



About This Paper

This technical paper is supplied as a service to our customers to clarify the appearance and electrical parameters of the ITG Molded Inductors SM and SMHC Series. The incentive is that it will give our customers a better understanding as to the type of cosmetic irregularities that may occasionally occur during the manufacturing process of the component or during the use of the component.

INTRODUCTION

Surface Irregularities

The following pages include descriptions of the most common irregularities seen on SM and SMHC inductors. Common causes are described along with variations in their magnitude. Customers may, at some time, see one or all of these irregularities. Those that are determined to be in a position to adversely affect the customer's use of the component are rejected at the factory level but minor (acceptable) irregularities will occasionally be present. With the use of this guide a customer will better understand the nature of each irregularity.

Definition of Molded Inductor Surface

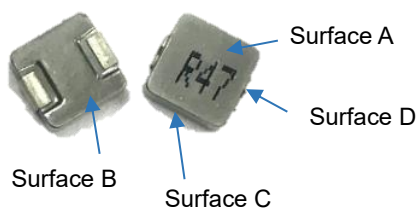


Figure:1 Surface of inductor

Surface A: Marking Surface (Top Surface).

Surface B: The surface with Pads (Bottom Surface).

Surface C: Side without Pad.

Surface D: An extended surface with an electrode.



Limits/Types of Surface Irregularities

CRACKS

Cracks on the inductor body do occur during the manufacturing process. This can happen because:

1. Small cracks are caused by die wall friction when the parts are ejected during the pressing process.
2. And by the expansion of the coil during the process of curing the resin binder in the powdered iron body.

Unlike with ferrite material, cracks on the SM/SMHC body do not affect the electrical performance of the component. Reliability testing has shown that even cracks in excess of 0.005 inch will not alter the electrical characteristics of the component or cause a physical breakdown during field applications. Acceptance widths are adopted based on the ability to detect cracks both at the component and circuit level.

Micro cracks are acceptable (pictures shown at 40 times magnification).

Micro cracks are those that are nearly invisible without magnification (The crack does not extend to the edge of the body). Figure 2,3, and 4 are on all surfaces of different inductors.

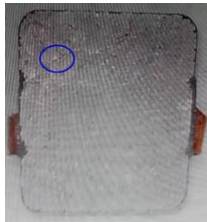


Fig. 2. Surface A



Fig. 3. Surface B

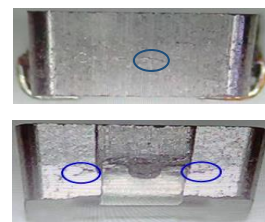


Fig. 4. Surface C and D

Minor cracks (Picture shown at 40 times magnification).

Minor cracks are those that are visible without magnification but are not apparent without close inspection. Surface A Crack (The crack does not extend to the edge of the body):

Figure 5 is acceptable surface A, figure 6 is rejectable surface A.



Fig.5. Surface A acceptable.



Fig.6 Surface A rejectable.

Appearance Criteria for Molded Inductors

Surface B crack:

Surface B cracks should not exceed half of the length of the part and the cracks are not extended to the edge of the body. Figure 7 is acceptable surface B. Figure 8 is rejectable surface B.



Fig.7. Surface B acceptable.

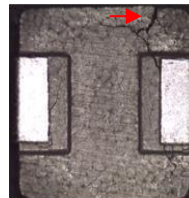


Fig.8 Surface B rejectable.

Surface C Crack:

If the length of the crack to the edge of the body is $< 1.3\text{mm}$, it is rejectable like figure 11.

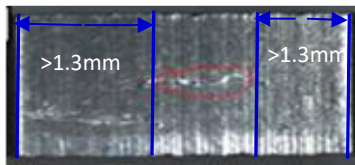


Fig.9. Surface C acceptable.



Fig.10 Surface C acceptable.

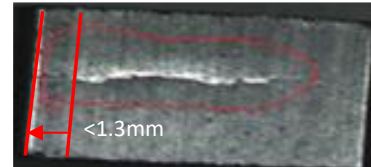


Fig.11 Surface C rejectable.

Surface D Crack:

The length of crack is not extended to the R angle it is acceptable as in figure 12 and 13.

Figure 14 is rejectable.

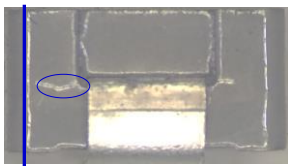


Fig.12. Surface D acceptable.

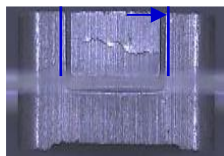


Fig.13 Surface D acceptable.



Fig.14 Surface D rejectable.

Moderate cracks are rejectable

Moderate cracks are those that are obvious upon examination and continue across most of the component as shown in Figure 15, 16, 17.



Fig. 15. Surface A



Fig. 16. Surface B



Fig. 17. Surface C and D



Major cracks are rejectable

Major cracks are those that are obvious to a customer and would possibly result in large chip-outs that would expose the coil and lead frame. As shown in Figure 18,19,20.



Fig. 18. Surface A



Fig. 19. Surface B

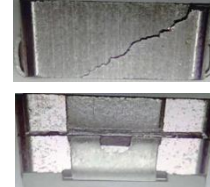


Fig. 20. Surface C and D

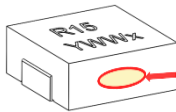
Chips

Chipping of the inductor body can occur during normal processing and testing of the inductor. The acceptance criteria for chipping varies with the size of the component are according to the acceptance Standards of IPC-A-610. The effect of chipping is negligible as long as the inductor coil is exposed to the air. Please refer to: IPC Standard class 1 and 2 components.

