PROGRAM OPTIMISASI PROSES PEMESINAN

DIBUAT OLEH :

JONG CHING SIONG

24490051

JURUSAN TEKNIK MESIN

```
uses dos,crt;
var d_o,dm,a,lt,d,rt,re,cr,f,f1,f2,b,h : real;
f3                                     : array [1..30] of real;
i,kr,a1,a2                             : byte;
n,vf,tc,v,ctvb,n1,p,m,vb,q,ct,t        : real;
nc,eff,fv,ks,ks11,z,ck,cj,cvb,cv       : real;
tm,td,k1,k2,k3,te,ve,ne,np1            : real;
cm1,cm2,coti,e,csh,r,ce1,ce2,cp        : real;
ne1              : array [1..8] of integer;
cpe,cr1,tme,ne2,tp,vp,np,cpp,tmp       : real;
jawaban                                : char;
reg                                    : registers;

Procedure Rasio;
Begin
f1:=a/a1*sqr(sin (kr/180*3.14));
f2:=a/a2*sqr(sin (kr/180*3.14));
gotoxy (10,4);write ('f1 =  ',f1:6:3);
gotoxy (35,4);write ('mm/rev');
gotoxy (10,5);write ('f2 =  ',f2:6:3);
gotoxy (35,5);write ('mm/rev');
if (f>=f1) and (f<=f2) then
begin
for i:=1 to 30 do
begin
if f<>f3[i] then
begin
gotoxy (10,6);
write ('Gerak makan tidak sesuai dengan data yang ada');
gotoxy  (10,7);
write ('Masukkan data gerak makan yang ada dan sesuai');
gotoxy (10,8);write ('Gerak makan (f) = ');
end;
end;
end
Else
Begin
gotoxy  (10,6);
write ('Gerak makan diluar rasio dari data yang ada');
gotoxy  (10,7);
write ('Masukkan data gerak makan yang ada dan sesuai');
gotoxy (10,8);write ('Gerak makan (f) = ');
end;
gotoxy (30,8);read (f);
gotoxy (35,8);write ('mm/rev');
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b:=a/(sin (kr/180*3.14));
gotoxy (10,9);write ('Lebar geram (b) = ',b:6:3);
gotoxy (35,9);write ('mm');
h:=f*sin(kr/180*3.14);
gotoxy (10,10);
write ('Tebal geram sebelum terpotong (h) = ',h:6:3);
gotoxy (55,10);write ('mm');
gotoxy (10,11);write ('Putaran spindel (n) = ');
gotoxy (35,11);read (n);
gotoxy (40,11);write ('rpm');
vf:=f*n;
gotoxy (10,12);write ('vf = ',vf:6:3);
gotoxy (25,12);write ('mm/min');
tc:=lt/vf;
gotoxy (10,13);write ('tc = ',tc:6:3);
gotoxy (25,13);write ('menit');
v:=3.14*d*n/1000;
gotoxy (10,14);write ('v  = ',v:6:3);
gotoxy (25,14);write ('m/min');
gotoxy (10,15);write ('ctvb = ');
gotoxy (20,15);read (ctvb);
gotoxy (10,16);write ('n1   = ');
gotoxy (20,16);read (n1);
gotoxy (10,17);write ('p    = ');
gotoxy (20,17);read (p);
gotoxy (10,18);write ('m    = ');
gotoxy (20,18);read (m);
gotoxy (10,19);write ('vb   = ');
gotoxy (20,19);read (vb);
gotoxy (25,19);write ('mm');
gotoxy (10,20);write ('q    = ');
gotoxy (20,20);read (q);
ct:=ctvb*exp(ln(vb)*m)*exp(ln(h)*(-p))*exp(ln(b)*(-q));
gotoxy (10,21);write ('ct   = ',ct:6:3);
t:=exp(ln(ct/v)*(1/n1));
gotoxy (10,22);write ('Umur pahat (t) = ',t:6:3);
gotoxy (35,22);writeln ('menit');Readln;
gotoxy (10,23);writeln ('Press Enter to Continue');Readln;
clrscr;
gotoxy (10,5);write ('ks11  = ');
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gotoxy (20,5);read (ks11);
gotoxy (10,6);write ('z      = ');
gotoxy (20,6);read (z);
gotoxy (10,7);write ('ck     = ');
gotoxy (20,7);read (ck);
gotoxy (10,8);write ('cj     = ');
gotoxy (20,8);read (cj);
gotoxy (10,9);write ('cvb    = ');
gotoxy (20,9);read (cvb);
gotoxy (10,10);write ('cv     = ');
gotoxy (20,10);read (cv);
gotoxy (10,11);write ('eff    = ');
gotoxy (20,11);read (eff);
ks:=ks11*exp(ln(f)*(-z))*ck*cj*cvb*cv;
gotoxy   (10,12);
write ('Gaya potong spesifik (ks) = ',ks:8:3);
gotoxy (50,12);write ('N/mm2');
fv:=ks*b*h;
gotoxy (10,13);write ('Gaya pemotongan (Fv) = ',fv:8:3);
gotoxy (50,13);write ('N');
nc:=fv*v/(60000*eff);
gotoxy   (10,14);
write ('Daya yang dibutuhkan (Nc) = ',nc:8:3);
gotoxy (50,14);write ('KW');
gotoxy (10,16);write ('td = ');
gotoxy (17,16);read (td);
gotoxy (25,16);write ('menit');
tm:=(tc+td*tc/t);
gotoxy (10,17);write ('tm = ',tm:8:3);
gotoxy (25,17);write ('menit/produk');Readln;
gotoxy (10,20);writeln('Press Enter to Continue');readln;
clrscr;
gotoxy (10,5);write ('cm     = Rp ');
gotoxy (25,5);read (cm1);
gotoxy (30,5);write ('/menit');
gotoxy (10,6);write ('coti   = Rp ');
gotoxy (22,6);read (coti);
gotoxy (10,7);write ('e      = ');
gotoxy (20,7);read (e);
gotoxy (10,8);write ('csh    = Rp ');
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gotoxy (22,8);read (csh);
gotoxy (10,9);write ('r      = ');
gotoxy (20,9);read (r);
cm2:=cm1*tm;
gotoxy (10,11);write ('Cm = Rp ',cm2:6:3);
gotoxy (25,11);write ('/produk');
ce1:=coti/e+csh/r;
ce2:=ce1*tc/t;
gotoxy (10,12);write ('Ce = Rp ',ce2:6:3);
gotoxy (25,12);write ('/produk');
cp:=cm2+ce2;
gotoxy (10,13);write ('Cp = Rp ',cp:6:3);
gotoxy (25,13);write ('/produk');
k1:=td+ce1/cm1;
k2:=lt*3.14*d/(1000*f);
k3:=ct;
gotoxy (10,14);write ('K1 = ',k1:6:3);
gotoxy (10,15);write ('K2 = ',k2:6:3);
gotoxy (10,16);write ('K3 = ',k3:6:3);
te:=k1*((1/n1)-1);
ve:=k3*exp(ln(te)*(-n1));
ne:=1000*ve/(3.14*d);
gotoxy  (10,18);
write ('Umur pahat pada kondisi ekonomis (T,e) = ',te:6:3);
gotoxy (60,18);write ('menit');
gotoxy (10,19);write ('Kecepatan potong (v,e)  = ',ve:6:3);
gotoxy (60,19);write ('m/menit');
gotoxy (10,20);write ('Putaran spindel (n,e) = ',ne:6:3);
gotoxy (60,20);write ('rpm');
ne1[1]:=30; ne1[2]:=50;
ne1[3]:=80; ne1[4]:=125;
ne1[5]:=175; ne1[6]:=290;
ne1[7]:=475; ne1[8]:=725;Readln;
gotoxy (10,22);writeln ('Press Enter to Continue');readln;
clrscr;
gotoxy (10,5);write ('Putaran spindel (n,e) = ',ne:6:3);
gotoxy (45,5);write ('rpm');
for i:=1 to 8 do
begin
if ne<>ne1[i] then
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begin
gotoxy  (10,7);write ('Putaran spindle tidak sesuai  dengan
data yang ada');
gotoxy  (10,7);write ('Masukkan data putaran  spindle  yang
ada dan sesuai');
end;
end;
gotoxy (10,9);write ('Putaran spindel (n,e) = ');
gotoxy (49,9);read (ne);
gotoxy (60,9);write ('rpm');
ve:=3.14*d*ne/1000;
te:=exp(ln(k3/ve)*(1/n1));
cr1:=0;
cpe:=cr1+cm1*(k2*exp(ln(ve)*(-1))*(1+k1*exp(ln(te)*(-1))));
tme:=k2*exp(ln(ve)*(-1))*(1+td*exp(ln(te)*(-1)));
ne2:=fv*ve/(60000*eff);
gotoxy (10,10);write ('Kecepatan potong (v,e) = ',ve:6:3);
gotoxy (60,10);write ('m/menit');
gotoxy (10,11);write ('Umur pahat (T,e) = ',te:6:3);
gotoxy (60,11);write ('menit');
gotoxy  (10,12);
write ('Ongkos produksi termurah (Cp,e) = Rp ',cpe:6:3);
gotoxy (60,12);write ('/produk');
gotoxy (10,13);write ('Waktu pemesinan (tm,e) = ',tme:6:3);
gotoxy (60,13);write ('menit');
gotoxy (10,14);
write ('Daya pemesinan yang dibutuhkan (N,e) = ',ne2:6:3);
gotoxy (60,14);write ('KW');
tp:=td*((1/n1)-1);
vp:=k3*exp(ln(tp)*(-n1));
np:=1000*vp/(3.14*d);
gotoxy  (10,16);
write ('Umur pahat pada kondisi produktif (T,p)= ',tp:6:3);
gotoxy (63,16);write ('menit');
gotoxy (10,17);write ('Kecepatan potong (v,p) = ',vp:6:3);
gotoxy (63,17);write ('m/menit');
gotoxy (10,18);write ('Putaran spindel (n,p) = ',np:6:3);
gotoxy (63,18);write ('rpm');Readln;
gotoxy (10,20);writeln('Press Enter to Continue');Readln;
clrscr;
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gotoxy (10,5);write ('Putaran spindel (n,p) = ',np:6:3);
gotoxy (45,5);write ('rpm');
for i:=1 to 8 do
begin
if np<>ne1[i] then
begin
gotoxy  (10,7);write ('Putaran spindle tidak sesuai  dengan
data yang ada');
gotoxy  (10,7);write ('Masukkan data putaran  spindle  yang
ada dan sesuai');
end;
end;
gotoxy (10,9);write ('Putaran spindel (n,p) = ');
gotoxy (49,9);read (np);
gotoxy (60,9);write ('rpm');
vp:=3.14*d*np/1000;
tp:=exp(ln(k3/vp)*(1/n1));
cpp:=cr1+cm1*(k2*exp(ln(vp)*(-1))*(1+k1*exp(ln(tp)*(-1))));
tmp:=k2*exp(ln(vp)*(-1))*(1+td/tp);
np1:=fv*vp/(60000*eff);
gotoxy (10,10);write ('Kecepatan potong (v,p) = ',vp:6:3);
gotoxy (60,10);write ('m/menit');
gotoxy (10,11);write ('Umur pahat (T,p) = ',tp:6:3);
gotoxy (60,11);write ('menit');
gotoxy  (10,12);
write ('Ongkos pemotongan (Cp,p) = Rp ',cpp:6:3);
gotoxy (60,12);write ('/produk');
gotoxy (10,13);write ('Waktu pemesinan (tm,p) = ',tmp:6:3);
gotoxy (60,13);write ('menit');
gotoxy (10,14);
write ('Daya pemesinan yang dibutuhkan (N,p) = ',np1:6:3);
gotoxy (60,14);write ('KW');
readln;
end;
begin
repeat
clrscr;
gotoxy    (20,5);
writeln ('PROGRAM OPTIMISASI PROSES PEMESINAN');
gotoxy (30,8);writeln ('DIBUAT OLEH :');
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gotoxy (28,10);writeln('JONG CHING SIONG');
gotoxy (32,12);writeln('24490051');
gotoxy (25,14);writeln('JURUSAN TEKNIK MESIN');readln;
clrscr;
gotoxy (10,5);writeln ('Diameter awal (do)   = ');
gotoxy (35,5);read (d_o);
gotoxy (40,5);write ('mm');
gotoxy (10,6);write ('Diameter akhir (dm)  = ');
gotoxy (35,6);read (dm);
gotoxy (40,6);write ('mm');
gotoxy (10,7);write ('Kedalaman potong (a) = ');
gotoxy (35,7);read (a);
gotoxy (40,7);write ('mm');
d:=(d_o+dm)/2;
gotoxy (10,9);write ('Panjang pemotongan (lt) = ');
gotoxy (37,9);read (lt);
gotoxy (45,9);write ('mm');
gotoxy (10,10);write ('Diameter rata-rata (d)  = ',d:6:2);
gotoxy (45,10);write ('mm');
gotoxy  (10,12);
write ('Tingkat kekasaran permukaan (rt) = ');
gotoxy (50,12);read (rt);
gotoxy (55,12);write ('um');
gotoxy (10,13);write ('Radius pojok pahat (re) = ');
gotoxy (50,13);read (re);
gotoxy (55,13);write ('mm');
gotoxy (10,14);write ('Konstanta (cr) = ');
gotoxy (48,14);read (cr);
f:=sqrt(8*rt*re/cr);
gotoxy (10,16);write ('Gerak makan (f) = ',f:6:2);
gotoxy (40,16);writeln ('mm/rev');Readln;
gotoxy (10,18);writeln('Press Enter to continue');Readln;
clrscr;
for i:=1 to 30 do
begin
if i<13 then
f3[i]:=0.04+0.01*i
else if (i>12) and (i<15) then
f3[i]:=0.06+0.01*i
else if (i>14) and (i<18) then
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f3[i]:=0.07+0.01*i
else if i=18 then
f3[i]:=0.26
else if (i>18) and (i<21) then
f3[i]:=0.09+0.01*i
else if i=21 then
f3[i]:=0.33
else if i=22 then
f3[i]:=0.38
else if i=23 then
f3[i]:=0.4
else if i=24 then
f3[i]:=0.44
else if i=25 then
f3[i]:=0.46
else if i=26 then
f3[i]:=0.48
else if i=27 then
f3[i]:=0.53
else if i=28 then
f3[i]:=0.55
else if i=29 then
f3[i]:=0.58
else if i=30 then
f3[i]:=0.66;
end;
Gotoxy(10,3);Write('input kr : ');
Gotoxy(25,3);Read(kr);
if a>2 then
begin
a1:=20;a2:=5;
rasio;
end
Else
begin
a1:=8;a2:=3;
rasio;
end;
gotoxy (10,16);write ('Mengisi lagi (Y/T) ? ');
gotoxy (31,16);read (jawaban);
intr (5,reg);
until (jawaban='t') or (jawaban='T');
end.
