Rapid Prototyping of Castings, expensive gadget or real engineering tool?

Thomas Becker, ACTech North America, Inc

Agenda

- ACTech - brief overview
- What is a prototype casting ?
- Who uses it ?
- Cost of traditional Prototyping vs. Rapid Prototyping
- The hidden costs
- How does it work ?

ACTech®

brief introduction

1995 • established with 3 employees and less than 300sqf space to utilize the patent for laser-sintering of Croning® sand

1998 • ACTech has been equipped with its own casting laboratory

1999 • new service full machined castings

2001 • moved into the new plant

2003 • ACTech North America Inc. as subsidiary in the US

… • expanding space, services and employees

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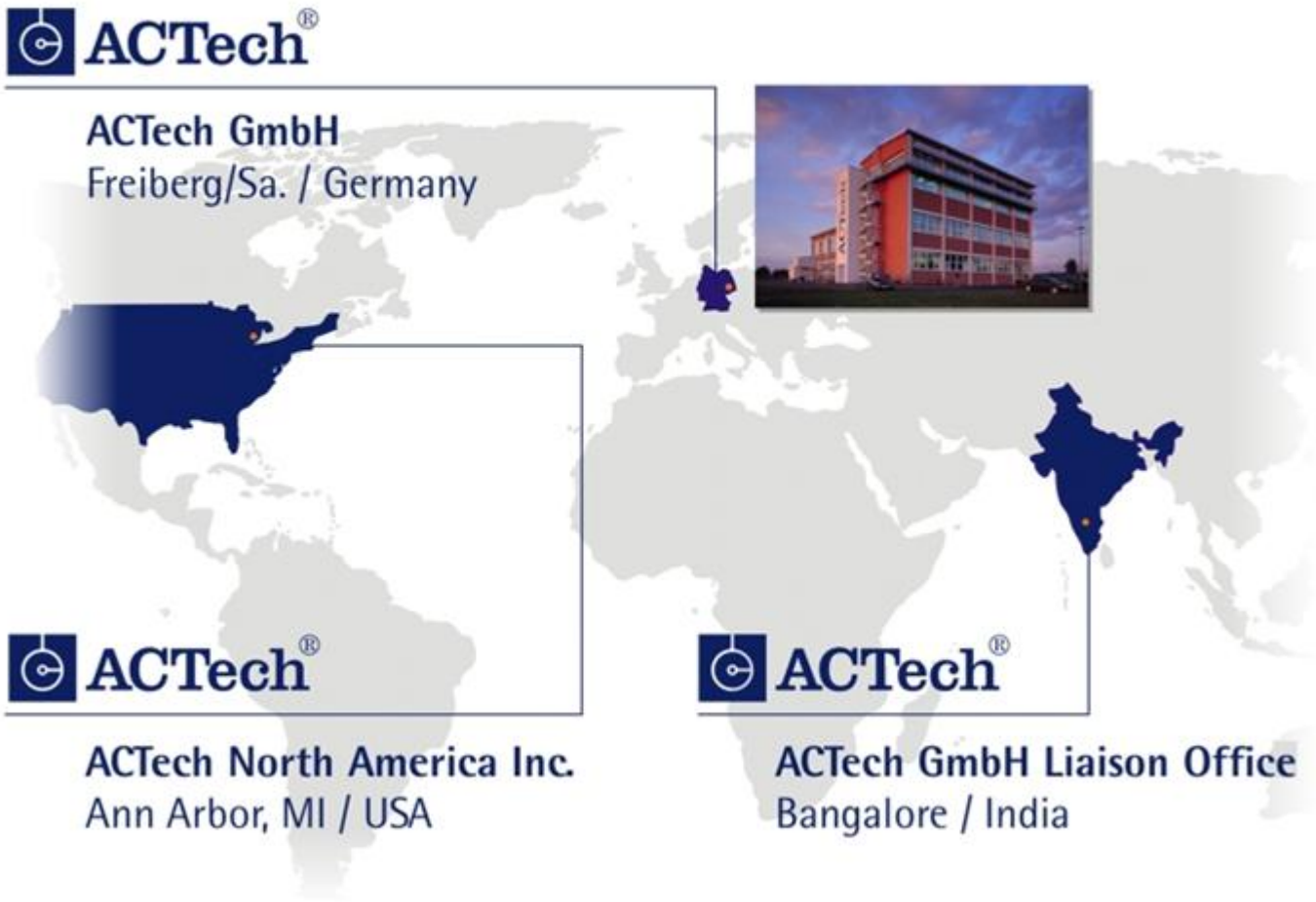
here we are

400 employees
100,000 sqf. production area
app. 15,000 casting prototypes per year
short run and small batch production
full machined and pre-assembled

certified according to the European standard
EN ISO 14001 (2004) and ISO/TS 16949 (2009)

Locations


ACTech®
ACTech GmbH
Freiberg/Sa. / Germany
ACTech®
ACTech North America Inc.
Ann Arbor, MI / USA
ACTech®
ACTech GmbH Liaison Office
Bangalore / India

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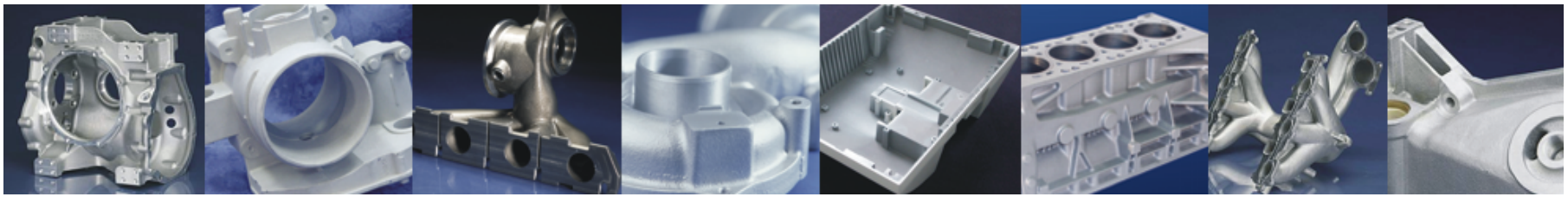
capacities



>20,000 different casting designs

>150,000 castings total

>1,075 customers in 35 countries
annual capacity: 15,000 prototype castings,
fully machined and ready for assembly.

total since May 1995 (as of 1'st September 2012)

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What is a prototype casting ?

it is

- used during the development process
- ordered in minor quantities only
- of greatest value if properties are similar to production parts
- **more expensive than production parts based on unit costs**

it's not

- manufactured with production tooling
- associated with high set-up costs and long lead times

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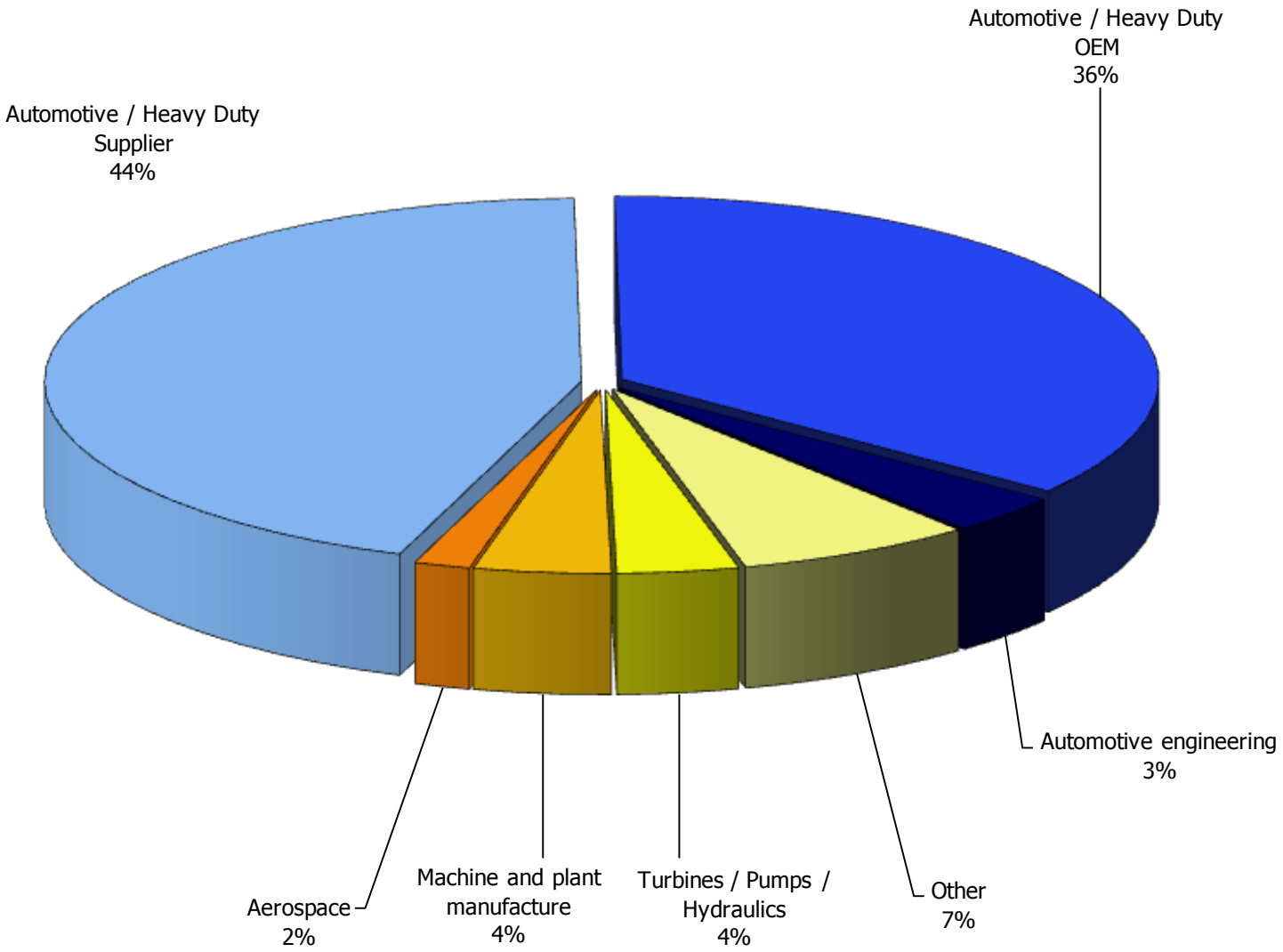
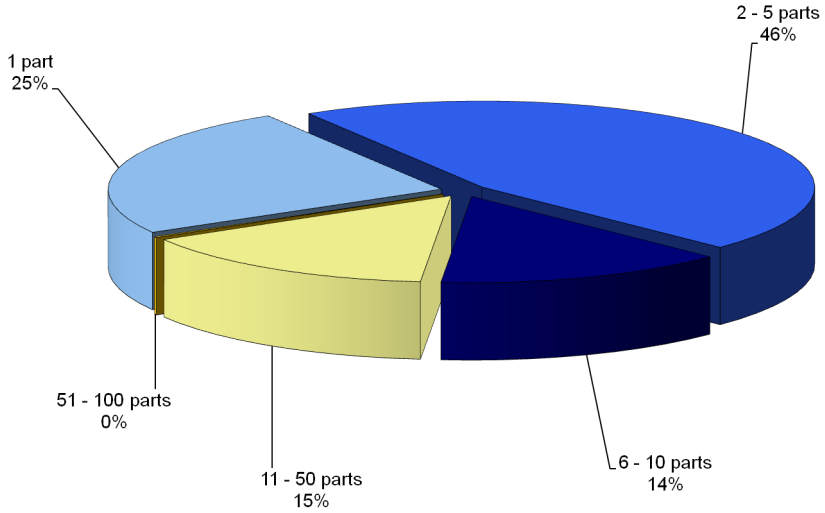
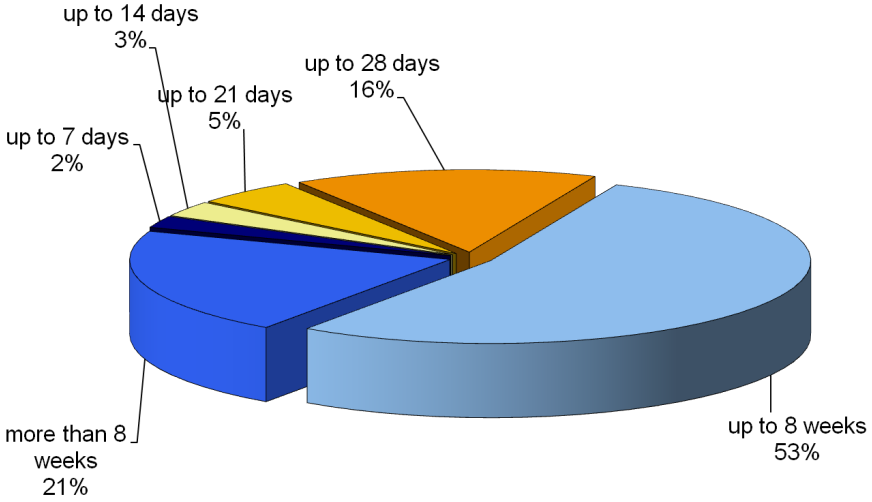
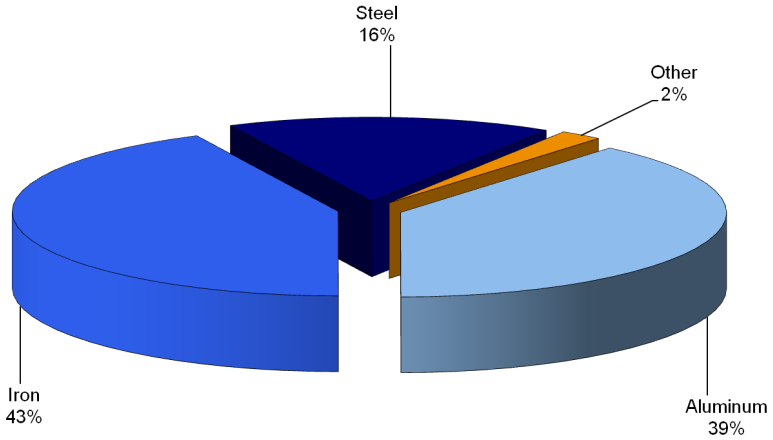
Who uses it?


