



The aluminum mold alloy that
out-machines, out-cools,
out-cycles, out-produces
and outsmarts steel.



ALCOA



Aluminum: GAME- CHANGING

IT'S TIME TO THINK DIFFERENTLY ABOUT MOLD MATERIALS FOR PRODUCTION-READY PLASTIC INJECTION MOLDING. IT'S TIME TO THINK ALUMINUM INSTEAD OF STEEL.

As Alcoa's next generation mold alloy, QC-10[®] expands mold design options and brings new performance capabilities to high volume manufacturing. It machines 8-10 times faster than steel, reducing finishing costs and lead times by 20-30%. Plus it conducts heat nearly 5 times faster than P-20 tool steel, shortening production cycle times by 20-40%.

No wonder it's the new mold material of choice.

FOR MOLD MAKERS:

Faster and easier machining

For mold makers, aluminum offers significant benefits over tool steels – benefits that allow them to **expand their design options** and take advantage of its unrivaled thermal and machining properties.

A **lighter** metal, aluminum is easier to cut and faster to machine into molds, translating into faster machining rates, shorter mold production time, and extended tooling life. **Fewer water lines are required for gun drilling,**

reducing machining time. And because heat developed during machining stays largely in the chips, **cutting tools stay sharp and last longer.** Not only that: with one-third the density of steel, aluminum's lighter weight makes it easier and **less expensive to handle and transport.**



QC-10 COMPARISON

Mold Material		Thermal Conductivity (Btu/ft/hr/ft ² /°F)	Density lb/in ³	Hardness	Yield Strength (ksi)	Coefficient of Expansion
QC-10	7xxx Aluminum	92.2	0.103	150-170 HB	66 - 76	13.7
7075 - T651	7xxx Aluminum	75	0.101	150 HB	48-73	13.1
6061 - T651	6xxx Aluminum	96	0.098	95 HB	40-42	13.1
2618 T6	2xxx Aluminum	102	0.101	95 HB	28-30	12.9
P20 Grade Steel	Carbon Steel	20	0.285	28-36 Rc	130-135	7.1
MoldMax HH®	Beryllium Copper	75	0.302	40 Rc	140-145	9.7

15-25%
savings
in tooling,
depending on
mold simplicity*

*www.moldmakingtechnology.com/articles/120801.html

fewer
machine hours
per mold



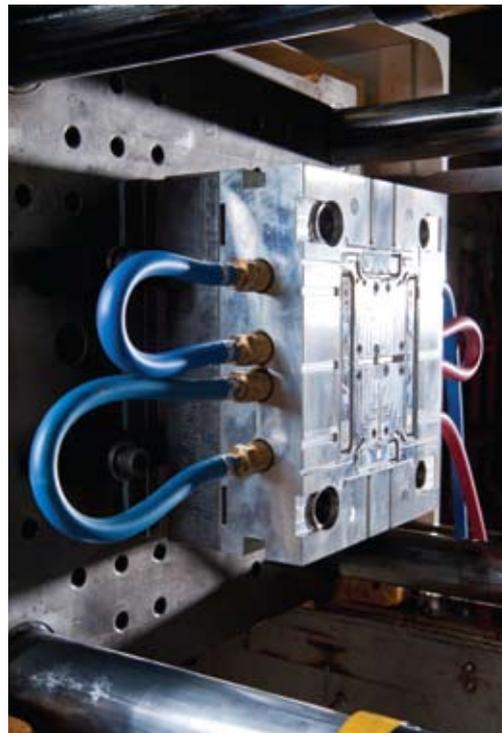
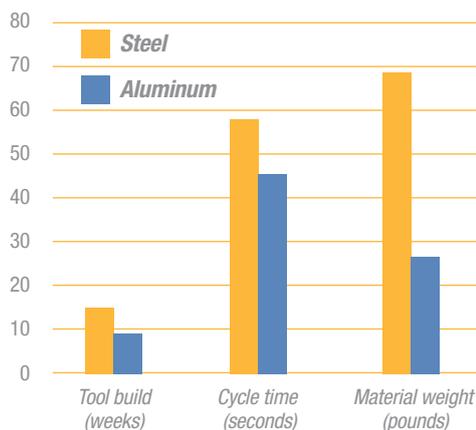
Aluminum: SAVINGS OVER S