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```
Diameter awal (do)    =   94    mm
Diameter akhir (dm)   =   88    mm
Kedalaman potong (a)  =   3     mm

Panjang pemotongan (lt) =  4         mm
Diameter rata-rata (d)  =  91.00     mm

Tingkat kekasaran permukaan (rt) =       32    um
Radius pojok pahat (re)          =       0.4   mm
Konstanta (cr)                   =     2300

Gerak makan (f) =   0.21       mm/rev

Press Enter to continue
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```
input kr :     95
f1 =   0.149              mm/rev
f2 =   0.596              mm/rev
Gerak makan tidak sesuai dengan data yang ada
Masukkan data gerak makan yang ada dan sesuai
Gerak makan (f) =   0.2  mm/rev
Lebar geram (b) =  3.011 mm
Tebal geram sebelum terpotong (h) =  0.199   mm
Putaran spindel (n) =    290  rpm
vf = 58.000    mm/min
tc =  0.069    menit
v  = 82.865    m/min
ctvb =    245
n1   =    0.23
p    =    0.15
m    =    0.45
vb   =    0.4  mm
q    =    0.09
ct   = 187.109
Umur pahat (t) = 34.510  menit
Press Enter to Continue
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```
ks11  =   960
z     =   0.2
ck    =   1
cj    =   1.12
cvb   =   1.16
cv    =   1.06
eff   =   0.68
Gaya potong spesifik (ks) = 1824.094    N/mm2
Gaya pemotongan (Fv)      = 1094.456    N
Daya yang dibutuhkan (Nc) =    2.223    KW

td =   0.67    menit
tm =    0.070  menit/produk


Press Enter to Continue
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```
cm    = Rp     42.5 /menit
coti  = Rp  15000
e     =   4
csh   = Rp  181000
r     =   750

Cm = Rp  2.988 /produk
Ce = Rp  7.976 /produk
Cp = Rp 10.964 /produk
K1 = 94.584
K2 =  5.715
K3 = 187.109

Umur pahat pada kondisi ekonomis (T,e) = 316.650  menit
Kecepatan potong (v,e)                 = 49.769   m/meni
Putaran spindel (n,e)                  = 174.177  rpm

Press Enter to Continue
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Putaran spindel (n,e) = 174.177 rpm

Masukkan data putaran spindle yang ada dan sesuai

Putaran spindel (n,e)	= 175	rpm
Kecepatan potong (v,e)	= 50.004	m/menit
Umur pahat (T,e)	= 310.226	menit
Ongkos produksi termurah (Cp,e)	= Rp 6.338	/produk
Waktu pemesinan (tm,e)	= 0.115	menit
Daya pemesinan yang dibutuhkan (N,e)	= 1.341	KW

Umur pahat pada kondisi produktif (T,p)	= 2.243	menit
Kecepatan potong (v,p)	= 155.383	m/menit
Putaran spindel (n,p)	= 543.790	rpm

Press Enter to Continue

Putaran spindel (n,p) = 543.790 rpm

Masukkan data putaran spindle yang ada dan sesuai

Putaran spindel (n,p)	= 475	rpm
Kecepatan potong (v,p)	= 135.727	m/menit
Umur pahat (T,p)	= 4.038	menit
Ongkos pemotongan (Cp,p)	= Rp 43.700	/produk
Waktu pemesinan (tm,p)	= 0.049	menit
Daya pemesinan yang dibutuhkan (N,p)	= 3.641	KW

Mengisi lagi (Y/T) ? y

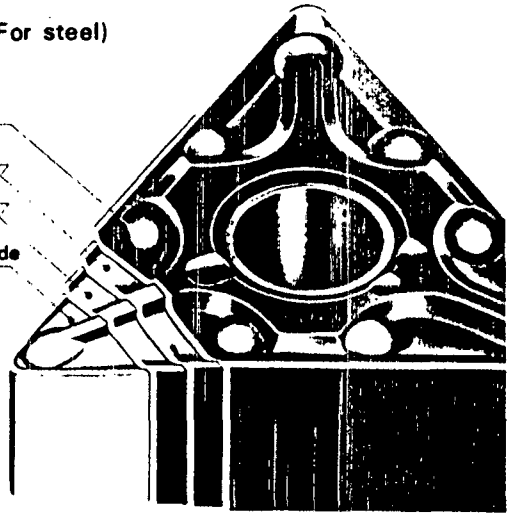
Type	Symbol	Tensile test		
		Yield point kgf/mm^2 (N/mm^2)	Tensile strength kgf/mm^2 (N/mm^2)	Elongation %
1	FCD 40	26 min. (255) min.	40 min. (392) min.	15 min.
2	FCD 45	30 min. (294) min.	45 min. (441) min.	10 min.
3	FCD 50	35 min. (343) min.	50 min. (490) min.	7 min.
4	FCD 60	40 min. (392) min.	60 min. (588) min.	2 min.
5	FCD 70	45 min. (441) min.	70 min. (686) min.	2 min.

Type	Symbol	Hardness H_B
1	FCD 40	121 - 197
2	FCD 45	143 - 217
3	FCD 50	170 - 241
4	FCD 60	207 - 285
5	FCD 70	229 - 321

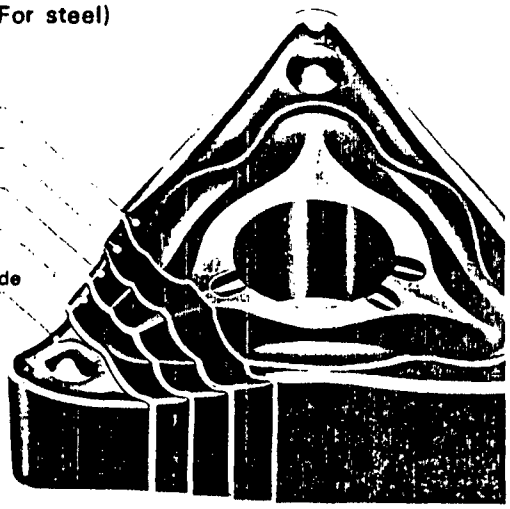
COATED GRADES MULTI-PHASE CERAMIC COATED INSERTS

FOR TURNING

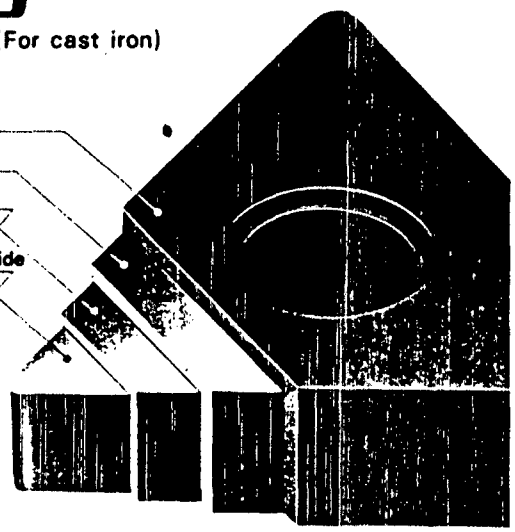
U610
●P01~P20(For steel)



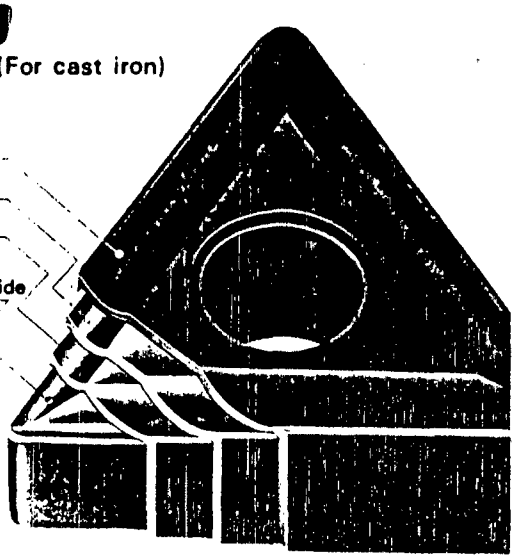
U625
●P20~P40(For steel)



U505
●K01~K10(For cast iron)

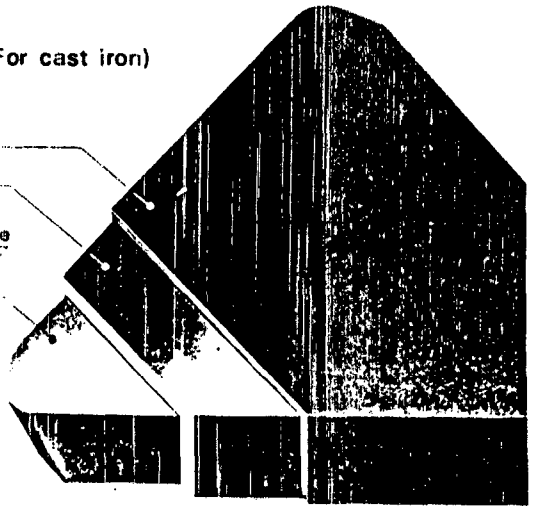


U510
●K01~K20(For cast iron)

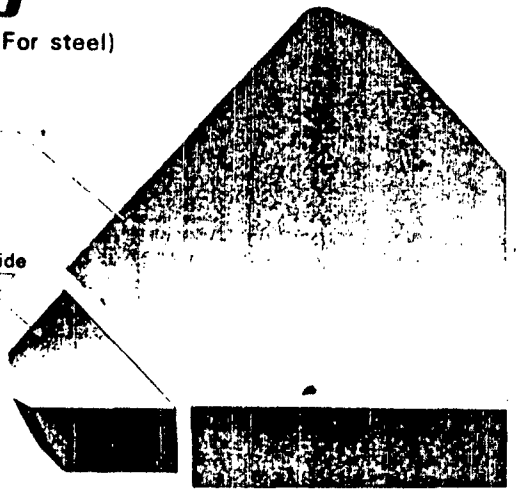


FOR MILLING

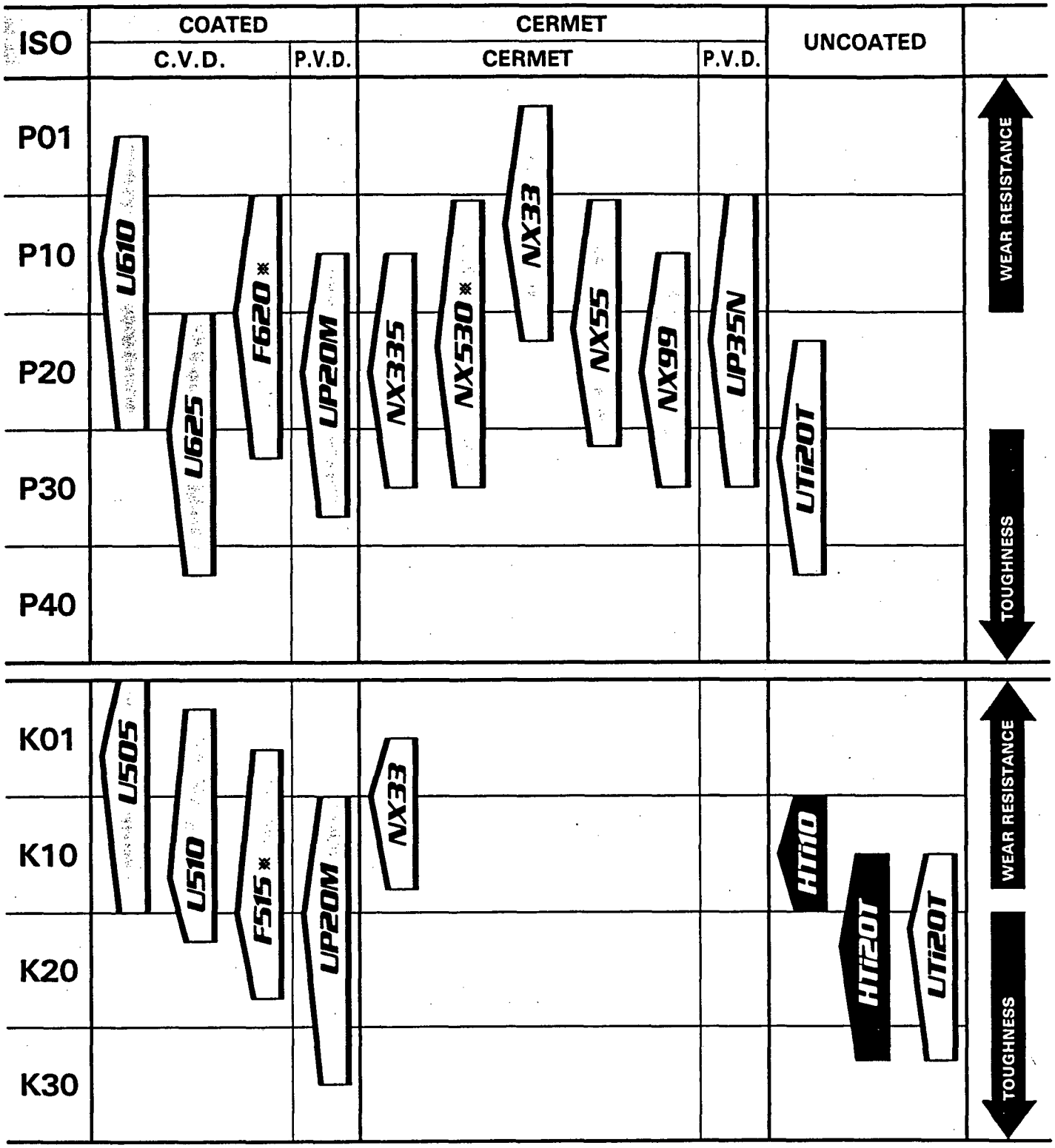
F515
●K10~K20(For cast iron)



F620
●P10~P30(For steel)



MITSUBISHI CARBIDE GRADES



※Milling grades

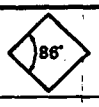
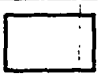
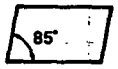
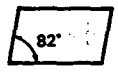
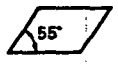
HNICAL DATA

MITSUBISHI CARBIDE GRADES

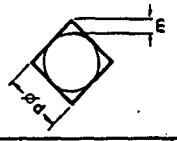
Grades			Application Recommendations
Coated	(C.V.D.)	U505	Coated carbide grade which has the highest wear resistance. Is the most suitable for turning and boring of cast irons.
		U510	Coated carbide grade which has good balance of wear resistance and toughness. Is suitable for medium to heavy duty cutting of cast irons.
		U610	Coated carbide grade which has high wear resistance and high plastic deformation resistance. Is suitable for cutting of steels at medium and high speeds. This coated carbide is also suitable for cutting of cast irons.
		U625	Coated carbide grade which has high tougrness and high reliability on the cutting edge. Is suitable for interruped cutting of steels and stainless steels.
		F515	Coated carbide grade. Suitable for face miling of conventional cast iron, ductile cast iron and nodular cast iron at elevated speeds.
		F628	Coated carbide grade having a tough substrate ideal for milling most Kinds of steel.
	(P.V.D.)	UP20M	Titanium compound coating on UTi20T. Designed for added wear resistance when milling and turning of steels, stainless steel and cast iron.
Cermet		NX335	Titanium carbonitride cermet developed NX99 giving increased toughness on more difficult cutting applications.
		NX530	Titanium carbonitride cermet for milling steels. Good toughness and thermal shock resistance. NX530 should be selected for steel cutting operations when NX55 encounters edge chipping.
		NX33	Titanium carbonitride cermet for high speed finish turning of steels and cast irons. Excellent resistance to wear and deformation. NX33 is designed for applications with low to moderate feed rates.
		NX55	Titanium carbonitride cermet for turning and milling steels. Good balance of wear resistance and toughness. NX55 can be selected for steel cutting operations when NX33 encounters edge chipping.
		NX98	Titanium carbonitride cermet for steel turning operations when NX55 encounters edge chipping.
		UP35N	A PVD coated cermet capable of both wet and dry cutting on a wide range of steels. Can also be used on interrupted cut applications.
Uncoated		UTi20T	Uncoated M20 carbide grade with extreme edge strength. Designed for general purpose turning and milling of steels and cast irons. Especially for rough machining conditions, such as interrupted cutting.
		HTi10	Uncoated carbide grade for general purpose turning or milling of aluminum, cast iron, and all non-ferrous materials.
		HTi20T	Uncoated carbide grade. Suitable for rough machining of nickel base alloys.
Polycrystalline diamond		MD220	For the general finishing of aluminum alloy, non-ferrous metals and non-metals.
Cubic boron nitride		MB710	For semi-finishing and finishing of cast iron and ferrous sintered alloys.
		MB820	For finishing of hardened steel.

XABLE INSERTS

■ISO CODES-Indexable Insert Code Key

H		M	
O		V	
P		W	
S		L	
T		A	
C		B	
D		K	
E		R	
F			

❶ Symbol for insert shape



Triangular insert with a facet (secondary cutting edge)

Symbol	m(mm)	d(mm)	s(mm)
A	±0.005	±0.025	±0.025
F	±0.005	±0.013	±0.025
C	±0.013	±0.025	±0.025
H	±0.013	±0.013	±0.025
E	±0.025	±0.025	±0.025
G	±0.025	±0.025	±0.13
J	±0.005	±0.05~±0.13	±0.025
K*	±0.013	±0.05~±0.13	±0.025
L*	±0.025	±0.05~±0.13	±0.025
M*	±0.08~±0.18	±0.05~±0.13	±0.13
N*	±0.08~±0.18	±0.05~±0.13	±0.025
U*	±0.13~±0.38	±0.08~±0.25	±0.13

*As a rule, the sides of these inserts are as sintered.
Tolerance differs with insert size. For the accuracy of Class M, refer to the table on the right.

