



DYNA-BLUE® & DYNA-BLUE PLUS: The Ultimate Protection against wear, erosion, heat checking & soldering for Die Cast Dies

by Loren Epler– President of Dynamic Surface Technologies

New technology has lead to an advancement in Surface Treating to increase the Tool Life of Diecasting Dies for Structural Diecasting components as well as conventional Aluminum Alloys. The metallurgy and terminology as to how these new Ferritic Nitrocarburizing processes have increased resistance to wear, corrosion, erosion, heat checking and soldering will be explored.

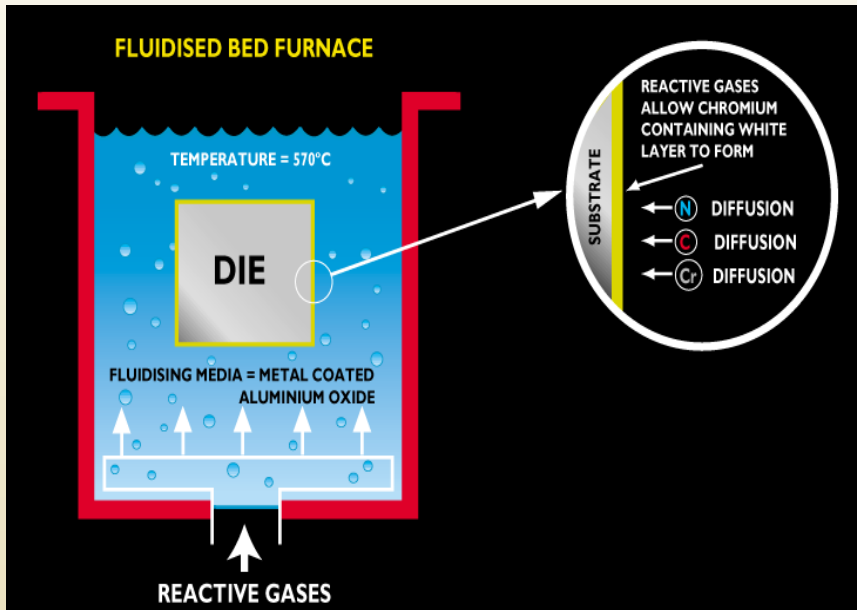
Structural Die Casting

Die Casting structural components such as Cross Members, Sub Frames, Shock Towers, and A& B Pillars, requires the use Aluminum Alloys such as Silifont™ 36 , Aural™ 2 or Mercalloy™ to obtain higher mechanical properties than conventional Aluminum Alloys. However these grades of Aluminum have proven to significantly reduce tool life due to an acceleration of heat checking, soldering, erosion and breakout or chunking of the die surface. The Tool Steel by itself cannot withstand the attack from these alloys, so testing was initiated to find a Surface Treatment that would improve the properties required for better Tool Life. The standard DYNA-BLUE 6B process was tried on 2 sets of H-13 Dies with an improvement of 2-3 times. By refining the process and developing a deeper compound zone supported by a nitrogen rich diffusion zone the new process called DYNA-BLUE 8D has increased tool life by 8 times or more. The newest process called DYNA-BLUE PLUS is also being tested.

Fluidized Bed Furnaces

Fluidization is the term applied when making aluminum oxide or sand particles react similar to a liquid with excellent temperature uniformity and fast heating. Process gases are introduced to the furnace through a diffusion plate, located in the bottom of the furnace. The gases are pressurized and make the particles move around and continually scrub 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.

