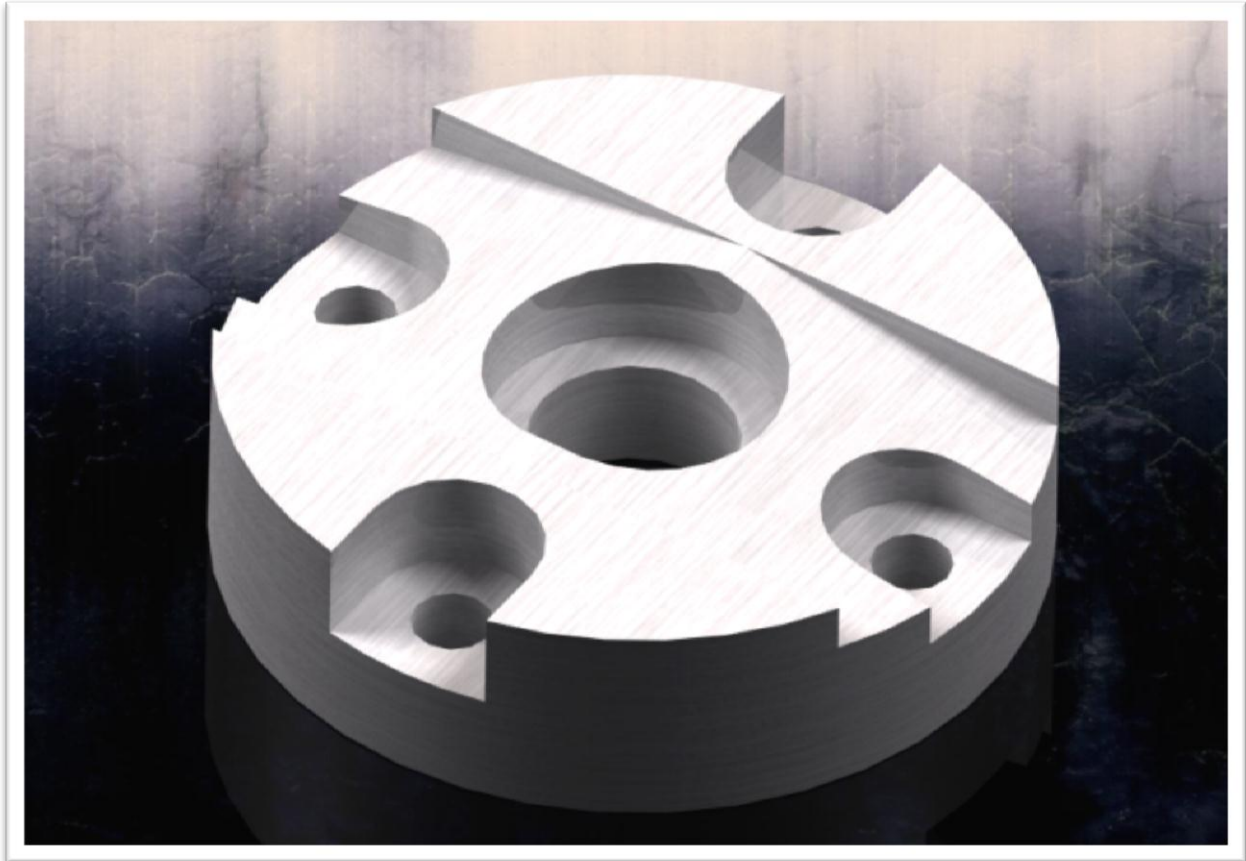


CPMU PROJECT



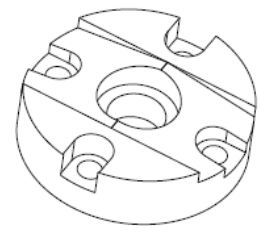
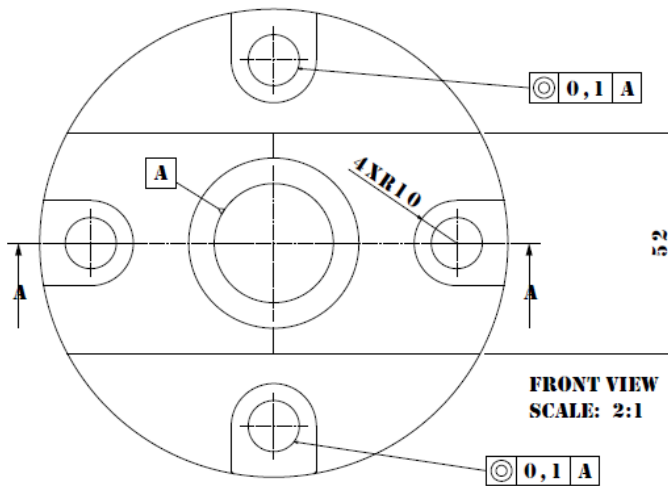
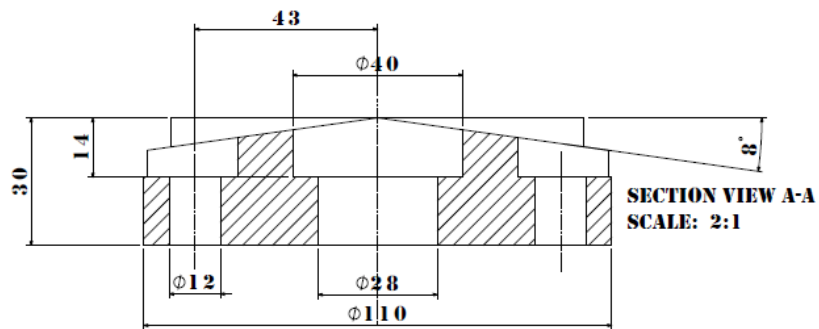
STUDENT: SÓLYOM CSABA

GROUP: 1542, INDUSTRIAL ROBOTS

1. DRAFT:

PART: RETAINING CAP

MATERIAL: ALUMINUM 7050-T7451



OPERATIONS:

- Facemilling
- Pocket milling
- Drilling

2. TOOLS AND CUTTING DATA:

• CENTERING – T01 D01=91 D02=8

CUTTER BODY – 856.1-0800-05A0 N20C

Product 856.1-0800-05-A0 N20C

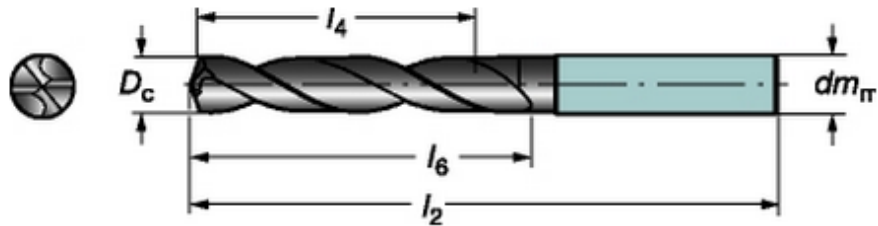
[Close](#)

Select information type

[Catalogue drawing](#)

[Download CAD drawing](#)
[Catalogue drawing](#)

Parameter	Value
Weight	0.06
Dc	8
dmm	8
l2	91
l4	40
l6	53



[092041.jpg](#)

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For PC users only

CUTTING DATA – F1056 S63

Workpiece material		Cutting data recommendation	
National standard WERKSTOFF-NUMMER		Net power (Pc):	1.1 kW
Denomination 0.7050		Feed force (Ff):	802 N
Hardness 230 HB		Torque (Mc):	3.4 Nm
Insert grade 1220		Metal removal rate (Q):	53 cm ³ /min
Parameters		Cutting time per hole (t):	0.23 sec
Drill diameter (Dc): 8 mm		Hole depth:	0.50 xDc
Hole depth (L): 4 mm			
vcMin - vcMax 80 - 110	Cutting speed (vc): 80 m/min	Spindle speed (n): 3200 rpm	
fnMin - fnMax 0.25 - 0.4	Feed (fn): 0.33 mm/r	Feed (vf): 1056 mm/min	

