Methodology for checking the sensing elements of the LDS as the part of an aeroplane

1. Introduction

The verification procedure is based on the recommendations of the manufacturer and the supplier of these articles. The verification procedure was adapted taking into account the peculiarities of the use of these articles as the part of RRJ-95 aeroplane.

The LDS system consists of 6 circuits. Each circuit consists of two lines (two parallel sensing elements). The circuits are connected to the IAMS control units which provide processing and transmission of the corresponding signals to the formation of alarm messages. The circuits lines are divided into line A and line B. The Line A is connected with the channel 1B of IAMS control unit and line B is connected with channel 2B.

2. Equipment

The following equipment is required to perform a sensor test:

2.1.Stopwatch with a range of at least 2 minutes and a resolution of 1 s.

2.2.Heating air dryer (heater)

Specifications:

- supply temperature up to +350°C;
- temperature control step 10°C;
- nozzle diameter 25мм*;
- protective screen approximately 50 mm** wide;
- airflow rate 4-13 CFM;
- temperature tolerance ±5°C.

For example, a STEINEL air dryer Model HG 2620 E with STEINEL reflector 50x35mm Part No. 110038725 or with DeWalt dryer kit D26960K and accessories can be used to perform the test.

* If only a heating air dryer with a smaller nozzle is available then increase the test duration by 30 seconds and for enlarging the area of the sensor heated surface carefully move the heating air dryer from side to side while heating.

** If the protective deflector is not available, when heated, a metal plate must be placed behind the sensing elements to protect the aircraft structural elements from exposure to excessive heat and possible damage. The metal plate used for testing must be made of non - flammable materials.

2.3. Two temperature sensors

Type K 0-594°C thermocouple or more is recommended for use. Equivalent temperature sensors may be used. The permitted tolerance is ± 2,2°C or 0,75% whichever is greater.

2.4.Temperature measuring instrument

A digital multimeter (DMM) is used to measure temperature with a thermocouple. It is recommended Fluke 289 Tester or equivalent digital temperature meter (such as Fluke 52-2 or Omega HH501 BJK) that provides temperature measurement.

3. Conditions for the inspection

a) The test must be carried out at a temperature between 13°C and 30°C and a relative humidity not higher than 90%.

b) The test area must be free of flammable vapours.

c) Each sensing element must be checked at 3 points. The first point should be at a distance of 100…250 mm from the beginning of the sensitive element. The second point should be approximately in the middle of the sensing element. The third point should be at a distance of 100...250 mm from the opposite end of the sensing element.

WARNING: Do not test within 25.4 mm (1 in.) of the connectors

d) To check the operation of the sensing element, it is necessary to disconnect the adjacent parallel line. For example, to check the sensing elements included in the line "Left ACU A", it is necessary to disconnect the line "Left ACU B". To determine the composition of the lines, you must be guided by Appendix B. It is allowed to prepare several circuits of the LDS at the same time - for example, disconnect the lines A of all the circuits being tested and check the sensing elements in the lines B

4. Precautions

When using the heater the following precautions must be observed:

- The heater supplies high temperature air. Do not direct the airflow towards clothes, hair and other parts of the body. It the hot air temperature is set to over 200°C make sure there are no fuel valors or other sources of ignition nearby;
- Do not use the heater near flammable liquids or in explosive environment (vapour, gases or dust). Remove materials or debris that can catch fire from work area.
- Always hold the tool by the plastic housing. Approximately 20 minutes are required to cool metal parts of heater. Do not touch them until they have cooled;

- Do not put the instrument back in place until the handpiece has cooled to room temperature. During cooling place the tool in a clean place away from combustible materials;
- Do not block airflow. Keep air intakes clean and free from foreign objects;
- Place the instrument on flat surface when holding it in hands. Place the cord in a position that will not cause the tool to tip over;
- During operation and cooling do not leave the tool unattended;
- Keep fire extinguisher ready- use nearby;
- Follow the safety precautions in the hot air dryer's instruction manual.

