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An ISO 9001:2015 Certified Company

REPORT XYZ-005

ASSESSMENT OF A SILVER CONDUCTIVE EPOXY

Submitted to:

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Background

A number of LED snow plow headlamps with heat grid exhibited a functionality issue. Due to the fact that LEDs do not radiate heat, a heat grid has applied to the lens to melt snow build up during winter.

Conductive ink from Henkel EDAG 479SS E&C was used to print the heat grid on the B side of the lens (reference attached drawing H4139-6).

A circuit board (heat grid controller) has attached to the lens to control power to the heat grid using conductive epoxy from MG Chemical part # 8331S (reference attached drawing MG8331S). After applying the conductive epoxy paste, the lenses with the heat grid controller were baked inside the oven at +65C for 2 hrs.

The issue we are having is that the conductive epoxy which makes electrical contact between the controller circuit and the heat grid on the lens has increased resistance. 8pcs out of 126pcs exhibited failure. The resistance of the heat grid which is around 12ohms was measured over 50ohms at the controller.

Therefore, a request was made to X-Ray the contact as shown below on two headlamps, as well as to establish the degree of curing of the conductive epoxy.


X-Ray to find any voids

Test Procedure

The contact areas from two of the headlamps exhibiting the problem were inspected in an X-ray machine. Upon completion of the inspection, a sample of the epoxy was collected from one of the lamps and ran through a differential scanning calorimeter (DSC), in order to establish the degree of curing.

Glass transition temperature (T_g) was measured during a first and second heating of the epoxy and delta

T_g value (difference between the parameter measured during first and second heating) calculated.

Results and Discussion

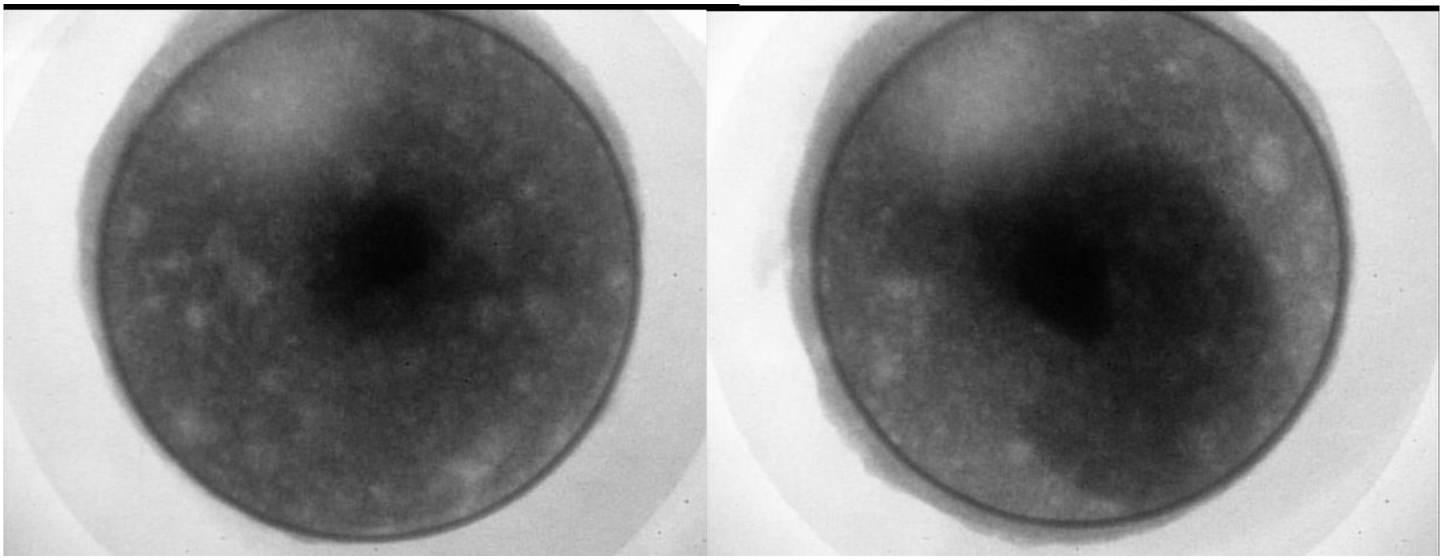
Typical results of the analysis are shown in the Figures1 through 3 below. As can be seen from the results of X-ray inspection of the areas of interest, no voiding but rather areas with different shades of grey were observed in the conductive epoxy of both headlamps – Figs. 1 and 2. Brighter contrast areas indicate the presence of fewer Ag particles, compared to the darker looking areas.

