



Plastic Injection Molds: DYNA-BLUE® Ferritic Nitrocarburizing

“Increasing Tool Life is dependent upon choosing the best surface treatment for your tooling. DYNA-BLUE & DYNA-BRITE are low temperature surface treatments that are proven to prevent wear, abrasion, and corrosion, while increasing release properties to dramatically improve Tool Life and they are VERY COST EFFECTIVE”

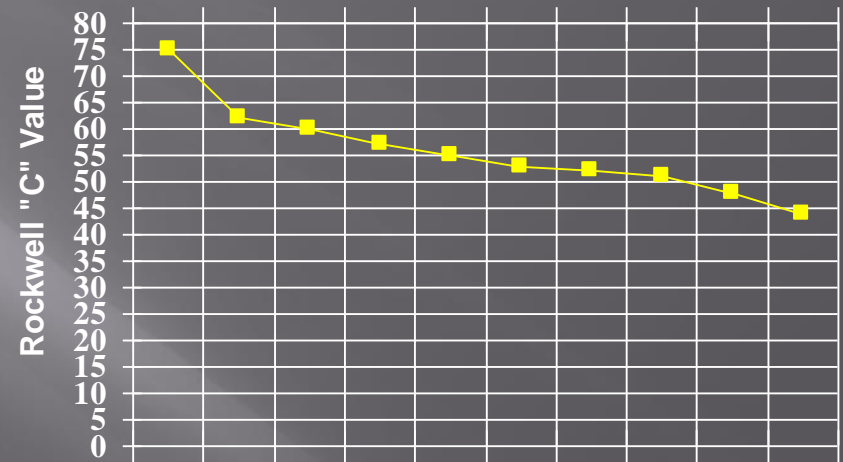
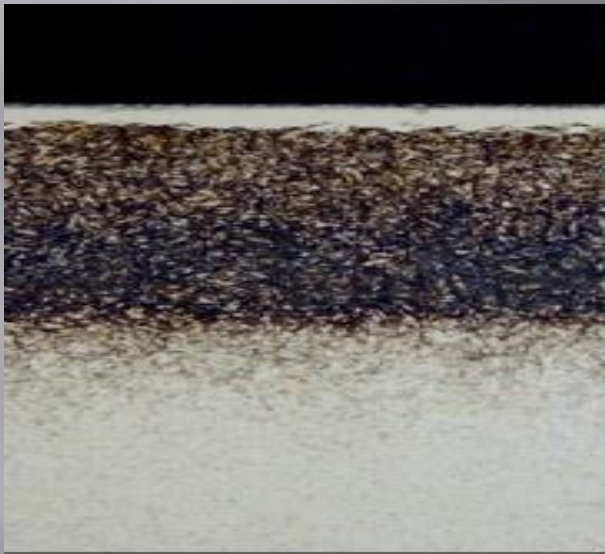


What is DYNA-BLUE®?

DYNA-BLUE is a low temperature, (typically 950° – 1060 ° F), thermal-chemical diffusion process that yields two metallurgical characteristics:

