

汽车差速器壳体加工解决方案



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2019-9-26 南京



山高在众多典型汽车零部件上拥有成熟的解决方案

缸盖



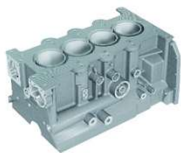
涡轮增压器



新能源电机壳



缸体



轴承盖



涡旋



连杆



变速箱壳体



活塞



农机齿轮箱



阀板



山高在众多典型汽车零部件上拥有成熟的解决方案

转向节



制动钳体



同步器环



制动支架



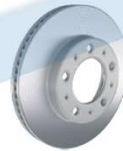
齿轮



差速器壳体



刹车盘



主减壳



桥壳



高效多齿PCD面铣刀

刀体：D=220mm 航空铝质刀盘

刀片：PCD刀片

切削参数：

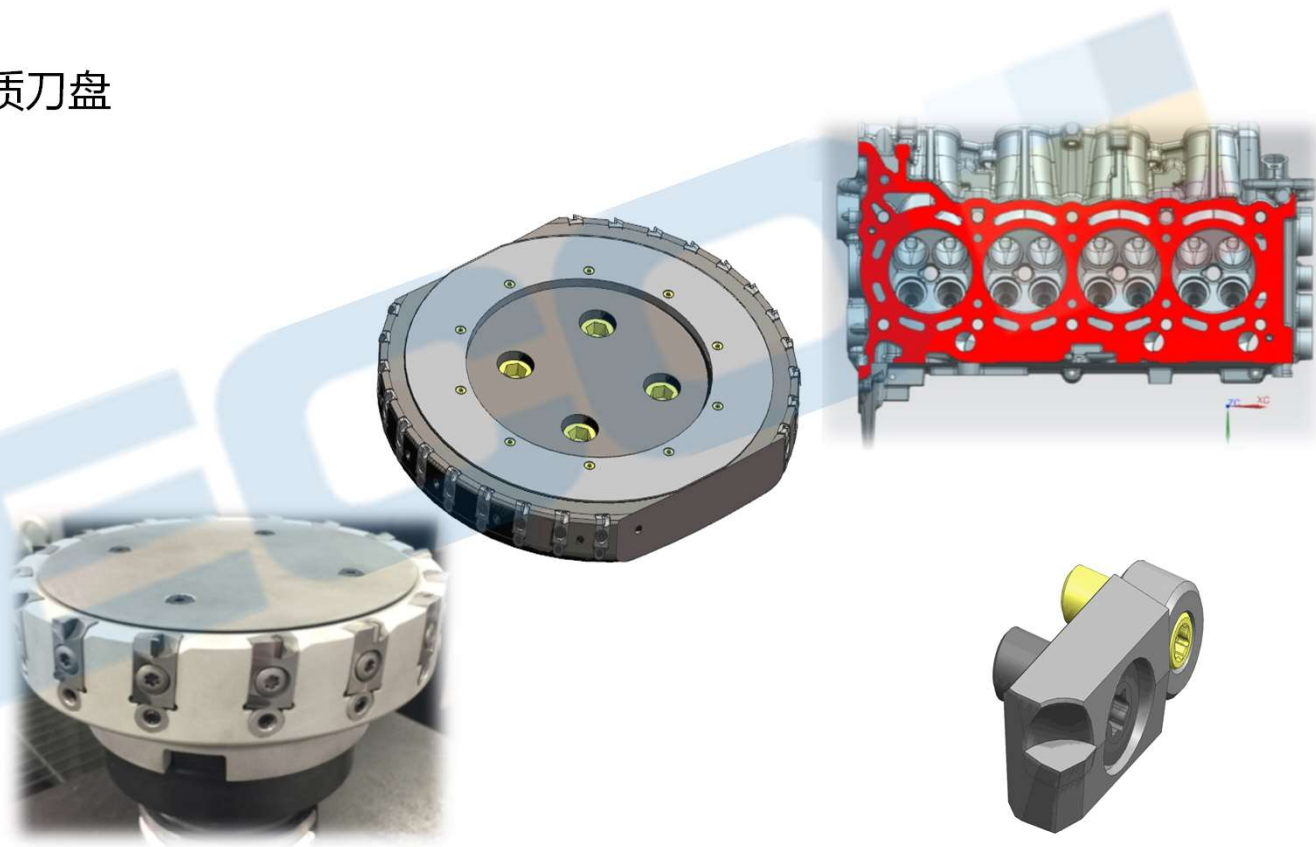
$V_c = 2800\text{m/min}$;

$F_z = 0.1\text{mm/t}$;

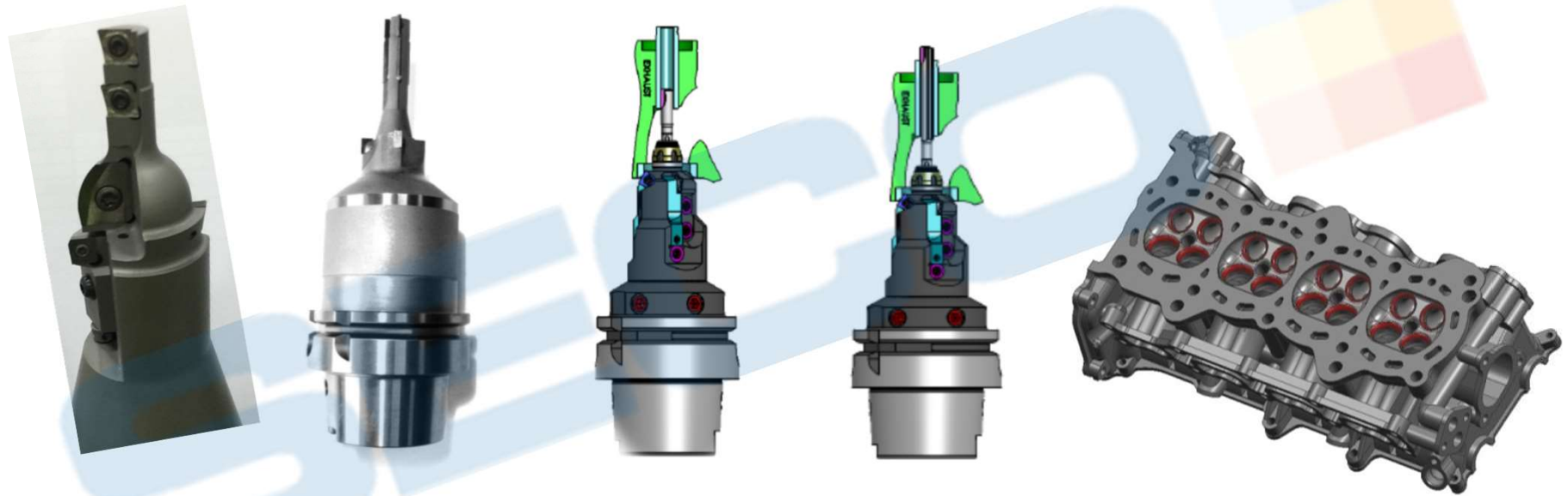
$a_p = 0.5\text{ mm}$;

$Z = 22$

刀具寿命:8000-16000件



缸盖-气门阀座导管孔



曲轴孔的双金属铰削

加工材料:

双金属曲轴孔1: 缸体AlSi9Cu3硬度 $HB \geq 85$ 、曲轴盖QT500硬度 $HB170 \sim 241$

双金属曲轴孔2: 缸体AlSi9Cu3硬度 $HB \geq 85$ 、曲轴盖F0203J硬度 $HB \geq 110$

加工直径: $\phi 51.7 / \phi 52$

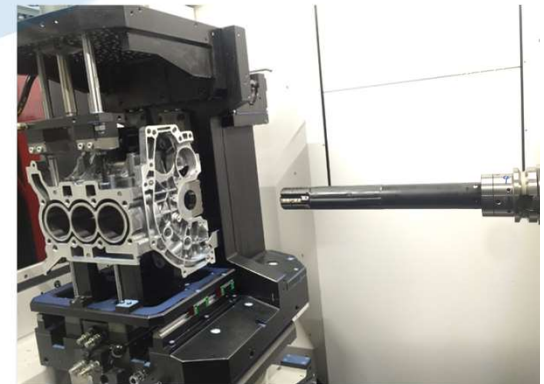
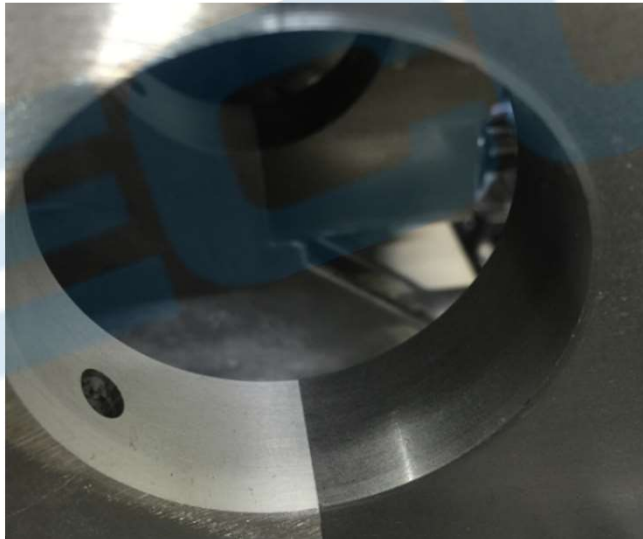
合金刀片: PV4-EN1-06, CP20

