KAISER

Cutting Data Tables

FOR MACHINE OPERATORS
NC - PROGRAMMERS
AND WORK PLANNERS

Contents

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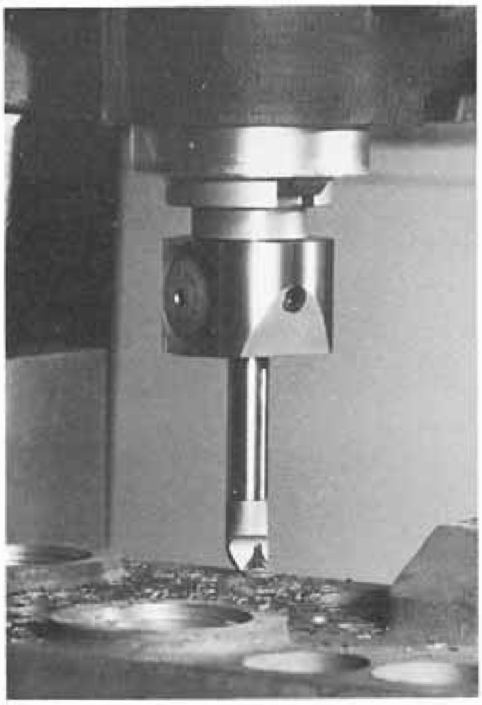
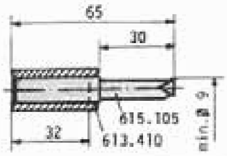
Cutting Data Tables

for KAISER boring tools



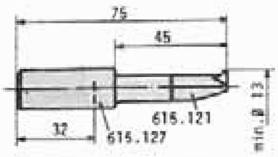
Single-cutter boring heads 112/EW 2-40



Boring diameter range 9-15 mm

1

Material	Machining allowance Guide val. mm on dia.	Machining allowance min. - max. mm. on dia.	Carbide Tip Kaiser Art. No.	Carbide Tip Radius Grade	Cutting speed m/min	Feed rate mm/rev. Guide value for N7	Feed rate mm/rev. min. - max.
Ac 37/Ac 50 14 NiCr 14	0,2	0,1 - 0,4	651.833	0,2 TIT	140	0,07	0,05 - 0,12
Ck45/Ac60 2311/2312	0,2	0,1 - 0,4	651.833	0,2 TIT	130	0,07	0,05 - 0,12
X12CrNiMo18 8 4435/2080	0,2	0,1 - 0,3	651.833	0,2 TIT	120	0,07	0,05 - 0,1
GG 20 GGG 42	0,2	0,05- 0,4	651.623	0,3 K 10	110	0,08	0,05 - 0,12
Aluminium alloys	0,2	0,05- 0,4	651.723	0,3 K 10	150	0,08	0,05 - 0,12

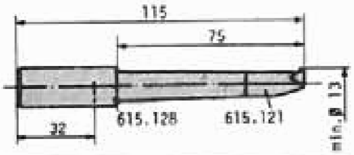


Boring diameter range 13-20 mm

2

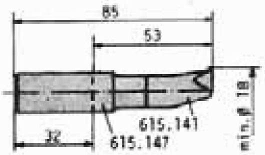
Material	Machining allowance Guide val. mm on dia.	Machining allowance min. - max. mm. on dia.	Carbide Tip Kaiser Art. No.	Carbide Tip Radius Grade	Cutting speed m/min	Feed rate mm/rev. Guide value for N7	Feed rate mm/rev. min. - max.
Ac 37/Ac 50 14 NiCr 14	0,2	0,1 - 0,5	651.833	0,2 TIT	160	0,07	0,05 - 0,15
Ck45/Ac60 2311/2312	0,2	0,1 - 0,5	651.833	0,2 TIT	150	0,07	0,05 - 0,15
X12CrNiMo18 8 4435/2080	0,2	0,1 - 0,4	651.833	0,2 TIT	140	0,07	0,05 - 0,12
GG 20 GGG 42	0,2	0,1 - 0,6	651.623	0,3 K 10	110	0,08	0,05 - 0,15
Aluminium alloys	0,2	0,1 - 0,6	651.723	0,3 K 10	180	0,08	0,05 - 0,15

TIT = multi-coated

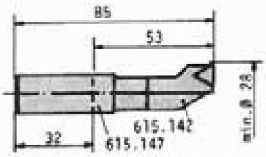


Boring diameter range 13-20 mm

	Material	Machining allowance Guide val. mm on dia.	min. - max. mm on dia.	Carbide Tip Kaiser Art. No.	Radius Grade	Cutting speed m/min	Feed rate mm/rev. Guide value for N7	min. - max.
3	Ac 37/Ac 50 14 NiCr 14	0,2	0,1 - 0,3	651.833	0,2 TIT	140	0,07	0,05 - 0,15
	Ck45/Ac60 2311/2312	0,2	0,1 - 0,3	651.833	0,2 TIT	130	0,07	0,05 - 0,15
	X12CrNiMo18 8 4435/2080	0,2	0,1 - 0,25	651.833	0,2 TIT	120	0,07	0,05 - 0,12
	GG 20 GGG 42	0,2	0,05- 0,3	651.623	0,3 K 10	110	0,08	0,05 - 0,15
	Aluminium alloys	0,2	0,05- 0,4	651.723	0,3 K 10	150	0,08	0,05 - 0,15

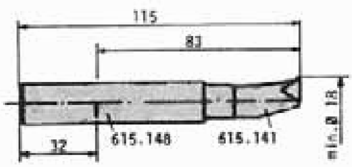


Ø 18-30 mm

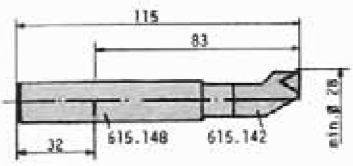


Ø 28-42 mm

	Material	Machining allowance Guide val. mm on dia.	min. - max. mm on dia.	Carbide Tip Kaiser Art. No.	Radius Grade	Cutting speed m/min	Feed rate mm/rev. Guide value for N7	min. - max.
4	Ac 37/Ac 50 14 NiCr 14	0,3	0,15 - 0,9	651.233	0,4 TIT	200	0,1	0,08 - 0,15
	Ck45/Ac60 2311/2312	0,3	0,15 - 0,8	651.233	0,4 TIT	180	0,1	0,08 - 0,15
	X12CrNiMo18 8 4435/2080	0,3	0,15 - 0,7	651.233	0,4 TIT	150	0,1	0,08 - 0,15
	GG 20 GGG 42	0,2	0,1 - 0,9	651.423	0,4 K 10	120	0,1	0,06 - 0,15
	Aluminium alloys	0,3	0,1 - 0,9	651.523	0,4 K 10	200	0,1	0,08 - 0,15



Ø 18-30 mm



Ø 28-42 mm

	Material	Machining allowance Guide val. mm on dia.	min. - max. mm on dia.	Carbide Tip Kaiser Art. No.	Radius Grade	Cutting speed m/min	Feed rate mm/rev. Guide value for N7	min. - max.
5	Ac 37/Ac 50 14 NiCr 14	0,3	0,15 - 0,7	651.233	0,4 TIT	140	0,1	0,08 - 0,15
	Ck45/Ac60 2311/2312	0,3	0,15 - 0,6	651.233	0,4 TIT	130	0,1	0,08 - 0,15
	X12CrNiMo18 8 4435/2080	0,3	0,15 - 0,5	651.233	0,4 TIT	120	0,1	0,08 - 0,15
	GG 20 GGG 42	0,2	0,1 - 0,7	651.423	0,4 K 10	110	0,1	0,06 - 0,15
	Aluminium alloys	0,3	0,1 - 0,9	651.523	0,4 K 10	150	0,1	0,08 - 0,15