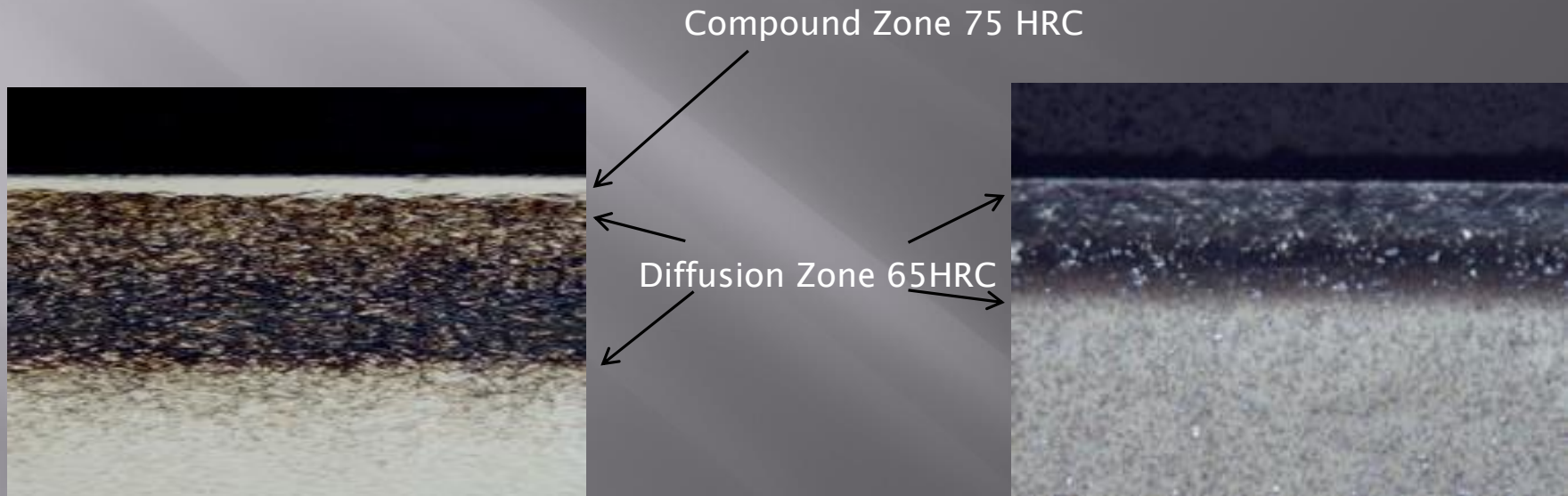
- 1) Epsilon Iron Carbonitride Compound layer that is composed of Nitrogen & Carbon and has a hardness of up to 75HRC. The layer can be produced from .0001” – .002”. Exact case depth is engineered for each application.
- 2) A nitrogen enriched diffusion zone 60+ HRC that supports the compound zone. This layer can be produced from .001” to greater than .015”. Exact case depth is engineered for each application.
- 3) A blue/black oxide layer that resists corrosion and will further enhance release properties.

Microstructure and Microhardness Graph



The picture on the left shows an .0008" Iron Carbo-nitride compound (white) layer supported by a nitrogen rich (dark) diffusion zone which increases yield & fatigue strength up to 4 times. The graph on the right exhibits a typical microhardness traverse on H-13 with DYNA-BLUE 5D cycle. The first value is 75 at .0005" with each descending value equal to .001".