FOR MOLD USERS:

Faster cycle times, lower production costs

Aluminum's shorter lead times mean mold users can be **up and running parts** while steel tools are still being built. In addition, mold startup time is shortened since tools come up to temperature so quickly. And because aluminum heats up and cools down faster than steel, molders can **increase parts-per-hour** on existing presses with fewer rejections. Parts are ejected more quickly, with less distortion, warpage, and post-mold shrinkage than parts from a steel mold on a comparable cycle. Better thermal conductivity creates **20-40% faster cycle times** and uses less energy, which lowers production costs. Plus aluminum's ability to manage temperature evenly across the surface of a mold **eliminates hot spots**, resulting in better-formed plastic parts with less residual stress.

Aluminum molds are more efficient than steel molds



Below: This series of six photos illustrates a machining time of 11 minutes from start to rough-cut core features. QC-10 mold alloy is ideal for lights-out machining and boosting process efficiency.



“

Aluminum tooling for mainstream injection molded auto parts is continuing to gather interest, with Ford Motor Company executives urging mold makers and molders alike to learn more about using it.

”

Posted 10-26-09 by plasticsnews.com

LOWER PRODUCTION COSTS

ALUMINUM ACROSS THE SUPPLY CHAIN



FOR OEMs:

Lower piece cost, high piece quality

Aluminum delivers critical advantages for OEMs as well. Spurred by increased globalization, increased demand for worldwide product availability is **shortening already short product life cycles**. Aluminum molds help mold users meet the demanding delivery needs of OEMs. Faster cycle times for mold users mean faster delivery times for end users, leading in turn to **faster manufacturer throughput**.

To keep costs down, OEMs are turning to their suppliers for **greater process efficiencies**. Lower production costs for aluminum mold users are reflected in **lower piece costs** for end users – as well as lower overall manufacturing costs. In addition, the improved quality and consistency of aluminum-molded parts is a definite plus for OEMs.

less
energy
used





QC-10[®]:

MOLD - MAKING

**YOU KNOW THE POSITIVES
OF ALUMINUM AS A MOLD
MATERIAL.**

**NOW KNOW THIS: QC-10 IS
THE BEST OF THE BEST.**

Specifically designed for high production injection and blow mold applications, QC-10 offers greater strength, stability, and durability than any other high-grade aluminum mold alloy on the market today.

Its improved alloy composition provides outstanding, 1"-24" thick section strength and hardness equal to that of rolled plate. While its quench insensitive microstructure allows minimal strength drop-off and unequalled machinability.



Large plastic pallets are easily molded using Alcoa QC-10 mold block.

FOR MOLD MAKERS:

The fastest machining

A high hard type of aluminum mold material, **QC-10 machines 8-10 times faster** than P20 steel for rough milling. In fact with high-speed spindles, rough machining of QC-10 can occur at cutting speeds of 20,000 rpm¹ and feed rates of 0.325 mmpt – significantly faster than the 2,000 rpm and 0.127 feed rates of P20 steel.

These kinds of speeds mean QC-10 production molds can be made in hours or days rather than weeks or months, resulting in **20% faster mold delivery times**. In addition, a cutting force one-third of that required by P20 steel means **cutting tools last longer** machining QC-10.

Specifically designed for production molds, QC-10 balances strength, toughness, and corrosion resistance to provide optimal

hardness and **extended mold life**. In fact, QC-10 molds in use today have achieved **hundreds of thousands of shots**. The superior strength of QC-10 allows mold makers to design molds with **deeper parts**. And its consistent through-thickness hardness is critical for holding a sharp edge along the parting line.

