Case studies

GC of Cast Iron

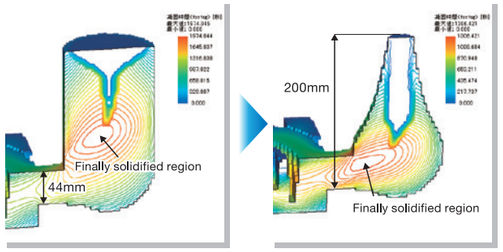
Improve yield rate by changing riser design

Courtesy of Chang Technical Office Co. Ltd.

Riser volume: 1850cm³
Riser weight: 12kg

Riser volume: 980cm³
Riser weight: 6.7kg

Riser size decreased by 44%



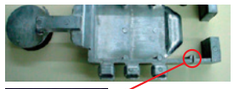
Grade: FCD450, Product weight: 22kg

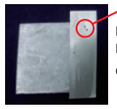
Local solidification time contour and macro-shrinkage (Riser analysis)

HPDC of Al-Alloy

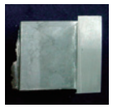
Eliminate gas defects by changing injection conditions

Courtesy of Toshiba Machine Co. Ltd.

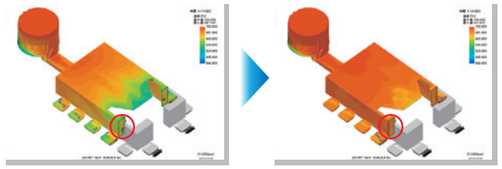




Low speed: 0.3m/s
High speed: 1m/s
Gas defect exits



Low speed: 0.3m/s
High speed: 4m/s
Gas defect free

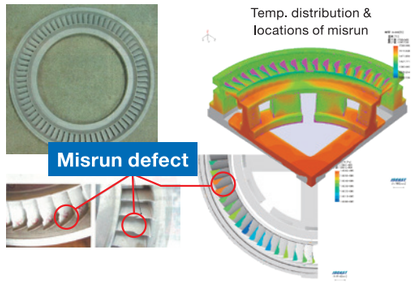


Filling patterns, temperature distribution and backpressure

Large-Sized Investment Casting Product

Observed and predicted locations of misrun/cold shut

Courtesy of Kingparts Co. Ltd.



Pressure of gas in the cavity, [Pa]

System Requirements

O S : 32-bit edition: Windows 10, Windows 8.1, Windows 7
64-bit edition: Windows 10, Windows 8.1, Windows 7 (Recommended)
CPU : Core i5 2.6GHz or higher
(Recommended: Intel Xeon E5-1650v4 or higher)
RAM : 4GB or more (Recommended: 16GB or more)
HDD : 40GB or more (Recommended: 1TB or more)
Resolution : 1024×768 (65,000 colors or more)
Video Card : Must support OpenGL 1.4 or higher
(Recommended: Nvdia Quadro P2000 or higher)
Others : MS-Office2010 or higher
(Create report using MS-Excel)

QUALICA Inc.

<Contact us for further information and service>
3-1-1 Ueno (Inside the Komatsu Osaka Plant)
Hirakata-shi, Osaka, 〒573-1175
TEL:072-898-8791 FAX:072-840-2164
E-mail : jscast@qualica.co.jp

<Head Office>
Sumitomo Real Estate Shinjuku Grand Tower 23F,
Nishi Shinjuku 8-17-1, Shinjuku-ku, Tokyo. 〒160-0023
TEL 03-5937-0740 FAX 03-5937-0802
http://www.qualica.co.jp

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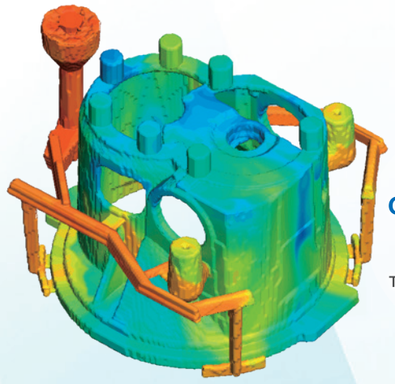
QUALICA
TIS INTEC Group

Ultra-High-Speed Casting Simulation JSCAST



Gravity Casting

Coupled melt and
gas flow (Sand mold)
Temperature distribution

Benefits

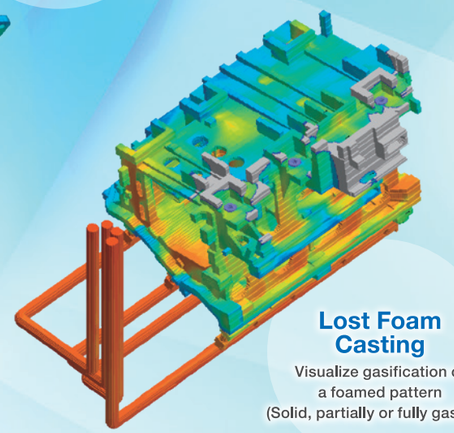
- Decreased scrap rate with less trial and error
- Improved yield rate
- Improved casting design leading to increased proposal power
- Accumulated company-specific casting knowledge
- Superior product quality compared to the competitors
(particularly for complicated & thin walled castings)
- Facilitates global expansion