Detailed dimension of M class insert

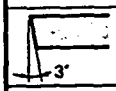
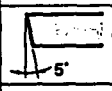
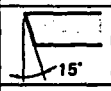
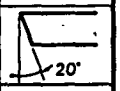
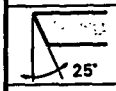
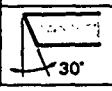
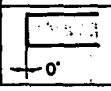
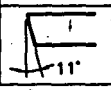
●Tolerances of insert height (mm)

Inscribed circle	T	S	C	D	V
6.35	±0.08	—	—	—	—
9.525	±0.08	±0.08	±0.08	±0.11	±0.13
12.70	±0.13	±0.13	±0.13	±0.15	—
15.875	±0.15	±0.15	±0.15	±0.18	—
19.05	±0.15	±0.15	±0.15	±0.18	—
25.40	—	±0.18	—	—	—
31.75	—	±0.25	—	—	—

●Tolerances of inscribed circle (mm)

Inscribed circle	T	S	C	D	V	R
6.35	±0.05	—	—	—	—	—
9.525	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05
12.70	±0.08	±0.08	±0.08	±0.08	—	±0.08
15.875	±0.10	±0.10	±0.10	±0.10	—	±0.10
19.05	±0.10	±0.10	±0.10	—	—	±0.10
25.40	—	±0.13	—	—	—	±0.10
31.75	—	±0.20	—	—	—	±0.12

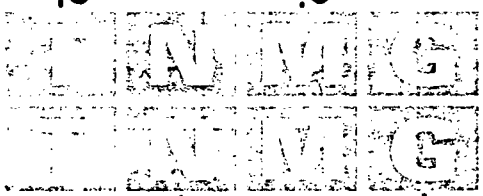
❸ Symbol for tolerances

A	B	C	D	E
				
F	**G**	**N**	**P**	**O**
				Other Clearance Angle

❷ Symbol for normal clearance

[METRIC]

[INCH]



❹ Symbol for chip breakers and/or for fixation

Metric										Inch		
Symbol	Type	Hole configuration	Chipbreaker	Shape	Symbol	Type	Hole configuration	Chipbreaker	Shape	Shape	Inscribed circle over 6.35	Inscribed circle under 5.556 (including 7.938)
W	With hole	Cylindrical hole/ One countersink (40°~60°)	No chipbreaker		A	With hole	Cylindrical hole	No chipbreaker			N	E
T	With hole		One-sided chipbreaker		M	With hole	Cylindrical hole	One-sided chipbreaker			F	L
Q	With hole	Cylindrical hole/ Double countersinks (40°~60°)	No chipbreaker		G	With hole	Cylindrical hole	Double-sided chipbreaker			R	S
U	With hole		Double-sided chipbreaker		N	Without hole	—	No chipbreaker			A	D
B	With hole	Cylindrical hole/ One countersink (70°~90°)	No chipbreaker		R	Without hole	—	One-sided chipbreaker			G	K
H	With hole		One-sided chipbreaker		F	Without hole	—	Double-sided chipbreaker			M	P
C	With hole	Cylindrical hole/ Double countersinks (70°~90°)	No chipbreaker		X	—	—	—	Special design	Special design	X	X
J	With hole		Double-sided chipbreaker									

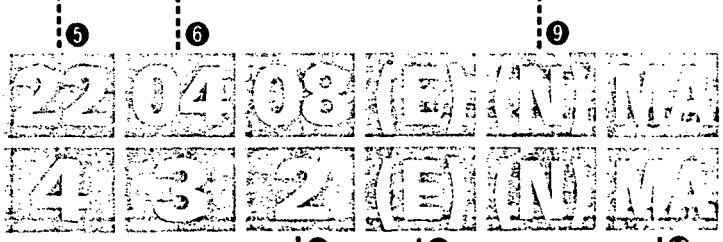
MITSUBISHI CARBIDE

Metric						Diameter of inscribed circle (mm)	Inch	
(R)	(V)	(D)	(C)	(S)	(T)		Inscribed circle over 6.35	Inscribed circle under 5.556 (including 7.938)
		04	03	03	06	3.969		5
		05	04	04	08	4.762		6
		06	05	05	09	5.556		7
06						6.00		
	11	07	06	06	11	6.35	2	(8)
		09	08	07	13	7.94		0
08						8.00		
09	16	11	09	09	16	9.525	3	
10						10.00		
12						12.00		
12	19	15	12	12	22	12.70	4	
		19	16	15	27	15.875	5	
16						16.00		
19		23	19	19	33	19.05	6	
20						20.00		
		27	22	22	38	22.225	7	
25						25.00		
25		31	25	25	44	25.40	8	
31		38	32	31	53	31.75		
32						32.00	0	

❺ Symbol for insert size

Metric	Thickness (mm)	Inch	
		Inscribed circle over 6.35	Inscribed circle under 5.556 (including 7.938)
01	1.59	—	2
02	2.38	—	3
T2	2.78	—	—
03	3.18	2	4
T3	3.97	—	5
04	4.76	3	6
06	6.35	4	—
07	7.94	5	—
09	9.52	6	—

❻ Symbol for insert thickness



❾ Symbol for cutting direction

Shape	Hand	Symbol
	Right	R
	Left	L
	None	N

❼ Symbol for insert corner configuration

Metric	Corner roundness	Inch
00	Sharp nose	0
02	0.2	Y
04	0.4	1
08	0.8	2
12	1.2	3
16	1.6	4
20	2.0	5
24	2.4	6
28	2.8	7
32	3.2	8
00(inch) or M0(metric)	Round insert	0

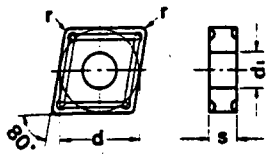
❽ Symbol for cutting edge condition

Shape	Honing	Symbol
	No honing	F
	Round honing	E
	Chamfer honing	T
	Round and Chamfer honing	S

❿ Symbol for chip breaker

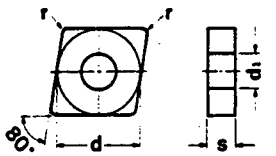
No symbol	C	CA	D
F	HA	MA	MAT
MS	MT	PK	SA

CNGG●●●●●●PK

Shape	ISO Code		Cermet		Dimensions (mm)			
	Metric	Inch	NX55		d	s	r	d_1
	12	CNGG120404PK	CNGG431PK	●	12.70	4.76	0.4	5.16
		CNGG120408PK	CNGG432PK	●			0.8	

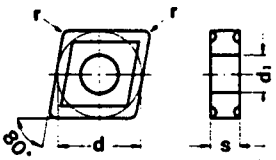
Ordering example ; 300pcs CNGG120404PK NX55

CNMA●●●●●●

Shape	ISO Code		Coated			Uncoated			Dimensions (mm)			
	Metric	Inch	U505	U510	UP20M	UTi20T	HTi05T	HTi10	d	s	r	d_1
	12	CNMA120404	CNMA431	●	●			●	●	12.70	4.76	0.4	5.16
		CNMA120408	CNMA432	●	●		●	●	●			0.8	
		CNMA120412	CNMA433	●	●				●			1.2	
		CNMA120416	CNMA434		●							1.6	
	16	CNMA160612	CNMA543	●						15.875	6.35	1.2	6.35
		CNMA160616	CNMA544	●								1.6	
	19	CNMA190608	CNMA642							19.05	6.35	0.8	7.93
		CNMA190612	CNMA643	●	●							1.2	
		CNMA190616	CNMA644		●							1.6	
		CNMA190624	CNMA646									2.4	

Ordering example ; 300pcs CNMA120404 U505

CNMG●●●●●●

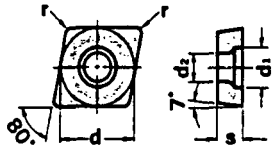
Shape	ISO Code		Coated					Cermet			Uncoated		Dimensions (mm)			
	Metric	Inch	U505	U510	U610	U625	UP20M	NX33	NX55	NX99	UTi20T	HTi10	d	s	r	d_1
	09	CNMG09T304			●				●				9.525	3.97	0.4	3.81
		CNMG09T308			●				●						0.8	
	12	CNMG120404	CNMG431	●		●	●	●	●	●	●	●	12.70	4.76	0.4	5.16
		CNMG120408	CNMG432	●	●	●	●	●	●	●	●	●			0.8	
		CNMG120412	CNMG433	●	●	●	●		●			●			1.2	
		CNMG120416	CNMG434			●									1.6	
	16	CNMG160608	CNMG542										15.875	6.35	0.8	6.35
		CNMG160612	CNMG543			●	●					●			1.2	
		CNMG160616	CNMG544				●								1.6	
	19	CNMG190608	CNMG642			●	●						19.05	6.35	0.8	7.93
		CNMG190612	CNMG643	●		●	●					●			1.2	
		CNMG190616	CNMG644			●	●								1.6	
		CNMG190624	CNMG646												2.4	

Please refer to page 2 for details of stock symbols.

Ordering example ; 300pcs CNMG09T304 U610

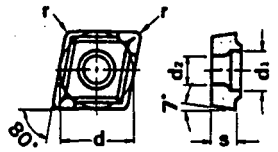
XABLE INSERTS

CCGW●●●●●

Shape		ISO Code	Cermet			Uncoated			Dimensions (mm)				
		Metric	NX33	NX55		HTi10			d	s	r	d_1	d_2
	06	CCGW060200		●					6.35	2.38	0 / 0.05	3.75	2.8
		CCGW0602V5		●									
	09	CCGW09T300		●					9.525	3.97	0 / 0.05	6.0	4.4
		CCGW09T3V5		●									

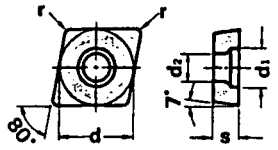
Ordering example ; 300pcs CCGW060200 NX55

CCMT●●●●●

Shape		ISO Code	Coated			Cermet				Uncoated		Dimensions (mm)				
		Metric	U610	U625	UP20M	NX33	NX55	NX99	UP35N	UTi20T		d	s	r	d_1	d_2
	06	CCMT060202	●			●		●	●	●		6.35	2.38	0.2 / 0.4	3.75	2.8
		CCMT060204	●	●			●	●	●	●						
	08	CCMT080304	●					●	●	●		7.94	3.18	0.4 / 0.8	4.5	3.4
		CCMT080308	●					●	●	●						
	09	CCMT09T302				●		●	●			9.525	3.97	0.2 / 0.4 / 0.8	6.0	4.4
		CCMT09T304	●	●		●	●	●	●	●						
		CCMT09T308	●	●	●			●	●	●						
	12	CCMT120404	●	●		●		●	●	●		12.70	4.76	0.4 / 0.8 / 1.2	7.5	5.5
		CCMT120408	●					●	●	●						
		CCMT120412	●	●												

Ordering example ; 300pcs CCMT060202 U610

CCMW●●●●●

Shape		ISO Code	Coated			Cermet		Uncoated			Dimensions (mm)				
		Metric	U505	UP20M		NX33		UTi20T	HTi10		d	s	r	d_1	d_2
	06	CCMW060202									6.35	2.38	0.2 / 0.4	3.75	2.8
		CCMW060204	●						●						
	09	CCMW09T302									9.525	3.97	0.2 / 0.4 / 0.8	6.0	4.4
		CCMW09T304	●						●						
		CCMW09T308	●					●	●						
	12	CCMW120404	●						●		12.70	4.76	0.4 / 0.8 / 1.2	7.5	5.5
		CCMW120408							●						
		CCMW120412							●						

ease refer to page 2 for details of stock symbols.

Ordering example ; 300pcs CCMW060204 U505

ISO CODE KEY-Turning Tools for External Machinings

A	B	D	E	F
90°	75°	45°	60°	90°
G	**J**	**K**	**L**	**N**
90°	93°	75°	95° / 95°	63°
Q	**S**	**T**	**V**	**X**
15°	45°	60°	73°30′	Special design

❶ Tool Style

C	M
P	**S**

❶ Method of Holding

C	D	R
80°	55°	
S	**T**	**W**

❷ Insert Shape

❶	❷	❸	❹	❺	❻	❼	❽	❾
P	C	L	N	R	25	25	M	16

❹ Insert Normal Clearance

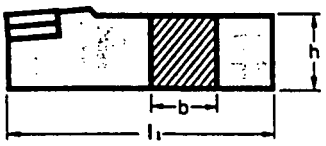
C	N	P
7°	0°	11°

❺ Hand of Tool

R	L	N

❻ ❼ Tool Size (Height(h) and Width(b)) (mm)

08	10	12	16	20	25	32	40	50
8	10	12	16	20	25	32	40	50



❽ Tool Length (l1) (mm)

D	E	F	H	K	M	N	P	R	S	T	U
60	70	80	100	125	150	160	170	200	250	300	350

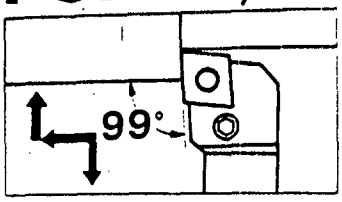
❾ Insert Size

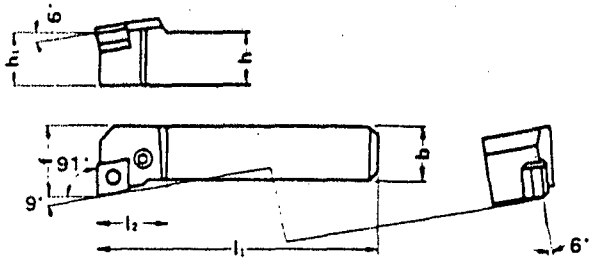
Inscribed circle of insert (mm)	4.76	5.56	6.35	7.94	9.525	12.7	15.875	19.05	25.4
T	08	09	11	13	16	22	27	33	44
S R			06	07	09	12	15	19	25
80° C					09	12	16	19	25
55° D					11	15	19	23	31

IING SYSTEM

LL TYPE

PCFNR/L





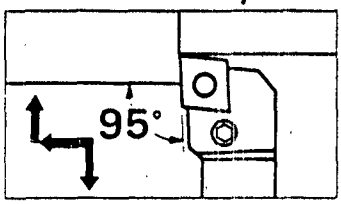
Right hand tool holder shown

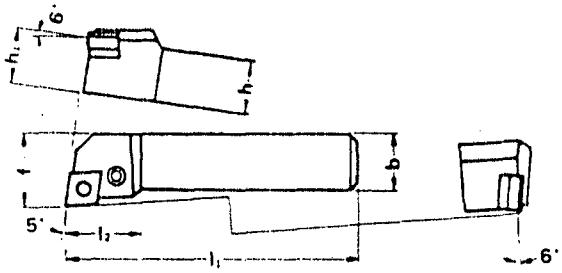
Tool Holder No.	Stocked		Dimensions (mm)						Insert No.		Spare Parts					
											Shim	Shim Pin	Clamp Lever	Clamp Screw	Wrench	Punch
	R	L	h	b	l_1	l_2	h_1	f								
PCFNR/L1616H09	●	●	16	16	100	22	16	20	CNMG	09T3	LLSCN3T3	LLP13	LLCL13	LLCS106	HKY25R	LLH3
PCFNR/L2020K09	●	●	20	20	125	22	20	25								
PCFNR/L2020K12	●	●	20	20	125	28	20	25	CNMA CNMG CNMM CNGG	1204	LLSCN42	LLP14	LLCL14	LLCS108	HKY30R	LLH4
PCFNR/L2525M12	●	●	25	25	150	28	25	32								

Please refer page 19 for inserts and page 268 for spare parts.

Ordering example : 5pcs PCFNR1616H09

PCLNR/L





Right hand tool holder shown

Tool Holder No.	Stocked		Dimensions (mm)						Insert No.		Spare Parts					
											Shim	Shim Pin	Clamp Lever	Clamp Screw	Wrench	Punch
	R	L	h	b	l_1	l_2	h_1	f								
PCLNR/L1616H09	●	●	16	16	100	22	16	20	CNMG	09T3	LLSCN3T3	LLP13	LLCL13	LLCS106	HKY25R	LLH3
PCLNR/L2020K09	●	●	20	20	125	22	20	25								
PCLNR/L2020K12	●	●	20	20	125	28	20	25	CNMA CNMG CNMM CNGG	1204	LLSCN42	LLP14	LLCL14	LLCS108	HKY30R	LLH4
PCLNR/L2525M12	●	●	25	25	150	28	25	32								
PCLNR/L3225P12	●	●	32	25	170	28	32	32								
PCLNR/L2525M16	●	●	25	25	150	32	25	32		1606	LLSCN53	LLP15	LLCL25	LLCS508	HKY30R	-
PCLNR/L3225P16	●	●	32	25	170	32	32	32								
PCLNR/L3232P16	●	●	32	32	170	32	32	40								
PCLNR/L3232P19	●	●	32	32	170	40	32	40		1906	LLSCN63	LLP16	LLCL16	LLCS310	HKY40R	-
PCLNR/L4040R19	●	●	40	40	200	40	40	50								

Please refer page 19 for inserts and page 268 for spare parts.

Please refer to page 2 for details of stock symbols.