DYNA-BLUE Surface Treatments

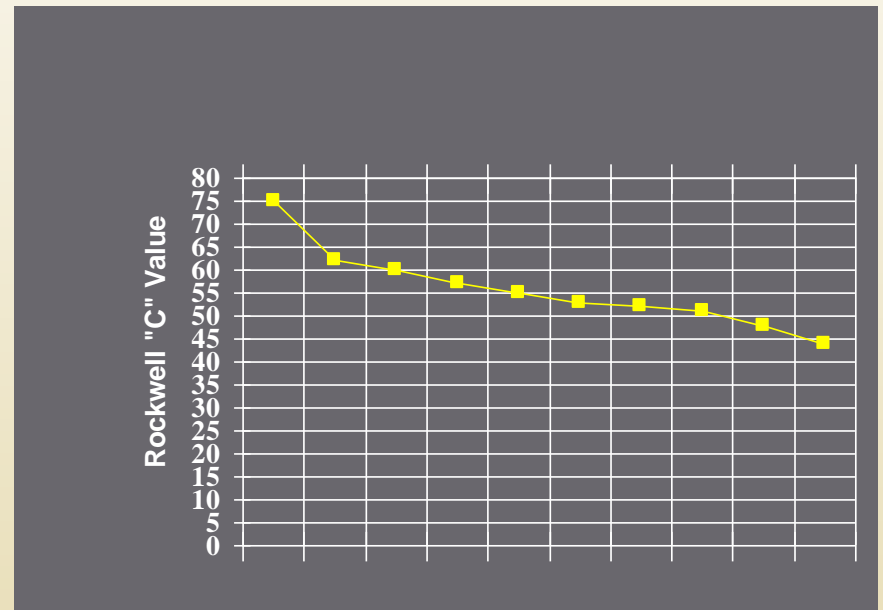
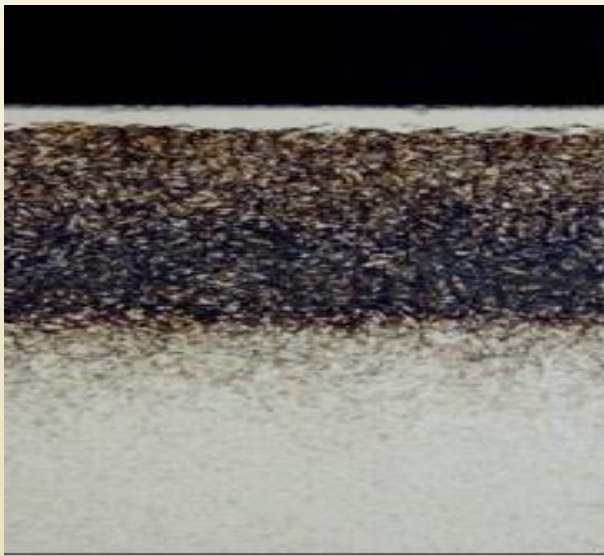


- Uniform heating to prevent distortion
- Maintains surface finish
- Temperature Uniformity ± 2 °F
- High degree of mixing of Aluminum Oxide Particles (dry)
- Ensures even surface treatment—penetrates holes
- 6 times the thermal transfer of atmosphere

What is DYNA-BLUE®?

