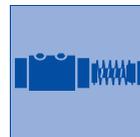
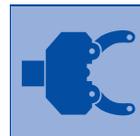
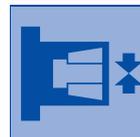




# SKM 1200 / SKM 1500 ELECTRONIC GRIPPING FORCE MEASURING DEVICES



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## **FORKARDT DEUTSCHLAND GMBH**

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## 1.0 Features

The SKM gripping force meters are compact electronic / mechanical units. Suitable for stationary testing of 2 - 6 jaw chucks. They are equipped with high precision force pick-up heads. The electronics ( C-MOS technology ) is housed in an ergonomically designed aluminium casing. A microprocessor and program routine ensure the testing operation described in this manual will be carried out consistently with the highest accuracy.

The SKM 1200 and SKM 1500 include many advanced features, such as:

- advanced technology
- lightweight, easy handling
- sophisticated software
- consistently high accuracy
- robust design
- service-free operation
- carry-case with accessories.

## 1.1 Usage

The utilisation of modern CNC lathes and new cutting tool materials is allowing the use of ever increasing cutting speeds, thus considerably improving machine efficiency and productivity. High quality and powerful chucks produce the high gripping forces necessary to transmit the power to the work piece, maximising the accuracy and high machining speeds offered by the machine.

However, it should be noted that the European Norm EN 1550 clearly states that the operation of chucks should be regularly checked by measuring the static gripping forces. Use of the FORKARDT SKM series of gripping force meters can satisfy this requirement.

The SKM 1200 and SKM 1500 gripping force meters can be used to:

- check the safety of the chucking operation for high cutting speeds and feeds
- focus and optimise the use of the workholding fixture
- measure the gripping force of the chuck relative to the number of jaws without moving the jaws out of alignment
- determine the chuck factor (i.e. the ratio of gripping force to axial force or adjusted pressure)
- monitor lubrication of the chuck
- determine lubrication intervals for safe chucking
- provide information regarding preventative chuck servicing
- save energy, reduce stress, wear and tear on the chuck and minimise distortion of the work piece through focused interpretation of dynamic gripping force (  $F_{spo}$  ).

## 2.0 Safety instructions

### 2.1 General

This instruction manual contains the information required for the correct use of the FORKARDT SKM 1200 and SKM 1500 gripping force meters. It is directed at technically qualified personnel who have been appropriately trained.

Knowledge and the precise following of the safety information and warnings contained in this manual are preconditions for the safe handling, operation and maintenance of the devices described. Only qualified persons in the sense of section 2.2 have the necessary technical expertise to correctly interpret and take notice of safety notes and warnings given in this manual.

**Attention!** It should be noted that no liability will be assumed for damage resulting from failure to heed the instructions contained in this manual.

### 2.2 Qualified personnel

Interfering with the unit by unqualified persons or failure to follow the safety warnings given in this manual can lead to serious injury or material damage for which FORKARDT takes no responsibility.

Qualified personnel within the meaning of the safety instructions given in this manual are persons who

- have been instructed in the handling of chucking workholding equipment and who are familiar with the contents of this manual referring to the handling of the gripping force meter
- are installation and / or service personnel who have undergone training enabling them to repair / install chucks and workholding equipment and gripping force measuring devices.

### 2.3 Warning symbols

The following signs are here both for the personal safety of the Operator and to prevent damage to either the product described or equipment connected to it.

Safety instructions and warnings are included to avert danger to the lives and the health of Operators or maintenance personnel, or to avoid material damage. These are highlighted with the symbols defined below:



This symbol is found next to all safety instructions where potentially life-threatening danger exists. Take particular notice of these instructions and proceed in such cases with extreme caution.



This symbol is found at all parts of this manual where particular notice should be taken in order that the guidelines, regulations, instructions and correct work procedures are obeyed and hence damage or destruction of the product can be prevented.

## 2.4 Directions for the use of gripping force meters

Danger can arise from the incorrect usage and handling of chucks.

**Attention!** Always ensure that the gripping force is sufficiently high for the work to be carried out in the planned manner. This is a point of considerable importance for the correct use of chucks.

