Metal Locking Service Inc.
MLS Machine Shop

"FIRST AID FOR METAL"

Metal Stitching • On-site Machining • Turn-key Rebuilds • Fabrications

Crosshead Guide Repair Proposal

www.castironrepair.com

Who we are…

Metal Locking Service Inc./MLS Machine Shop

Founded in 1942, our company pioneered the repair of cast machine parts, without the use of heat.

We now service industry world wide and an ever increasing list of satisfied customers confirms our success at effecting prompt, dependable service.

Table of Contents

What we are proposing and why…

- We have developed a mechanical procedure for repairing sustained damage to the crosshead guide area.
- We feel that your company would be better served by utilizing a time proven mechanical repair for your cast iron frames.

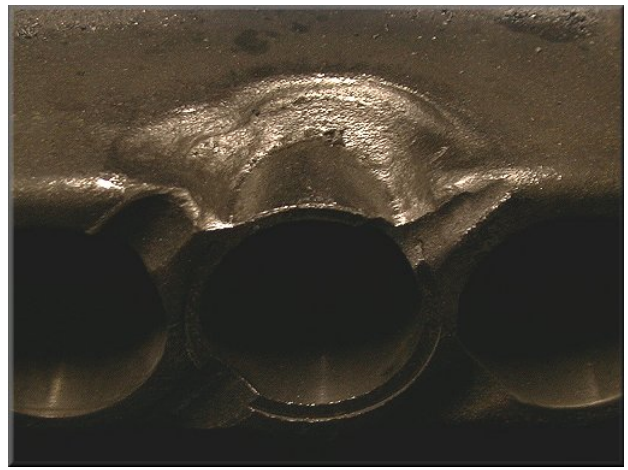
Damaged cam, aluminum liner, and crosshead guide (note center section)

Understanding the problem…

When failure occurs, for whatever reason, in the crosshead guide area, it is our understanding that there are currently only two options:

- **Option 1**
  Repairing the damage by inserting and welding a steel liner in the affected bores.

- **Option 2**
  Scrapping of the engine frame.



Close up of the damaged bore with the inserted steel liner yet to be welded

Reviewing the options…

- **Option 1 (Lining the bore with a steel sleeve and welding)**

  We feel that a mechanical repair is better suited than welding for two primary reasons:

  1) **The integrity of the casting has been compromised.**
     a) The broken area is being replaced with a steel liner.
     b) Stresses are being imposed on the casting, due to welding, which are prohibitive to longevity.
     c) The liner is shouldering the burden of strength.
  2) **Aluminum and steel liners possess different characteristics.**
     a) Thermal expansion rates differ
     b) Heat transmission rates differ
     c) Possible differences in lubrication qualities

Reviewing the options…continued

- **Option 2 (Scrapping)**

  Our repair procedure, which is outlined on the following pages, will help to eliminate scrapping many of your frames due to damage in the crosshead guide area.

Our proposal for repair…

Metal Locking Service is successfully utilizing the following repair method in the field. We would like to see this approved for use during the refurbishing process at your facility.

Our proposed procedure can be broken down into four major steps.

1) The preparation of the replacement casting
2) The removal of the affected area
3) The fitting and locating of the replacement casting
4) The final component installation

Preparing the replacement casting…

Rough casting (left side) and finish machined casting (right side)

- Requisitioning a Grade 40 casting
  - Local order for quick turnarounds
- Machining to developed specifications
  - Finish bores to size
  - Facing of the mating surface
  - Location and drilling of the bolt pattern
  - Facing the attachment ribs

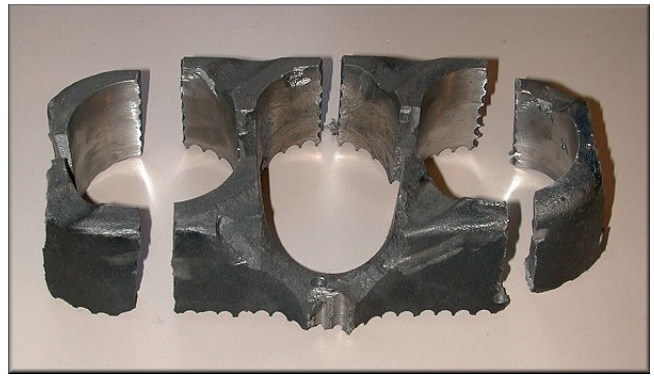
We keep a minimum of two completely machined castings at our facility at all times.

Removing the affected area…

- Dye penetrant/magnaflux is used for determining the extent of the damage.
- Drilling and ripping away the damaged material is done in sections.
- Machining the mating surface.

A cutter is located on each individual bore for machining purposes.

The ribs are hand fit to mate with the replacement casting.



