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Specification for Auto Control for NAE Electro-thermal wing De-icing System.

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SUBJECT SPECIFICATION FOR AUTO CONTROL FOR NAE ELECTRO-THERMAL WING DE-ICING SYSTEM

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SPECIFICATION FOR AUTO CONTROL FOR NAE ELECTRO-THERMAL WING DE-ICING SYSTEM

1.0 INTRODUCTION

The NAE Electro-thermal Wing De-icing System is composed of:

1.1 Continuously Heated Parting and Dividing Strips

Ice must not be allowed to form on these and therefore they must be switched on immediately the aircraft enters icing conditions. Under varying icing conditions they must be supplied with sufficient heat to prevent ice forming, but any excess of heat is not only wasteful, but detrimental to the shedding process on the shedding areas. The temperature of the parting and dividing strips must also be prevented from becoming excessive and causing a breakdown of the organic insulation.

1.2 Intermittently Heated Shedding Zones

A number of shedding zones are provided along the span of the wing and on the tail unit. Ice is allowed to form on these, and then when sufficient ice has accreted, each section is heated in turn until the ice is shed. Heating must not be initiated till sufficient ice has formed, and each section is heated only until the ice is shed. If the heat is not then turned off, run-back will occur. An excess of heat may also cause excessive temperatures.

1.3 These requirements are met by two sets of controls. The first is an anti-icing control; which can be applied to any thermal anti-icing system, and the second is a combination of an off-period control, which can be applied to any de-icing system, and a cycling control, which can be applied to any thermal de-icing system.

2.0 ANTI-ICING CONTROL

2.1 On receiving the first signal from an ice detector, the control will turn full heat on to the parting or dividing strips until a period of time T_1* seconds has elapsed. During this time an over-ride will be in

* See Appendix.

operation which will turn off the heat if a critical temperature θ_1* is reached in the parting or dividing strips, but will turn it on again as soon as the temperature drops to θ_2*.

2.2 After T_1 seconds, control is taken over by a temperature controller, which turns on the heat when the surface temperature at the parting or dividing strip falls below θ_3* and turns it off when it rises to θ_4*. Probably either a Barber-Colman or a Westinghouse temperature control unit will be used for this purpose.

2.3 The temperature controller is kept energised only so long as signals from the ice detector keep arriving within a fixed period of each other.

2.4 As soon as the period between ice detector signals exceeds T_2* seconds, indicating that icing has ceased or is occurring at a very low rate, the control is de-energised, turning off the heat to the parting and dividing strips.

2.5 After the control has been de-energised the next signal from the ice detector starts the initial operation again.

3.0 OFF-TIME AND SHEDDING CONTROL

This consists of a Counter, an Operation Co-ordinator, and a Cycling Control, which are interdependent.

3.1 The Counter receives signals from the ice detector. When a selected number of signals, N*, has been received, the Counter transmits a signal to the Co-ordinator. The value of N should be selectable manually.

3.2 When the Co-ordinator receives this signal from the Counter it will normally pass it on to the Cycling Control.

3.3 When the Cycling Control receives the signal it will start to apply heat to each shedding section in turn. Heat will be applied to each section either until the surface temperature at that section reaches θ_5*, or until T_3* seconds have elapsed, with an override time ot T_4* seconds. Heat will then be applied to the next section, and so on.

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* See Appendix.

At the present stage of development the heat-on period will probably be determined by the time T_3, which may be manually selected or made dependent on outside air temperature. At a later stage the heat-on period will probably be dependent on θ_5. In both cases an override time of T_4 will be used.

3.4 If the Counter receives N signals from the ice detector before the shedding sequence is completed, then the Co-ordinator will store the subsequent signal from the Counter until the shedding is complete, when a new shedding sequence will be initiated. At the same time the Counter will be made to dwell at N, until the next shedding sequence is begun, when the Counter will return to zero and resume counting.

This operation is for use in exceptionally severe icing conditions, where more than the required amount of ice can accrete during the shedding cycle.

3.5 The Cycling Control is to be able to deal with up to eight shedding sections.

3.6 When the Control is switched off, the Counter is to return to zero.

4.0 MANUAL CONTROL

4.1 Provision is to be made for energising the Anti-icing Control manually.

4.2 Provision is to be made for cutting out the Counter, and initiating the Cycler manually.

4.3 Provision is also to be made for cutting out the Cycler, and applying heat to any shedding section manually.

5.0 A Control which meets this Specification is shown on N.A.E. Drgs. Nos.

17188 Auto Control for Thermal De-icing Combining Counter, Co-ordinator, and Cycling Control with Manual Selection of On Time.

17189 Auto Control for Thermal De-icing Combining Counter, Co-ordinator, and Cycling Control with Temperature Control of On Time.

APPENDIX

It is not yet possible to assign definite values to all the constants given in this Specification. The following are tentative values.

T_1 - 20 or 30 seconds

T_2 - between 60 and 120 seconds

T_3 - the following values should be selectable: 2, 4, 6, 10, 15, 20 seconds

T_4 - about 20 seconds

θ_1 - about +100°C.

θ_2 - about +90°C.

θ_3 - about 0°C.

θ_4 - about +3°C.

θ_5 - 0°C. to +5°C.

N - the following values should be selectable: 10, 20, 30, 40, 50.