$V_c = 200 \text{ m/min}$

$n = 1225 \text{ rev/min}$

$f_z = 0.11 \text{ mm/t}$

$V_f = 135 \text{ mm/min}$

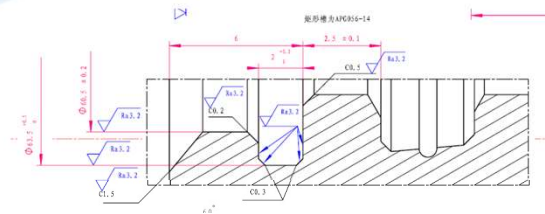


制动钳加工刀具-密封槽铣削

- Sealing Groove Disc milling
- Densimet shank + steel cutter, to dampen vibrations.
- Left and right insert design for protection groove to prevent chips jammed.
- Standard insert for dirt groove to reduce cost per part.
- Cutting edges: 4 (cutter diameter $\geq D44$)
- $V_c=200$ m/min, $f_z=0.2$ mm
- Cycling passes: 3
- Tool life: 1700 parts per edge



Special Insert with 4 edges



转向节加工刀具



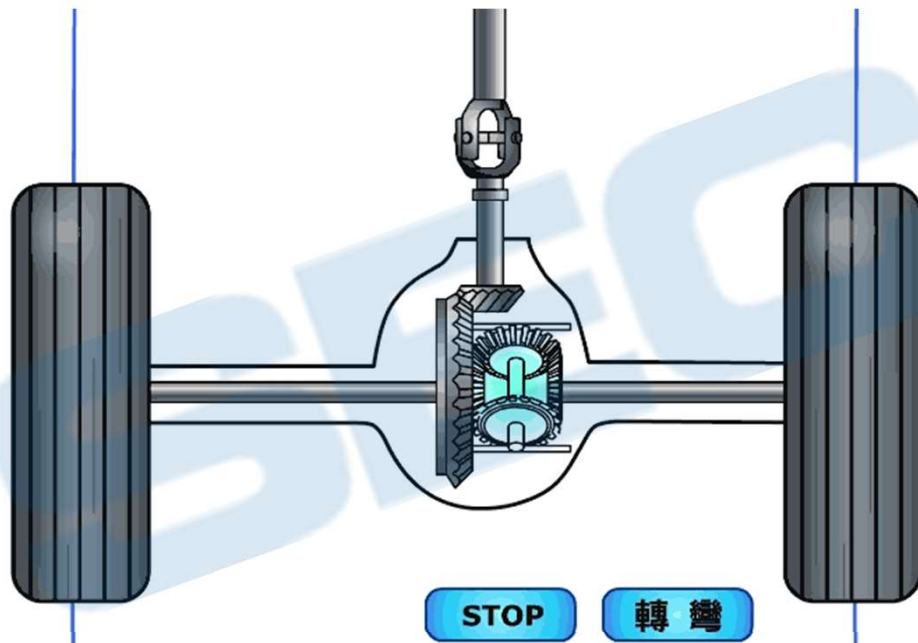
DIFFERENTIAL HOUSING

1. Function



DIFFERENTIAL HOUSING

1. Function



- 差速器部件功能：
- 汽车差速器是驱动轿的主件。它的作用就是在向两边半轴传递动力的同时，允许两边半轴以不同的转速旋转，满足两边车轮尽可能以纯滚动的形式作不等距行驶，减少轮胎与地面的摩擦。

DIFFERENTIAL HOUSING

2. Component

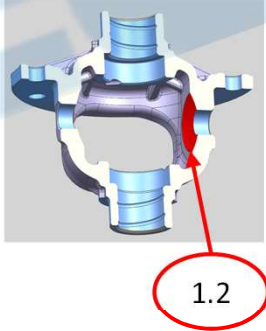
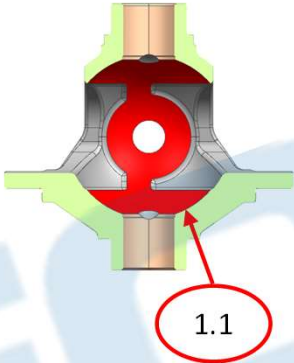
Two types :

- Monobloc-1

- Full Spherical-1.1
- Half Spherical-1.2

- Open: (in 2 parts)-2

- the housing -2.2
- the cover-2.1



DIFFERENTIAL HOUSING

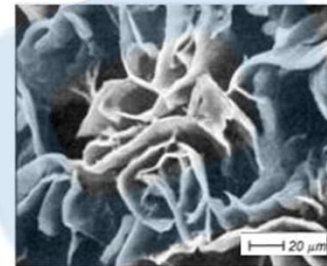
3. Material

■ Nodular Cast Iron «GGG»-SMG K4

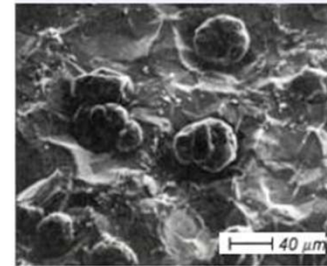
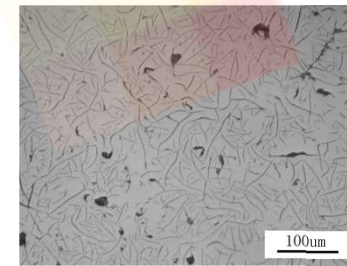
- QT500-7
- QT600-3