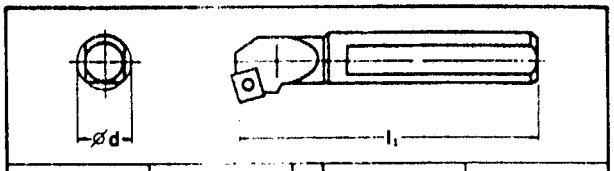
Ordering example : 5pcs PCLNR1616H09

BORING SYSTEM

ODE KEY-Boring Tools for Internal Machinings

A	●Tool holder with oil hole ●Steel Shank
C	Carbide Shank
S	Steel Shank

❶Shank Material



08	8
10	10
12	12
16	16
20	20
25	25
32	32
40	40
50	50

❷Tool Diameter Ød(mm)

F	80
H	100
K	125
M	150
Q	180
R	200
S	250
T	300
U	350

❸Tool Length l_1 (mm)

M	
P	
S	

❹Method of Holding

❶ ❷ ❸ ❹ ❺ ❻ ❼ ❽ ❾

S 16 M S [ ] [ ] C R 09

❺Insert Shape

C	80°
D	55°
S	
T	
V	35°
W	60°

❼Tool Style

F	90°
K	75°
L	95° 95°
Q	107°30' 117°30'
U	93°
Z	

❻Insert Normal Clearance

C	7°
N	0°

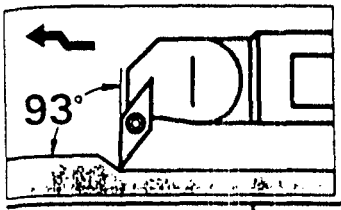
❽Hand of Tool

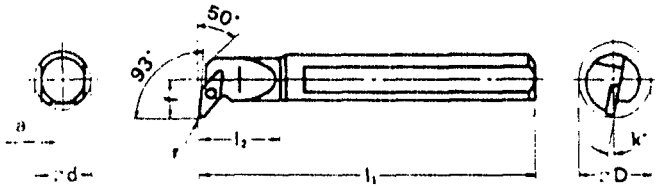
R	
L	

❾Insert Size

Inscribed circle of insert(mm)	C 80°	D 55°	S	T	V 35°	W 60°
3.97						02
4.76						
5.56				09		S3
6.35	06	07		11	11	04
9.525	09	11	09	16	16	06
12.70	12	15	12	22		08
15.875	16					
19.05	19		19			

S•••SVUCR/L





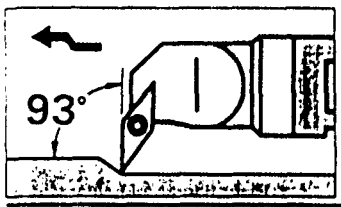
Right hand tool holder shown

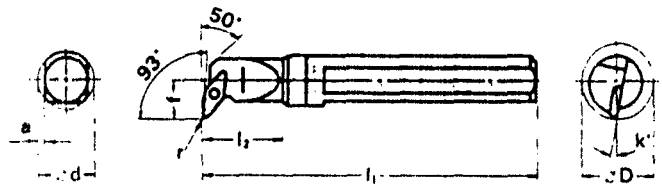
Tool Holder No.	Stocked		Dimensions (mm)						D	r	Insert No.		Spare Parts	
													Clamp Screw	Wrench
	R	L	d	l_1	l_2	f	a	k'						
S20QSVUCR/L11	●	●	20	180	32	13	1	7	25	0.4	VCMW VCMT	1103○○	TS25	TKY08F
S25RSVUCR/L16	●	●	25	200	40	17	1	5	32	0.8				
S32SSVUCR/L16	●	●	32	250	50	22	1	5	40	0.8		1604○○	TS4	TKY15F
S40TSVUCR/L16	●	●	40	300	63	27	1.5	5	50	0.8				

Please refer page 54 for inserts and page 268 for spare parts.

Ordering example ; 5pcs S20QSVUCR11

C•••SVUCR (CARBIDE SHANK)





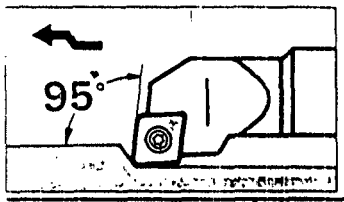
Right hand tool holder shown

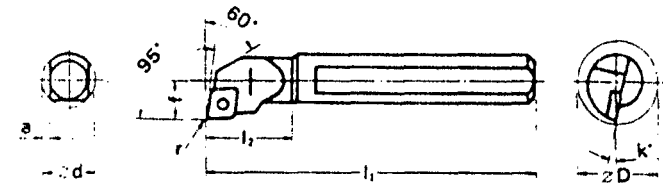
Tool Holder No.	Stocked	Dimensions (mm)						D	r	Insert No.		Spare Parts	
												Clamp Screw	Wrench
	R	d	l_1	l_2	f	a	k'						
C20SSVUCR11	●	20	250	32	13	1	7	25	0.4	VCMW VCMT	1103○○	TS25	TKY08F
C25TSVUCR16	●	25	300	40	17	1	5	32	0.8		1604○○	TS4	TKY15F

Please refer page 54 for inserts and page 268 for spare parts.

Ordering example ; 5pcs C20SSVUCR11

S•••SCLCR/L





Right hand tool holder shown

Tool Holder No.	Stocked		Dimensions (mm)						D	r	Insert No.		Spare Parts	
													Clamp Screw	Wrench
	R	L	d	l_1	l_2	f	a	k'						
S08FSCLCR/L06	●	●	8	80	12	6	0.5	15	11	0.4	CCMW CCMT CCGW	0602○○	TS25	TKY08F
S10HSCLCR/L06	●	●	10	100	16	7	0.5	13	13	0.4				
S12KSCLCR/L06	●	●	12	125	20	9	0.5	10	16	0.4				
S16MSCLCR/L09	●	●	16	150	25	11	1	7	20	0.8		09T3○○	TS4	TKY15F
S20QSCLCR/L09	●	●	20	180	32	13	1	7	25	0.8				
S25RSCLCR/L12	●	●	25	200	40	17	1	5	32	0.8				
S32SSCLCR/L12	●	●	32	250	50	22	1	5	40	0.8		1204○○	TS5	TKY25F
S40TSCLCR/L12	●	●	40	300	63	27	1.5	5	50	0.8				

Please refer page 18 for inserts and page 268 for spare parts.

Please refer to page 2 for details of stock symbols.

Ordering example ; 5pcs S08FSCLCR06

Tingkat Kekasaran, ISO Number	Mean Roughness Index R_a ; µm	R_z ; µm	Peak to Valey Height R_t ; µm	Simbol Segitiga	Keterangan
N 12	50	163	120		Sangat Kasar
N 11	25	84	63		
N 10	12,5	44	32	▽	Kasar
N 9	6,3	23	18		
N 8	3,2	12	10	▽▽	Normal
N 7	1,6	6,2	6		
N 6	0,8	3,2	3		Halus
N 5	0,4	1,7	1,6	▽▽▽	
N 4	0,2	0,9	0,9		Sangat Halus
N 3	0,1	0,4	0,5	▽▽▽▽	

Analisa Rinci Proses Simulasi Langkah 1-2

n (rpm)	V (m/det)	C_p (Rp/Produk)	R_p (Produk/men)	N_c (KW)
80	19,217	46,706	0,91	0,515
125	30,026	30,738	1,43	0,805
175	42,037	25,243	2,00	1,128
290	69,661	29,37	3,28	1,866
475	114,1	93,96	5,03	2,884
725	174,152	360,246	5,56	4,401
800	192,168	498,387	5,21	4,875
900	216,189	736,53	4,57	5,464
1000	240,21	1045,88	3,83	6,07
