



Zion
INDUSTRIES, INC.



Zion Industries Inc.

Precision Induction Heat Treating

Who is
Zion Industries?

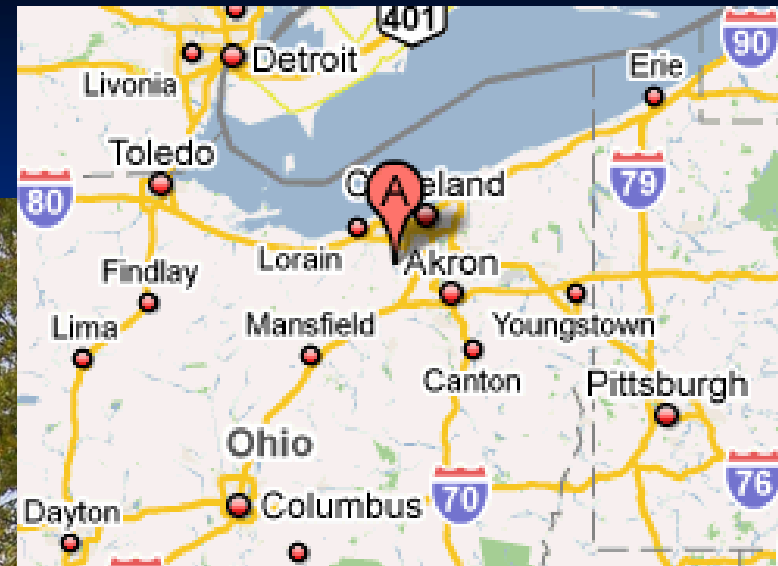
For over 30 Years - A leader in the induction heat treating business, providing high quality both in heat treating services and handling equipment for induction heating applications.



