GREAT DESIGNS IN STEEL

TWENTY YEARS

LASER HEAT TREATING ON FORM, TRIM AND HOT STAMPING DIES

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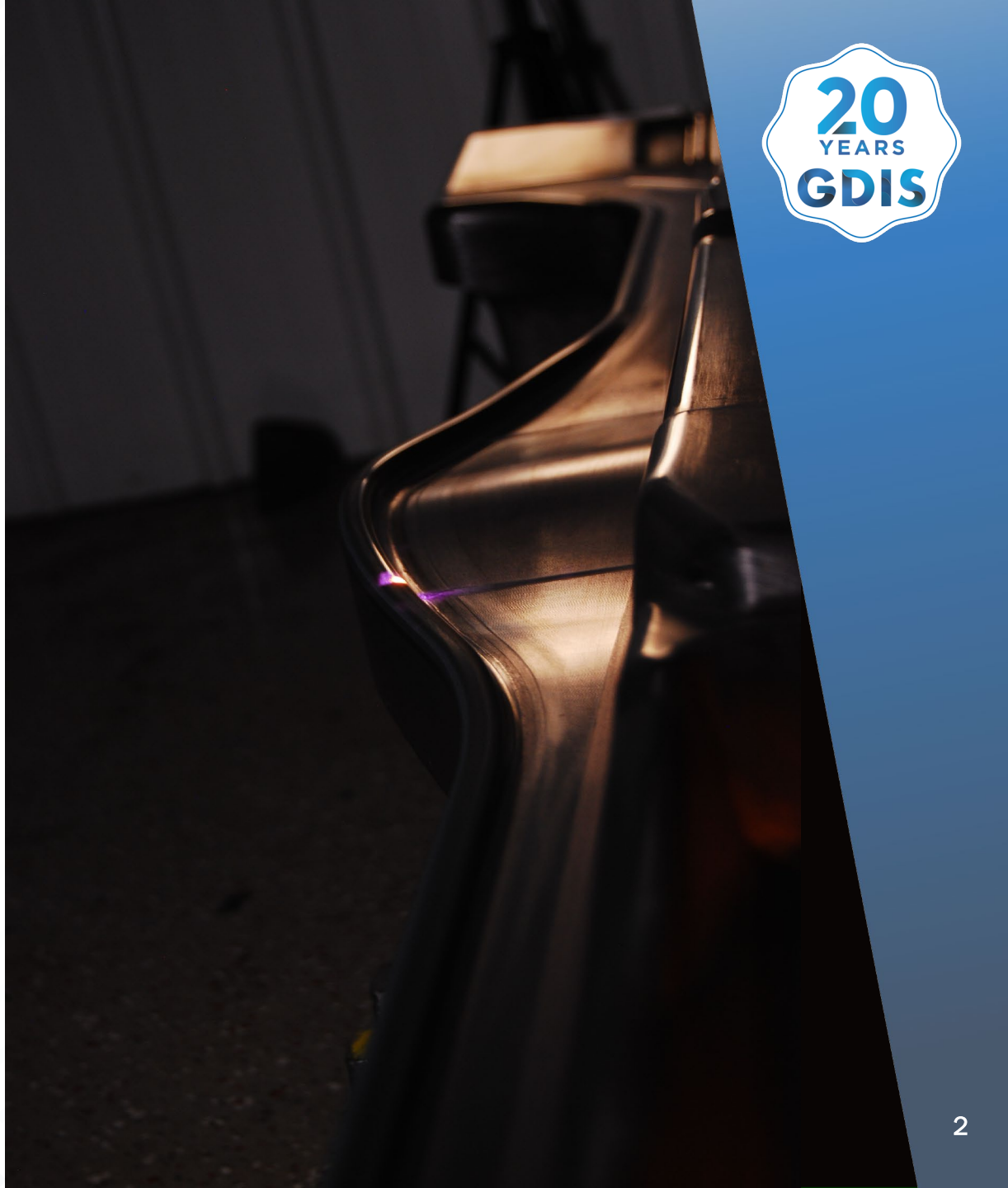
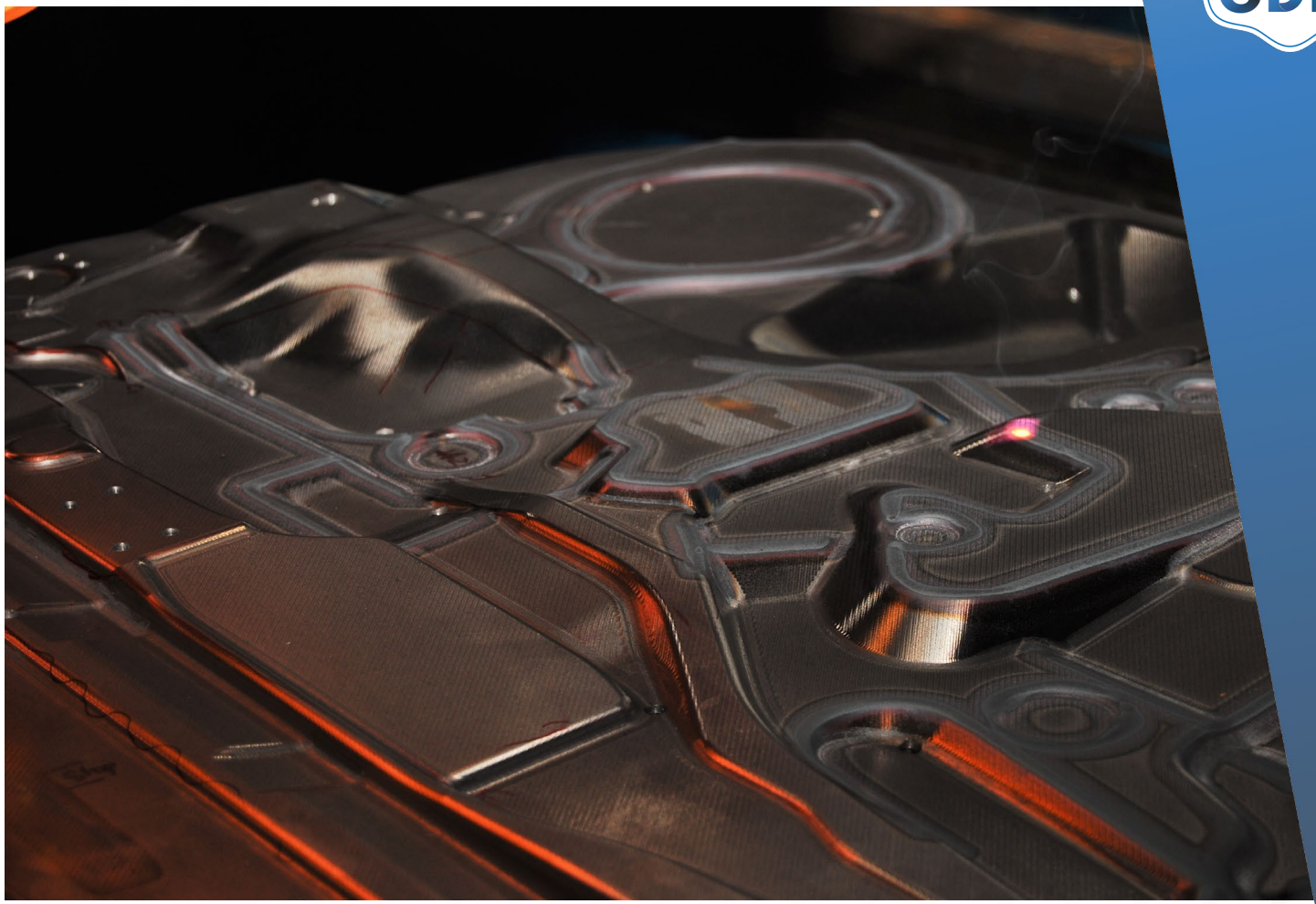


