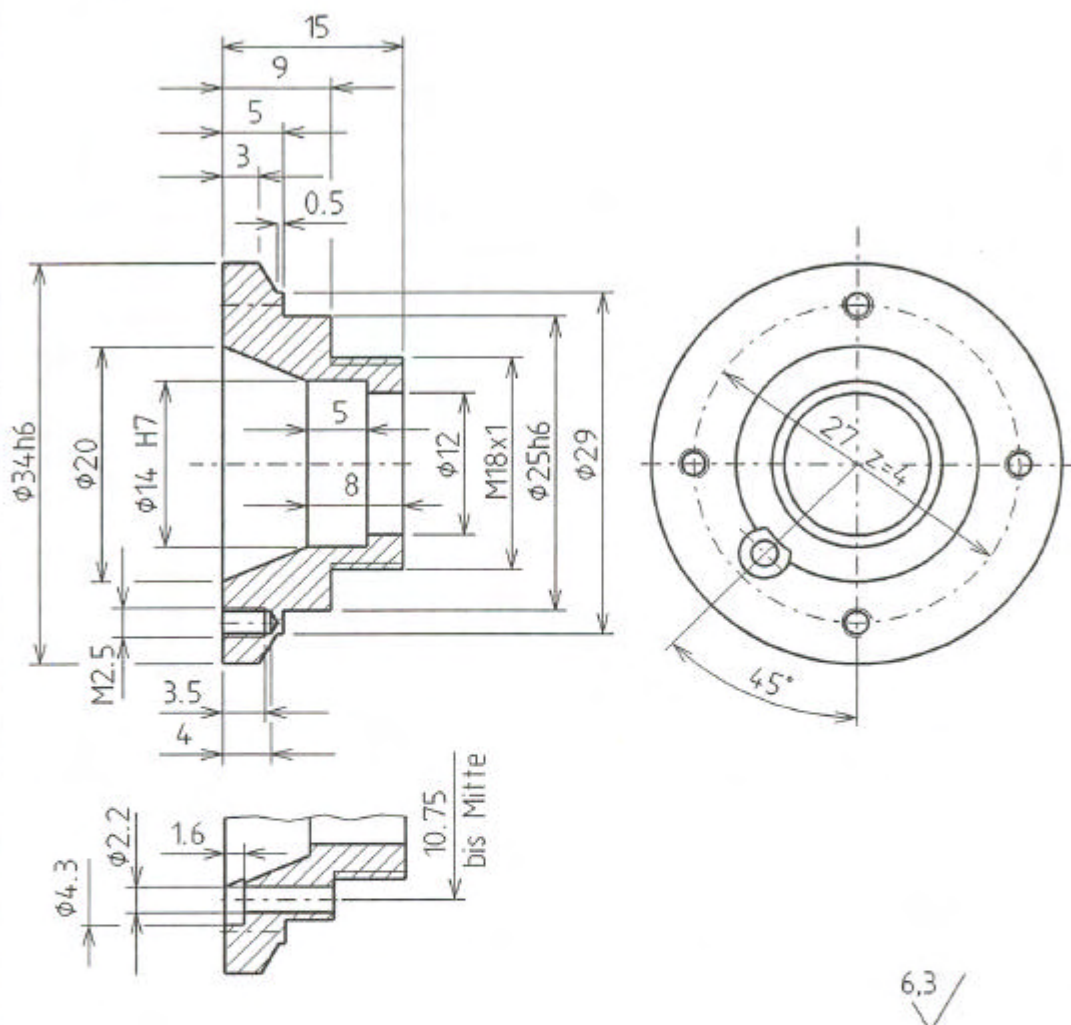


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Zentrierstück

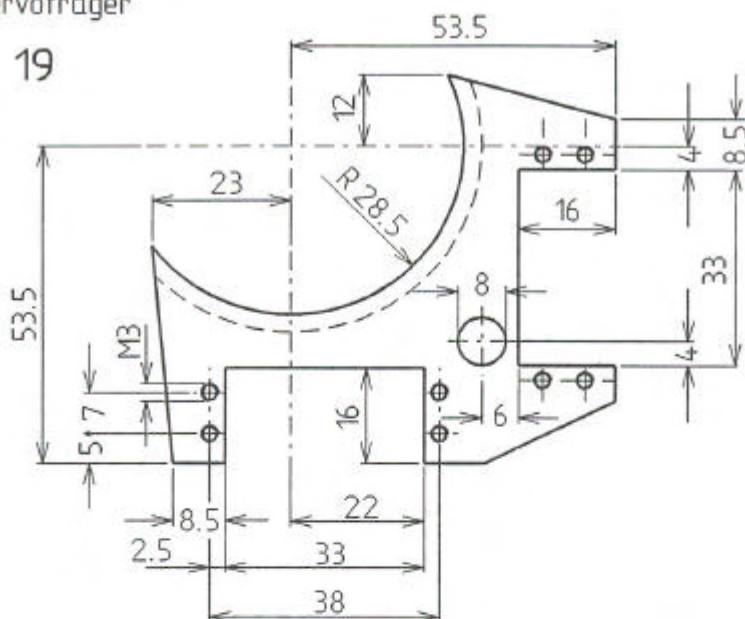
18



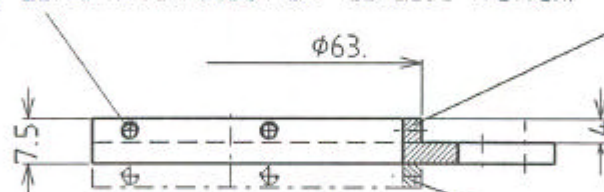
				MINI 80				Prüfänderungen in Zeichnungen nach VN 1631			
								VN		Datum	
								Bestell- und Liefervorschrift		Ges.	
And. kennst. vgl.				Änderungs-Nr.		Datum		Name		Maßstab im Orig. 2:1	
				25h6		0		DIN 7168 - mB für Schweißteile		R _a in µm	
				14H7		+0.018		DIN 8570 - BE		DIN ISO 1302	
34h6				0		-0.016		1991		Datum	
Paßmaß				Abmaße		Paßmaß		Abmaße		Gez. 25.6.	
Freigabevermerk				Gepr.		Adl.		tsh		Ges.	
				Norm						Benennung	
				Kanten DN 6784 Innenkanten Außenkanten		+1.6 -0.2				Einzelteil 18	
CAD										Zeichnungs-Nr. / Sach-Nr. ZEICHNUNG nach IS BEARBEITUNG	
										2.73-7258	
										Blatt 17	
										Efs. I.	
										Efs. II	

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Servoträger



Befestigung so,dass Zyl.-Schrauben M3x7.5
nicht auf Stiftschrauben am Gehäuse treffen.