To this end, the expected cutting power should first be determined ( refer to the relevant technical literature or the cutting tool manufacturer's data ).

After this, the required gripping force should be determined and set with the help of the chuck's Operating Manual.

With manual chucks this is done using the chuck key, and with power chucks by adjusting chucking pressure.

However, appropriate safety factors must be taken into account and maximum permitted ratings complied with in accordance with the relevant product specifications.

Finally the correct setting of gripping force can be checked with the gripping force meter SKM directly in the chuck jaws.

**Attention!** Due to dirt and loss of lubricant, most chucks and workholding fixtures lose part of their gripping force after a certain length of time in operation. Should the gripping force fall below the minimum required for machining, the stability of the workpiece in the jaws can no longer be guaranteed. The result of this is often unclean machining, inaccurately machined workpieces and tool breakage.



In extreme cases, the workpiece may break loose from the chuck jaws and be catapulted outwards. This can result in considerable damage to the chuck / workholding fixture, tools, tool holders, protection devices and other parts of the machine. Danger can also arise for the Operator of the machine.

By taking regular readings with a FORKARDT SKM, it may be determined whether the gripping force of the chuck is sufficient and at what point the workholding fixture must be brought back into a safe operating state by re-lubrication or cleaning etc.

Unfortunately, it is not possible to quote a universal time interval between testing, re-lubrication and servicing because this is dependent upon operating conditions, frequency of use etc. As a guideline for gripping force readings, FORKARDT recommends that at least one reading is taken per shift, preferably at the beginning. Gripping force levels should be carefully documented. From the tendency of a gradual reduction in gripping force, longer test intervals may then, under certain circumstances, be set.

### **Note :**

Use of minimum maintenance chucks, such as those designed and marketed by FORKARDT, can significantly extend the intervals between chuck lubrication stops.

## 2.5 Correct usage



The unit should only be used in the manner indicated within this manual and only in connection with third party apparatus and components which have been recommended or permitted by FORKARDT.



The FORKARDT SKM meters are exclusively for testing stationary gripping force on non-rotating chucks / workholding equipment ( i.e. spindle speed = 0 r.p.m. )!

The spindle drive must not be engaged when the gripping force meter is clamped.



Preconditions for the safe operation of the SKM meters include appropriate transportation, correct storage, assembly and mounting as well as careful maintenance.

### 3.0 Description of apparatus

#### 3.1 Function

The FORKARDT SKM meters ( SKM 1200 and SKM 1500 ) are hand-held electronic / mechanical devices for measuring stationary gripping force. They contain a force receptor and processor-driven electronics with sophisticated software. The various functions are suitable for every day measuring and checking of the gripping force of chucks.

The meters` microprocessor multiplies the level of jaw power by the previously selected number of jaws to give the total jaw force of the chuck. This value, which is then displayed, is the decisive factor for deciding whether the workpiece can safely be held.

The last settings remain stored in the meter when it is switched off. Upon switching it back on work can be started again immediately. Rechargeable power cells in the meter and a mains adapter allow problem-free and mobile use.