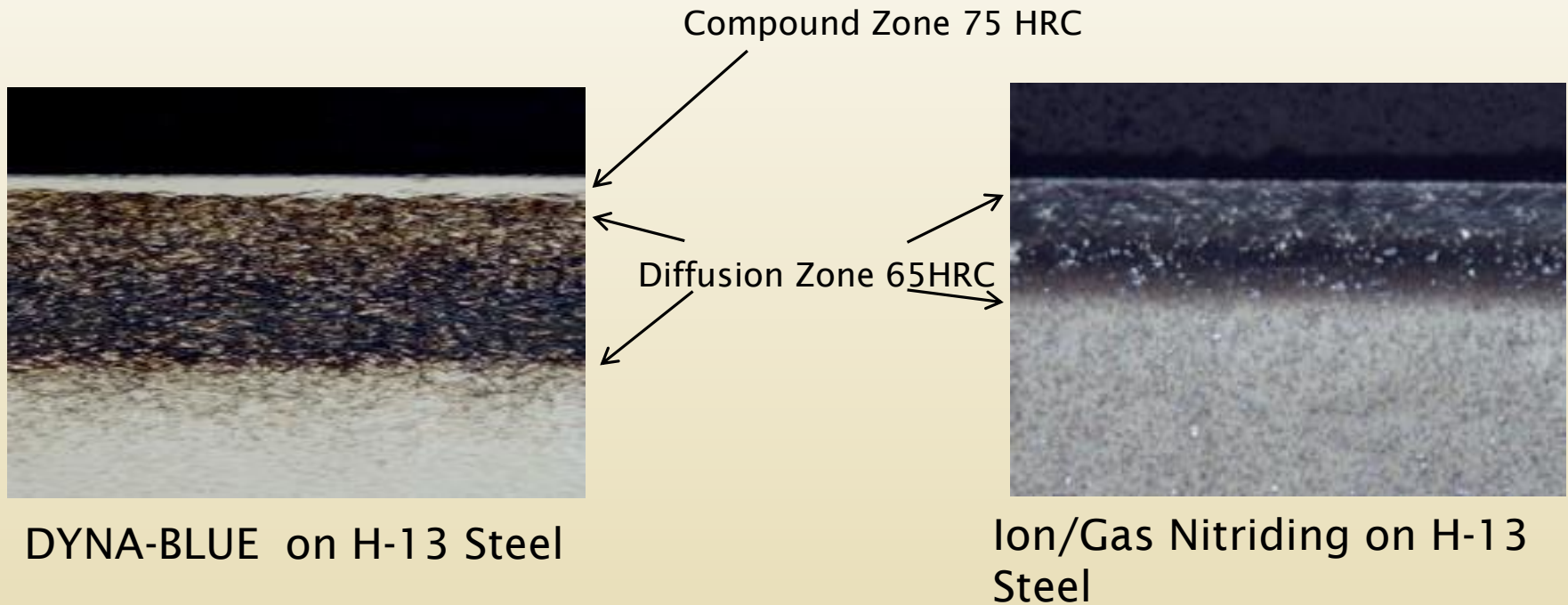
DYNA-BLUE is a low temperature Fluidized Bed Ferritic Nitrocarburizing process, (typically 950° – 1060 ° F) diffusion process that produces a compound layer composed of Nitrogen & Carbon @75HRC typically .0005”–.001”.supported by a nitrogen rich diffusion zone 60+ HRC typically .004”–.008” deep. This process imparts high levels of Residual Compressive Stress and also provides excellent corrosion resistance as well as solder resistance and less buildup on the die surface. The process penetrates holes, bores and ribs and is not line of sight like Nitriding or PVD Coatings

Microstructure and Microhardness Graph



The picture on the left shows .0007" compound (white) layer supported by a nitrogen rich (dark) diffusion zone. The graph on the right exhibits a typical microhardness traverse on H-13 with DYNA-BLUE 8D cycle. The Compound Zone is 75HRC at .0007" and total diffusion zone .008"-.010" deep.