TIT = multi-coated

Single cutter boring tools 312

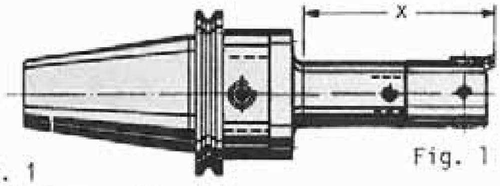


Fig. 1

Boring diameter range 20-26 mm

Boring head 312.101 / tip holder 625.151

Guide data for boring depth x = 65 mm, preferably as per Fig. 1

6

Material	Machining allowance Guide val. mm on dia.	min. - max. mm on dia.	Carbide Tip Kaiser Art. No.	Radius Grade	Cutting speed m/min	Feed rate mm/rev. Guide value for N7	min. - max.
Ac 37/Ac 50 14 NiCr 14	0,2	0,1 - 0,5	651.833	0,2 TIT	160	0,07	0,05 - 0,15
Ck45/Ac60 2311/2312	0,2	0,1 - 0,5	651.833	0,2 TIT	150	0,07	0,05 - 0,15
X12CrNiMo18 8 4435/2080	0,2	0,1 - 0,3	651.833	0,2 TIT	140	0,07	0,05 - 0,12
GG 20 GGG 42	0,2	0,1 - 0,6	651.623	0,3 K 10	110	0,08	0,05 - 0,15
Aluminium alloys	0,2	0,1 - 0,6	651.723	0,3 K 10	180	0,08	0,05 - 0,15

Boring diameter range 25-33 mm

Boring head 312.201 / tip holder 625.251

Guide data for boring depth x = 80 mm, preferably as per Fig. 1

7

Material	Machining allowance Guide val. mm on dia.	min. - max. mm on dia.	Carbide Tip Kaiser Art. No.	Radius Grade	Cutting speed m/min	Feed rate mm/rev. Guide value for N7	min. - max.
Ac 37/Ac 50 14 NiCr 14	0,2	0,1 - 0,6	651.833	0,2 TIT	180	0,07	0,05 - 0,15
Ck45/Ac60 2311/2312	0 2	0,1 - 0,6	651.833	0,2 TIT	160	0,07	0,05 - 0,15
X12CrNiMo18 8 4435/2080	0,2	0,1 - 0,4	651.833	0,2 TIT	150	0,07	0,05 - 0,12
GG 20 GGG 42	0,2	0,1 - 0,7	651.623	0,3 K 10	110	0,08	0,05 - 0,15
Aluminium alloys	0,2	0,1 - 0,7	651.723	0,3 K 10	200	0,08	0,05 - 0,15

TIT = multi-coated

Boring diameter range 32-42 mm

Boring head 312.301 / tip holder 625.351

Guide data for boring depth x = 100 mm

8

Material	Machining allowance Guide val. mm on dia.	min. - max. mm on dia.	Carbide Tip Kaiser Art. No.	Radius Grade	Cutting speed m/min	Feed rate mm/rev. Guide value for N7	min. - max.
Ac 37/Ac 50 14 NiCr 14	0,2	0,1 - 0,6	651.833	0,2 TIT	200	0,07	0,05 - 0,15
Ck45/Ac60 2311/2312	0,2	0,1 - 0,6	651.833	0,2 TIT	180	0,07	0,05 - 0,15
X12CrNiMo18 8 4435/2080	0,2	0,1 - 0,6	651.833	0,2 TIT	150	0,07	0,05 - 0,12
GG 20 GGG 42	0,2	0,1 - 0,7	651.623	0,3 K 10	110	0,08	0,05 - 0,15
Aluminium alloys	0,2	0,1 - 0,7	651.723	0,3 K 10	200	0,08	0,05 - 0,15

Note: Tip holder 625.352 only up to x = 115 mm, cutting data see dia. 41-54 (tip IC = 6.35 mm)

Single cutter boring tools

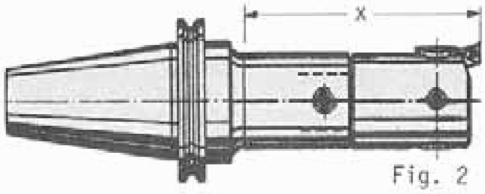


Fig. 2

Boring diameter range 41-54 mm

Boring head 312.401 / tip holder 625.451

Guide data for boring depth x = 130 mm

9

Material	Machining allowance Guide val. mm on dia.	Machining allowance min. - max. mm on dia.	Carbide Tip Kaiser Art. No.	Carbide Tip Radius Grade	Cutting speed m/min	Feed rate mm/rev. Guide value for N7	Feed rate mm/rev. min. - max.
Ac 37/Ac 50 14 NiCr 14	0,3	0,15 - 1,0	651.233	0,4 TIT	200	0,1	0,08 - 0,15
Ck45/Ac60 2311/2312	0,3	0,15 - 1,0	651.233	0,4 TIT	180	0,1	0,08 - 0,15
X12CrNiMo18 8 4435/2080	0,3	0,15 - 0,6	651.233	0,4 TIT	150	0,1	0,08 - 0,15
GG 20 GGG 42	0,3	0,1 - 1,0	651.423	0,4 K 10	110	0,1	0,05 - 0,15
Aluminium alloys	0,3	0,15 - 1,0	651.523	0,4 K 10	200	0,1	0,08 - 0,15

Note: Tip holder 625.453, cutting data see dia. 32-42 (tip IC = 4,2 mm)

Boring diameter range 53-150 mm

Boring heads 312.501/601/603 / tip holders 625.551/651

Guide data for boring depth x = 160 mm

10

Material	Machining allowance Guide val. mm on dia.	Machining allowance min. - max. mm on dia.	Carbide Tip Kaiser Art. No.	Carbide Tip Radius Grade	Cutting speed m/min	Feed rate mm/rev. Guide value for N7	Feed rate mm/rev. min. - max.
Ac 37/Ac 50 14 NiCr 14	0,3	0,15 - 1,0	651.233	0,4 TIT	220	0,1	0,08 - 0,15
Ck45/Ac60 2311/2312	0,3	0,15 - 1,0	651.233	0,4 TIT	180	0,1	0,08 - 0,15
X12CrNiMo18 8 4435/2080	0,3	0,15 - 0,8	651.233	0,4 TIT	150	0,1	0,08 - 0,15
GG 20 GGG 42	0,3	0,1 - 1,0	651.423	0,4 K 10	110	0,1	0,05 - 0,15
Aluminium alloys	0,3	0,15 - 1,0	651.523	0,4 K 10	250	0,1	0,08 - 0,15

N7 (Ra = 1,6 µm)

Boring diameter range 150-500 mm

Boring head 315.101 / tip holder 625.751

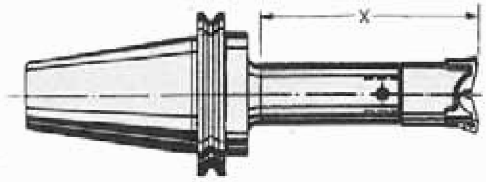
Guide data for boring depth x = 260 mm (ISO 50 x CK7 = shank dia. 90 mm)

11

Material	Machining allowance Guide val. mm on dia.	Machining allowance min. - max. mm on dia.	Carbide Tip Kaiser Art. No.	Carbide Tip Radius Grade	Cutting speed m/min	Feed rate mm/rev. Guide value for N7	Feed rate mm/rev. min. - max.
Ac 37/Ac 50 14 NiCr 14	0,3	0,15 - 1,0	651.233	0,4 TIT	200	0,1	0,08 - 0,15
Ck45/Ac60 2311/2312	0,3	0,15 - 1,0	651.233	0,4 TIT	180	0,1	0,08 - 0,15
X12CrNiMo18 8 4435/2080	0,3	0,15 - 1,0	651.233	0,4 TIT	150	0,1	0,08 - 0,15
GG 20 GGG 42	0,3	0,1 - 1,0	651.423	0,4 K 10	110	0,1	0,05 - 0,15
Aluminium alloys	0,3	0,15 - 1,0	651.523	0,4 K 10	200	0,1	0,08 - 0,15