■ Grey cast iron «GG» -SMG K1-K2

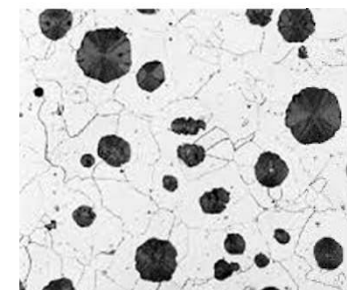
- for low power vehicles



带状石墨的灰口铸铁扫描电子显微镜照片



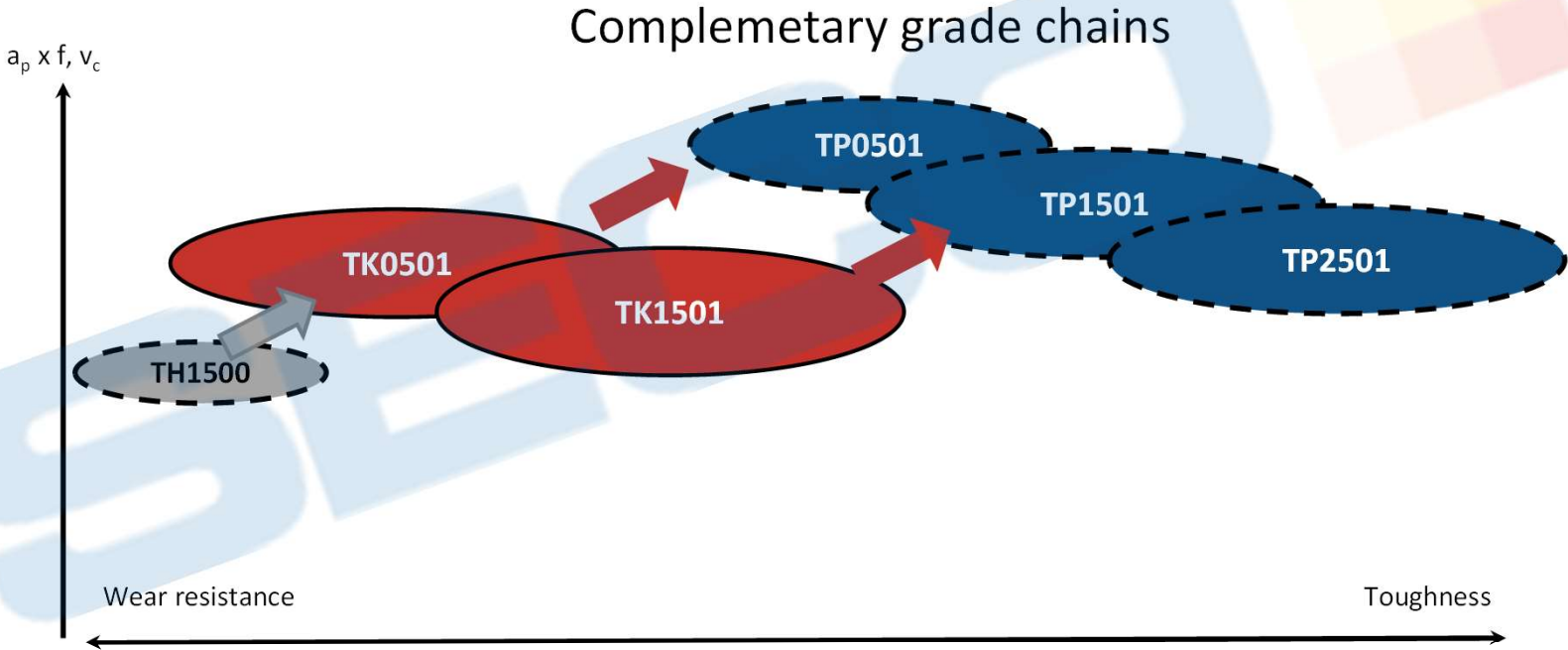
带石墨球的球墨铁扫描电子显微镜照片



DIFFERENTIAL HOUSING

3. Duratomic® for Cast Iron Turning

FOR INTERNAL USE ONLY



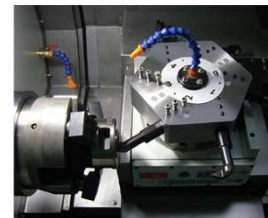
DIFFERENTIAL HOUSING

4. Machining Process

- Option 1: CNC Lathe+ Vertical Mach. Center with 4th axis
- Option 2: Vertical turning center with pick-up spindle
- Option 3: CNC Lathe+TurnMill Center

Comments:

- Low investment
- Start from Cast
- Long production line



DIFFERENTIAL HOUSING

4. Machining Process

- Option 1: CNC Lathe+ Vertical Mach. Center with 4th axis
- Option 2: Vertical turning center with pick-up spindle
- Option 3: CNC Lathe+TurnMill Center

Comments:

- Easy to automation system
- Component needs to be pre machined
- Less machines involved in the production line



DIFFERENTIAL HOUSING

4. Machining Process

- Option 1: CNC Lathe+ Vertical Mach. Center with 4th axis
- Option 2: Vertical turning center with pick-up spindle
- Option 3: CNC Lathe+TurnMill Center

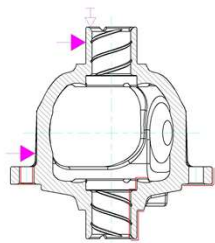
Comments:

- Good choice for the old production line update
- Invest only for the TurnMill Center to control the important dimensions



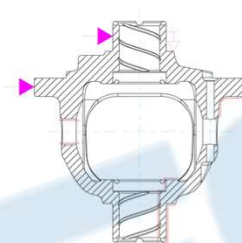
DIFFERENTIAL HOUSING

- A typical processing plan for Monobloc half Spherical Housing



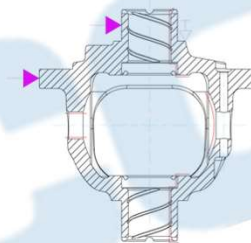
OP10

Turn the external and internal dimensions on the flange side



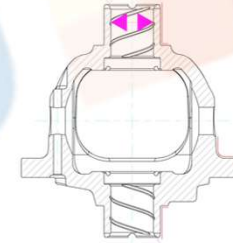
OP20

Turn the external and internal dimensions on the other side



OP30

Finish turning the internal dimensions on both sides and spherical surface

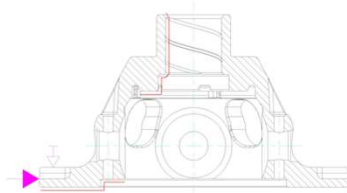


OP40

Finish turning the external dimensions on both sides

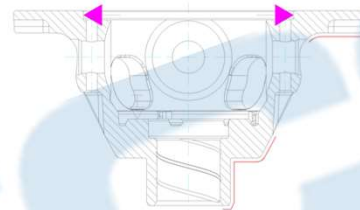
DIFFERENTIAL HOUSING

- A typical processing plan for Open Housing



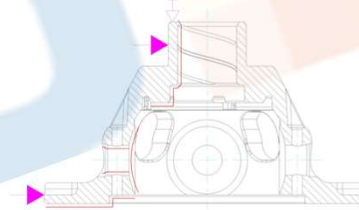
OP10

Rough turning
the internal
dimensions from
the flange side



OP20

Rough and finish
turning the
external
dimensions



OP30

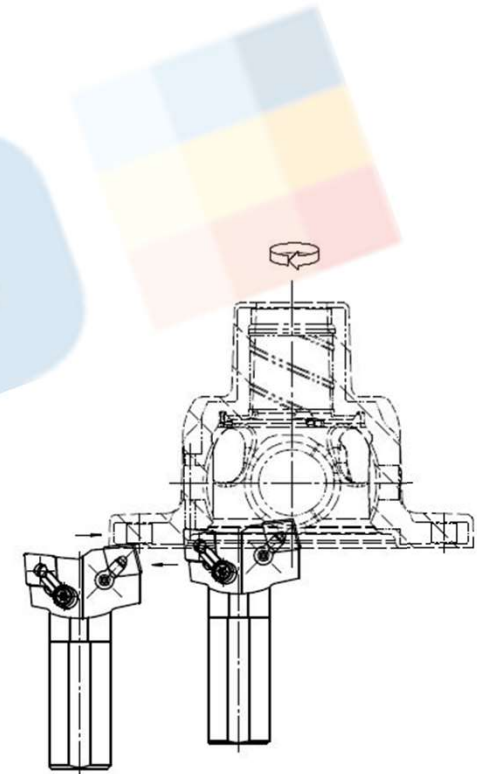
Finish turning
the internal
dimensions and
spherical surface

DIFFERENTIAL HOUSING

Machining Process-Turning

- Combined tools to reduce tool change time
- Custom designed tools to obtain the most rigidity
- Use as much cutting edges as possible to reduce cost per part.

| | |
|---------------|----------------------|
| Insert | CNMG120408-M3,TK1501 |
| Toolholder | |
| Cutting Speed | m/min |
| feedrate | mm/r |

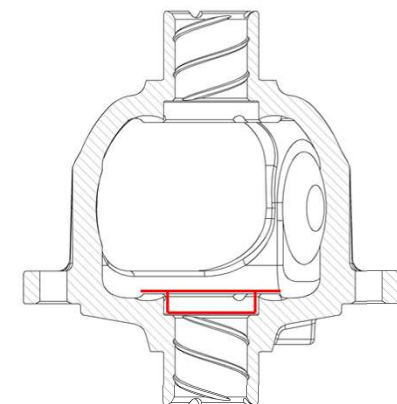
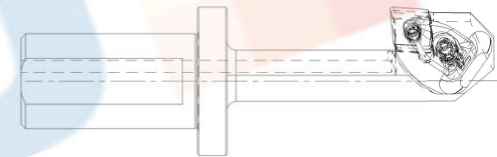
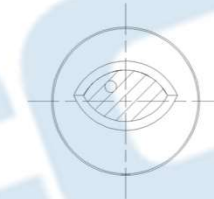


DIFFERENTIAL HOUSING

Machining Process-Turning

- Densimet tool bar to damp vibration
- Ellipse-shaped bar to reinforce the rigidity

| | |
|---------------|---------------------------|
| Insert | CNMG120408-M3,TK1501 |
| Toolholder | |
| Cutting Speed | 230 m/min |
| feedrate | 0.3-0.4 mm/r (ap=1-1.5mm) |