Cross-sectional SEM analysis of the areas might be beneficial in understanding the distribution of the particles in the epoxy.

DSC analysis of the epoxy showed that it was properly cured as glass transition temperature (Tg) was measured at 28^0C during both cycles of heating - Fig 3.

Conclusion

Based on the findings it seems reasonable to conclude that additional tests would require to shed more light on the root cause of the functional failure of the headlamps.



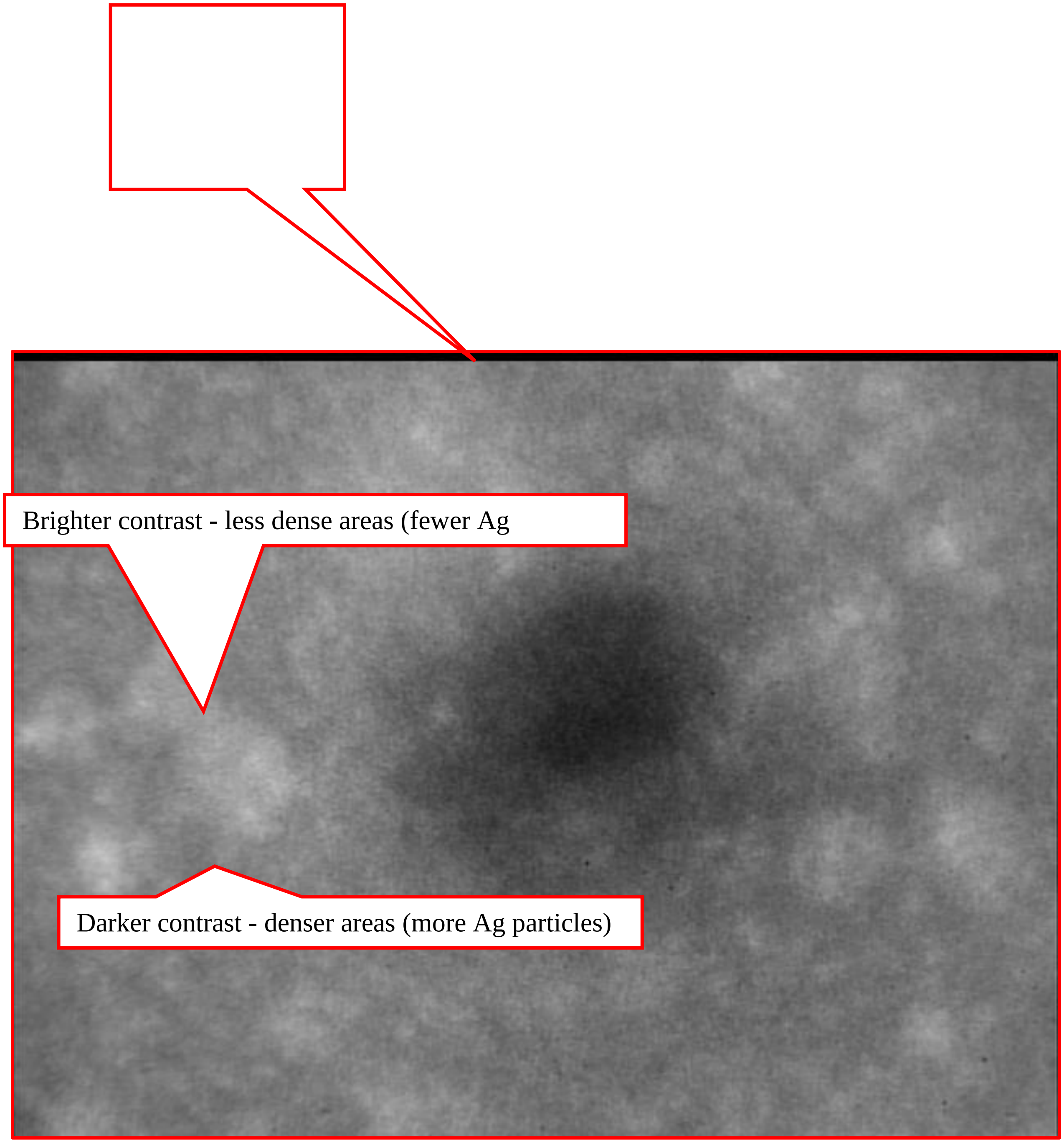


Figure 1. Typical results of X-ray inspection of a fist headlamp (37.4 Ω).

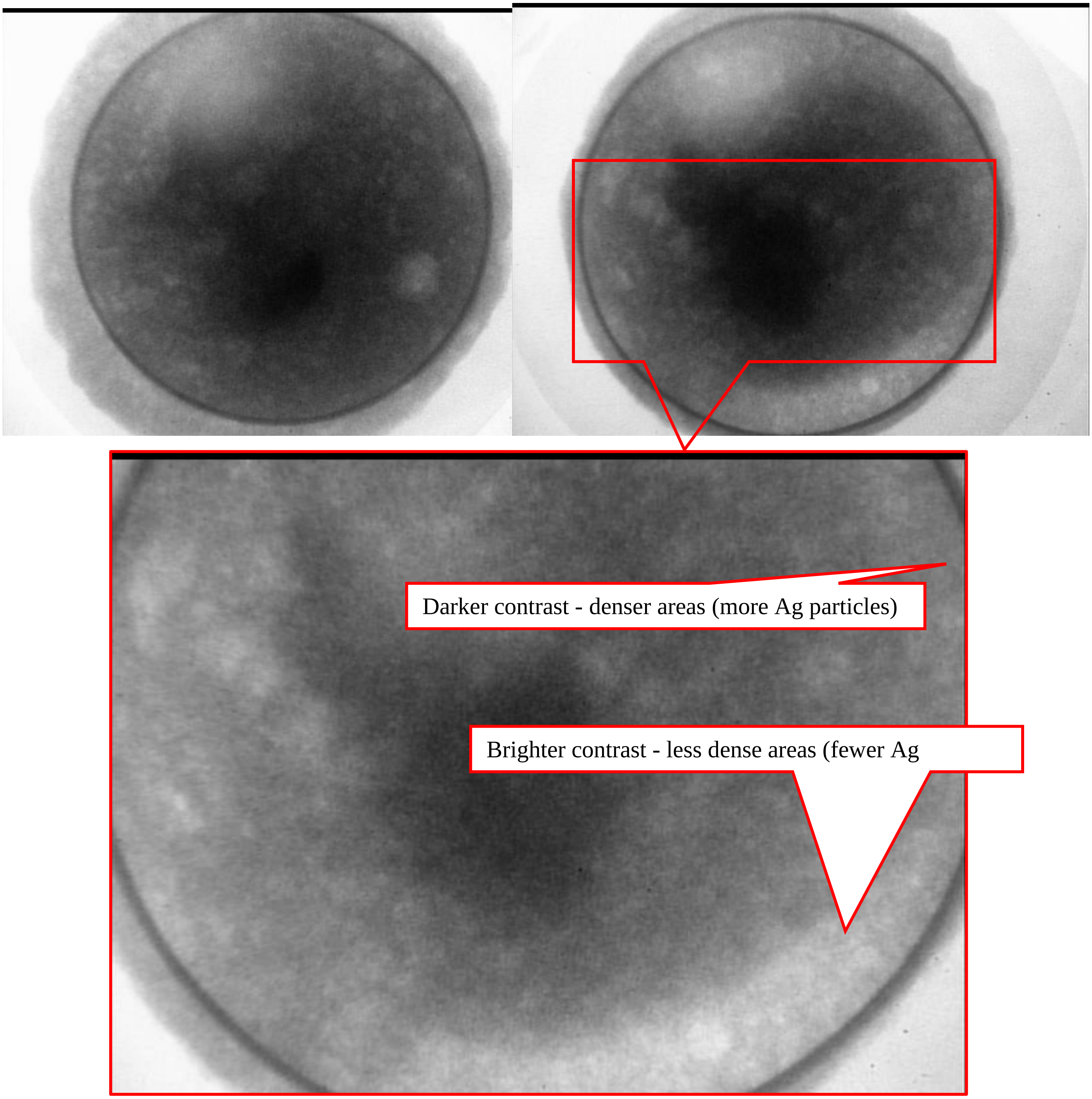


Figure 2. Typical results of X-ray inspection of the second headlamp (300 Ω).