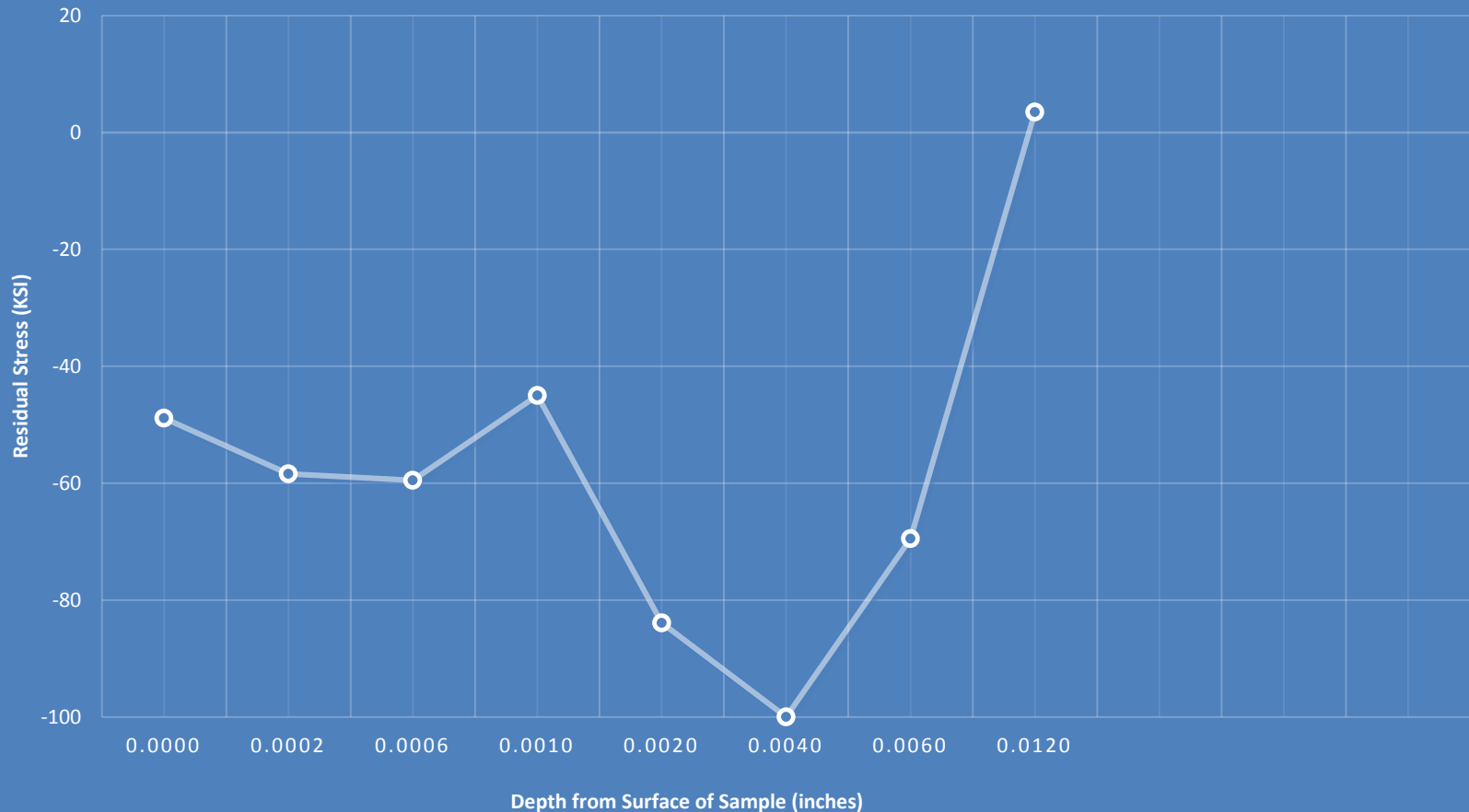
Microstructure of DYNA-BLUE vs Nitride



The DYNA-BLUE process provides a hard wear resistant 75+ HRC compound layer supported by a nitrogen rich diffusion layer that nitriding does not. This increases wear resistance up to 10 times more than Nitriding

Residual Compressive Stress of DYNA-BLUE 8D on H-13 Steel

RESIDUAL STRESS OF DYNABLUE 8D ON H-13



Test for Fatigue Strength– Heat Check Resistance

NADCA tested DYNA-BLUE in a “Dunk Test” vs Nitriding and also with untreated H-13. The “Dunk Test is used to evaluate thermal fatigue resistance. The test piece is 2”x2”x7” with a hole 1.5” x 6.5” in the center for internal water cooling. The

Test Specimens are alternately cycled between molten Aluminum at 1350F and removed and sprayed with water.

There is also continuous water cooling thru the internal center hole. The test specimens are removed and evaluated for cracks at 5,000, 10,000 and 15,000 cycles. The test shows that even at 15,000 cycles the DYNA-BLUE had minimal crack length while the nitrided and untreated showed much larger crack length.