WARNING: two people are required to carry out the work.

5. Test procedure

5.1.Perform a resistance check between the terminals of the electrical connectors of the cable network connected to the control units IAMS 1 and IAMS 2: To do this:

- on aeroplanes prior to SB RRJ–21–00308–БД check the serviceability of the LDS in accordance with AMM 36-22-00-720-801;
- on aeroplanes after SB RRJ–21–00308–БД perform control of LDS failures using CMS in accordance with AMM 36-22-00-740-801.

Fill in the resistance values in the test protocol

The measured resistance must be within the specified range of values. When resistances go beyond the specified range of values it is necessary to search for increased resistance (of failed sensitive element) and replace the failed sensitive element.

5.2.Prepare equipment for testing for which:

a) install the heat shield on the heater .
   NOTE: it is recommended to use a heat shield that is attached to the outlet on the heater. If a curved heat shield is not available use a flat heat shield (i.e metal plate) and hold heater approximately 25,4-31,75 мм (1-1,25 inch) from thermocouple\sensitive element while preparing and performing test. The metal plate used as a heat shield must be made of non- flammable materials.

b) connect the thermocouple to the temperature measuring instrument;

c) place thermocouple inside the heat shield without touching it at approximate location of LDS sensitive element so that the sensitive element of thermocouple is located on the central axis of heater outlet (see central thermocouple in Fig. 1-3).