TIT = multi-coated

Twin cutter roughing tools 314



Boring diameter range 25-33 mm

Boring head 314.201 / tip holder 637.121

Guide data for boring depth x = 80 mm

	Material	Machining allowance Guide val. mm on dia.	min. - max. mm on dia.	Carbide Tip Kaiser Art. No.	Radius Grade	Cutting speed m/min	Feed rate mm/rev. Guide value for N7	min. - max.
	Ac 37/Ac 50 14 NiCr 14	2,5	0,5 - 3,5	654.183	0,5 P 20	130	0,25	0,2 - 0,35
12	Ck45/Ac60 2311/2312	2,5	0,5 - 3,5	654.183	0,5 P 20	120	0,25	0,2 - 0,3
	X12CrNiMo18 8 4435/2080	2,5	0,5 - 3	654.183	0,5 P20	100	0,25	0,2 - 0,3
	GG 20 GGG 42	4	0,5 - 6	654.128	0,5	100	0,25	0,15 - 0,3
	Aluminium alloys	3	0,5 - 6	654.187	0,5	150	0,25	0,15 - 0,3

Boring diameter range 32-42 mm

Boring head 314.301 / tip holder 637.131

Guide data for boring depth x = 100 mm

	Material	Machining allowance Guide val. mm on dia.	min. - max. mm on dia.	Carbide Tip Kaiser Art. No.	Radius Grade	Cutting speed m/min	Feed rate mm/rev. Guide value for N7	min. - max.
	Ac 37/Ac 50 14 NiCr 14	3,5	1 - 4,5	654.240	0,4 TIT	200	0,35	0,3 - 0,45
13	Ck45/Ac60 2311/2312	3,5	1 - 4,5	654.240	0,4 TIT	180	0,3	0,3 - 0,45
	X12CrNiMo18 8 4435/2080	3	1 - 4	654.240	0,4 TIT	150	0,35	0,3 - 0,45
	GG 20 GGG 42	5	1 - 7	654.259	0,8 K 30	100	0,3	0,2 - 0,4
	Aluminium alloys	5	1 - 7	654.287	0,8 TIT	200	0,35	0,3 - 0,45

Boring diameter range 41-54 mm

Boring head 314.401 / tip holder 637.141

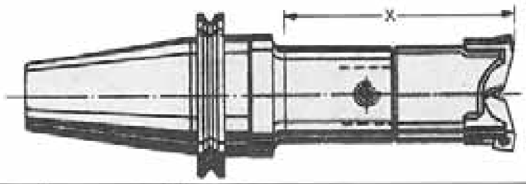
Guide data for boring depth x = 130 mm

	Material	Machining allowance Guide val. mm on dia.	min. - max. mm on dia.	Carbide Tip Kaiser Art. No.	Radius Grade	Cutting speed m/min	Feed rate mm/rev. Guide value for N7	min. - max.
	Ac 37/Ac 50 14 NiCr 14	4	1 - 5	654.240	0,4 TIT	200	0,35	0,3 - 0,5
14	Ck45/Ac60 2311/2312	4	1 - 5	654.240	0,4 TIT	180	0,3	0,3 - 0,45
	X12CrNiMo18 8 4435/2080	3,5	1 - 4,5	654.240	0,4 TIT	150	0,35	0,3 - 0,5
	GG 20 GGG 42	6	1 - 8	654.259	0,8 K 30	100	0,3	0,2 - 0,4
	Aluminium alloys	6	1 - 8	654.287	0,8 K 10	200	0,35	0,3 - 0,45

TIT = multi-coated

Twin cutter roughing tools

Boring diameter range 53-70 mm



Boring head 314.501 / tip holder 637.151

Guide data for boring depth x = 160 mm

15

Material	Machining allowance		Carbide Tip		Cutting	Feed rate mm/rev.	
	Guide val. mm on dia.	min. - max. mm on dia.	Kaiser Art. No.	Radius Grade	speed m/min	Guide value for N7	min. - max.
Ac 37/Ac 50 14 NiCr 14	6	1,5 - 8	654.340	0,4 TIT	220	0,45	0,4 - 0,6
Ck45/Ac60 2311/2312	6	1,5 - 8	654.340	0,4 TIT	200	0,4	0,3 - 0,55
X12CrNiMo18 8 4435/2080	6	1,5 - 7	654.340	0,4 TIT	150	0,45	0,4 - 0,6
GG 20 GGG 42	10	1 - 12	654.359	0,8 K 30	100	0,4	0,2 - 0,45
Aluminium alloys	10	1,5 - 12	654.387	0,8 K10	250	0,45	0,4 - 0,6

Note: Tip 654.350 permits about 15% higher feed rates with suitably reduced machining allowance

Boring diameter range 68-150 mm

Boring heads 314.601/603 / tip holders 637.161/62/63/64

Guide data for boring depth x = 160 mm

16

Material	Machining allowance		Carbide Tip		Cutting	Feed rate mm/rev.	
	Guide val. mm on dia.	min. - max. mm on dia.	Kaiser Art. No.	Radius Grade	speed m/min	Guide value for N7	min. - max.
Ac 37/Ac 50 14 NiCr 14	10	1,5 - 12	654.340	0,4 TIT	220	0,45	0,4 - 0,55
Ck45/Ac60 2311/2312	10	1,5 - 12	654.340	0,4 TIT	200	0,4	0,3 - 0,55
X12CrNiMo18 8 4435/2080	7	1,5 - 9	654.340	0,4 TIT	150	0,45	0,4 - 0,6
GG 20 GGG 42	12	1 - 14	654.359	0,8 K 30	100	0,4	0,2 - 0,45
Aluminium alloys	12	1 - 14	654.387	0,8 K 10	250	0,45	0,4 - 0,6

TIT = multi-coated

Boring diameter range 150-310 mm

Boring heads 316.101/201/301 / tip holders 636.741/841

Guide data for boring depth x = 260 mm (ISO 50 x CK7 = shank dia. 90 mm)

17

Material	Machining allowance		Carbide Tip		Cutting	Feed rate mm/rev.	
	Guide val. mm on dia.	min. - max. mm on dia.	Kaiser Art. No.	Radius Grade	speed m/min	Guide value for N7	min. - max.
Ac 37/Ac 50 14 NiCr 14	13	2 - 15	654.740	0,8 TIT	130	0,45	0,4 - 0,55
Ck45/Ac60 2311/2312	13	2 - 15	654.740	0,8 TIT	120	0,4	0,3 - 0,5
X12CrNiMo18 8 4435/2080	12	2 - 15	654.740	0,8 TIT	100	0,45	0,4 - 0,55
GG 20 GGG 42	16	1 - 25	654.747	0,8 K 10	100	0,4	0,2 - 0,45
Aluminium alloys	16	1 - 25	654.777	0,8 K 10	250	0,45	0,4 - 0,6

Notes on the cutting data tables

Finish-machining, single cutter boring heads (tables 1 to 11)

1. Machining allowance

All machining allowance data refer to the bore diameter, since the setting and reading scales on the boring and gauging tools are also referred to the diameter.

1.1 Guide value

The recommended guide data permit clean chip separation, favourable chip formation and uncomplicated chip removal.
In finish-machining, the type of chip produced depends roughly equally on the magnitude of the machining allowance and on the feed rate.

We have: increased machining allowance ⇒ increased chip formation

increased feed rate ⇒ increased chip formation

Changing the feed rate, however, also influences the surface finish. In finish-machining, therefore, chip formation may be essentially influenced only by the machining allowance.

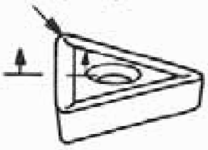
Ideal chip form when finish-machining steel with carbide tips

1.2 Minimum machining allowance

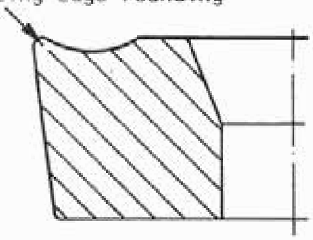
The minimum possible machining allowance depends on the shape and condition of the cutting edge, i.e. the sharper the cutting edge, the smaller may be the smallest chip that can be separated.

DO NOT confuse cutting edge rounding with cutting edge radius.