ABOUT SYNERGY

- Capabilities
  - Handle dies up to 30,000 lbs.
  - 20-ft. to 10-ft. in dimensions.

- Experience
  - Laser Heat Treated 300+ large form dies.
  - Form, trim, hot stamping, hem dies, molds etc.

- Location
  - Clinton Township, Michigan



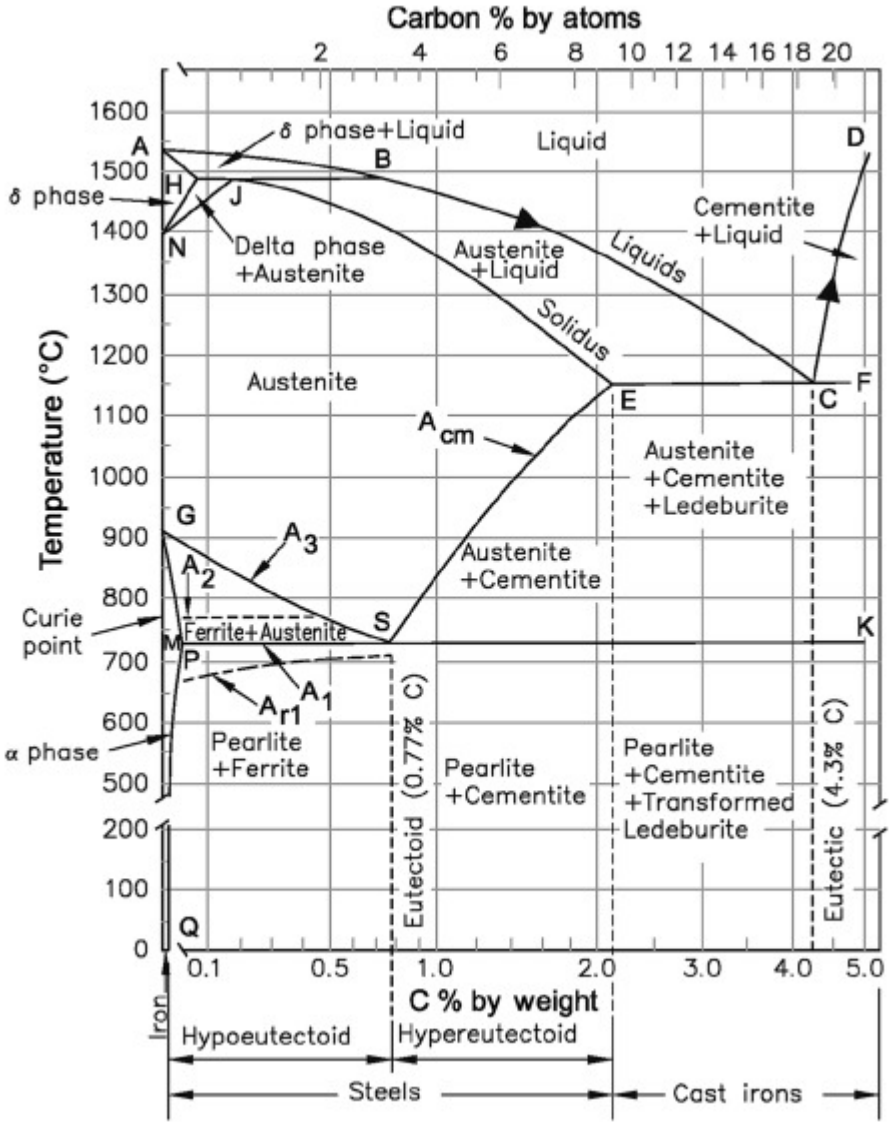
FUNDAMENTALS OF LASER HEAT TREATING

Process:
Laser beam illuminates the surface of metal raising the temperature:

Stage 1: Austenite formation from pearlite-cementite (hypereutectoid steels) or from pearlite-ferrite (hypoeutectoid steels)

