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April 11th, 1944.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1624.

Examination of Welded Bogie Suspension
Bracket from Snowmobile.

Bureau of Mines
Division of Metallic
Minerals.

Ore Dressing
and Metallurgical
Laboratories

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
Mines and Geology Branch

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Bracket from Snowmobile.

Origin of Material:

On February 7th, 1944, Mr. H. Stevenson, Assistant Director General, Army Engineering Design Branch, Department of Munitions and Supply, Ottawa, Ontario, submitted a snowmobile bogie suspension bracket for examination. This bracket was made by Messrs. Farand and Delorme, Montreal, Quebec, and is stated to be representative of production of that time.

The plant of Farand and Delorme, 433 St. Martin Street, Montreal, Quebec, was visited on February 16th, 1944, to obtain information and observe welding procedures. It was learned that the assembly was tacked with Wilson No. 98 electrode and finished with Hollup-type N electrode. The welding sequence and jigging were well planned and should be productive of good weldments. The welding supervision was better than is

(Origin of Material, cont'd) -

ordinarily encountered but the one supervisor is unable to completely supervise the work of all of the welders employed on this job.

It was noticed that the welders tended to use too high welding currents for the size of electrodes employed. It was also noted that in welding materials of unequal thicknesses the welders were directing the arc improperly. Fillet welding technique was also faulty in that improper inclination of electrode was employed, resulting in improper location of weld metal. All of the above were brought to the attention of the welder and welding supervisor, with the result that corrections were made.

Object of Investigation:

1. To examine the welding of the bracket with a view to evaluating the suitability of the welding technique.
2. To make recommendations to improve the welding technique should this prove to be necessary.

Procedure:

1. The suspension bracket was subjected to a thorough visual examination. Figure 1 shows the bracket "as received".
2. The shaft rings were subjected to an x-ray examination by the National Research Council, Ottawa. Figures 2 to 11 are reproductions of the exographs of the welds of the shaft rings. In examining these reproductions it should be borne in mind that there is an inevitable loss of sensitivity in the reproduction process and that the colours of the reproduction are the reverse of the exograph itself.
3. Macro sections were machined from the welds of the shaft rings in those areas in which the exographs indicated the presence of welding defects. Figures 1, 12, 13 and 14 show the

(Procedure, cont'd) -

areas from which the samples were removed. Figures 15 to 17 show the macro samples after polishing and etching.

Discussion:

A visual examination of the bracket reveals considerable undercutting, irregular welds, and improperly located weld metal. The x-ray examination reveals porosity, undercutting, slag inclusions, and lack of fusion. All of the above are confirmed by macro examination and, in addition, there is some evidence of poor fit-up.

Porosity, undercutting and slag inclusions are probably the result of using too high a welding current. This leads to a pronounced boiling action of the molten metal which is then difficult to control and direct. In the fillet welds around the strap joining the shaft ring to the main body, lack of fusion at the root of the weld is probably the result of improperly cleaned surfaces. All scale, dirt and grease should be removed before welding.

There is room for improvement in the fit-up of parts to be welded. It cannot be reasonably expected that the welding technique can in any way compensate for poor alignment of parts to be welded. The electrode used should be quite suitable for this part.

It will be noted from the above that the majority of the above defects arise from the errors in technique of the individual welders. Such defects are not unusual and may be readily eliminated by instructing welders on proper welding currents, electrode inclination and arc direction on parts of unequal thicknesses. To ensure that these instructions are followed constant supervision and correction are required.

CONCLUSIONS:

1. The welding technique used is open to criticism. The following defects were found: porosity, undercutting, slag inclusions, and lack of fusion.

2. The electrodes and jiggling method are good and should permit production of satisfactory parts.

3. Poor fit-up and lack of fusion are easily remedied by close attention to matching of parts and cleaning before welding.

4. The welding defects found should be easy to eliminate. Instruction and supervision of welders as outlined above should have the desired effect.

Recommendations:

