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CLIENT: SURVIVAIR
3001 Susan Street
Santa Ana, CA 92704
Attn: Carl Toft

Test Report No:	**139404**	**Date:**	**October 20, 2000**

SAMPLE ID:	Survivair Twenty/Twenty RCS Kit, P/N 963050, SmallTalk Plus Kit P/N 963070, RCS/SmallTtalk Plus Kit P/N 963080, RCS/RPTT Kit P/N 963073, RCS/SmallTalk Plus/RPTT Kit P/N 963074
DATE OF RECEIPT:	Entered into SGS USTC sample tracking system on April 3, 2000 as STN 31477
TESTING PERIOD:	April 17, 2000 through April 27, 2000 and August 8, 2000
AUTHORIZATION:	Client's Purchase Order Number 46117-001 OP, dated April 11, 2000.
TESTS REQUESTED:	Intrinsic Safety evaluations of above sample to the requirements of ANSI/UL 913-88, Intrinsically Safe Apparatus and Associated Apparatus, for Division 1, Class I, Groups A, B, C and D, Class II, Groups E, F, G, and Class III hazardous locations.
TEST RESULTS:	See page 2.
CONCLUSION:	Considering the results of the tests and evaluations that were conducted, the Survivair Twenty/Twenty consisting of RCS Kit, P/N 963050, SmallTalk Plus Kit P/N 963070, RCS/SmallTtalk Plus Kit P/N 963080, RCS/RPTT Kit P/N 963073, RCS/SmallTalk Plus/RPTT Kit P/N 963074 were found to comply with the requirements of ANSI/UL 913-88, for Division 1, Class I, Groups A, B, C and D, Class II, Groups E, F, G, and Class III hazardous locations. In addition, they are permitted in Division 2, Class I, Groups A, B, C and D, Class II, Groups F, G, and Class III. The unit is recommended for inclusion into the SGS U.S. Testing Company.

Prepared by

Chris Lund
Project Engineer

Signed for and on behalf of SGS U.S. Testing Company Inc.

John Lomash
Branch Director

CLIENT: SURVIVAIR

GENERAL INFORMATION FOR EVALUATIONS:

FUNDAMENTAL REQUIREMENTS: The energy available from an intrinsically safe apparatus or circuit shall not be capable of igniting a specified flammable mixture by arcing (electrical sparks) or by hot surfaces while the sample is operating normally.

IGNITION SOURCES: Spark ignition, if there is sufficient energy flow, can only occur at the actual point of the physical interruption. The energy is combination from the power supply(s), from a charged capacitor or inductor, or from energy supplied by the materials at the point of sparking. The interruption may be from a switch, poor connection, or some other mechanical means such as the fusing of a wire. Thermal ignition can result by a component or surface that heats to the point of causing ignition or breaks into flame such as an over heated component or fusing of a wire.

HAZARDOUS LOCATION: An area that is or may become explosive by the mixing of air with ignitable liquid vapors, fumes, gases, dusts, or flyings. The hazard is always presumed to be dangerous and is defined in Article 500 of the National Electrical Code, ANSI/NFPA 70-1987.

TEST CONDITIONS: Test conditions are considered to have an ambient temperature of 40°C (104°F), an oxygen concentration of 21-percent or less, and a pressure of one (1) atmosphere.

NORMAL ENERGY: Normal energy is the energy drawn when the voltage, components, and adjustments set to the most unfavorable settings or tolerances. It is also to include the maximum energy draw from opening or shorting of any one-field wires or the shorting of any two-field wires. For battery powered apparatus the voltage is to be the maximum open circuit voltage on a fresh primary or recharged battery. The battery current is to be the maximum initial current.

FAULT: A defect or electrical breakdown, whether artificially induced or not, of any component, spacing, or insulation that adversely affects the electrical or thermal characteristics of an intrinsically safe circuit. When a fault is applied and it causes a chain reaction of failures or breakdowns, both the initial and subsequent failures are considered one fault. The most unfavorable normal, single or double fault condition will be applied to the test sample for evaluation purposes.