1100	264,231	1437,25	3,13	6,678
1200	288,252	1921,85	2,54	7,285

Analisa Rinci Proses Simulasi Langkah 1-3

n (rpm)	V (m/det)	C_p (Rp/Produk)	R_p (Produk/men)	N_c (KW)
80	12,058	22,49	1,89	0,266
125	18,84	14,448	2,96	0,416
175	26,376	10,471	4,13	0,582
290	43,709	7,274	6,85	0,964
475	71,592	9,349	11,11	1,58
725	109,327	25,43	16,13	2,275
800	120,576	34,106	17,24	3,999
900	135,648	49,256	18,18	4,499
1000	150,72	69,044	18,52	4,999
1100	165,792	94,155	20	5,499
1200	180,864	125,307	17,86	5,999

Analisa Rinci Proses Simulasi Langkah 1-4

n (rpm)	V (m/det)	C_p (Rp/Produk)	R_p (Produk/men)	N_c (KW)
80	22,859	10,733	4	0,613
125	35,717	7,28	6,25	0,958
175	50,004	6,338	8,70	1,341
290	82,865	10,964	14,29	2,223
475	135,727	43,7	20,41	3,43
725	207,161	173,809	17,86	5,243
800	228,592	241,088	15,38	5,785
900	257,166	356,992	12,20	6,508
1000	285,74	507,486	9,62	7,231
1100	314,314	697,835	7,62	7,954
1200	342,88	933,492	5,81	8,677

Analisa Rinci Proses Simulasi Langkah 1-5

n (rpm)	V (m/det)	C_p (Rp/Produk)	R_p (Produk/men)	N_c (KW)
80	24,618	20,722	2,08	0,543
125	38,465	14,367	3,25	0,849
175	53,878	13,329	4,55	1,189
290	89,284	27,368	7,30	1,97
475	146,241	116,338	10,10	3,043
725	223,097	466,201	7,69	4,643
800	246,176	647,094	6,41	5,123
900	276,948	958,665	4,95	5,764
1000	307,72	1363,17	3,77	6,404
1100	338,492	1874,78	2,88	7,044
1200	369,264	2508,14	2,22	7,685

Analisa Rinci Proses Simulasi Langkah 1-6

n (rpm)	V (m/det)	C_p (Rp/Produk)	R_p (Produk/men)	N_c (KW)
80	34,54	100,051	0,45	0,927
125	53,996	86,021	0,70	1,448
175	75,556	122,19	0,97	2,027
290	125,271	455,593	1,46	3,166
475	205,081	2254,02	1,34	5,19
725	313,019	9229,68	0,56	7,921
800	345,4	12827,5	0,42	8,741
900	388,575	19022,3	0,30	9,833
1000	432,75	27063,3	0,21	10,926
1100	474,925	37232	0,16	12,019
1200	518,1	49819,7	0,12	13,111

Analisa Rinci Proses Simulasi Langkah 1-7

n (rpm)	V (m/det)	C_p (Rp/Produk)	R_p (Produk/men)	N_c (KW)
80	23,864	18,742	2,28	0,213
125	37,287	12,559	3,57	0,333
175	52,202	10,533	5	0,467
290	86,551	16,221	8,13	0,773
475	141,764	60,748	12,05	1,196
725	216,267	239,024	11,36	1,824
800	238,64	331,335	10,10	2,013
900	268,47	490,388	8,33	2,265
1000	298,3	696,93	6,62	2,516
1100	328,13	958,187	5,24	2,768
1200	357,96	1281,64	4,12	3,02

Analisa Rinci Proses Simulasi Langkah 1-8

n (rpm)	V (m/det)	C_p (Rp/Produk)	R_p (Produk/men)	N_c (KW)
80	42,704	55,152	0,89	1,146
125	66,759	63,344	1,38	1,79
175	93,415	122,728	1,88	2,506
290	154,881	560,439	2,49	3,914
475	253,555	2862,79	1,50	6,417
725	387,005	11764,4	0,48	9,794
800	427,04	16354,2	0,35	10,807
900	480,42	24256,5	0,24	12,158
1000	533,8	34513,5	0,17	13,509
1100	587,18	47484,1	0,13	14,859
1200	640,56	63540,1	0,09	16,21

Analisa Rinci Proses Simulasi Langkah 1-9

n (rpm)	V (m/det)	C_p (Rp/Produk)	R_p (Produk/men)	N_c (KW)
80	14,444	54,528	0,78	0,387
125	22,569	35,184	1,22	0,605
175	31,596	25,924	1,71	0,848
290	52,386	20,5	2,82	1,403
475	85,761	38,357	4,52	2,301
725	130,965	126,392	6,21	3,31
800	144,44	172,597	6,41	3,655
900	162,495	252,788	6,45	4,112
1000	180,55	357,172	6,21	4,569
1100	198,605	489,387	5,75	5,026
1200	216,66	653,211	5,15	5,483

Analisa Rinci Proses Simulasi Langkah 1-10

n (rpm)	V (m/det)	C_p (Rp/Produk)	R_p (Produk/men)	N_c (KW)
80	18,84	13,339	3,19	0,505
125	29,437	8,759	5	0,79
175	41,212	6,87	6,99	1,106
290	68,33	7,995	11,49	1,83
475	111,919	24,865	17,86	2,828
725	170,737	94,557	20	4,321
800	188,4	130,759	18,87	4,768
900	211,95	193,174	16,67	5,364
1000	235,5	274,259	14,08	5,96
1100	259,05	376,847	11,76	6,556
1200	282,6	503,876	9,52	7,152