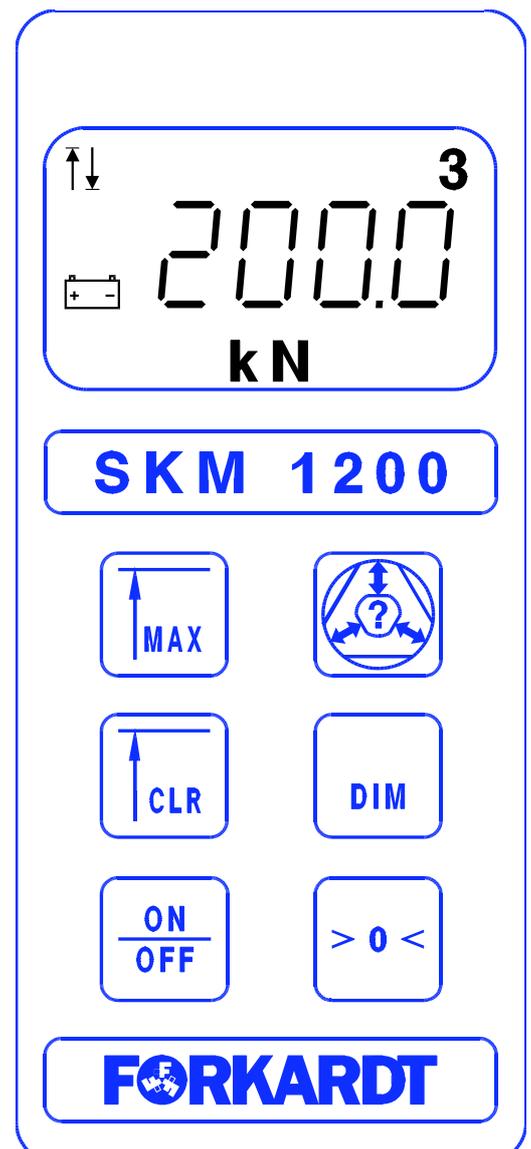
The ergonomic casing is made from aluminium. Its robust construction means that it is suitable for use in the rough conditions typical of the modern machine stop.

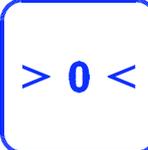
#### 3.2 Operation

<b>Number of jaws</b>	2, 3, 6
↑ / ↑↓	Record maximum / overload
<b>Gripping force</b>	0 - 200 kN ( SKM 1200 ) 0 - 500 kN ( SKM 1500 )
<b>Battery</b>	needs charging
<b>Unit scale display</b>	t, kN, k lbs

**Meter type** SKM 1200 or SKM 1500

<b>Key</b>	Record maximum value	Number of jaws
<b>Key</b>	Clear maximum value	Unit scale
<b>Key</b>	On / Off	Adjust zero-point



Key	Function
	<p><b>Record maximum value ↑</b></p> <p>The maximum value recorded is stored and displayed. Maximum value mode makes it possible to take a reading in chucking situations where the display cannot be viewed. The maximum value remains displayed after the meter has been removed. The memory can be cleared before a new maximum value reading is taken by pressing CLR. Should this not be done, the memory will automatically be cleared when the next reading is taken and the new value displayed. In order to avoid misinterpreting readings, the maximum recorded value is automatically deleted, when the meter is switched off.</p>
	<p><b>Changing the number of jaws</b></p> <p>The number of jaws changes each time this key is pressed. The chosen number of jaws is shown in the top right corner of the display. It can be changed between 2, 3 and 6 ( jaws ). <u>The reading eventually displayed is the actual measurement multiplied by the jaw number selected, and the maximum value is cleared.</u></p>
	<p><b>Clear maximum value ↑</b></p> <p>The recorded maximum value is cleared, but the unit remains in maximum value mode.</p>
	<p><b>Changing the unit scale</b></p> <p>On pressing this button the unit scale is changed. Available unit scales are t, kN and k lbs. The value read is recalculated and displayed when the unit scale is changed.</p> <p>1 kN = 1000 N, 1 t = 9807 N, 1 k lbs = 1000 lbs = 4448 N</p>
	<p><b>Switching on / off</b></p> <p>Last settings remain stored when the meter is switched off. Upon switching it back on, work can be started immediately.</p>
	<p><b>Adjusting the zero-point</b></p> <p>The zero-point on the meter is adjusted by pressing this button. This function should only be used when the meter is not clamped or loaded in any way.</p>

The maximum gripping forces which can be measured by the SKM meters are as follows:

	<b>SKM 1200</b>	<b>SKM 1500</b>
2-jaw readings	133,3 kN	333,3 kN
3-jaw readings	200,0 kN	500,0 kN
6-jaw readings	400,0 kN	1000,0 kN

**Attention!** Loads in excess of the maximums set out above result in the display and the flashing sign  $\uparrow\downarrow$ . The meters can tolerate overloads of up to 120% of the maximum without suffering damage. If the gripping force falls below 100% again, the meter returns to normal display mode.