Cutting edge radius



Cutting edge rounding



Practical values for cutting edge rounding

Cutting material	Type of cutting edge	Cutting edge	Min. possible machining allowance mm on dia. *	Min. feed rate on dia. *	Cutting pressure withdrawal mark
HSS	ground and honed	very sharp	0.004	0.03	very slight
HM	ground	sharp	0.006	0.03	very slight
HM	ground and coated	slight rounding	0.01	0.04	slight
HM	sintered	distinct rounding	0.05	0.07	visible**
HM	sintered and coated	marked rounding	0.15	0.1	distinctly visible**

* Minimum values - attainable in the shop only under the most favourable conditions (in respect of tool and machine) and with enhanced attention in one-off production.

** For N7 surface finish tool must be withdrawn with cutter lifted clear.

If the cutting edge removes chips only intermittently, i.e. alternately cuts and does not cut, the rounding of the edge is too large or the machining allowance is too small. The minimum data stated in Table 1 to 11 for the machining allowance relate to series production with correct conditions. As a rule, however, a machining allowance in accordance with the guide data should be aimed at.

Important: Changing the cutting data (machining allowance, feed rate, cutting speed) may result in a change in dimensions.

Important note for machining individual bores:

Machining allowance and feed rate may affect flexing of the boring bar to a varying extent - and hence the diameter of the bore. In one-off production, therefore, the last two cuts should be performed under identical conditions. (Max. deviation of 10% for quality IT6 and 20% for IT7).

Example:

Manufacture of a bore diameter 22-H7, Material St 37 (guide data as per Table 4)

a) Tool diameter 21.15 mm;
   produces a bore with a diameter of about 21.4 mm, remaining machining allowance 0.6 mm on diameter

b) rough-finishing cut to 21.7 mm diameter (machining allowance 0.3 mm on dia.)

c) accurate gauging gives 21.72 mm diameter; there is a gap of 0.29 mm to middle of tolerance

d) open up by 0.29 mm on diameter

e) finishing cut to 22-H7 diameter

1.3 Maximum machining allowance

In finish-machining, the maximum possible machining allowance depends less on the size of the tip than on the shape and size of the chip breaker. All the tips recommended for the single-cutter finishing tools are designed for cutting small and extremely small chips. Excessive machining allowance leads of necessity to excessive compression of the chips, to clogging of the chip breaker and, in the extreme case, to fracture of the cutting edge. If the use of single-cutter tools cannot be avoided for rough-machining in an emergency, HSS cutting tools or cutting tools with brazed-on tips should preferably be used, and the cutting edge geometry must be tailored to the specific working conditions by regrinding. (Enlargement of the chip breaker.)

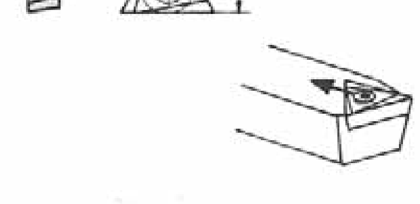
Special notes:

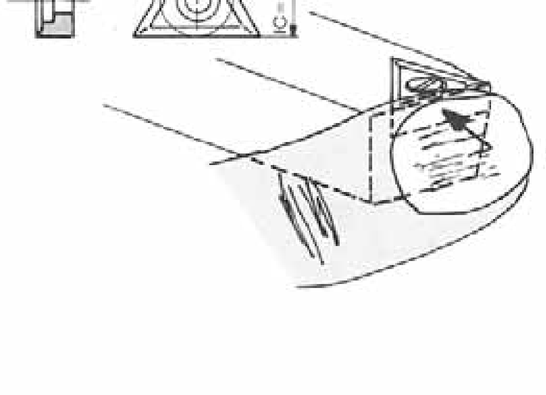
DO NOT combine maximum machining allowance with maximum feed rate. When boring soft steels tending to clog or glaze (e.g. 14 NiCr 14), use boring emulsion.

2. Carbide tips

The precision-ground tip with IC = 4.2 mm is pressed into contact with the mating and locating surfaces in the tip holder by a screw with conical head. The screw should be tightened with the special key only until the tip is firmly in contact with the face of the seating.

The larger tip (IC = 6.35 mm) is tightened with a fillister head screw. When tightened with a screw-driver (Size 2), the tip should be pressed into contact with the mating surfaces with the finger (see diagrams).





The tips recommended are tailored to the special requirements of internal turning. In combination with the guide data (machining allowance, feed rate, cutting speed) they produce excellent results. Unfavourable working conditions (long boring bars, unstable and thin-walled workpieces, inappropriate clamping devices, poor spindle bearings) may cause vibration and hence render clean, regular chip removal impossible.

Vibration can be stopped or reduced at the tool by the following measures, (which should be taken in the sequence given):

a) Use shorter boring bar, perhaps with stepped reductions, optimally matched to the workpiece.

b) Use a tip with smaller corner radius and as small as possible rounding of the cutting edge.

c) Reduce the cutting speed. (Use HSS cutting tools in the extreme case).

d) Equip boring bar with guide bushes and support inside the workpiece or on an auxiliary device.

In special cases special types of tips are more suitable instead of those recommended in Tables 1 to 11 (see Table below).

cutting edge radius		→	smaller	→	→
cutting edge		→	sharper	→	→
Tips as per Tables 1 to 11	651.833	651.723*	651.823*	HSS	Special ground cutting tools
	651.623	651.723	651.823	HM	
	651.723		651.823	HM	
	651.233	651.833*1)	651.123*	HSS	
	651.423	651.623*1)	651.123	HM	
	651.523	651.723*1)	651.123	HM	
Life		→	shorter	→	→
Stock removal capacity		→	smaller	→	→

* Because of their higher resistance to abrasion, the tips with small radii in application group K are also used for fine-finishing-steel.

1) These tips require special tip holders

Notes:

Smaller cutting edge radii and larger rake angles indicate high cutting ability of the tips and hence less susceptibility to vibration. Smaller radii, however, require lower feed rates with corresponding performance reductions (longer machining times).

3. Cutting speed

The data listed in the Tables give a life of not less than 20 minutes. When turning bores, the cutting speed is limited less by the life than by the tendency to vibration. Good, non-vibration conditions therefore also permit higher cutting speeds.

Effects of changes in cutting speed:

lower	←	**Cutting speed**	→	**higher**
longer	←	Machining time	→	shorter
rougher	←	Surface finish	→	finer
longer	←	Life	→	shorter
less	←	Tendency to vibration	→	more
longer boring bars and interrupted cuts possible	←		→	rational machining of soft steel possible (has the same effect as larger positiv rake angle)

4. Feed rate

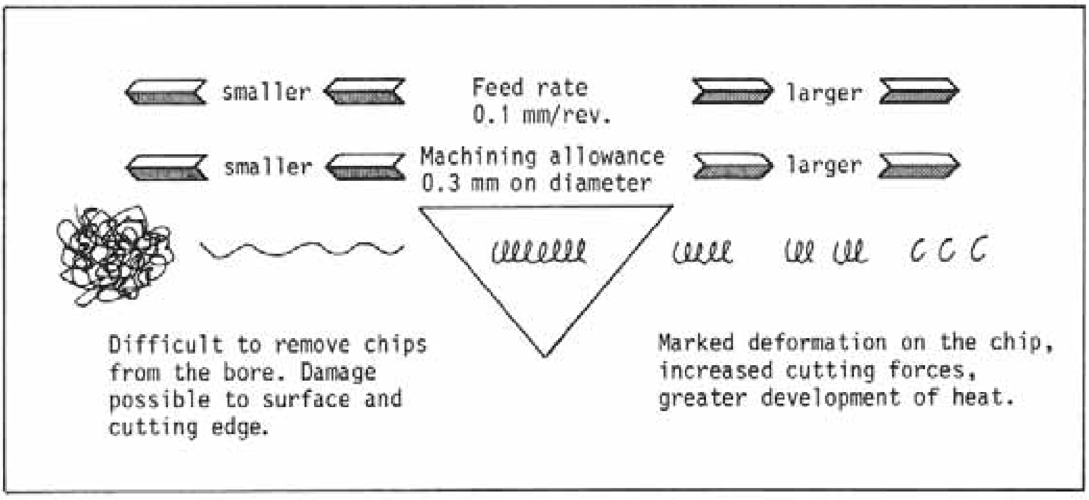
The required surface finish of the bore determines the magnitude of the feed rate. For a given tip radius, therefore, the feed rate can be varied within only narrow limits. This makes it impossible to change the chip type via the feed rate. In the case of long-chip materials, however, the type or shape of the removed chip is very important because this has to be removed from the bore as easily as possible. This can be achieved only by means of carefully selected cutting-edge geometry in combination with suitable cutting data. (See also Section 1.1, Page 1).