Microstructure of DYNA-BLUE® vs Nitride



DYNA-BLUE on H-13 Steel

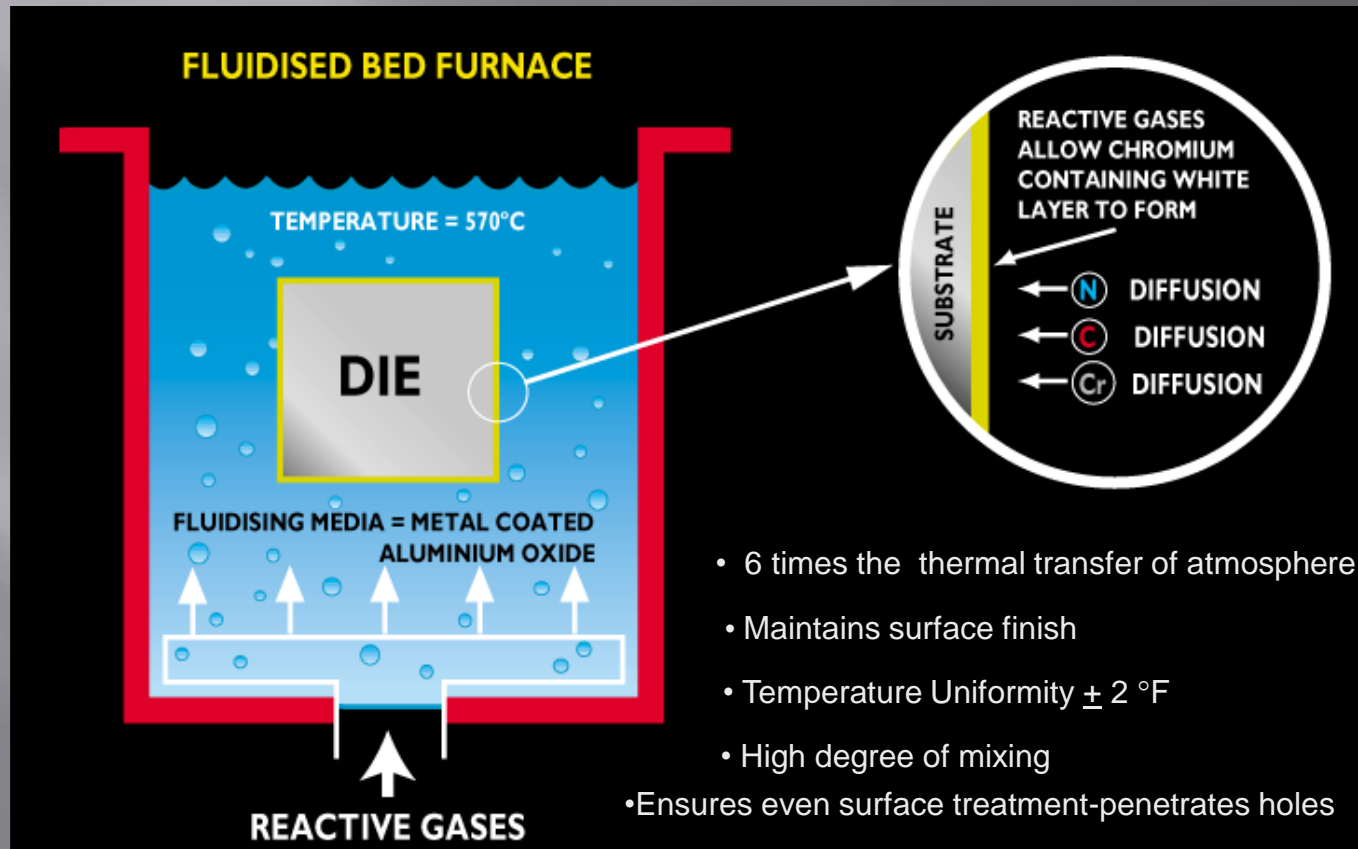
Nitriding on H-13 Steel

The DYNA-BLUE process provides a hard wear/corrosion resistant 75+ HRC compound layer that nitriding does not, supported by a nitrogen rich diffusion zone (just like Ion/Gas Nitriding). The hard compound zone increases wear resistance up to 10 times longer than Nitriding.

Fluidized Bed Furnaces

Fluidization is the term applied when making aluminum oxide or sand particles react like a liquid in a heat treating furnace. Process gases are introduced to the furnace through a diffusion plate, located in the bottom of the furnace. The gases are pressurized thus lifting and moving the sand, scrubbing the part with fresh reactive gases and provides uniform heating $\pm 2^{\circ}\text{F}$, thereby ensuring consistent metallurgical properties with 6 times the thermal transfer of atmosphere. The process is not inhibited by part geometry or blind holes and maintains finish.