**Attention!** When exceeding the maximum measurable force by more than 20%, the reading value is no longer displayed and the  $\uparrow\downarrow$  sign continues to flash. A critical overload limit has been reached which, under certain circumstances, may lead to lasting distortion of the measuring bolts. This causes displacement of the zero- point. If, after the meter is released, it shows a value other than zero, it can be reset to zero by using the reset zero-point key. The zero-point is automatically adjusted when the meter is switched on (Note: Following such an instance, if in doubt, the meter should be returned to FORKARDT for servicing).

**Attention!** If the zero-point has been displaced more than once by previous overloading, a further overload of less than 120% may lead to the display being shut off. Again, this is shown by the flashing  $\uparrow\downarrow$ .

The zero-point is automatically adjusted when the meter is switched on. This means that the meter must not be clamped when it is switched on. Displacement of the zero-point of 20% is signalled by the display permanently flashing, and indicates previous overloading of the unit or incorrect usage as described above.

**Attention!** The gripping force meter must not be clamped when switched on, i. e., it must not be subjected to gripping force at this time.

The gripping force meter can operate for approximately 10 hours from fully charged batteries. The meter indicates that it is time to recharge the batteries when the battery symbol appears on the display. After this point reliable readings can no longer be guaranteed and the meter must be connected to the recharging unit. It is possible to use the meter whilst it is being recharged, however, this increases recharging time.

### 3.3 Technical details

	SKM 1200	SKM 1500
Measuring range	0 ... 200,0 kN	0 ... 500,0 kN
Lowest unit of measurement	0,1 kN	
Permitted overload	100 ... 120% of max. range value, ↑↓ and display flash	
Excess overload	> 120% of max. range value, ↑↓ flashes, display blank	
Display range	0 ... 20.000 digit	
Measuring tolerance	< +/- 0,5 %	
Measuring frequency	1000 Hz	
Display frequency	4 Hz (average value from 250 readings)	
Maximum value record	maximum value memory	
Unit scales	t, kN, k lbs	
Number of jaws	2, 3, 6	
Battery	rechargeable with mains adapter 230 VAC / 50 Hz	
Operating time	10 hours from a full charge	
Recharging time	8 hours with unit switched off	
Casing dimensions	155 x 75 x 39 mm	
Insulation	to IP 65 standards	
Measuring head dimensions	55 mm Ø	104 mm Ø
Chuck diameter	63 ... 293 mm Ø	114 ... 544 mm Ø
Weight	approx. 1,3 kg	approx. 2,9 kg

The SKM 1200 and SKM 1500 gripping force meters meet EMV regulation 89 / 336 / EWG and are marked with the **CE**-sign to indicate conformity with the relevant European safety standards.

Please refer to Appendix 1, at the end of this document, for the physical dimensions of the FORKARDT SKM meters.

### 3.4 Accessories

Extension pieces can be screwed into the head of the FORKARDT SKM meters using combinations of tension and compression bolts so that chucking diameters of 63 to 293 mm (SKM 1200) and 114 to 544 mm (SKM 1500) can be accommodated ( at 10 mm intervals ). Details of these FORKARDT accessories are shown below:

SKM 1200			SKM 1500		
System M6 3 pieces each	Length l [mm]	Ident- No.	System M12 3 pieces each	Length l [mm]	Ident- No.
Tension bolt	4	164809020	Tension bolt	5	164814020
Tension bolt	9	164809021	Tension bolt	10	164814021
Tension bolt	14	164809022	Tension bolt	15	164814022
			Tension bolt	20	164814023
Compression bolt	15	164809025	Compression bolt	20	164814025
Compression bolt	30	164809026	Compression bolt	40	164814026
Compression bolt	60	164809027	Compression bolt	80	164814027
			Compression bolt	160	164814028
2 Spanners (gauge 12)			2 Spanners (gauge 22)		
Carry-case, mains adapter			Carry-case, mains adapter		

For further details concerning the relevant dimensions of the tension or compression bolts, please refer to the Appendices at the end of this document. In particular, to Appendix 2 for the SKM 1200 and Appendix 3 for the SKM 1500.

