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The following is a brief summary of the UL file 521 and the tests applicable to the DETECT-A-FIRE® heat detector.

D-A-F (DETECT-A-FIRE) devices have been approved and recognized by the UL (Underwriters Lab) file 521. The Underwriters Laboratories, Inc have passed these devices.
The tests are included -

- Oven Test - A heat detector is installed in a special design heat chamber (oven), it is mounted in different position permitted by design. After installation in the oven, the heat detector is to be subjected to the time temperature condition. Oven temperature at the start of the test is to be 85 to 90 °F and slowly increasing temperature. Heat detector shall be uniform in operation when mounted in the same position. This test is to verify uniform performance of a heat detector, the test is to be repeated four times using a different sample for each test, but each of the five samples is to be installed on the sample-mounting panel in the same position. Upon operation of the heat detector, the current applied to the bank of heaters is to be cut off and the oven is to be cool to room temperature by use of the external-cooling fan.

- Fire Test - This test is to be conducted in a 60 by 60-foot test room with a smooth ceiling at a height of 15 feet, 9 inches. The heat detectors are to be installed at their designated spacing in line with the sprinkler and fire test pan. The fire tests are to be produced by burning denatured alcohol consisting of 190 proof ethanol to which 5 % methanol has been added as a denaturant in steel pans of size to produce a temperature rise within the limits. The fire tests are to be conducted to develop information regarding the operating time of the heat detectors when installed at their recommend spacing schedule as compared with the operating time sprinklers installed on a standard 10 by 10 foot (3.05 by 3.05m) spacing schedule. Operation of the heat detectors within 130 seconds will qualify the device for the spacing on which it was installed.

- High Temperature Exposure Test - A heat detector shall withstand the high temperature exposure and operate as intended when subjected to the operating temperature test. 5 sample heat detectors of the each temperature rating are to be tested for their intended operating temperature (if capable of repeated operation), or rate-of-rise temperature, after which they are to be placed in an oven maintained at the temperature which is specified. Wire connections are made between the terminals or leads of the heat detector and an indicating circuit consisting of an incandescent lamp connected to a 6-volt direct current (dc) source or the equivalent. The lamp current is to be approximately 50 milliamperes under closed circuit conditions. The average response obtained shall not be greater than 50 percent of the value recorded on as-received samples.

- Operating Temperature Test - A fixed-temperature heat detector shall operate within the temperature tolerance range according to its rating. A heat sensitive cable is to be added when subjected to an operating temperature test in a water bath, oil bath, air oven, or equivalent method. This heat sensitive cable is to be installed on the ceiling to form a 90-degree angle, with 2 legs, each 10-feet long located at 90 degrees. The fire source is to be located at 45-degree angle from the point of intersection of the 2 legs. Each heat detector is to be monitored for operation and the temperature of the test medium is to be instant of operation.

- Rate-of-Rise Operation Test - Heat detectors that operate on the rate-of-rise principle shall be calibrated so that the devices will function at the rate of rise for which they are intended. It is tested in the testing oven under various uniform temperature-rise conditions. Typical rates of rise of temperature such as 12, 15, and 20°F per minute and the intended (rated) temperature rate of rise are to be employed. Each unit is to remain in the oven ambient at least 5 minutes prior to a test run. N/A - THE DAF IS NOT ROR

- Low Temperature Exposure Test - Three heat detectors shall comply with the requirements of the Oven Test, the Operating Temperature Test, or the Rate-of-Rise Operation Test, whichever is applicable, after

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exposure for 24 hours to a temperature of -22 ± 3.6°F (-30 ± 2°C). The units are to be tested immediately after the contacts return to the normal position. A 3-foot length, concentrically wound in a coil having a maximum diameter of 4 inches is to be used. This test is generally to be conducted only on heat detectors of the low degree rating and ordinary degree rating unless there is a reason to anticipate behavior different from those of other ratings.