The following Table illustrates the connection between cutting edge radius, feed rate and surface finish of the bore produced.

Cutting edge radius	Feed rate mm/rev.	
0.4	0.10	0.12
0.3	0.08	0.10
0.2	0.06	0.08
0.1	0.04	0.06
	N7	N8
	Surface finish	

finish N7, Ra=1,6 µm   finish N8, Ra=3,2 µm

Influencing the chip shape/form by changing feed rate and machining allowance (example for tip 651.233, Material St 50):



5. Cooling

Fine machining of workpieces in steel or grey iron with carbide cutting edges is normally performed without coolant. When fine-finishing bores of maximum precision, however, cooling may prevent any thermal expansion of the workpiece and, more specifically, of the cutting edge.

Special coolants are recommended for machining light alloys. Ordinary boring emulsion is adequate for one-off production.

Rough-machining, twin-cutter boring heads (tables 12 to 17)

1. Machining allowance

All machining allowance data refer to the bore diameter, since the setting and reading scales on the boring and gauging tools are also referred to the diameter.

1.1 Guide value

The recommended guide data permit clean chip separation, favourable chip formation and uncomplicated chip removal. Short chips are an absolute must when rough-machining bores. Long chips clog the chip space on the tool, which may lead to damage to the tool and to the cutting edge. Short, broken C-shaped chips are obtained by correct matching of machining allowance, feed rate and cutting-edge geometry.

1.2 Minimum machining allowance

Not any machining allowances can be removed with the tips intended for rough-machining (there is a limit to the "smallness" of the machining allowance). In certain circumstances the stated minimum values no longer permit optimum chip formation. Entangled chips may be produced, and their removal is difficult and time consuming (don't put your fingers in there, use a chip hook).

1.3 Maximum machining allowance

The maximum possible machining allowance does not depend solely on the tool, but in certain circumstances is limited by:

a) the machine power available

b) unfavourable chip formation

c) the length of the boring bar

d) development of a lot of heat

e) unstable workpieces

2. Carbide Tips

The recommended tips meet the special requirements for rough-machining bores in respect of cutting edge geometry, chip breaker and grade of carbide used. Assuming correct setting of the tool, short, broken chips are produced, provided the guide data and the special notes in Section 4 (Feed rate) are complied with.

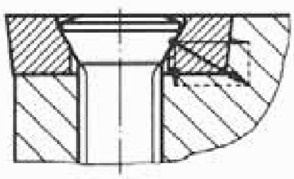
2.1 Fixing the tips

The method of fixing used (countersunk screws) is distinguished by two features which are important in machining bores:

a) Absolutely correct, positive mechanical location of the tips

b) No clamping elements whatsoever which hinder chip flow.

In addition, the absolute minimum of spare parts is needed (1 screw)



The clamping screw with a taper of 40° ensures intimate, close contact of the tip with the seating and also leaves sufficient room for chip breakers in the case of small tips.

Tighten the clamping screw only until the tip is in close contact with the mating surface of the seating (in actual practice the screws are often tightened excessively, and this of necessity leads to difficulties when dismantling). Replace defective screws and keys at once.

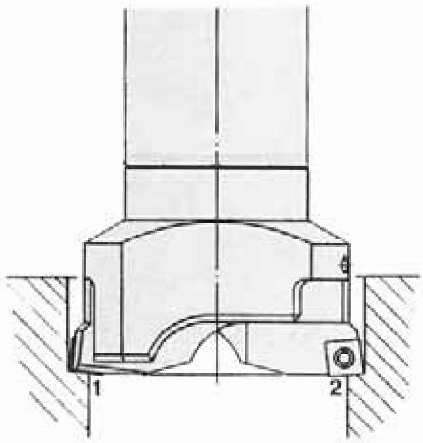
3. Cutting speed

The data listed in the Tables give a life of not less than 20 minutes. When turning bores, the cutting speed is limited less by the life than by the tendency to vibration. Good, non-vibration conditions therefore also permit higher cutting speeds. Special attention must be paid to chip removal in tight, stepped or blind bores.

4. Feed rate

4.1 Rotationally symmetrical cutting edges (cutting edges with same setting in respect of diameter and height)

The feed rate data stated in the Tables are applicable to two-lip tools with rotationally symmetrical arrangement of the cutting edges, i.e. the recommended spindle feed rate has only half the set effect on the single cutting edge. However, this is true only if the two cutting edges are set to the same height or level. Even a slight shift, caused for example by the manufacturing tolerance of the tips, may have a very disadvantageous effect on the machining process (especially in the case of materials producing long chips).



Example:

Feed rate 0.4 mm/rev.
One cutting edge (1) projects 0.05 mm beyond the other cutting edge (2).
(Dimensional differences of the tips used, Type SCMM 1205, permissible tolerance 0.08 mm as per ISO).

Chip thickness for cutting edge 1 = 0.20 mm (half feed rate)
+ 0.05 mm (shift)
0.25 mm

Chip thickness for cutting edge 2 = 0.20 mm (half feed rate)
- 0.05 mm (shift)
0.15 mm

Chip 1 is 67 % thicker than chip 2, which has the following practical effects:

a) Unequal loading of the two cutting edges, "wobbling" of the boring bar, extra load on the bearing of the machine.
b) As a rule, the bore diameter becomes larger than that set on the tool.
c) When machining long-chip materials, uniform chip formation is not possible. The cutting edge set to the rear usually produces excessively long chips which clog the chip space and may lead to fracture of the cutting edge.

Careful presetting of the two-lip boring heads is therefore an absolute necessity. The Table below lists the limit values permissible in practice for height and diameter differences.

Boring diameter range mm	Max. permissible difference Height mm	Diameter mm
25 - 33	0.015	0.2
32 - 42	0.02	0.3
41 - 54	0.025	0.3
53 - 70	0.03	0.4
68 - 150	0.04	0.4
150 - 500	0.05	0.5

With the two-cutter rough-machining tool the height setting is more important than the diametral setting;

Rule of thumb: set the cutting edges 10 times more accurately for height than the diameter.

A hint for setting the tool: set the diameter first, then the cutting edge height.

Ideal chip shapes/forms when rough-machining steel with carbide tips:

dia. up to 50 mm   dia. 50 - 100 mm   dia. 100 - 500 mm

If, despite careful setting of the tool with the guide data stated in the Tables, short chips are not produced, the feed rate may be increased up to the maximum value. This value may be exceeded (by up to about 15 %), provided the following conditions are complied with:

a) The machining allowance does not exceed the stated guide value.

b) There is no excessive displacement of the initial bore with respect to the axis of the tool.

c) The drive rating of the machine is adequate.

If the chips do not break, despite the measures just described, the tips must be used with smaller chip breakers.

Good feed rate data for tips with different chip breakers (Material St 37):

Tip			Width of chip breaker	Feed rate mm/rev.
Art.No.	Radius	Grade		
654.250	0,8	TIT	1,0	0,35
654.240	0,4	TIT	1,3	0,4
654.254	0,8	P30	1,6	0,4
654.340	0,4	TIT	1,6	0,45
654.350	0,8	TIT	2,2	0,6
654.354	0,8	P30	2,2	0,45

TIT = multi-coated

Principles:

- The smaller the chip breaker, the smaller is the feed rate needed for chip fracture.
- Uncoated tips require lower feed rates for proper breaking than coated tips of the same design (about 0,15 mm/rev.).

In addition to the chip breaker and the grade of carbide, the shape of the cross section of the chip influences chip fracture (relation between chip thickness and width).