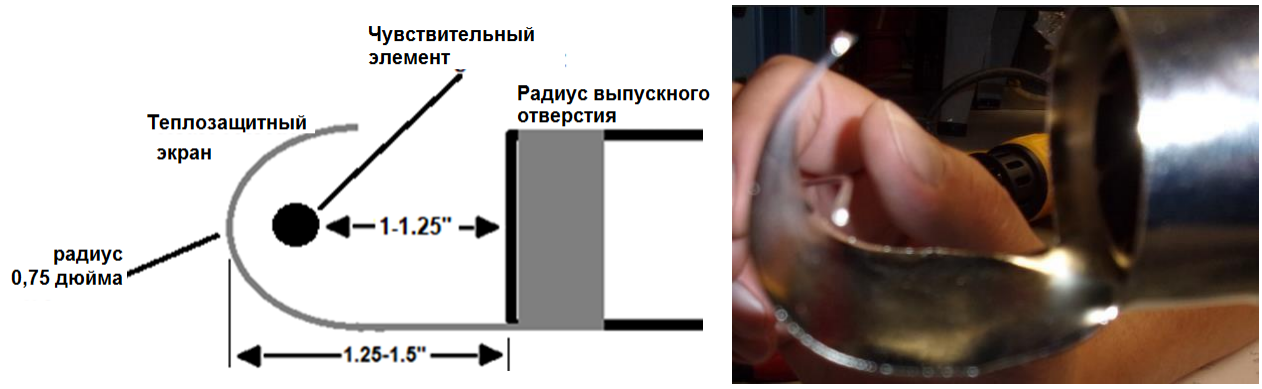

Fig. 1. The location of the sensitive element when heated. Side view

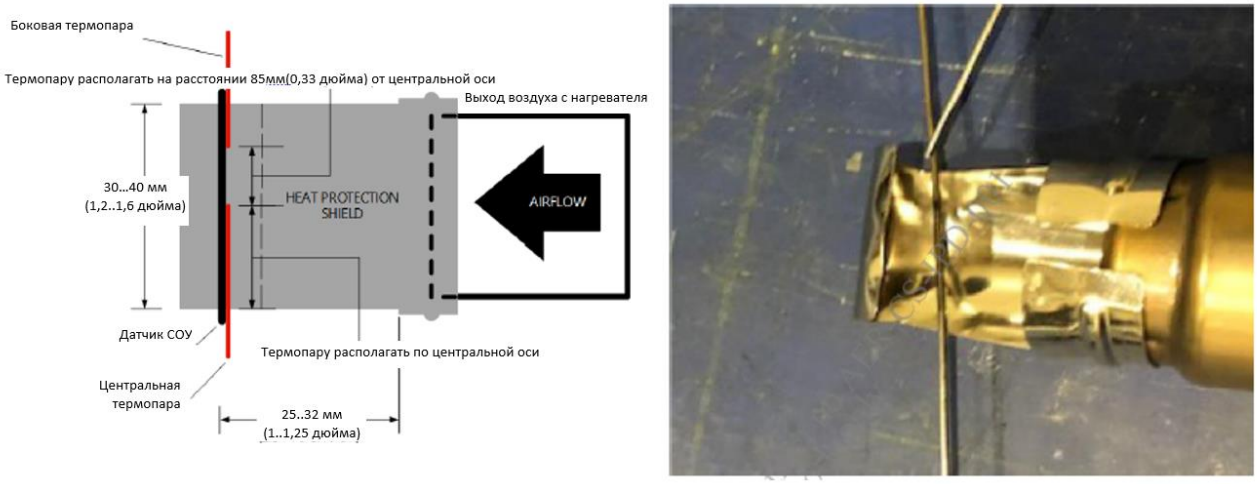

Fig. 2. The location of the sensitive element when heated. Top view.

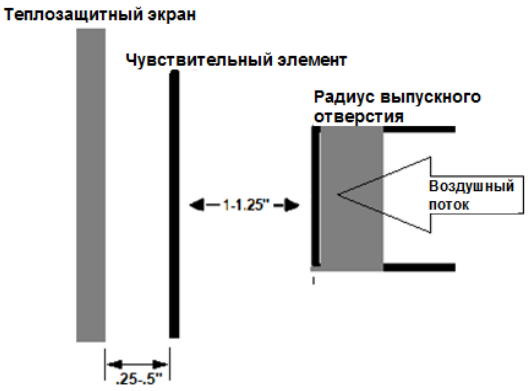

Fig 3. Location of the sensitive element when heated using a metal plate as a heat shield. Top view

d) set the maximum airflow if the air dryer has such an installation option.

e) adjust the heater temperature so that the thermocouple reading matches the Desired Test Temperature (DTT) shown in Table 1.

NOTE: it is recommended to ensure that the actual temperature at the thermocouple is closer to the upper limit of the DTT values.

NOTE: for heaters with a digital display, the temperature on the display is usually higher than the temperature of the thermocouple which is acceptable.

NOTE: when setting flow temperature, thermocouple temperature may change due to the regulation in the heater. Average values must be used.

f) check that the temperature at the central thermocouple is within the allowable range of DTT values, record the value (Tcenter).

g) move the thermocouple to the lateral position, right or left (displacement of about 85 mm from the central axis, see Fig.2) to the approximate location of LDS sensitive elements.

NOTE: when positioned sideways to the left of the central axis, bring the thermocouple to the left. When positioned sideways to the right of the central axis, bring the thermocouple to the right.

NOTE: the temperature value of the side thermocouple may be below the DTT limit.

h) record the temperature value of the side thermocouple (Tb).

i) compute the average value between central and side values.

Average temperature = (Tcenter+Tside)/2.

NOTE: it is recommended to ensure that the average temperature is equidistant from the upper and lower limits of the DTT values.

NOTE: to ensure that the temperature of the heater is stable during the test steps d-i must be repeated every time the hair dryer is turned on\off and at least 4 hours of testing or when environmental conditions change.

j) If average temperature is outside of allowable DTT range, repeat steps d-i with a side thermocouple on the opposite side and ensure that the average temperature is within allowable DTT range. In case of failing to secure the average temperature replace the heater and use a heater with a more uniform outlet temperature profile.

k) record the average temperature in the pre-test notes in the data sheet used (for reference)

Table 1. Desired Testing Temperature

The last character in the LDS sensor designation	Desired testing temperature
A	(135...152)°C
C	(167...184)°C
D	(219...236)°C

5.3. Provide access to sensing elements to be tested. If necessary remove sensing elements from clamps.

5.4. Determine the length of the sensing element. In article designation the three elements before the last symbol is sensing element length in centimeters.
For example the sensor part number 04-90030-9344A is Type A and is 344 cm long.