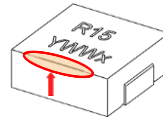
Reference for the area of chipping (Minor chipping, acceptable)

Table 1 is all kind of chip off area.

(a)



(b)



(c)



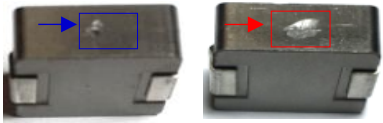
When the chip off is on 1 face	When the chip off is between 2 faces	When the chip off is between 3 faces
Part Size $\geq 10(L) \times 10(W)$ mm : Length * width $\leq 1.5 \times 1.5$ mm ²  ≤ 2.25 mm ² , OK > 2.25 mm ² , NG	Part Size $\geq 10(L) \times 10(W)$ mm : Length * width $\leq 2.2 \times 2.2$ mm ²  ≤ 4.84 mm ² , OK > 4.84 mm ² , NG	Part Size $\geq 10(L) \times 10(W)$ mm : Length * width $\leq 2.7 \times 2.7$ mm ²  ≤ 7.29 mm ² , OK > 7.29 mm ² , NG
Part Size $< 10(L) \times 10(W)$ mm: Length * width $\leq 0.75 \times 0.75$ mm ²  ≤ 0.563 mm ² , OK > 0.563 mm ² , NG	Part Size $< 10(L) \times 10(W)$ mm: Length * width $\leq 1.0 \times 1.0$ mm ²  ≤ 1.0 mm ² , OK > 1.0 mm ² , NG	Part Size $< 10(L) \times 10(W)$ mm: Length * width $\leq 1.35 \times 1.35$ mm ²  ≤ 1.82 mm ² , OK > 1.82 mm ² , NG

Table 1. Chip off area.



Notes:

1. The part of chip off is two places or less.
2. Chips typically occur on the edges and corners of the inductor body. They are slightly darker in color and rougher in appearance than the surrounding material.
3. No coil wire or lead frame is showing and the chip does not affect the performance or reliability of the component.
4. Major chips in the inductor body are those that are very obvious to the customer and may expose the wire coil or lead frame.

Others

Two types of marking are acceptable

Ink-jet Marking: Marking can be identified by naked eyes and a minor missing dot is acceptable as shown in Figure 21.



Figure 21. Ink-jet Marking acceptable.

Laser Marking: A slight yellow substance on the laser marking surface is acceptable as shown in Figure 22. Severely rusty and extend to top surface is rejectable as shown in Figure 23.



Fig. 22. Laser Marking acceptable.



Fig. 23. Laser Marking rejectable.

Minor scratches on the surface of the inductor body are acceptable as shown in Figure 24.

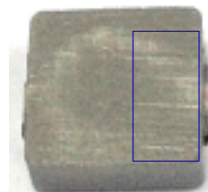
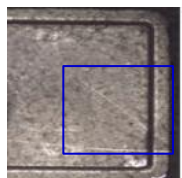


Figure 24. Minor Scratches

Appearance Criteria for Molded Inductors

Foreign material

If material appears on the side of the inductor body and will not affect the solder ability it is acceptable. If the material appears on the pad of the inductor as it may affect the solder ability, it is rejectable. As illustrated in figure 25.



Figure 25. Foreign material on side and on pad.

Electrode Indentation (unexposed copper)

If the electrode has an indentation and the copper is not exposed, it will be acceptable. As illustrated in figure 26 and 27. If the electrode has an indentation and the copper is exposed, it is rejectable. As illustrated in figure 28.

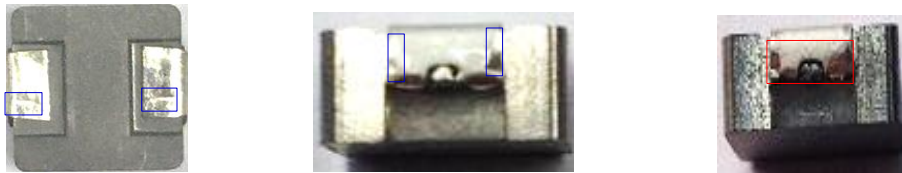


Fig.26. unexposed copper.

Fig.27 unexposed copper.

Fig.28 exposed copper

Skewed beyond the inner edge of the groove and residual coating of copper wire.

Please see figure 29 and 30. The figure 29 is skewed pad. The figure 30 is residual coating of copper wire. Both are rejectable.



Figure 29. Skewed pad.

Figure 30. Residual coating of copper wire.

The diameter of a point or pit $\leq 0.40\text{mm}$, five places or less is acceptable.

As illustrated in figure 31.



Figure 31. Acceptable point.



Coil exposed

The Coil being exposed is rejectable as shown illustrated in Figure 32.



Figure 32. Coil exposing inductors.

Rust on the surface

Rust on the surface is rejectable as shown in Figure 33.



Figure 33. Rust on the surface of inductors.

Conclusion

The ITG, SM & SMHC Series of products are molded technology inductors. Molding technology offers many advantages but the manufacturing process can and does result in minor imperfections. Cosmetic molded inductor body irregularities such as small cracks and chips as outlined above do not affect the electrical properties or the reliability of the component. If and when the surface irregularities do not meet the outlined acceptability criteria they are rejected at the factory level

ITG is one of the leading world-wide companies in the design and manufacture of a variety of inductors. If customers have any additional assembly or selection issues that may not be covered or satisfactorily explained in this document, please contact us at;

sales@itg-electronics.com.