Thin, wide chips (low feed rate and large machining allowance) can hardly be broken at all, from which it may be concluded that:

Favourable chip deformation (chip fracture) is achieved when feed rate and machining allowance bear a given relationship to each other:

Boring dia. range	Feed rate mm/rev.	Machining allowance mm on dia.	Relationship Feed rate:mach.allow.
25 - 33	0,25	2,5	1 : 10
32 - 42	0,35	3,5	1 : 10
41 - 54	0,35	4	1 : 11
53 - 70	0,45	6	1 : 13
68 - 150	0,45	8	1 : 18
150 - 310	0,45	13	1 : 29

The following general rule of thumb can be derived from this Table for St 37:

The relationship between feed rate and machining allowance (between chip thickness and chip width) must be between 1 : 10 for small bores and 1 : 30 for large bores.

Important: When machining a material for the first time or when machining a new batch, check chip fracture and adjust properly. It should be noted that rather longer chips are always produced in the edge zone as a rule (the determining factor here is chip fracture as from a depth of about 10 mm penetration).

4.2 Cutting edges with different setting for height and diameter

Larger machining allowances than stated in the Table can be completed in one machining cycle with offset cutting edges, though these must be at right angles to each other.

With the tool setting it must be ensured that cutting is uniformly distributed between the two cutting edges. The following procedere should be followed:

Advance cutting edge 1 (precutter) by the spindle feed in the feed direction as compared with cutting edge 2 and uniformly distribute the cutting work between the two cutting edges.

Important: Under these conditions the feed rate data stated in Tables 12 to 17 should be halved.

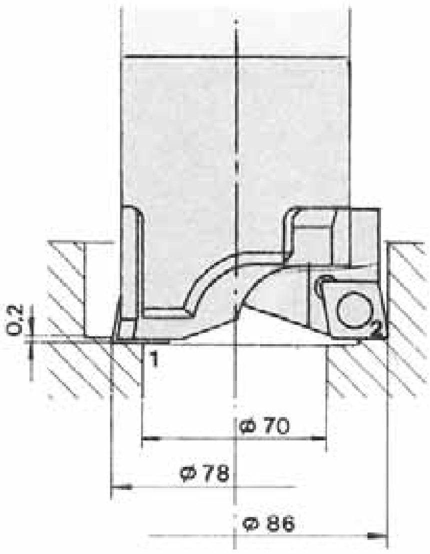
Example: Rough-machining diameter 70 mm to diameter 86 mm in CK45

Setting instructions:
Machining allowance 86 - 70 dia. = 16 mm, equals 8 mm per cutting edge.

Feed rate as per Table is 0,4 mm divided by 2 = 0,2 mm/rev.

Advance cutting edge 1 by 0,2 mm and set to 70 + 8 dia. = 78 mm

Set cutting edge 2 (is set back by 0,2 mm in relation to cutting edge 1) to 86 mm diameter



5. Cooling

When rough-machining one-off work and small batches on conventional machines, no coolant is normally employed. In machining centres with appropriate treatment of the coolant, cooling is recommended for the following reasons:

a) Good, continuous dissipation of heat.

b) Chips are flushed from the bore.

c) Clean working conditions, no casting dust.

Special coolants are recommended for machining light alloys. Ordinary boring emulsion is adequate for one-off and small batch production.

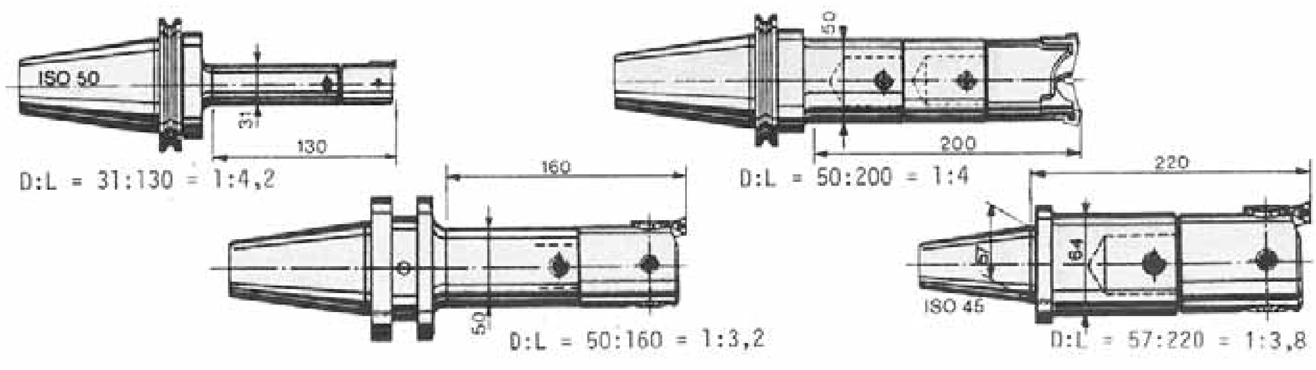
Principle:
Either no cooling at all or very intensive cooling.

Notes on length of boring bars

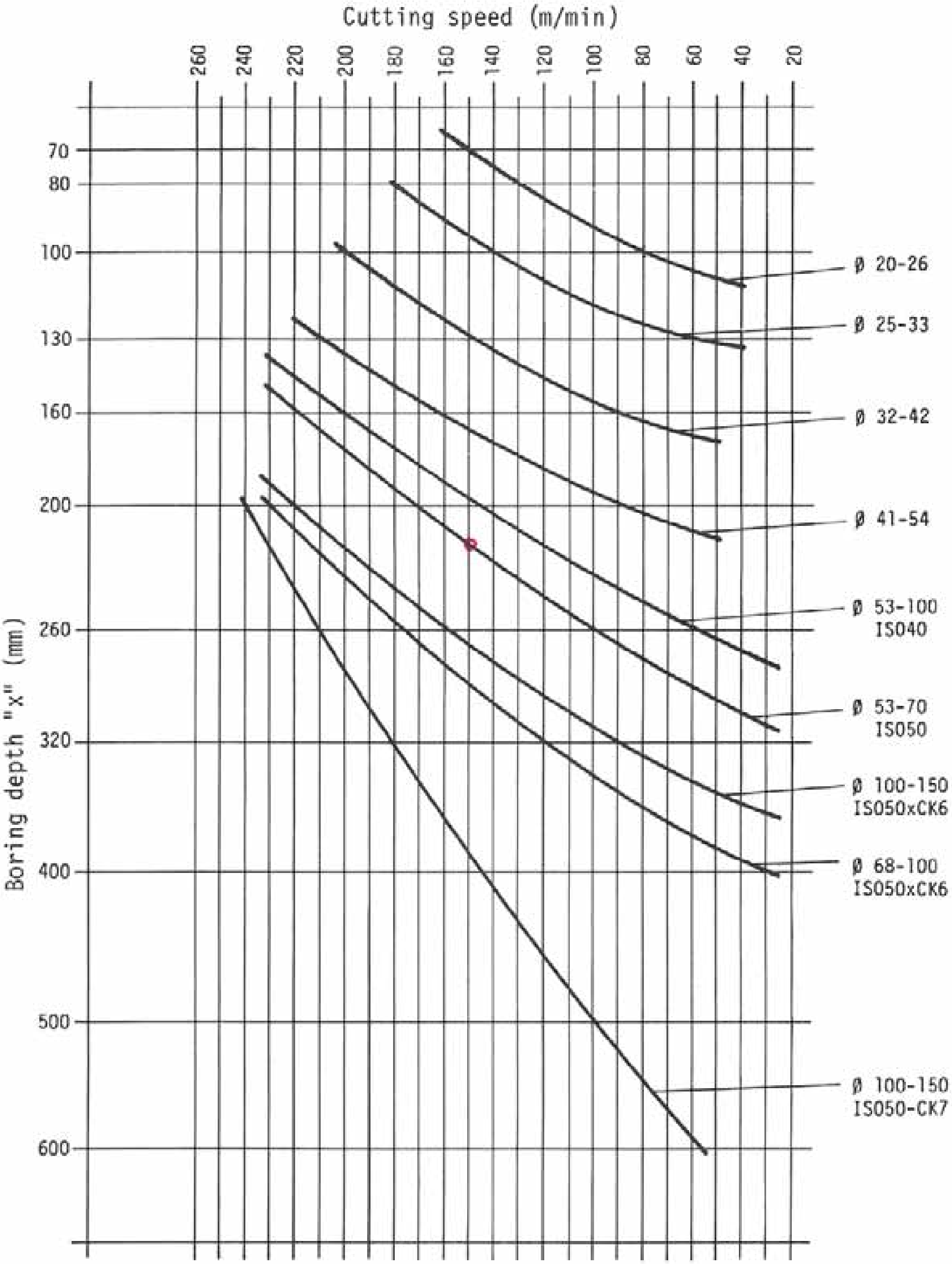
When using boring bars with a diameter/length ratio of up to 1 : 3 no problems arise, while with ratios of up to 1 : 4 they arise only rarely. Beyond this ratio vibration is to be increasingly expected, and in certain circumstances this can be suppressed only by drastically reducing the spindle speeds and hence the cutting speed.