One of the tension or compression bolts must always be screwed into the hole at the top of the measuring head when viewed with the display side up. The load sensor is located at this position in the measuring head ( the joint is recognisable ). The remaining tension or compression bolts should be positioned appropriately according to the number of jaws.

**Attention!** Where extension bolts are used, the gripping force meter must be supported axially, e. g. with the help of the tailstock centre or toolholder, to avoid bending the extensions.

## 4.0 Working with the gripping force meter

### 4.1 Preparation of the power chuck and machine

Testing of gripping force should always be carried out with the chuck set up as for the current workholding task. In particular the gripping force meter should be positioned, if possible, in the ridges of the top jaws which are used for each machining process.

**Attention!** This is especially important with high and wide top jaws which overhang the chuck. In such instances, even a chuck in good condition regularly delivers lower gripping force readings than obtained when chucking with short jaws. The reduced ratings to be expected with such top jaws should be taken from the appropriate chuck Operating Manual. For all FORKARDT chucks, this information is clearly displayed at the end of the relevant manual. For measurements with other chucks, FORKARDT recommends consultation with the appropriate manufacturer.



Before testing begins, make sure that the workspindle of the machine is blocked and that the chuck cannot be set in motion, even accidentally.



Also make sure that there is no potential danger to the operator from other parts of the machine like tools, tool holders, loading devices, chip conveyors, protection devices etc., for example through unexpected movements or protrusions into the working area and other restrictions of the Operator's movements.

**Attention!** When taking readings on 6-jaw chucks the chuck must be in compensating mode so that all tension bolts are evenly loaded. False readings will otherwise result.

### 4.2 Preparation of the gripping force meter

The maximum gripping force of FORKARDT chucks can be found in the relevant Operating Manual supplied with the chuck.

**Attention!** It must be checked that the expected gripping force of the chuck is inside the permitted range of the gripping force meter ( see section 2.5 ).

In the case of non- FORKARDT chucks or lack of operational documents FORKARDT recommends consultation with the appropriate manufacturer.

**Attention!** The meter should be set up for the number of jaws and gripping diameter of the chuck to be tested by screwing in appropriate tension and compression bolts. Tension bolts with rounded heads should always be screwed in last for contact with the chuck jaws. All extension pieces must be screwed in tightly. For range of tension and compression bolts and fitting details see section 3.4.

A second set of tension and compression bolts is required for testing 6-jaw chucks. This is not included in the standard package and can be ordered separately from your nearest FORKARDT Operation or Representative ( see section 5.2 and 5.3 ).

**4.3 Measuring gripping force**



There is risk of serious injury when tensioning the chuck. The gripping force meter must always be handled in such a manner that no parts of the body or any objects get into the areas around the jaws.

**Attention!** Place the meter carefully into the open chuck jaws so that the tension bolts make contact as closely as possible with the centre of each jaw. The tension bolts or sensor body must be mounted straight in the jaws or chuck body.

**Attention!** False readings can result if the gripping force meter is not in the jaws perpendicular to the axis of chuck rotation.

**Attention!** If extensions are used the gripping force meter must be supported axially, e. g. with the help of the tailstock centre or toolholder, to avoid bending the extensions.

**4.4 Calculating dynamic gripping force**

With high rotational speeds ( greater than 30% of maximum permitted spindle speed ) the gripping force of many chucks is reduced significantly by the effect of centrifugal forces on the jaws. The full gripping force registered under stationary conditions is therefore sometimes not obtained whilst the chuck rotates.

The extent of gripping force loss caused by jaws and operational spindle speed can, in the case of FORKARDT chucks, be found in the appropriate Operating Manual or product brochure.