Analisa Rinci Proses Simulasi Langkah 1-11

n (rpm)	V (m/det)	C_p (Rp/Produk)	R_p (Produk/men)	N_c (KW)
80	20,347	24,052	1,78	0,546
125	31,792	15,951	2,78	0,853
175	44,509	12,937	3,89	1,194
290	73,796	17,495	6,37	1,977
475	120,873	60,95	9,62	3,055
725	184,396	236,793	9,90	4,666
800	203,472	327,95	9,01	5,149
900	228,906	485,05	7,69	5,793
1000	254,34	689,089	6,25	6,436
1100	279,774	947,2	5,05	7,08
1200	305,208	1266,77	4,03	7,724

Analisa Rinci Proses Simulasi Langkah 1-12

n (rpm)	V (m/det)	C_p (Rp/Produk)	R_p (Produk/men)	N_c (KW)
80	21,854	112,493	0,38	0,586
125	34,147	75,546	0,59	0,916
175	47,806	63,789	0,83	1,282
290	79,262	100,242	1,36	2,123
475	129,826	381,186	1,99	3,281
725	198,055	1503,18	1,86	5,012
800	218,544	2084	1,64	5,531
900	245,862	3084,72	1,34	6,222
1000	273,18	4384,21	1,06	6,913
1100	300,498	6027,91	0,84	7,605
1200	327,816	8062,91	0,66	8,296

Analisa Rinci Proses Simulasi Langkah 1-13

n (rpm)	V (m/det)	C_p (Rp/Produk)	R_p (Produk/men)	N_c (KW)
80	26,125	54,088	0,8	0,701
125	40,82	38,29	1,25	1,095
175	57,177	37,536	1,74	1,532
290	94,75	86,576	2,80	2,538
475	155,195	383,909	3,66	3,922
725	236,756	1548,41	2,53	5,991
800	261,248	2150,01	2,07	6,611
900	293,904	3186,11	1,56	7,438
1000	326,56	4531,19	1,17	8,264
1100	359,216	6232,31	0,89	9,091
1200	391,872	8338,24	0,68	9,917

Analisa Rinci Proses Simulasi Langkah 1-14

n (rpm)	V (m/det)	C_p (Rp/Produk)	R_p (Produk/men)	N_c (KW)
80	30,395	38,489	1,14	0,815
125	47,492	29,6	1,78	1,274
175	66,523	34,913	2,48	1,782
290	110,238	107,259	3,89	2,786
475	180,471	512,563	4,31	4,567
725	275,456	2089,63	2,25	6,971
800	303,952	2903,35	1,75	7,692
900	342,946	4304,54	1,26	8,653
1000	379,94	6123,39	0,92	9,615
1100	417,934	8423,57	0,68	10,576
1200	455,928	11270,9	0,52	11,538

Analisa Rinci Proses Simulasi Langkah 1-15

n (rpm)	V (m/det)	C_p (Rp/Produk)	R_p (Produk/men)	N_c (KW)
80	35,796	69,717	0,65	0,96
125	55,96	62,344	1,02	1,499
175	78,304	93,498	1,41	2,1
290	129,826	363,863	2,08	3,281
475	212,539	1815,09	1,79	5,379
725	324,401	7438,72	0,71	8,209
800	357,96	10339	0,53	9,059
900	402,705	15332,7	0,37	10,191
1000	447,45	21814,5	0,27	11,323
1100	492,195	30011,4	0,20	12,456
1200	536,94	40158,2	0,15	13,588

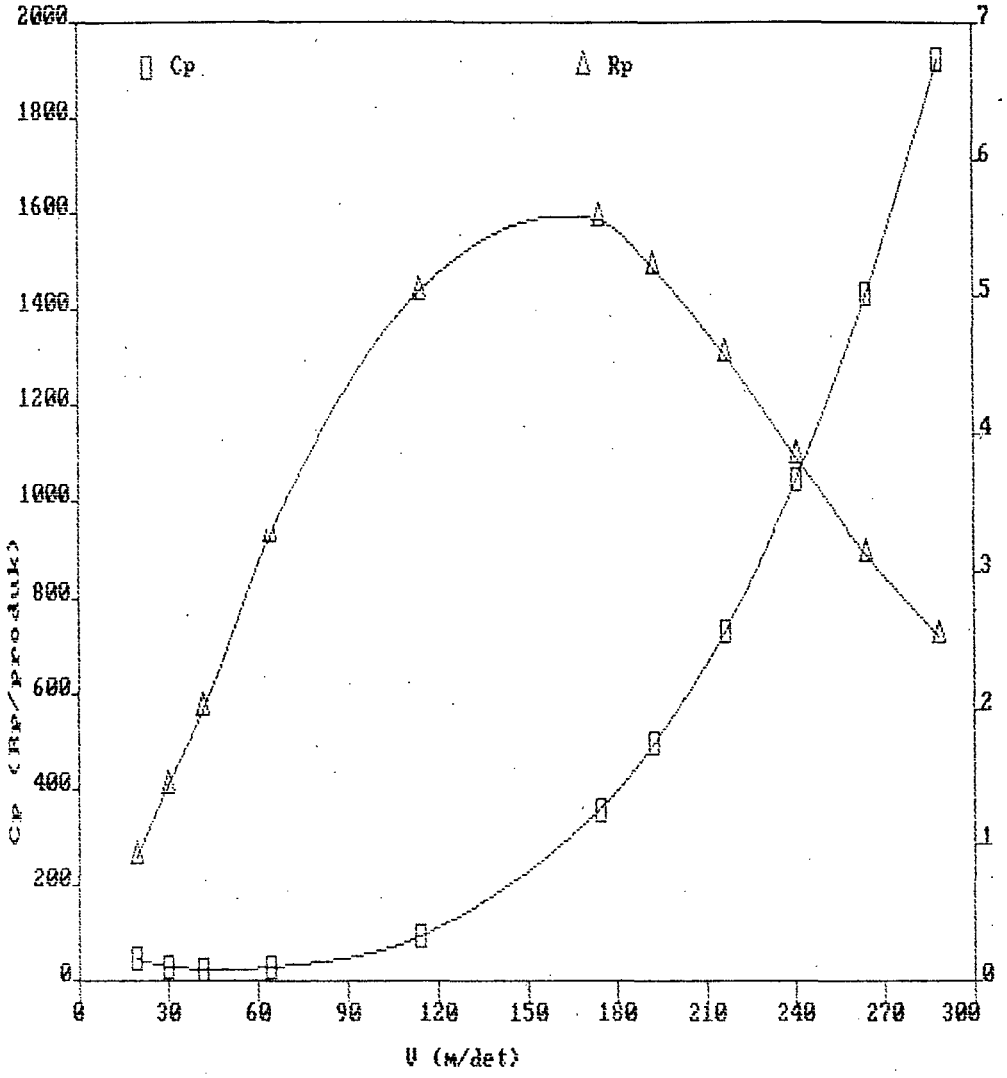
Analisa Rinci Proses Simulasi Langkah 1-16

n (rpm)	V (m/det)	C_p (Rp/Produk)	R_p (Produk/men)	N_c (KW)
80	9,797	174,114	0,24	0,234
125	15,307	111,753	0,38	0,365
175	21,43	80,708	0,53	0,511
290	35,531	54,306	0,88	0,848
475	58,198	61,978	1,44	1,389
725	88,829	153,768	2,15	2,12
800	97,968	204,023	2,34	2,337
900	110,214	292,297	2,56	2,481
1000	122,46	407,832	2,74	2,756
1100	134,706	554,623	2,86	3,032
1200	146,952	736,843	2,92	3,308

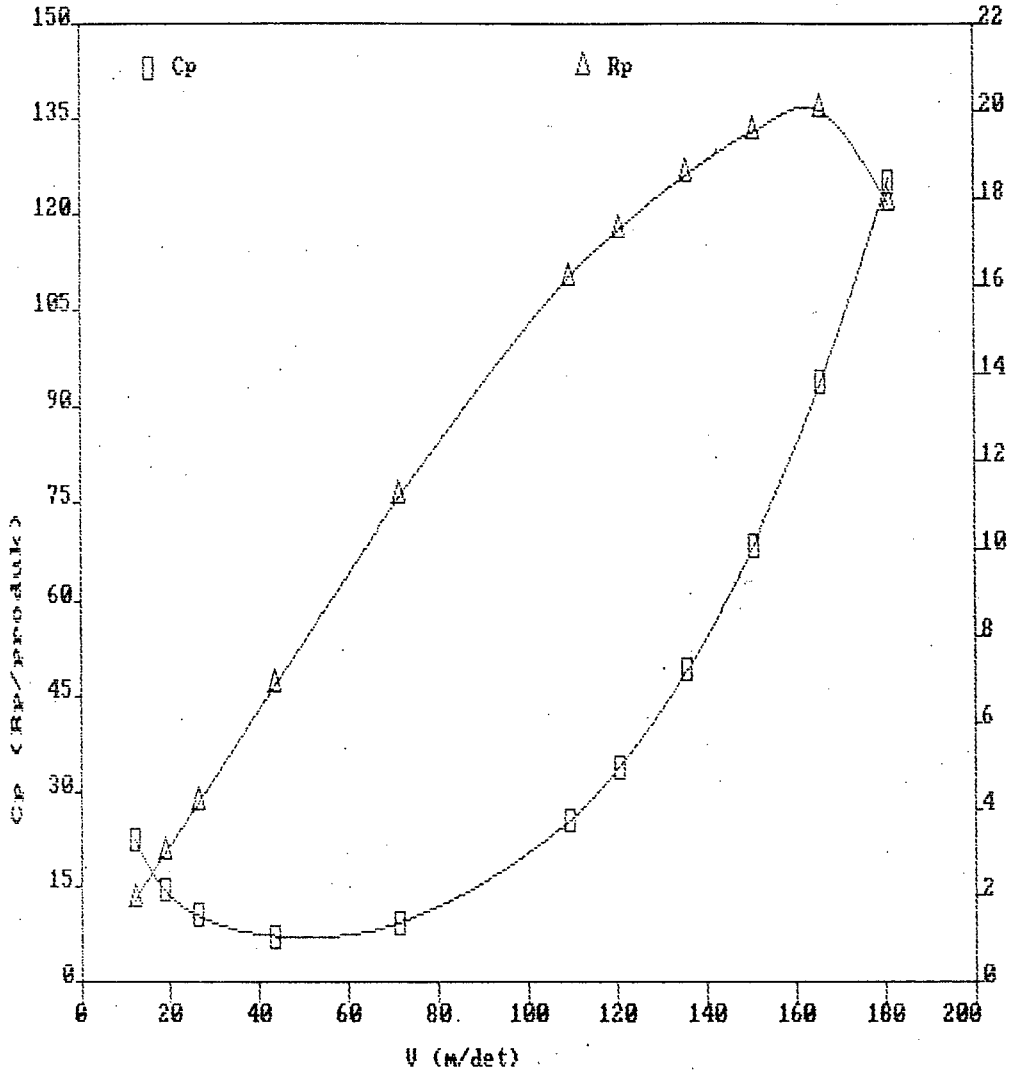
Analisa Rinci Proses Simulasi Langkah 1-17

n (rpm)	V (m/det)	C_p (Rp/Produk)	R_p (Produk/men)	N_c (KW)
80	10,55	174,118	0,24	0,126
125	16,485	111,772	0,38	0,197
175	23,079	80,768	0,53	0,275
290	38,265	54,633	0,88	0,457
475	62,675	63,686	1,44	0,748
725	95,661	160,8	2,15	1,142
800	105,504	213,783	2,34	1,187
900	118,692	306,774	2,56	1,336
1000	131,88	428,433	2,74	1,484
1100	145,068	582,968	2,86	1,633
1200	158,256	774,772	2,92	1,781

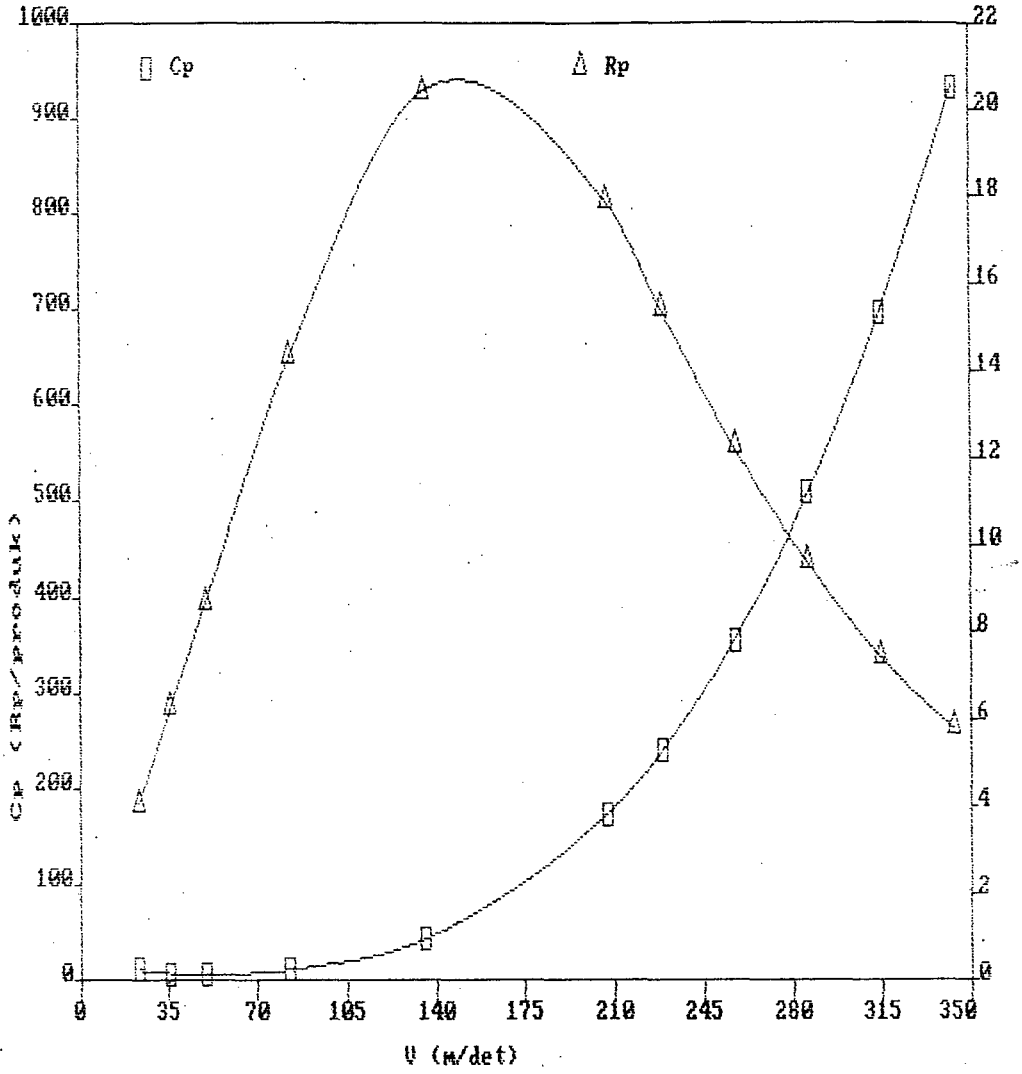
Langkah 1-2


Cp
Rp
Cp (Rp/produksi)
V (m/det)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
7
6
5
4
3
2
1
0
0
30
60
90
120
150
180
210
240
270
300

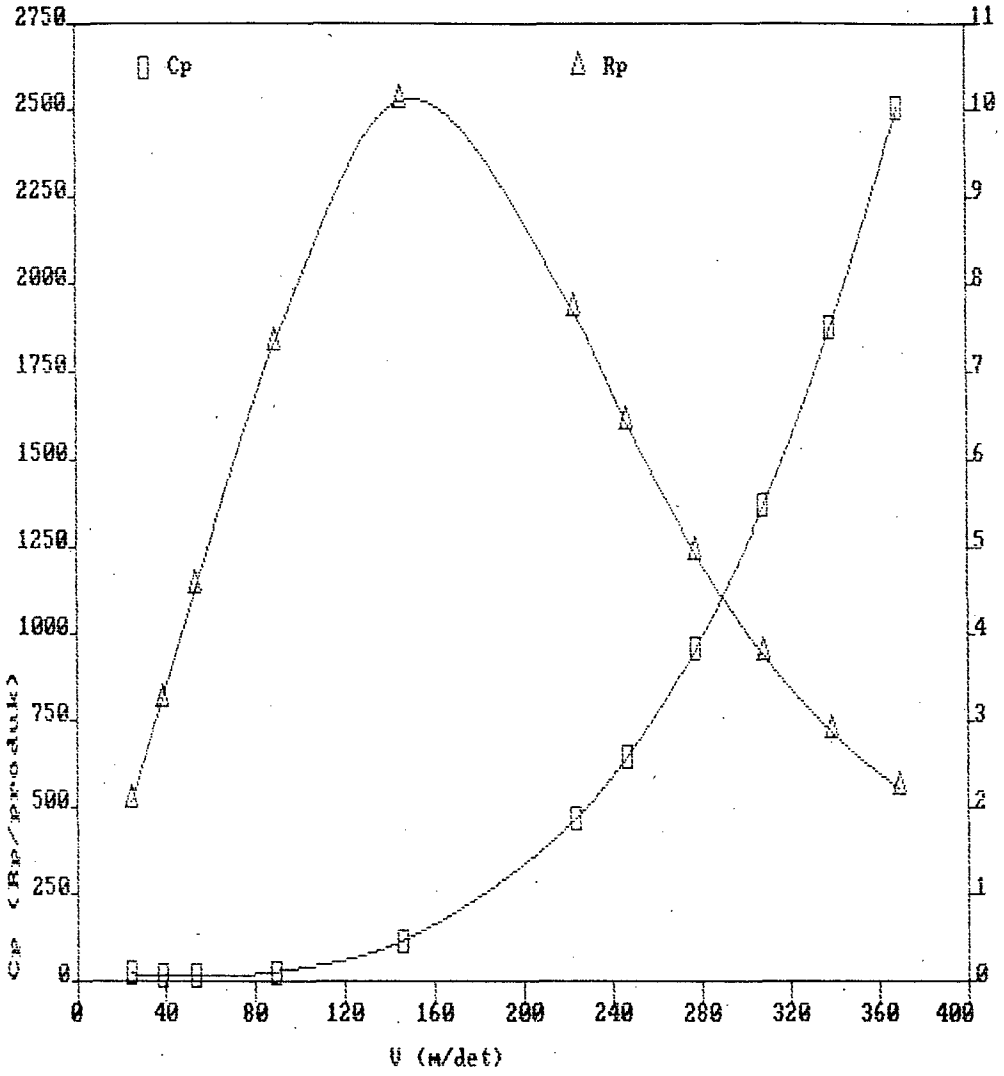
Langkah 1-3


Cp
Rp
150
135
120
105
90
75
60
45
30
15
0
22
20
18
16
14
12
10
8
6
4
2
0
0
20
40
60
80
100
120
140
160
180
200