Ausführung
bei rechtslfd. Prop.

Ausführung
bei linksld. Prop.

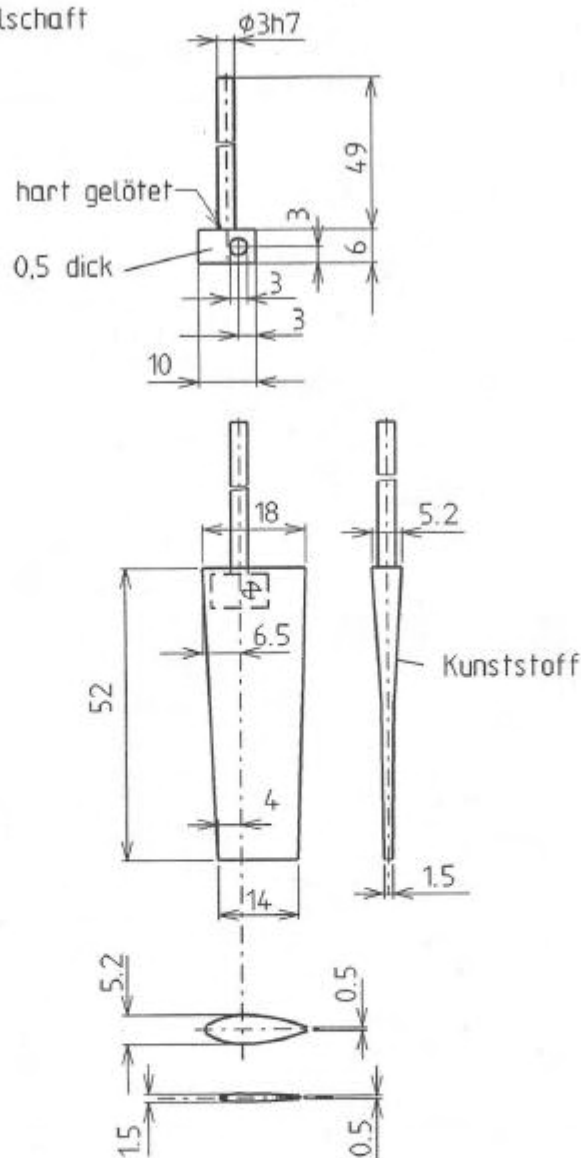
25 ✓

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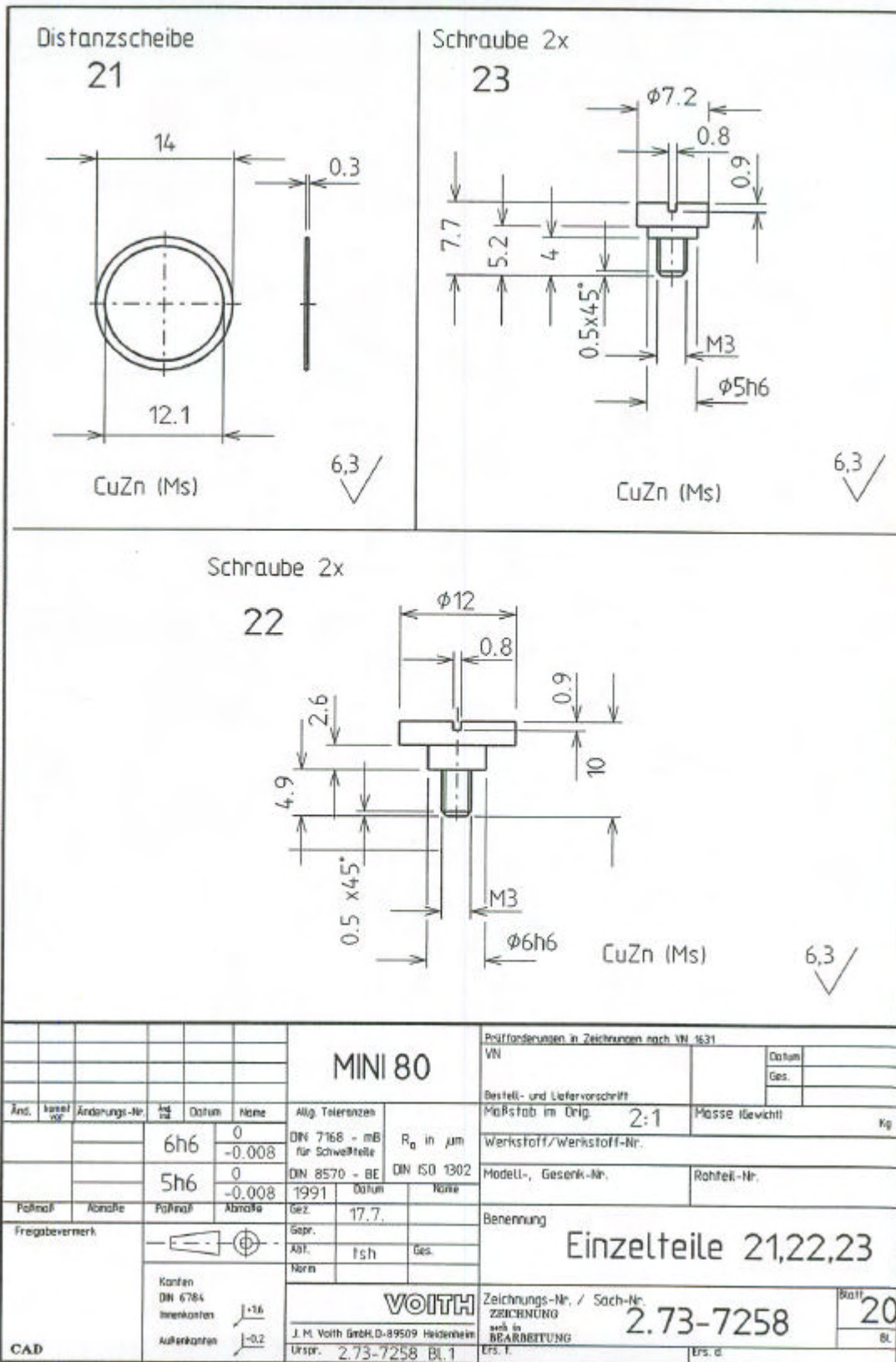
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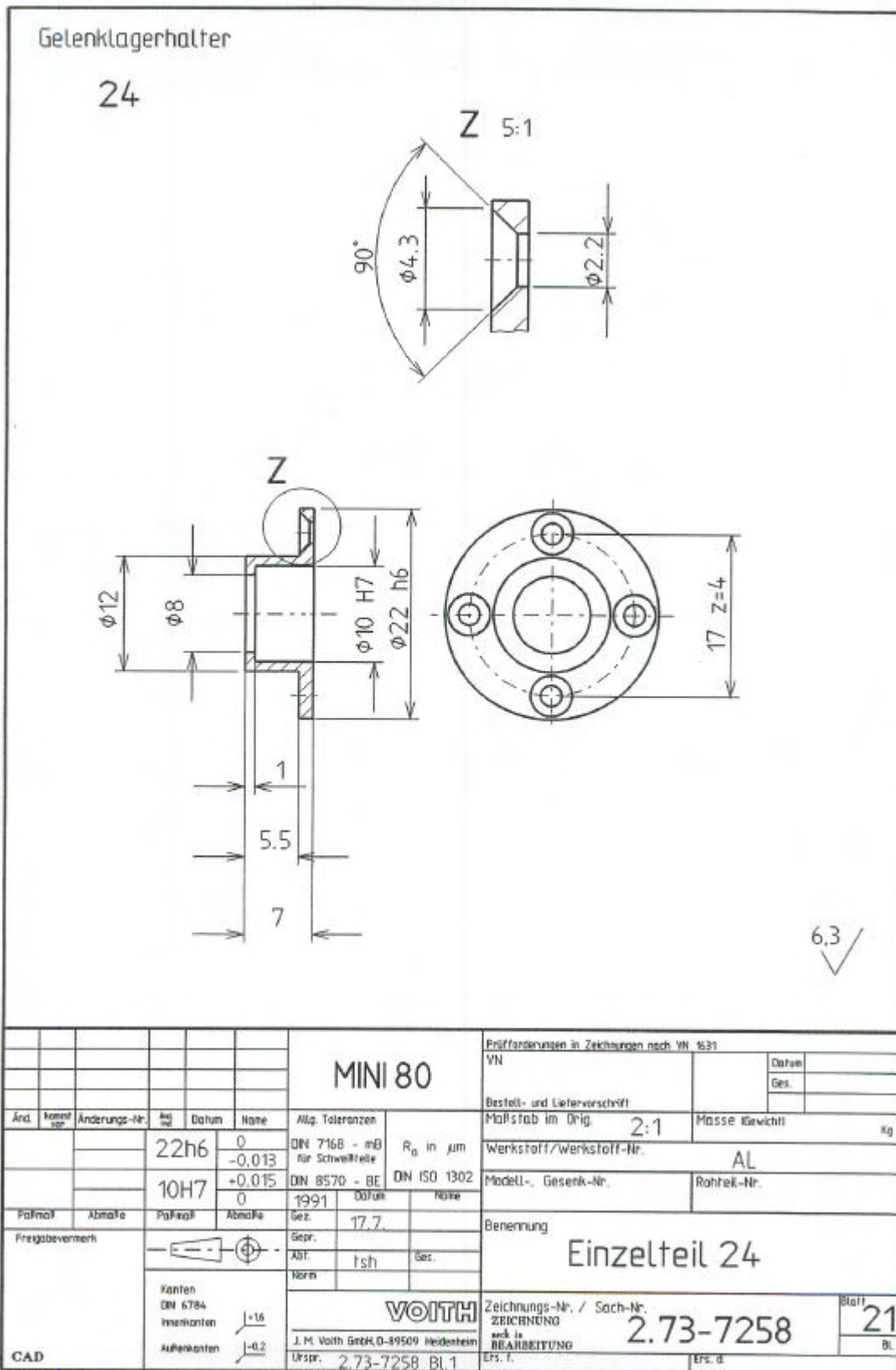
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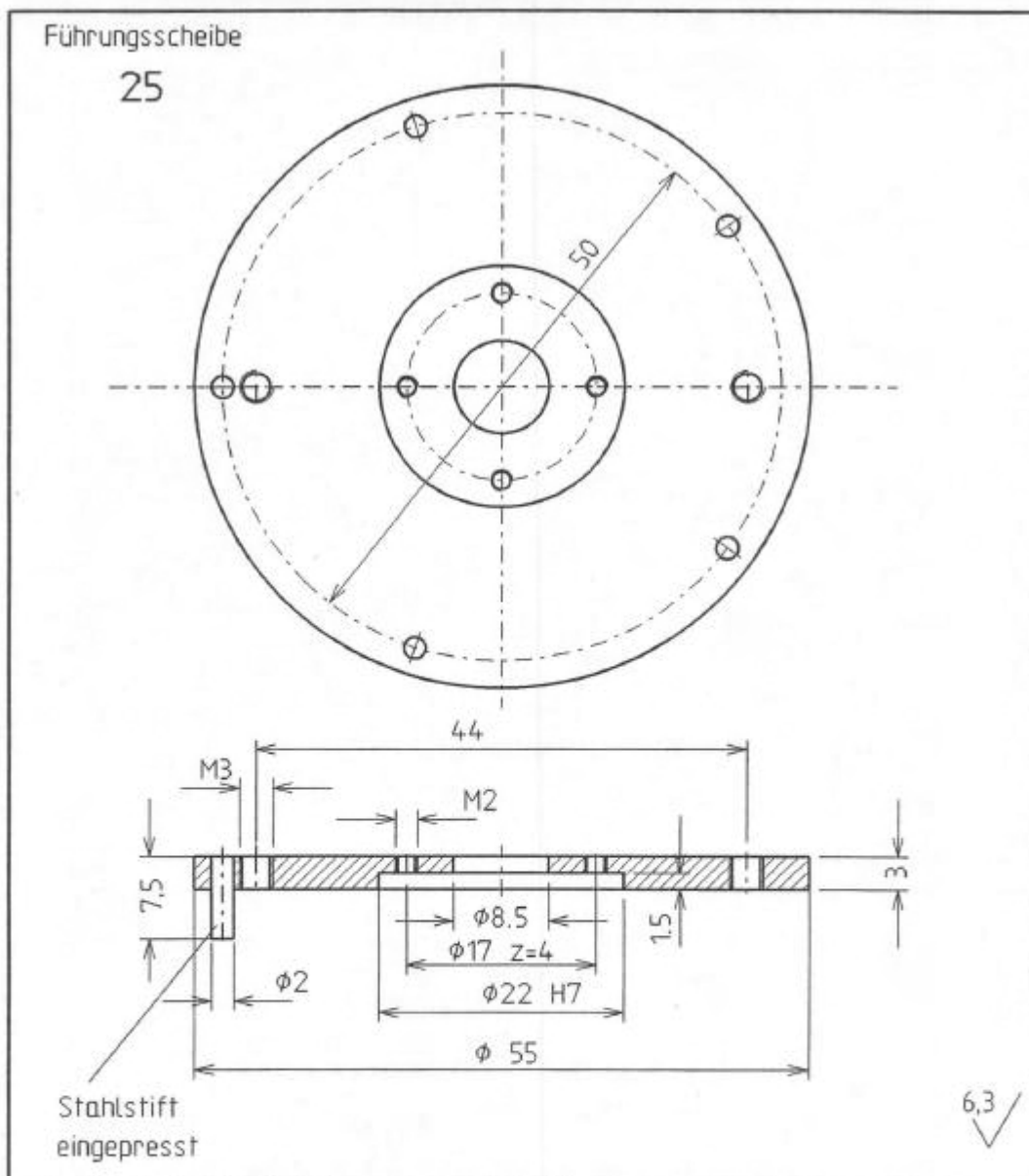
				MINI80		Prüfbedingungen in Zeichnungen nach VN 1631	
						VN	
						Datum	
						Ges.	
Änd.	Änderungs-Nr.	Ing.	Datum	Name		Bestell- und Liefervorschrift	
						Maßstab im Orig. 1:1	
						Masse/Gewicht Kg	
						Werkstoff/Werkstoff-Nr. CuZn (MS)	
						Modell-, Gesenk-Nr. Rohreil-Nr.	
						Benennung	
						Einzelteil 20	
						Zeichnungs-Nr. / Sach-Nr. 2.73-7258	
						Blatt 19	
						Ers. I.	
						Ers. II.	