Gravity Tilt Casting

Coupled melt and
gas flow
(Permanent mold)
Temperature
distribution

Al-Alloy HPDC

Vacuum die casting
Melt through
different ingates



Lost Foam Casting

Visualize gasification of
a foamed pattern
(Solid, partially or fully gasified)

**Compatible with all casting processes and casting alloys.
Assists casting engineers efficiently to investigate casting defects and determine appropriate countermeasures.**

JSCAST is an integrated CAE system specialized for the field of casting. Numerous efforts have been made to make it possible to predict various types of casting defects (such as misrun, shrinkage, gas entrapment) for various casting processes, casting alloys and molding materials.
JSCAST is widely used both in Japan and abroad as it is a powerful tool that can be used for visualizing the invisible mold filling and solidification patterns, optimizing casting designs, training young engineers and creating better proposals for customers.

JSCAST is composed of a basic module and various optional modules (selectable according to the casting process or purpose).

Basic Module (Pre-/post-processors, solvers and property database are included.)

Property database (more than 200 materials)
Casting alloys (cast iron, steel, Al-alloys, etc.), molding materials (permanent mold, green/furan/
artificial sand, etc.), and others (sleeve, chill, etc.)

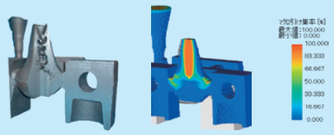
Pre-processor
Import 3D CAD data (STL-format)
Create primitive 3D geometry
Generate mesh (Even or uneven interval)
Feasibility check of injection speeds using P-Q2 diagram

Mold filling & solidification solvers with high precision
Consider filters, sleeves, backpressure, etc.

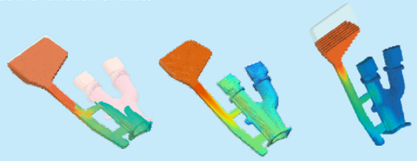
Post-processor
Create movie files of mold filling/solidification (temperature, pressure, velocity vector, melt tracer, etc.)
Use different colors to distinguish melt through different ingates.
Display various types of markers.
Individual filling plot in the case of multiple castings per shot.
Solidification sequence, hot-spot, solidification time, G/sqrt(R).
Post viewer, automatic generation of simulation reports.
Weight calculation (including volume, surface area & modulus of casting).
Solidification modulus (casting product only or including riser and gate system).
Temperature evolution plot (arbitrary element).

Optional Modules

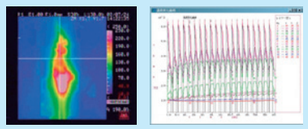
①Riser Analysis & Macro-Shrinkage Prediction
Quantitatively predicts macro-shrinkage with consideration of solidification contraction, mass feeding and liquid level drop in liquid and mushy regions.



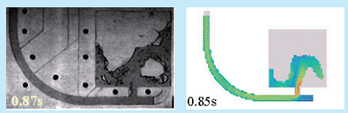
②Gravity Tilt Casting Mold Filling
Simulates mold filling during gravity tilt casting by defining the tilt angle as the function of time.



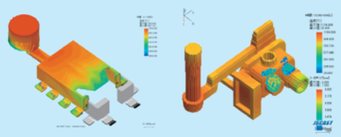
③Cyclic Casting Solidification
Simulates cyclic casting processes in permanent mold casting. Essential for the cooling system design of dies.



④Mixed Mesh Mold Filling & Solidification
One of JSCAST's original developments for increasing the accuracy of geometry approximation. Improves the mesh quality of thin-walls and curved surfaces of the castings, and consequently, simulation accuracy.

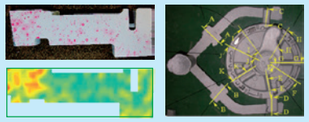


⑤Back-Pressure Permanent/Sand Mold
Considers the effect of backpressure on mold filling for both permanent and sand mold casting processes. Predicts gas defects caused by poor design of gas-evacuation and gating systems.



⑥Porosity (Ductile, Stress method) Solidification
Considers the unique solidification phenomena of ductile cast iron. The maximum principal stress during solidification is used as the prediction criteria for porosity defects.