5.5. Mark hot spots using a permanent ink marker.

5.6. Fill in the information about the sensing element in the test protocol..

NOTE: designation and serial number of the sensing element is marked on one of the connectors.

5.7. Perform verification procedure:

5.7.1. Connect the ground source of electrical power to the aeroplane (see task 24-41-00-860-801).

5.7.2. Make sure press button switches L AIR и R AIR on AIR controller of ceiling unit are in AUTO position. Make sure there are no messages:

AIR L DET LEAK FAULT (yellow)
AIR R DET LEAK FAULT (yellow)
AIR L PACK DET LEAK FAIL (yellow)
AIR R PACK DET LEAK FAIL (yellow)
AIR APU DET LEAK FAULT (yellow)
AIR TRIM DET LEAK FAULT (yellow)

5.7.3. Turn on heating air dryer. Perform heater setting according to section 5.2.

5.7.4. To test each sensing element :

a) Disconnect any electrical connector at the sensing element from adjacent line - when testing the sensor from Line A, Line B is disconnected at any place and vice versa (for example to check element 11-H360 of Line B remove the connector from sensing element 15-H360 of Line A).
b) Heat the 1st point of the sensing element until the corresponding CAS message is issued but no more than 120 seconds. Correspondence between the CAS message and the tested sensing element is given in Appendix B.
c) Finish heating the sensing element and wait for it to cool down for at least 3 minutes. To restore the sensor to room temperature, wipe it with a damp cloth if necessary.
d) Wait for the leaked CAS message to disappear.

e) Sequentially repeat steps a-d for the 2nd and 3rd points.
f) Paint one face of the hex nut of the sensor connector with a green marker.
g) Connect the previously disconnected sensing element electrical connector
h) Enter the data in the verification protocol.

5.7.5. Carry out a similar check as per paragraph 5.7.4 for other sensing elements. Checking the sensing elements in lines A perform by disconnecting the sensing elements of line B of the indicated circuits. While checking sensing elements 17-H360 and 19-H360 CAS-messages are not issued use CMS for operation check (see task 36-22-00-740-801) - check for fault messages in Trim loop A/B circuits in Leak field value «1».

WARNING: 1) If the sensing element did not pass any of the checks then the product is considered faulty and must be replaced.
2) the replaced sensing element is subject to the same test procedure.

5.8.Block access

Appendix A – An example of verification protocol – on 1 page in one copy.

Protocol for checking LDS sensing elements

Aeroplane number:_____ Date:_____

Resistance measurement results:

Contact number	1-H210 (IASC1), Ом	2-H210 (IASC2), Ом
DB1-DB2		
DB3-DB4		
DC1-DC2		
DC3-DC4		
DD1-DD2		
DD3-DD4		

Hot air dryer model _____

Ambient temperature: _____

Hot air dryer setting :

Temperature of the central thermocouple, °C	Side thermocouple temperature, °C	Average temperature, °C

Test results:

Schematic position	p/n	s/n	1st point, OK/FAIL	2 nd point OK/FAIL	3rd point, OK/FAIL
_____-H360	04-90030_____				
_____-H360	04-90030_____				
_____-H360	04-90030_____				
_____-H360	04-90030_____				
_____-H360	04-90030_____				
_____-H360	04-90030_____				

Initilals:_____

Signature:_____

Appendix B.

Correspondence of sensing elements, CFI position, circuit and CAS-messages.