Automotive / Heavy Duty
OEM
36%
Automotive / Heavy Duty
Supplier
44%
Automotive engineering
3%
Other
7%
Turbines / Pumps /
Hydraulics
4%
Machine and plant
manufacture
4%
Aerospace
2%

Who uses it?


2 - 5 parts
46%
1 part
25%
51 - 100 parts
0%
11 - 50 parts
15%
6 - 10 parts
14%


up to 14 days
3%
up to 28 days
16%
up to 21 days
5%
up to 7 days
2%
more than 8
weeks
21%
up to 8 weeks
53%


Steel
16%
Other
2%
Iron
43%
Aluminum
39%

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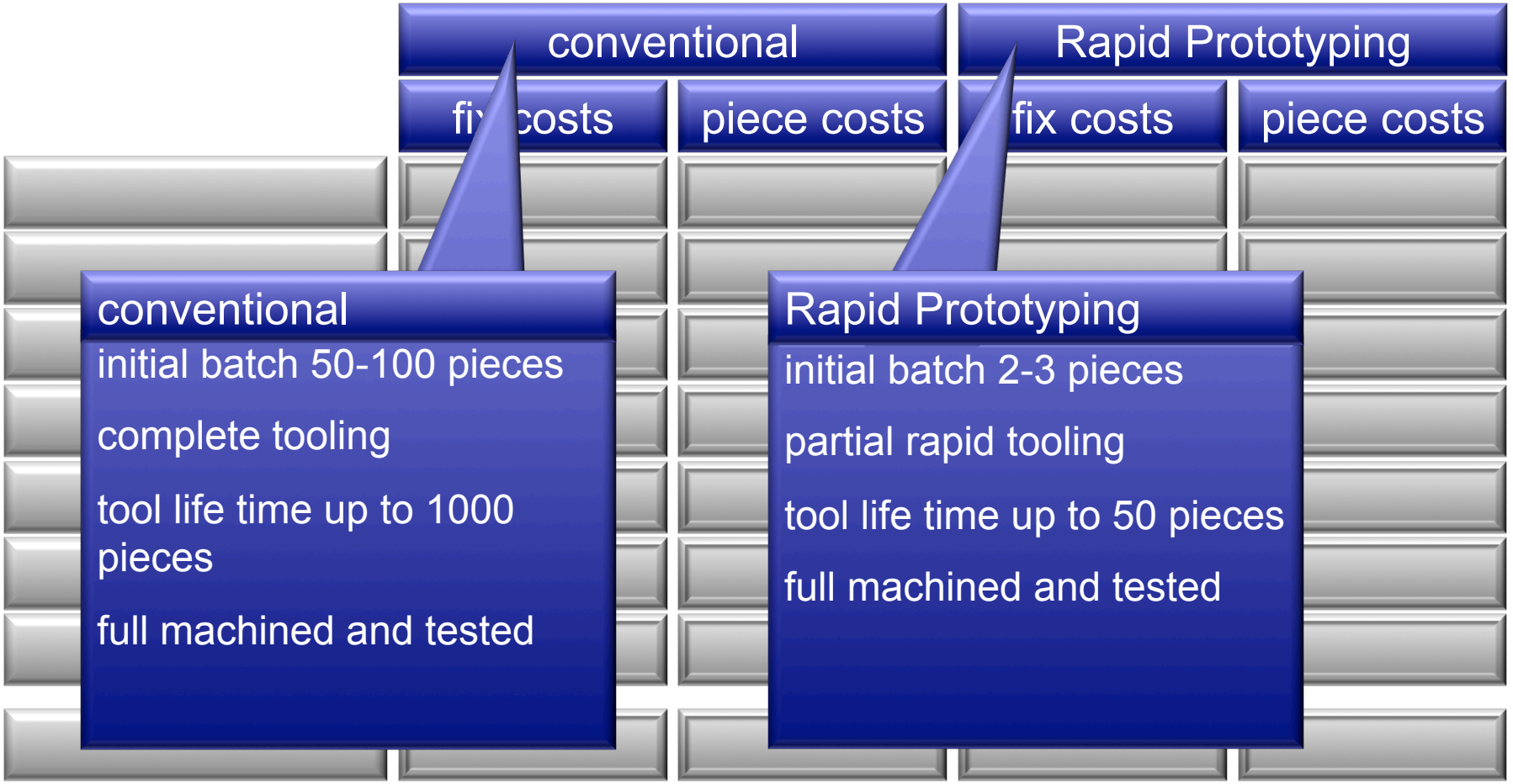
cost comparison



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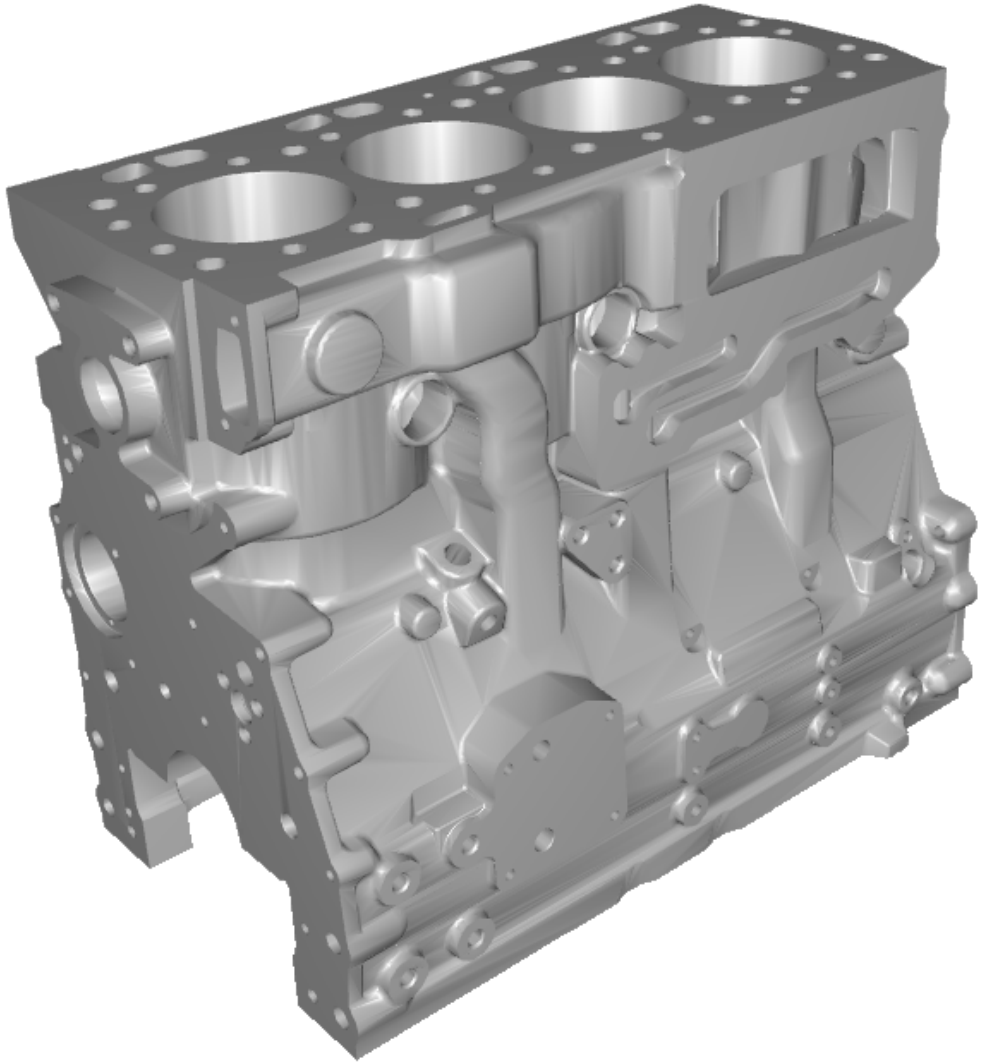
crank case



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cost comparison

	conventional		Rapid Prototyping	
	fix costs	piece costs	fix costs	piece costs
crank case	$ 125,000	$ 5,000	$ 20,000	$ 10,000

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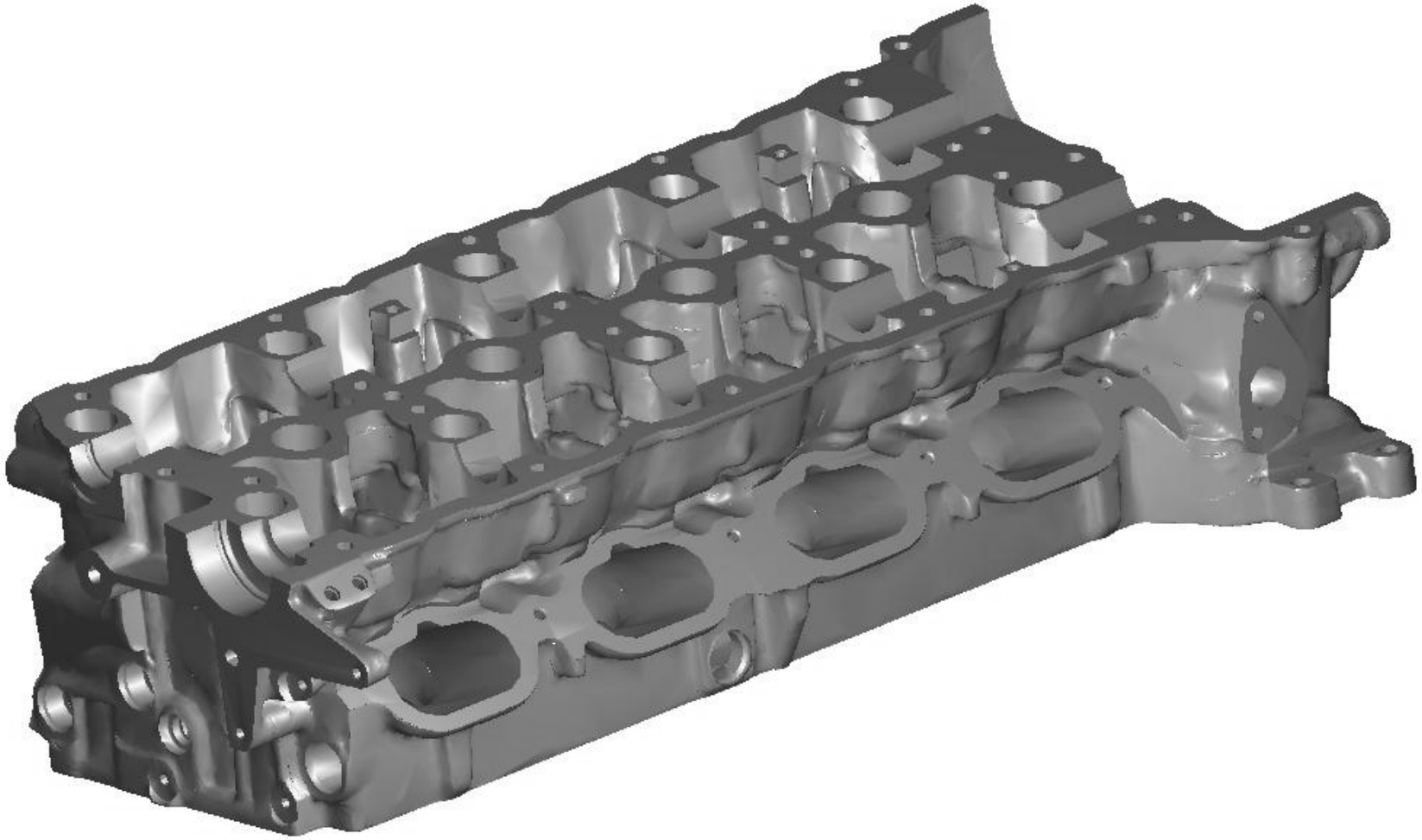
cylinder head



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cylinder head	$ 130,000	$ 5,000	$ 25,000	$ 12,000