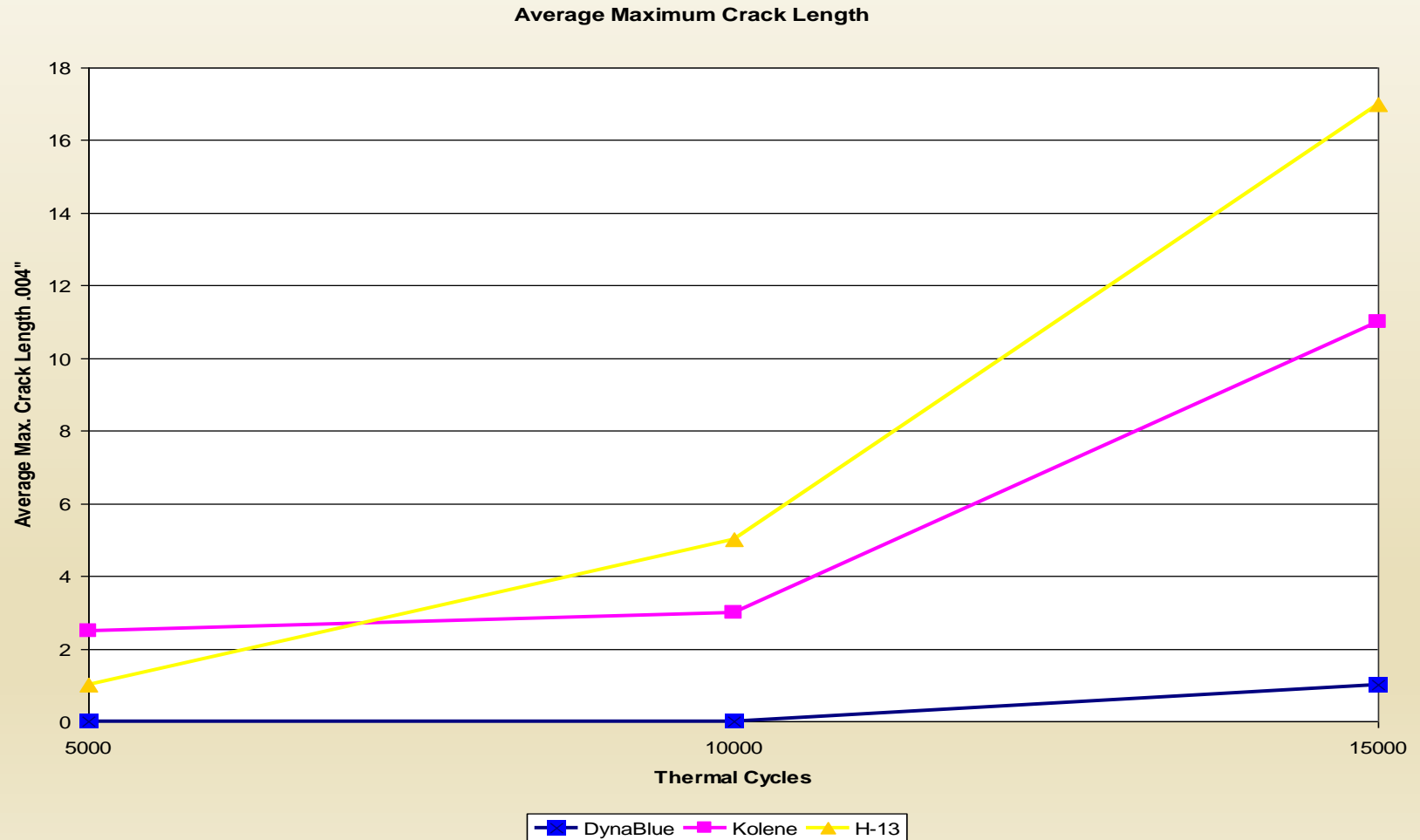
Comparative - Independent Study

Acknowledgement - Case Western Reserve University, OH

John F. Wallace - LTV, Professor of Metallurgy, Emeritus: Xiaofeng Su - Post Doctoral Professional: David Schwam - Principal Scientist