FNC & Duplex Surface Treatments



Benefits of DYNA-BLUE ®

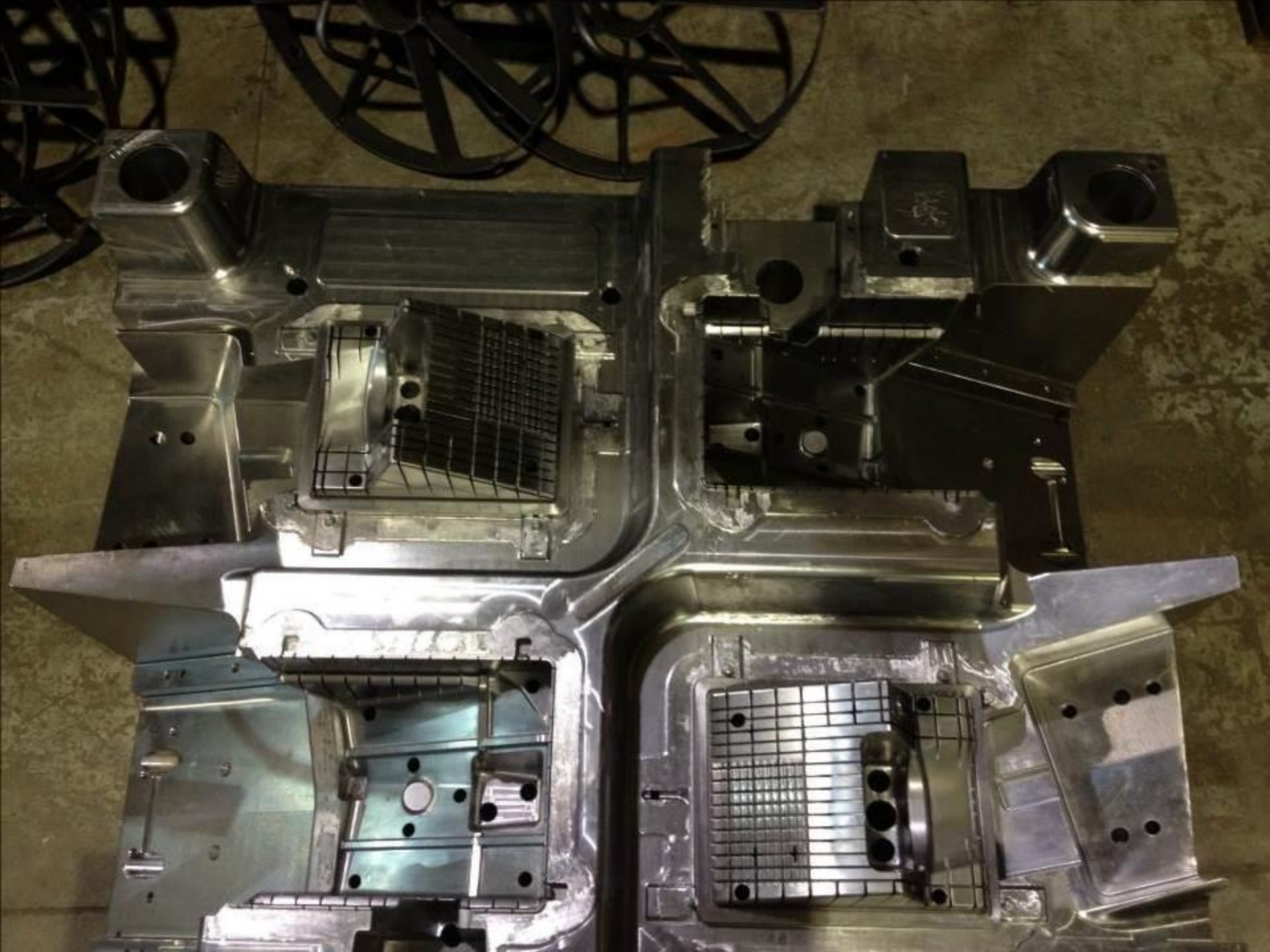
- 1- Resists wear from glass filled plastic 2-10 times longer than nitriding/chrome plating.
- 2- Corrosion resistance: resists attack from PVC, Acetic Acid, Citric Acid, Salt water
- 3- Increased release properties & lubricity-reduces coefficient of friction
- 4- Reduces parting line erosion from glass filled plastics
- 5- No flaking since the process is a diffusion process and not a coating.
- 6- Capacity 75"x120" - up to 30,000 lbs.
- 7- Growth of .0001"- .0002" per side.
- 8- Will not soften even at elevated temperatures.
- 9- High surface hardness, Hrc 75+ no brittleness
- 10- Enhanced die repair and weldability
- 11- Anti-galling & anti-sticking properties.
- 12-Overnight service available

