ISO 9001:2008

TUV Rheinland

DYNA-BLUE®: THE ULTIMATE PROTECTION AGAINST WEAR AND THERMAL FATIGUE ON FORGING & HOT FORM DIES

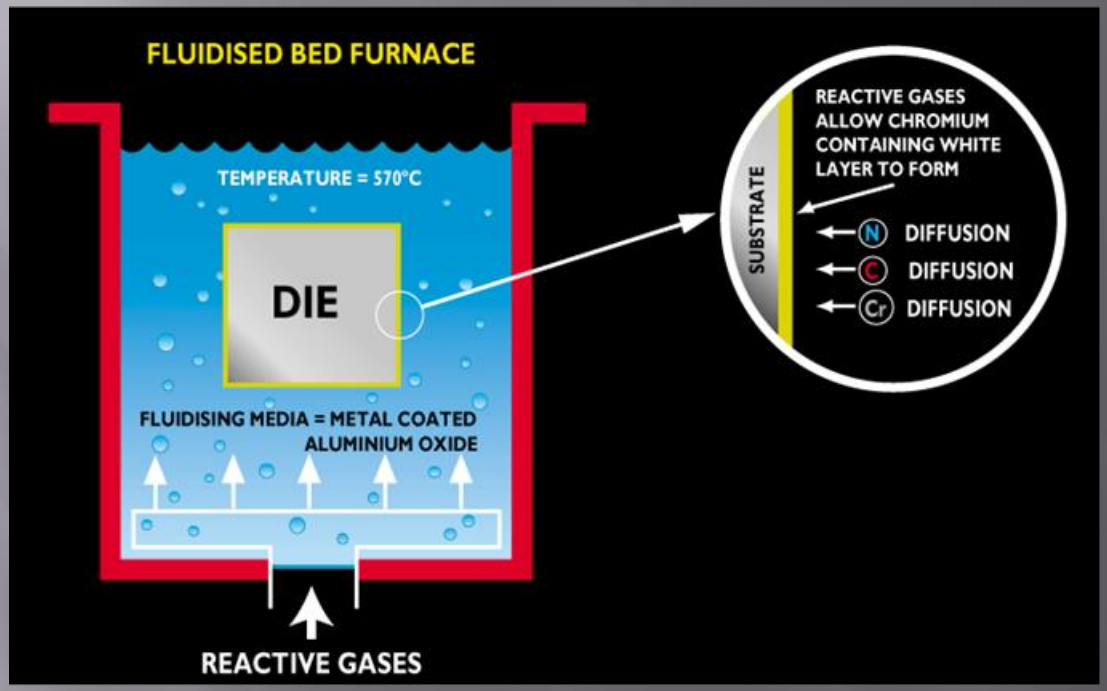
Increasing Tool Life and producing quality parts at a lower cost is the “Ultimate Goal”. Achieving that goal is dependent upon controlling the metallurgical properties of the Forge/Hot Form Tooling to prevent wear, softening, thermal fatigue and heat checking. This presentation will explore:

Benefits of DYNA-BLUE® Ferritic Nitrocarburizing & DYNA-BLUE PLUS processes to increase wear resistance, reduce heat checking thermal fatigue and softening, while increasing material flow and release properties.

Fluidized Bed DYNA-BLUE® & DYNA-BLUE® PLUS

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 + 2˚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.

Fluidized Bed Schematic



The fluidized bed furnace is capable of maintaining temperatures of +/- 2 ° F. Inert, atmospheres are introduced through the bottom of the furnace while the furnace shell/retort is electrically heated. As the retort heats, the inert gas scrubs the heat off the walls transferring heat directly to the dies, much like that of boiling water. When the furnace reaches the desired set point, the DYNA-BLUE ® reactive gases can be introduced, providing excellent case depth uniformity.

What is DYNA-BLUE® Ferritic Nitrocarburizing?

DYNA-BLUE is a low temperature, (typically 950° - 1060 ° F), thermal-chemical diffusion process applied via a Fluidized Bed Furnace, 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" depending upon the application and properties needed. Exact case depth is engineered for each application.

2) A nitrogen enriched diffusion zone 60+ HRC supports the compound zone. This layer can be produced from .001" to greater than .015. Exact case depth is engineered for each application.