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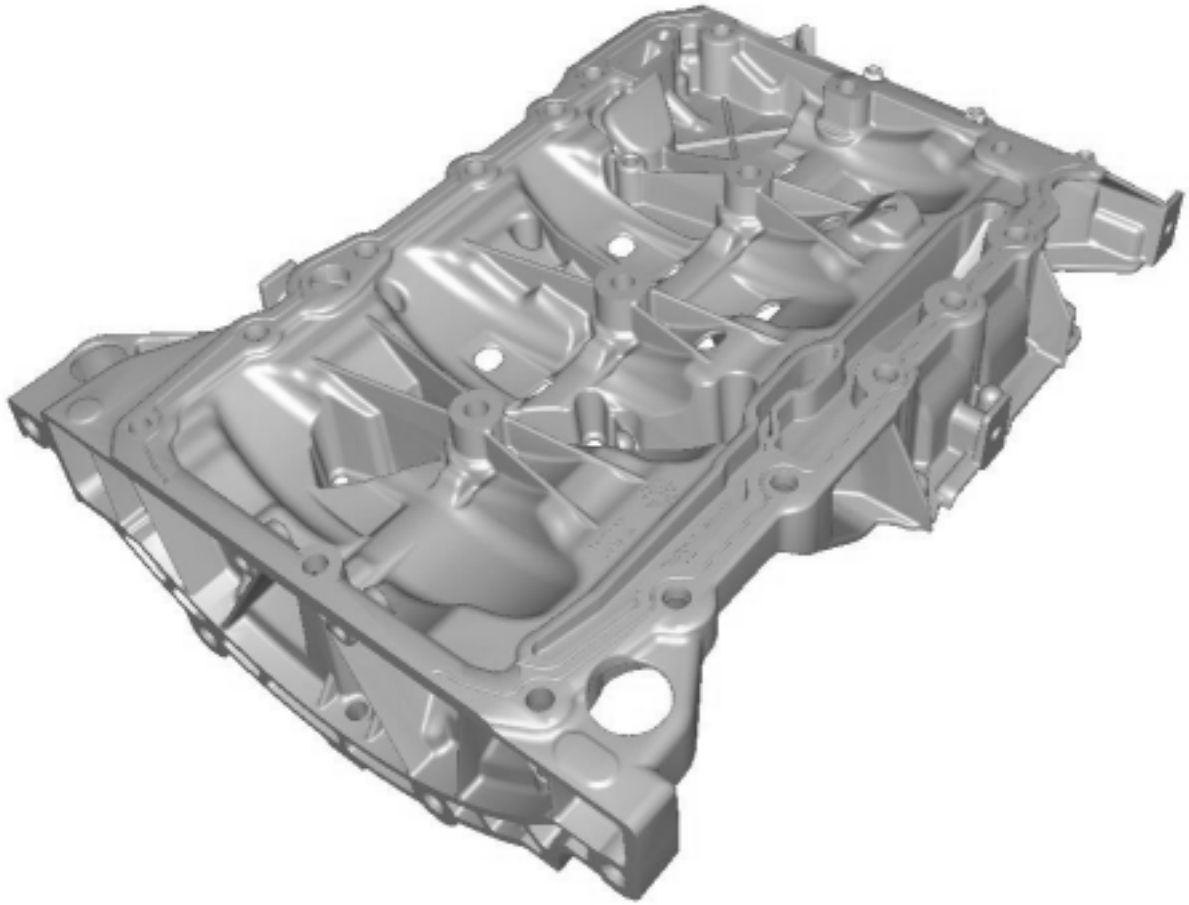
oil pan



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cost comparison

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crank case	$ 125,000	$ 5,000	$ 20,000	$ 10,000
cylinder head	$ 130,000	$ 5,000	$ 25,000	$ 12,000
oilpan	$ 20,000	$ 2,000	$ 5,000	$ 3,500

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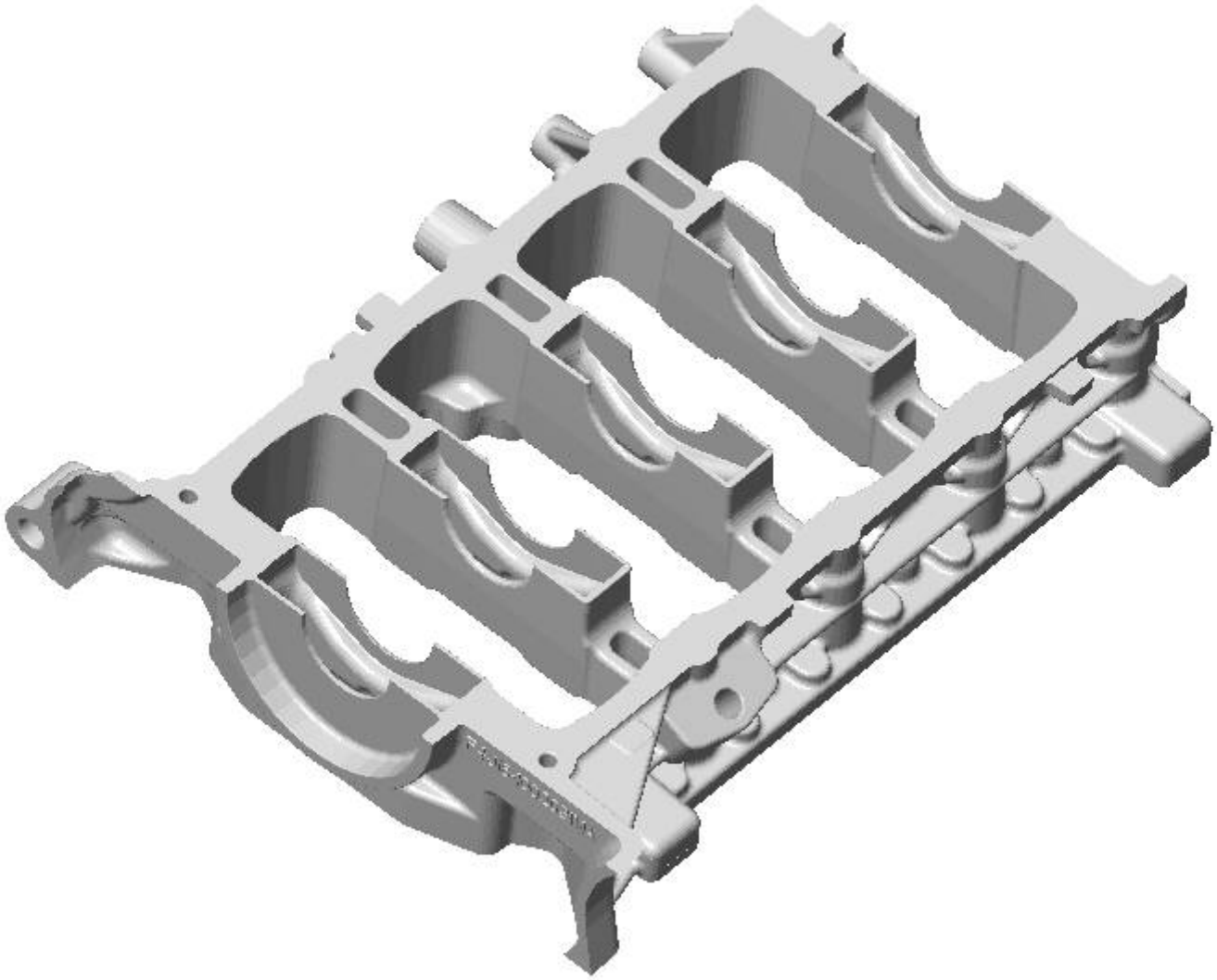
bedplate



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oilpan	$ 20,000	$ 2,000	$ 5,000	$ 3,500
bedplate	$ 25,000	$ 2,500	$ 7,000	$ 5,000

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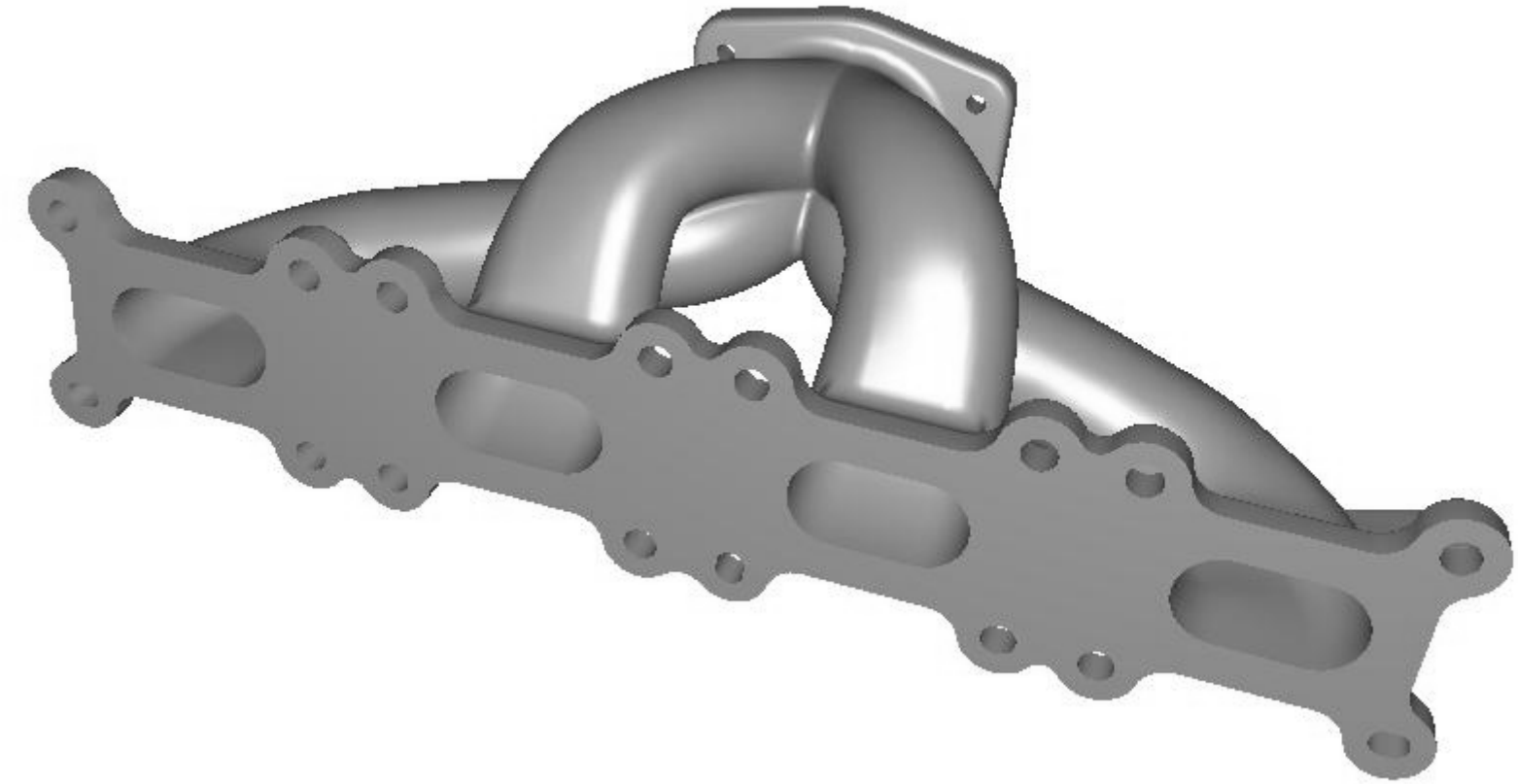
exhaust manifold



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oilpan	$ 20,000	$ 2,000	$ 5,000	$ 3,500
bedplate	$ 25,000	$ 2,500	$ 7,000	$ 5,000
exhaust manifold	$ 18,000	$ 2,000	$ 5,000	$ 3,000

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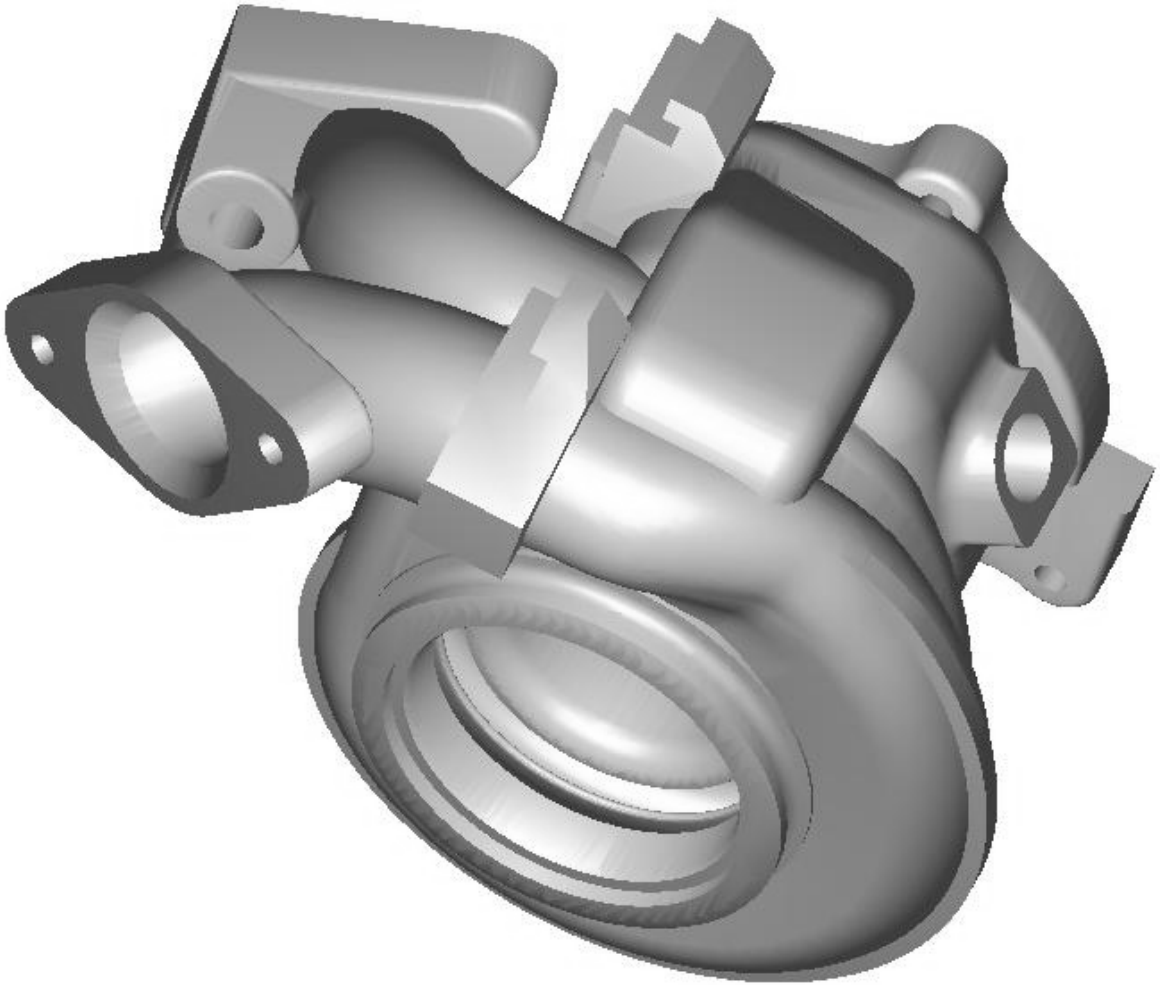
turbocharger