The following formula is used to calculate dynamic gripping force and the actual loss of gripping force with power chucks ( without centrifugal compensation [ refer to the end of section for key to symbols used ] ):

<b>Dynamic gripping force</b>	$F_{sp} = F_{sp0} \pm \Delta F_{sp}$	①
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The comparative value for gripping force measurement can be calculated from the first part of the gripping force formula

<b>Available gripping force <math>F_{sp0}</math> in stationary condition ( n = 0 )</b>	$F_{sp0} = \frac{C1}{C2 + a} * F_{ax}$	②
----------------------------------------------------------------------------------------	----------------------------------------	---

The gripping force value given by the SKM meter should be at least equal to the calculated comparative value. If this is not so, the chuck must be lubricated or cleaned.

Loss of gripping force from centrifugal force is unrelated to the maintenance condition of the chuck. Therefore, direct measurement using a ( costly ) dynamic gripping force meter is not

required. For FORKARDT chucks, gripping force loss through centrifugal force may be calculated with the second part of the formula for dynamic gripping force  $F_{sp}$ :

**Loss of gripping force**

$$\Delta F_{sp} = 0,0008 * (C3 + Ma) * n^2 \quad \textcircled{3}$$

Actual  $F_{sp}$  available for machining can be calculated as follows:

**Actual dynamic gripping force**

$$F_{sp} = \left( \frac{C1}{C2 + a} * Fax \right) \pm 0,0008 * (C3 + Ma) * n^2 \quad \textcircled{4}$$

Where  $Ma$  represents the total moment of the top jaws and is calculated as follows:

**Total moment of top jaws**

$$Ma = \frac{\left( \frac{D_{sp}}{2} \pm Y_{AB} \right) * G * i}{1000} \quad \textcircled{5}$$

The value for dynamic gripping force  $F_{sp}$  must be calculated for each machining task and compared with the transmitted cutting force ( further details can be found in the Operating Manuals of FORKARDT chucks ).

Key to value used in the formula:

$F_{sp}$  = dynamic gripping force ( daN ),  
total gripping force of all operative jaws  
( - with external chucking )  
( + with internal chucking )

$C1, C2, C3$  = chuck constants

$F_{ax}$  = actuating force ( daN )

$n$  = spindle speed ( rpm )

$Ma$  = total moment of top jaws ( kgm )

$D_{sp}$  = gripping diameter ( mm )

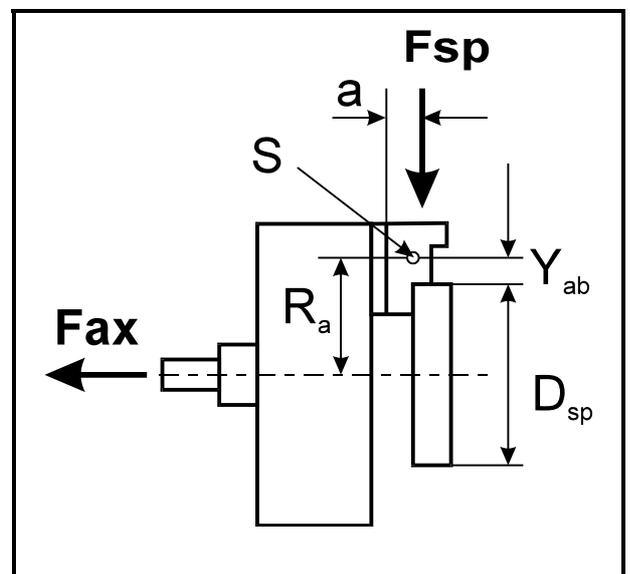
$Y_{AB}$  = distance between gripping diameter  
and top jaw centre of gravity

$a$  = jaw overhang ( mm )

$i$  = number of top jaws

$G$  = weight of one top jaw ( kg )

$R_a$  = radius of centre of gravity of top jaws ( mm )