Alcoa's Signature Stress Relief SSR cold-worked technology gives QC-10 consistent **strength in the middle of the block**, differentiating it from other aluminum mold alloys. Fully wrought and heat-treated, it offers greater process efficiency as it requires **no post-machining** heat treatment.

¹"General Guidelines for QC-10 Injection Molds", July 2009

QC-10 MECHANICAL PROPERTIES

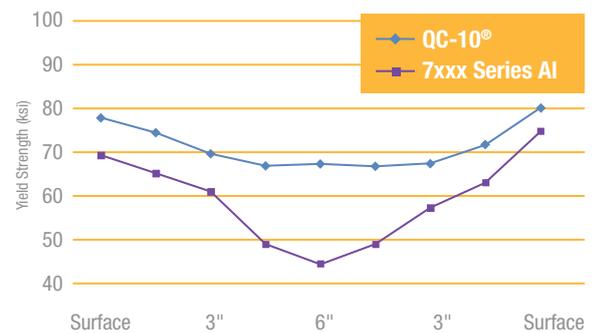
STRENGTH		2-6	8-12	14-18	>20
Inches	Millimeters	50-150	150-300	300-450	>450
Yield	KSI	76	72	68	66
	MPA	525	500	470	455
Ultimate	KSI	82	77	74	72
	MPA	565	530	510	500
Elongation (%)		10	8	6	3

YS, UTS, and elongation values at center (L/T direction)

QC-10 PHYSICAL PROPERTIES

PARAMETER	UNITS	
Thermal conductivity	BTU/°F	92
	W/m-K	160
Coefficient of thermal expansion	10 ⁻⁶ /°F	13.7
	10 ⁻⁶ /°C	24.7
Modulus of elasticity	psi	10.4E x 10 ⁶
	GPA	70
Density	lb/in ³	0.103
	g/cm ³	2.85
Specific heat	Btu/lb-°F	0.210
	J/g-°C	0.844
Hardness at center	Brinell	150 - 170

QC-10 THICKNESS COMPARISON



Faster cycle times use less energy

Can be textured and polished

Industrial housing for irrigation systems



Availability of the widest range of

material sizes for enhanced mold design



Sporting goods

Improved hardness strength

QC-10®: GREATER PRODUCTIVITY

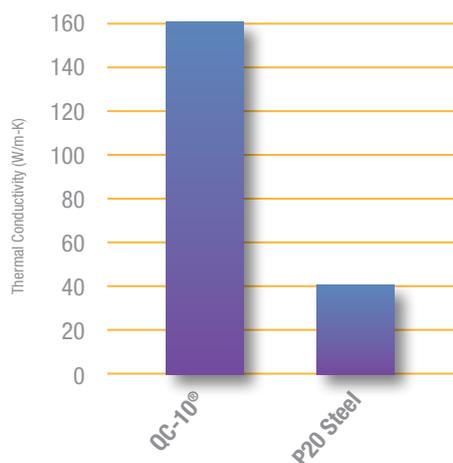
FOR MOLD USERS:

The fastest cycle times

QC-10's **outstanding thermal conductivity** is key to faster cycle times. The aluminum mold block conducts heat **nearly 5 times faster** than P-20 tool steel, reducing molding cycle times by 20-40%. Reduced cycle time increases productivity. Plus because QC-10 molds heat and cools faster than steel molds, plastic flows better and resin is processed more efficiently.

With as much as 75% of the heat dissipating in the mold, **parts cool more quickly**, without the "hot spots" and molded-in stresses common to parts from steel molds. That means QC-10 tools offer the kind of **improved finished part stability** that translates into better all-around quality.