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cost comparison

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oilpan	$ 20,000	$ 2,000	$ 5,000	$ 3,500
bedplate	$ 25,000	$ 2,500	$ 7,000	$ 5,000
exhaust manifold	$ 18,000	$ 2,000	$ 5,000	$ 3,000
turbocharger	$ 40,000	$ 3,000	$ 12,500	$ 6,000

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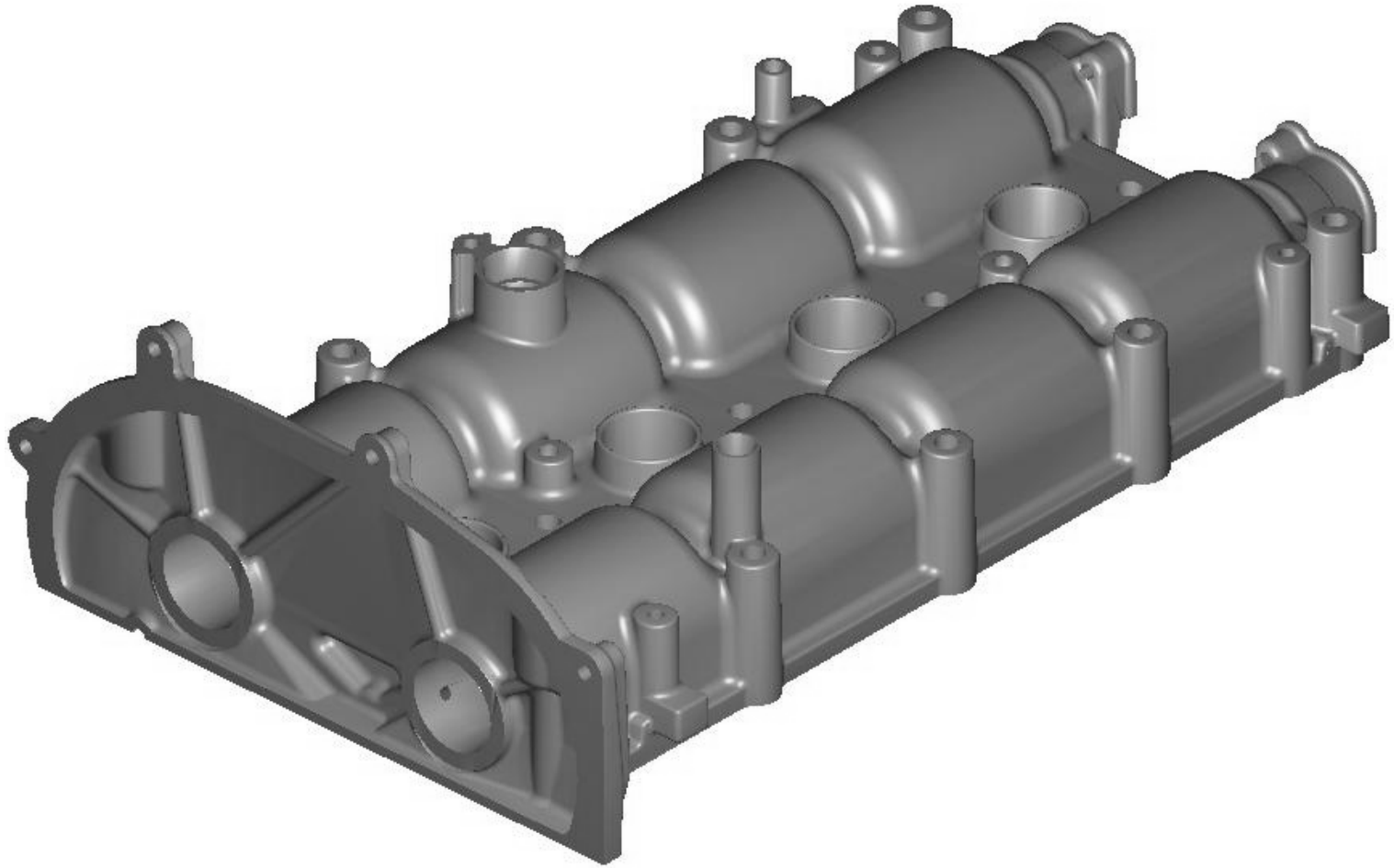
cylinder head cover



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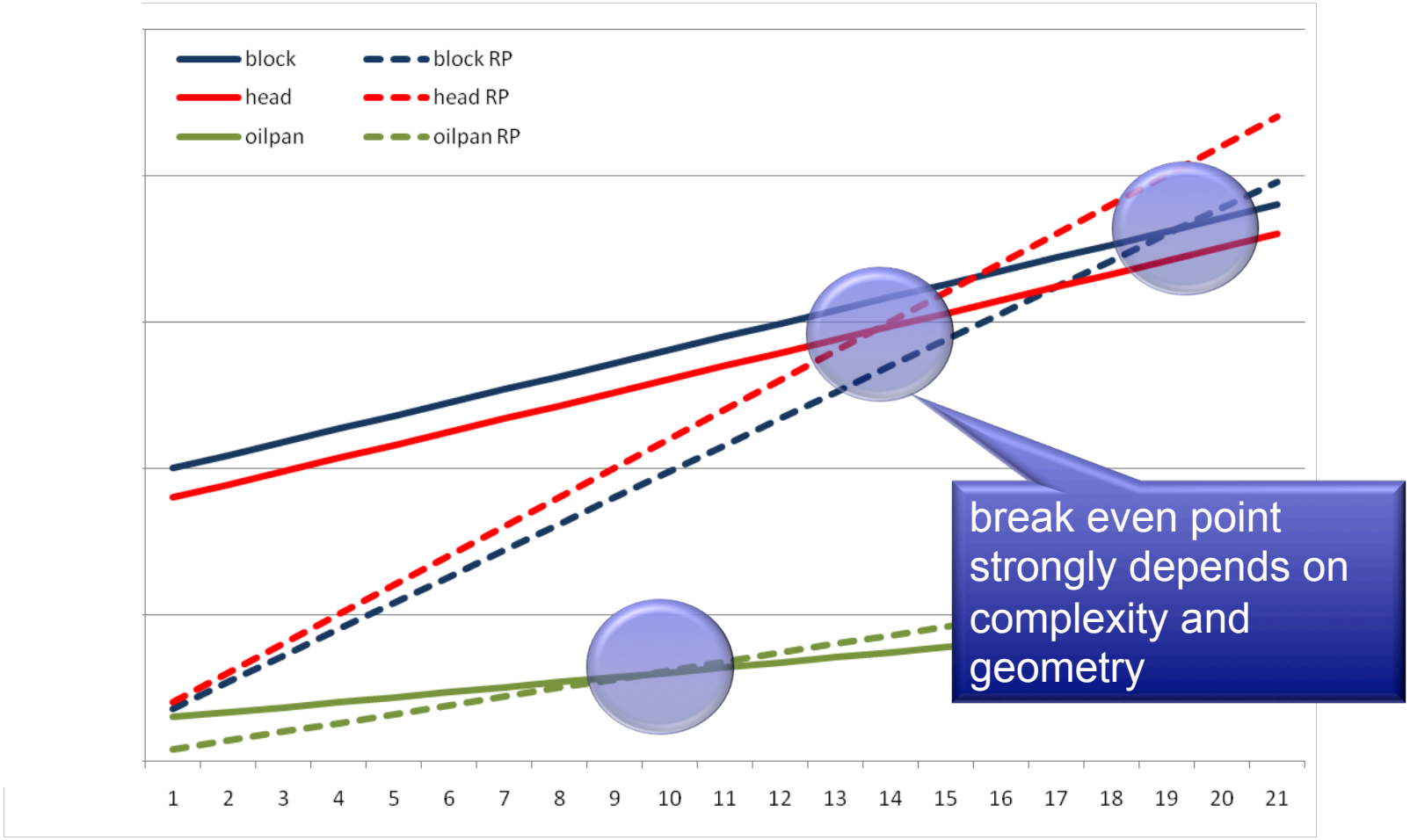
oilpan	$ 20,000	$ 2,000	$ 5,000	$ 3,500
bedplate	$ 25,000	$ 2,500	$ 7,000	$ 5,000
exhaust manifold	$ 18,000	$ 2,000	$ 5,000	$ 3,000
turbocharger	$ 40,000	$ 3,000	$ 12,500	$ 6,000
cyl. head cover	$ 22,000	$ 2,500	$ 10,000	$ 6,000
total	$ 380,000	$ 22,000	$ 84,500	$ 45,500

cost advantage for the initial batch

1 set of castings: $ 271,500

standard break even situation



Only valid for the assumption that the use of RP techniques are maximized.

Depending on real geometry and requirements, the estimated prices can vary !