#### 4.4.1 Example chuck constants for FORKARDT power chucks NH, FNC and KT

a) NH:

chuck	diameter [mm]							
	160-37	175-42	200-48	250-65	315-82	400-120	500-160	630-168
3NH								
C1 [mm]	315	400	439	624	850	1032	1233	1721
C2 [mm]	185	219	223	299	389	474	565	736
C3 [kgm]	0,063	0,099	0,1	0,2	0,38	1,0	1,63	3,18

b) FNC:

chuck	diameter [mm]									
	175-42	200-45	250-65	250-72	315-65	315-82	400-85	400-92	500-125	630-125
3FNC										
C 1 [mm]	390	412	620	580	820	780	960	940	1200	1760
C 2 [mm]	213	221	310	290	410	390	490	482	600	880
C 3 [kgm]	0,065	0,09	0,18	0,187	0,33	0,33	0,73	0,73	1,66	2,80

c) KT:

chuck		diameter [mm]						
		160	200	250	315	400	500	630
	KTN / KTG							
C 1 [mm]	2-, 3-, 4- KTN / KTG	516	634	909	1075	1777	2547	3130
C 2 [mm]	2-, 3-, 4- KTN / KTG	235	308	424	508	790	1101	1361
C 3 [kgm]	2- KTN / KTG	0,09	0,13	0,26	0,45	1,2	1,9	3,1
	3- KTN / KTG	0,13	0,2	0,4	0,67	1,8	2,8	4,7
	4- KTN / KTG	-	0,26	0,53	0,9	2,4	3,7	6,2

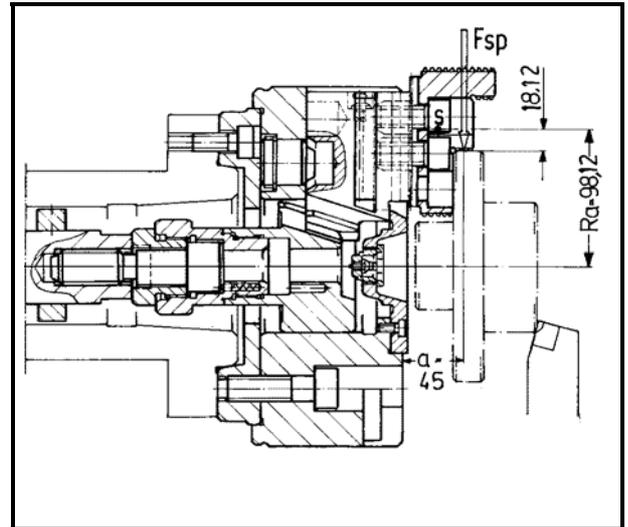
The chuck constants " C " take into account specific properties of each chuck. They are required in the calculation of stationary gripping force (  $n = 0$  ) and at operational spindle speeds, as well as for calculating permitted centrifugal momentum of the top jaws.

\* For non-FORKARDT chucks, this data should be obtainable from the relevant manufacturer.

For FORKARDT chucks, please refer to the Operating Manual or product brochure.

### 4.4.2 Example calculation

Power chuck type: 3 KTG 250  
 Max. actuating force  $F_{ax}$ : 7000 daN  
 Jaw type: hard top jaws  
 type HB 12  
 Gripping diameter  $D_{sp}$ : 160 mm  
 Operating spindle speed  $n$ : 3000 rpm  
 Chuck constant  $C1$ : 909 mm  
 Chuck constant  $C2$ : 424 mm  
 Chuck constant  $C3$ : 0,4 kgm  
 Jaw overhang  $a$ : 45 mm  
 Number of jaws  $i$ : 3



How high is stationary gripping force  $F_{sp0}$  ( $n = 0$ ), and how high is the gripping force at spindle speed?

$n = 3000$  rpm  
 $D_{sp} = 160$  mm  
 $Y_{ab} = 18,12$  mm  
 Jaw weight  $G = 1,416$  kg per jaw