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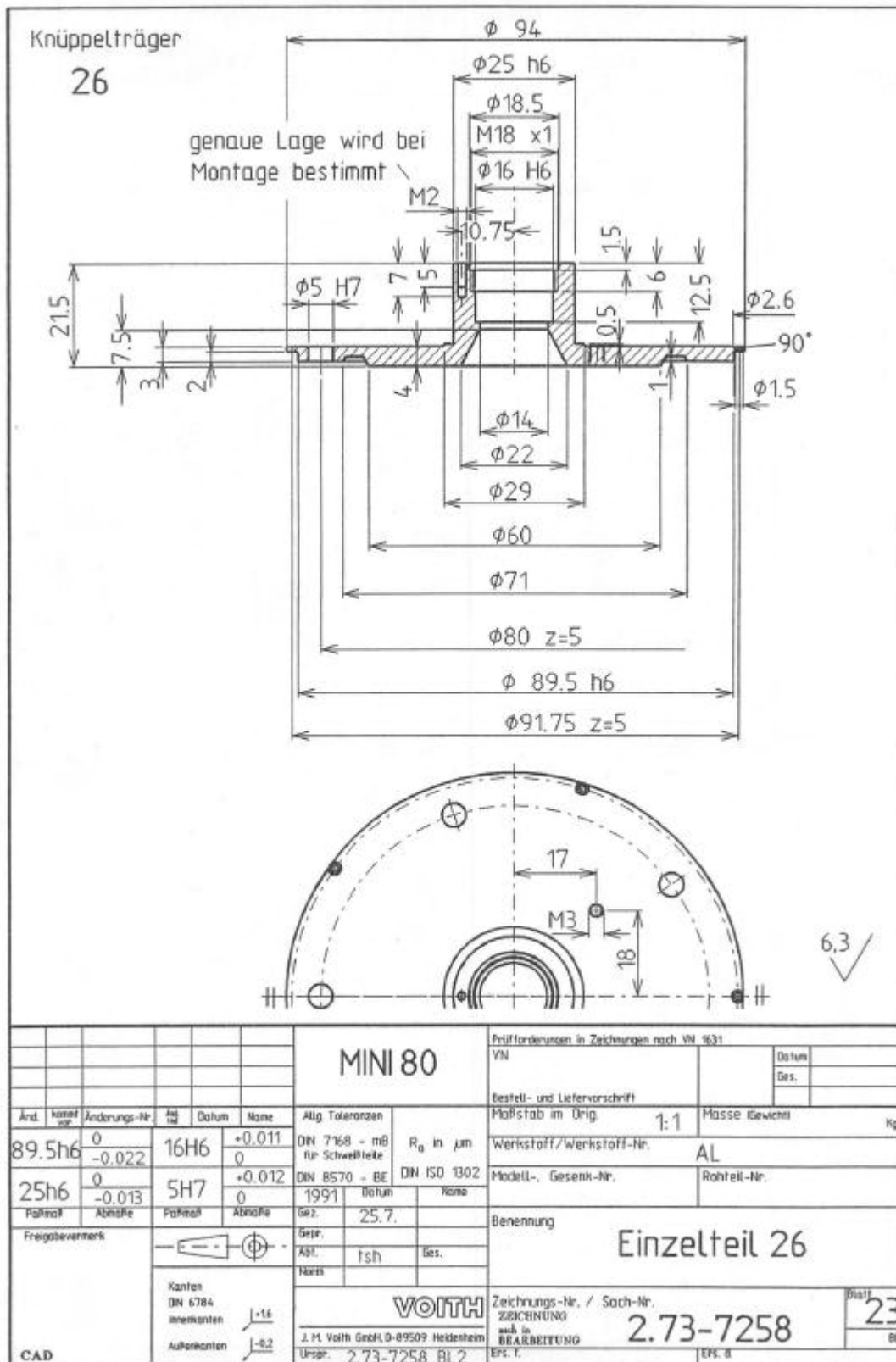