1. Every effort should be made to improve fit-up of parts to be welded.

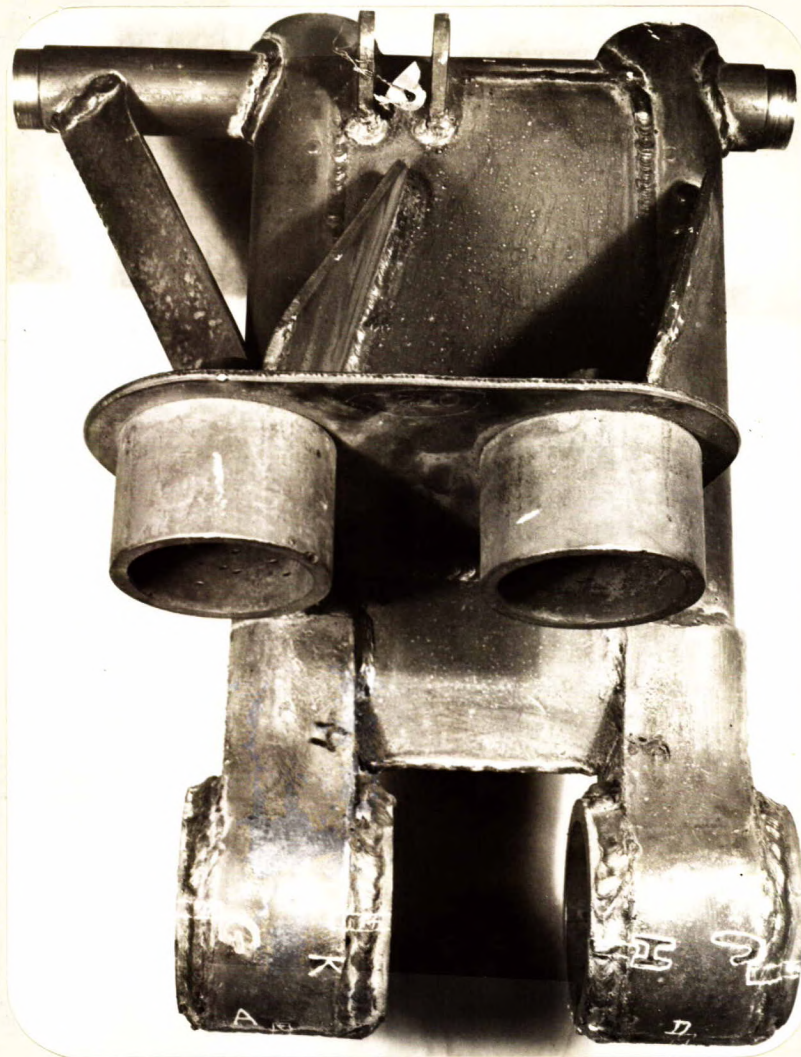
2. Surfaces to be welded should be cleaned of all scale and dirt.

3. Welding supervision should instruct welders on the effects of too high welding currents, improper electrode inclination, etc., and attempt to ensure that instructions are carried out.

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HJN:GHB.

Figure 1.



BRACKET IN 'AS RECEIVED' CONDITION.

White rectangles indicate areas from
which macro samples were received.

Figure 2.

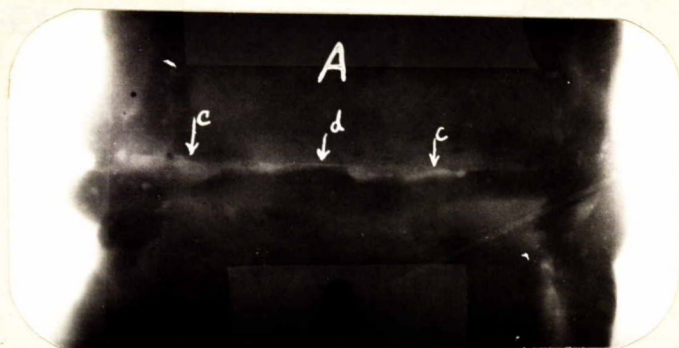


Figure 3.

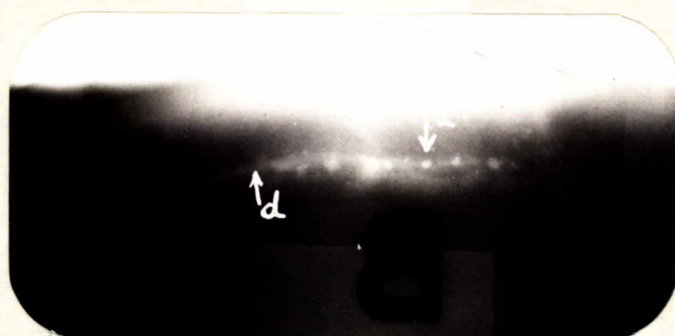


Figure 4.



Legend: a - porosity or gas inclusions.
b - undercutting.
c - slag inclusions.
d - lack of fusion.

Figure 5.



Figure 6.



Figure 7.



Legend:

- a - porosity or gas inclusions.
- b - undercutting.
- c - slag inclusions.
- d - lack of fusion.

Figure 8.



Figure 9.

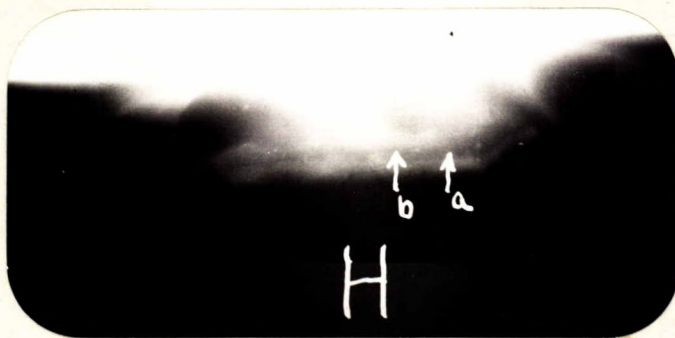


Figure 10.