Fan Blades



Glass Encapsulation Mold

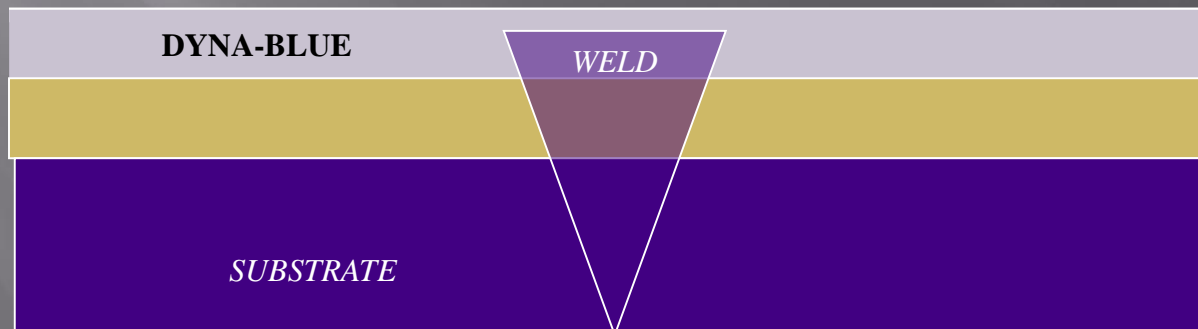






Welding DYNA-BLUE

Engineering changes are no problem as a DYNA-BLUED surface can be welded with no pin hole porosity which is inherent with Ion/gas Nitriding and does not need to be striped. See “Recommendations for Welding DYNA-BLUE” Also re-DYNA-BLUEING is no problem as DYNA-BLUE will add hardness back into heat effected zone (softened area) of weld. DYNA-BLUE will homogenize the surface.





7784 Ronda Drive
Canton, MI 48187
Phone: 734-459-8022
Fax: 734-459-7863

Recommendations for Welding DYNA-BLUE®

I. Die Preparation

We recommend that the die/mold be cleaned of all residuals (plastics, aluminum, etc) and oxides before welding. A successful method we have used is:

1. Hydrochloric acid pickle (less than 40% HCL) or
2. Glass bead with 100% coverage at low pressure to maintain micro finish.
3. Bevel cut the area to be filled 90 degrees.

II. Welding Procedure

1. Preheat the die to minimum of 950°F. Use weld rod identical to the base material, such as H-13, P-20, etc.
2. Use proper rod and gap angle (rod angle 10-15°, arc gap angle equal to diameter of weld rod.)
3. For MIG welding use appropriate wire material (see #1 above) and the heaviest inert gas possible. For multiple pass welding start at the root of the bevel and make multiple passes, from left to right then the middle until the bevel is slightly overfilled.

III. Machine welded area

1. Machine /bench welded area to desired finish. If porosity is present there is a high probability that the shielding gas was disrupted. Die penetrant, magnetic particle inspection or acid etching can be used to verify integrity of the weld.

IV. Stress Relieve

Stress relieve at a temperature of 50°F less than the original tempering temperature or at a minimum of 1000°F for DYNA-BLUE 5A and 1100°F for DYNA-BLUE 3A. Hold for 1 hour per inch of thickness.