3 Locations

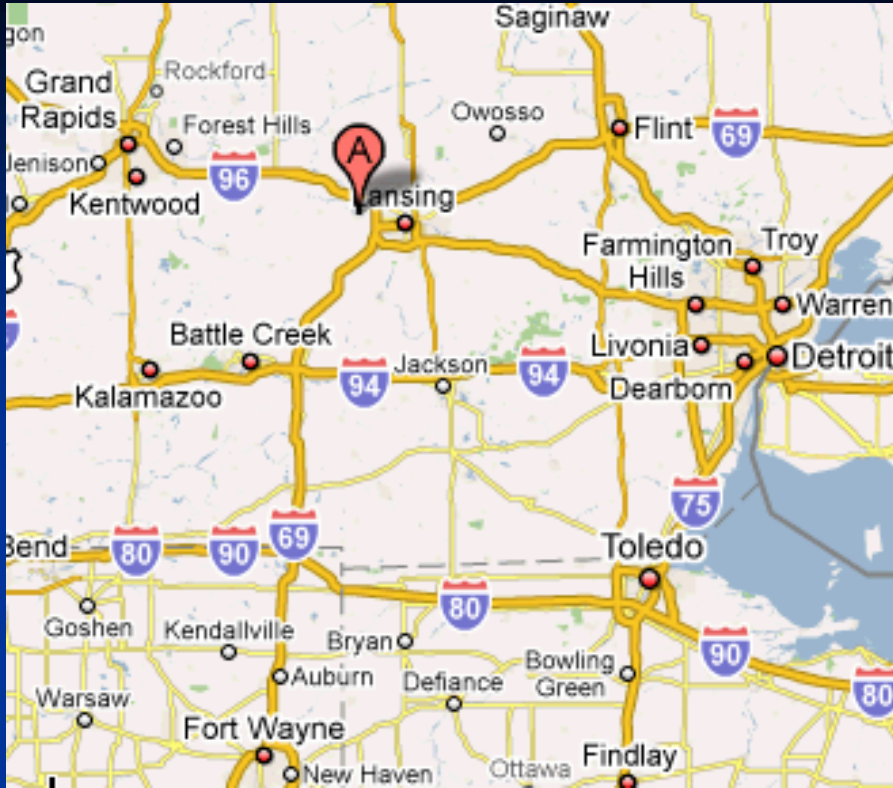
To better serve our
customers

Valley City Ohio



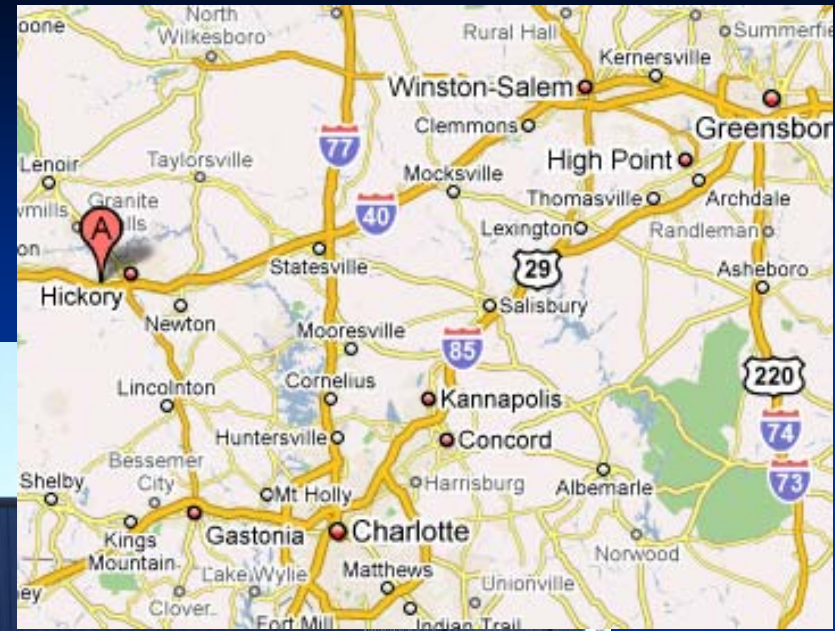
**Induction Heat Treating
Equipment Division
Corporate Headquarters**

Grand Ledge Michigan



Induction Heat Treating

Hildebran North Carolina

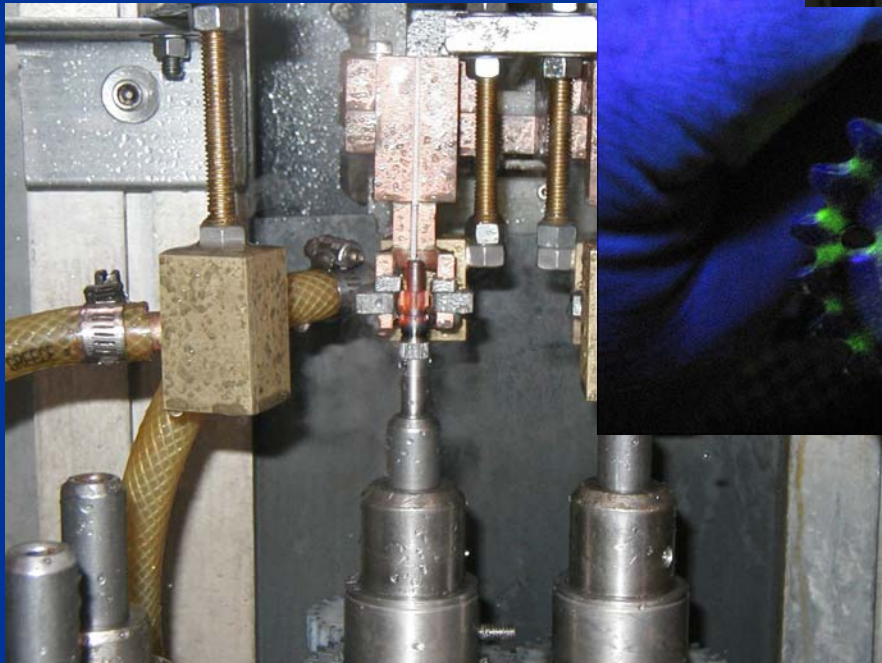
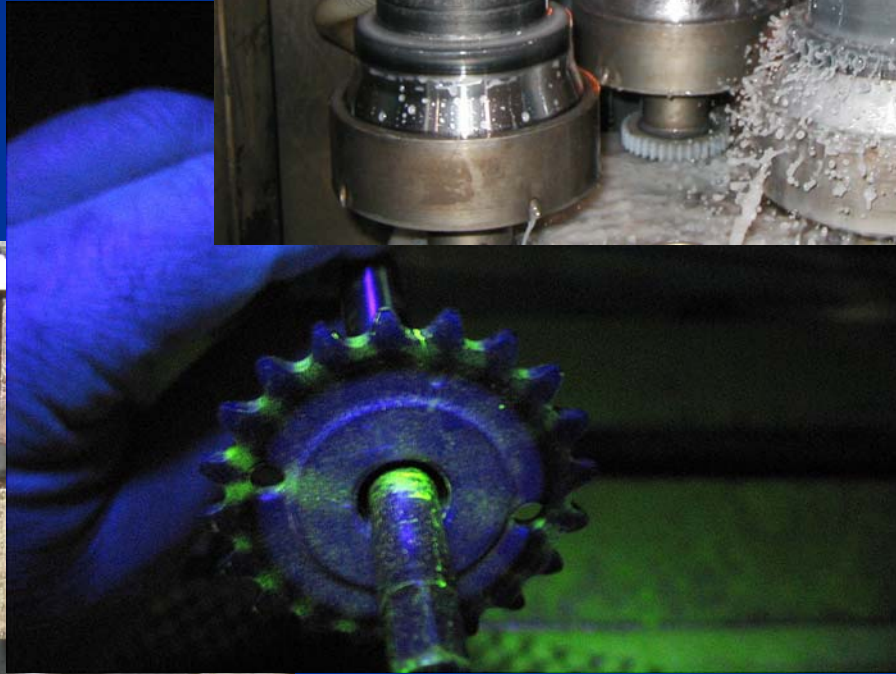