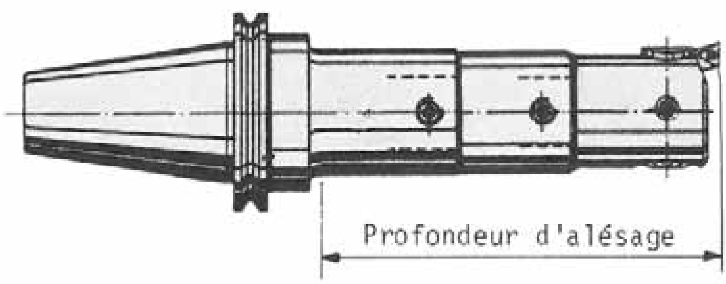
The cutting speeds recommended in Tables 6 to 17 relate to the stated tool combinations, assuming a machine of suitable performance and in good order is used. The guide data for the cutting speed for longer boring bars can be taken from the diagram on Page 16.

The diagram below shows some types of boring bar together with the theoretical diameter/length ratios.



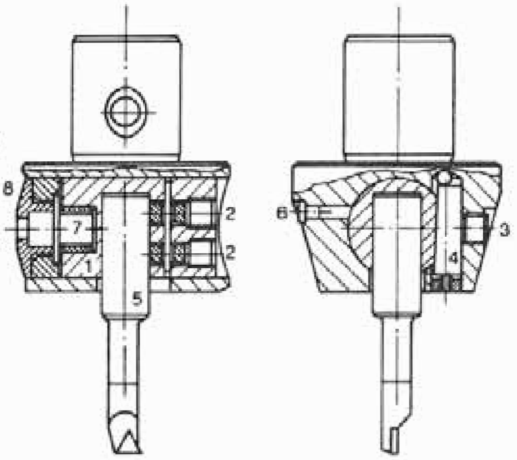
Guide data for the cutting speed when machining steel, taking into account the boring diameter and depth (length of the boring bar)





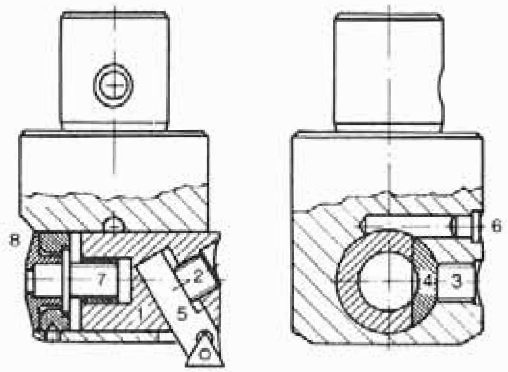
Instructions for use

Single-cutter boring heads 112/EW 2-40



- Insert the cutting tool or tip holder (5) - if necessary using a reducing bush - into the 16 mm dia. tool hole of the carrier (1). Align the cutting edge by the mark on the face of the boring head and tighten the 2 screws (2).
- Locate the carrier (1) in the desired position by rotating the set screw (7) with the clamping screw (3) released. The scale disc (8) enables the change in diameter to be read off accurately.
- Tighten the clamping screw (3).

Single-cutter boring heads 312



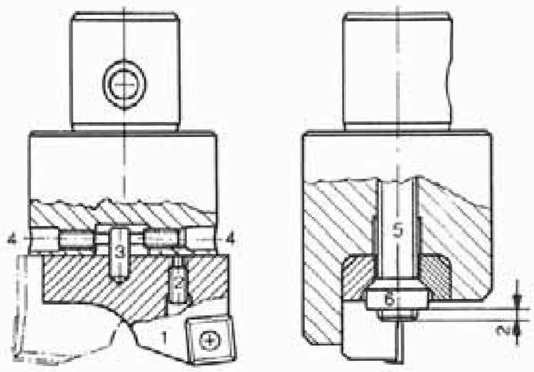
- Fix the cutting tool or tip holder (5) in the carrier (1) by means of the screw (2).
- Release the clamping screw (3).
- By rotating the set screw (7) shift the carrier (1) into the desired position. The scale disc (8) enables the change in diameter to be read of accurately.
- Tighten the clamping screw (3)

IMPORTANT:
Note that carrier travel is limited. DO NOT use force when adjusting. All screws must be tightened during boring operations

Periodic lubrication via the lube nipple (6) ensures high precision combined with long life. The lubrication oil is flung outwards inside the boring head during boring operations and thus prevents ingress of dirt.

A light machine oil is recommended, e.g. Mobil Vactra Oil No. 2, BP Olex HLP-D, Klüber Isoflex PDP 94.

Twin cutter roughing heads 314 (a setting device is needed for setting)*



- Insert a pair of tip holders (1) into the tool head and screw in the differential screw (5) with fitted nut (6). The differential screw must project about 2 mm beyond the nut.
- Back off all set screws (2, 4) until the tip holders are intimately in contact with the mating surfaces.
- Lightly clamp the tip holders by rotating the differential screw (5)
- Set the cutting edges individually to the required boring diameter by means of the set screws (4).
- Tighten the differential screw (5).
- Raise the lower cutting edge by means of set screw (2). The height setting is very important when boring long-chip materials; maximum permissible difference is 0.02 to 0.03 mm.

Important: It is normally not necessary to correct the diameter setting following setting the height with a rough-machining tool.

- Ligthly tighten all screws not needed for settings, in order to prevent them from falling out.

* If a presetting device is not available, the setting aid, Order No. 788.045, is very useful. It is also suitable for presetting single-lip boring heads in the diameter range from 20 to 150 mm.

Tool length, boring depth

Shanks

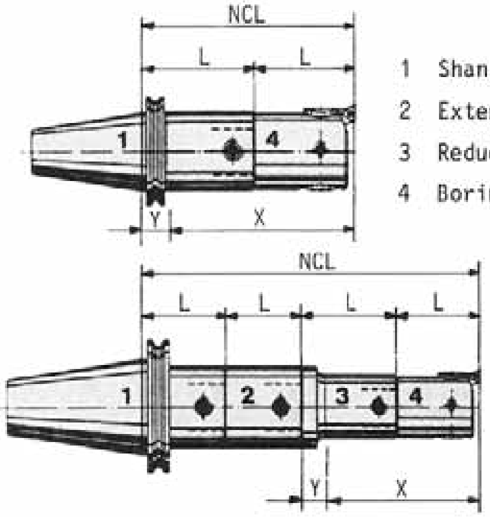
	X	ISO40/M16 DIN2080 Y=16 Order No	L	ISO50/M24 DIN2080 Y=20 Order No.	ATC	L	V40/M16 ANSI B5.50/DIN69871/ISO 7388 Y=40 Order No.	V45/M20	V50/M24	L	Order No	L	Order No	L
CK1	80	321.411	66,5	321.811	325.111	70,5	326.011	325.811	325.911	90,5				
	100	321.412	86,5	321.812		90,5		325.812	325.912	110,5				
CK2	80	321.421	60,5				326.021			84,5				
	100	321.422	80,5	321.822	325.122	84,5	326.022	325.822	325.922	104,5				
	130	321.423	110,5	321.823		114,5		325.823	325.923	134,5				
CK3	80	321.431	56				326.031			80				
	100			321.832	325.132	80		325.832	325.932	100				
	130	321.433	106	321.833	325.133	110	326.033	325.833	325.933	130				
	160	321.434	136	321.834		140			325.934	160				
CK4	80	321.441	49				326.041			73				
	100			321.842	325.142	73		325.842	325.942	93				
	160	321.444	129	321.844	325.144	133	326.044	325.844	325.944	153				
	200	321.445	169	321.845		173			325.945	193				
CK5	80	321.451	39				326.051			63				
	100			321.852	325.152	63		325.852	325.952	83				
	160	321.454	119	321.854	325.154	123	326.054	325.854	325.954	143				
	200	321.455	159	321.855	325.155	163		325.855	325.955	183				
	260			321.856		223			325.956	253				
CK6	100	321.462	45	321.862	325.162	49	326.062	325.862	325.962	69				
	160	321.464	105	321.864	325.164	109	326.064	325.864		129				
	200	321.465	145	321.865	325.165	149		325.865	325.965	169				
	260			321.866		209			325.966	229				
	320			321.867		269								
CK7	160			321.874	325.174	63		325.874	325.974	83				
	260			321.876		163								