V (m/det)

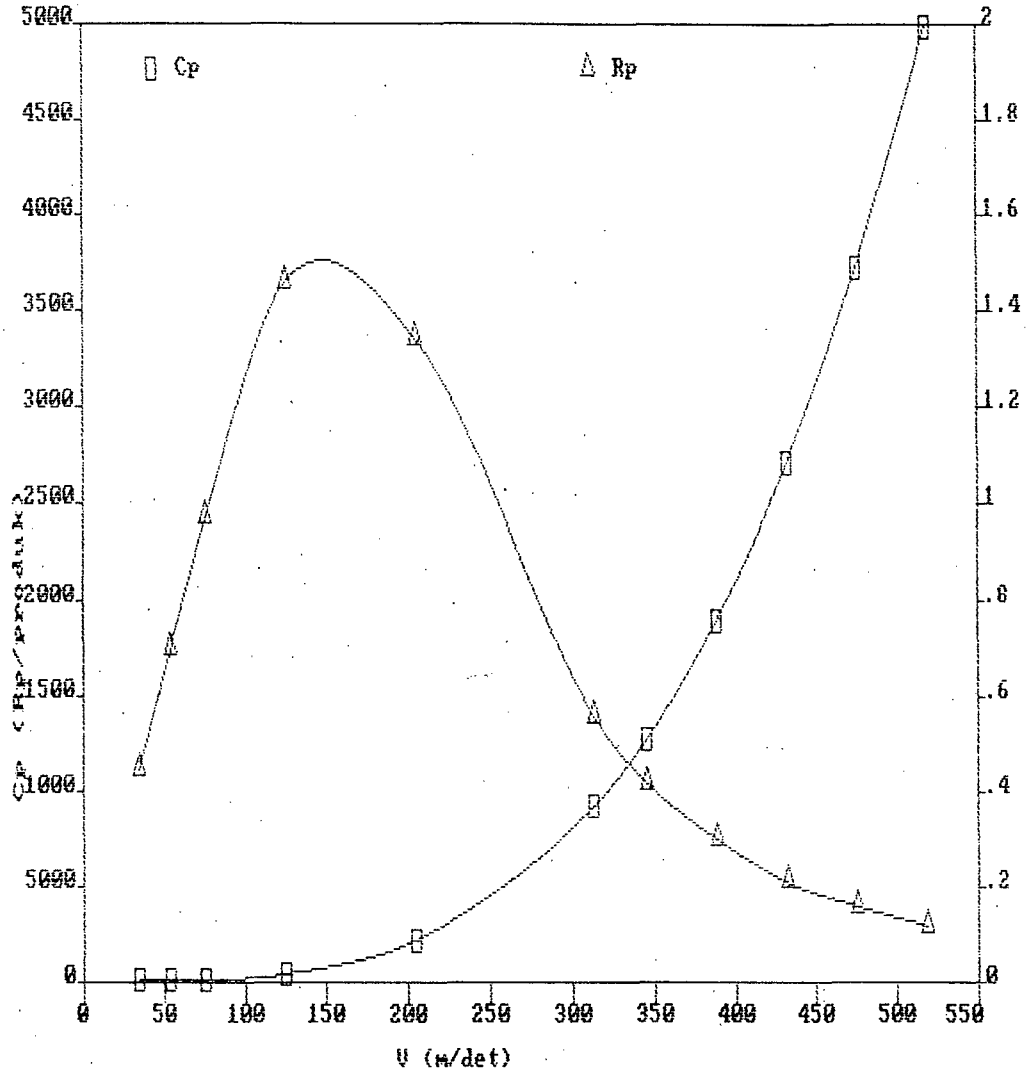
Langkah 1-4


Cp
Rp
Cp (Rp/produksi)
V (m/det)
0
35
70
105
140
175
210
245
280
315
350
100
200
300
400
500
600
700
800
900
1000
2
4
6
8
10
12
14
16
18
20
22

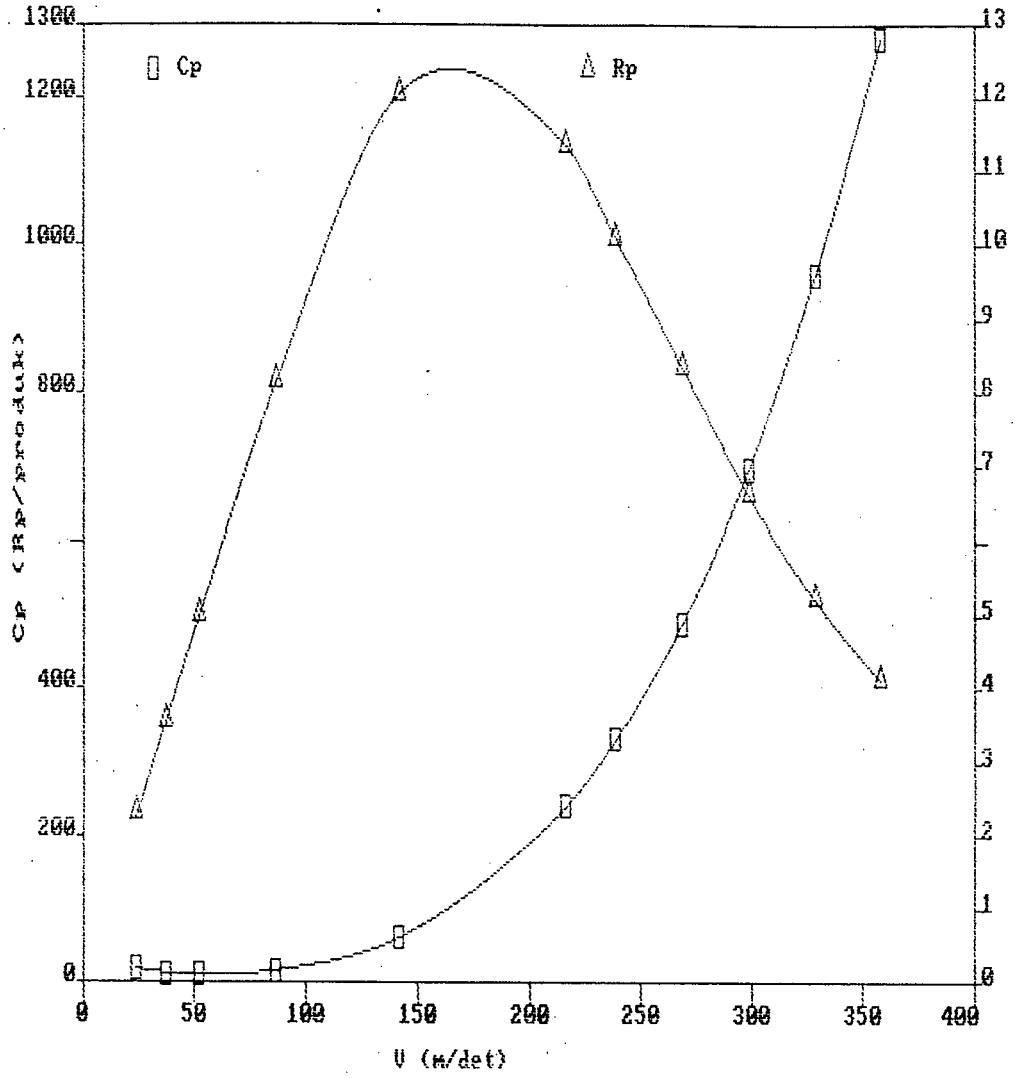
Langkah 1-5


Cp
Rp
2750
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
11
10
9
8
7
6
5
4
3
2
1
0
0
40
80
120
160
200
240
280
320
360
400
V (m/det)

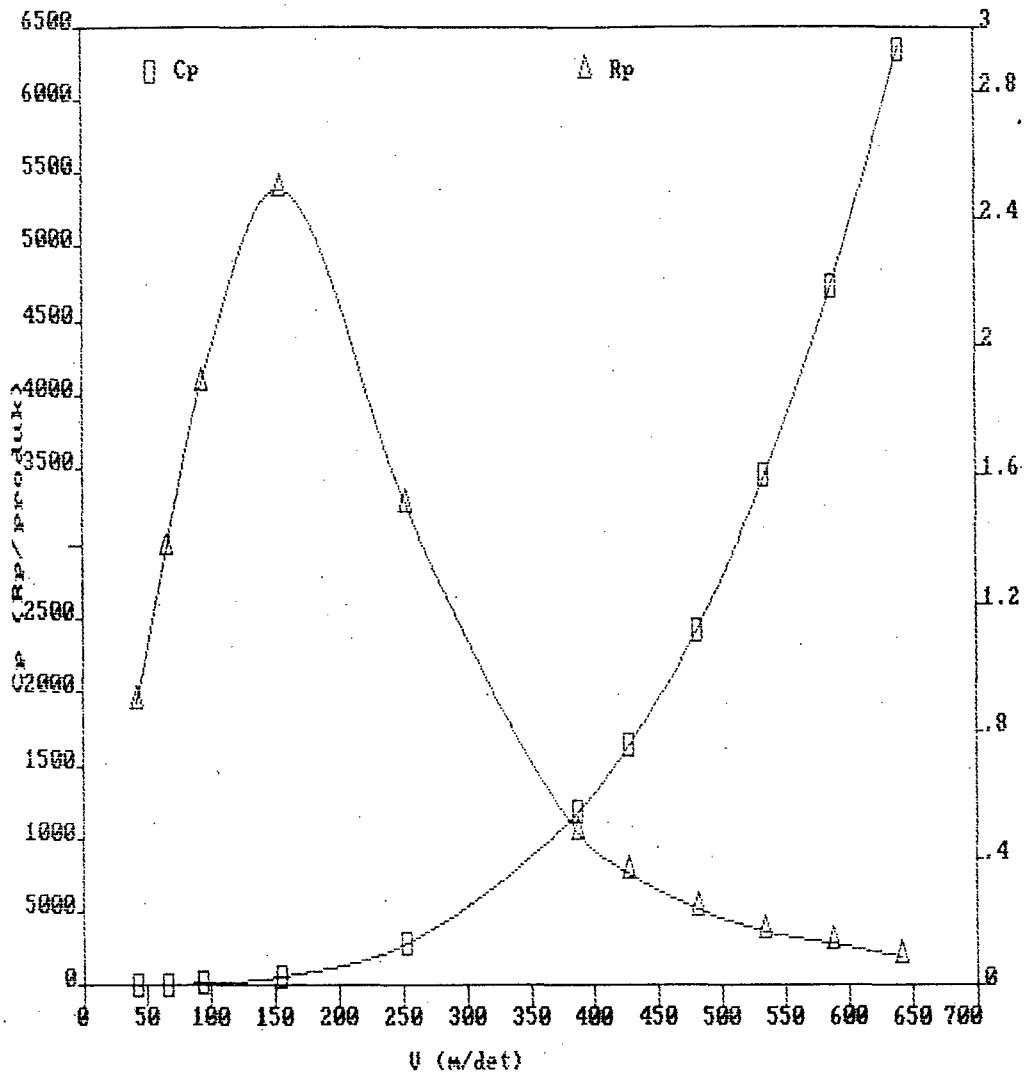
Langkah 1-6


Cp
Rp
5000
4500
4000
3500
3000
2500
2000
1500
1000
5000
0
2
1.8
1.6
1.4
1.2
1
.8
.6
.4
.2
0
0
50
100
150
200
250
300
350
400
450
500
550
V (m/det)

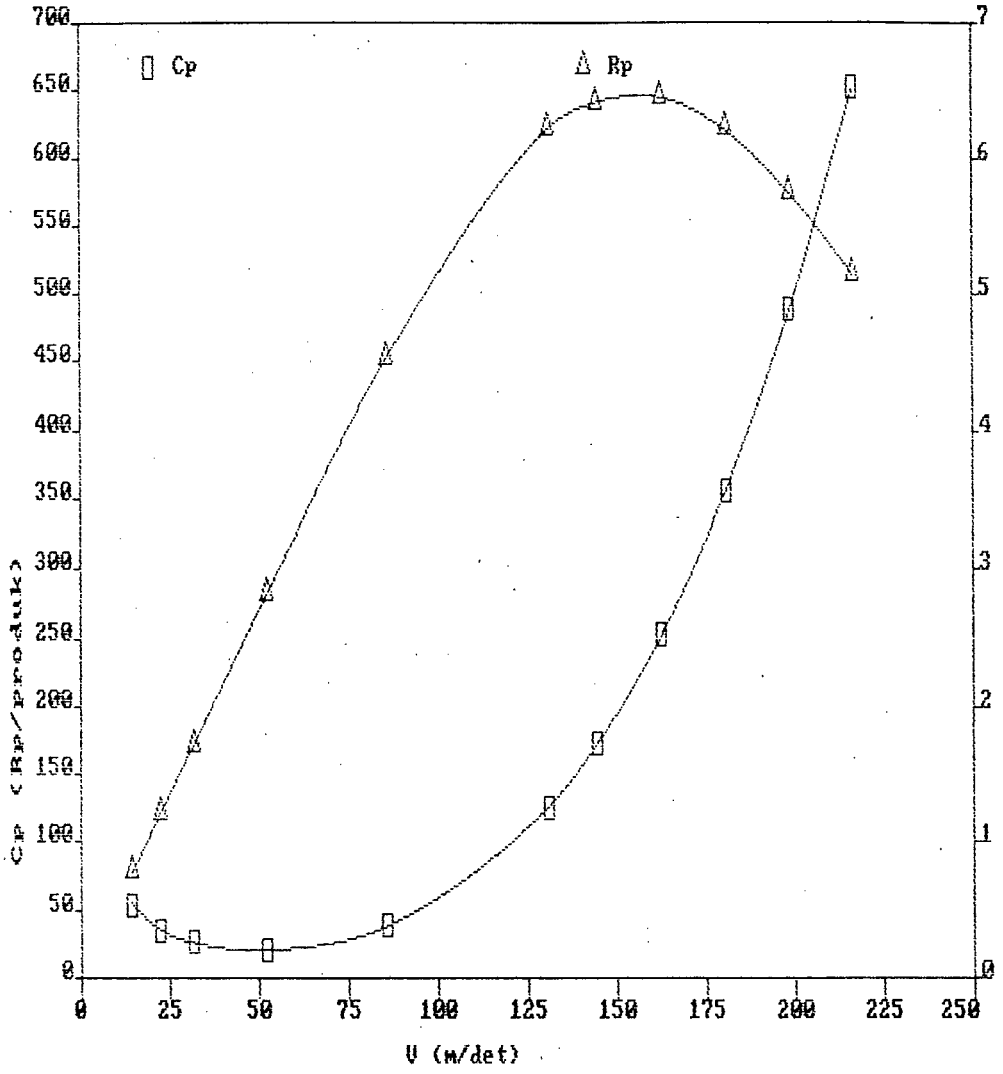
Langkah 1-7

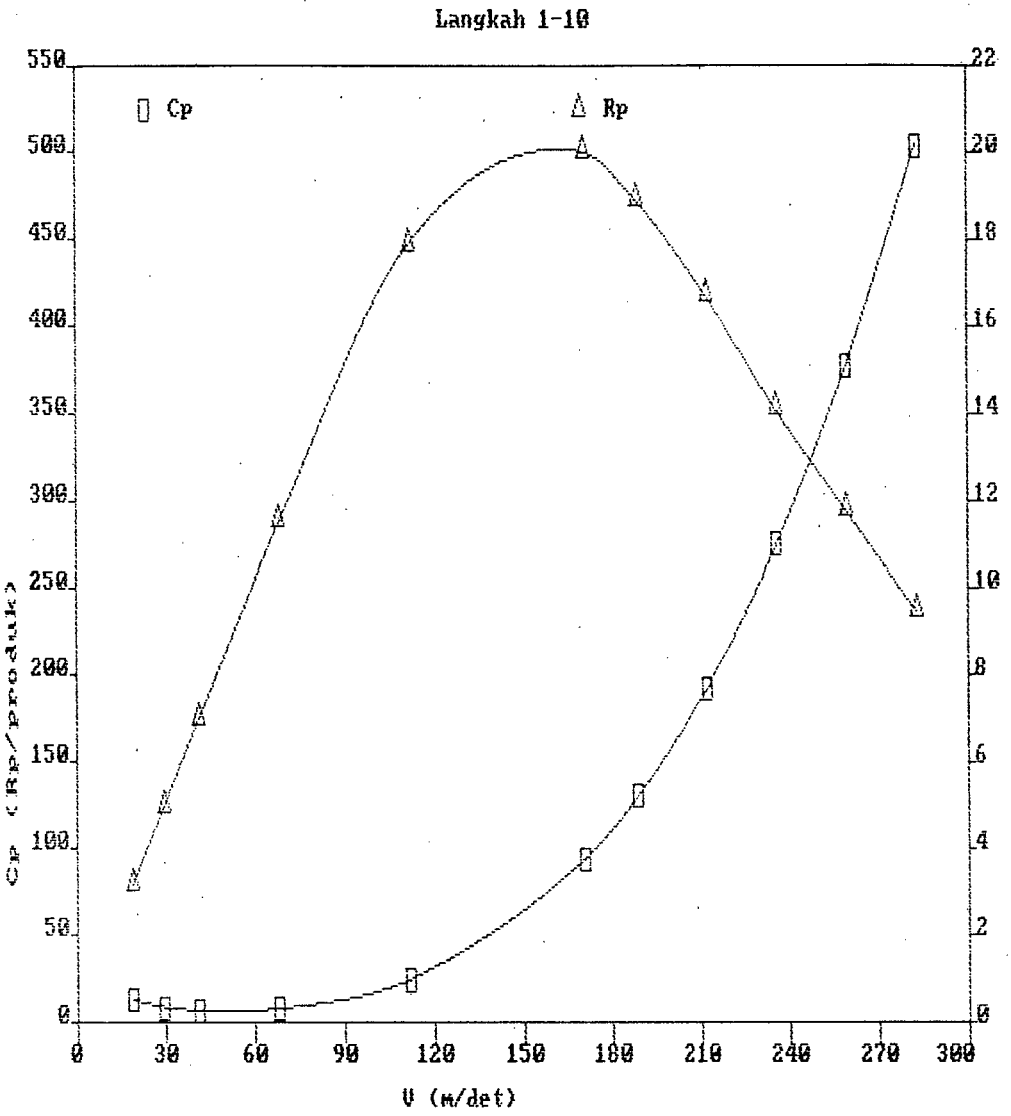

Cp
Rp
Cp (Rp/produk)
V (m/det)
0
50
100
150
200
250
300
350
400
200
400
800
1000
1200
1300
1
2
3
4
5
6
7
9
10
11
12
13

Langkah 1-8

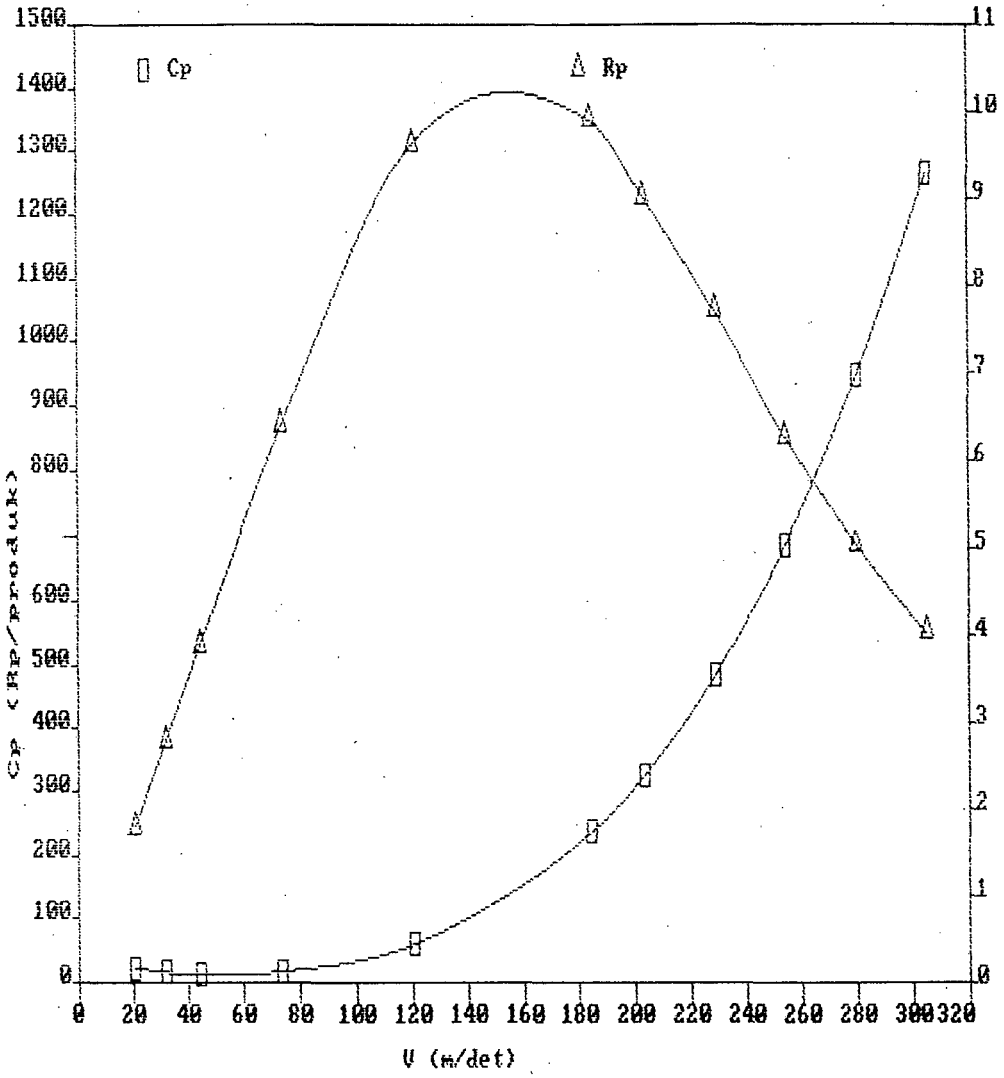

Cp
Rp
6500
6000
5500
5000
4500
4000
3500
2500
2000
1500
1000
5000
0
3
2.8
2.4
2
1.6
1.2
.8
.4
0
0 50 100 150 200 250 300 350 400 450 500 550 600 650 700
V (m/det)

Langkah 1-9

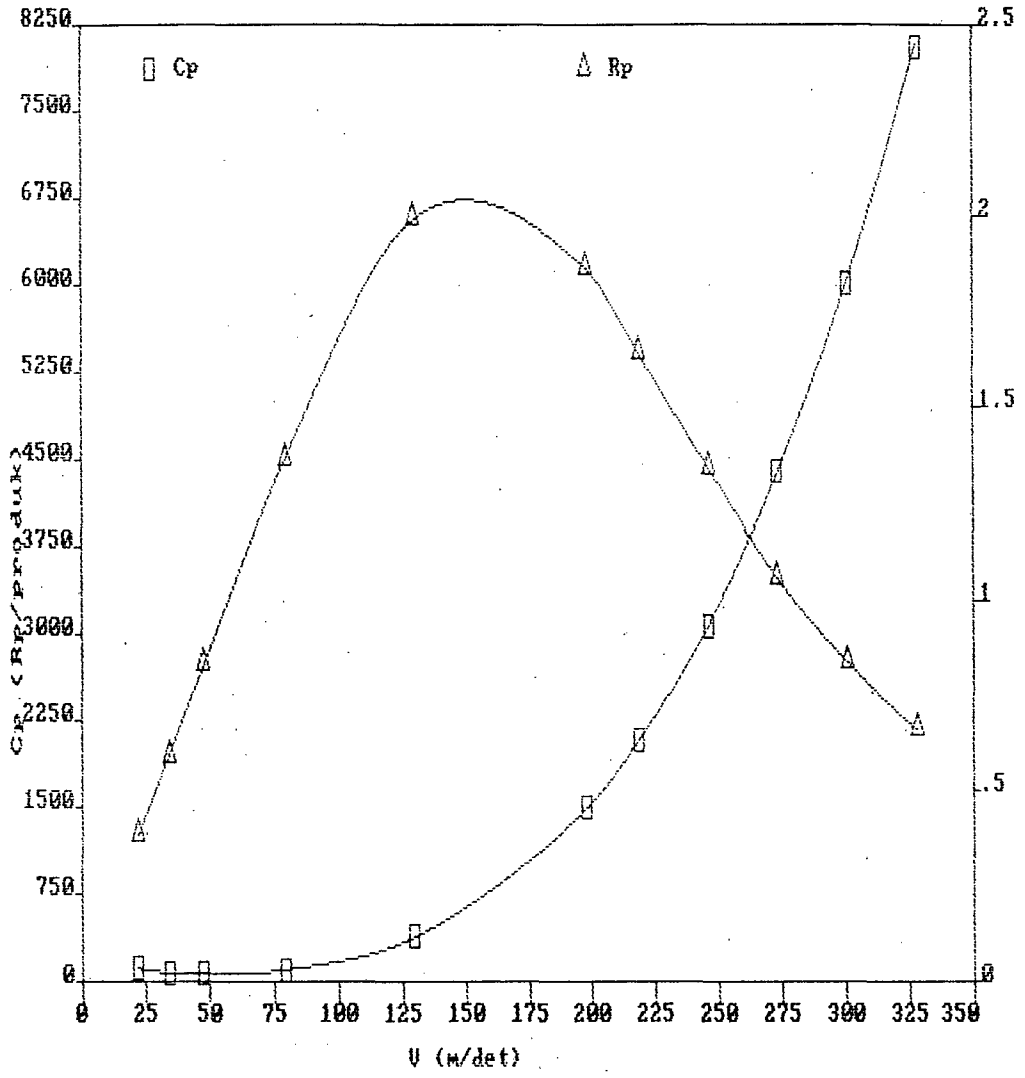

Cp
Rp
Cp (Rp/produk)
V (m/det)
0
25
50
75
100
125
150
175
200
225
250
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
0
1
2
3
4
5
6
7


Langkah 1-10
Cp
Rp
Cp (Rp/produk)
V (m/det)
550
500
450
400
350
300
250
200
150
100
50
0
22
20
18
16
14
12
10
8
6
4
2
0
0
30
60
90
120
150
180
210
240
270
300

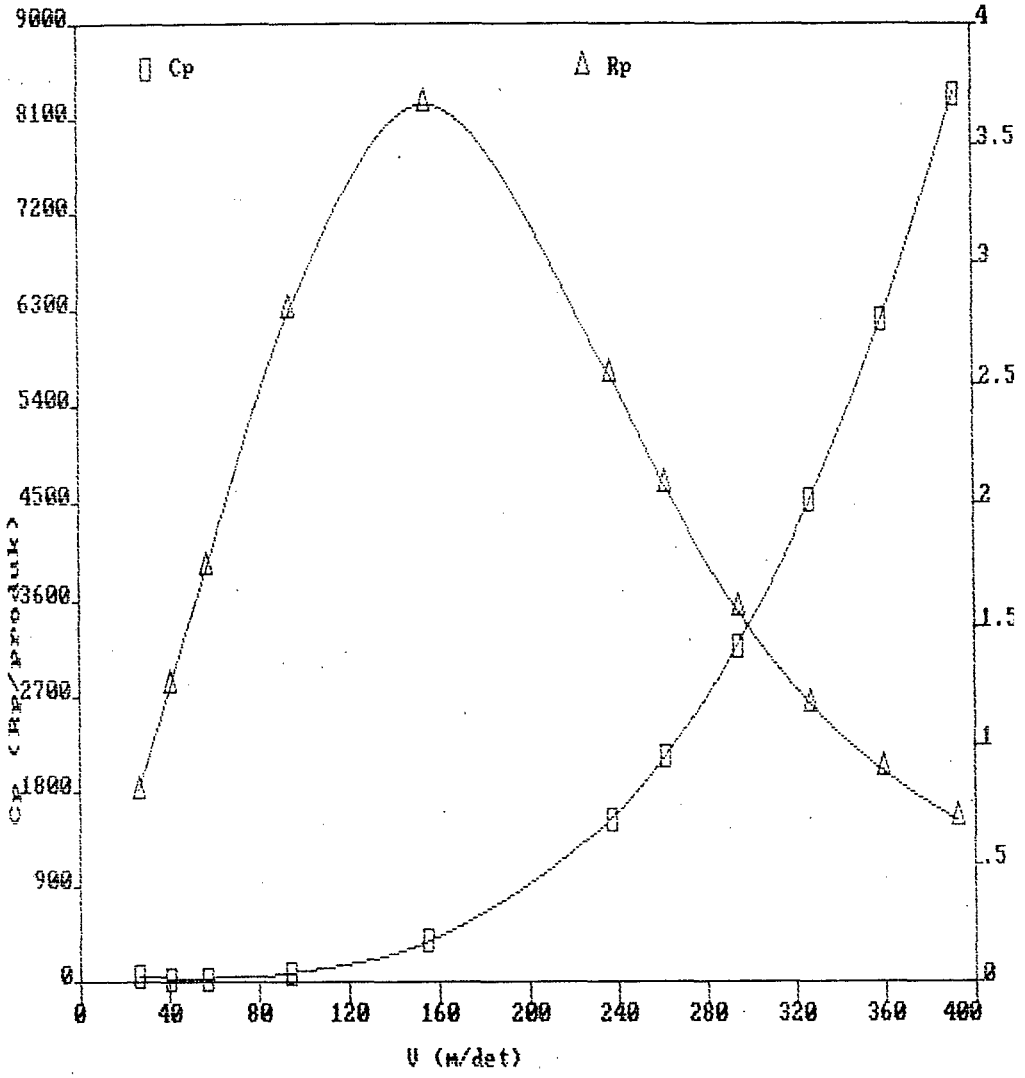
Langkah 1-11


Cp
Rp
Cp (Rp/produk)
V (m/det)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
0
1
2
3
4
5
6
7
8
9
10
11
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320

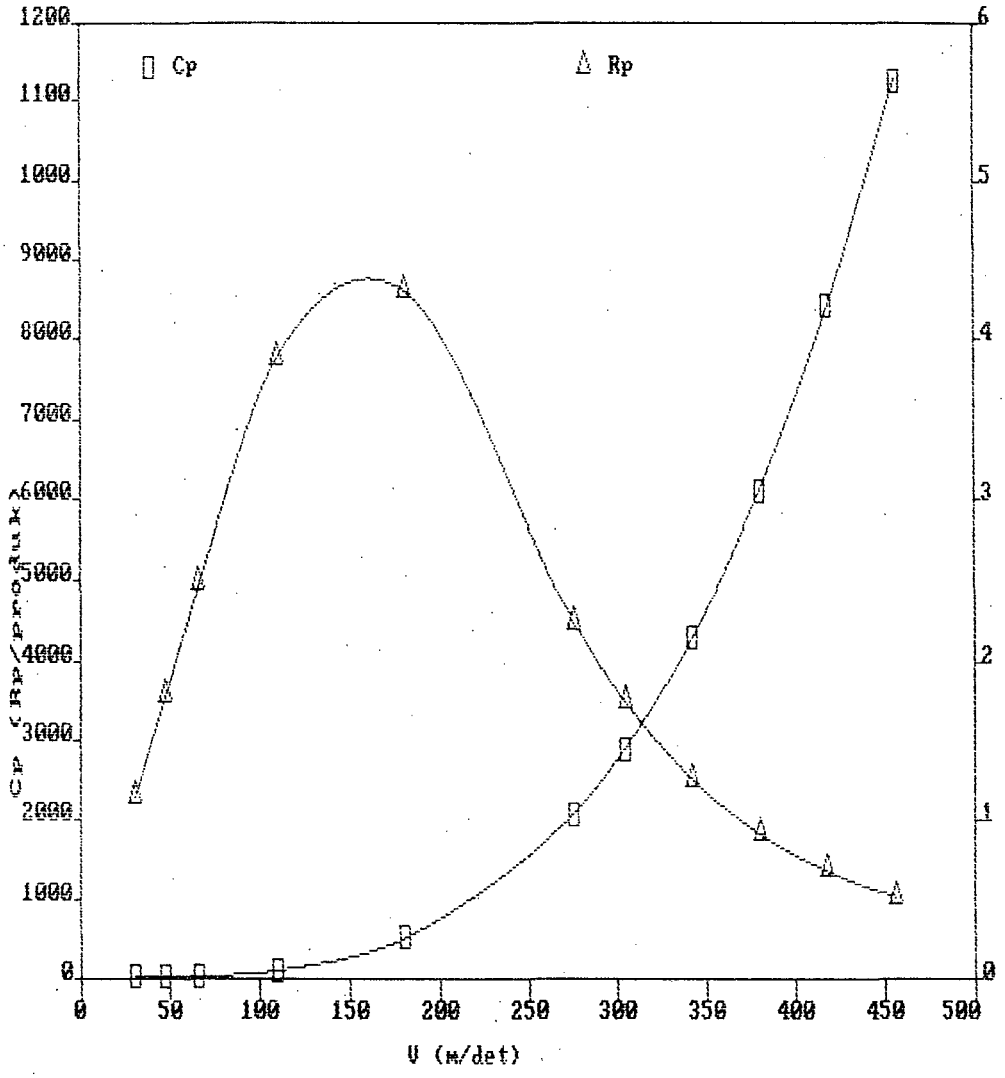
Langkah 1-12


Cp
Rp
8250
7500
6750
6000
5250
4500
3750
3000
2250
1500
750
0
2.5
2
1.5
1
.5
0
0 25 50 75 100 125 150 175 200 225 250 275 300 325 350
V (m/det)

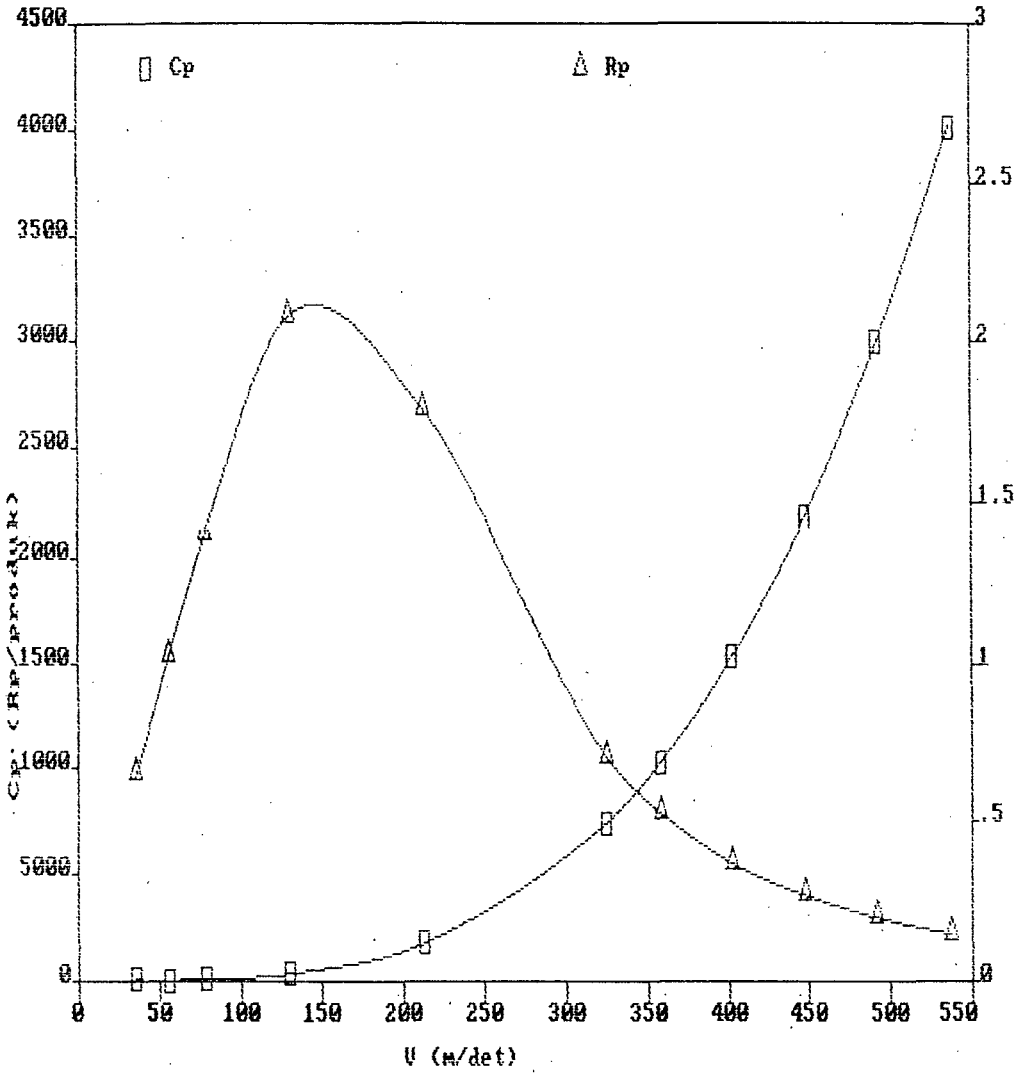
Langkah 1-13

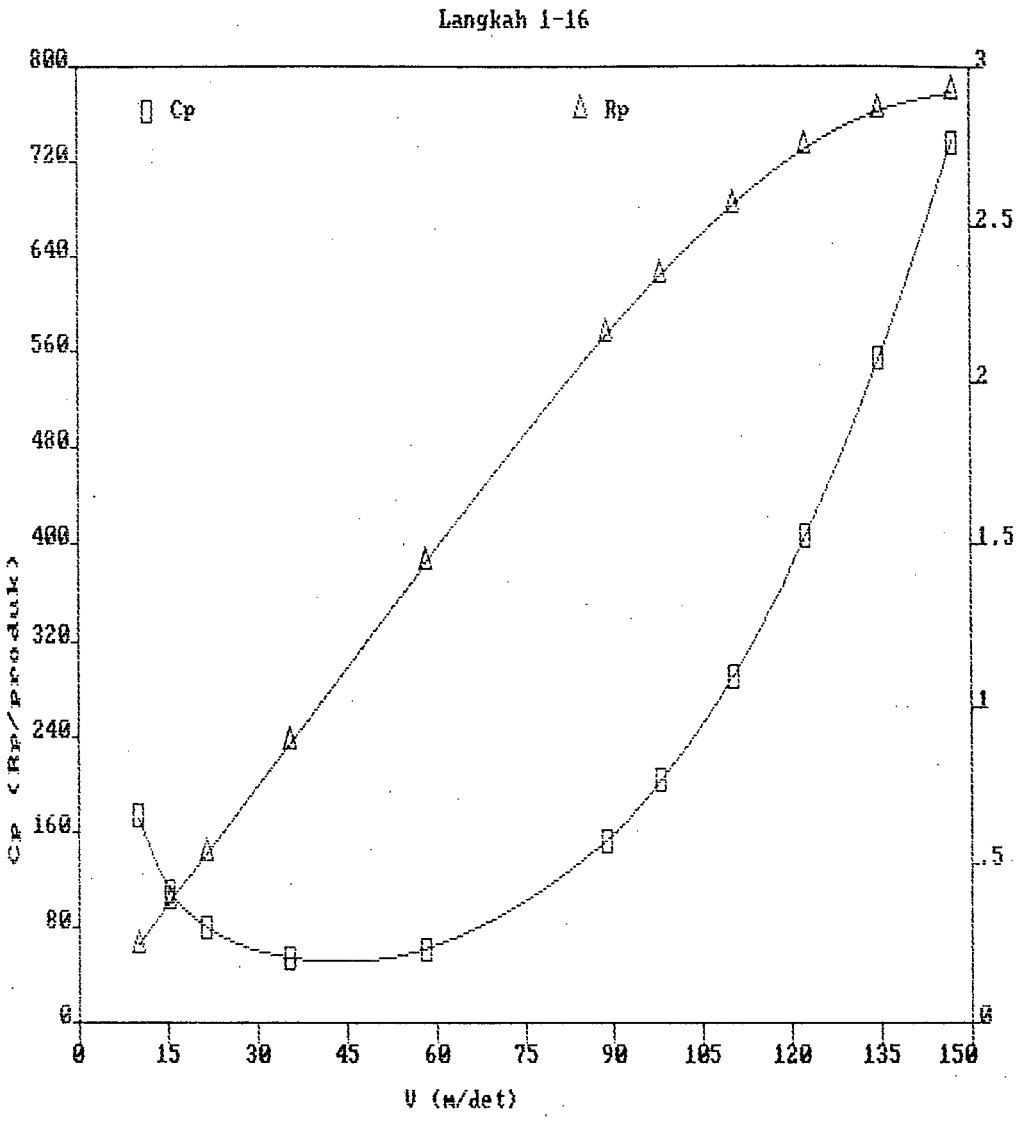

Cp
Rp
9000
8100
7200
6300
5400
4500
3600
2700
1800
900
0
4
3.5
3
2.5
2
1.5
1
.5
0
0
40
80
120
160
200
240
280
320
360
400
V (m/det)

Langkah 1-14

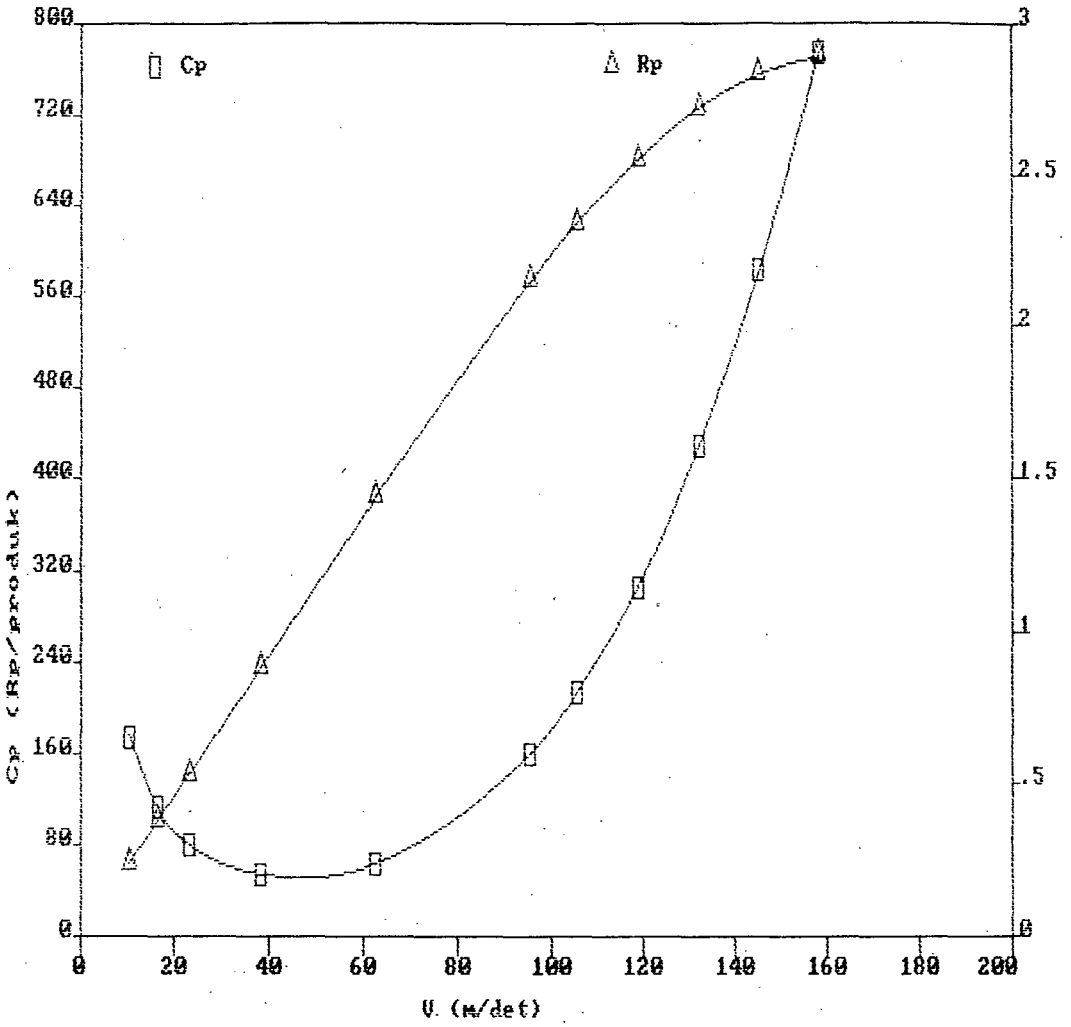

Cp
Rp
Cp (Rp/proyek)
V (m/det)
0
50
100
150
200
250
300
350
400
450
500
1000
2000
3000
4000
5000
6000
7000
8000
9000
1100
1200
1
2
3
4
5
6

Langkah 1-15

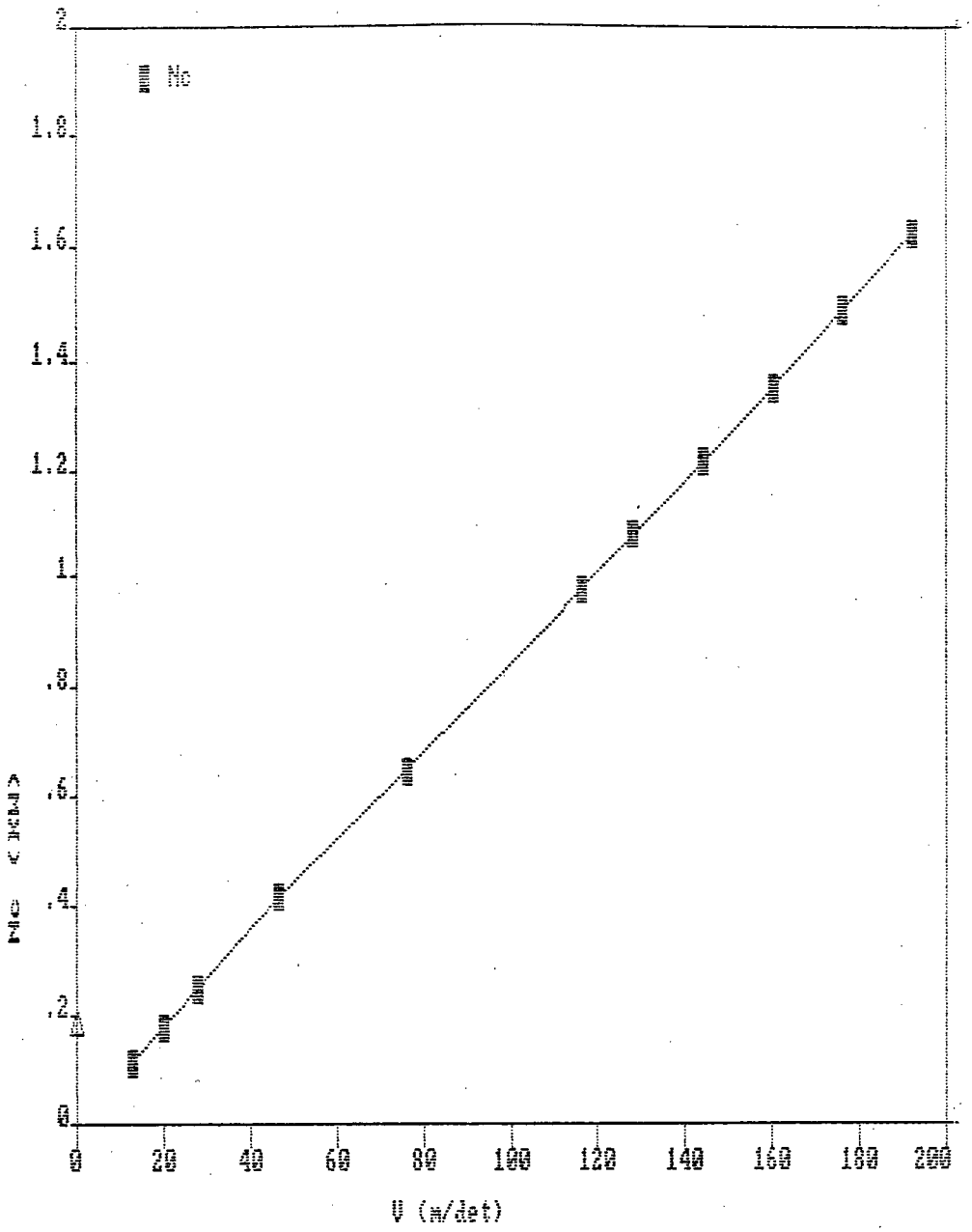

Cp
Rp
4500
4000
3500
3000
2500
2000
1500
1000
5000
0
3
2.5
2
1.5
1
.5
0
0
50
100
150
200
250
300
350
400
450
500
550
V (m/det)


Langkah 1-16
Cp
Rp
Cp (Rp/produk)
V (m/det)
800
720
640
560
480
400
320
240
160
80
0
3
2.5
2
1.5
1
.5
0
0
15
30
45
60
75
90
105
120
135
150

Langkah 1-17


Cp
Rp
800
720
640
560
480
400
320
240
160
80
0
3
2.5
2
1.5
1
.5
0
0
20
40
60
80
100
120
140
160
180
200
V. (m/det)
Cp (Rp/produk)

Langkah 1-1



```
es dos,crt;
  d_o,dm,a,lt,d,f,b,h : real;
                      :byte;
vf,tc,v,ctvb,n1,p,m,vb,q,ct,t : real;
nc,eff,fv,ks,ks11,z,ck,cj,cvb,cv : real;
tm,td,cm1,cm2,coti,e,csh,r,ce1,ce2,cp : real;
jawaban             : char;
reg                 : registers;

Begin
repeat
clrscr;
gotoxy (20,5);writeln ('PROGRAM SIMULASI PROSES BUBUT');
gotoxy (30,8);writeln ('DIBUAT OLEH :');
gotoxy (28,10);writeln ('JONG CHING SIONG');
gotoxy (32,12);writeln ('24490051');
gotoxy (25,14);writeln ('JURUSAN TEKNIK MESIN');readln;
clrscr;
gotoxy (10,5);writeln ('Diameter awal (do)   = ');
gotoxy (35,5);read (d_o);
gotoxy (40,5);write ('mm');
gotoxy (10,6);write ('Diameter akhir (dm)  = ');
gotoxy (35,6);read (dm);
gotoxy (40,6);write ('mm');
gotoxy (10,7);write ('Kedalaman potong (a) = ');
