

A red industrial robotic arm is shown in a factory setting, positioned over a large industrial machine. The machine has a rotating component that appears to be shaping a metal wheel. The background shows various industrial structures, including a green vertical pipe and metal scaffolding.

IMPERIUM

WHEEL MANUFACTURING



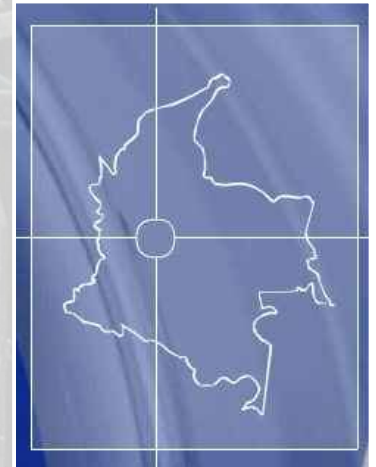
SOUTH AMERICAN OPERATION CENTER



PRODUCTION CENTER



Founded in 1988, Imperium is a leading manufacturer of aluminum Wheels within the South America Region.



PRODUCTION CENTER



GENERAL INFORMATION

RAW MATERIALS

- Aluminum alloy AlSi11
- Aluminum alloy AlSi7

SUPPLIERS

- Alcoa (Brasil)
- Beck Aluminun (E.U.)
- MIT

Annual Capacity

- 720.000 Units

PRODUCTION CENTER



PRODUCTS:

PASSENGER CAR WHEELS, LIGHT TRUCK AND SUV ALUMINUM WHEELS, MOTORCYCLE PARTS, PISTONS FOR AFTERMARKET.

SIZES:

15" TO 24"

WIDTHS UP TO 14"

- 100% of our products are fabricated using low pressure permanent mold process
- 65% are heat treated AlSi7 (AC4W - T6) (A356.0)
- 35% are non heat treated AlSi11

PRODUCTION CENTER



PRODUCTION FACILITIES

- 3 Melting Furnaces
- 13 Low Pressure casting machines
- 2 Heat Treatment Units
- 5 CNC Machining Cells
- 1 Powder and Liquid Paint Units

SERVICES

- Mold maintenance workshop
- Mold making workshop
- Wheel testing labs

PROCES FLOWCHART



START



Raw Material Inspection



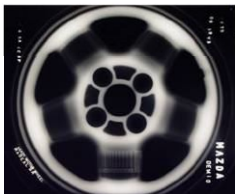
Metal Melt



Cast



Heat Treatment



Casting Evaluation



A

RAW MATERIAL INSPECTION



- As soon as the raw material arrives to Imperium from Brasil, a chemical analysis is performed by means of an optical spectrometer. (17 elements checked)

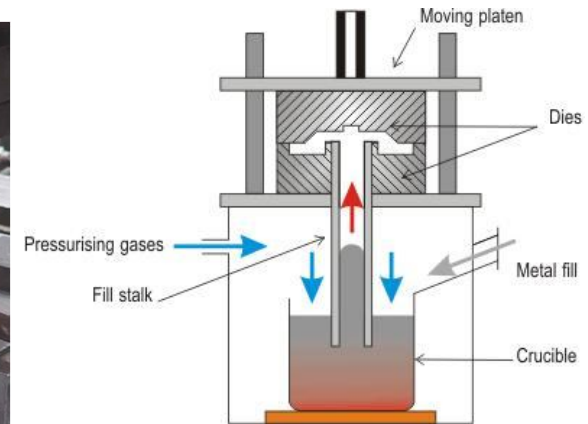


ALUMINUM SMELTING

- In order to get the best mechanical properties, our alloys include titanium and strontium as grain refiner and micro-structure modifiers



CASTING



- Ever since the beginning, Imperium has used the permanent-mold, low-pressure casting process.
- Imperium carefully controls variables like cooling rate and air pressure throughout the casting process.