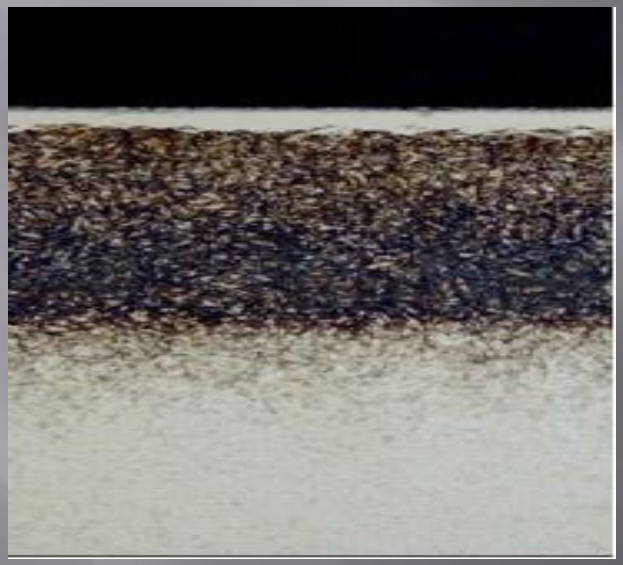
What is DYNA-BLUE® PLUS?

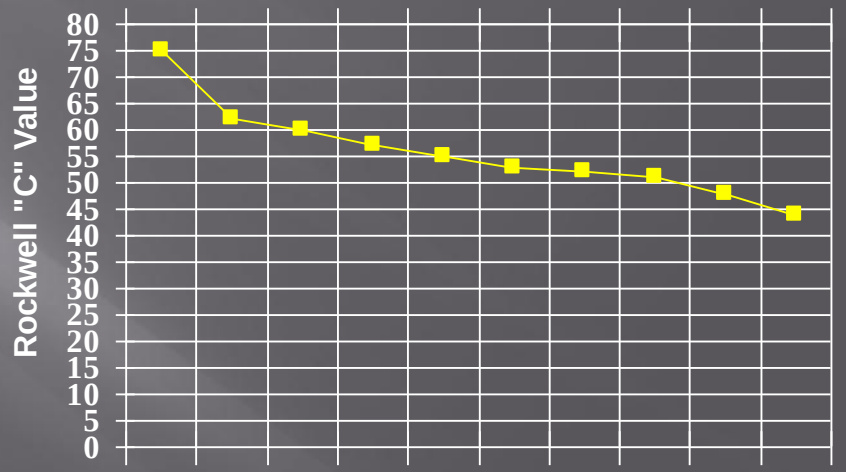
DYNA-BLUE® PLUS is a new improved process developed to increase Tool Life and increase release properties. As with all our Dynamic processes our goal is to attain the best die life performance at a price that is the most cost effective. This new process incorporates a deeper DYNA-BLUE process plus a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

DYNA-BLUE+ PVD Coatings

DYNA-BLUE can also be used as a substrate for PVD Coatings such as TiN, TiAN, 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!!!

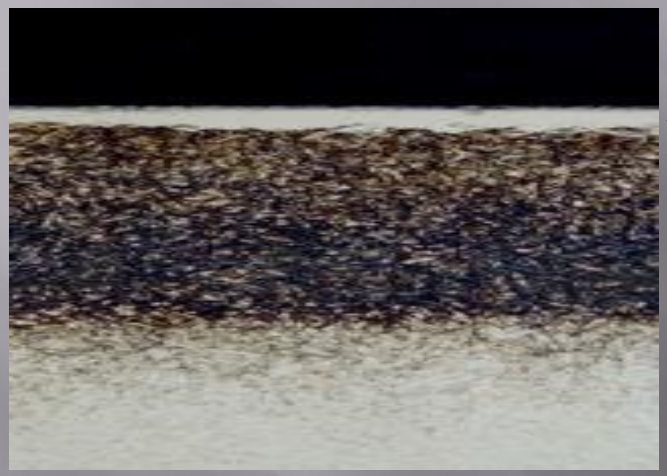
Microstructure and Microhardness Graph





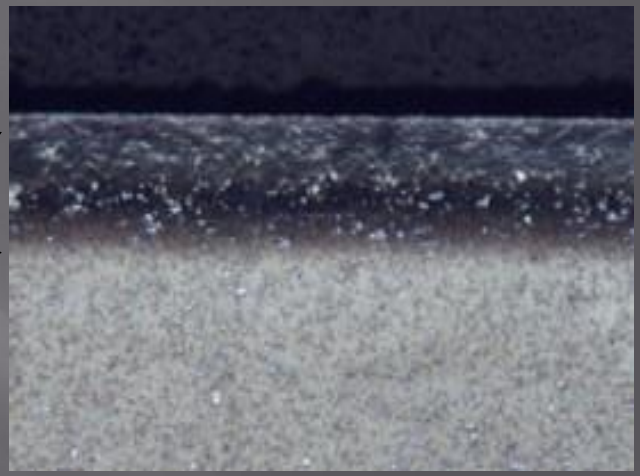
The picture on the left shows .0007” compound (white) layer supported by a nitrogen rich (dark) diffusion zone. The graph on the right exhibits a typical microhardness traverse on H-13 with DYNA-BLUE 6B cycle. The first value is 75HRC at .0007” with each descending value equal to .001”.