Stage 2: Martensite transformation from Austenite

- Cooling rates (~100°C/sec) > Critical cooling rates for martensite formation



MATERIALS

Heat Treatable Materials

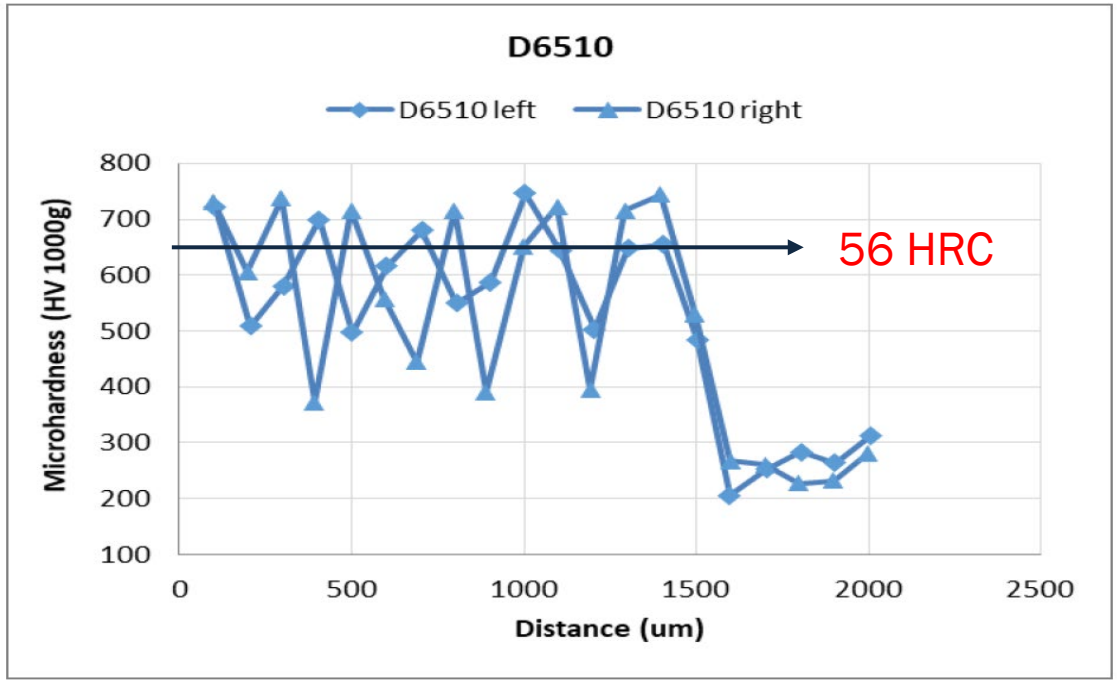
Any material with 0.2% or higher C, including:

- D6510
- 0050A
- A2
- D2
- S7
- G3500
- 4140
- P20,
- GM338
- GM190
- H13 and others