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				MINI 80		Prüfverfahren in Zeichnungen nach VN 1631	
						VN	Datum
						Bestell- und Lieferanschrift	Bes.
						Maßstab im Orig. 2:1	Masse/Gewicht Kg
						Werkstoff/Werkstoff-Nr.	AL
						Modell-, Gesenk-Nr.	Rohteil-Nr.
						Benennung	
						Einzelteil 25	
						Zeichnungs-Nr. / Sach-Nr.	Blatt 22
						2.73-7258	Bl.
						ZEICHNUNG	
						BEARBEITUNG	
						EPS. I.	EPS. d.
						Urspr. 2.73-7258 BL1	

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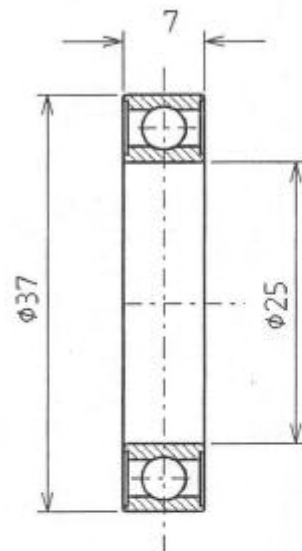


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Rillenkugellager 61805

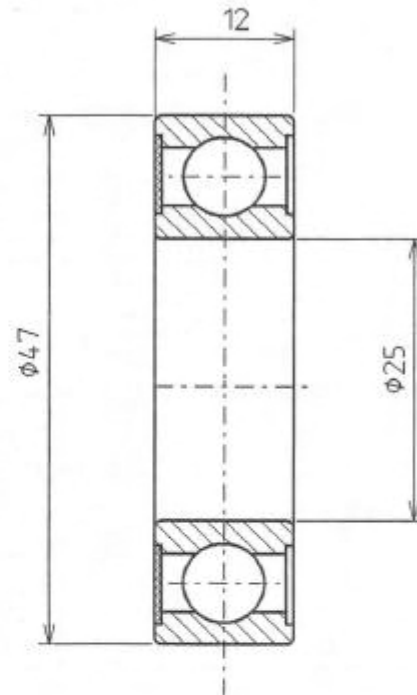
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Hersteller SKF,FAG

