O T T A W A March 16th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1180.

Examination of Springs,
Part No. 5277Q5.

(Copy No. 10.)

BUREAU OF MINES
DIVISION OF METALLIC MINERALS

ORE DRESSING AND
METALLURGICAL LABORATORIES

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

O T T A W A March 16th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1180.

Examination of Springs,
Part No. 5277Q5.

Origin of Request and Object of Investigation:

On March 10th, 1942, Mr. A. S. Lane, Inspector-in-Charge, British Air Commission, Canadian Aircraft Group, Montreal, Quebec, submitted for examination six springs, Part No. 5277Q5. Accompanying these springs was Mr. Lane's letter of March 9th, File No. CANAID/M.244/9449, and also a copy of Specification No. DTD 187A which is the Air Ministry Material Specification For Spring Steel Strips.

Mr. Lane stated in his letter that the springs,

(Origin of Request and Object of Investigation, cont'd) -

in their present condition, were soft and therefore unserviceable. He requested that we determine whether the chemical analysis or the heat treatment was at fault.

Figure 1 is a photograph, natural size, of the spring.

Physical Tests:

Vickers hardness tests were conducted on all the springs, using a 5-kilogram load. The results are given in Table I.

Table I.
Hardness Tests.

No. tested	Small end	Middle	Large end
3	240	300	446
1	409	227	216
1	197	203	247
1	274	232	249

It is specified, in Specification DTD 187A, paragraph 8(b), that these springs shall have a hardness of not less than 380 Brinell (395 Vickers) nor more than 460 Brinell (493 Vickers).

Chemical Analysis:

The chemical analysis obtained and the specified analysis according to Specification No. DTD 187A are as follows:

		Spring, Part No. 5277Q5.	Specification No. DTD 187A.
Carbon, per cent	-	0.78	0.70 minimum
Manganese, "	-	0.54	1.0 maximum
Silicon, "	-	0.23	0.3 maximum
Phosphorus, "	-	0.009	0.05 maximum
Sulphur, "	-	0.030	0.05 maximum.

Microscopic Examination:

One of the springs having high hardness values in the large end and low hardness values in the small end was prepared for microscopic examination. Figures 2, 3, 4, and 5 are photomicrographs at 500 diameters taken from areas starting at the soft end and working towards the hard end. The etching reagent used was 4 per cent picric acid in alcohol.

Discussion of Results:

Chemical analysis shows that proper material was used.

The variations in hardness would indicate irregularities in the heat-treating practice. This is confirmed by the microscopic examination.

Figure 2, which was taken from the soft end, would indicate that the steel was probably in the spheroidized condition for fabrication.

An examination of Figure 5 reveals that, while the metal in this area is entirely sorbitic, there still remain some undissolved spheroidized carbides. This could mean that the steel in this area was not held at the quenching temperature for a long enough period of time to dissolve all the carbides.

The presence of a little sorbite in the soft end (Figure 2) indicates that the steel in this end probably was heated to a temperature just over the AC_1 temperature. As we progress towards the hard end (Figures 3 and 4) the increasing amount of sorbite present indicates that the temperature of the steel is gradually approaching the AC_3 temperature and Figure 5 could be interpreted as meaning

(Discussion of Results, cont'd) -

that the temperature of the steel in the hard end had exceeded the AC_3 temperature slightly.

Conclusions:

1. The chemical analysis is in full compliance with Specification No. DTD 187A.

2. The heat treatment practice is faulty, resulting in erratic quality of product.

Recommendations:

Proper precautions should be taken that these springs be uniformly heated to the proper quenching temperature (860° C.). This heating should be done under such conditions that the danger of decarburization is minimized.

oooooooooooo
oooooo
oo

HVK:GHB.

Figure 1.

PHOTOGRAPH OF SPRING, PART NO. 5277Q5.
(Natural size).

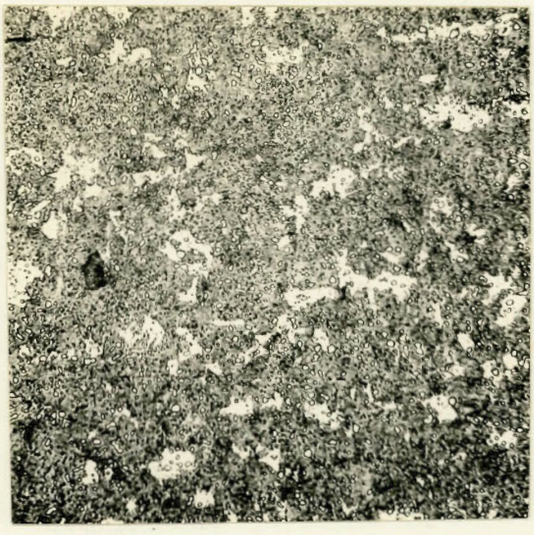
Figure 2.

X500, picral etch.
PHOTOMICROGRAPH OF SOFT END.

Figure 3.

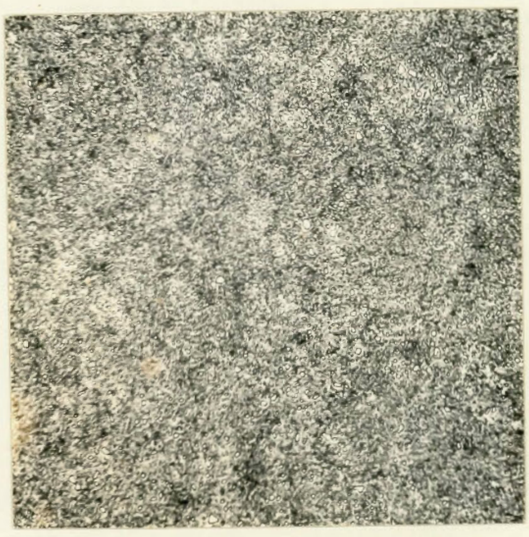
X500, picral etch.
PHOTOMICROGRAPH OF INTERMEDIATE ZONE.

Figure 4.



X500, picral etch.
PHOTOMICROGRAPH OF
INTERMEDIATE ZONE.

Figure 5.



X500, picral etch.
PHOTOMICROGRAPH OF HARD END.

HVK:GHB.