North American Die Cast Congress - November 2000

“Die Materials of Critical Applications and Increased Production of Castings”



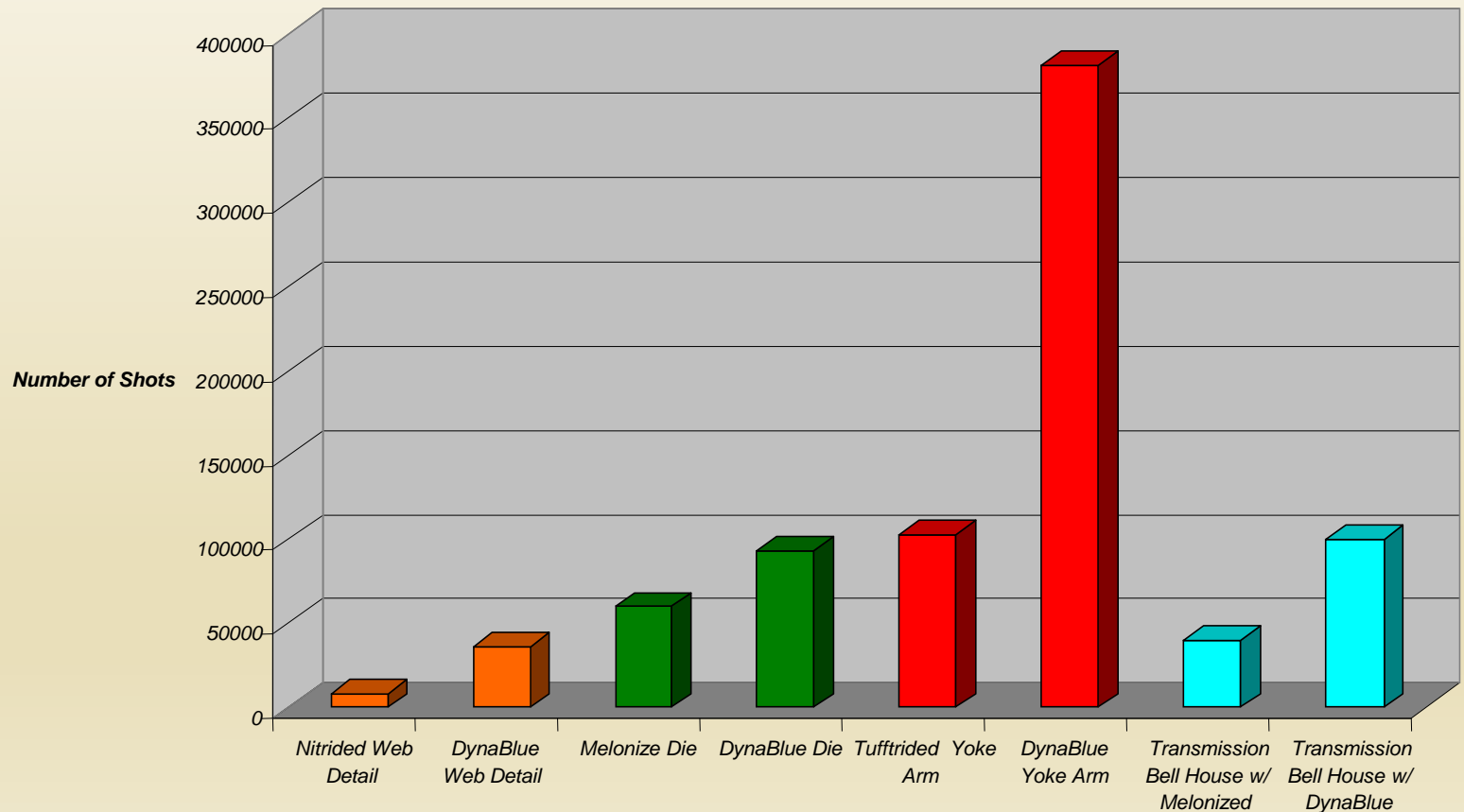
Benefits of DYNA-BLUE

- 1– Resists wear, heat checking, erosion, soldering up to 10 times longer than Nitriding.**
- 2– Resists corrosion & attack from Aluminum or harsh chemicals.**
- 3– Increased resistance to Thermal Fatigue.**
- 4– Dimensionally stable–low temperature process.**
- 5– Diffused into the steel, not a coating that can flake off.**
- 6– Low dimensional variation, less than .0002” growth.**
- 7– Will not soften even at elevated temperatures.**
- 8– Reduces Aluminum buildup on die– easier cleanup**
- 9– Weldable– no problem with pin hole porosity.**
- 10 High levels of Residual Compressive stress (opposite of tensile stress) that resists cracking.**
- 11– DYNA-BLUE Capacity 77” x 110”**