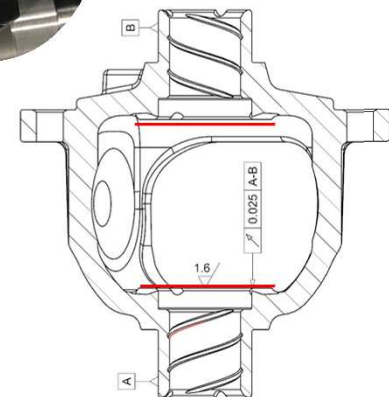


DIFFERENTIAL HOUSING

Machining Process-Turning

- Densimet tool bar to damp vibration
- Finish turning both sides in one cutter to keep the distance tolerance
- Ellipse-shaped bar to reinforce the rigidity

| | |
|---------------|----------------------|
| Insert | TCMT16T308-M3,TK1501 |
| Toolholder | |
| Cutting Speed | 230 m/min |
| feedrate | 0.35 mm/r |

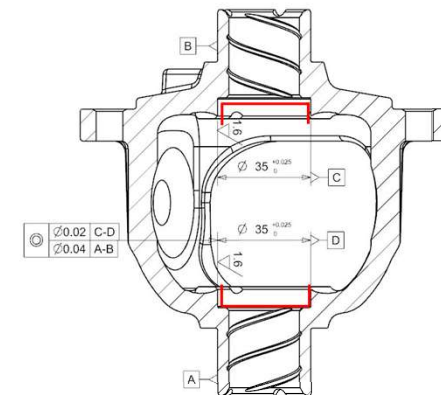
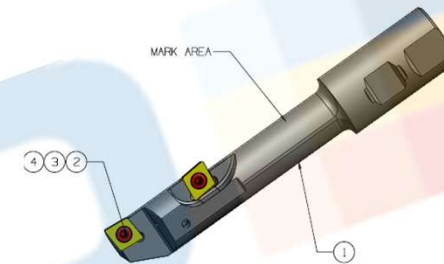


DIFFERENTIAL HOUSING

Machining Process-Turning

- Densimet tool bar to damp vibration
- Finish turning both sides in one cutter to keep the axially tolerance
- Ellipse-shaped bar to reinforce the rigidity

| | |
|---------------|----------------------|
| Insert | CCMT120408-M3,TK1501 |
| Toolholder | RH-500.22-03208682 |
| Cutting Speed | m/min |
| feedrate | mm/r |

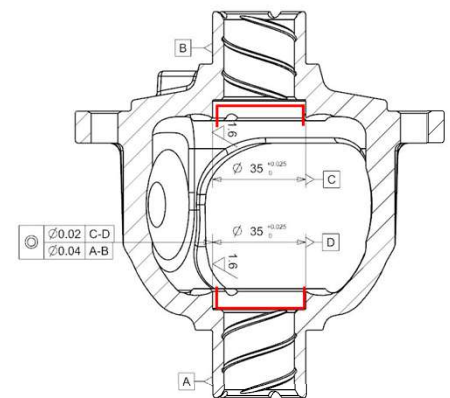
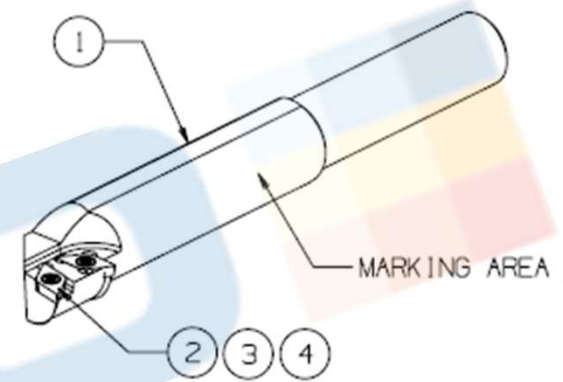


DIFFERENTIAL HOUSING

Machining Process-Turning

- Densimet tool bar to damp vibration
- Finish turning both sides in one cutter to keep the axially tolerance
- Ellipse-shaped bar to reinforce the rigidity

| | |
|---------------|----------------------|
| Insert | DCGT11T04F-AL,TS2050 |
| Toolholder | RT-500.32-03262536 |
| Cutting Speed | 140 m/min |
| feedrate | 0.08 mm/r |

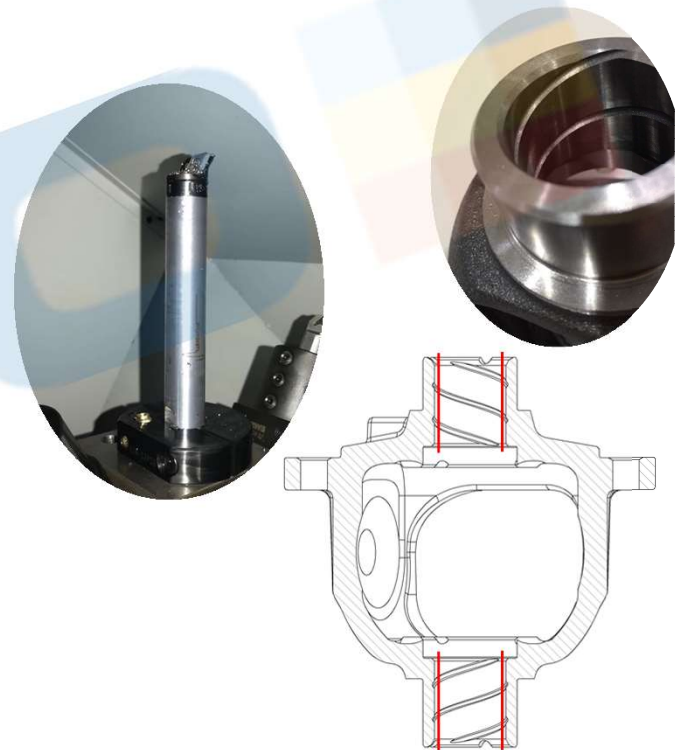


DIFFERENTIAL HOUSING

Machining Process-Turning

- Steadyline bar to damp vibration
- Positive insert to reduce cutting forces

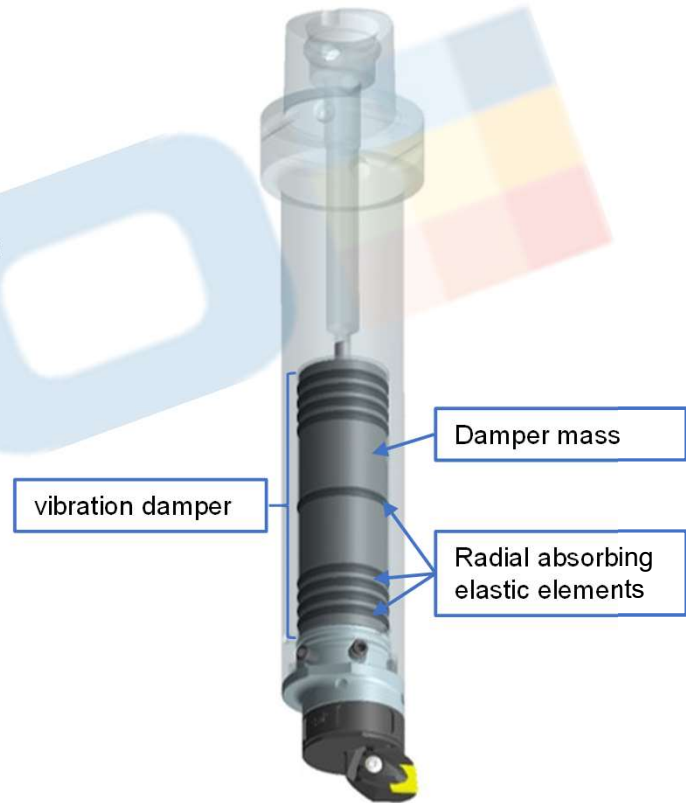
| | |
|---------------|-------------------------------------|
| Insert | DCGT11T04F-AL,TS2050 |
| Toolholder | GL25-SDUCL-17020-11 D25-130-GL25 |
| Cutting Speed | 160 m/min |
| feedrate | 0.08 mm/r |



DIFFERENTIAL HOUSING

Steadyline-Passive, dynamic damping system

- The vibration is absorbed as soon as it is transmitted to the turning bars body