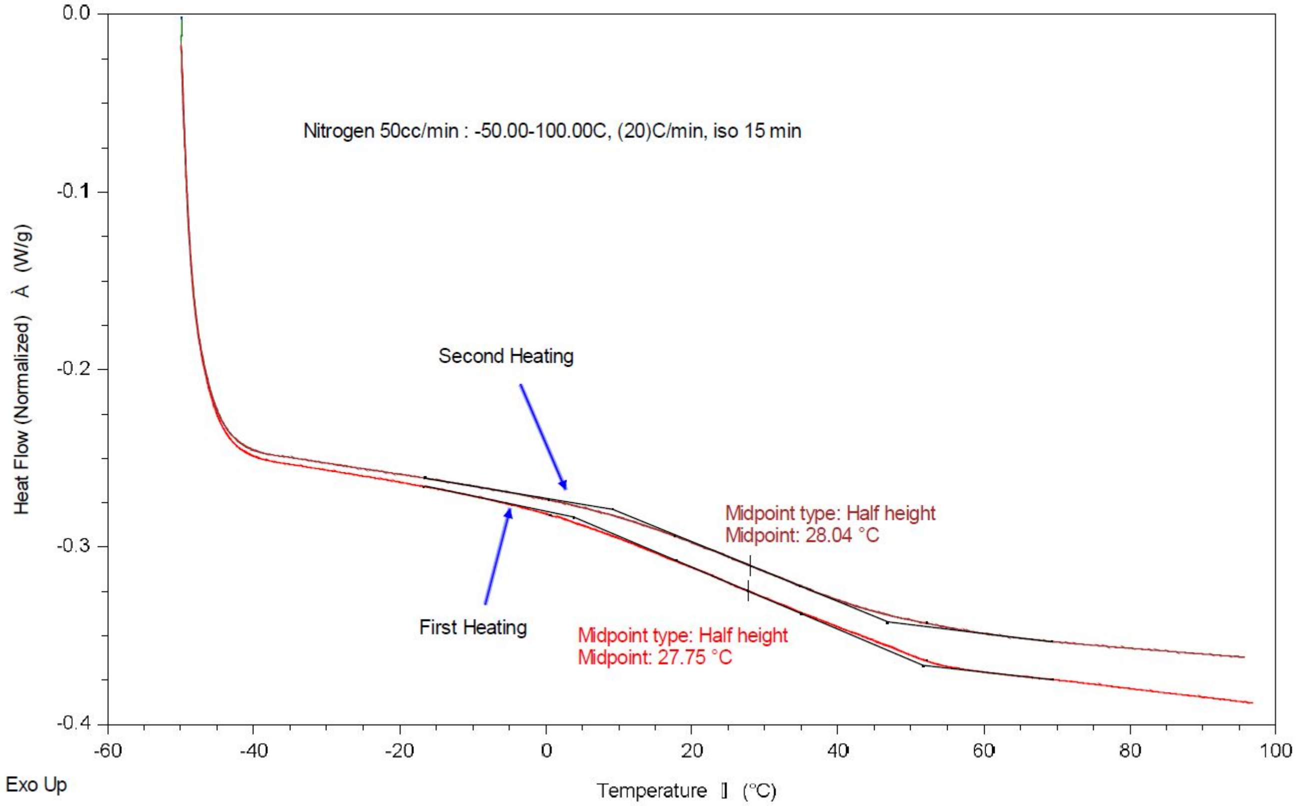


Figure 3. Typical results of the DSC test. The epoxy was cured properly.