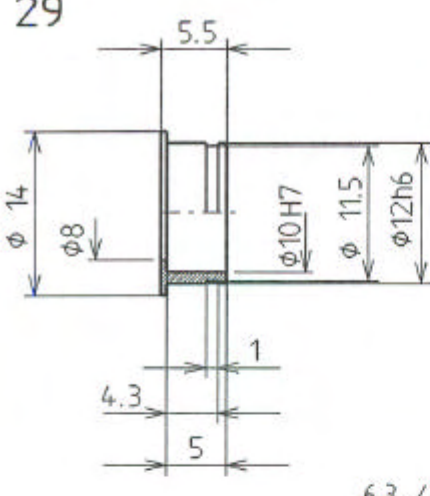
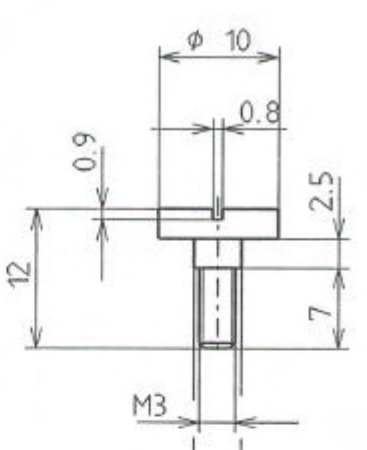
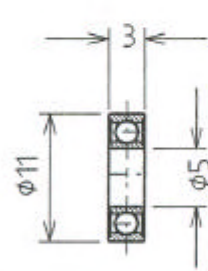
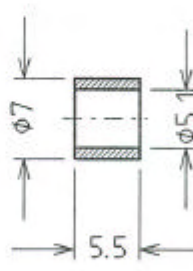
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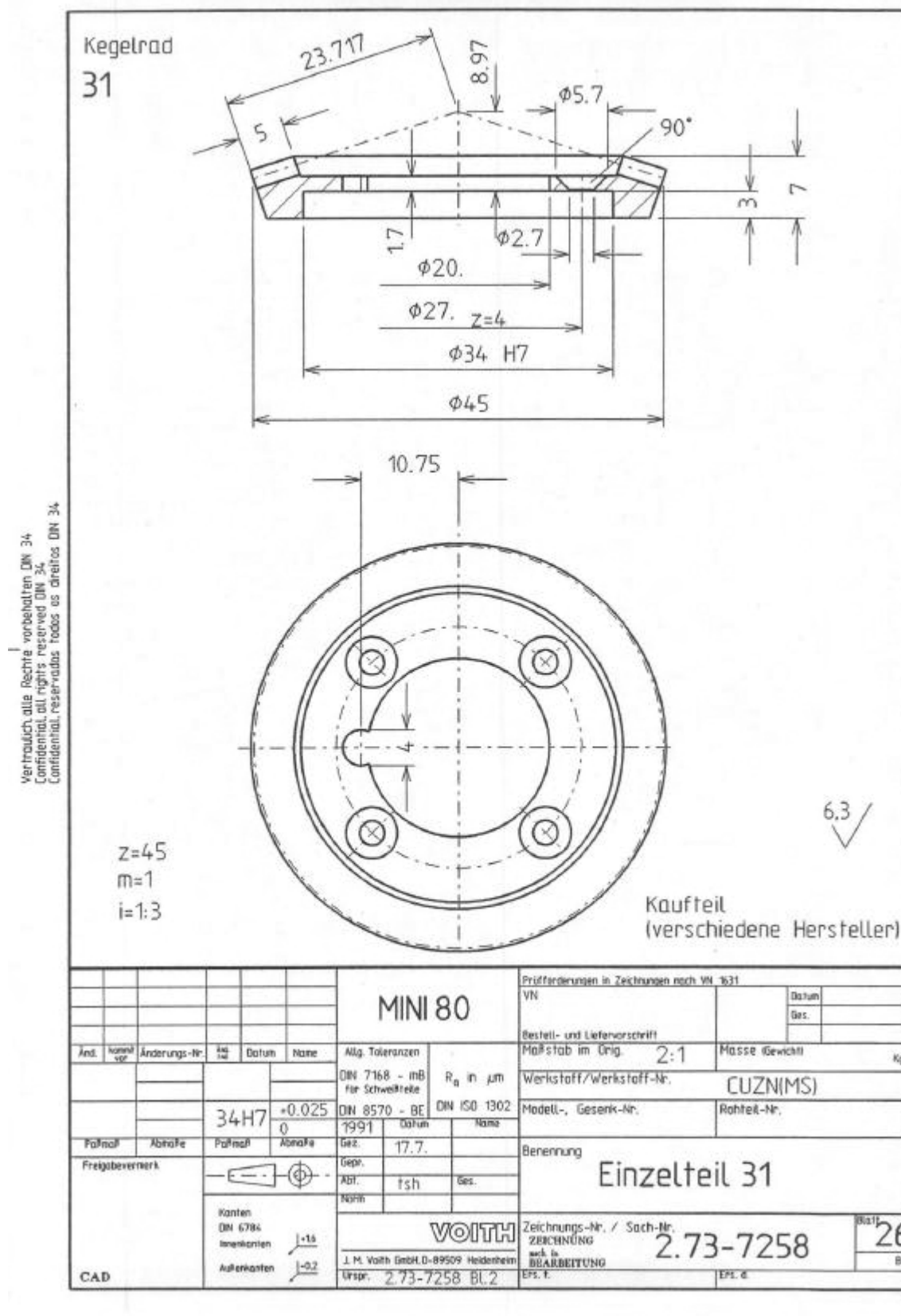


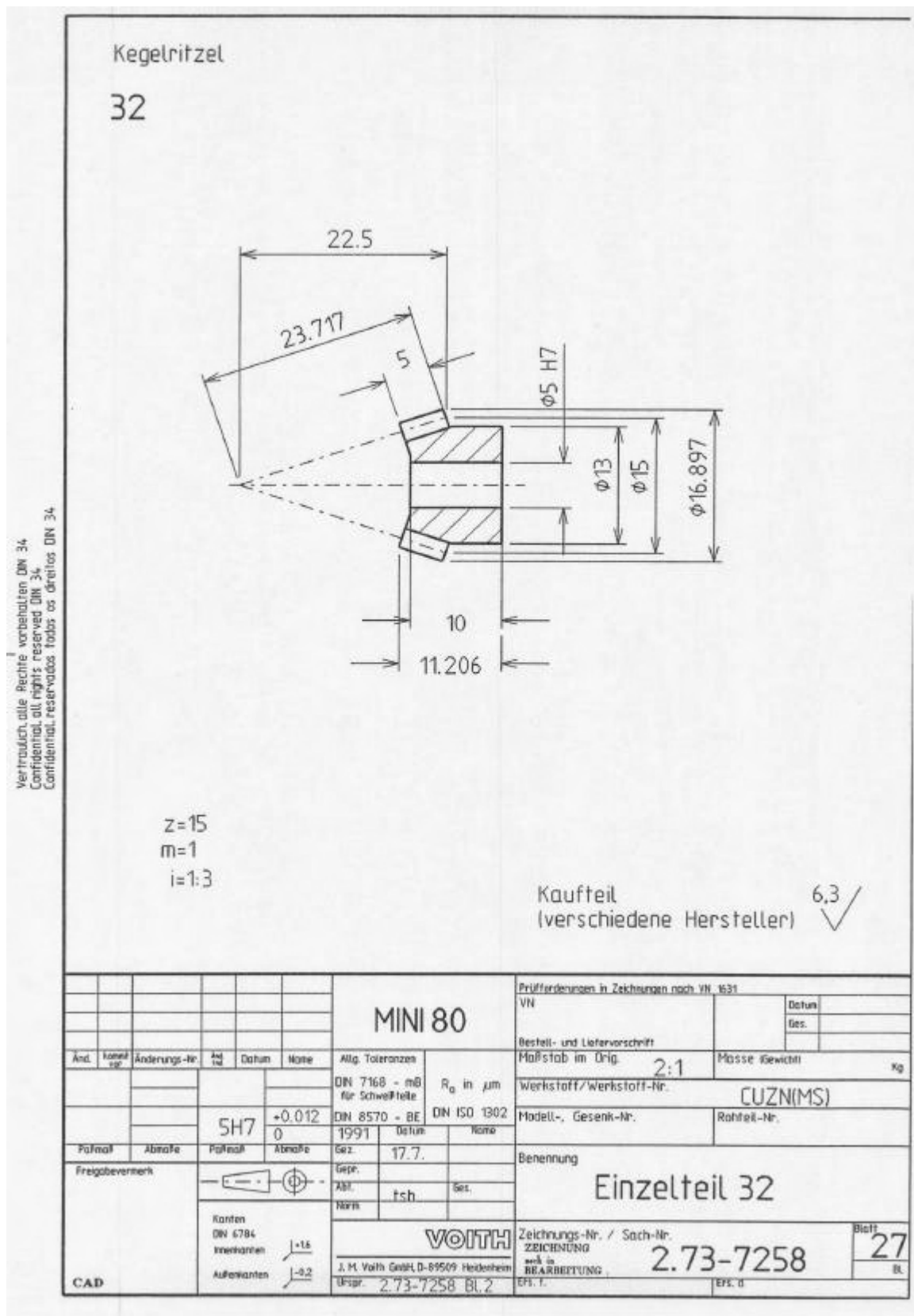
				MINI 80		Prüfverfahren in Zeichnungen nach VN 1631	
						VN	
						Datum	
						Ges.	
						Bestell- und Liefervorschrift	
						Maßstab im Orig. 2:1	
						Masse/Gewicht	
						kg	
						Werkstoff/Werkstoff-Nr.	
						Modell-, Gesenk-Nr.	
						Rohrteil-Nr.	
						Benennung	
						Einzelteile 27,28	
						Zeichnungs-Nr. / Sach-Nr.	
						2.73-7258	
						Blatt 24	
						BL	
						EFS. I.	
						EFS. G.	