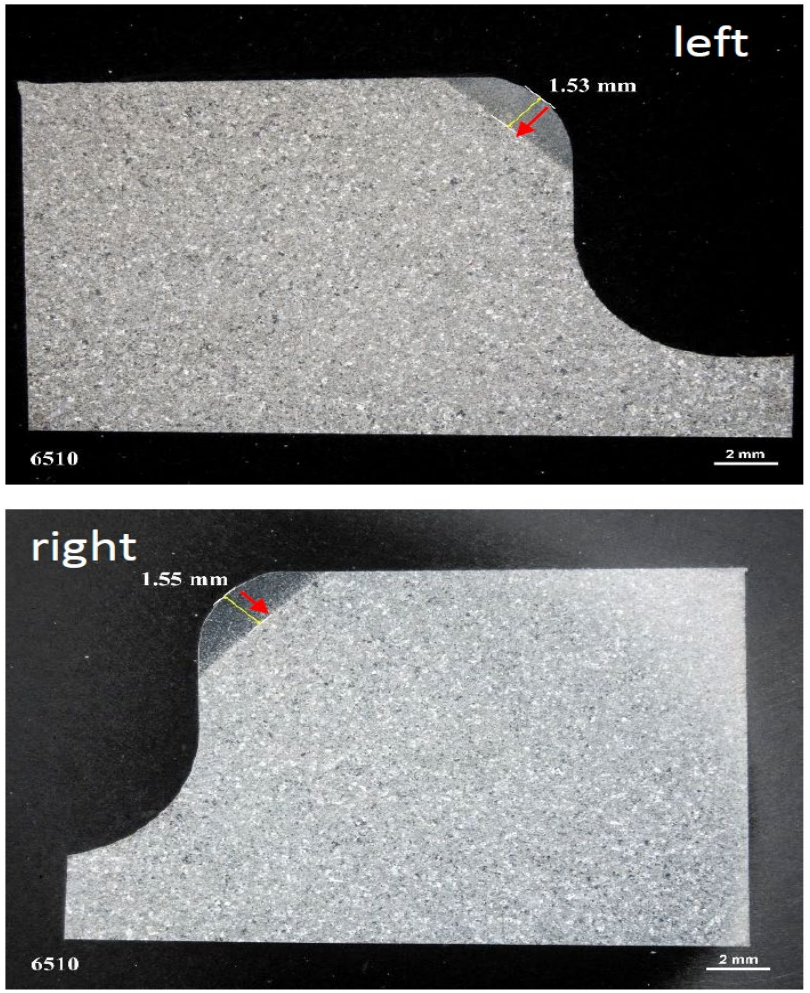
LASER HEAT TREATABLE MATERIALS

Typical Hardness reaches the theoretical hardness of the material

Hardness Depth: 1-1.5 mm (0.040-0.060”)



