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# PARTIAL DISCHARGE MEASUREMENTS IN INSULATION OF LOW VOLTAGE ASYNCHRONOUS MOTORS

## 1. Introduction

The aim of the work the part of which is presented in this report, was to proof the possibility of the application of partial discharge measurements to the quality control of the insulating systems low voltage asynchronous motors. It should be particularly proved if p.d. can appear under the influence of standard a.c. test voltage.

## 2. Results

The technique of p.d. measurements is up to now applied to high voltage insulating systems only because of the fact that partial discharges are initiated at relatively high electrical field stress. However, in the constructions of low voltage insulating systems, sharp edges, wire terminations, soldered joints ets. can exist, on which the conditions for discharges, particularly in the form of surface ones, at a determined voltage value may not be excluded. Bearing in mind that the standard a.c. voltage testing is carried out at the voltage value about 7 times greater than the normal operating voltage, p.d. inception during this testing is quite possible.

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The typical stress configurations in low voltage insulating systems are as follows [1]:

a) extrem inhomogenous,

b) middle homogenous.

Partial discharges in the models as above are of the form of creepage discharges. The investigation program has been done to determine the discharge characteristics of the above mentioned insulating models. The lowest discharge inceptionvoltages were found to exist in the models of b) type. Their values are in the range of about 0,5 up to 1,2 kV for creepage distances from 0,5 up to 10 mm. The phenol resin PS31 was used as the insulating material and the measurements were carried out at atmospheric conditions from 20/63 up to 40/95. The influence of humidity and temperature results in the decrease of p.d. inception voltage especially in the case of polluted surface.

According to the standards [2,3] the creepage distances in low voltage arrangements should ensure the discharge-and breakdown values to be not lower than those given in the table 1. The a.c. voltage testing of motor insulating windings is to be carried out at the voltage value of $U = 2 \cdot U_n + 1000$ V (e.g. 1,78 kV for $U_n = 380$ V).

T a b l e 1

Examples of discharge ($U_o$)- and breakdown ($U_b$) voltage in inhomogenous field, unpolluted surface, clim. cat. 20/63

| Creepage distance mm | $U_o$ kV | $U_b$ kV |
|---|---|---|
| 1,0 | 0,67 | 1,23 |
| 2,0 | 0,73 | 2,00 |
| 5,0 | 0,79 | 3,65 |
| 10,0 | 0,82 | 5,80 |
| 20,0 | 0,82 | 9,0 |

The measurements of partial discharges were carried out on the typical winding insulation of an asynchronous motor EMER L x 4 (made in GDR) in the voltage range up to the standard test voltage equal 1,78 kV. The first unstable discharges occured at the voltage value of 0,75 kV, while the p.d. inception value was determined to be 1 kV. This value is in good ac-

cordance with the results obtained on the models of insulation system air-solid referred as above. The type of the charge distributions at the test voltage of 1,78 kV indicated the existence of surface discharges. It is possible, that they occured at the ends of motor windings.

## 3. Conclusions

It has been proved that during the voltage test of winding insulation of asynchronous motors the discharge inception voltage values can be exceeded.

The effect of p.d. action on the later conditions in operating work is unknown. If this effect would be unfavourable, the test conditions should be changed: test voltage value or test voltage type.

## References

1. Insulation co-ordination within low voltage systems including clearances and creepage distances for equipment. I.E.C. Publ. 664, 664A.

2. TGL 20445-03 Isolationskoordination; Betriebsmittel und Anlagen mit Wechselspannungen bis 1000 V. Ausg. Febr. 1986.

3. TGL 16559 Kriech-und Luftstrecken. Ausg. Dez. 1975 einschl. 1 Aenderungsblatt vom Nov. 1981.