DIFFERENTIAL HOUSING

Steadyline-Passive, dynamic damping system

- Modular designed GL connection
- One bar for a wide range of turning heads

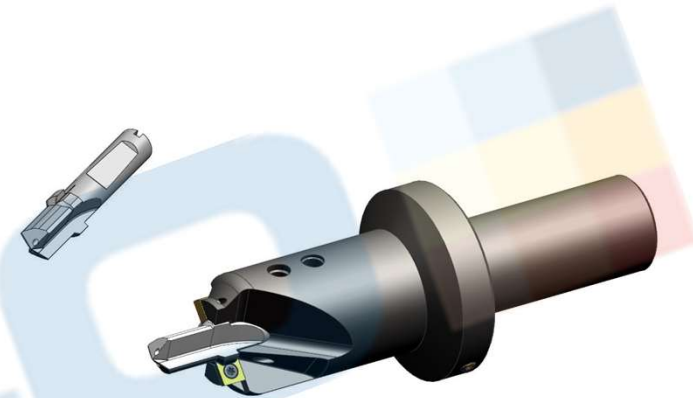


DIFFERENTIAL HOUSING

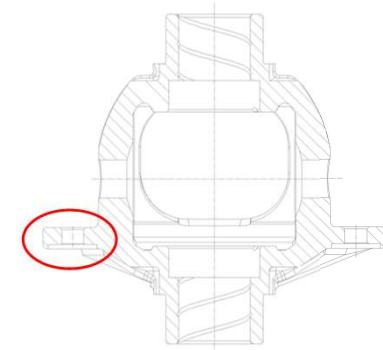
Machining Process-Drilling

- Combined drilling and spotfacing in one cutter
- S type insert for spotfacing- stable and predictable tool life
- Internal coolant design

| | |
|---------------|--|
| Drill | Φ10.4 S.C. drill with chamfer |
| Insert | SPMX060204-75,F40M |
| Toolholder | Φ23 Spotfacing |
| Cutting Speed | S2400- 80 m/min for drill S1600- 116 m/min for spotfacing |
| feedrate | 0.26 mm/r for drill 0.06 mm/r for spotfacing |

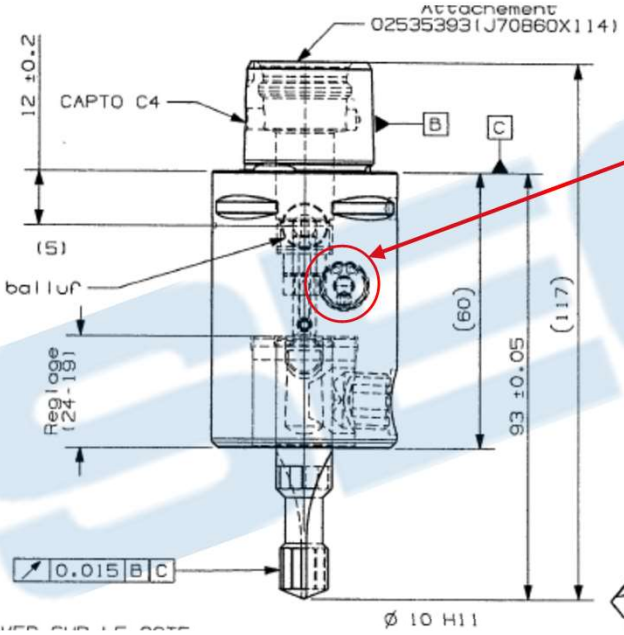


Driven by a VDI toolholder.



DIFFERENTIAL HOUSING

Machining Process-Drilling



Front fine axial adjustment
(EPB technology)

Drill+chamfer+back
chamfer

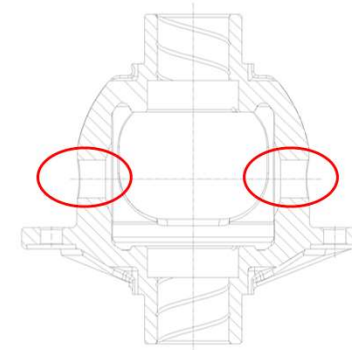
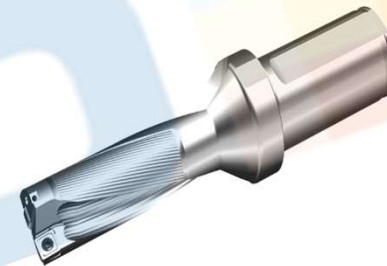


DIFFERENTIAL HOUSING

Machining Process-Drilling

- Seco new Perfomax Drill
- Economical solution due to the indexable insert solution
- Standard drill body and inserts

Driven by a VDI toolholder.



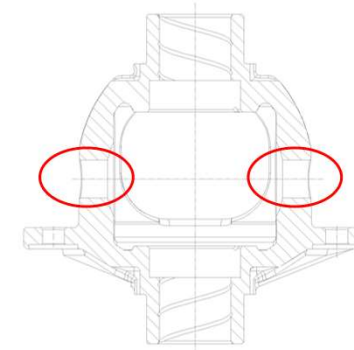
| | |
|---------------|---|
| Insert | SCGX050204-P2,DP2000 SPGX0502-C1,T400D |
| Drill | SD523-17-51-20R7 |
| Cutting Speed | 117 m/min (S=2200) |
| feedrate | 0.08 mm/r |

DIFFERENTIAL HOUSING

Machining Process-Drilling

- Rough boring the hole with chamfer and back chamfer in one cutter
- Only one type of S insert is used

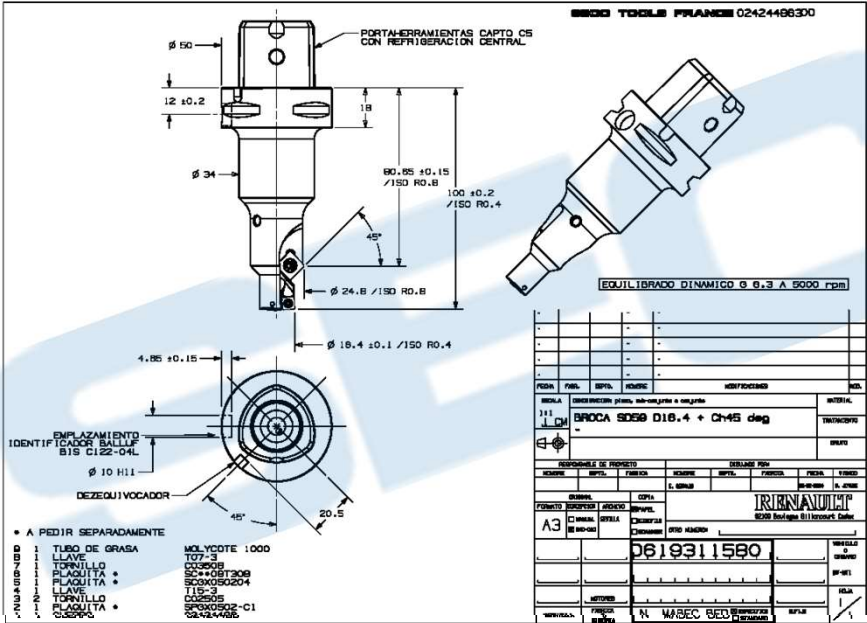
Driven by a VDI toolholder.



| | |
|---------------|--|
| Insert | SCGX060204-P2,DP3000 |
| Cutter | D17.7 boring bar with chamfer and back chamfer |
| Cutting Speed | 83 m/min (S=1500) |
| feedrate | 0.12 mm/r |

DIFFERENTIAL HOUSING

Machining Process-Drilling



DIFFERENTIAL HOUSING

Machining Process-Drilling

- Material Cast Iron GS54 (GGG600)
- Component has 2 thru holes , hole depth approx. 15mm.
- Coolant 5-6bar, 5-8% oil.
- Tool life 300 components/edge = 600 holes/edge

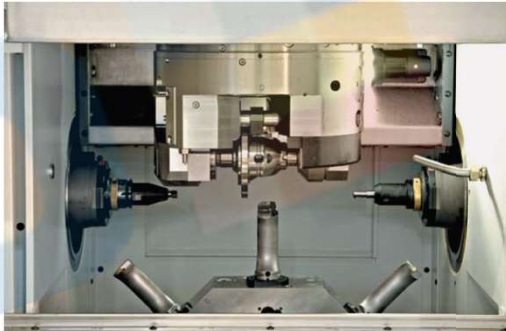
| | |
|---------------|---|
| Insert | SCGX050204-P2,T2000D SPGX0502-C1,T400D |
| Drill | D16.4 drill with chamfer |
| Cutting Speed | 154 m/min (S=2984 rpm) |
| feedrate | 0.1 mm/r (F=298 mm/min) |