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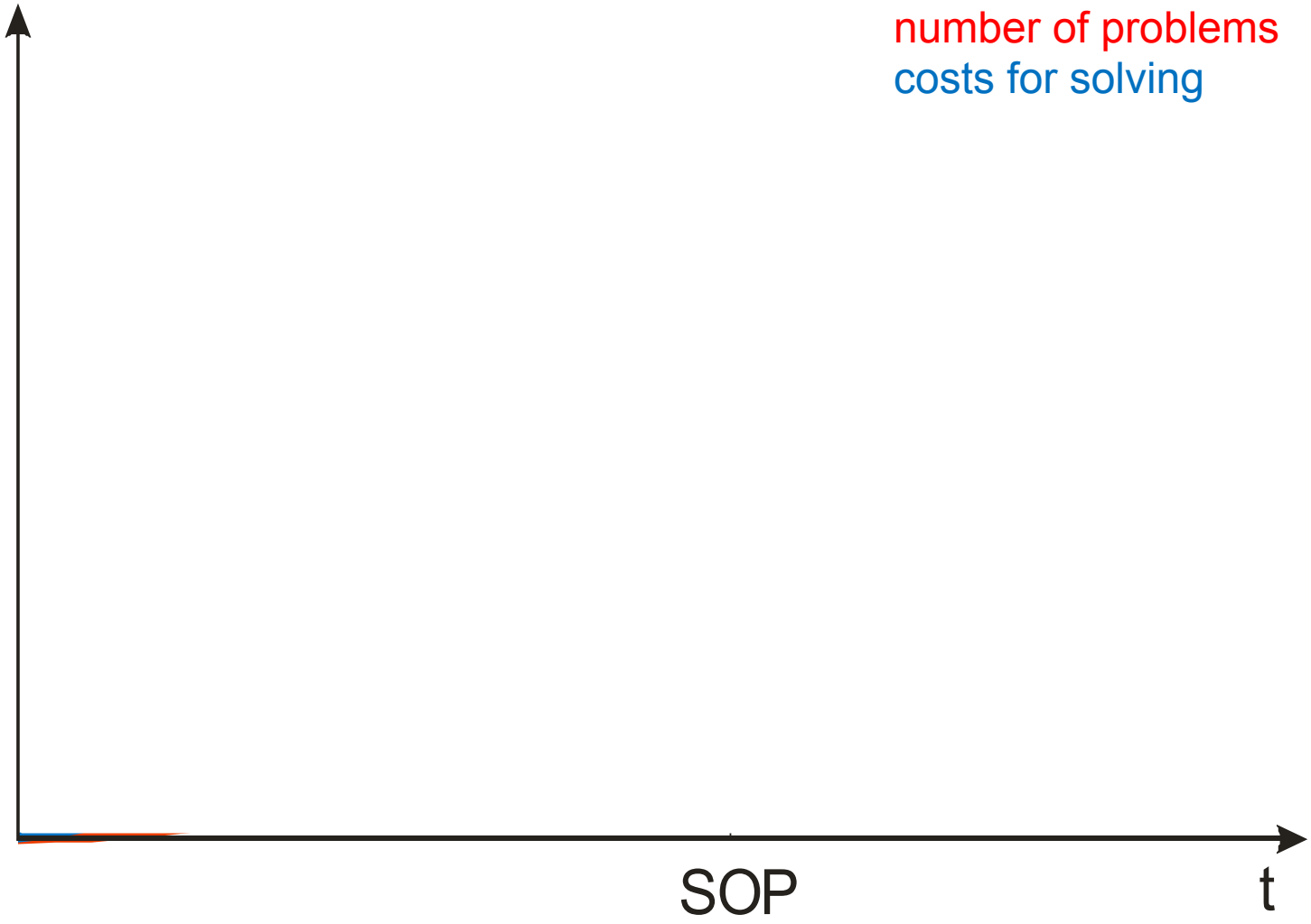
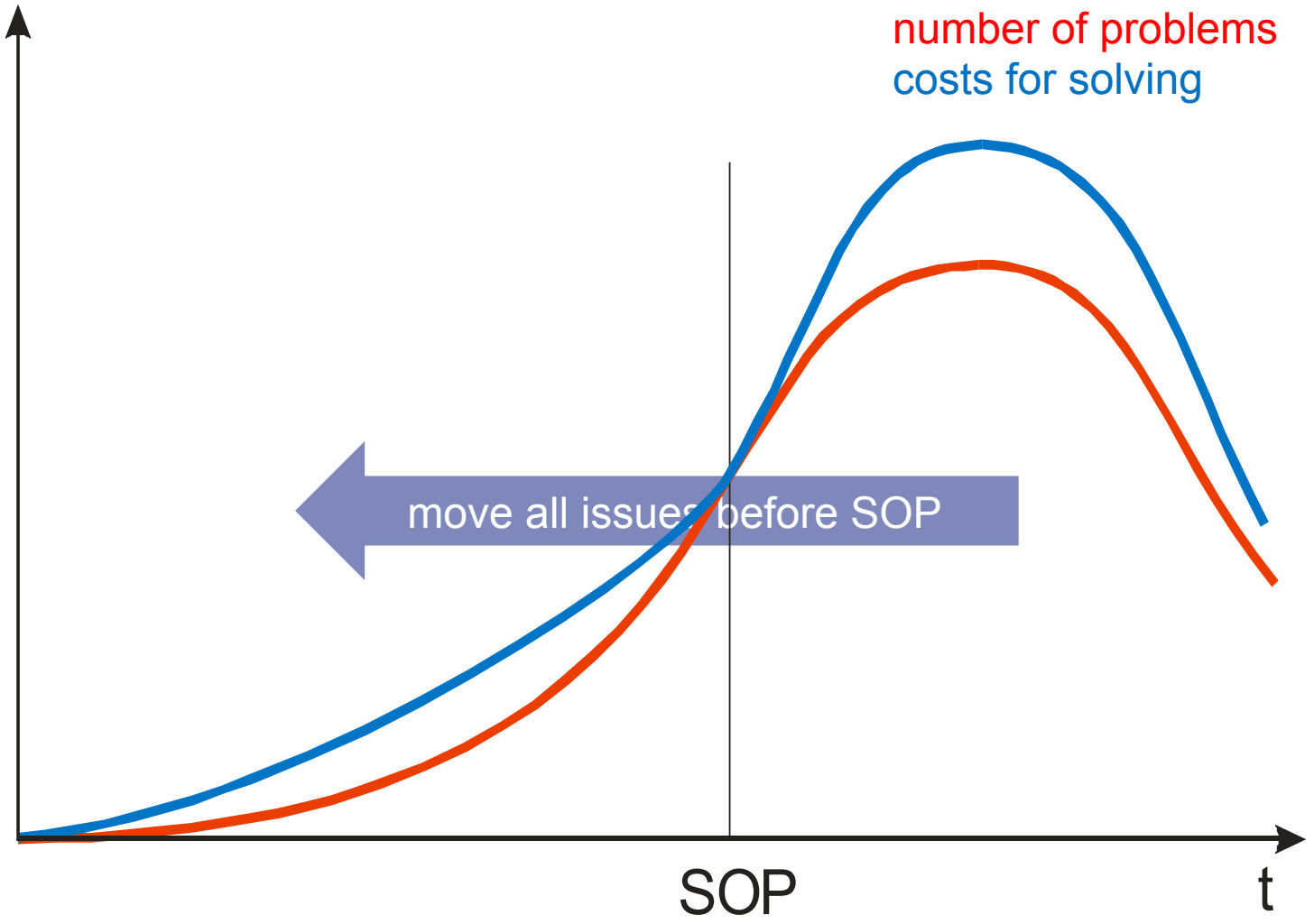
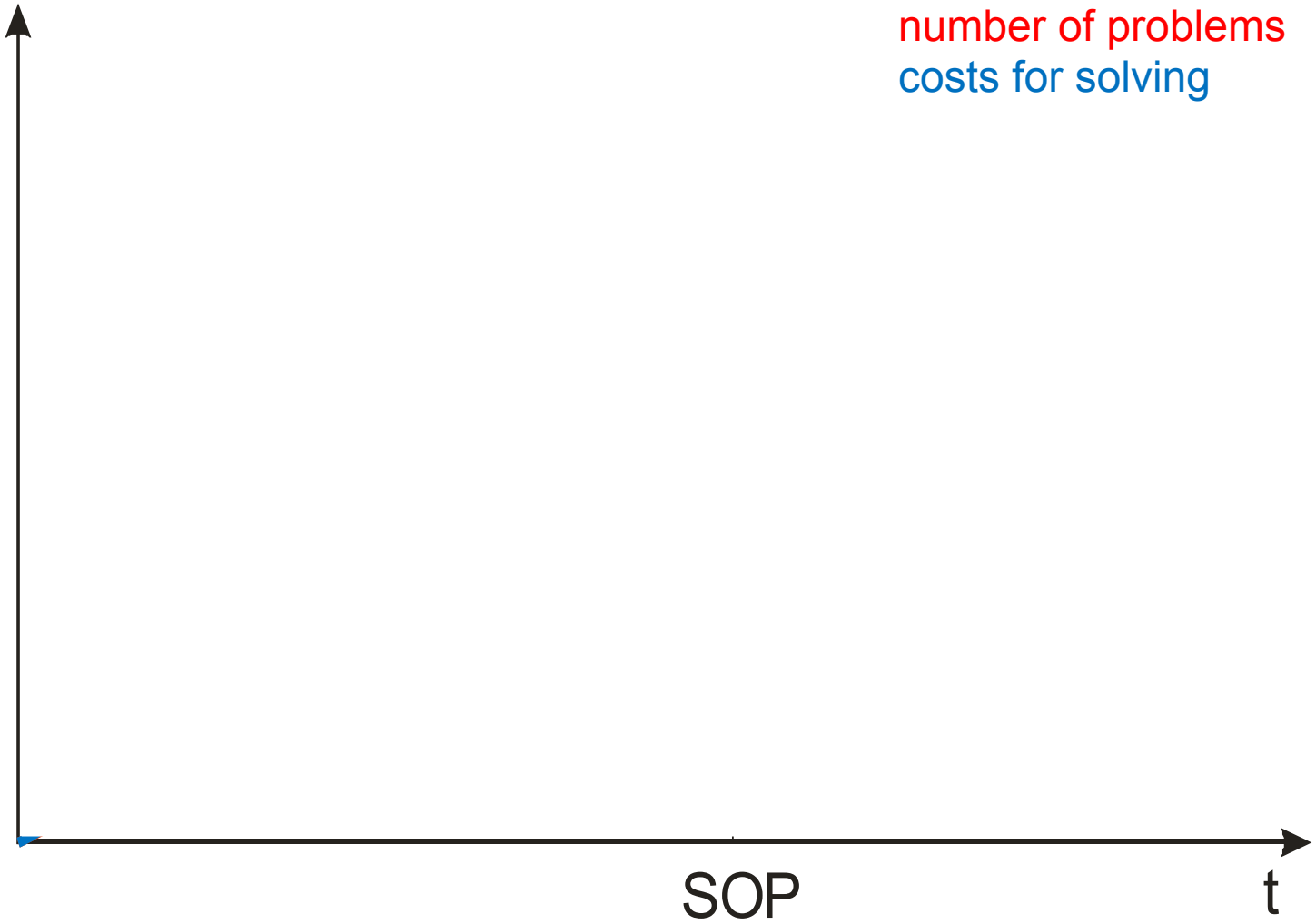
bad surprises at SOP



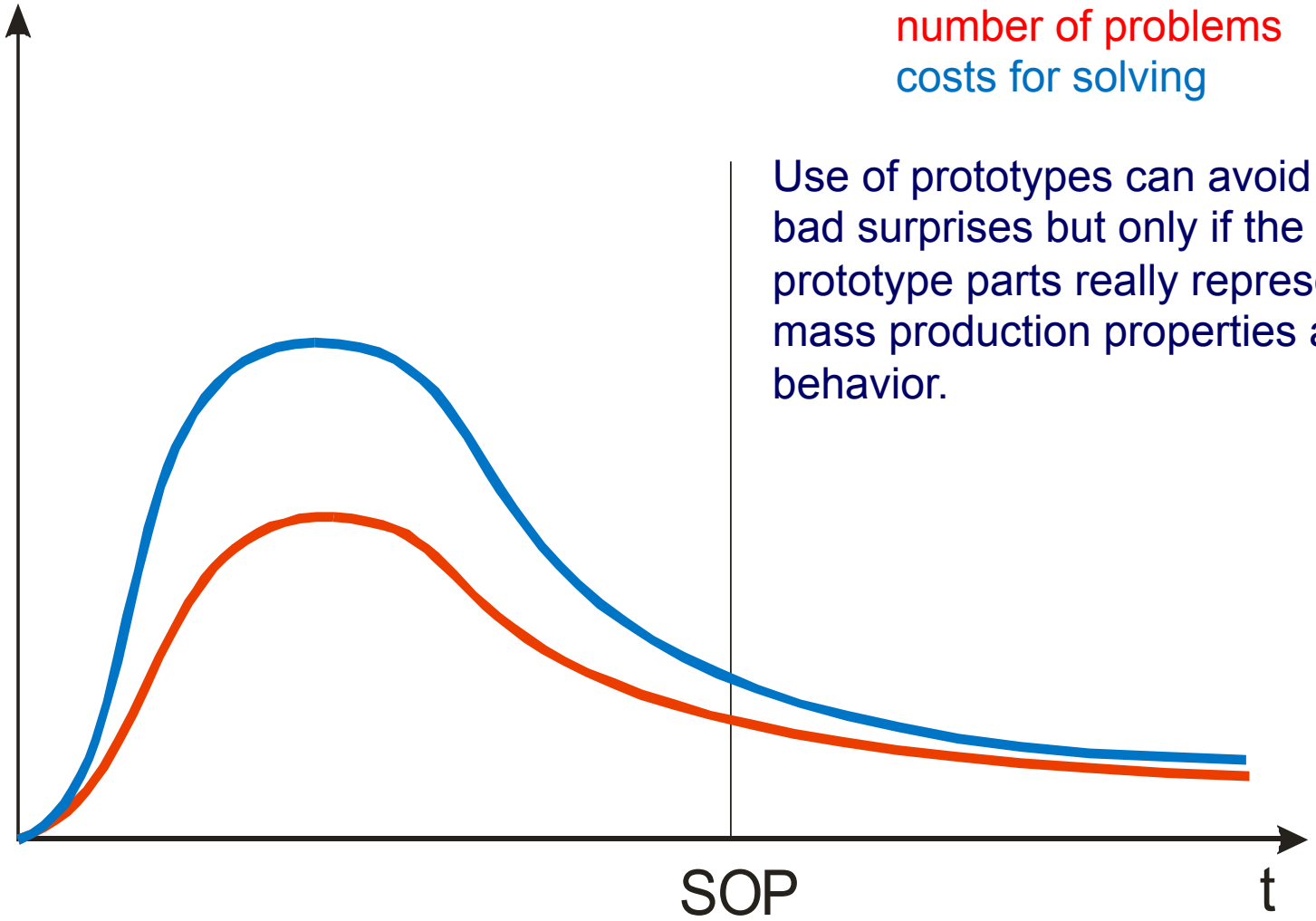
avoiding bad surprises at SOP



avoiding bad surprises at SOP

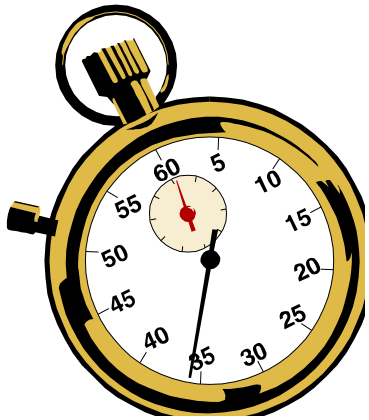


avoiding bad surprises at SOP



Use of prototypes can avoid bad surprises but only if the prototype parts really represent mass production properties and behavior.

TIME IS MONEY!



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lead time comparison for initial part

	conventional foundry	specialized in small batches	RP provider
crank case			
cylinder head			
oilpan			
bedplate			
exhaust manifold			
turbocharger			
cyl. head cover			
total			

lead time comparison for initial part

	conventional foundry	specialized in small batches	RP provider
crank case	> 20 weeks		
cylinder head	> 20 weeks		
oilpan	> 12 weeks		
bedplate	> 12 weeks		
exhaust manifold	> 10 weeks		
turbocharger	> 10 weeks		
cyl. head cover	> 8 weeks		
total	> 20 weeks		

lead time comparison for initial part

	conventional foundry	specialized in small batches	RP provider
crank case	> 20 weeks	> 12 weeks	
cylinder head	> 20 weeks	>12 weeks	
oilpan	> 12 weeks	6 weeks	
bedplate	> 12 weeks	6 weeks	
exhaust manifold	> 10 weeks	8weeks	
turbocharger	> 10 weeks	8 weeks	
cyl. head cover	> 8 weeks	6 weeks	
total	> 20 weeks	>12 weeks	

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lead time comparison for initial part

	conventional foundry	specialized in small batches	RP provider
crank case	> 20 weeks	> 12 weeks	6 weeks
cylinder head	> 20 weeks	>12 weeks	6 weeks
oilpan	> 12 weeks	6 weeks	3 - 4 weeks
bedplate	> 12 weeks	6 weeks	3 - 4 weeks
exhaust manifold	> 10 weeks	8weeks	3 - 4 weeks
turbocharger	> 10 weeks	8 weeks	3 - 4 weeks
cyl. head cover	> 8 weeks	6 weeks	3 - 4 weeks
total	> 20 weeks	>12 weeks	6 weeks

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lead time comparison for initial part

lead time advantage for the initial set

1'st development loop: 6 … > 14 weeks
2'nd development loop: 12 … > 28 weeks
3'rd development loop: 18 … > 42 weeks
between 18 and > 42 weeks !

Plus cost savings !

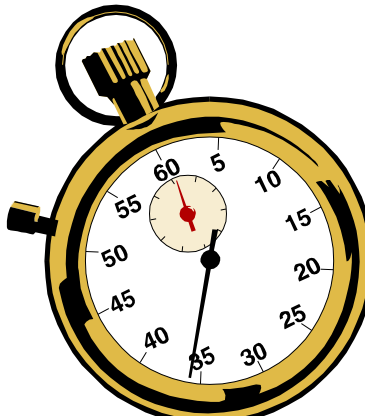
total	> 20 weeks	>12 weeks	6 – 8 weeks

lead time comparison for initial part

Depending on real geometry and requirements the lead times can vary !

total	> 20 weeks	>12 weeks	6 – 8 weeks

WHY IS TIME MONEY?