• 12 MM DRILLING – T02 D03=89 D04=12

CUTTER BODY – R880-D1200L20-02

i Product 880-D1200L20-02

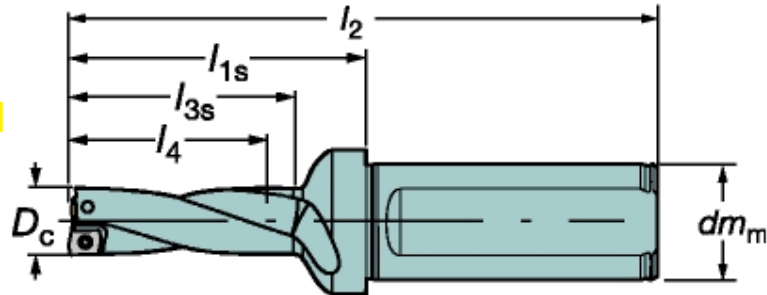
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Catalogue drawing

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[Download CAD drawing](#)
[Catalogue drawing](#)

Parameter	Value
Weight	0.2
Dc	12
dmm	20
l1s	39
l2	89
l3s	27
l4	24
Central_Insert	880-010203H-C-GR
Peripheral_Insert	880-0102W04-P-GR
RadialAdjust	0.25
Dc_max	12.5
ItemWeight	0.2



[070805.jpg](#)

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INSERT – 880-01 02 W04H-P-LM 4044

i Product 880-01 02 W04H-P-LM 4044

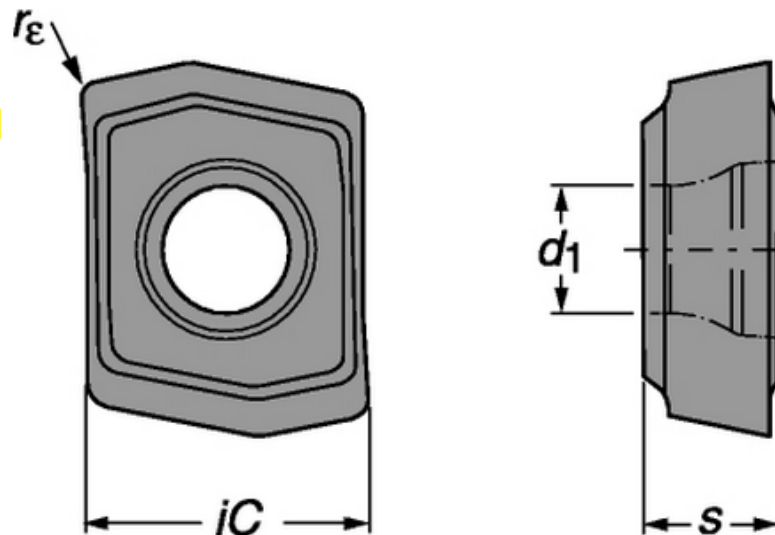
[Close](#)

Select information type

Catalogue drawing

[Cutting data recommendation](#)
[Catalogue drawing](#)

Parameter	Value
Weight	0.001
Insert_Size	1
iC	4.8
s	2.2
d1	2.2
re	0.4



CUTTING DATA – F200 S62

Workpiece material		Cutting data recommendation	
National standard WERKSTOFF-NUMMER <input type="text"/>		Net power (Pc):	<input type="text" value="0.6"/> kW i
Denomination <input type="text" value="0.7050"/>	Hardness <input type="text" value="230"/> HB	Feed force (Ff):	<input type="text" value="358"/> N i
Peripheral insert grade		Torque (Mc):	<input type="text" value="2.2"/> Nm i
<input type="text" value="4044"/>	<input type="text" value="LM"/>	Metal removal rate (Q):	<input type="text" value="23"/> cm ³ /min i
Parameters		i Cutting fluid flow (q):	<input type="text" value="9.6"/> l/min
i Drill diameter (Dc):	<input type="text" value="12"/> mm	Cutting time per hole (t):	<input type="text" value="9.02"/> sec
i Hole depth (L):	<input type="text" value="30"/> mm	i Hole depth:	<input type="text" value="2.50"/> xDc
vcMin - vcMax	Cutting speed (vc):	Spindle speed (n):	
80 - 135	<input type="text" value="94"/> m/min	<input type="text" value="2500"/> rpm	
fnMin - fnMax	Feed (fn):	Feed (vf):	
0.06 - 0.1	<input type="text" value="0.08"/> mm/r	<input type="text" value="200"/> mm/min	