Legend:

- a - porosity or gas inclusions.
- b - undercutting.
- c - slag inclusions.
- d - lack of fusion.

Figure 11.

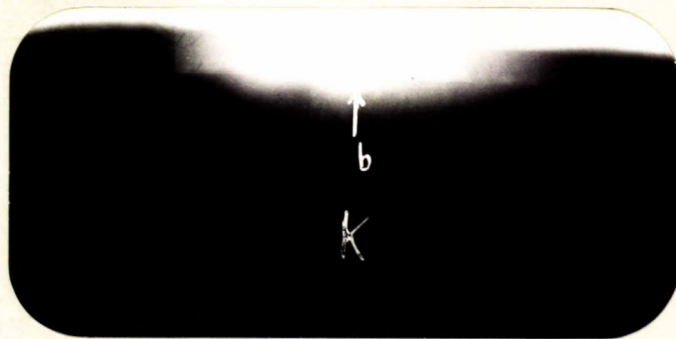


Figure 12.



CLOSE-UP OF ONE SHAFT RING.

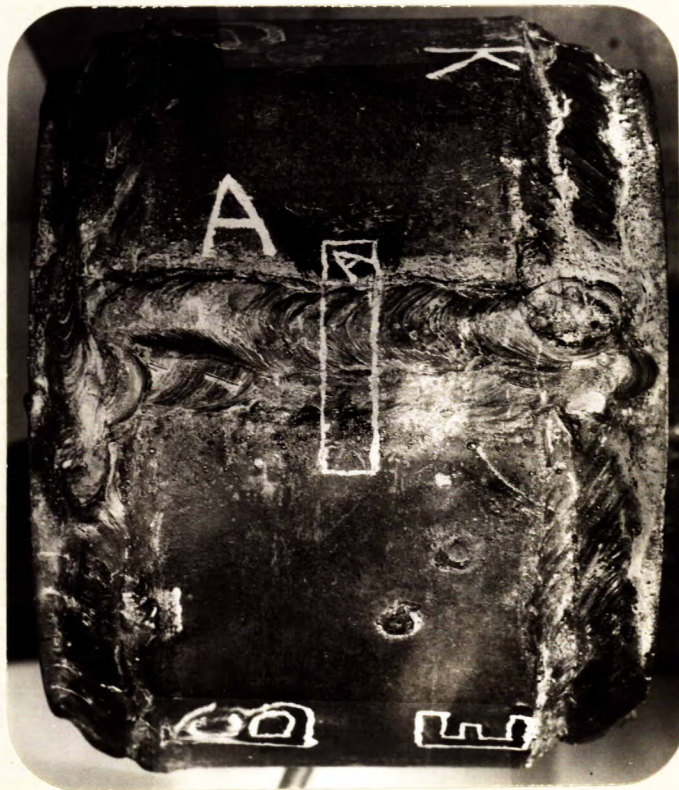
White rectangles indicate areas from
which macro samples were machined.
Note irregularity of welds.



CLOSE-UP OF WELD JOINING ENDS OF STRAP.

Note irregular width of weld.
White rectangles indicate areas from
which macro samples were machined.

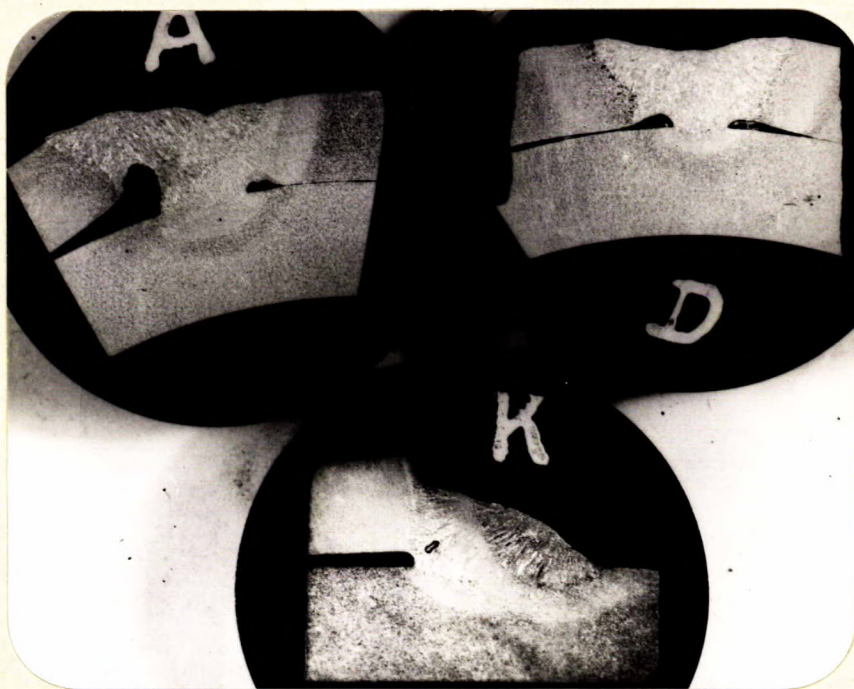
Figure 14.