gotoxy (35,7);read (a);
gotoxy (40,7);write ('mm');
d:=(d_o+dm)/2;
gotoxy (10,8);write ('Panjang pemotongan (lt) = ');
gotoxy (37,8);read (lt);
gotoxy (40,8);write ('mm');
gotoxy (10,9);write ('Gerak makan (f) = ');
gotoxy (30,9);read (f);
gotoxy (35,9);write ('mm/rev');
gotoxy (10,10);write ('Putaran spindle (n) = ');
gotoxy (35,10);read (n);
gotoxy (40,10);write ('rpm');
gotoxy (10,11);write ('input kr = ');
gotoxy (25,11);read (kr);
gotoxy (10,12);write ('ctvb = ');
gotoxy (20,12);read (ctvb);
gotoxy (10,13);write ('n1   = ');
gotoxy (20,13);read (n1);
gotoxy (10,14);write ('p    = ');
gotoxy (20,14);read (p);
gotoxy (10,15);write ('m    = ');
gotoxy (20,15);read (m);
gotoxy (10,16);write ('vb   = ');
gotoxy (20,16);read (vb);
gotoxy (25,16);write ('mm');
gotoxy (10,17);write ('q    = ');
```

```
gotoxy (20,17);read (q);
gotoxy (10,18);write ('td    = ');
gotoxy (17,18);read (td);
gotoxy (25,18);write ('menit');
gotoxy (10,19);write ('cm    = Rp ');
gotoxy (25,19);read (cm1);
gotoxy (30,19);write ('/menit');
gotoxy (10,20);write ('coti = Rp ');
gotoxy (22,20);read (coti);
gotoxy (10,21);write ('e     = ');
gotoxy (20,21);read (e);
gotoxy (10,22);write ('csh   = Rp ');
gotoxy (22,22);read (csh);
gotoxy (10,23);writeln ('Press Enter to Continue');readln;
clrscr;
gotoxy (10,4);write ('r     = ');
gotoxy (20,4);read (r);
gotoxy (10,5);write ('Diameter rata-rata (d)    = ',d:6:2);
gotoxy (45,5);write ('mm');
v:=3.14*d*n/1000;
gotoxy (10,6);write ('v    = ',v:6:3);
gotoxy (25,6);write ('m/min');
gotoxy (10,7);write ('ks11    = ');
gotoxy (20,7);read (ks11);
gotoxy (10,8);write ('z       = ');
gotoxy (20,8);read (z);
gotoxy (10,9);write ('ck      = ');
gotoxy (20,9);read (ck);
gotoxy (10,10);write ('cj      = ');
gotoxy (20,10);read (cj);
gotoxy (10,11);write ('cvb     = ');
gotoxy (20,11);read (cvb);
gotoxy (10,12);write ('cv      = ');
gotoxy (20,12);read (cv);
gotoxy (10,13);write ('eff     = ');
gotoxy (20,13);read (eff);
b:=a/(sin(kr/180*3.14));
gotoxy (10,14);write ('Lebar geram (b) = ',b:6:3);
gotoxy (35,14);write ('mm');
h:=f*sin(kr/180*3.14);
gotoxy (10,15);write ('Tebal geram sebelum terpotong (h) = ',h:6:3);
gotoxy (55,15);write ('mm');
vf:=f*n;
tc:=lt/vf;
gotoxy (10,16);write ('vf  = ',vf:6:3);
gotoxy (25,16);write ('mm/min');
```

```
gotoxy (10,17);write ('tc  = ',tc:6:3);
gotoxy (25,17);write ('menit');
ct:=ctvb*exp(ln(vb)*m)*exp(ln(h)*(-p))*exp(ln(b)*(-q));
gotoxy (10,18);write ('ct  = ',ct:6:3);
t:=exp(ln(ct/v)*(1/n1));
gotoxy (10,19);write ('Umur pahat (t)  = ',t:6:3);
gotoxy (35,19);write ('menit');
ks:=ks11*exp(ln(f)*(-z))*ck*cj*cvb*cv;
gotoxy (10,20);write ('Gaya potong spesifik (ks)  = ',ks:8:3);
gotoxy (50,20);write ('N/mm2');
fv:=ks*b*h;
gotoxy (10,21);write ('Gaya pemotongan  (Fv) = ',fv:8:3);
gotoxy (50,21);write ('N');
nc:=fv*v/(60000*eff);
gotoxy (10,22);write ('Daya yang dibutuhkan  = ',nc:8:3);
gotoxy (50,22);write ('KW');
gotoxy (10,23);writeln ('Press Enter to Continue');readln;
clrscr;
cm2:=cm1*tm;
gotoxy (10,5);write ('Cm  = Rp ',cm2:6:3);
gotoxy (25,5);write ('/produk');
ce1:=coti/e+csh/r;
ce2:=ce1*tc/t;
gotoxy (10,6);write ('Ce  = Rp ',ce2:6:3);
gotoxy (25,6);write ('/produk');
cp:=cm2+ce2;
gotoxy (10,7);write ('Cp  = Rp ',cp:6:3);
gotoxy (25,7);write ('/produk');
tm:=(tc+td*tc/t);
gotoxy (10,8);write ('tm  = ',tm:8:3);
gotoxy (25,8);write ('menit/produk');
gotoxy (10,16);write ('Mengisi lagi (Y/T) ? ');
gotoxy (31,16);read (jawaban);
intr (5,reg);
until (jawaban='t') or (jawaban='T');
end.
```