TEST FACTORS: Test factors are artificial increases to the available energy. They provide a cushion of safety for the day-to-day variations that occur in the manufacturing processes but may not be seen in the test samples. For a comparison evaluation, Section 5, normal operation will include an energy factor of 0.8 for less than two faults or 0.9 times for two or more faults. For spark ignition evaluation, Section 8, the normal operation will include a 1.5-times energy increase for up to one fault, and no increase for two or more faults.

THERMAL RISE TESTS: Thermal rise is the final, stabilized temperature of component(s) under test, for normal or fault conditions, which ever is worst. A normalized temperature rises greater than 100°C will require an NFPA temperature code on the label. A temperature code aids in determining the lowest ignition point of materials that may be safely used with the sample(s) under evaluation.

COMMENTS: The sample(s) were tested or reviewed to applicable sections in the controlling standards. Nothing should to be construed regarding sections not specifically evaluated, tested, and reported herein. The standards often have more than one method to test a sample. All approved methods yield a safe product. Deliberately increasing test severity does not make a product safer than a safe one. Thus, all tests were to the most unfavorable conditions consistent with the provisions of the standards.

ANSI/UL 913-88 EVALUATION AND/OR TESTING

DRAWING PACKAGE: The following drawings were used during the evaluation and test of the supplied samples. Components referenced by letters and numbers, such as R9 or C2, refer to components on the drawing(s):

Ref No.	Drawing Title	Drawing No.	Pg./Pg.	Last Rev.	Date
1	Radio Communications System (RCS) Kit, Twenty/Twenty	963050	1/1	B	8/4/00
2	Radio Comm System Twenty Twenty Plus Schematic	963024	1/4	B	7/17/00
3	Radio Comm System Twenty Twenty Plus Schematic	963024	2/4	B	7/17/00
4	Radio Comm System Twenty Twenty Plus Schematic	963024	3/4	B	7/17/00
5	Radio Comm System Twenty Twenty Plus Schematic	963024	4/4	B	7/17/00
6	Control Drawing Survivair 2020 RCS Kit	963025	1/1	A	4/19/00

SECTION 1.5 – TYPES OF INTRINSIC EVALUATIONS: There are two types of intrinsic safety evaluations, system, or entity. In the system evaluation, the sample is a stand-alone or can be a combination of an associated apparatus to an apparatus, or apparatus to apparatus. The entity is a general evaluation of a single sample to predetermined electrical limits. Both will have a control drawing showing the proper connection and installation including any special requirements to maintain intrinsic safety after it is connected.

RESULTS: This evaluation consists of three major electrical components. A communications cover (for facemask) with a VPS Module attached. A RCS Module or a RPTT Module attached to the communications cover. See attached references for an overview.

SECTION 2.2 – EVALUATION OF AN INTRINSICALLY SAFE SYSTEM

SECTION 2.2.1 – NORMAL ENERGY, APPLICATION OF FAULTS AND TEST ENERGY: Circuits are to be analyzed as to normal, faulted and test current per Sections 2.1 to 2.14 below.

SECTION 2.1.1.1 -- NORMAL OPERATION: Normal energy is what is drawn from the power source under the conditions below. The resulting current could be resistive, resistive-capacitive or resistive-inductive depending on circuit components. (1) For normal operation the supply voltage is set to rated maximum, all components related to maximum power modified to their worst-case operation, and all adjustments to worst case. Nominal line voltages are 120, 240 or 480 and are increased 10-percent for normal operation. For battery operation, the initial peak voltage from a fresh primary or a secondary battery immediately after a full charge is used. (2) Environmental conditions are to be within stated limits. (3) Components are adjusted to their plus or minus tolerance in a manner that increases energy draw from the source. (4) Adjustments are made at the most unfavorable settings. (5) Opening any one of the field wires, shorting of any two-field wires, or grounding of any one of the field wires.