DIFFERENTIAL HOUSING

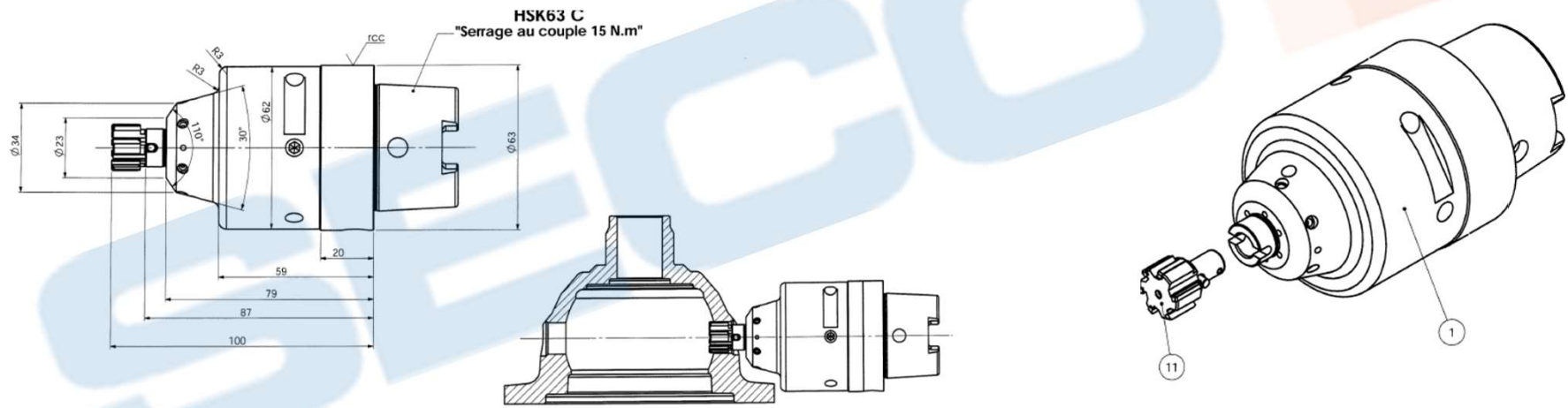
Machining Process-Satellite axis reaming

Technical drawing of a differential housing. The drawing includes a title block with the part number 902F36, a general note, and a table of materials. It features several views: a front view, a side view, a top view, and a bottom view. Key features are labeled, including 'MARCAGE: Ø A', 'MARCAGE: Ø B', 'MARCAGE: Ø C', and 'MARCAGE: Ø D'. A note indicates 'Portaherramientas HSKA-63'. A warning note states 'Atencion! Sin tubo de refrigeracion'. The drawing also includes a detail view of a hole with a diameter of 10.5 mm and a depth of 1 mm. A table at the bottom right contains the Renault logo and the text 'N° MABEC BED'.



DIFFERENTIAL HOUSING

Machining Process-Satellite axis reaming

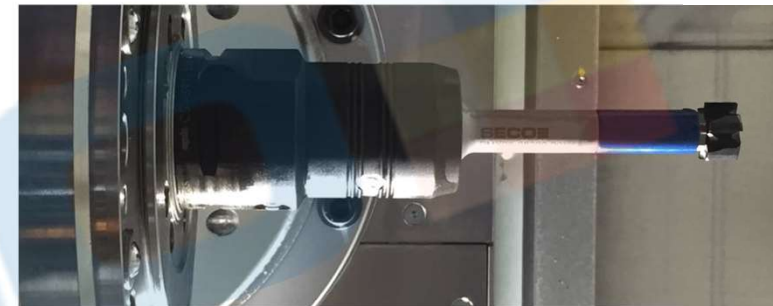


DIFFERENTIAL HOUSING

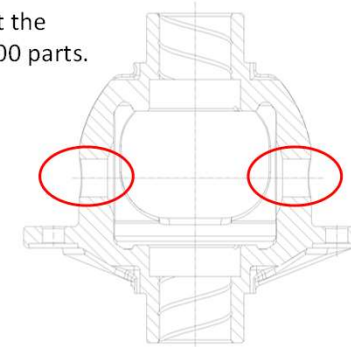
Machining Process-Satellite axis reaming

- Solid carbide reaming head-higher cutting speed;
- Multi teeth design-higher federate;
- Hole Diameter – $\Phi 19.12G7 (+0.007/+0.028)$;
- Roughness- Ra3.2;

| | |
|---------------|---|
| Reamer | PMX5-19.122/19.143-EB845, RX2000 (Z=6) |
| Shank | PMX08-08200-20N1 |
| Cutting Speed | 39.5 m/min (S=650) |
| feedrate | 0.7 mm/r (F=450) |

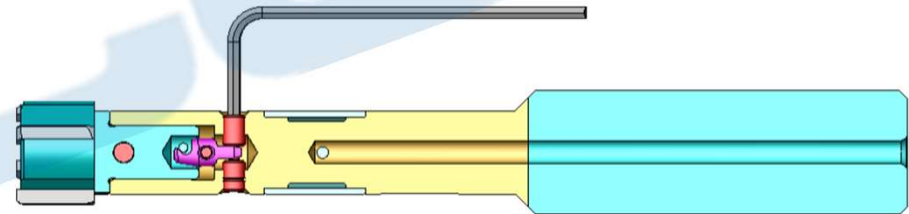
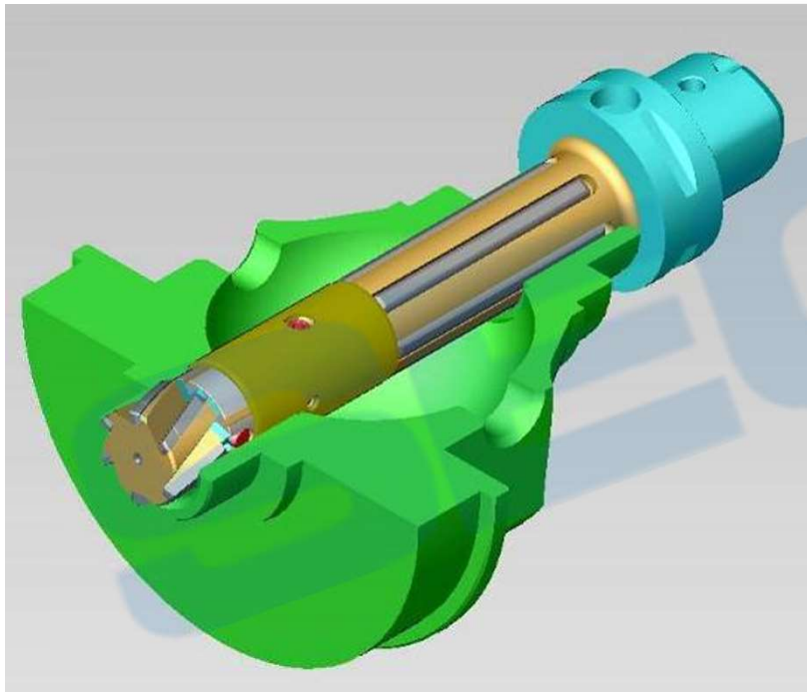


Diameter is out of tolerance but the roughness is still Ra3.0 after 4000 parts.