QC-10 THERMAL PROPERTIES



FOR OEMs:

Lower piece-p

By offering **reduced molding cycle times of 20-40%**, QC-10 aluminum tooling has clear cost advantages for original equipment manufacturers. Currently, as much as 50% of the cost of an injection-molded part is cycle time². Cutting cycle time **increases production** and decreases piece-part costs, creating **significant savings** that can be passed onto OEMs.

What's more, the advent of shorter product life cycles, combined with increasing consumer

QC-10 automotive applications include:

- Rear deck trays
- Trunk liners
- Wheel well liners
- Center consoles
- Glove box interiors
- Climate control/HVAC components
- Rocker panels
- Bumpers/bumper components
- Instrument panel end caps
- Cup holders and bins
- Spare tire and underbody covers
- Engine protection covers



turning, milling and drilling operations
are easily performed

ITY THROUGHOUT THE CHANNEL.

part pricing

demand for variety, choice, and customization, have lowered production runs. For example in automotive, the shift towards a wide variety of vehicles with a mix of trim levels has created **shorter production runs**, making QC-10 molds even more feasible. Similarly, automotive's increasing use of polypropylene, thermoplastic polyolefin, and polyethylene materials have also **expanded QC-10's viability** for production injection molding.

² <http://www.plasticstoday.com/imm/articles/moldmakingaluminum-honda-0210>



Decked Out Like Never Before.

Traditionally, injection molds for plastic automotive components have been made of P-20 steel. But with the creation of Alcoa's

QC-10, there's now a better

way. Working

jointly with

an automotive

interior parts

supplier, a rear deck

mold was made from forged

QC-10 aluminum and put into full

production. The results were impressive:

- Mold machining costs were cut and development time was significantly shortened.
- Cycle times were reduced by as much as 25% for faster part production.

As of September of 2010, over 700,000 shots³ on rear deck tray have been produced, proving aluminum molds capable of high-volume production runs.

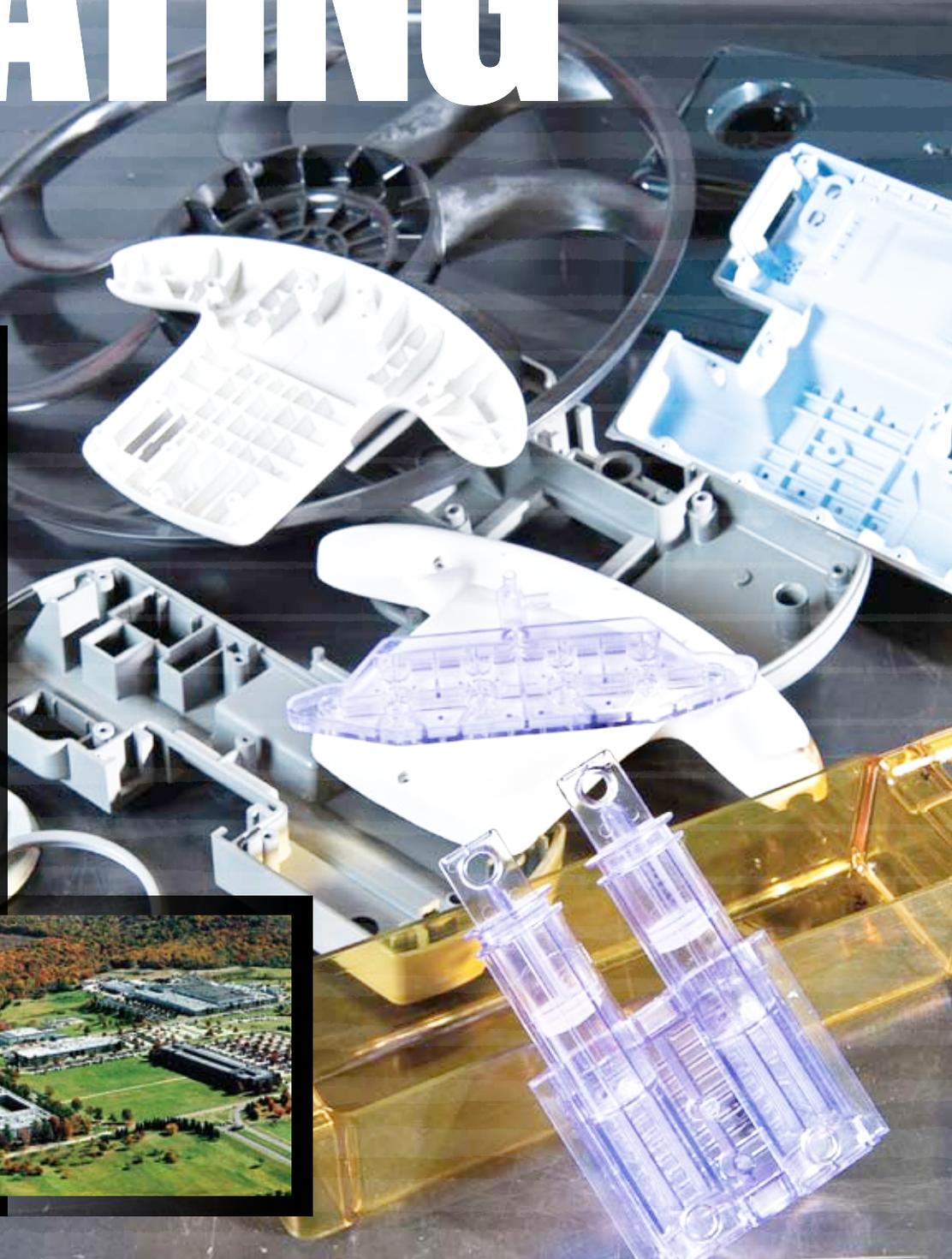
³ "Honda Sets the Stage for Broader Use of Aluminum Molds," www.plasticstoday.com/imm/articles/moldmaking-aluminum-honda-0210