Induction Heat Treating

SERVICES

- Induction Hardening
- Induction Annealing
- Induction Brazing
- Furnace Tempering
- Straightening
- Hardness testing and Quality Services
- NDT – Magnetic Particle Inspection

SERVICES



INDUCTION TOOLING

We provide our own in-house engineering and manufacturing of production tooling as well as tooling for end users.

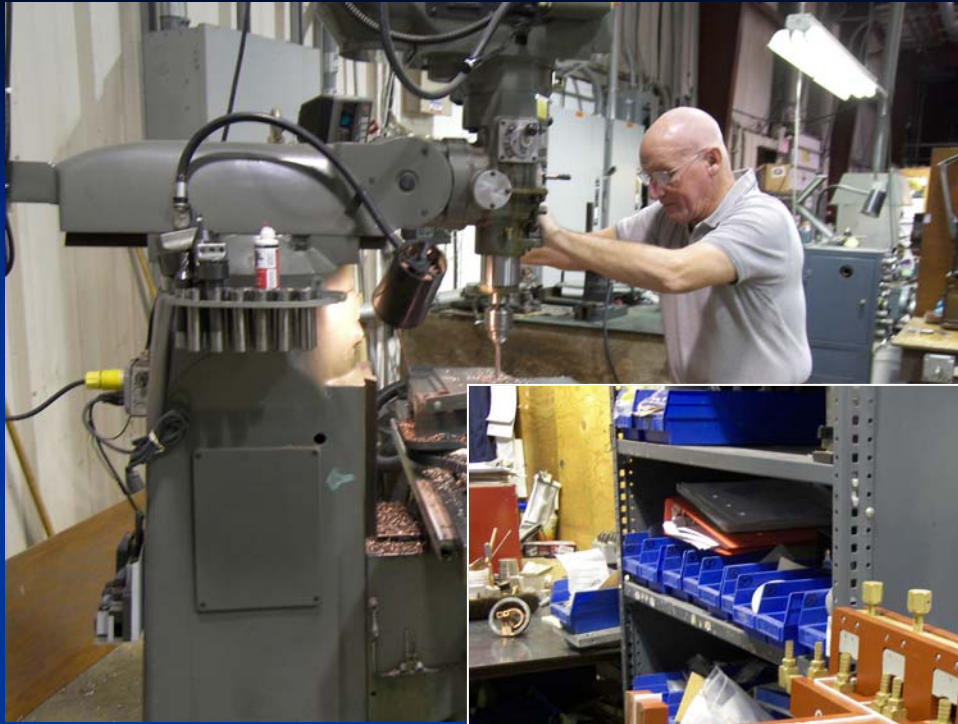
Design

Machining

Brazing / Fabricating

Development

Machining



Fabrication



You will find Zion parts here...