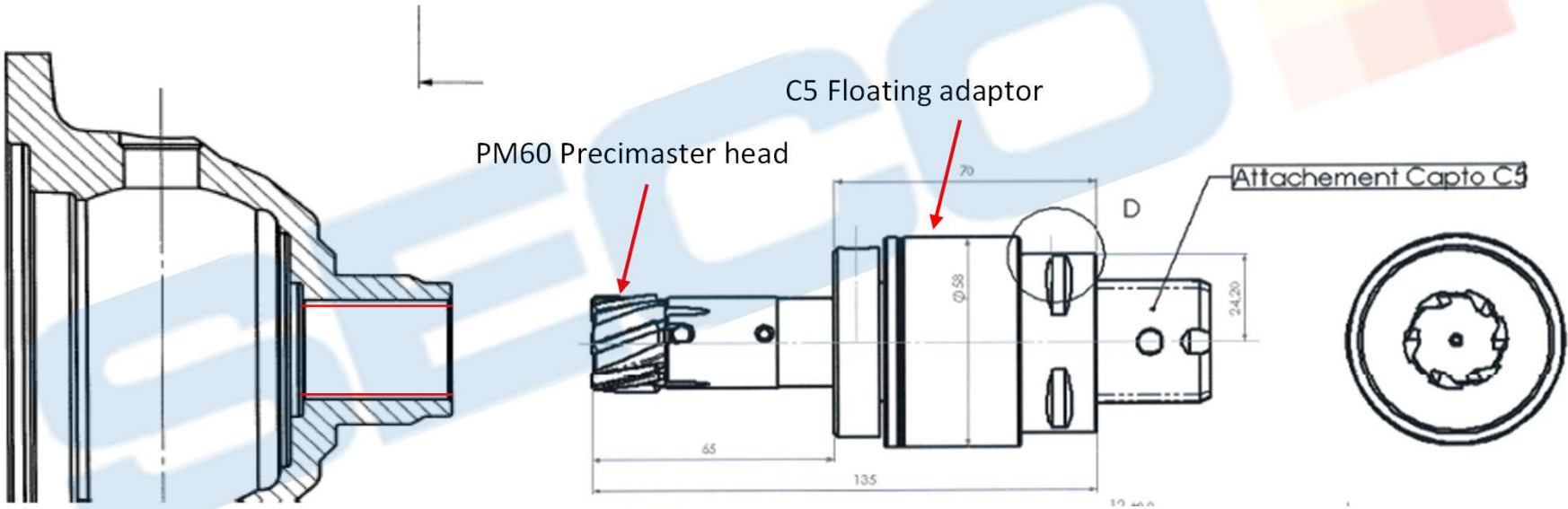
DIFFERENTIAL HOUSING

Machining Process-Planetary axis reaming



DIFFERENTIAL HOUSING

Machining Process-Planetary axis reaming

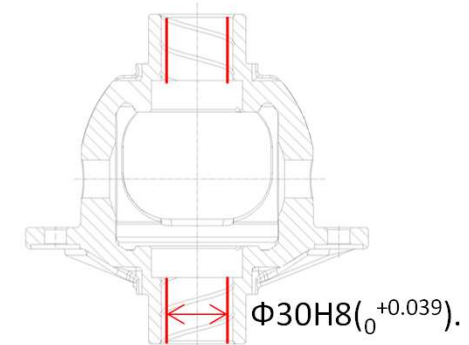
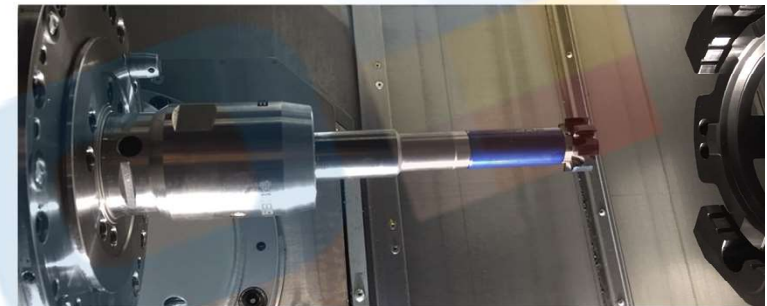


DIFFERENTIAL HOUSING

Machining Process-Planetary axis reaming

- Hole Diameter - $\Phi 30H8({}_0^{+0.039})$;
- Roughness- Ra3.2;
- L/D ratio is 6;
- Solid Carbide shank

| | |
|---------------|-----------------------------|
| Reamer | PMX5-30H7-EB45,RX2000 (Z=8) |
| Shank | PMX12THM-43675 (OAL=193) |
| Cutting Speed | 75 m/min (S=800) |
| feedrate | 0.75 mm/r (F=600) |

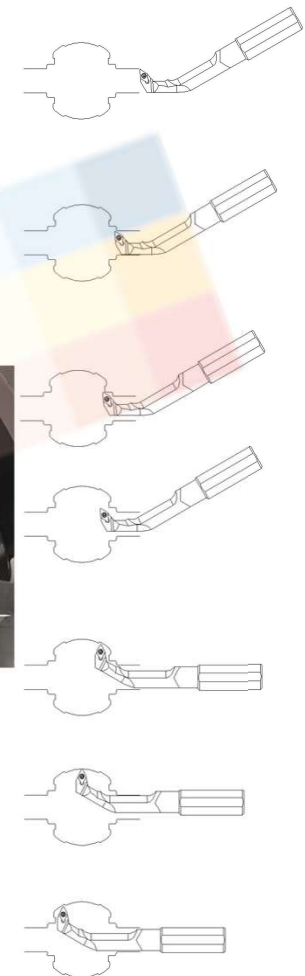


DIFFERENTIAL HOUSING

Machining Process-Spherical roughing

- Used in machines with B axis
- Steel bar for roughing

| | |
|---------------|----------------------|
| Insert | DCMT11T308-F1,TK2001 |
| Tool | |
| Cutting Speed | m/min (S=650) |
| feedrate | 0.1 mm/r |

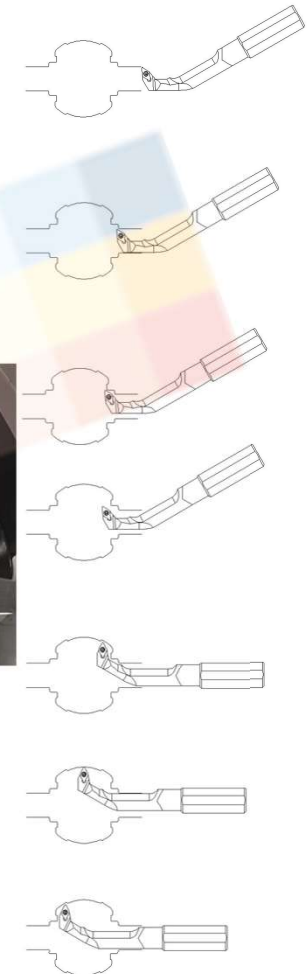


DIFFERENTIAL HOUSING

Machining Process-Spherical finishing

- Used in machines with B axis;
- Brazed Carbide bar for finishing;
- Roughness- Ra1.6;

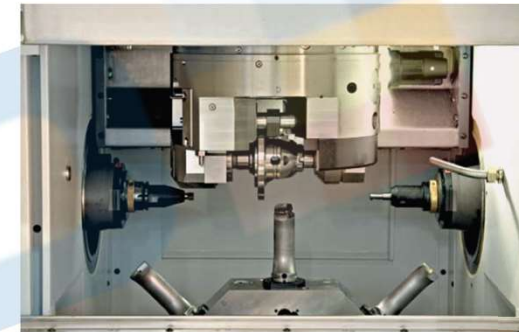
| | |
|---------------|-----------------------------------|
| Insert | DCGW11T304S-01020-L1-B, CBN010 |
| Tool | |
| Cutting Speed | 177 m/min (S=600) |
| feedrate | 0.1 mm/r |



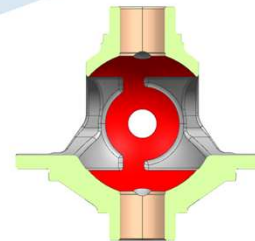
DIFFERENTIAL HOUSING

Machining Process-Full Spherical machining

- The cutter feed into the housing from the side window

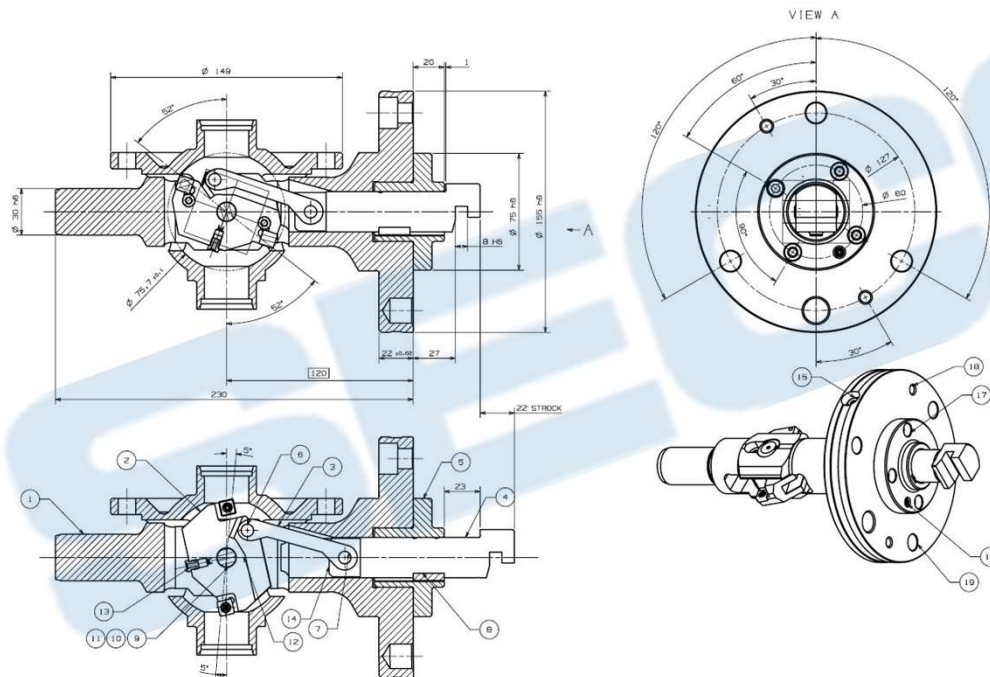


| | |
|---------------|----------------------|
| Insert | DCMT11T308-F1,TK2001 |
| Tool | |
| Cutting Speed | m/min (S=?) |
| feedrate | ? mm/r |