Hardness vs. Depth



Laser heat treated D6510 radii cross section

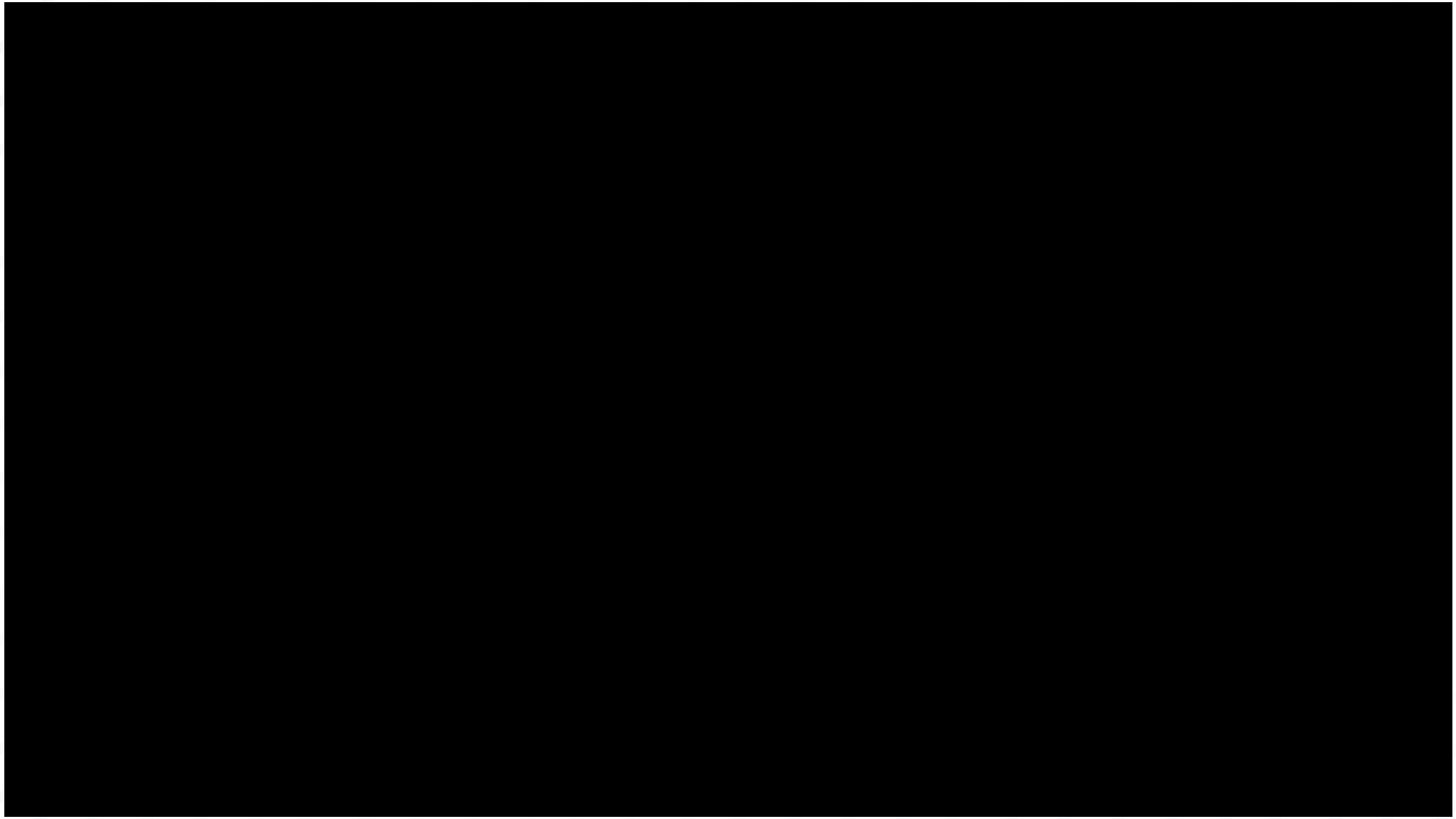
FORM DIES

- Sheet metal bends over male radii
- Typical radii ranges from 0.25” to 1”
- Laser heat treating performed on male radii
- Most common materials include:
  D6510 and 0050A

Why Laser Heat Treat?

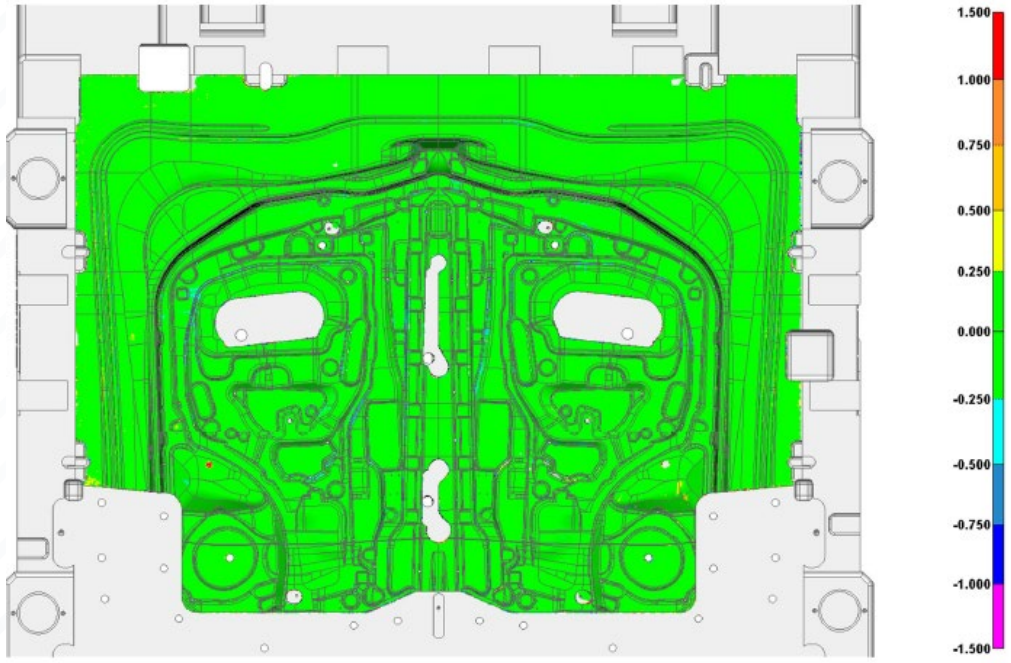
- Quality improvements
  - Hardness consistency
  - Minimal to no distortion
- Cost savings
  - Reduced processing steps
  - Reduced lead time