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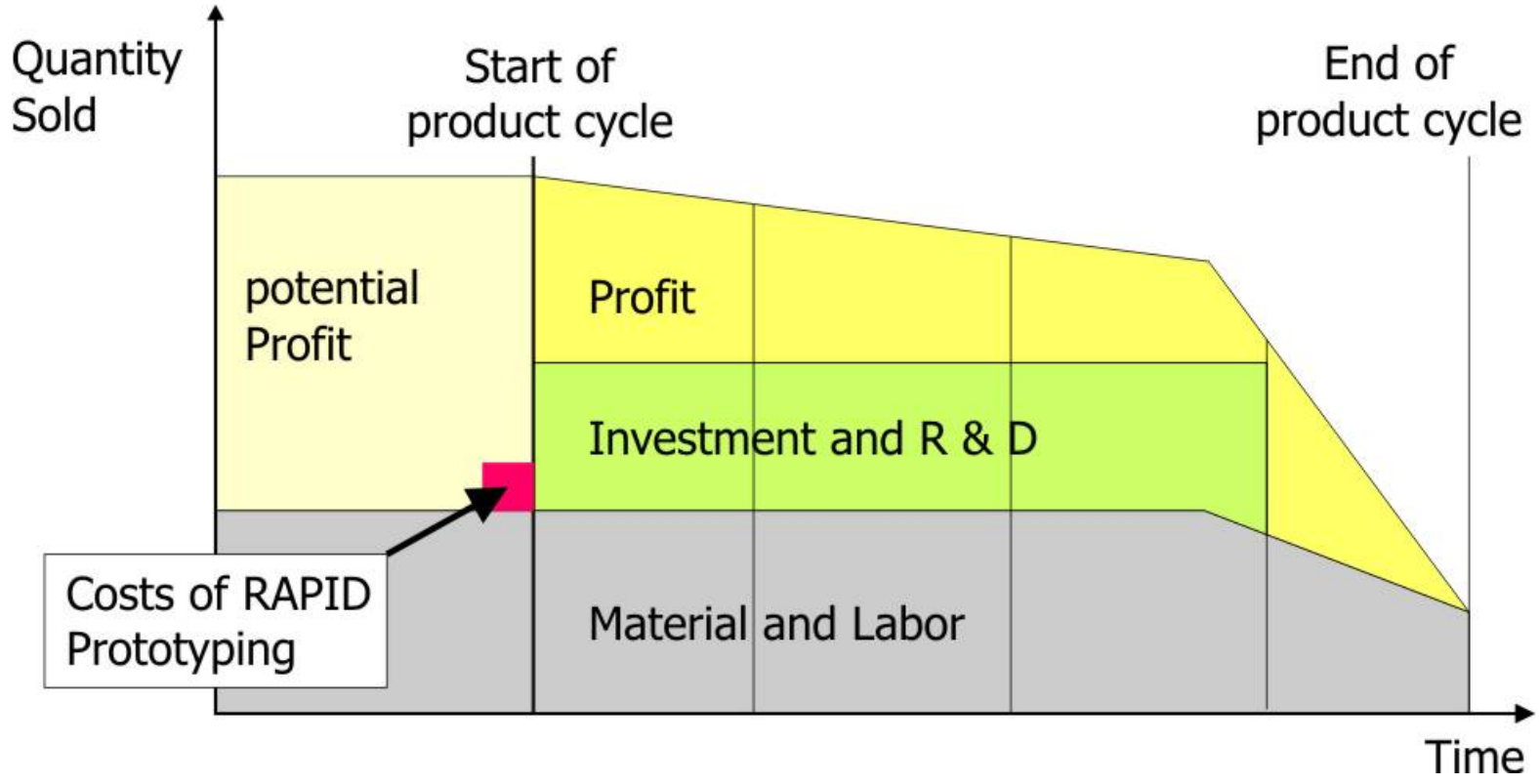
The hidden costs



- accelerated development
  - better products in less time
    - shorter time to market

The use of prototype castings accelerates the development of new casting designs.

Only when the prototype parts have mass production properties, significant results are expected. In this case all parts will have similar properties and behavior.

Therefore the total quantity of prototype parts can decrease, consuming less build up and test time.

The use of Rapid Prototyping techniques for casting prototypes can speed up the manufacturing at lower total costs with similar properties than mass production.

Conclusion: to realize these benefits it may be time to reevaluate your development process.

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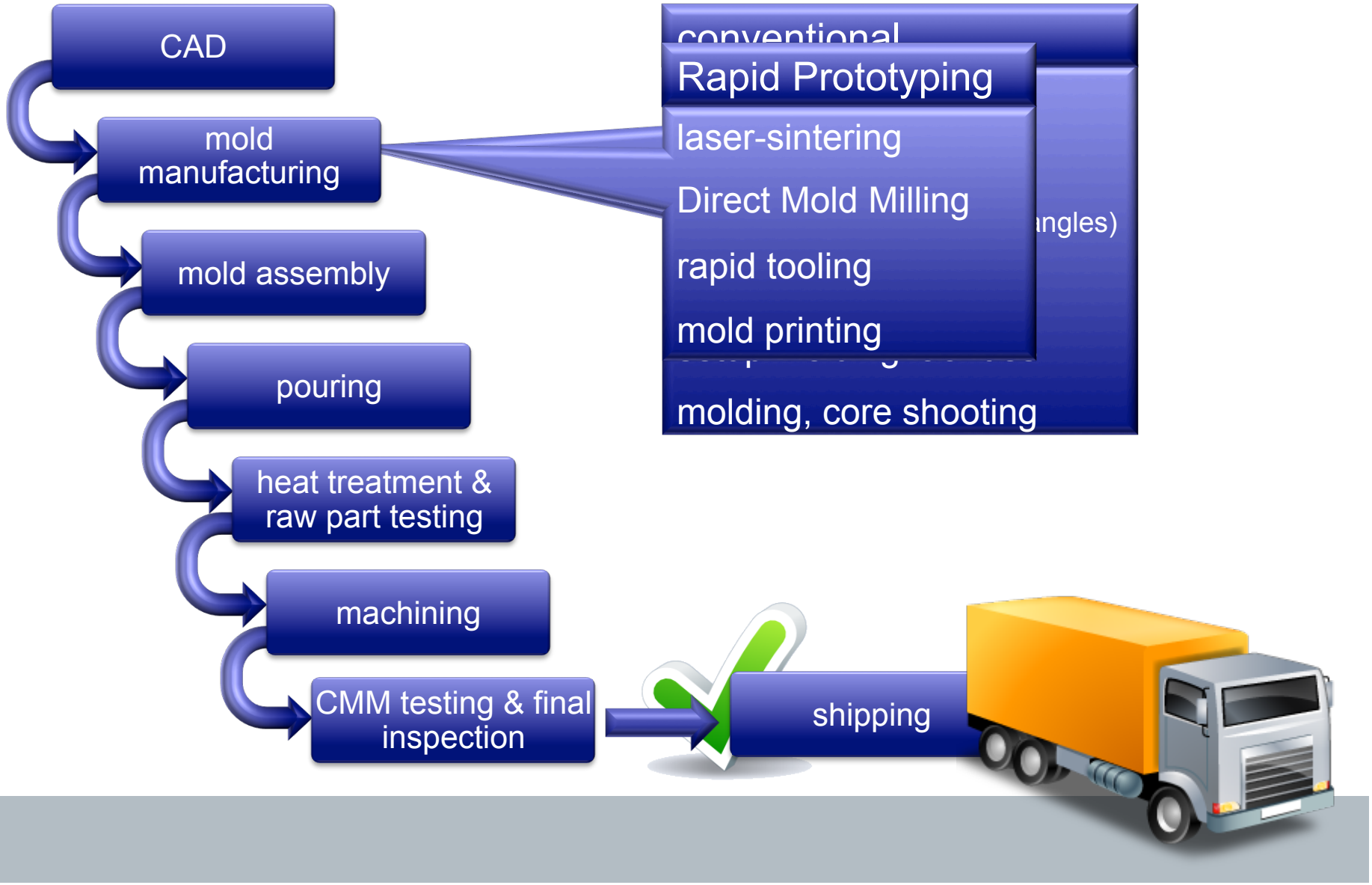
How does it work ?



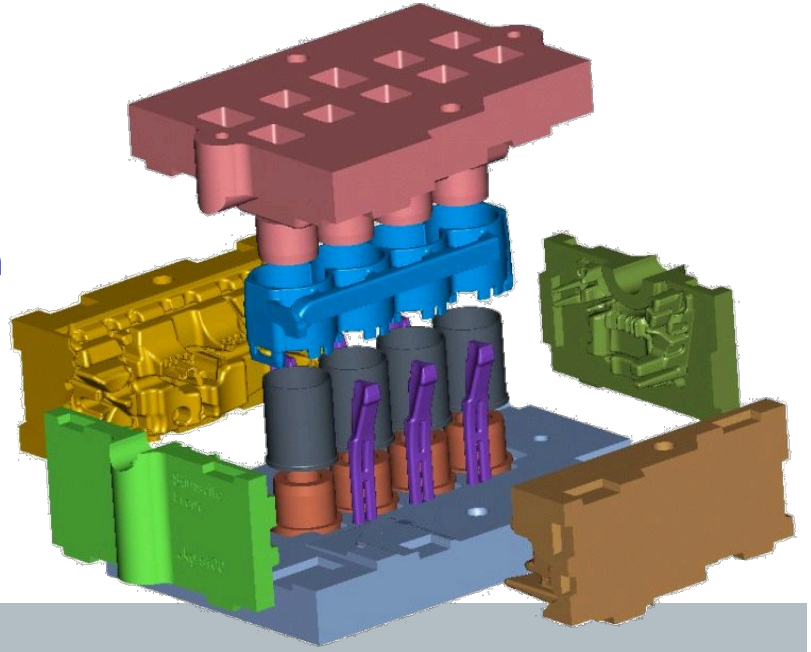
1st step: CAD

mold design and simulation

- raw part design, adding machining allowance, design of the prepared feeding and gating system
- define the split lines for mold segmentation and necessary cores, cores fitted with core prints for mold assembly
- mold segments and cores are fitted with interlocks
- finally the assembly of the generated mold is checked

- optimal mixture of different mold production techniques is provided by special software developed by ACTech which takes into consideration the best price/performance ratio

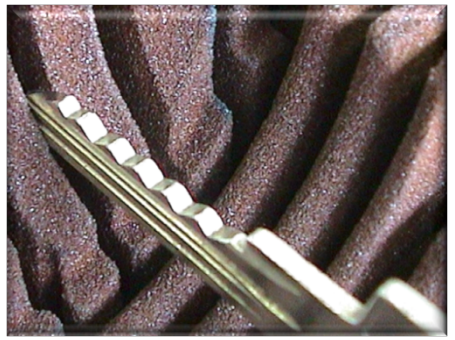
- mold filling and solidification simulation if needed or required

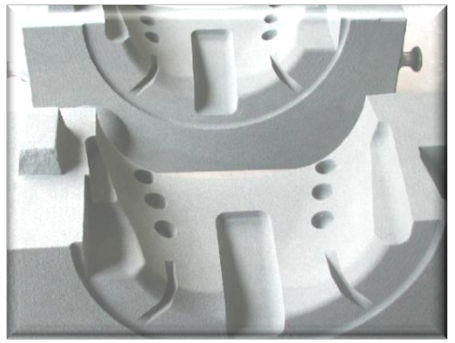


choosing the right operation for mold manufacturing

laser-sintering of Croning® sand

- intricate geometries
- small cores and mold segments
- small quantities, depending on geometry





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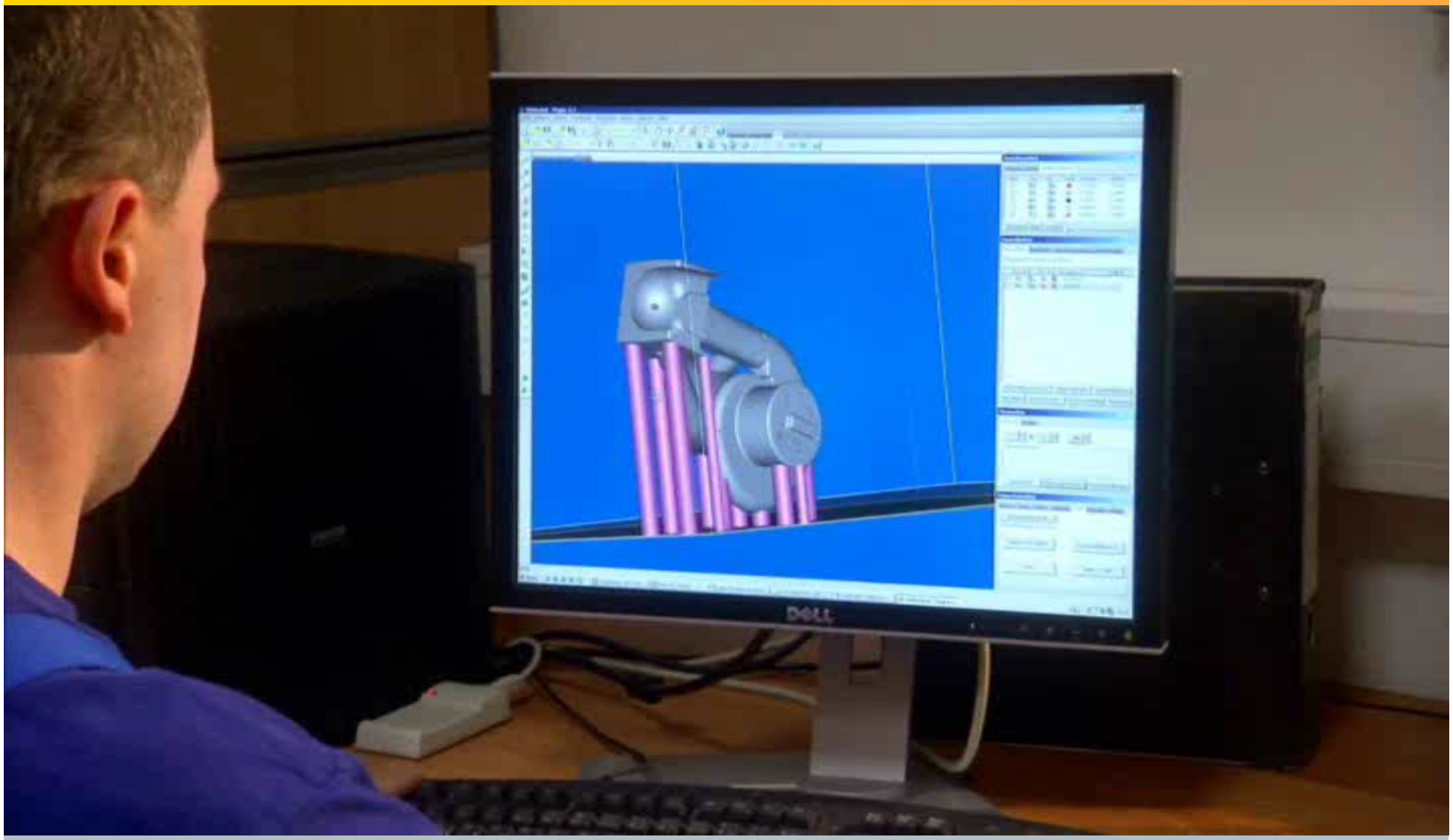
laser-sintering of Croning® sand