#### Radius of centre of gravity of top jaws $Ra$

$$Ra = \frac{D_{sp}}{2} + Y_{ab} = \frac{160}{2} + 18,12 = 98,12 \text{ mm}$$

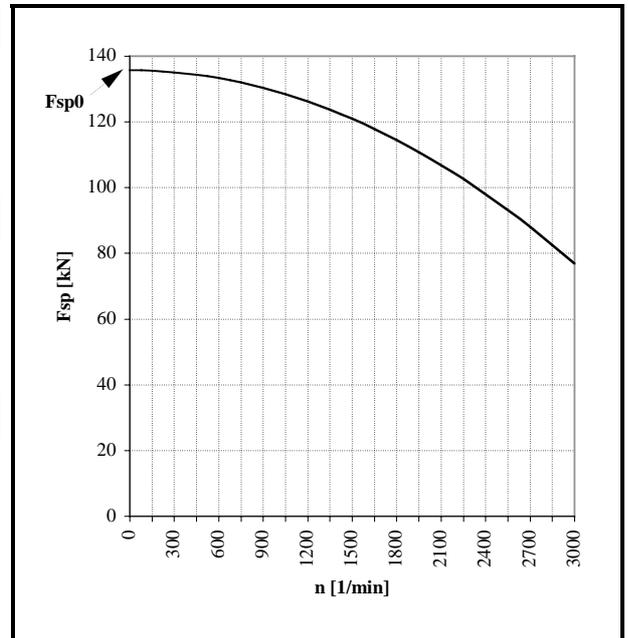
#### ⑤ Total moment of top jaws $Ma$

$$Ma = \frac{Ra * G * i}{1000} = \frac{98,12 * 1,416 * 3}{1000} = 0,417 \text{ kgm}$$

#### ② Stationary gripping force ( $n = 0$ )

$$F_{sp0} = \frac{C1}{C2 + a} * F_{ax}$$

$$F_{sp0} = \frac{909}{424 + 45} * 7000 = 13567 \text{ daN} \approx 135,7 \text{ kN}$$



#### ④ Dynamic gripping force at spindle speed $n = 3000$ rpm

$$F_{sp} = \left( \frac{C1}{C2 + a} * F_{ax} \right) - 0,0008 * (C3 + Ma) * n^2 = \left( \frac{909}{424 + 45} * 7000 \right) - 0,0008 * (0,4 + 0,417) * 3000^2$$

$$F_{sp} = 13567 - 5882 = 7685 \text{ daN} \approx 76,9 \text{ kN}$$

## **5.0 Troubleshooting guide**

### **5.1 Electrical faults**

When the battery symbol is permanently illuminated on the display, a reliable reading can no longer be guaranteed. The gripping force meter must be recharged. It is possible to use the meter while recharging, however this lengthens recharging time.

The display and  $\uparrow\downarrow$  sign begin to flash when the gripping force meter is exposed to a load of greater than 100% of the maximum value. Overloading up to 120% of the maximum is of no consequence to the meter. If the gripping force falls below 100% again, the meter returns to normal display mode again.

**Attention!** By overloading greater than 120%, the reading value is no longer displayed. The  $\uparrow\downarrow$  sign continues to flash. A critical overload limit has been reached which, under certain circumstances, may lead to lasting distortion of the measuring bolts. This causes displacement of the zero-point.

**Attention!** If the zero-point has been displaced more than once by previous overloading, a further overload of less than 120% may lead to the display being shut off. Again this is shown by the flashing  $\uparrow\downarrow$  sign

The gripping force meter automatically carries out an adjustment of the zero-point when it is switched on. If the zero-point has been displaced by more than 20% of the maximum measuring range value the display flashes. This indicates previous mechanical overloading of the gripping force meter and lasting distortion of the measuring bolt. In this case, the meter should be returned to FORKARDT for testing and repair.

### **5.2 Mechanical damage**

The SKM 1200 and SKM 1500 gripping force meters are robustly constructed. Should the unit, however, have been damaged in any way, it should be returned for testing and repair.

Worn or lost tension and compression bolts may be re-ordered from FORKARDT as follows:

**SKM 1200** set of tension and compression bolts Ident-No. 300224003

**SKM 1500** set of tension and compression bolts Ident-No. 300229003

### **5.3 Replacement parts and service address**

To order replacement parts or for repairs please contact your nearest FORKARDT Operation or:

**FORKARDT Deutschland GmbH**

**Phone: +49 7127 5812 0**

**Email: [info@forkardt.com](mailto:info@forkardt.com)**

**Website: [www.forkardt.com](http://www.forkardt.com)**





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## FORKARDT LOCATIONS

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