- Corrosion Tests – Five samples are to be exposed to each applicable test atmosphere for 10 days. Heat sensitive cable is to be used. For indoor-use or outdoor-use heat detectors, Hydrogen Sulfide or Carbon Dioxide-sulfur Dioxide is to be supplied to the test chamber. An amount of these two chemical substances is to be introduced into the chamber each working day on different testing. A small amount of water is to be maintained at the bottom of the chamber. The chamber is to be at room temperature throughout the test period. The apparatus for Salt spray (fog) testing, a special design of a fog chamber which measures 48 by 30 by 36 inches. A salt solution reservoir, a supply of conditioned compressed air, one dispersion tower constructed in accordance with Salt Spray (Fog) Testing, ASTM B117-73, for producing a salt fog, specimen supports, provision for heating the chamber. The device is to suspend vertically in the fog chamber. The sensitivity of fixed-temperature heat detectors, after they are subjected to corrosive atmospheres, shall not show a time variation of more than 50 % from the value obtained in the Oven Test. No false operation shall occur during the exposure. The sensitivity of heat detectors operating on the Rate-or-Rise principle, after they are subjected to corrosive atmospheres, shall not show a variation of more than 50 % from the value obtained in the Rate-or-Rise Operation Test. No false operation shall occur during the exposure to the corrosive atmospheres or at a temperature rise of 12°F per minute or less until a temperature of at least 130°F is reached.

- Determination of Stress cracking Test – A diaphragm enclosure of a rate-of-rise heat detector that made of copper alloy shall be subjected to the physical stresses imposed on or within a part as the result of assembly with other components. Three samples of heat detector, not painted or coated, shall be subjected to an ammonia stress cracking test or salt immersion cycling test. Upon removal from the solution, the samples are to be examined visually for cracking.

- Bond Secureness Test – High temperature- Humidity Exposure – Five samples are to be exposed for 10 days to a temperature of 150°F in a circulating air oven, followed by exposure to a 95 ±2 percent relative humidity environment maintained at 140°F. Temperature Cycling Test – Five samples are to be subjected for 10 days to temperature cycling, each cycle consisting of exposure for 24 hours at -40°F followed by 24 hours at 140°F, for a total of 5 cycles. The bond between a diaphragm enclosure of a rate-of-rise heat detector and the support base shall withstand the above exposure.

- Humidity Test – Three heat detectors shall subject to exposure for 24 hours to moist air having a relative humidity of 85±5 percent, at a temperature of 86±3°F. The units are to be tested immediately after removal from the humidity environment. This test is to be conducted only on heat detectors of the low-degree rating or ordinary-degree rating. Heat sensitive cable is to be used.

- Transient Tests – An electronic heat detector shall operate for its intended signaling performance and shall not initiate a false alarm or a trouble signal. The sensitivity shall not be adversely affected after being subjected to 500 internally induced transients, extraneous transients, 500 (high voltage) supply line transients, and 60 supply line (low voltage) circuit transients while energized from a source of supply and connected to the devices intended to be used with the detector.

- Vibration Test – A heat detector shall withstand vibration without false operation, breakage, or damage to the parts. Five heat detectors are to be secured in a position of intended use on a mounting board and the board, in turn, is to be securely fastened to a variable-speed vibration machine having an amplitude

of 0.01inch (total displacement of 0.02 inch). The frequency of vibration is to be varied from 10 to 35 hertz in increments of 5 hertz until the resonant frequency is obtained. The samples are then to be vibrated at the maximum resonant frequency for a period of 15 minutes. If no resonant frequency is obtained, the samples are to be vibrated at 35 hertz for a period of 4 hours. Each heat detector is to be individually connected to a lock-in circuit consisting of an indicating lamp and a power source, as a means of indicating false operation during the test run. Upon completion of the vibration test, the samples are to be checked for sensitivity.