Microstructure of DYNA-BLUE vs Nitride



Compound Zone

Diffusion Zone



DYNA-BLUE on H-13 Steel

Nitriding on H-13 Steel

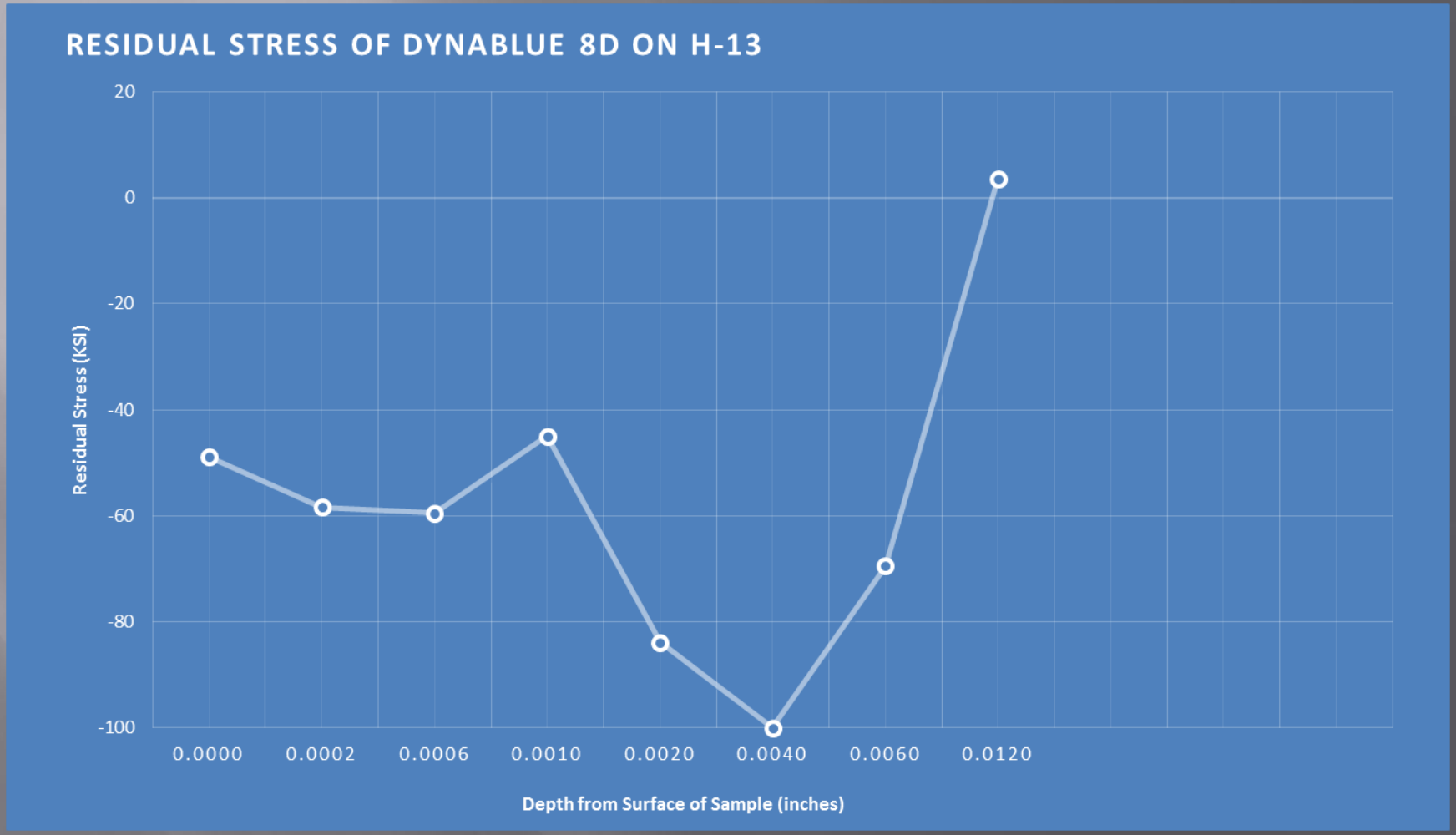
The DYNA-BLUE process provides a hard wear resistant 75+ HRC compound layer supported by a nitrogen rich diffusion layer that nitriding does not which increases wear resistance up to 10 times more than Nitriding