Reductions

		Order No	X	Y	L
CK2	CK1	332.210	55	10,5	36
CK3	CK1	332.310	60	10	40,5
CK3	CK2	332.320	60	10	34,5
CK4	CK1	332.410	75	12	57,5
CK4	CK2	332.420	75	12	51,5
CK4	CK3	332.430	75	12	47
CK5	CK1	332.511	70	17	57,5
CK5	CK1	332.510	100	17	87,5
CK5	CK2	332.521	70	17	51,5
CK5	CK2	332.520	100	17	81,5
CK5	CK3	332.531	70	17	47
CK5	CK3	332.530	100	17	77
CK5	CK4	332.541	70	17	40
CK5	CK4	332.540	100	17	70
CK6	CK1	332.611	65	31	66,5
CK6	CK1	332.610	100	31	101,5
CK6	CK2	332.621	80	16	60,5
CK6	CK2	332.620	115	16	95,5
CK6	CK3	332.631	80	16	56
CK6	CK3	332.630	115	16	91
CK6	CK4	332.641	80	16	49
CK6	CK4	332.640	115	16	84
CK6	CK5	332.651	80	16	39
CK6	CK5	332.650	115	16	74
CK7	CK6	332.760	160	17	106
CK7	F97	316.780			47,5
CK7	F145	316.790			47,5

Extensions

	Order No	L
CK1	331.110	20
CK2	331.220	30
CK3	331.330	30
CK4	331.440	40
CK5	331.550	60
CK6	331.660	60
CK7	331.770	100



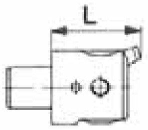
1 Shank
2 Extension
3 Reduction
4 Boring head

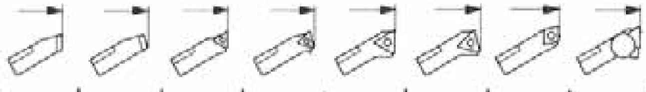
The tool length NCL (clamp datum point to front edge of cutting edge) of a composite boring bar is obtained by adding together the lengths L of the shanks, extensions, reductions and boring heads used. The boring depth X corresponds to the maximum penetration of the boring bar taking into account the length of the boring heads and the section Y not normally penetrating into the bore.

The length tolerances of the individual components should be kept so tight that under normal working conditions correct operation is ensured. If, however, special requirements have to be met in respect of the total length NCL, the boring bars must be gauged on a presetting device and appropriate corrections made tc the control system of the machine.

Boring heads

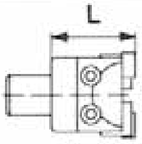
Single cutter heads
Type AW/EW × CK/F

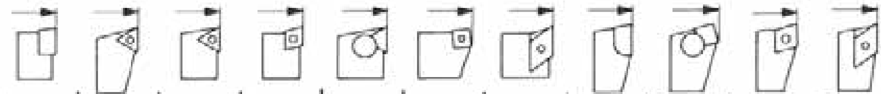




Type	Size	No.		621/622	621/622	625	625	625	625	625	625			
AW EW	20– 26 × CK1	311.101 312.101	Best.Nr.	div.	div.	625.151	625.111							
			L =	29,5	30,2	32,5	34,5							
AW EW	25– 33 × CK2	311.201 312.201	Best.Nr.	div.	div.	625.251	625.211							
			L =	35,5	36,4	37,5	39,5							
AW EW	32– 42 × CK3	311.301 312.301	Best.Nr.	div.	div.	625.351	625.311							
			L =	40	41,1	41	43							
AW EW	41– 54 × CK4	311.401 312.401	Best.Nr.	div.	div.	625.453	625.413	625.451	625.411					
			L =	47	48,5	47	49	47	50					
AW EW	53– 70 × CK5	311.501 312.501	Best.Nr.	div.	div.	625.553	625.513	625.551	625.511		625.554			
			L =	57	59	57	59	57	60		67			
AW EW EW	68–100 × CK6 100–150 × CK6	311.601 312.601 312.603	Best.Nr.	div.	div.	625.653	625.613	625.651	625.611		625.654			
			L =	71	73,5	71	74	71	74		78			
EW	100–500 × F	315.101	Best.Nr.	div.	div.			625.751	625.711	625.752	625.754			
			L =	69,5	73			69,5	72	69,5	69,5			

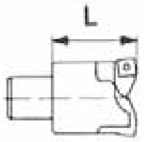
Twin cutter heads
Typ ZW × CK/F

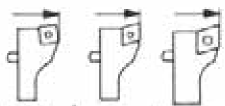




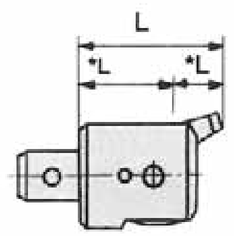
Type	Size	No.		631	633	633	633	633	633	635	636	636	636	636
ZW	20– 26 × CK1	313.101	Best.Nr.	631.151 631.171	633.110	633.315 633.317								
			L =	29,5	30	31,5								
ZW	25– 33 × CK2	313.201	Best.Nr.	631.251 631.271	633.120	633.325 633.327								
			L =	39,5	36	37,5								
ZW	32– 42 × CK3	313.301	Best.Nr.	631.351 631.371	633.130	633.235 633.237	633.335 633.337		633.531 633.533					
			L =	40	40	40	42		43,5					
ZW	41– 54 × CK4	313.401	Best.Nr.	631.451 631.471	633.140	633.245 633.247	633.345 633.347		633.541 633.543					
			L =	47	47	47	49		50,5					
ZW	53– 70 × CK5	313.501	Best.Nr.	631.551 631.571			633.355 633.357	633.455 633.457	633.551 633.553	635.550 635.570				
			L =	57			61	57	62,2	57,5				
ZW ZW	68–100 × CK6 93–125 × CK6	313.601 313.602	Best.Nr.	631.651 631.751				633.465 633.475	633.561 633.563	635.650 635.750				
			L =	71				71	76,2	71,5				
ZW	100–150 × F97	316.101	Best.Nr.								636.700	636.710	636.741	636.730
			L =								69,5	72,8	73,5	70
ZW ZW	150–230 × F145 230–310 × F145	316.201 316.301	Best.Nr.	631.851 631.871							636.800	636.810	636.841	636.830
			L =	61							69,5	72,8	73,5	70

Roughing heads
Typ RW × CK





Type	Size	No.		637	637	637
RW	25– 33 × CK2	314.201	Best.Nr.	637.121		
			L =	35,5		
RW	32– 42 × CK3	314.301	Best.Nr.	637.131	637.231	
			L =	40	40	
RW	41– 54 × CK4	314.401	Best.Nr.	637.141	637.241	
			L =	47	47	
RW	53– 70 × CK5	314.501	Best.Nr.	637.151	637.251	
			L =	57	57	
RW	68–106 × CK6	314.601	Best.Nr.	637.161 637.162	637.261 637.262	637.361 637.362
			L =	71	71	71
RW	100–150 × CK6	314.603	Best.Nr.	637.163 637.164	637.263 637.264	637.363 637.364
			L =	71	71	71



L = *L (Boring toolhead) + *L (Insert toolholder)
all measures in mm