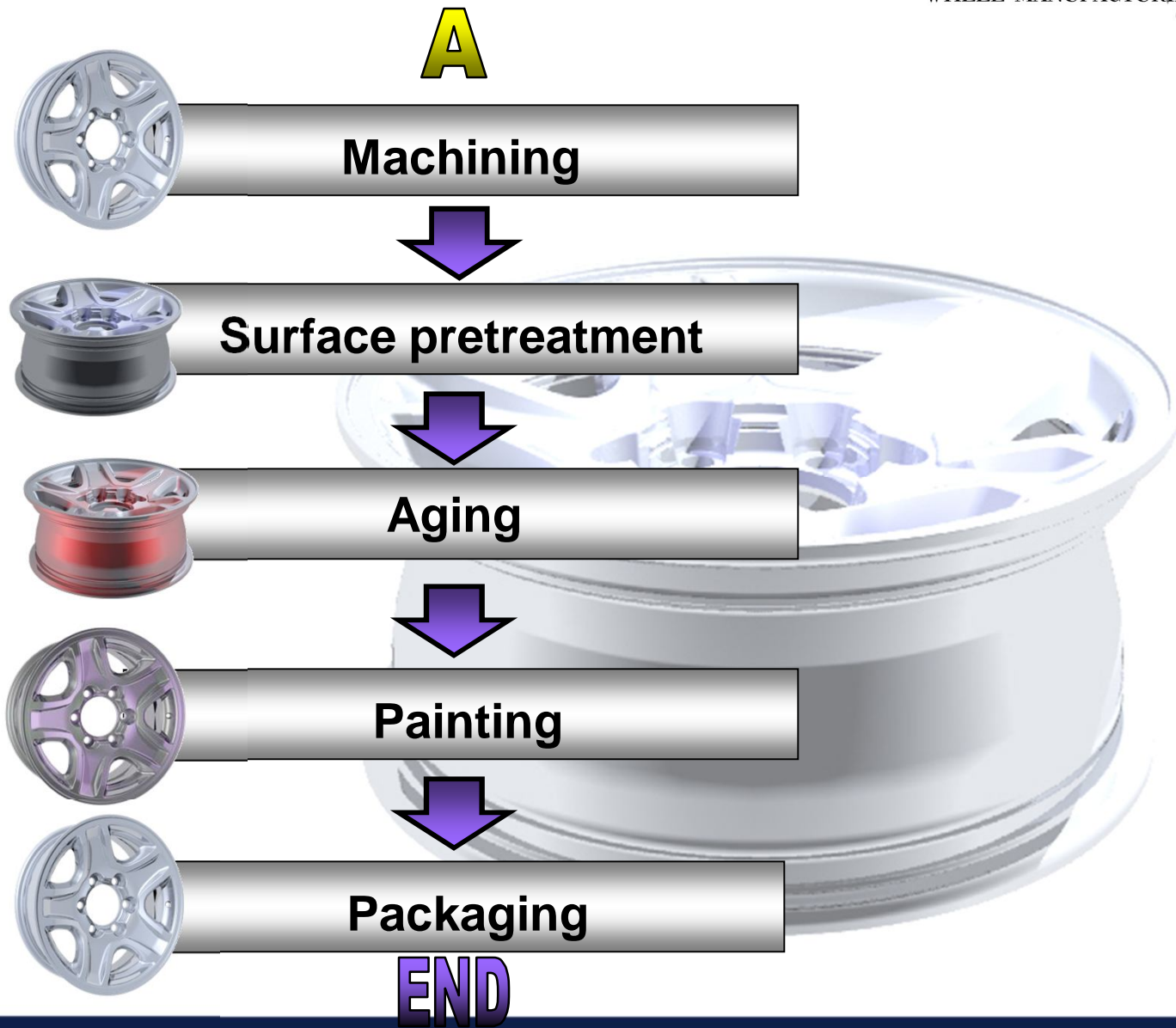


CASTING EVALUATION

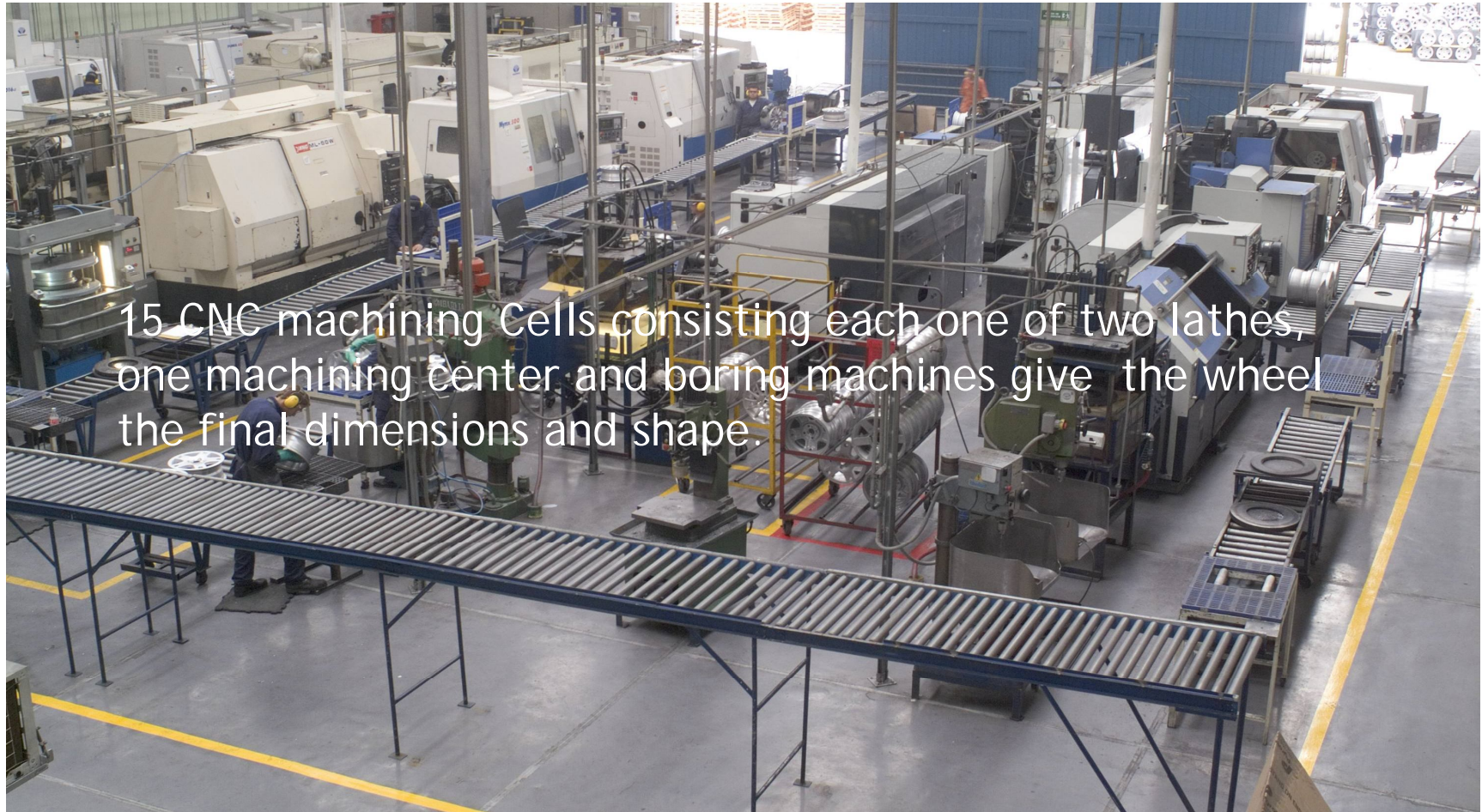


- Two automatic fluoroscopic X-Ray machines are used to test 100% of the wheels.
- This prevents wheels with hidden pores, shrinkage or inclusions to continue in the process.
- Strict standards are met and trained personnel is in charge of this process.

PROCES FLOWCHART (Cont.)



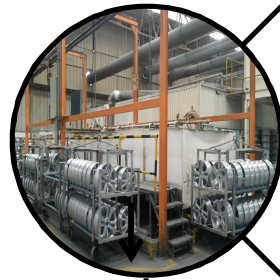
MACHINING



15 CNC machining Cells consisting each one of two lathes, one machining center and boring machines give the wheel the final dimensions and shape.

PAINTING

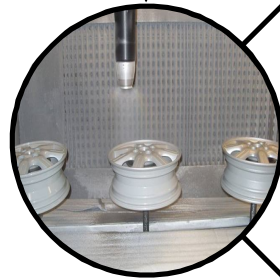
Process Flow Diagram



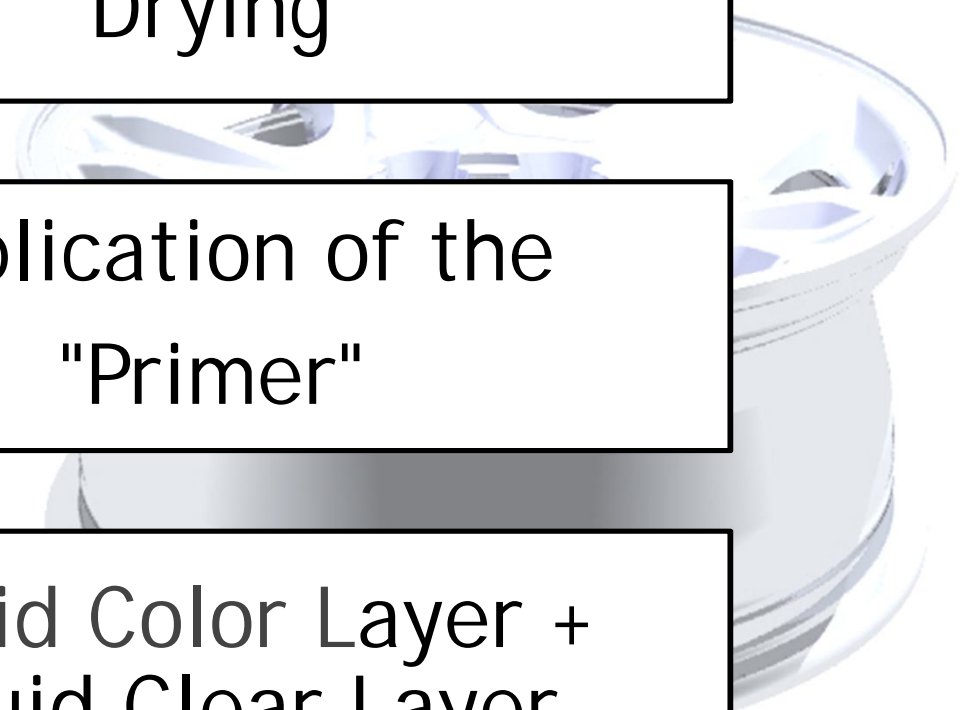
Surface Pretreatment /
Drying



Application of the
"Primer"



Liquid Color Layer +
Liquid Clear Layer



Surface Pretreatment / Drying

System preparation of the aluminum substrate to ensure optimum anchoring of the paint through a process of dipping and drying.

This chemical process begins with a thorough cleaning of the wheel surface (degreasing and rinse tanks), followed by generating a surface profile (conversion tank) and finally drying (through a utilization of residual energy of curing ovens).



ARTIFICIAL AGING

- At present, Imperium primer is capable of withstanding temperatures up to 165°C, which lets us do both the paint curing and the aging process in our paint ovens.