Alcoa: PARTNER- CREATING

Working jointly with mold makers and mold users/OEMs, we use a collaborative design approach to challenge conventional practices and provide innovative solutions that deliver greater value.

By working with our scientists and engineers, as well as the experts at the Alcoa Technical Center – the world's largest and most advanced light metals research and development center with more than 120 Ph.D.s – you can benefit from our in-depth knowledge. In fact, no other company in the world can offer you Alcoa's combination of aluminum engineering expertise and world-class fabrication facilities – facilities that span two continents and include the world's largest forging presses and widest rolling mills.



Looking to the long term.

We are continually investing to make sure our QC-10 manufacturing capabilities can meet the promise of our proprietary advanced alloys, our technical and engineering expertise, and our collaborative design capabilities. Not only that: with plants located in Cleveland, Ohio, and Samara, Russia, Alcoa is uniquely positioned to provide high quality QC-10 in thicknesses up to 24" virtually on demand.



Interested in the
opportunities
presented by
QC-10?

Contact Alcoa at (216) 641-4162
for more information. Or visit:
www.alcoaqc10.com.



About Alcoa Forgings and Extrusions

Alcoa Forgings and Extrusions (AFE) produces QC-10 mold block in thicknesses above 7". The business unit is a part of Alcoa's Engineered Products and Solutions Group, and is the leading global supplier of hard-alloy forged and extruded aluminum products. The world's number one producer of aerospace and defense forgings and extrusions, AFE also provides innovative solutions for the industrial, transportation, and oil & gas markets.

North American Rolled Products

Manufacturing QC-10 in thicknesses up to 6", Alcoa North American Rolled Products produces the widest variety of aluminum plate and sheet in the world. They are a leading value-added supplier to the aerospace, automotive, commercial transportation, building and construction, industrial, and packaging markets.

Alcoa Forgings and Extrusions
1600 Harvard Avenue
Cleveland, OH 44105-3092
Phone: (216) 641-3600
www.alcoa.com