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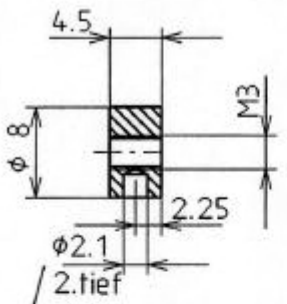
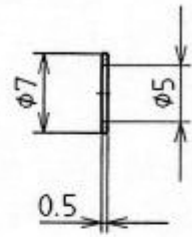
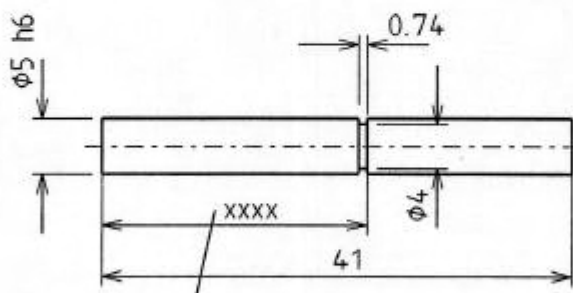
<p>Schubstangenhülse 29</p>  <p style="text-align: right;">6.3 CUZN (MS)</p>	<p>Schraube zum Führungskreuz 2x 30</p>  <p style="text-align: right;">6.3 CUZN (MS)</p>
<p>Hersteller SKF, FAG Rillenkugellager 618/5 2x 34</p>  <p style="text-align: right;">6.3 CUZN(MS)</p>	<p>Distanzbüchse 35</p>  <p style="text-align: right;">6.3 CUZN(MS)</p>

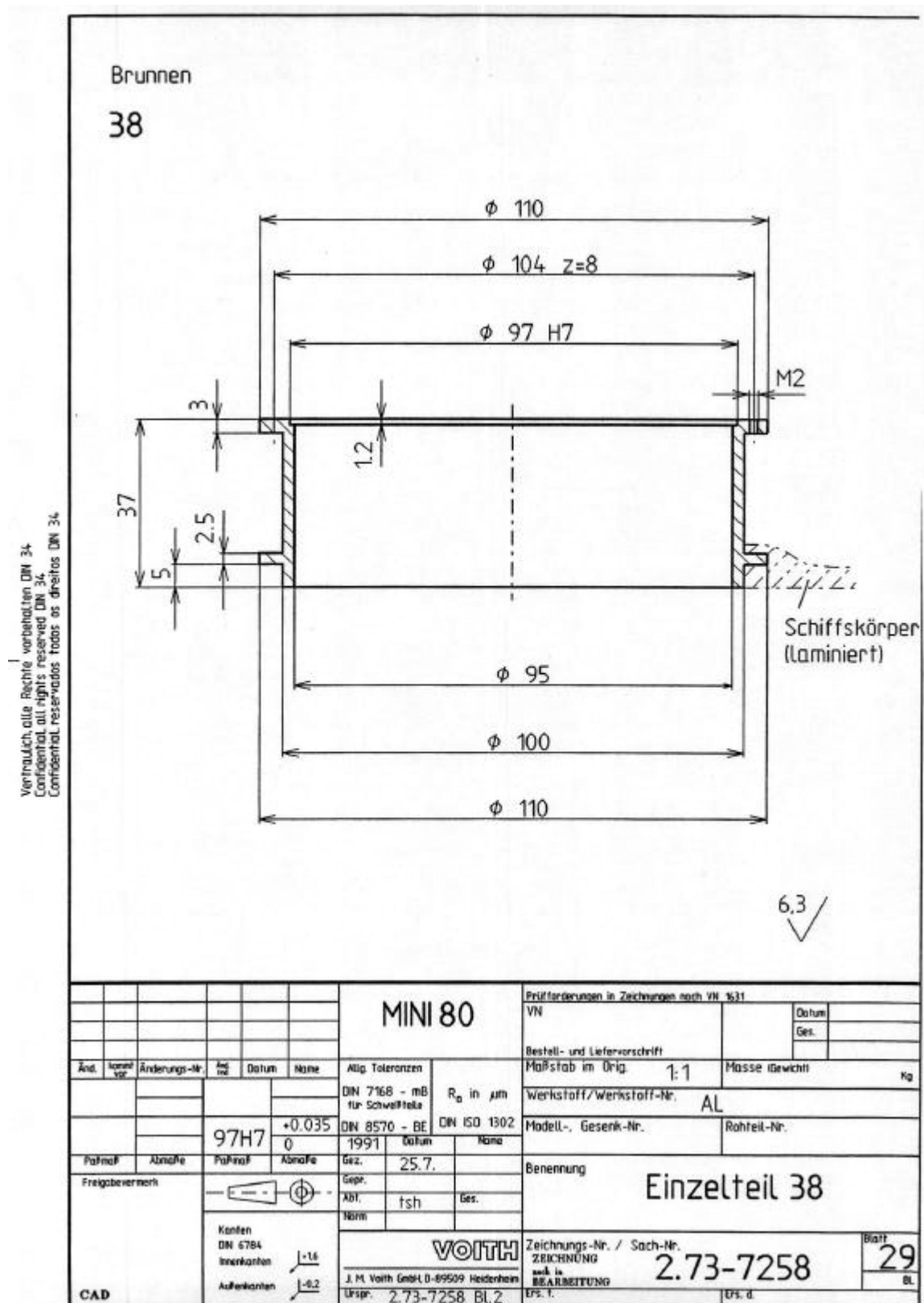
MINI 80				Prüfänderungen in Zeichnungen nach VN 1631 VN Datum Ges. 	
Bestell- und Liefervorschrift Maßstab im Orig. 2:1		Masse (Gewicht) kg			
Werkstoff/Werkstoff-Nr.					
Modell-, Gesehk-Nr.			Rohteil-Nr.		
Benennung Einzelteile 29,30,34,35					
VOITH J. M. Voith GmbH D-89509 Heidenheim Urspr. 2.73-7258 BL2				Zeichnungs-Nr. / Sach-Nr. 2.73-7258 ZERZEICHNUNG nach in BEARBEITUNG Ers. 1. Ers. d.	
Kanten DIN 6784 Innenkanten $\sqrt{r_1}$ Außenkanten $\sqrt{r_2}$				Blatt 25 BL	