PAINTING



- Electrostatic bell type sprayers for liquid paint
- Color and clear coat
- (Same)

- The paint is made up of three layers:
- Initial powder coating layer
- Liquid color
- Liquid clear coat layer.



- Powder primer
- (IONTECH)
- (Corona System)

ADDITIONAL PROCESSES

GRAVITY CASTING

Currently the process of Gravity Casting is used for the manufacture of pistons for automotive aftermarket.

CASTING



CUTTING



HEAT
TREATMENT



MACHINING



Final product



ENGINEERING FACILITIES



Product development:

- Once the customer requirements are understood, tools like FEA, CATIA, Proengineer, etc are used to minimize the possibility of product failure during initial, tests. Emphasis on light weight and high structural properties are the main goal. Final stages of product development include a high variety of life and quality tests. All tests required by customers are met and tested on our own laboratories.

Tooling development

- The basic tool for manufacturing cast wheels are the molds. These are designed, and tested on our engineering division.- Highly trained personnel are in charge of this operation. Our 20 years experience on this process is a proof of the quality.

ENGINEERING FACILITIES



SOFTWARE

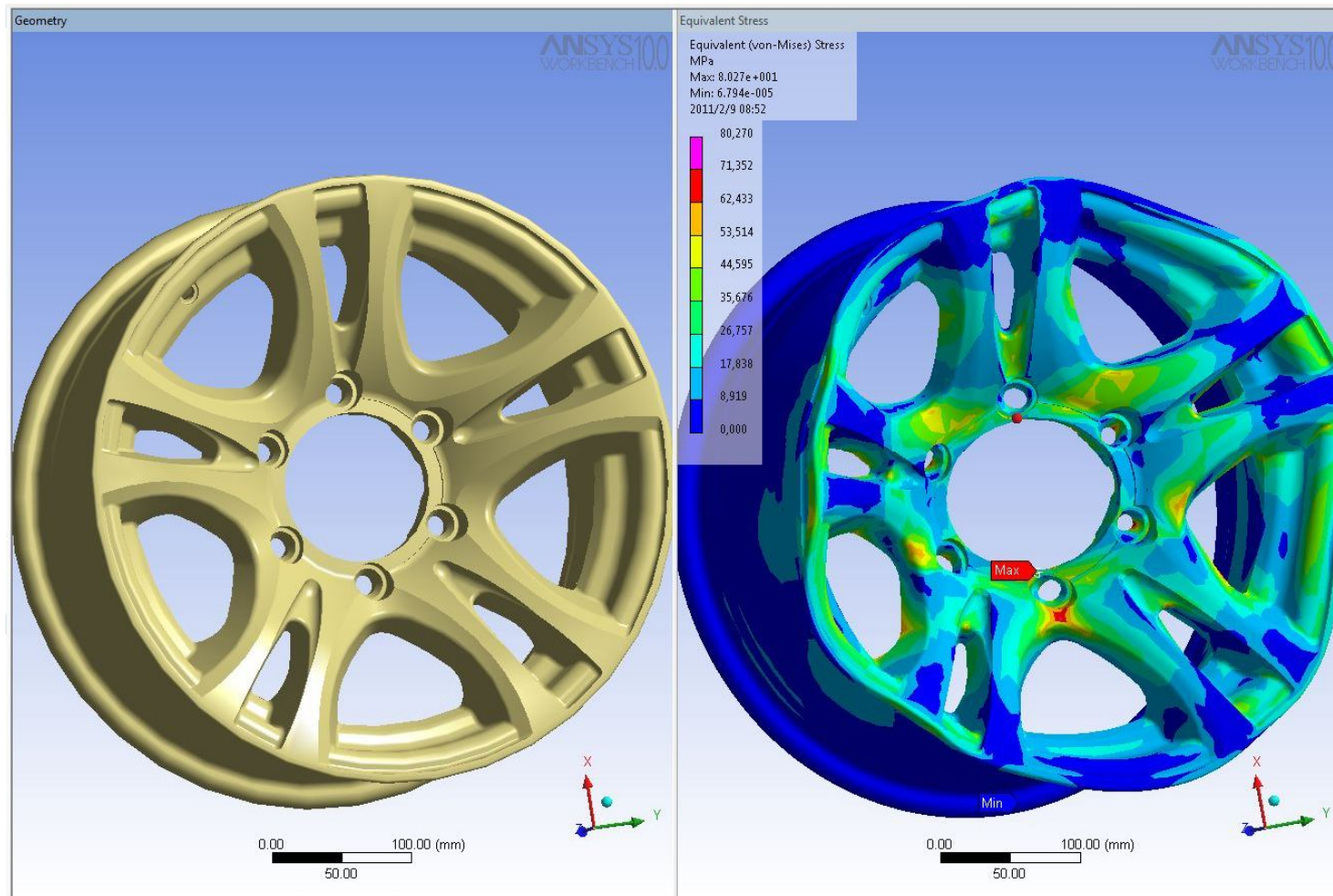
- Proengineer (3D CAD)
- Proengineer (CAM)
- Esprit (CAM)
- ANSYS (FEA)
- Catia (3D CAD)
- Solid cast



Example of designed wheel (3D)