• 28 MM DRILLING – T03 D05=142 D06=28

CUTTER BODY – R880-D2800L32-02

[i](#) Product 880-D2800L32-02

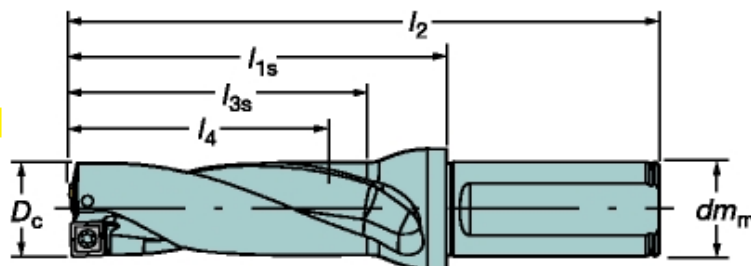
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Select information type

Catalogue drawing

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[Download CAD drawing](#)
[Catalogue drawing](#)

Parameter	Value
Weight	0.6
Dc	28
dmm	32
l1s	82
l2	142
l3s	60
l4	56
Central_Insert	880-050305H-C-GM
Peripheral_Insert	880-0503W05H-P-GM
RadialAdjust	0.6
Dc_max	29.2
ItemWeight	0.6



[041614.jpg](#)

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INSERT – 880-05 03 W08H-P-LM 4044

i Product 880-05 03 W08H-P-LM 4044

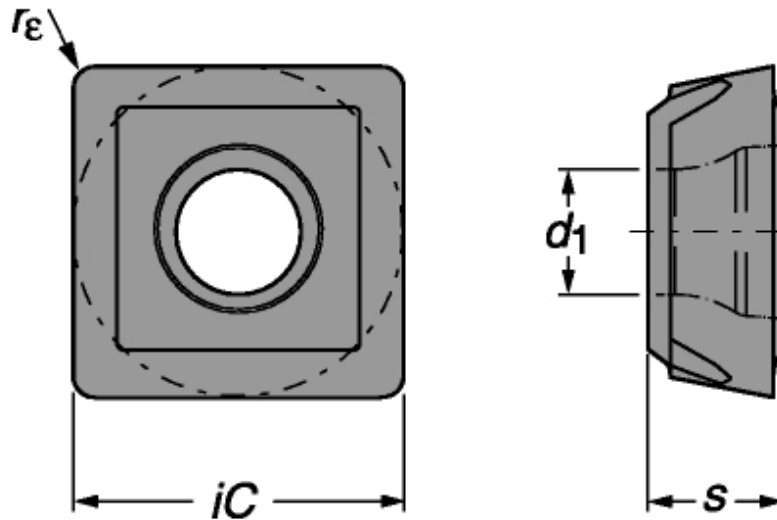
[Close](#)

Select information type

Catalogue drawing

[Cutting data recommendation](#)
[Catalogue drawing](#)

Parameter	Value
Weight	0.003
Insert_Size	5
ic	8.9
s	3
d1	3.2
re	0.8



CUTTING DATA – F138 S53

Workpiece material (choose either Standard and Denomination, or CMC)		Cutting data recommendation	
National standard WERKSTOFF-NUMMER	CMC No: 09.1	Net power (Pc):	2.0 kW
Denomination 0.7050	Hardness 230 HB	Feed force (Ff):	1071 N
Peripheral insert grade 4044 LM		Torque (Mc):	15 Nm
Parameters		Metal removal rate (Q):	85 cm ³ /min
Drill diameter (Dc):	28 mm	Cutting fluid flow (q):	22 l/min
Hole depth (L):	30 mm	Cutting time per hole (t):	13.1 sec
112% Cutting speed (vc):	110 m/min	Hole depth:	1.07 x Dc
Spindle speed (n):	1250 rpm	Calculate << Back	
100% Feed (fn):	0.11 mm/r		
Feed (vf):	138 mm/min		