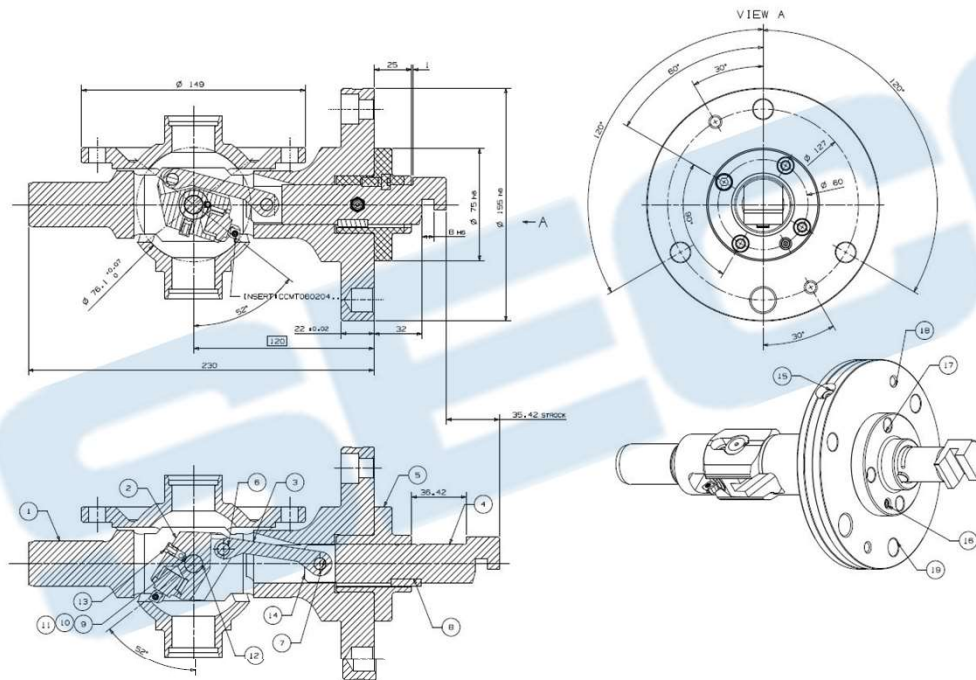
DIFFERENTIAL HOUSING

Machining Process-Spherical machining with feed-out tool-Roughing



DIFFERENTIAL HOUSING

Machining Process-Spherical machining with feed-out tool-Finishing



DIFFERENTIAL HOUSING

Machining Process-Planetary gear contact faces machining

Material: nodular cast iron GH603810

Hardness: 170 to 210 HB

Vc = 100 m/min

Fn = 0,1 mm/rev

Wet machining

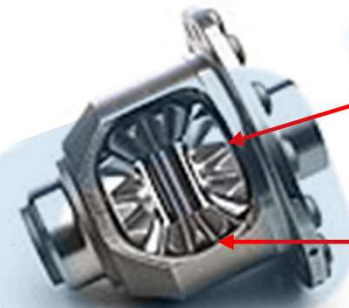
Power on the machine= 61,6 kw

Tool life :

SCMT insert= 750 pcs/edge

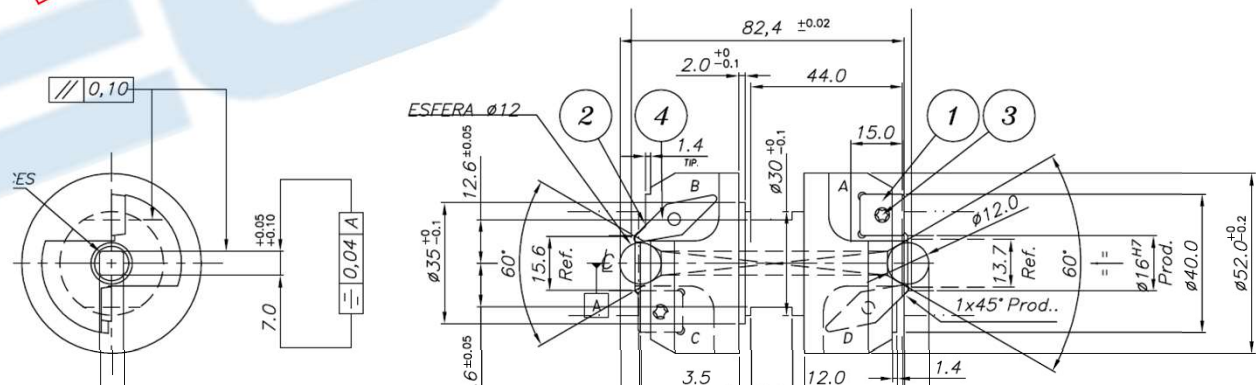
DCMT insert= 3000 pcs /edge

SECO Brazil experience



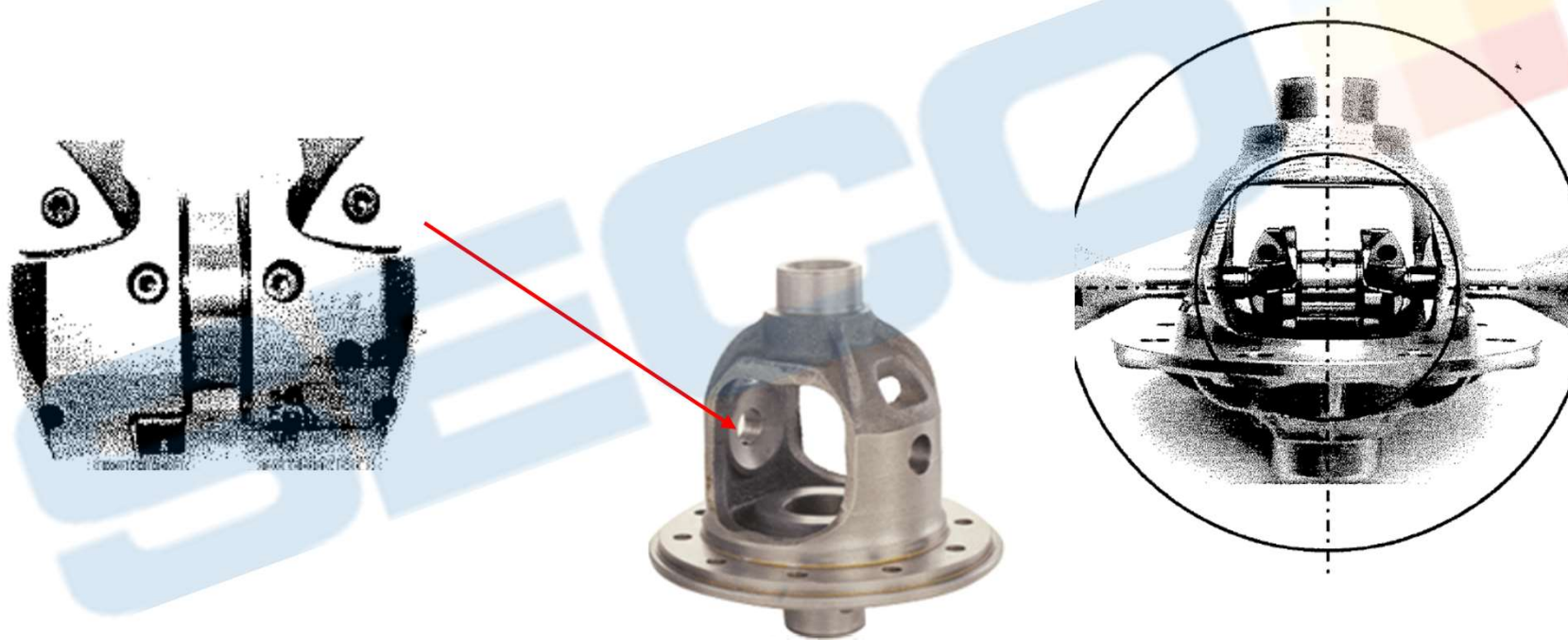
Planetary gear plane machining

Satellite spherical machining



DIFFERENTIAL HOUSING

Machining Process-Satellite spherical contact faces machining



SECO 