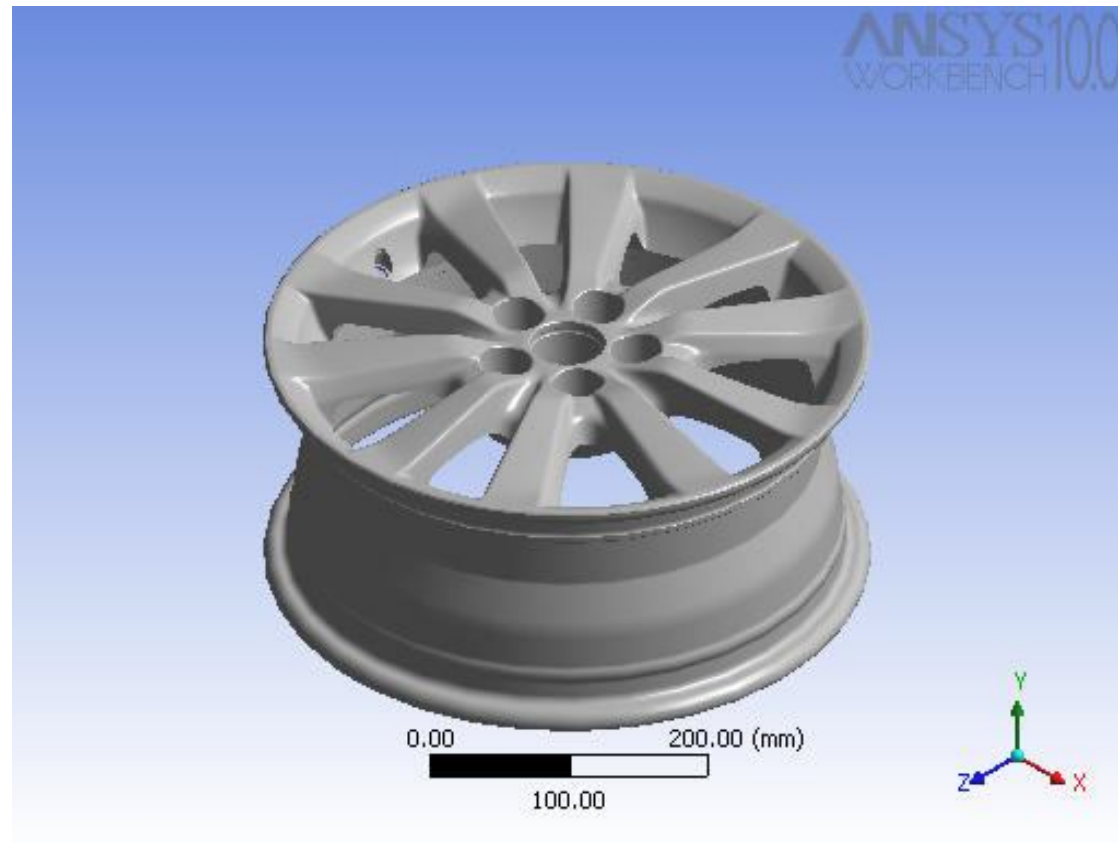
FEA (FINITE ELEMENT ANALYSIS)





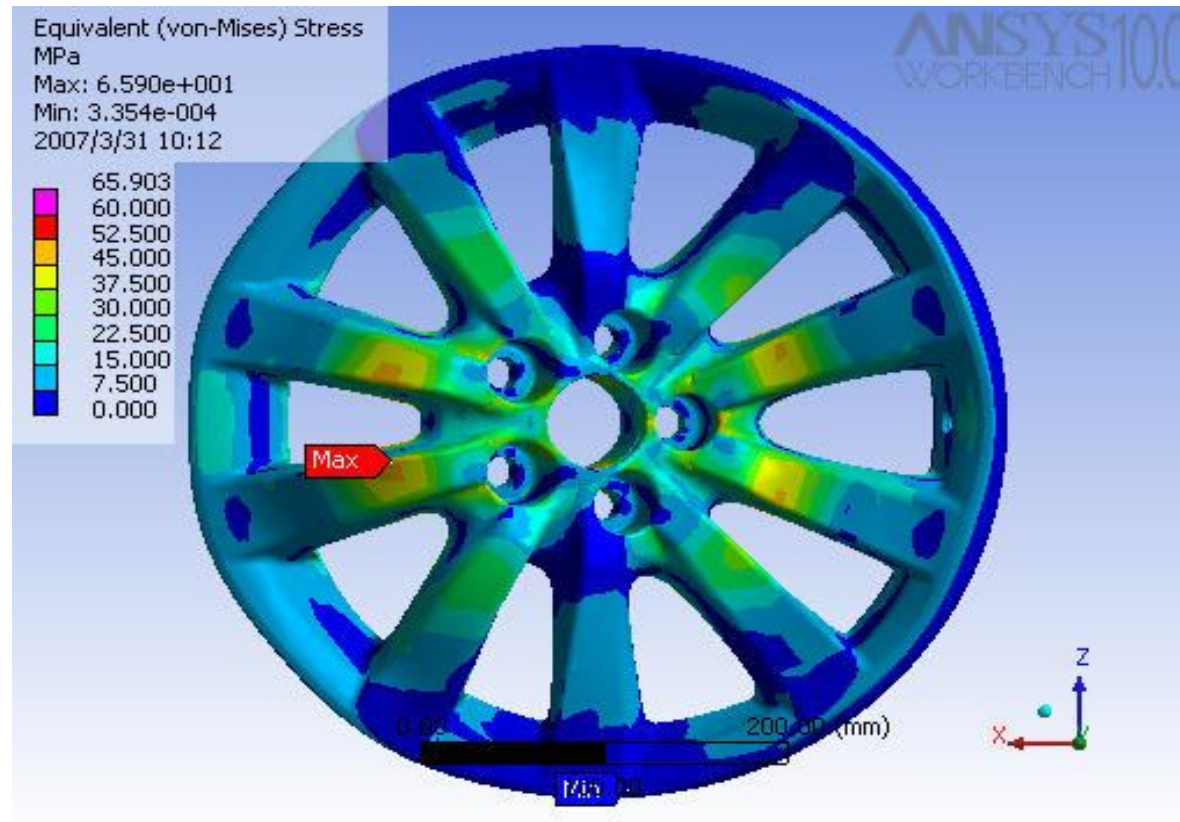
- Example of a designed wheel (3D)