Loren J. Epler
President
lepler@dynablue.com

DYNA-BRITE

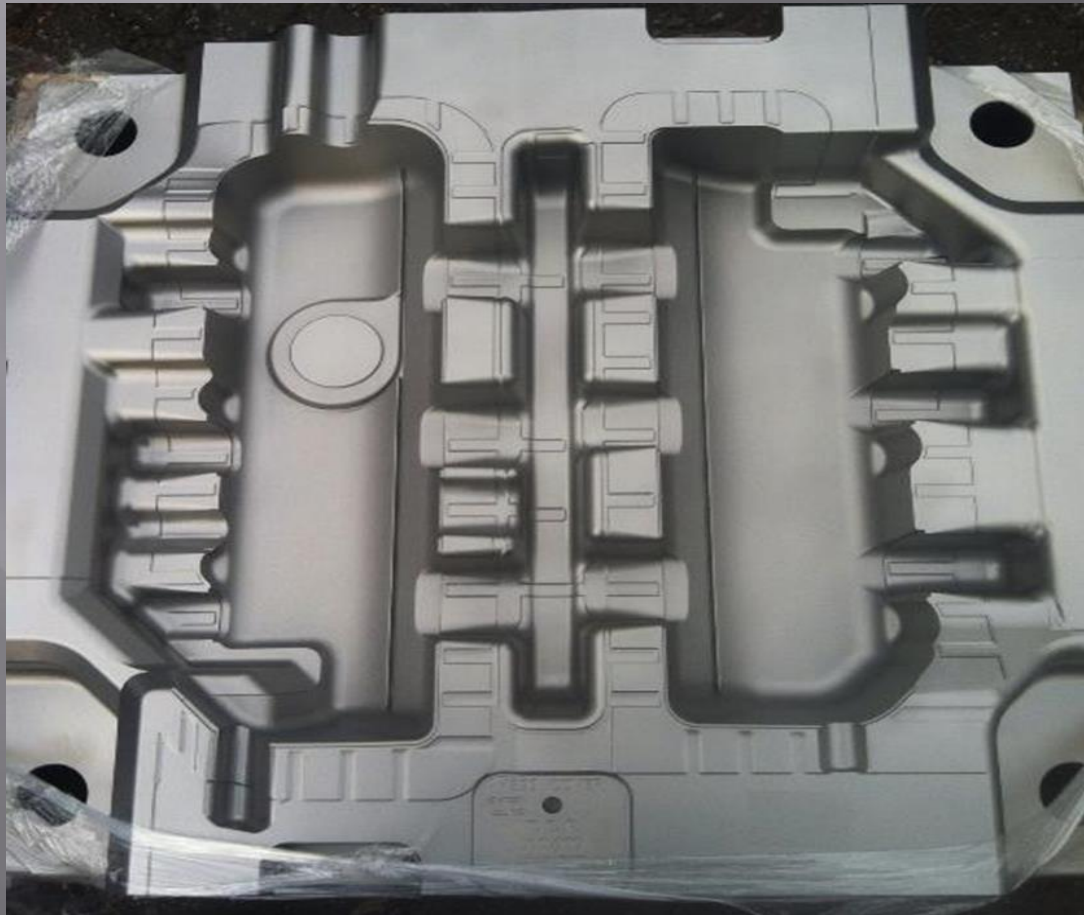
DYNA-BRITE is a proprietary new process to minimize or eliminate polishing time after DYNA-BLUE on Lens/Lighting Molds and Class “A” Finishes. DYNA-BRITE is a DYNA-BLUE® process with a nitrogen cooling cycle to reduce the oxide layer.





DYNA-GLOSS

DYNA-GLOSS is a proprietary new process developed for textured molds to maintain/restore gloss levels after DYNA-BLUE by eliminating the oxide layer.