Benefits of DYNA-BLUE vs. Nitride

- 2-10 times increase in tool life due to 75 HRC compound zone as compared to Nitriding with no compound zone @ 60-65 HRC.
- Compound zone resists heat checking, thermal fatigue, thermal softening (temper resistant) and wear.
- Reduced coefficient of friction= better material flow.
- DYNA-BLUE penetrates holes, bores, while ion nitride does not as it is “line of sight”.
- Maintains excellent micro-finish, no post polishing needed as other nitriding processes do.
- Increases Lubricity- better release
- Overnight turnaround
- Enhanced die repair and weldability

ENVIRONMENTALLY FRIENDLY

DYNA-BLUE 8D on H-13 Steel



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”

Temper Resistance

DYNAMIC

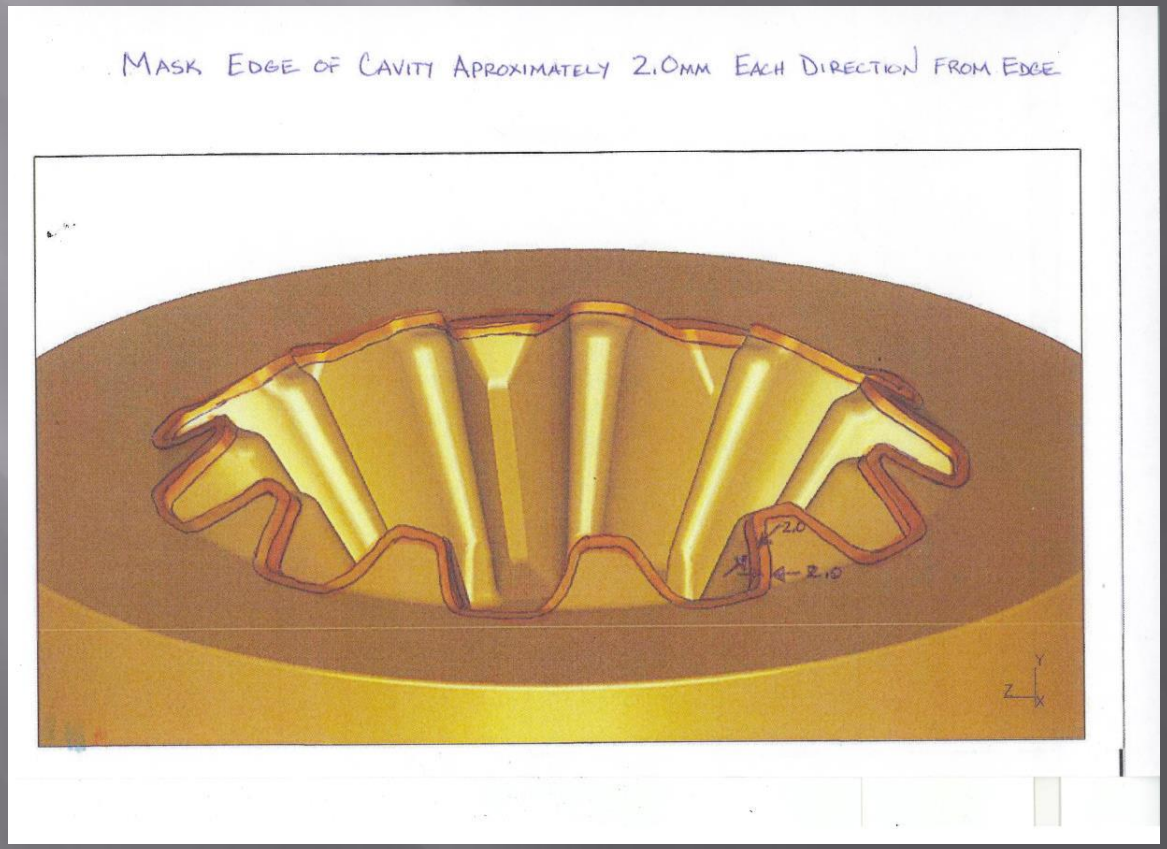
Temper Resistance Test 6/20/11

	W360	DYNA-BLUE 6B @.001"	DYNA-BLUE 6B @.005	DYNA-BLUE 6B @.010"
	HRC	HRC	HRC	HRC
Austenitized 1920F & tempered @1080F	52.5-54	67.0	63.7	56.9
After 10 hrs@1100F	49-50	61.7	63.4	53.5
After 20 hrs @1100F	45-46.5	62.8	62.4	53.6