FEA (FINITE ELEMENT ANALYSIS)



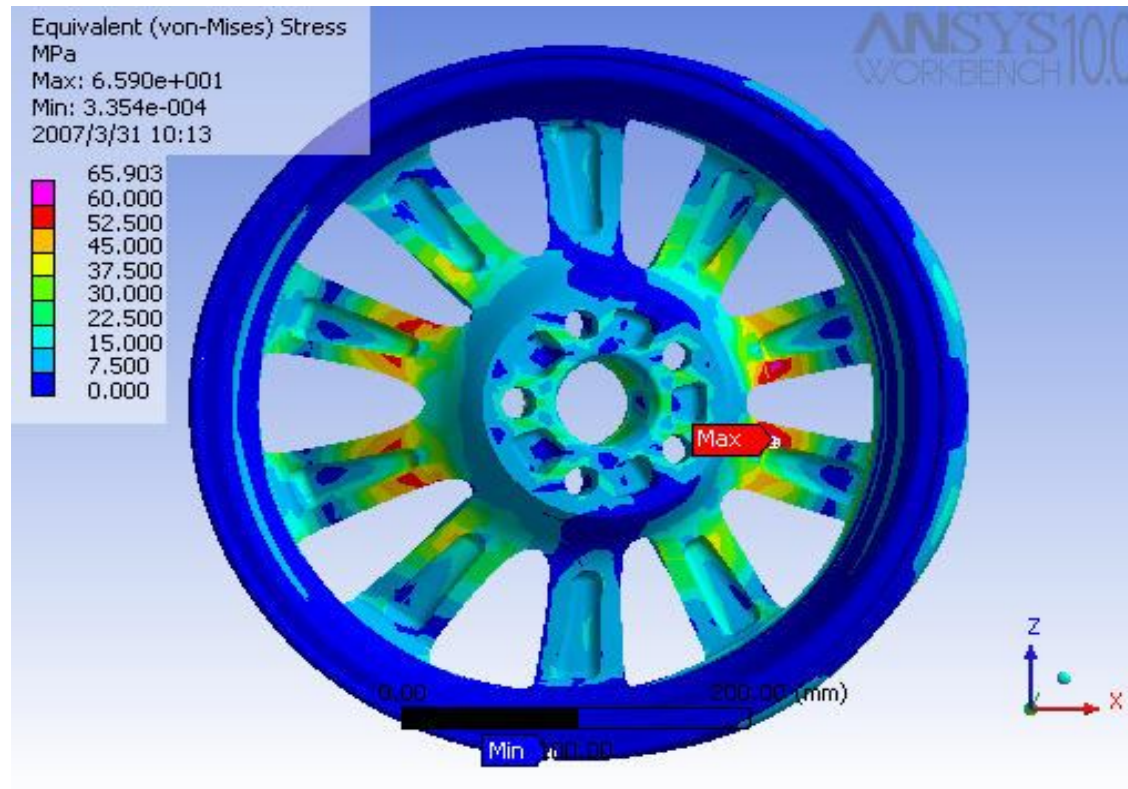
- "Geometry".
- Overall geometry of the wheel and axis location

FEA (FINITE ELEMENT ANALYSIS)