- Overload Test – A detector shall operate for its intended signaling operating after being subjected to 50 cycles of alarm signal operation at a rate of not more than 6 cpm with the supply circuit to the detector at 115 percent of rated test voltage. Each cycle is to consist of starting with the detector energized in the standby condition, initiation of an alarm, and restoration of the detector to the standby condition. Rated test loads are to be connected to the output circuits of the detector energized from the detector power supply. The rated loads are to be established initially with the detector connected to a source of supply as specified in Test Voltages. Then the voltage is to be increased to 115 percent of rating. For the direct current rated signaling circuits, an equivalent test load is to have the required dc resistance for the test current and the inductance to obtain a power factor of 60 percent when connected to a 60 hertz potential equal to the rated dc test voltage. Separately energized circuits of a detector, such as dry contacts, shall operate as intended after being subjected for 50 cycles of signal operation at a rate of not more than 6 cpm while connected to a source of supply in accordance with the requirements specified in Test Voltage. It has a 150 percent rated loads at 60 percent power factor applied to output circuits that do not receive energy from the detector. There shall not be electrical or mechanical malfunction of the switching circuit.

- Endurance Tests – After the Overload Test, the same detector shall operate for its intended signaling operation after being subjected to 6000 cycles of 5-second alarm signal operation at a rate of not more than 10 cpm. The detector connected to a source of supply as specified in Test Voltages, and with related devices or equivalent loads connected to the output circuits. There shall not be electrical or mechanical malfunction or evidence of malfunction of the detector components. Separately energized circuits and non-electric type heat detectors, the same separately energized circuits of the detector shall operated for 6000 cycles at a rate of not more than 10 cpm at a duty time cycle of 50 percent off and 50 percent on. If an electrical load is involved, the contacts of the device are to make and break the normal current at the voltage specified by Test Voltages. The load is to represent that which the device is intended to control. The endurance test of the separately energized circuits may be conducted in conjunction with the endurance test of the detector. There shall not be electrical or mechanical malfunction of the detector nor malfunction or welding of any relay contacts.

- Rain Test – Heat detector intended for outdoor use shall be subjected to a 24-hour water spray, with out wetting of electrical parts or entry of water into functional areas. Three detectors are to be secured in a position of intended use on a flat mounting board in accordance with the manufacturer's installation instructions. The board is then to be secured in a vertical position to vertical wooden support. After the exposure, the outside of each sample is to be carefully wiped clear of water, and a visual examination is to be made of the interior to determine any entry of water. For a rate-of-rise heat detector, the air chamber is to be physically removed from the base and examined for internal entry of water. This is to be conducted following the dielectric Voltage-Withstand Test. The sensitivity of heat detectors intended for outdoor use shall not be affected when representative samples are subjected to the water spray test.

- Dielectric Voltage Withstand Test – A heat detector shall withstand for 1 minute, without breakdown. The application of an essentially sinusoidal ac potential of a frequency within the range of 40-70 hertz.

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- Marking Label Adhesion Tests – A pressure-sensitive label or a label secured by cement or adhesive is subject to be used for air oven aging test, immersion test, standard-atmosphere test and unusual-condition exposure test. Each specimen demonstrates good adhesion and the edges are not curled. The label resists defacement or removal as demonstrated by scraping with a 2-pound force across the test panel with a flat metal blade 5/64 inch thick, held at right angles to the test panel. The printing is legible and is not defaced by rubbing with thumb or finger pressure.

- Circuit Measurement Test – The input and output current of an electronic type detector shall not exceed the marked rating of the detector by more than 10 percent when operated under conditions of intended use and with the detector connected to a source supply as specified in Test Voltages. Measurements are also be made of components such as capacitors to determine that they are being employed within the manufacturer's ratings.