- 12–DYNA-BLUE: 1–2 Days turnaround time–overnight service available.**

Performance Tracking

200 – 400% Increase

Various Die Cast Die Comparison



DYNA-BLUE on Water Jackets



DYNA-BLUE 8D on H-13 Structural Die



Case Study of DYNA-BLUE Ferritic Nitrocarburizing on a Structural Die Cast Die

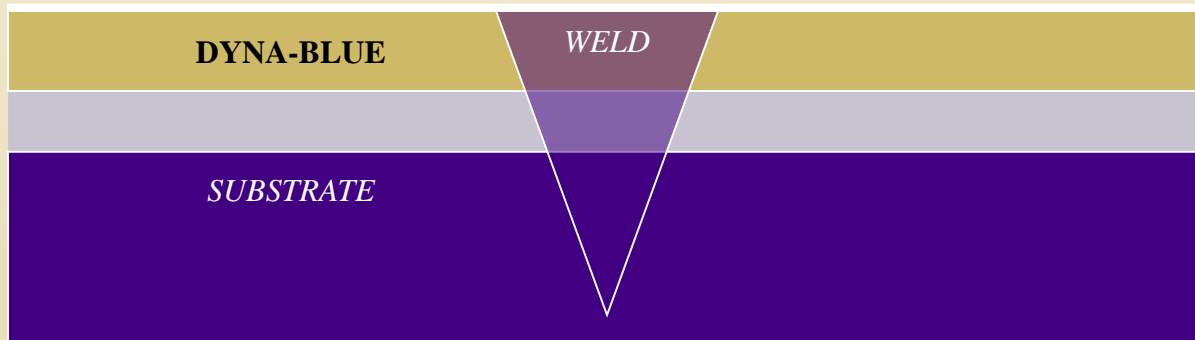
A Manufacturer of Structural Automotive Parts was experiencing very poor tool life due to the aggressive nature of the Aluminum they were using. The dies were typically treated using a Nitride process which yielded 5,000-10,000 pieces before the die was unusable. Then a DYNA-BLUE 6B process was tested on 2 sets of H-13 Dies with an improvement of 2-3 times. By refining the process and developing a deeper compound zone supported by a nitrogen rich diffusion zone the new process called DYNA-BLUE 8D has increased tool life by 8 times or more.