⑦Porosity Mold Filling & Solidification
Predicts porosities caused by gas entrainments during mold filling. Applicable to various casting alloys.



⑧Casting Deformation
Predicts casting stress, strain and deformation based on output data of solidification simulation.

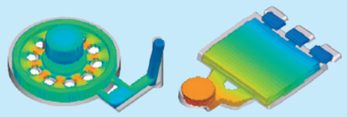
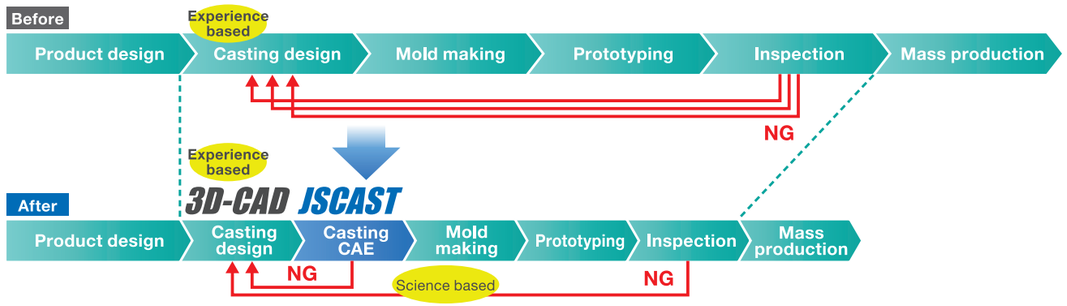


Image of CAE Application - Before and After

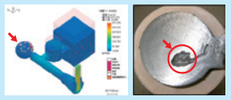


⑨Thermal Deformation I/F
Provides interface with commercial software, [Femap with Nastran], allowing users to export temperature data from JSCAST to NASTRAN for thermal deformation simulation and crack prediction with considering restraint of mold.

⑩HPDC Shot Sleeve Mold Filling
Simulates mold filling in HPDC with consideration of the shot-sleeve, including [Pouring of the shot-sleeve], [Holding before shot], and [Plunger moving].
Entrapment of cold flakes can also be predicted.

⑪Surface Tension Mold Filling
Considers the effects of surface tension and melt-mold wettability on mold filling behavior. This improves the accuracy of simulated free surface morphology and position, especially for thin-walled castings.

⑫Sand & Slag Inclusions Mold-Filling
Allows users to specify the generation conditions of sand and slag particles, and trace particle movement in the melt with consideration of buoyancy and predict particle final positions and adhesions to the mold.



- Particle status
  in melt, adhesion, etc.
- Adhesion mechanism
  Adhesion, stagnation, etc.
- Generation condition
  Pressure, velocity, fill rate, etc.

⑬Thermal Properties Calculation Module
Provides interface with JMatPro, which is originally developed by Sente Software Co. UK, allowing users to predict thermo-physical and mechanical properties of casting alloys simply by inputting their compositions.

⑭Lost Foam Casting Mold Filling & Solidification
Simulates how the foam pattern is replaced by liquid metal during mold filling. Considers the effects of vacuum suction and permeability of sand mold and coating.

System Lineup

	Casting Process					
	Gravity Casting	Gravity Tilt Casting	Lost Foam Casting	Investment Casting	LPDC	HPDC
1. Basic module (Pre-/post-processors, solvers and property database)	✓	✓	✓	✓	✓	✓
2. Optional module	–	–	–	–	–	–
①Riser Analysis and Macro-Shrinkage Prediction	✓	✓	✓	✓	✓	–
②Gravity Tilt Casting [Mold Filling]	–	✓	–	–	–	–
③Cyclic Casting [Solidification]	–	–	–	–	–	✓
④Mixed Mesh [Mold Filling & Solidification]	✓	✓	✓	✓	✓	✓
⑤Back-Pressure [Permanent/Sand Mold]	✓	✓	✓	✓	✓	✓
⑥Porosity [Ductile, Stress method]	✓	✓	✓	–	–	–
⑦Porosity [Mold Filling & Solidification]	✓	✓	✓	✓	✓	✓
⑧Casting Deformation	✓	✓	✓	✓	✓	✓
⑨Thermal Deformation I/F	✓	✓	✓	✓	✓	✓
⑩HPDC Shot Sleeve [Mold Filling]	–	–	–	–	–	✓
⑪Surface Tension [Mold Filling]	✓	✓	✓	✓	✓	✓
⑫Sand & Slag Inclusions [Mold-Filling]	✓	✓	–	–	–	–
⑬Thermal Properties Calculation Module	✓	✓	✓	✓	✓	✓
⑭Lost Foam [Mold Filling & Solidification]	–	–	✓	–	–	–
⑮High-Speed Calculation Module	✓	✓	✓	✓	✓	✓