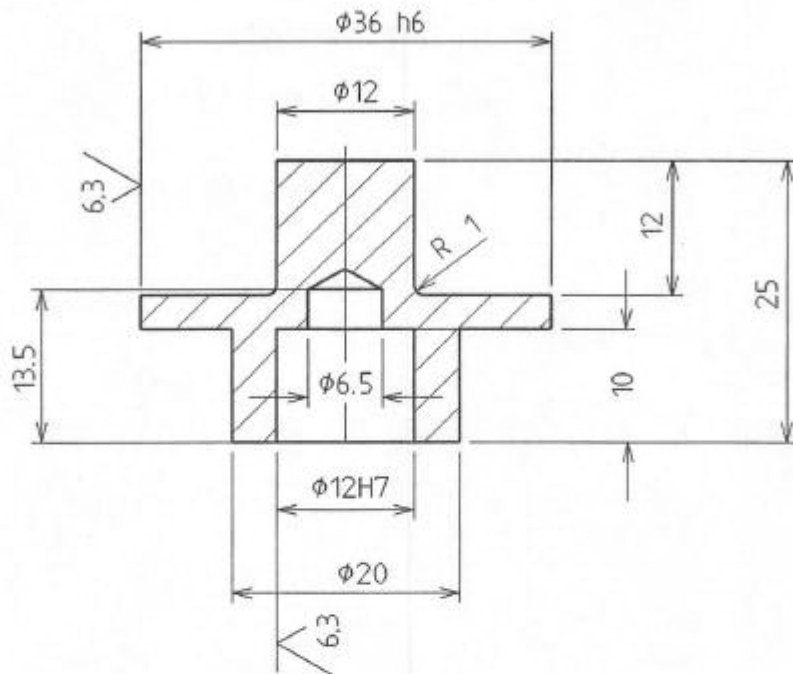
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<p>Kontermutter 2x 33</p>  <p style="text-align: center;">CUZN (MS) 6,3 ✓</p>	<p>Scheibe 36</p>  <p style="text-align: center;">CUZN(MS) 6,3 ✓</p>																																
<p>Ritzelwelle 37</p>  <p style="text-align: right;">St 6,3 ✓</p>																																	
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="4" style="text-align: center;">MINI 80</td> <td colspan="2"> Prüfforderungen in Zeichnungen nach VN 1631 VN </td> </tr> <tr> <td colspan="4" rowspan="2"> Best.- und Lieferanschrift: Maßstab im Orig. 2:1 </td> <td colspan="2"> Datum Ges. </td> </tr> <tr> <td colspan="2"> Masse (Gewicht) kg </td> </tr> <tr> <td colspan="4"> Werkstoff/Werkstoff-Nr. </td> <td colspan="2"> Modell-, Gesenk-Nr. </td> </tr> <tr> <td colspan="4"> Benennung <p style="text-align: center; font-size: 1.2em;">Einzelteile 33,36,37</p> </td> <td colspan="2"> Zeichnungs-Nr. / Sach-Nr. <p style="text-align: center; font-size: 1.2em;">2.73-7258</p> </td> </tr> <tr> <td colspan="4"> CAD </td> <td colspan="2"> Blatt 28 BL. </td> </tr> </table>		MINI 80				Prüfforderungen in Zeichnungen nach VN 1631 VN		Best.- und Lieferanschrift: Maßstab im Orig. 2:1				Datum Ges.		Masse (Gewicht) kg		Werkstoff/Werkstoff-Nr.				Modell-, Gesenk-Nr.		Benennung <p style="text-align: center; font-size: 1.2em;">Einzelteile 33,36,37</p>				Zeichnungs-Nr. / Sach-Nr. <p style="text-align: center; font-size: 1.2em;">2.73-7258</p>		CAD				Blatt 28 BL.	
MINI 80				Prüfforderungen in Zeichnungen nach VN 1631 VN																													
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CAD				Blatt 28 BL.																													



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Einstellhilfe



25 $\sqrt{6.3}$

				MINI 80				Prüfbedingungen in Zeichnungen nach VN 1631			
								VN		Datum	
								Bestell- und Liefervorschrift		Ges.	
								Maßstab im Orig. 2:1		Masse/Gewicht	
								Werkstoff/Werkstoff-Nr.		Kg	
								Modell-, Gesenk-Nr.		Rohteil-Nr.	
								Benennung			
								Einstellhilfe			
								Zeichnungs-Nr. / Sach-Nr.		Blatt	
								2.73-7258		30	
								Ers. f.		Ers. d.	