CLOSE-UP OF WELD JOINING ENDS OF STRAP.

Note irregularity of welds. White
rectangles indicate areas from which macro
samples were machined.

Figure 15.



MACRO SAMPLES OF WELDS OF SHAFT RINGS.

Letters same as in exographs and macrophotographs.

<u>Sample</u>	<u>Comment</u>
A	- Gas inclusion at root of weld. Low penetration. Poor fit-up on right side.
D	- Penetration low.
K	- Good weld with small gas inclusion.

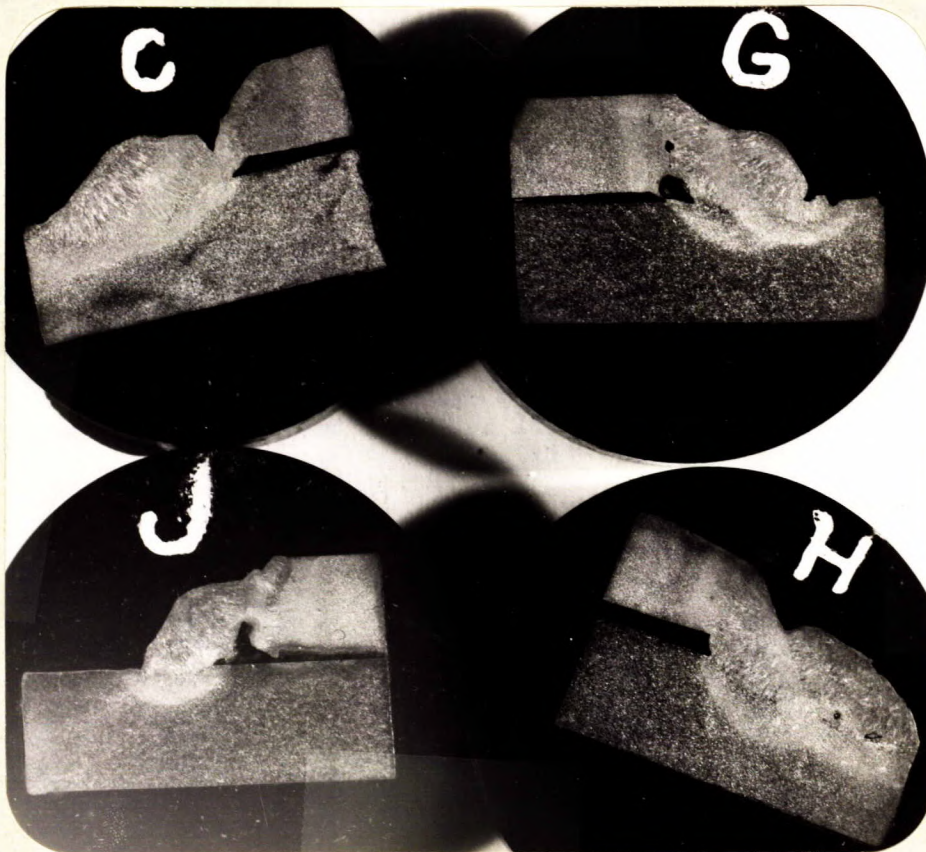
Figure 16.

MACRO SAMPLES OF WELDS OF SHAFT RINGS.

Letters same as in exographs and macrophotographs.

<u>Sample</u>		<u>Comment</u>
B ₁	-	Large gas inclusion at root of weld. Good penetration.
B ₂	-	Undercutting on vertical edge. Poor location of weld metal. Poor fit-up.
E	-	Good penetration; slight undercutting. Poor fit-up.
F	-	Poor penetration at root of weld. Very irregular and gassy weld.

Figure 17.



MACRO SAMPLES OF WELDS OF SHAFT RINGS.

Letters same as in exographs and macrophotographs.

<u>Sample</u>	<u>Comment</u>
C	- Poor fit-up; severe undercutting. Penetration good.
G	- Gas inclusions at root of weld. Penetration good.
J	- Lack of fusion at root of weld.
H	- Poor fit-up; some undercutting and gas inclusions.