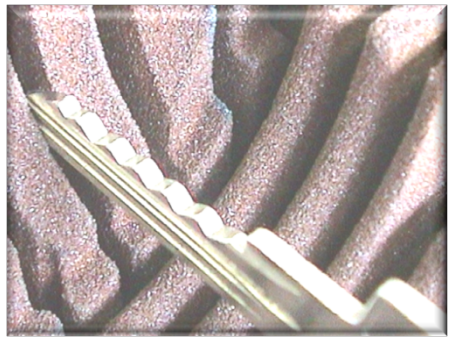
choosing the right operation for mold manufacturing

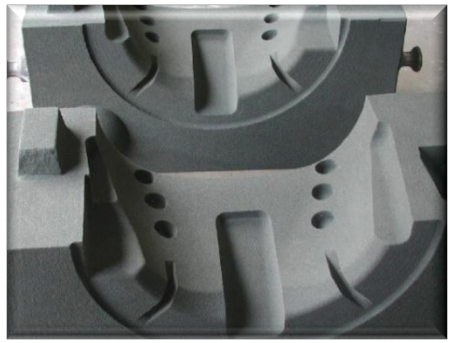
laser-sintering of Croning® sand

- intricate geometries
- small cores and mold segments
- small quantities, depending on geometry

Direct Mold Milling

- small quantities
- bigger cores and mold segments





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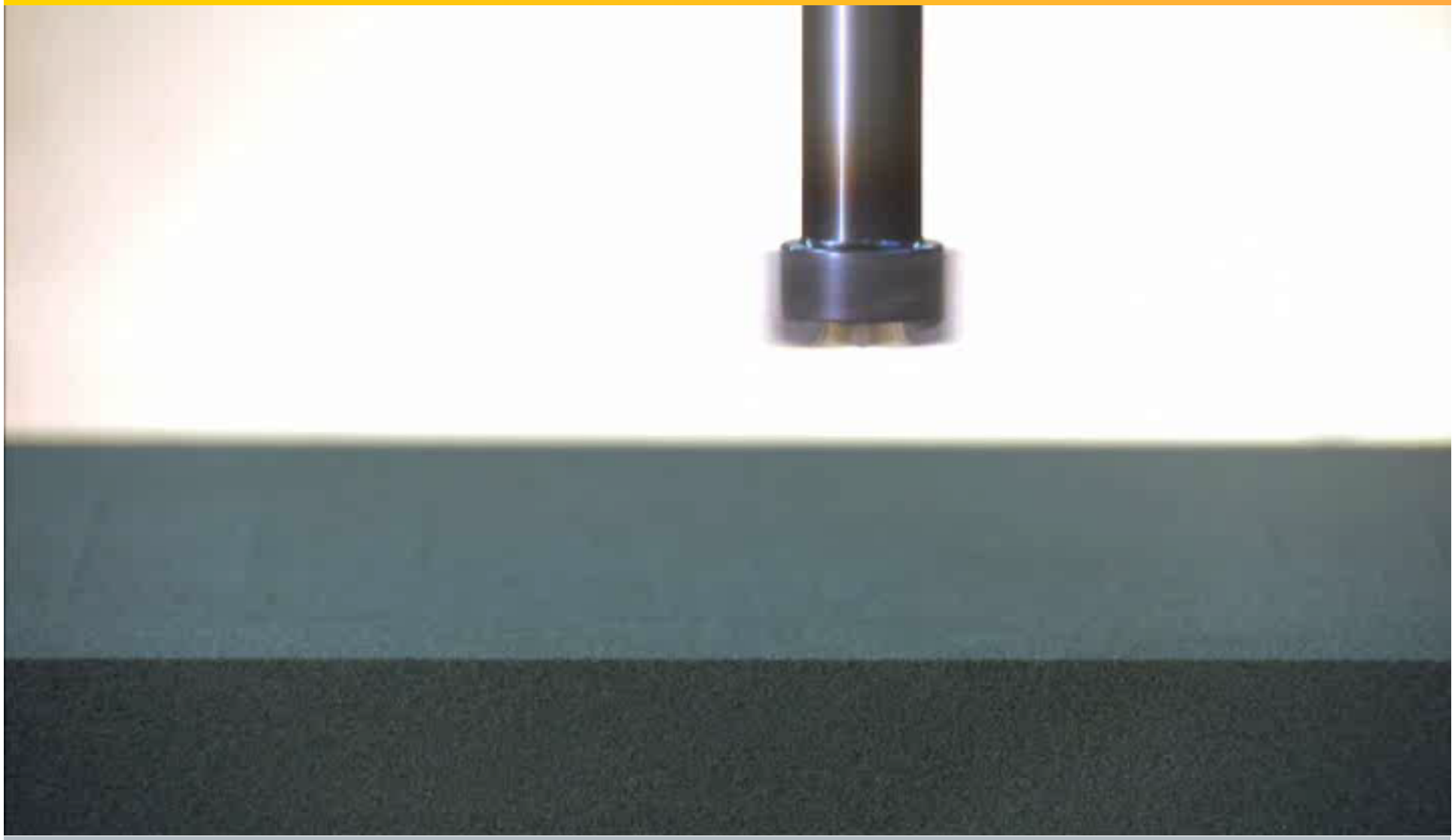
Direct Mold Milling



choosing the right operation for mold manufacturing

laser-sintering of Croning® sand

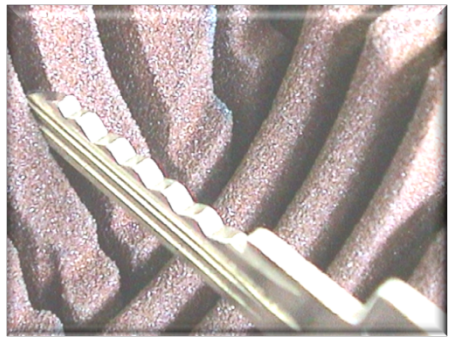
- intricate geometries
- small cores and mold segments
- small quantities, depending on geometry

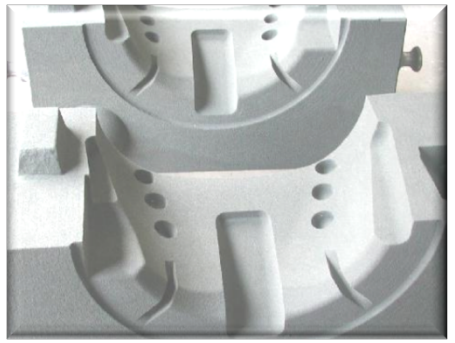
Direct Mold Milling

- small quantities
- bigger cores and mold segments

rapid tooling

- higher quantities
- assembled with loose parts from laser-sintering to avoid additional split lines due to local undercuts