• 40 MM MILLING TOOL – T04 D07=120 D08=40

CUTTER BODY – R290-040A32-12L

Product R290-040A32-12L

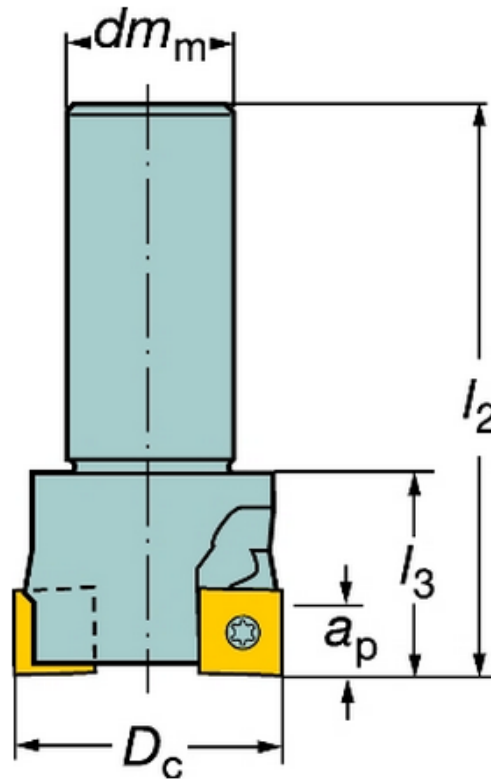
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Select information type

Catalogue drawing

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[Catalogue drawing](#)

Parameter	Value
Weight	0.379
Zc	3
Zn	3
Dc	40
dmm	32
l2	120
l3	39
ap_max	10.7
Max_rpm	21600
Insert_Size	12
Kappa_r	90



INSERT – R290-12T308M-PM 4220

Product R290-12T308M-PM 4220

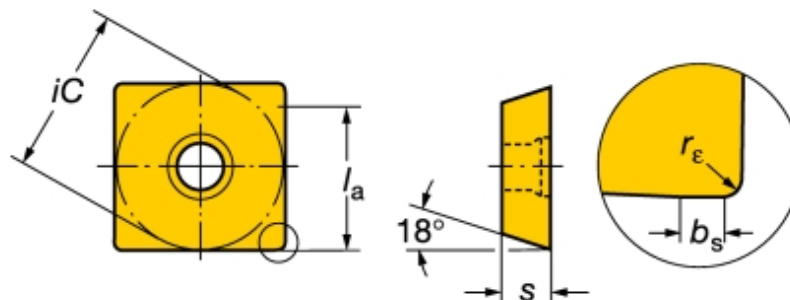
[Close](#)

Select information type

Catalogue drawing

[Cutting data recommendation](#)
[Catalogue drawing](#)

Parameter	Value
Weight	0.007
Insert_Size	12
iC	13.29
s	3.96875
bs	1.53
la	10.7
re	0.8



[962807.jpg](#)

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For PC users only

CUTTING DATA – F637,5 S53

Workpiece material			Cutting data recommendation		
National standard WERKSTOFF-NUMMER ▾			Cutting speed (vc): 155 m/min		
Denomination 0.7050 ▾			Spindle speed (n): 1233 rpm		
Hardness 230 HB			Feed speed (vf): 629 mm/min		
Coromant grades 4220 ▾			Cutting power for removal of chips (Pc): 10 kW		
Parameters (choose either fz, hex or hm)			Metal removal rate (Q): 252 cm ³ /min		
Feed per cutting edge (fz): 0.17 mm			Cutting torque (Mc): 81 Nm		
Maximum chip thickness (hex): 0.17 mm					
Average chip thickness (hm): 0.11 mm					
Cutting diameter (Dc): 40 mm					
Major cutting edge angle: (κ _r) 90 °					
Number of effective edges (zc): 3 pcs					
Cutting depth (ap): 10 mm					
Working engagement (ae): 40 mm					
Working engagement start (aei): mm					

In order to accommodate this data with the capabilities of the CPV1 machine-tool, the recalculation of the feed speed v_f is needed with the constraint, that the spindle speed be $n=1250$ RPM (which corresponds to the S53 command of the CPV1). The equation used is as follows:

$$v_f = f_z * n * z_n$$

Where:

- f_z – feed per cutting edge
- z_n – number of cutting edges

The result:

$$v_f = 0,17 * 1250 * 3 = 637,5 \text{ mm/s}$$

• 20 MM MILLING TOOL – T05 D09=115 D10=20

CUTTER BODY – R216.2-020

Product R216.2-020

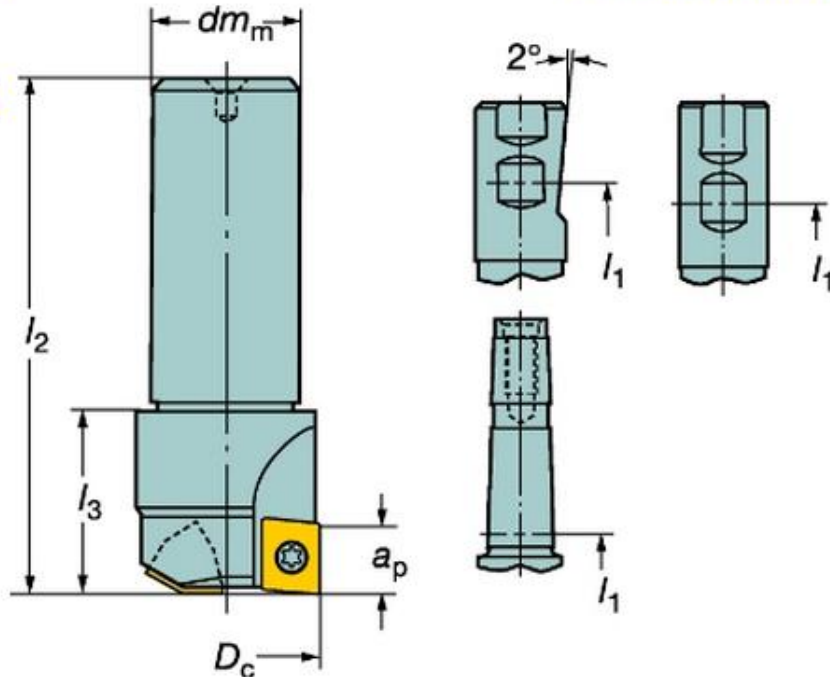
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Select information type

Catalogue drawing

[Download CAD drawing](#)
[Catalogue drawing](#)

Parameter	Value
Weight	0.369
Dc	20
Zc	1
Zn	1
ap_max	15
Insert_Size	17
dmm	20
l1	115
l2	115
l3	39.7
Max_rpm	15120
Kappa_r	90



INSERT – R216.2-17 03 08-2 235

Product R216.2-17 03 08-2 235

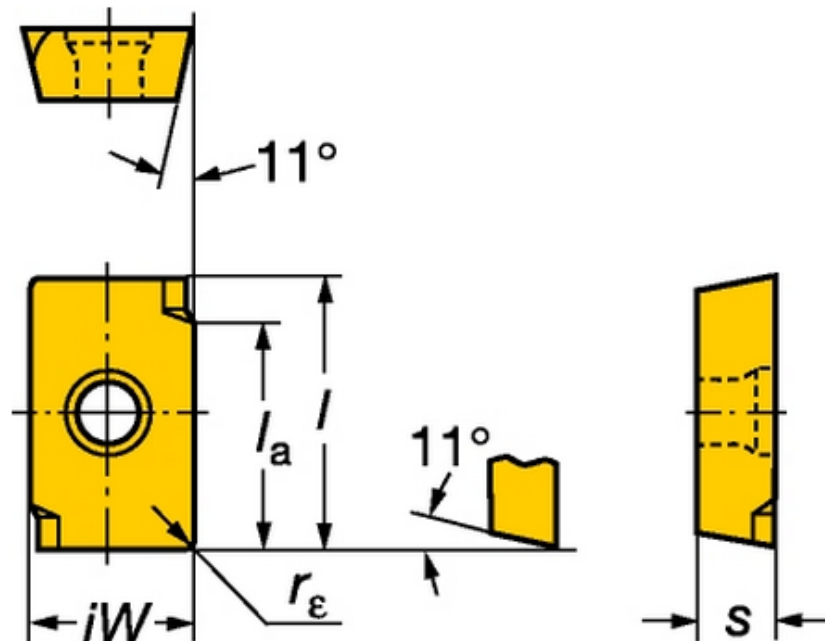
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Select information type

Catalogue drawing

[Catalogue drawing](#)