	Matrix	DYNA-BLUE 6B @.001"	DYNA-BLUE 6B @.005"	DYNA-BLUE 6B @.010"
	HRC	HRC	HRC	HRC
Austenitized 2084F tempered @1080	56.5-57	68.5	58.4	58.4
After 10 hrs. @1100F	54-55	61.2	61.2	57.5
After 20 hrs. @1100F	52.5-53.5	60.7	59.7	56.8

MASKING–STOP OFF

DYNA-BLUE can be stopped off or masked to prevent hardness on selected surfaces



MILWAUKEE FORGE PERFORMANCE TESTING

Milwaukee Forge has been using DYNA-BLUE on their Hammer Press Dies for over 6 months to replace a Nitriding process.

Press Type: Mechanical presses ranging in size from 1300 ton, 2500 ton, to4000 ton, Closed die.
Part Details - all symmetrical round forgings ranging in size from 3 lbs. to 55 lbs.
Die Performance: -The average die life for these arts was improved by 7 times with DYNA-BLUE. One particular job would get 1,500 pieces per die, but the DYNA-BLUE die is still running after 10,000 pieces and not showing any signs of wear. The interesting part of this story is that die has been in and out 3x and still endures all the heating and cooling associated with that. "We have done some machining of the DYNA-BLUE in localized areas and noticed extreme wear where we have cut through the DYNA-BLUE.
Lube used: non-graphite synthetic lube.
Surface treating process used before: Nitride

ACCUGEAR
SAN AAM COMPANY

Tooling Trial Data Sheet

Trial Number: Dynablue 223 Trial #2 **Date of Trial:** March 31st, 2011

Champion(s): Chris-Dilmar **Workcenter:** 1750A

Part Number:

Run-Settings:

	Run 1	Run 2	Run 3
Production Die Height:			
Dieset Hydraulic Pressure:	0		
~ OR~ Nitro:	√		
Total Tonnage:			
Billet Temperature:			

Success: ☐

Failure: ☐

Tool Number: DGF-650-FP-3-TNT-223

Tool Description: Dynablue Nitride, current matrix 58-60 HRc

Parts Produced: 25,732 **Std. Parts Produced:** 10,000

Total Cost: $1,643.75 **Std. Total Cost:** $2,100

CPU: $0.0638 **Std. CPU:** $0.21

Failure Mode & Description: Chipping around O.D. and cracking along tooth

Trial Failure Mode & Description: Abrasive Wear (No increase in the typical cracks in the cavity- tooth radius)

DGF-838 Coin Die

Material: Matrix (Duro F1)

Hardness: Rc 57-59

Tool Cost: $2,219

Date	Piece Count
1/25/2011	12,220
2/23/2011	5,000
2/23/2011	8,505
4/1/2011	29,393
4/1/2011	11,569
4/5/2011	18,164
4/28/2011	25,604
5/31/2011	14,058
8/1/2011	14,663
8/27/2011	20,345
Average	**15,952**

$0.14 CPU

DYNA-BLUE Added

Date	Piece Count
8/1/2011	30,095
10/5/2011	27,806
2/23/2012	50,250
2/23/2012	43,340
3/19/2012	47,592
4/3/2012	30,572
5/15/2012	26,726
7/6/2012	41,705
7/14/2012	21,948
Average	**35,559**

$0.06 CPU

Overview of Surface Treatments

- Nitriding is line of sight and does not penetrate holes, bores, is only 60-65HRC with no compound zone and may need post polishing.
- DYNA-BLUE Ferritic Nitrocarburizing will penetrate holes, bores and yields 75+ HRC with a compound zone supported by a diffusion zone for support, resists wear, heat checking, thermal softening/fatigue with better release/better material flow. 2-10 times increase in tool life over nitride.
- DYNA-BLUE PLUS is a deeper DYNA-BLUE + surface enhancement that further enhances resistance to wear, heat checking, thermal softening/fatigue and increased material flow and better release properties. Double tool life with little to no wear vs. nitride.