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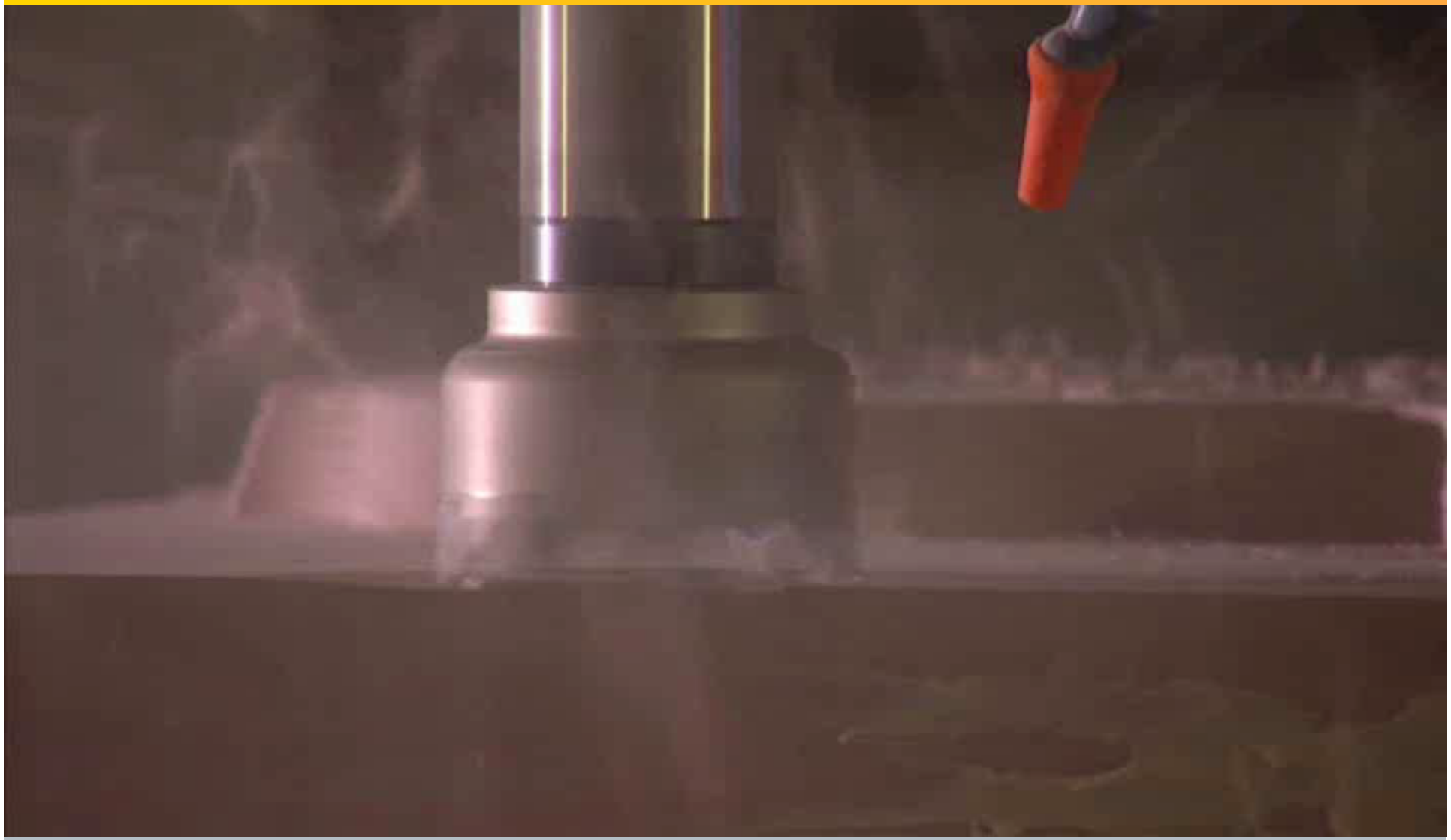
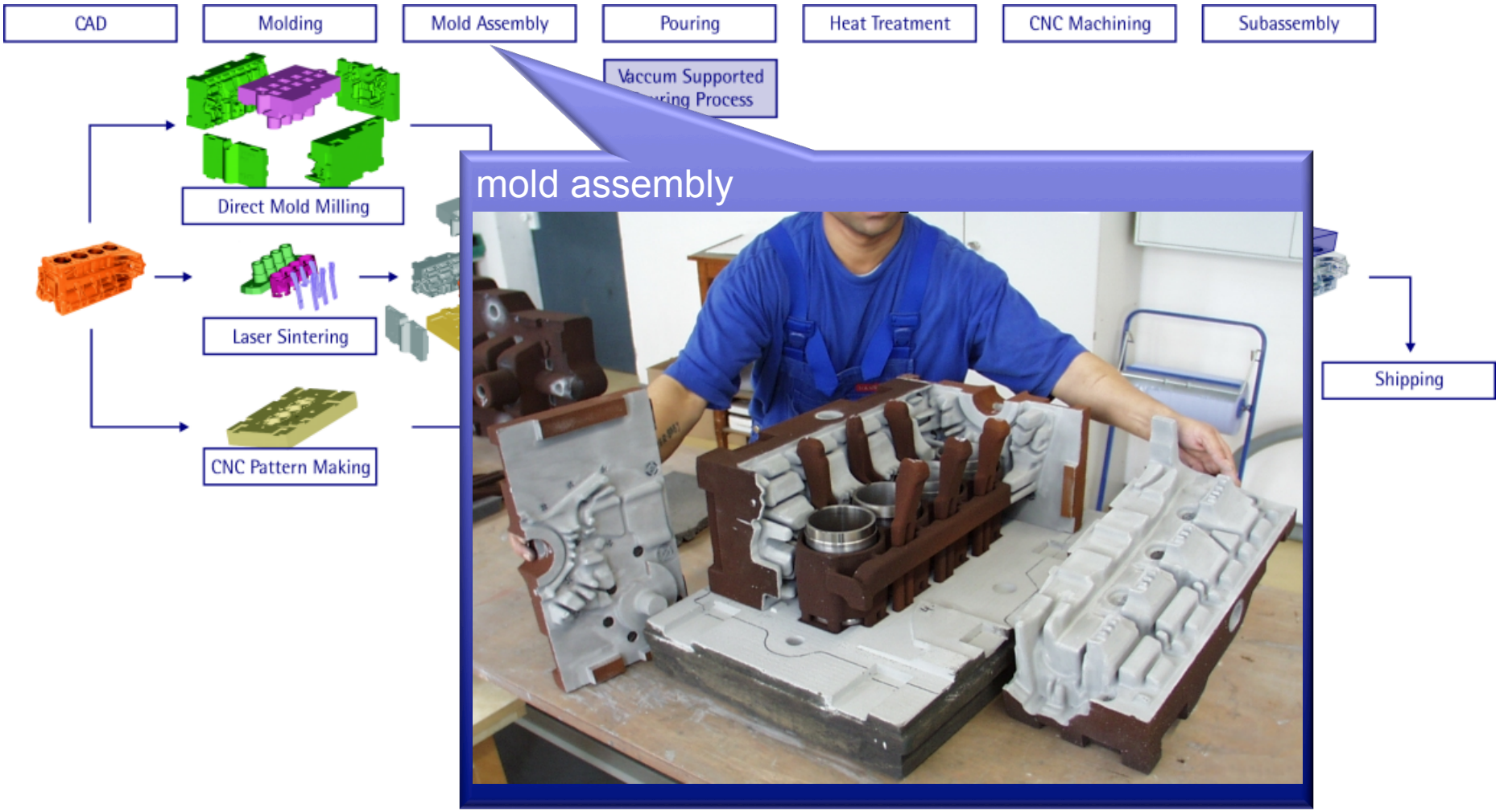
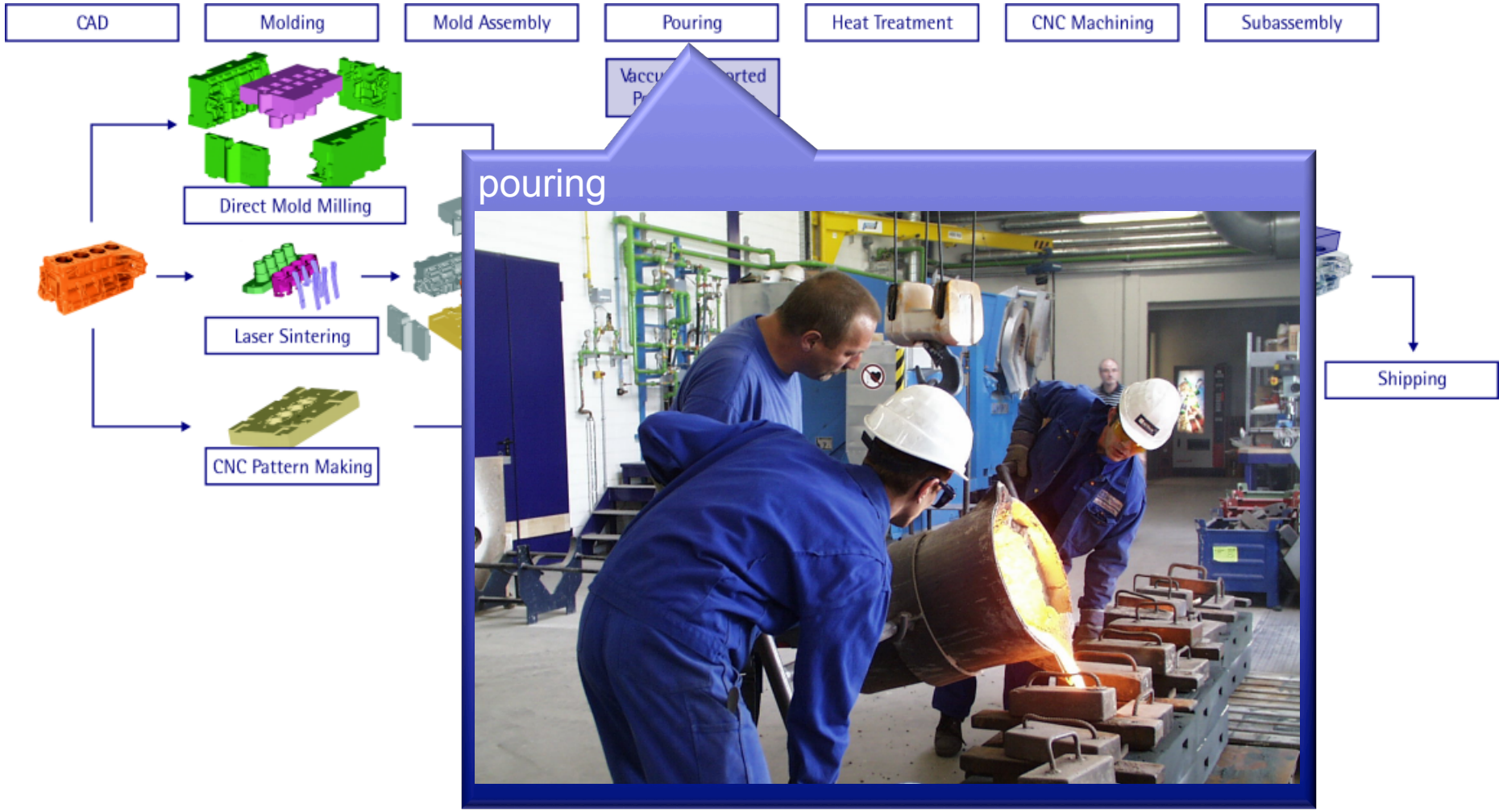
rapid tooling



further foundry operations



further foundry operations



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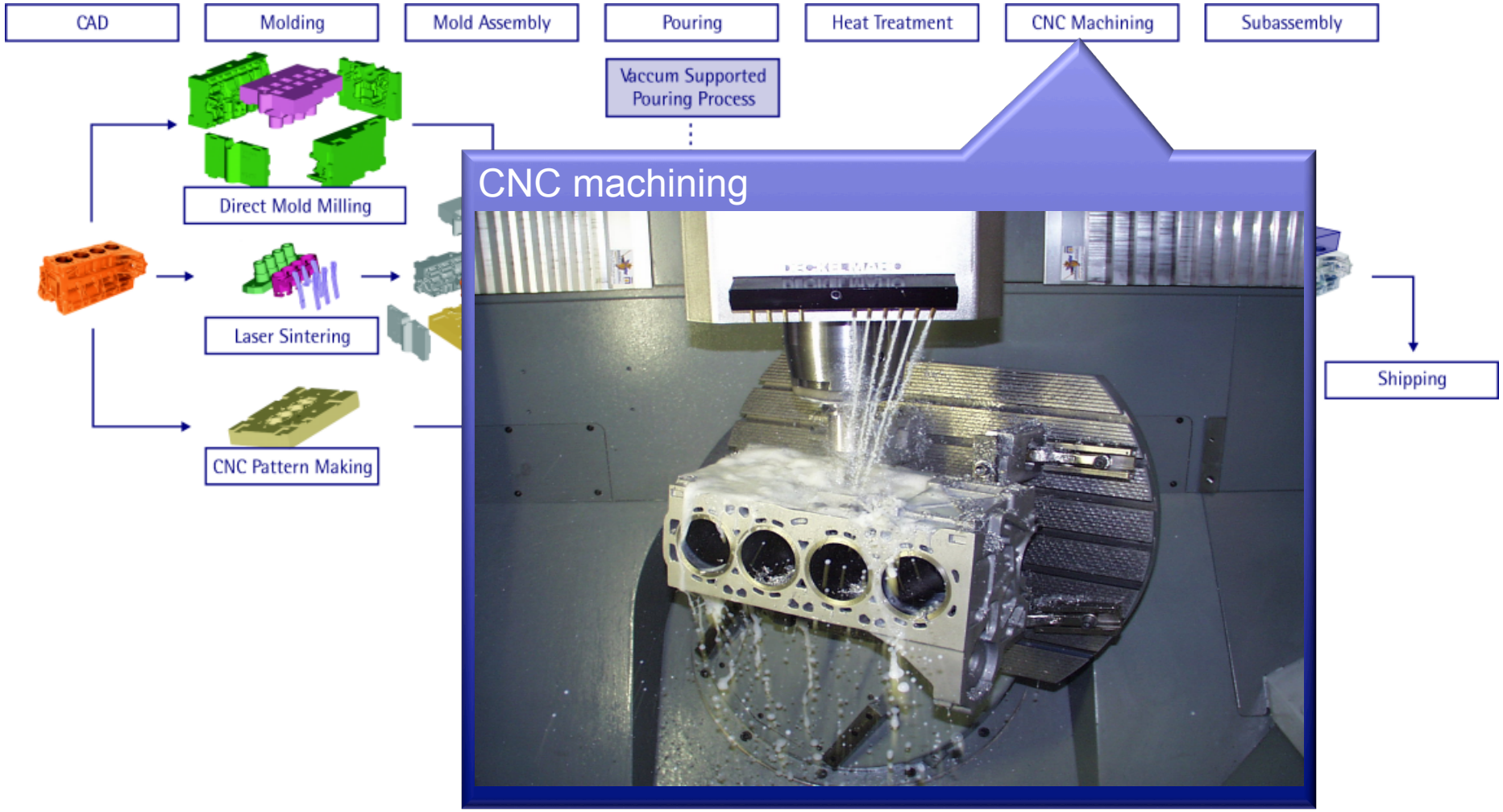
full machined prototype parts



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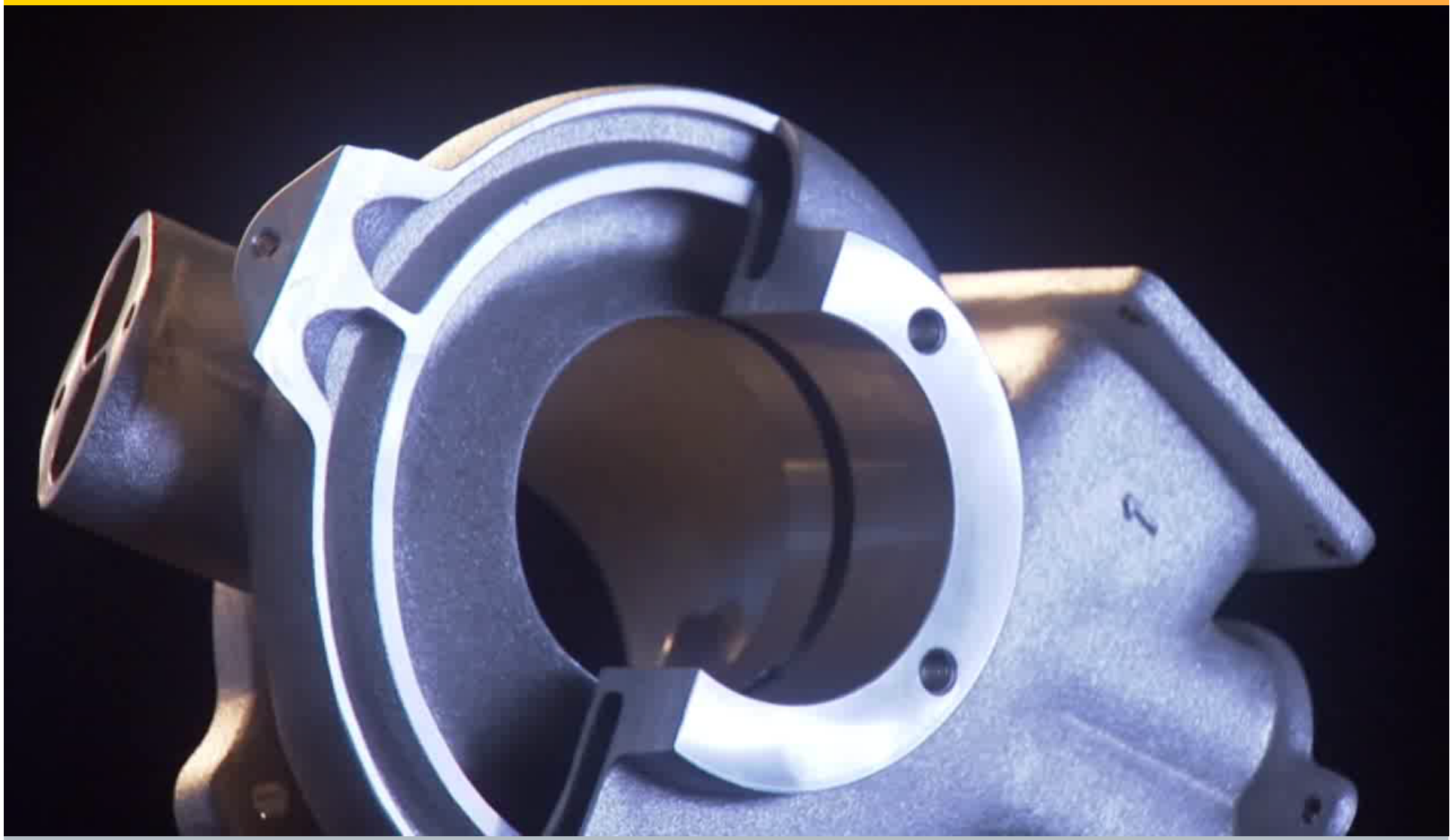
Thank you for your kind attention !



Any questions ?