Parameter	Value
Weight	0.006
Insert_Size	17
l	17.5
la	15
iW	10
d1	4
s	3.175
re	0.8
Er	89



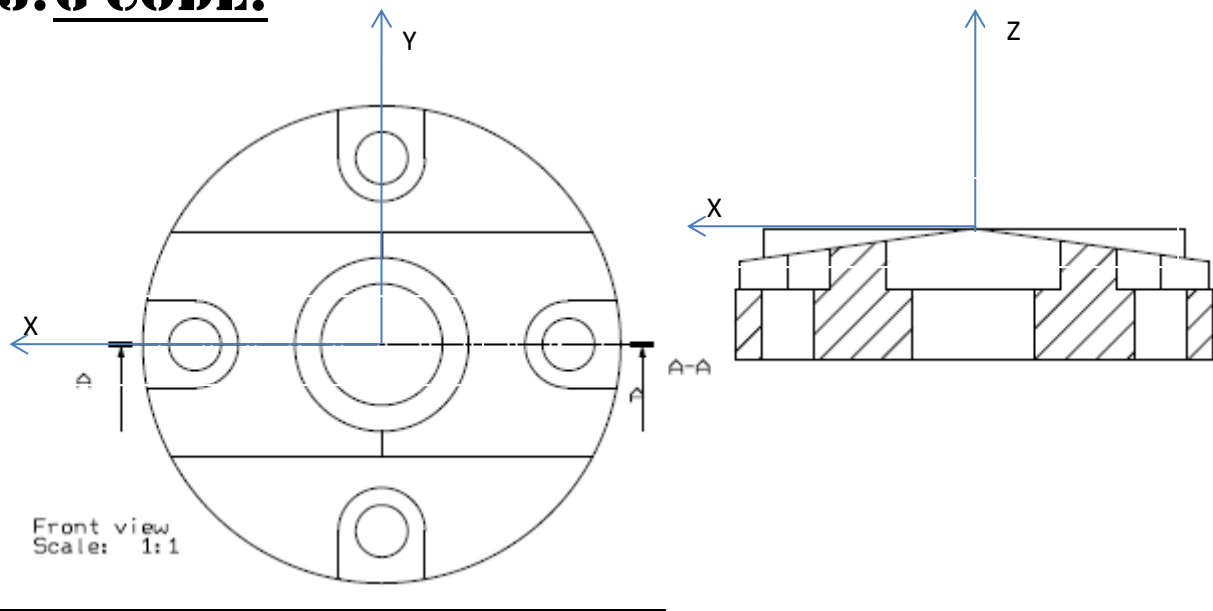
CUTTING DATA – F384 S63

Workpiece material			Cutting data recommendation	
National standard DIN			Cutting speed (vc):	220 m/min
Denomination Ck35_V			Spindle speed (n):	3501 rpm
Hardness 220 HB			Feed speed (vf):	420 mm/min
Coromant grades 235			Cutting power for removal of chips (Pc):	6.7 kW
Parameters (choose either fz, hex or hm)			Metal removal rate (Q):	118 cm ³ /min
Feed per cutting edge (fz):	Maximum chip thickness (hex):	Average chip thickness (hm):	Cutting torque (Mc):	18 Nm
0.12 mm	0.12 mm	0.08 mm		
Cutting diameter (Dc):		20 mm		
Major cutting edge angle: (κ_r)		90 °		
Number of effective edges (zc):		1 pcs		
Cutting depth (ap):		14 mm		
Working engagement (ae):		20 mm		
Working engagement start (aei):				

As in the previous case, the feed speed needs to be recalculated, with the spindle speed being maxed out at $n=3200$ RPM (S63). Using the same equation, the result will be:

$$v_f = 0,12 * 3200 * 1 = 384 \text{ mm/s}$$

3. G-CODE:



COMPULSORY POINTS:

Only points with different X or Y coordinates are enumerated. Points which differ only in the Z coordinate from another point will have this coordinate noted in parenthesis after the respective main point.