Zion
INDUSTRIES, INC.



Zion Industries

Effective Case Depth Vs. Total Case Depth.

Hardening steel

- Hardening steel involves transforming the iron and carbon contained in the steel into Martensite. Martensite is the desired metallurgical structure for hardened steel.
- This hardening is achieved by heating then rapidly cooling (quenching) the steel.
- The process can either be applied to the entire part or only to specific areas and surfaces, known as case hardening.

Case Hardening

- What is it and why is it necessary?

Case hardening or surface hardening is the process of hardening the surface of a metal.

Case Hardening

Case Hardening allows the surface to be hard for wear or strength, but the core to remain soft allowing for ductility and resistance to cracking.



Case Hardening

Case depth is only hardening the outer area or “case” of a part.



Case Hardening

Case hardening can only be achieved with a few processes.

- 1: Induction Heat Treating
- 2: Carburizing / Nitriding
- 3: Flame Heat Treating
4. Laser Heat Treating

Induction Heat Treating

Induction heat treating is heating up a conductive material such as steel using electricity. The steel is then quenched to create a case hardness.

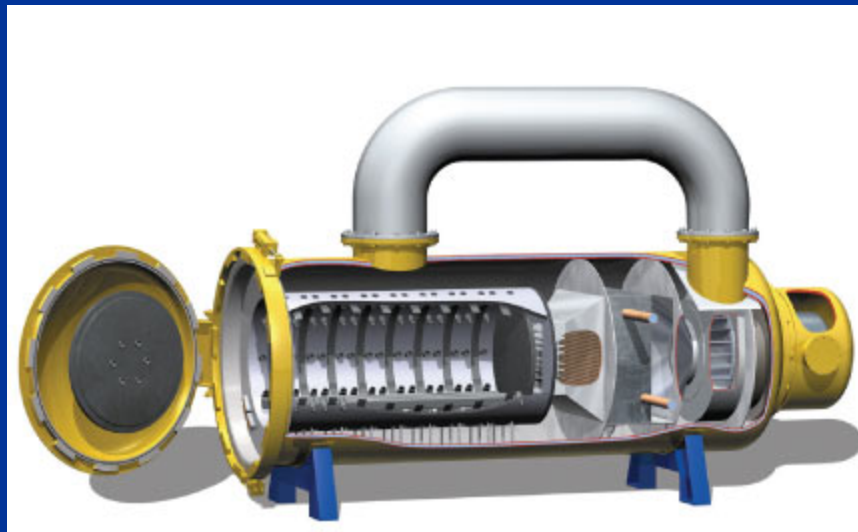


Carburizing

- Carburizing is a furnace process where carbon is added to a lower carbon steel in sufficient quantities to allow hardening to take place. The outer surface or case will have higher carbon content than the original material, thus creating a case depth in the material.
- Mostly used for shallow case depths it also puts a “case depth” on the entire part.

Carburizing

Typical Vacuum Carburizing furnace



Carburizing Furnace – Photo by Solar Mfg.

Nitriding

- Nitriding is a heat treating process that alloys nitrogen onto the surface of a metal to create a case hardened surface.
- Mostly used for shallow case depths and this also puts a “case depth” on the entire part.
- The three main methods used are: *gas nitriding*, *salt bath nitriding*, and *plasma nitriding*.

Nitriding



Plasma Nitriding – Photo by Fluidtherm

Flame Heat Treating

- Flame heat treating involves heating specific areas of a part using flame.
- This is most suitable for deeper case depths and localized heat treat areas.
- Mostly used for lower volume work



Flame Hardening – Photo by IBEDA Germany

Laser Heat Treating

- Laser heat treating involves the use of high powered industrial lasers to rapidly heat specific areas of the part.
- The process is best suited for shallower case depths.
- This is also mostly used for lower volume work.

Laser Heat Treating



Laser Hardening – Photo by Raymax Lasers

Case Depth

- Case depth can either be defined as “total case depth” or “effective case depth”
- Let’s look at how each are specified and measured.

Total Case Depth

The depth of case to where the hardened material and the core material can no longer be distinguished through chemical or physical analysis.



Total Case Depth Examples

Case Harden to 54-60 Rc Surface Hardness.