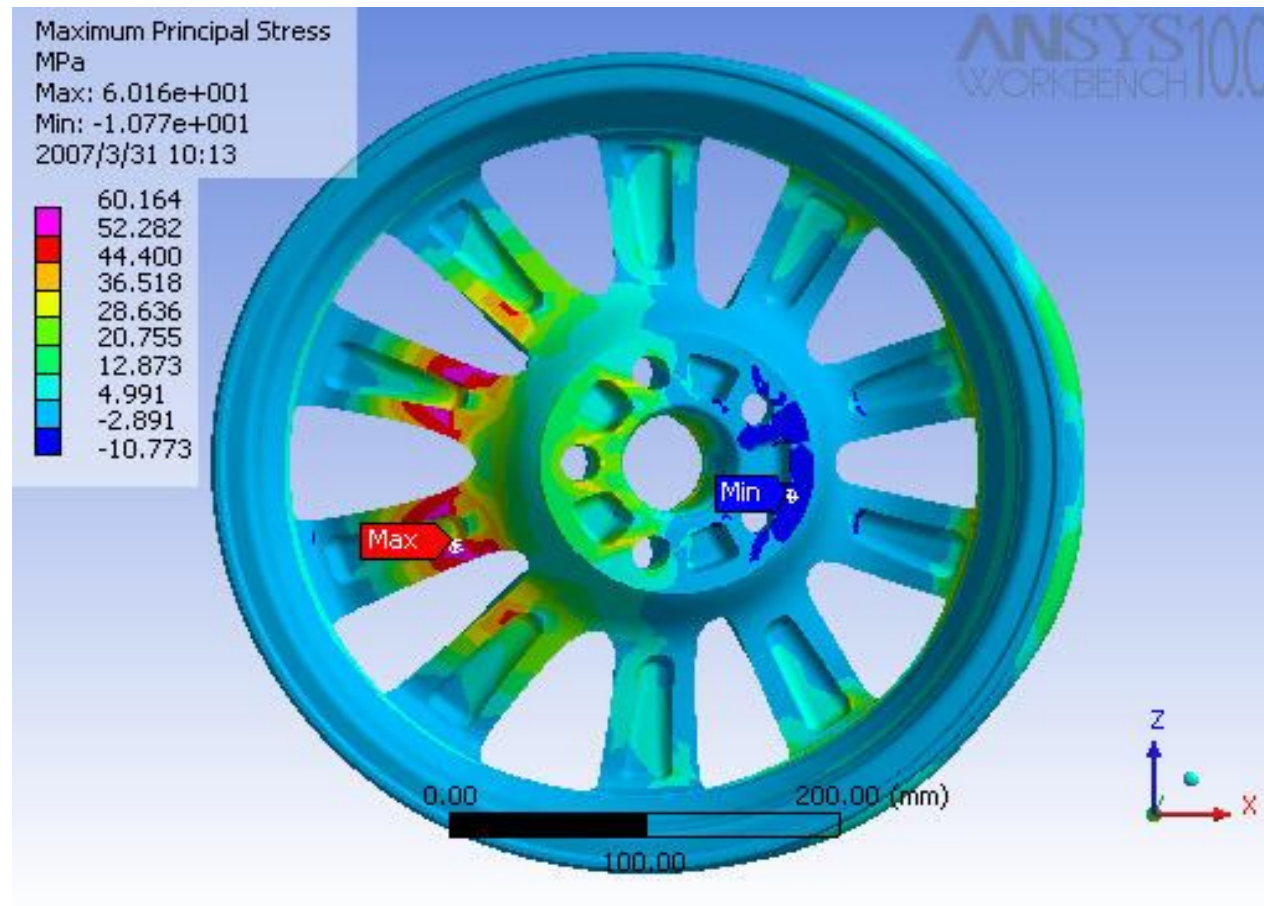
- "Equivalent Stress" Contours (Note that maximum stress is on back face)

FEA (FINITE ELEMENT ANALYSIS)



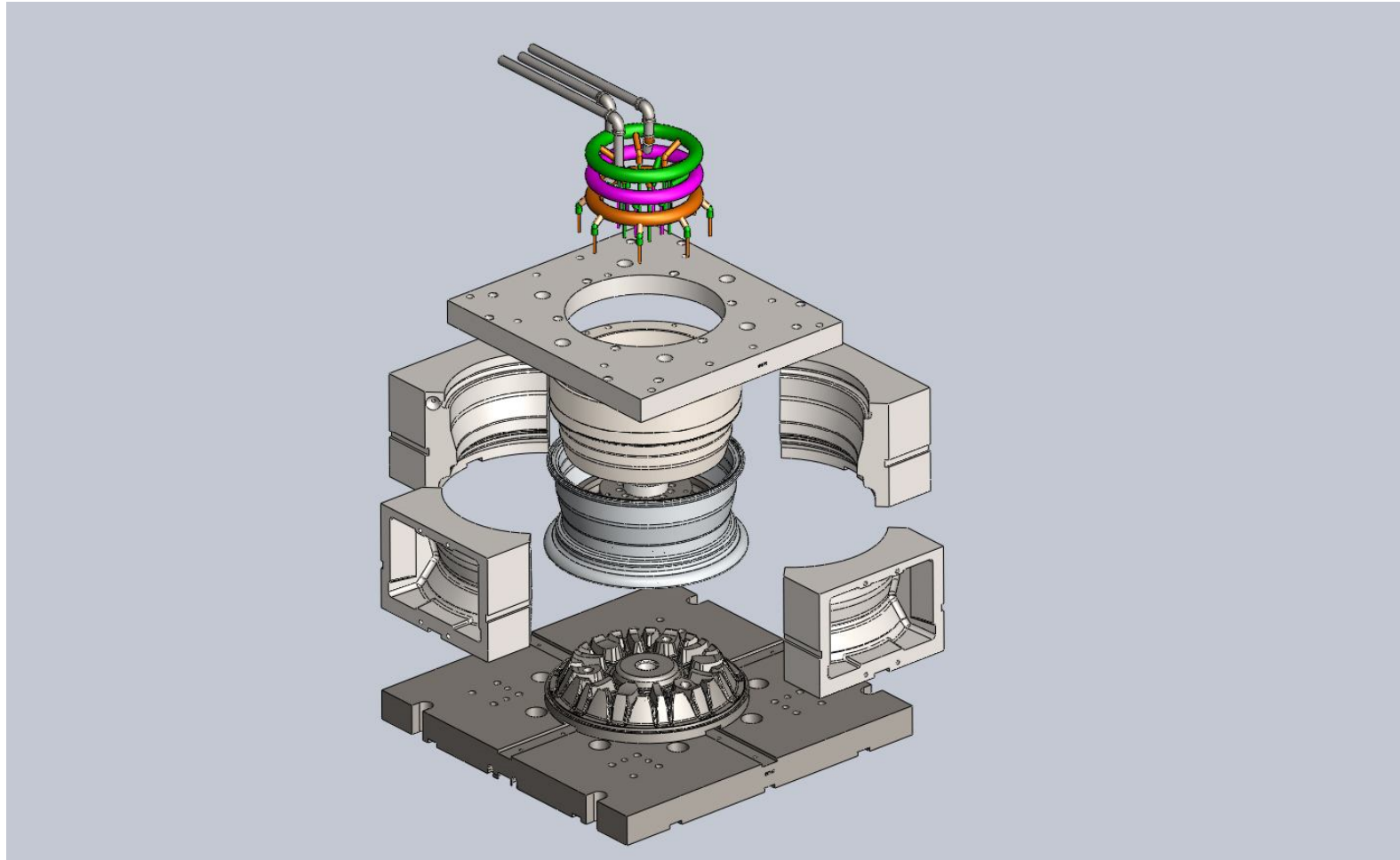
- "Equivalent Stress" Contours (Note different position compared with principal)