Damaged casting removed via drilling along a plane and removing with an air chisel

Fitting and locating the replacement casting…

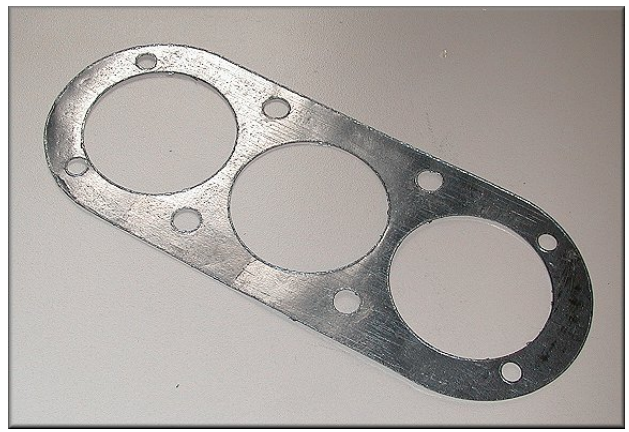
Typical Aluminum Liner used for alignment

- Two aluminum liners are inserted in the outside bores for aligning the replacement casting.
- A powdered developer is used for lapping the mating surfaces.
- The replacement casting is clamped in place.
- The replacement casting is used as a guide for drilling and tapping the head and face bolts.

The final component installation…

The last step in our repair is the installation/assembly of all the components.

- The replacement casting is clamped in place with the gasket sandwiched between.
- The head and face bolts are torqued to recommended values.
- The middle and side ribs are pinned and locked in place.
- The bolt heads are locked with lacing.
- The interior face receives two locks perpendicular to the joint line.



Graphite head gasket

The component list…

The complete assembly consists of six components. They are:

- ✓ One (1) replacement casting (Grade 40 cast iron)
- ✓ One (1) graphite gasket (note following pages for attributes)
- ✓ Four (4) 7/16” and six (6) 5/16” Unbrako brand head/face bolts
- ✓ Two (2) sets of annealed alloy locks
- ✓ Various alignment pins
- ✓ Various annealed Invar lacing and locktite

All components are of the highest quality.

The graphite gasket proven…

A very thorough search was undertaken to find the best gasket material for our application. Graphite is clearly the best due to it's following attributes:

- Graphite withstands temperatures from -200ºC to 1650ºC. It is resilient across the entire temperature range for any length of time.
- Completely unaffected by fatigue, graphite copes perfectly with changes in stress due to frequent hot/cold cycles, as well as with pressure fluctuations and vibration.
- Graphite is resistant to nearly all aggressive media such as highly concentrated acids, solvents and hot oils.
- Graphite is free from corrosion, embrittlement and ageing.
- Graphite is physiologically inert and lasts indefinitely in virtually any fluid sealing application.
- Flange distortions are reliably compensated for.

***Gasket information was gathered from various manufacturer's websites**

The prototype test subject…

The portable prototype

To test the feasibility of our procedure, we performed a mock repair on a scrap frame in our shop.

This prototype repair has enabled us to:

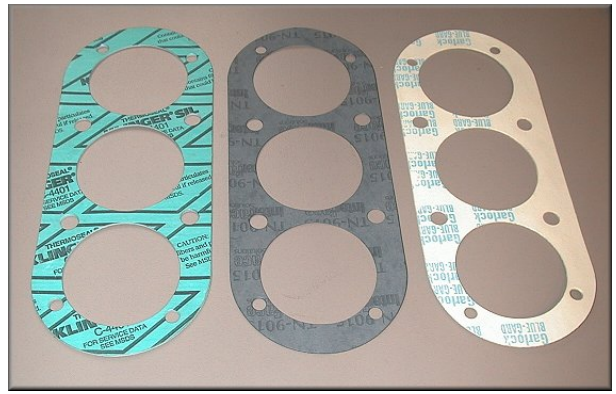
- Test a wide array of components.
- Prove our procedure.
- Prove our testing device.
- Provide a portable model for scrutiny.

Testing our procedure…

Testing revolved around two main areas of concern:

1) The gasket
   a. Material choice (Klinger-Thermoseal, Garlock-Blueguard, Interface-TN and pure Graphite).
   b. Thickness.
   c. Sealing characteristics.
   d. Durability through the repair.

2) The testing device
   a. Function.
   b. Portability.



Various gaskets that we tested

Testing device (1 of 6)

Testing results…

To prove both the gasket and the testing device, we subjected them to a series of hydrostatic tests.

By following the hydrotesting procedure (attachment) we were able to test and verify:

- Maintainable pressures in excess of 300psi (more than 200% above the maximum operating pressure of 120psi).
- The portability and function of the testing device.

Verification and witness to the hydrotesting was performed by an independent inspector (Hartford Steam Boiler & Inspection Company). All testing was done at our Buffalo, NY facility.

Benefits…

Reduction in the amount of scrapped frames

Substantial cost savings

Quick turnaround times

GE’s customer relationships

Wrap up…

We have developed and tested a bullet proof procedure for repairing an area that continues to cut at the profitability of your company.

Our proposal is based on a time and performance proven repair that has been carried out in the field for many years.

Testing has verified pressures that are more than double the operating environment.

The graphite gasket provides for a perfect seal, yet it is resistant to your acid dip and aging.

In conclusion, we feel we have found an excellent way to repair damage to the crosshead guide area and our testing proves that the solution is viable.

Contact Information

Metal Locking Service Inc./MLS Machine Shop

216 Colgate Avenue

Buffalo, NY 14220

PH: (716) 824-4359 Toll Free: (866) FIX-IRON

Fax: (716) 824-0903

Email: info@castironrepair.com

Website: www.castironrepair.com