Schematic position	Compartment	Circuit	Line	CAS message
18-H360	Ф3	APU bleed loop	A	AIR APU BLEED LEAK
20-H360	Ф3	APU bleed loop	B	AIR APU BLEED LEAK
61-H360	Ф3	APU bleed loop	B	AIR APU BLEED LEAK
51-H360	Ф3	APU bleed loop	A	AIR APU BLEED LEAK
57-H360	Ф4	APU bleed loop	A	AIR APU BLEED LEAK
55-H360	Ф4	APU bleed loop	A	AIR APU BLEED LEAK
53-H360	Ф4	APU bleed loop	A	AIR APU BLEED LEAK
62-H360	Ф4	APU bleed loop	B	AIR APU BLEED LEAK
63-H360	Ф4	APU bleed loop	B	AIR APU BLEED LEAK
64-H360	Ф4	APU bleed loop	B	AIR APU BLEED LEAK
66-H360	Ф5	APU bleed loop	B	AIR APU BLEED LEAK
60-H360	Ф5	APU bleed loop	A	AIR APU BLEED LEAK
59-H360	Ф5	APU bleed loop	A	AIR APU BLEED LEAK
65-H360	Ф5	APU bleed loop	B	AIR APU BLEED LEAK
39-H360	Ф2	L wing loop	A	AIR L BLEED LEAK
49-H360	Ф2	L wing loop	B	AIR L BLEED LEAK
13-H360	Пилон ЛБ	L wing loop	A	AIR L BLEED LEAK
22-H360	Пилон ЛБ	L wing loop	B	AIR L BLEED LEAK
31-H360	Пилон ЛБ	L wing loop	A	AIR L BLEED LEAK
41-H360	Пилон ЛБ	L wing loop	B	AIR L BLEED LEAK
47-H360	ОЧК ЛБ	L wing loop	B	AIR L BLEED LEAK
37-H360	ОЧК ЛБ	L wing loop	A	AIR L BLEED LEAK
35-H360	ОЧК ЛБ	L wing loop	A	AIR L BLEED LEAK
45-H360	ОЧК ЛБ	L wing loop	B	AIR L BLEED LEAK
43-H360	ОЧК ЛБ	L wing loop	B	AIR L BLEED LEAK
33-H360	ОЧК ЛБ	L wing loop	A	AIR L BLEED LEAK
42-H360	Ф2	R wing loop	A	AIR R BLEED LEAK
56-H360	Ф2	R wing loop	B	AIR R BLEED LEAK
40-H360	Ф2	R wing loop	A	AIR R BLEED LEAK

54-H360	Ф2	R wing loop	B	AIR R BLEED LEAK
44-H360	Ф3	R wing loop	A	AIR R BLEED LEAK
58-H360	Ф3	R wing loop	B	AIR R BLEED LEAK
14-H360	Пилон ПрБ	R wing loop	A	AIR R BLEED LEAK
21-H360	Пилон ПрБ	R wing loop	B	AIR R BLEED LEAK
32-H360	Пилон ПрБ	R wing loop	A	AIR R BLEED LEAK
46-H360	Пилон ПрБ	R wing loop	B	AIR R BLEED LEAK
52-H360	ОЧК ПрБ	R wing loop	B	AIR R BLEED LEAK
38-H360	ОЧК ПрБ	R wing loop	A	AIR R BLEED LEAK
50-H360	ОЧК ПрБ	R wing loop	B	AIR R BLEED LEAK
36-H360	ОЧК ПрБ	R wing loop	A	AIR R BLEED LEAK
34-H360	ОЧК ПрБ	R wing loop	A	AIR R BLEED LEAK
48-H360	ОЧК ПрБ	R wing loop	B	AIR R BLEED LEAK
17-H360	Ф2	Trim loop	A	CAS message is not provided, verification is done through CMS interactive mode on LEAK LOOPS IAMS page
19-H360	Ф2	Trim loop	B	
15-H360	УОВ лев	L Pack loop	A	AIR L PACK FAIL
11-H360	УОВ лев	L Pack loop	B	AIR L PACK FAIL
16-H360	УОВ прав	R Pack loop	A	AIR R PACK FAIL
12-H360	УОВ прав	R Pack loop	B	AIR R PACK FAIL