Total case depth .125 – .165

Clearly called out as “Total Case Depth”.

Total Case Depth Examples

Induction Harden Spline to 45-55 Rc. Case depth .050.

Not specified as total, there is no call out for a specific hardness at that depth. This is then interpreted as, “Total Case Depth”.

Measuring Total Case Depth

Visual Measurements of the pattern depth are taken with calipers or graduated eyepiece.



Effective Case Depth

- The depth of the case to where the deepest point of the specified hardness is reached.
- The hardness unless otherwise specified, is 50 Rc.
- The effective case depth is typically less than the total case depth. Sometimes as much as $2/3$ to $3/4$ of the total case depth.

Effective Case Depth Examples

Internal spline hardness to be Rc 52-58.

Minimum effective case depth .030 below root.

Clearly called out as “effective case depth” and also implied to be 50 Rc because no specific hardness is given.

Effective Case Depth Examples

Induction harden internal spline teeth.

Apparent hardness: R15N 80.4 minimum at depth .050 - .070 Partical Hardness HV 100 635 Min.

While not specifically called out as “Effective Case Depth”, they are calling for a specific hardness at a specific depth.

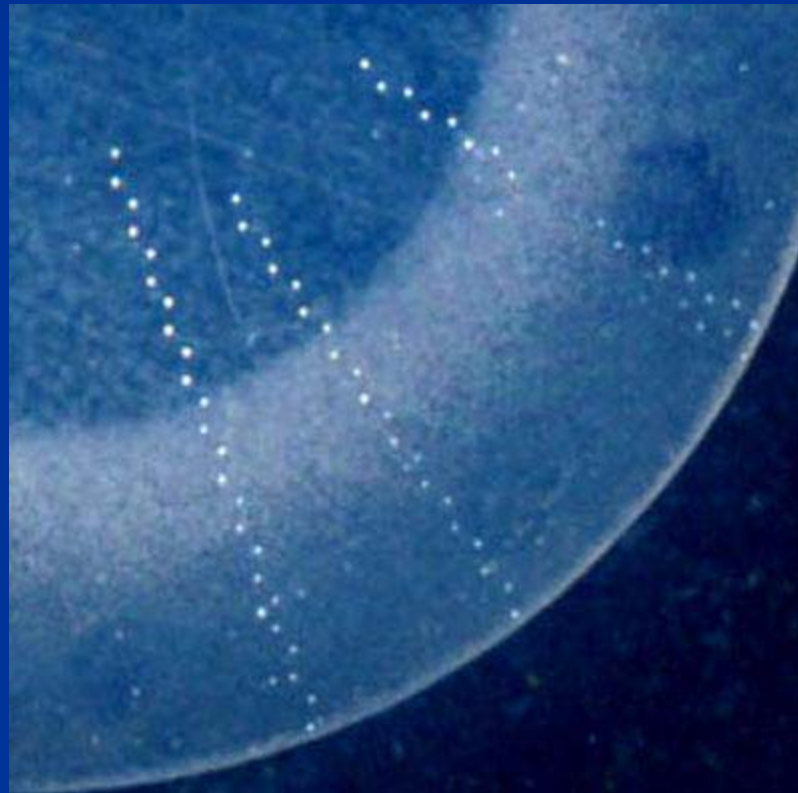
Measuring Effective Case Depth

- Measured by Hardness testing
(usually 15N Scale or Micro Hardness)
- Measurements taken with a Hardness Traverse method.



Measuring Effective Case Depth

Hardness readings are taken until the specified hardness is reached and then the depth is measured.



Case Depth Summary

- When reading a print or spec. the following things will help you determine whether it calls for “Total Case Depth” or “Effective Case Depth”.
 1. If the specific word “Total” or “Effective” are used then it should be straight forward.
 2. If a hardness at a certain depth is specified then this would mean, “Effective Case Depth”.

Case Depth Summary Cont.

3. If a depth but no hardness is given, this would be “Total Case Depth”.
4. If Surface hardness is specified along with a depth, this would be “Total Case Depth”. Do not confuse Surface hardness values with Effective Case Depth values.

Case Depth

Questions and Answers:

Case Depth

Thank You joining us today!

If you have any further questions or comments
we would love to hear from you at :

(330)483-4650

Or online at:

www.zioninduction.com