DYNA-BLUE 8D on H-13 Steering Knuckle Die



Welding DYNA-BLUE

DYNA-BLUE is weldable unlike gas/ion nitriding, which will exhibit pin hole porosity. DYNA-BLUE will add hardness back into the “heat effected zone” (area softened adjacent to weld). DYNA-BLUE will homogenize the surface hardness. See “Recommendations for Welding DYNA-BLUE”





MPD Welding, Inc.
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(248) 340-0330 • Fax (248) 340-0533

June, 13,2014

Loren Epler
Dynamic Surface Technologies
7784 Ronda Drive
Canton, MI 48187

Dear Loren,

MPD Welding Inc. is able to successfully weld on details that have been processed with Dynamic Surface Technologies DYNA-BLUE process. Through techniques and procedures that have been developed over the years MPD is able to produce weld repairs that are cosmetically acceptable for the end users purposes.

Sincerely Yours,

Thomas H. Schippert
Vice President
MPD Welding Inc.

P.O. Box 99277 • Troy, Michigan 48099-9277
4200 S. Lapeer Road • Orion, MI 48359

What is DYNA-BLUE® PLUS?

DYNA-BLUE® PLUS is a new improved process developed to increase Tool Life and increase release properties. As with all our Dynamic processes our goal is to attain the best die life performance at a price that is the most cost effective. This new process incorporates a deeper DYNA-BLUE process plus a surface enhancement to increase the surface finish to improve material flow as well as release properties. Other benefits include greatly improved solder resistance, erosion resistance and attack from aluminum is reduced. Potential stress risers that can increase heat checking and cracking are also eliminated.

Customer Comments

- “ DYNA-BLUE PLUS has rejuvenated our used dies and greatly reduced soldering and erosion even at end gate areas!!! It gave new life to a used die so I could make it thru the production schedule, it really saved us”
- DYNA-BLUE PLUS is the only process I can trust especially on our used dies. I can also re-apply when it eventually wears off as part of my maintenance schedule.”

Mercury Marine Comments

"I am writing to you because I have found that your DYNA-BLUE PLUS duplex process has been a pleasant surprise in our long time battle with erosion and soldering. The crankcase tool that you applied this process to at a shot count of 49,907 ran a very successful 6,383 piece run in automation with very little gate soldering and erosion. We were running a low .3% iron aluminum alloy so this only adds to the remarkable performance. The tool that we sent you was in very poor condition in front of the gate following a prior horrible run in the same die cast machine & process. I have started to use your process on other "used" tools which gives me flexibility as most good tool surface coating companies only want to deal with new tooling. I plan to utilize more of your new DYNA-BLUE PLUS process in the future coupled with 3 micron polishing and repaired inserts".

"Mercury has used your normal Dyna-blue process over the years for improved tool life. If this new process continues this trend, we will certainly consider using it on all new tools where we normally use your 6B process. Thank you for the many years of partnership in solving problems".

Steven Knickel
Tooling M.E.
Mercury Castings

DYNA-BLUE+ PVD Coatings

DYNA-BLUE can also be used as a substrate for PVD Coatings such as TiN, TiAlN, CrN, CrWN, etc. DYNA-BLUE provides a hard 75+ HRC support layer below the surface of a PVD coating. Typically when the PVD coating wears off tool life drops off dramatically but with a hard DYNA-BLUE layer beneath the coating even when the coating is gone DYNA-BLUE still provides excellent tool life. Also galling and “Egg Shell” effect are eliminated!!!

Conclusion: What have we learned?

1. Structural Die Casting requires the use of Aluminum that significantly reduces Tool Life due to an acceleration of heat checking, soldering, erosion, attack and breakout of the die surface .
2. Standard Surface Treatments such as Nitriding do not stand up well to this environment.
3. In order to obtain longer tool life, the surface treating process needs to be refined to resist wear, heat checking, soldering, erosion, attack and breakout of the die surface.
4. A process was developed called DYNA-BLUE 8D with a deeper compound zone supported by a nitrogen rich diffusion zone, that has increased tool life by 8 times or more.
5. The newest process called DYNA-BLUE PLUS incorporates a deeper compound and diffusion zone with a surface enhancement to increase Tool Life and release properties.
6. DYNA-BLUE can also be used as a substrate for PVD Coatings such as TiN, TiAN, CrN, CrWN, etc.