- Overvoltage and Undervoltage Tests –An electronic type detector shall operate as intended in the standby condition at maximum and minimum sensitivity settings and perform its intended signaling function, while connected to a supply source of 110 percent of rated value. For operation at the higher voltage, three detectors are to be subjected to the specified increased voltage in the standby condition for not less than 16 hours or other warm-up period as recommended by the manufacturer, and then each tested for their intended signaling operation and sensitivity. For operation at the reduced voltage, three detectors are to be subjected to the specified reduced voltage and tested for their intended signaling operation and sensitivity. Operation at 85 percent of rated voltage, reduction of the supply voltage to zero at a rate of 5 volts per minute shall not result in energization of the alarm circuit. A two-wire detector intended for connection to a two-wire initiating device circuit is to be tested at 100 percent of its rated voltage range.

- Component Temperature test - The materials or components employed in a detector shall not be subjected to a temperature rise greater than the desire values under any condition of intended operation. The temperature rise of a component in the standby condition may be exceeded, but in no case shall be greater than for the temperature permitted under an alarm condition, if malfunction of that component results in a trouble signal. All values for temperature rises apply to equipment intended for use in prevailing ambient temperatures that usually are not higher than 77°F. Temperature measurements on equipment intended for recessed mounting are to be made with the unit installed in an enclosure of nominal ¾ inch wood having clearances of 2 inches on the top, sides, and rear, and the front extended to be flush with the detector cover. A temperature is considered to be constant when three successive readings, taken at not less than 5 minutes intervals, indicate no change. Temperatures are to be measured by thermocouple. The thermocouple wire is to comply with the requirements for Special Thermocouples as listed in the Standard for Temperature Measurement of Thermocouples, ANSI/ISA MC96.1.

- Electrical Supervision Test – The electrical circuits formed by conductors extending from the installation wiring connections of a detector for interconnection to a power supply source. It provides electrical supervision so that a trouble signal indication is obtained at the connected control unit under any of the fault conditions if the fault prevents operation of the detector for fire alarm signal. The fault operations such as single open or single ground fault of the connecting field wiring. Failure of a limited-life component de-energization of the detector power supply circuit, and removal of a separable detector head from its base, unless the head is secured to the base after installation by a means that requires a special tool to release. Interruption and restoration of any source of electrical power connected to a detector shall not cause an alarm signal. To determine if a detector complies with the requirements for electrical supervision, the detector is to be tested with the representative system combination in the standby condition, and the type of fault to be detected is then to be introduced. Each

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fault is to be applied separately, the results noted, and the fault removed. The system combination is then to be restored to the standby condition prior to establishing the next fault.

- Stability Test - A different electronic heat detector may be employed for the testing. A detector shall operate for its intended signaling performance after being subjected for 14 days to an ambient temperature of 150 ± 5.4°F. Two samples are to be placed in a circulating air oven and energized for 14 days from a source of rated voltage and frequency. Following removal, the energized samples are to be permitted to cool to room temperature for at least 24 hours. A detector shall operate fifty cycles of momentary (approximately ½ second) interruption of the detector power supply at a rate of not more than 6 cycles per minute. The detector is to be plunged from one humidity level to the other in not more than 3 seconds per plunge and maintained at each humidity level for less than ½ hour between plunges. Three plunges from an ambient humidity of 20 ± 5 percent relative humidity to an ambient of 90 ± 5 percent relative humidity at 73.4 ±3.6 °F. During each testing, there shall not to be false alarms.

- Dynamic Load Immunity Test – A control unit having initiating device circuits intended for use with two-wire smoke detectors with pulsing normal operating current shall not false alarm due to the random pulsing load presented by the maximum number of detectors permitted to be connected to the circuit. The maximum number of two-wire smoke detectors specified in the installation wiring diagram are to be connected to an initiating device circuit and the control unit is to be energized from a source of rated voltage and frequency. The combination is to be operated in the normal supervisory condition for 30 days. During this time, there shall not be false alarms. The test is to be repeated for each type and combination of smoke detector specified on the installation-wiring diagram.