Jeep Engine Cover



Comparison of Coatings & Surface Treatments

	DYNA-BLUE	Nitride	Chrome Plating	Electroless Nickel
Compound Zone	.0003"-.0008"	0	0	0
Thickness	Diffusion zone .003"-.010"	Diffusion zone .003"-.010"	Coating .0002-.001"	Coating .0002"-.002"
Hardness	75+ HRC	60-65 HRC	60-65 HRC	50-60 HRC
Brittle Edges	No	Yes	Dulls edges	Dulls edges
Welding, repairing, design change	No problem no stripping	Problems with pin hole porosity	Needs to be stripped	Needs to be stripped
Size change	.0001"- .0002"/side	Depends on depth	Depends on coating thickness	Depends on Coating Thickness
Penetration of holes/ribs	Yes	Only penetrates width of hole	Uneven Penetration	Uneven Penetration
Resistance to spalling, peeling	Excellent as it diffuses into steel	Can be brittle if applied too deep	Poor-coating can peel/spall	Poor-coating can peel/spall
Maintains high finish	Yes, ask for DYNA-BRITE	Not usually	Depends on coater	Depends on coater
Dimensionally Stable	Yes	Depends on furnace	?	?
Turnaround time	1-2 days	2-5 days typical	?	?
Tool Life	2-5 times increase over Nitride, Chrome, Nickel	Less than DYNA-BLUE	Less than DYNA-BLUE	Less than DYNA-BLUE

Testimonial

LDM Technologies, Port Huron, Michigan has identified DynaBlue as “*Best Practice*” for the following reasons:

- 1- Reduced monthly tooling budget from \$70,000 to \$6,000
- 2- Eliminated deburring knives throughout the plant and also safety related issues.
- 3- Part component PPM from 36+ to single digit.
- 4- Ran one die using polypropylene with 30% glass, 2,000,000 plus cycles. Customer wanted to make an engineering change and was willing to pay \$360,000 for new tooling A new die was not required.

LDM saved Ford \$360,000.00

Overview of Coatings & Surface Treatments

DYNA-BLUE, DYNA-GLOSS & DYNA-BRITE are low temperature (no distortion) diffusion processes that increase resistance to wear (harder than Chrome, Nickel or Nitride) , abrasion and corrosion, while increasing release properties and reducing friction with no brittleness or flaking (like Chrome or Nickel Coatings), penetrates holes, pockets, & bores (which Ion/Gas Nitriding does not) and is weldable. Most important is that they are “COST EFFECTIVE”.



Injection Mold Customers

▣ Ford, GM Chrysler, Honda, Magna, : IAC, HP Pelzer, US Farathane, Johnson Controls-Intertek(JCIM Division),Novo Motor Acoustics, Royal Technologies Corp, SMR Automotive, Inalfa Sunroofs, Webasto Sunroofs, Summit Polymers, Summit Plastic Molding, Kuka Auto, Comau ,Denso, Michigan Rubber, Buckhorn Rubber-Zhongding USA,TAC (tokai Riku),Cooper Standard, Sudan Plastics, Behr, Valeo, Musashi Auto, Takata Auto, Il Stanley, Jay Industries, Incoe, TI Auto, Inteva, Whirlpool, Thyssen Krupp, Net Shape Corp, Gemini Group, Gibbs Technologies, Nu Step, Roush Automotive, DME, ABB Inc. Hutchinson Automotive, Henniges Automotive, Draxlmaier Automotive

Questions

1. Compare a tool built using a “soft” P-20 steel (28-32 Rc) and one of your treatments, with the same tool built in solid using a harder steel (such as H-13 steel hardened to 50 Rc). DYNA-BLUE at 75HRC will outlast hardened H-13 at 50HRC 3-10 times.
2. What happens to the treatment over time? Eventually the hard DYNA-BLUE layer will start to wear off but can be re-DYNA-BLUED to bring back to same case depth.
3. Describe the process required if the tool requires an engineering change. Can the treatment be welded through? Does it have to be stripped (if so how)? Can it be re-applied locally? DYNA-BLUE can be ground with carbide cutters and can be easily welded. DYNA-BLUE can be reapplied without stripping and will provide a uniform layer.
4. What experience do you have with this treatment on a class-A surface, possibly textured or polished? Class A surfaces or polished surfaces should have DYNA-BRITE and textured surfaces should have DYNA-GLOSS to maintain finishes or gloss levels.
5. Are there size, weight, or geometry limitations to the process? Capacity is 30,000 lbs. or 75”x 120”
6. Where can this treatment be applied or serviced globally? Currently the only location for DYNA-BLUE is in Canton, Michigan but we are offering licenses to do the DYNA-BLUE process