P₀₁ X000 Y-43 Z005 (Z-4, Z-30)
P₀₂ X-43 Y000 Z005 (Z-4, Z-30)
P₀₃ X000 Y043 Z005 (Z-4, Z-30)
P₀₄ X043 Y000 Z005 (Z-4, Z-30)
P₀₅ X075 Y-06 Z005 (Z0)
P₀₆ X000 Y-06 Z000
P₀₇ X000 Y006 Z000
P₀₈ X075 Y006 Z000 (Z30)
P₀₉ X-75 Y006 Z005 (Z0)
P₁₀ X000 Y006 Z000
P₁₁ X000 Y-06 Z000
P₁₂ X-75 Y-06 Z000 (Z30)
P₁₃ X000 Y-75 Z005 (Z-14)
P₁₄ X-75 Y000 Z005 (Z-14)
P₁₅ X000 Y075 Z005 (Z-14)
P₁₆ X075 Y000 Z005 (Z-14)

- – technological and auxiliary commands
- – comments
- – operations with technological feed

(Change to T01 for centering)

␣

N010 T01 F1053 S63 LF

N020 M06 M03 LF

(Centering operations P₀-P₄)

N030 G00 X0 Y0 LF

N040 G00 Z5 LF

N050 G01 Z-4 LF

N060 G00 Z5 LF

N070 G00 Y-43 LF

N080 G01 Z-4 LF

N090 G00 Z5 LF

N100 G00 X-43 Y0 LF

N110 G01 Z-4 LF

N120 G00 Z5 LF

N130 G00 X0 Y43 LF

N140 G01 Z-4 LF

N150 G00 Z5 LF

N160 G00 X43 Y0 LF

N170 G01 Z-4 LF

N180 G00 Z5 LF

(Change to T02 for 12mm drilling)

N190 T02 F200 S62 LF

N200 M06 M03 LF

(12mm drilling operations P₀-P₄)

N210 G00 X0 Y0 LF

N220 G00 Z5 LF

N230 G01 Z-30 LF

N240 G00 Z5 LF

N250 G00 Y-43 LF

N260 G01 Z-30 LF

N270 G00 Z5 LF

N280 G00 X-43 Y0 LF

N290 G01 Z-30 LF

N300 G00 Z5 LF

N310 G00 X0 Y43 LF

N320 G01 Z-30 LF

N330 G00 Z5 LF

N340 G00 X43 Y0 LF

N350 G01 Z-30 LF

```

N360 G00 Z5 LF
(Change to T03 for 28mm drilling)
N370 T03 F138 S53 LF
N380 M06 M03 LF
(28mm drilling operation P0)
N390 G00 X0 Y0 LF
N400 G00 Z5 LF
N410 G01 Z-30 LF
N420 G00 Z5 LF
(Change to T04 for 40mm boring/face milling)
N430 T04 F637.5 S53
N440 M06 M03 LF
(40mm boring operation P0)
N450 G00 X0 Y0 LF
N460 G00 Z5 LF
N470 G01 Z-14 LF
N480 G00 Z5 LF
(Face milling operation P5-P8)
N490 G00 X75 Y-6 LF
N500 G00 Z0 LF
(N510 G91 B8 LF)
N520 G90 G01 X0 Y-6 LF
N530 G01 Y6 LF
N540 G01 X75 LF
N550 G00 Z30 LF
N560 G00 X-75 LF
N570 G00 Z0 LF
(Face milling operation P9-P12)
(N580 G91 B-16 LF)
N590 G90 G01 X0 Y6 LF
N600 G01 Y-6 LF
N610 G01 X-75 LF
N620 G00 Z30 LF
(N630 G91 B8 LF)
(Change to T05 for 20mm pocket milling)
N640 T05 F384 S63 LF
N650 M06 M03 LF
(Pocket milling operations P13,14,15,16-P1,2,3,4)
N660 G90 G00 X0 Y-75 LF
N670 G00 Z-14 LF
N680 G01 X0 Y-43 LF
N690 G00 Z5 LF
N700 G00 X-75 Y0 LF
N710 G00 Z-14 LF

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N720 G01 X-43 LF
N730 G00 Z5 LF
N740 G00 X0 Y75 LF
N750 G00 Z-14 LF
N760 G01 Y43 LF
N770 G00 Z5 LF
N780 G00 X75 Y0 LF
N790 G00 Z-14 LF
N800 G01 X43 LF
N810 Z30 LF
N820 M05 M02 LF
```