- Polarity Load Immunity Test – An electronic type heat detector shall operate in its intended manner after being connected in each polarity for at least 24 hours or until a trouble or alarm signal is obtained. For a battery-operated detector intended to be connected by a polarized clip assembly, the reverse polarity is to be applied for a minimum of a second. A trouble or alarm signal is to be permitted under any incorrect polarity applied.

- Replacement Test, Head and Cover – A detector employing a cover that is intended to be attached or closed by a snap type action or removable head shall withstand 50 cycles of removal and replacement or opening and closure, where applicable.

- Jarring Test – A detector shall withstand jarring resulting from impact and vibration such as might be experienced in service, without causing an alarm signal, without dislodgment of any parts, and without impairing its subsequent operation. A momentary trouble signal resulting from the jarring may occur provided that the detector operation is not affected. Dislodgment of parts may occur provided that the dislodged part(s) does not affect the operation of the unit, and no high-voltage parts are exposed.

- Static Discharge Test – Each of the two detectors is to be mounted on the underside of ¾-inch thick plywood panel in its intended mounting position and connected to a source of supply in accordance with Test Voltages. An electrostatics voltmeter is to be employed to measure the voltage but is to be removed prior to conducting the discharge. Discharges are to be applied at 5-minute intervals to different points on the exposed surface of the detector as well as to internal parts that could be contacted during servicing. Discharges inside the detector are not to be applied if the detector is not serviced in the field but is to return to the factory for servicing. The intended performance of a detector shall not be impaired or a false alarm obtained, when the detector is subjected to static electric discharges. Operation of the trouble circuit during this test is not to be considered a malfunction if the subsequent intended operation is not affected. The test is to be conducted in an ambient temperature of 73.4 ±5°F at a relative humidity of 10±5 % and a barometric pressure of not less than 700 mm of mercury 193.5 kPa.

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- Dust Test – Two samples are to be placed de-energized, on metal supports in an airtight chamber having an internal volume of at least 3 cubic feet. Approximately 2 ounces of cement dust, maintained in an ambient room temperature are to be circulated for 15 minutes by means of compressed air or a blower in the chamber. The airflow is to be maintained at an air velocity of at least 50-fpm. The sensitivity of a detector shall not reduce by an accumulation of dust. The alarm or trouble circuit may be energized.

- Tests on Polymeric Materials – (Temperature Test) - Three samples are to be mounted on supports as intended in service and placed in the oven. Following the aging period, the samples are to be viewed for distortion, removed, permitted to cool to room temperature, and then re-examined. The detector cover may fail off provided that no high-voltage parts are exposed, operation is not affected, and the cover can be replaced as intended. (Flame Test) – The test samples are to be mounted as intended in service in the test chamber. The test flame is to be applied at an angle of 20 degrees from the vertical to any portion of the interior of the enclosure judged as likely to be ignited by proximity to live parts, coils and wiring. When tested, a plastic material employed as parts of a detector for the sole support of current-carrying parts. There shall not burn for more than 1 minute after the fifth 5-second application of a test flame, with an interval of 5 seconds between applications of the test flame. There shall not be flaming or dripping particles or complete consumption of the sample during the test, and the material shall not be destroyed in the area of the test flame to such an extent that the integrity of the enclosure are to be subjected to this test.

- Strain Relief Test – A strain relief test on a cord or leads that depend upon a thermoplastic enclosure and part is to be conducted following exposure to temperature conditioning test. The test is to be performed after the sample has been placed in a room temperature environment for at least 3 hours. Each lead employed for field connections or handling during installation and servicing, including a battery clip lead assembly shall withstand for 1 minute a force of 10 pounds without any evidence of damage or of transmitting the stress to internal connections.

- Abnormal Operations Test – Four samples are to be mounted on a 4-foot square board that is placed 5 feet above the center of a 3-foot square pan filled with denatured alcohol. The alcohol is to be ignited and the time and condition of the sample noted when an alarm is initiated. A detector with polymeric enclosure shall be constructed such that the detector will initiate an alarm signal before being consumed by heat from a fire.

Please call if you require any further information.

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