FORM DIE PROCESS VIDEO

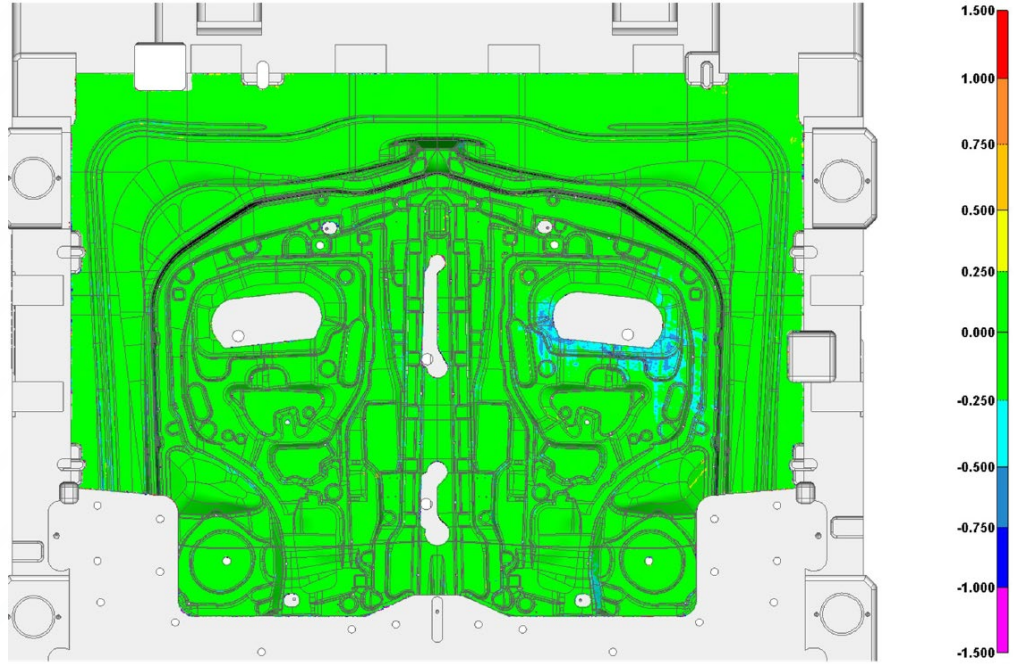


DISTORTION DATA

3D scans of the die before and after laser heat treating show negligible distortion



Die scan before Laser Heat Treating



Die scan after Laser Heat Treating

COST SAVING

- Data was collected by our customer over 100 applicable draw die castings.
- While the heat treating and non-perimeter shipping cost increased, this was offset by total process cost savings.
- Benefit to cost ratio of **28.6** over 11-months.
- Critical resource savings; **37%** reduction in machine time in our customers CNC Machine department.
- Cutter cost reduction of $17,850 as the castings are finish 3D machined soft, no ‘hard milling’ process is now required.
- Analyzing the results from these 100 castings **TTM averaged a 7-day** improvement.
- This resulted in a **40%** reduction in a draw die machining process.

AUTODIE
DESIGN + MACHINING + CONSTRUCTION + TRYOUT + STAMPING

SYNERGY
ADDITIVE MANUFACTURING, LLC.

HOT STAMPING DIES

HOT STAMPING DIES

- Hot stamping dies consists of several sections joined together
- Conventional process – Induction/flame/oven
- Conventional heat treating requires complete dis-assembly prior to heat treating. This is required to prevent O-rings from heat induced damage
- No dis-assembly is required for laser heat treat process for hot stamping dies resulting in cost savings

