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January 24th, 1944.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1581.

(Subsequent to Report of Investiga-  
tion No. 1462, August 2nd, 1943.)

Welded Packard Merlin Engine Exhaust  
Stubs for Mosquito Aircraft.

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Introduction:

In July, 1943, welded exhaust stubs were examined on behalf of the Department of National Defence, Air Service, Ottawa. The examination revealed numerous and serious defects. In the report covering this investigation (O.D.M.L. Report No. 1462, dated August 2nd, 1943), photographs of these defects were shown and their probable causes, together with recommendations for their elimination, were given. The stubs examined in this investigation were welded by the De Haviland Aircraft of Canada Limited, Toronto, Ontario.

As a result of the above investigation, the welding of these stubs was assigned to the Cockshutt Plow Company Limited, of Brantford, Ontario.

On January 18th, 1944, F/O N. S. Spence, R.C.A.F., on behalf of the Department of National Defence, Air Service,

(Introduction, cont'd) -

Ottawa, submitted for examination one single and one dual exhaust stubs welded by Cockshutt Plow. It would appear that the stubs now being manufactured, of which these samples are stated to be representative, are giving satisfactory service. In the present report, evidence is given that such improved service may be expected.

Object of Investigation:

To examine the welding of the exhaust stubs and to submit, if possible, recommendations for improvement of the welding technique.

Procedure:

- (1) The two stubs were examined visually for surface defects.
- (2) Both stubs were subjected to an x-ray examination by the National Research Council, Ottawa.

Discussion:

A visual examination of the welds revealed evidences of good workmanship. All welds on the outside are low and smooth. The welds on the inside reveal a little more irregularity of thickness and width than is desirable. It is appreciated, however, that without the use of back-up bars no great improvement is possible along this line. It would, nevertheless, be desirable to emphasize to the welders the necessity of holding penetration to that amount which just gives complete joint penetration. A small increase in welding speed with the present technique would have the desired effect.

An x-ray examination revealed no defects of any importance but did provide evidence that some improvements in welding technique are possible. In view of the absence of major welding defects it was not considered necessary to section

(Discussion, cont'd) -

the stubs for a closer examination.

It was noted that the sleeve of the stub had been spot-welded towards the casting end. Radiographs showed evidence of too high a welding current in making these spot welds, in that metal had been ejected from the weld "nugget", forming a very tiny hole. An examination of the timing cycle of the spot-welding machine would probably reveal a slight wandering from the original setting.

The fillet welds joining the sleeve material to the casting show a thin sharp line of entrapped slag towards the casting side of the weld. This defect is fairly common and every effort should be made to eliminate it. It is thought that this defect has been caused by the faulty positioning of the joint prior to welding. Apparently, the molten pool has sagged away from the casting, permitting slag to float to the upper side of the weld. Positioning the joint so that the molten pool is flat will probably eliminate this. It is suggested that this point be called to the attention of the welders.

In summary, it may be stated that the welding is vastly superior to that of the stubs previously examined. It is our opinion that the welding is satisfactory, but that some improvement can still be made.

CONCLUSIONS:

1. The welding of the exhaust stubs is considered to be satisfactory. Some improvement is possible, however.
2. The spot welds indicate the use of current levels slightly on the high side, permitting metal ejection from the nugget.

(Continued on next page)

(Conclusions, cont'd) -

3. Penetration varies slightly more than is desirable.

4. Fillet welds around the casting end of the stubs show entrapped slag.

Recommendations:

1. The timing cycle of the spot-welding machine should be checked and adjusted to slightly lower current values.

2. The welders should be cautioned that the penetration being secured is varying more than is desirable. It should be pointed out that excessive penetration, resulting in a high bead on the inside of the weld, is highly undesirable.

3. An effort should be made to so position the stub that when the fillet weld joining the sleeve to the casting is made, the molten pool is in the flat position and reaches to the top of the casting edge.

HJN:GHB.