FEA (FINITE ELEMENT ANALYSIS)



- "Maximum Principal Stress" Contours

Mold Structure Example



STANDARD TESTS FOR ALUMINUM WHEELS

**List of equipment, standards
and definitions.**

Chemical analysis

- To determine alloy chemical composition and compare it to specification.
- A back up system is available at Imperium
- Capable of reading up to 17 elements
- Standard specifies 11 elements



Material Mechanical properties

- Determine mechanical properties of samples taken from processed wheels
- Universal testing machine capable of reading:
 - Ultimate tensile Strength (UTS)
 - Yield point
 - Elongation
- Brinell hardness tester
 - Read Hb surface hardness



- Brinell hardness tester



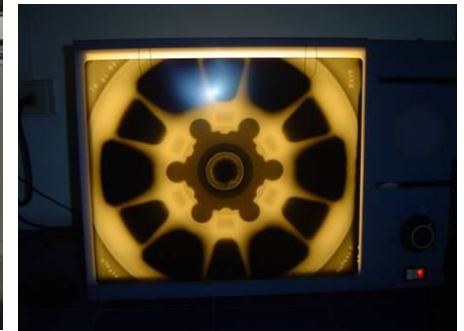
- Tinius Olsen 50 KN testing machine

Micrographic control

- To Check discontinuities in aluminum castings using X-Ray radiographs standards.
- A set of standard radiographs is used to compare the real results.
- Specifications for maximum allowable results is needed



- Rigaku
Radioflex X-
Ray system



- Sample
radiograph
(IMV)

Rotating bending Durability test (life test)



- To apply a rotating bending moment simulating real operating conditions to check for fatigue strength



- Cornering fatigue test machine

Radial Load Durability Test (drum test)



- Rotate the wheel with the tire installed under radial load. Measure fatigue strength



Impact test:

- Drop a weight onto the top surface of the assembled wheel. Measure possible fractures

- Picture shows 30° test.
- For 13° and 90° wheel stand and mass weight are changed



- Impact test stand for 13°



- Impact test apparatus

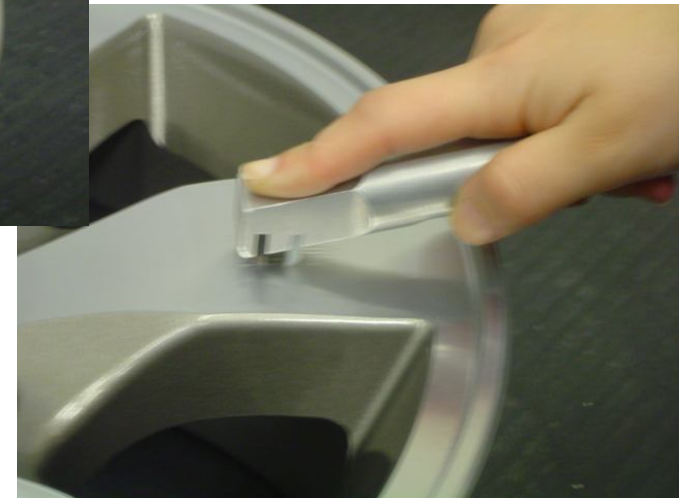
Adhesion test

- To measure the strenght of adhesion of paint to substrates

- Cross cut method
- X method
- Tensile method



- Adhesive tape



- Cutter knife