Die Material: H13 Equivalent

Hardness after laser heat treat: 55-60 HRC

Laser heat treated hot stamping die assembly

TRIM DIES

Laser Heat Treating on Trim dies and Inserts

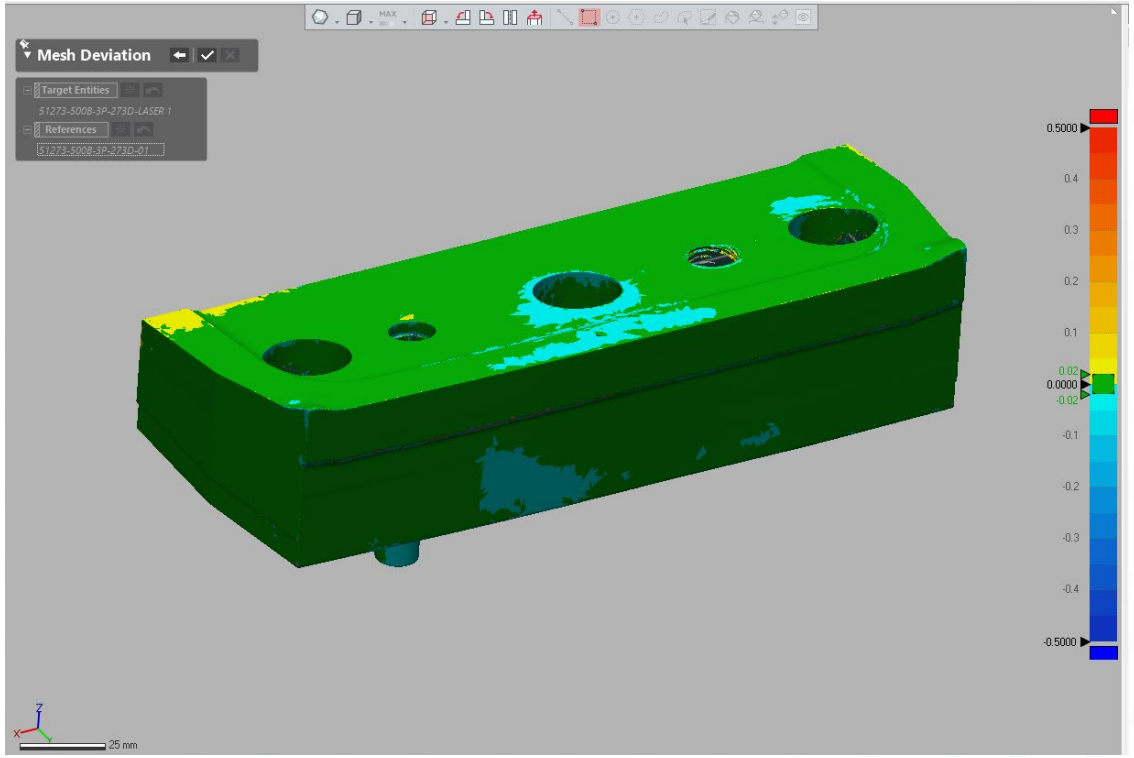
Current challenges:

- Hardness inconsistency
- Insert base warpage
- Rolled joint lines using either flame or induction hand applied methods

Benefits of using Laser Heat Treating:

- Eliminate machining joints after heat treat
- Reduce / eliminate finish profile hard cut
- One assembly process - laser heat treating after the trim inserts are fully assembled
- Eliminate requalifying of insert base flatness

TRIM INSERT CASE STUDY



- Material: 4140
- Hardness after LHT: 55-57 HRC

- Distortion after LHT: ± 10 microns
- Scan Measurement accuracy: ± 10 microns

MOLDS

Laser Heat Treating on Molds

Current challenges with flame HT:

- Difficult to predict distortion.
- Upper and lower molds don't match.
- Extra time required for spotting.

Benefits of using Laser Heat Treating:

- No additional spotting required.
- No rolling of edges.
- High heat treat consistency.

Material: P20
Hardness after Laser Heat Treating: 58-60 HRC

20 YEARS GDIS

ADDITIVE MANUFACTURING FOR TOOL AND DIE

Tool and die surface enhancement

- New die surface cladding and old die repair.
- Laser cladding up to 3 mm thick – No cracks and porosity
- Deposit material hardness up to 62 HRC.
- Deposit material choice based on application.

Base material: P20
Coating hardness: 60-62 HRC

SUMMARY

- Laser heat treating results in minimal to no distortion in large automotive dies
- Based on customers data benefit to cost ratio average of **28.6** over 11-months.
- Analyzing the results from these 100 castings **TTM averaged a 7-day** improvement.
- This resulted in a **40%** reduction in a draw die machining process.
- Synergy's laser heat treating process when applied to several different types of dies and molds resulted in substantial cost savings and improved quality.

FOR MORE INFORMATION

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