RESULTS: (1) The sample is powered from a 6-cell alkaline-manganese battery. The nominal voltage was 9.0-volts and the theoretical maximum for this battery is 9.9-volts. Twelve, factory fresh, batteries from 2 manufacturers were measured and the two-sigma plus value of 9.68-volts were calculated. This value will be used throughout the evaluation process. (2) The average laboratory temperature was 22.8°C, and the average relative humidity was 57%. The sample is rated from -30°C to 60°C. The manufacturer did not rate the sample for humidity. (3) The sample's components were calculated for worst tolerance values. The worst resistive component was R6, the current limiting for LED & U2, had a tolerance-adjusted value of 950-ohms, and current of 0.01-A at 9.68-volts. The worst inductive-resistive component LS2, the Knowles ear speaker, had a tolerance-adjusted value 3.360-mH of at a current of 0.1-amps at 8-volts. The worst-case capacitance resistance was component C6, LS1 D.C. blocking capacitor, with an adjusted value of 112.8-µF at 9.68–volts. (4) Sample does not have any adjustable components. (5) Sample did not have the usual wiring terminal or leads. Any "field wires" were connectors to other intrinsically safe components. Shorting, or opening, or grounding does not degrade intrinsic safety.

SECTION 2.1.1.2 – TEST ENERGY AVAILABLE AFTER FAULTS: Test factors are artificial energy increases providing a cushion of safety to the normal test energy. In a resistive circuit having an inductance of less than 5-μH, the energy is to be increased by a factor of 1.5 by the following methods, in order of preference. Increasing the current through limiting resistance to practicable levels, increase the main voltage source, increase other supply voltages, or increase the setting of voltage limiting devices; In resistive-inductive circuits the 1.5 energy factor is achieved by increasing the current by reducing the values of limiting resistance as practicable, and then by increasing the voltage. For resistive-capacitive circuits, the energy is to be increased by a factor of 1.5 by raising the voltage by a factor of 1.22. Finally, the energy factor can be accomplished by any method of equivalent severity, for example, the use of more easily ignited test gases.

When sample is battery operated, adding cells identical to those used in the battery pack achieve the energy increase. They are to be added in parallel or series to meet the method described above. The increase can also be emulated by a suitable power supply taking care to match internal battery resistance. Note: If separate cells are not available, batteries may be doubled for an energy factor of 2, instead of the usual 1.5, with the acceptance criteria remaining the same.

RESULTS: Evaluation of the sample construction in Sections 3 and 4 did not indicate the need to apply faults. The sample had a calculated voltage and current, that was below the values found in Section 5, the sample was comparison evaluated without the 1.5-factor per Section 5. The test energy remains the same as in Section 2.1.1.1 – Normal Operation and is summarized as follows. Resistive-energy with a current of 0.010-A at 9.68-volts. Inductive-energy with current of 0.1-amps for a 3.36-mH inductor. Capacitive energy with 9.68-volts for a 112.8-μF capacitor.

SECTION 2.1.2 TO 2.1.3 – APPLICATION OF FAULTS: Faults are an electrical breakdown defect of any component, spacing, or insulation that adversely affects the electrical or thermal characteristics of an intrinsically safe circuit. It can also include known problems (weakness) of components or materials. A fault can be a short, open, or grounding of the circuit(s). Maximums of two faults are to be applied to the sample(s). When an applied fault causes collateral breakdowns they are not counted towards the fault maximum and increased current is to be taken. Circuits in which no fault or only one fault can occur, must pass the requirements for normal operation and have an additional 1.5-factor applied to it. If double faults are applied, the 1.5-factor is not required.

RESULTS: The sample construction in Sections 3 and 4 did not indicate the necessity of applying faults. (See Sections 3 and 4)

SECTION 2.1.4 – APPLICABLE REQUIREMENTS: All intrinsically safe and associated apparatus and circuits are to meet the requirements in Sections 3 and 4. See below.

SECTION 2.2 – EVALUATION PROCEDURES -- GENERAL

SECTION 2.2.1 -- CIRCUITS TO BE ANALYZED: (1) All circuits are to be analyzed to ascertain circuit parameters per Sections 2.1 to 2.1.4. (2) For intrinsically safe equipment, each possible ignition point is to be evaluated per Section 2.2.4 as follows: (a) Circuit interruptions such as connectors, switches, relays, etc. (b) Short circuits or grounds due to spacing, selection of materials, or construction practices. Though not limited to these, any sources of sparking or heating is to be considered.

RESULTS: (1) the sample was analyzed for circuit parameters. See results in Sections 2.1 to 2.1.4. (2) The sample had the following possible ignition points. The main switch on "mini PCB", component SW2 of reference drawing number 4. The push-on/push off to mask circuits, component SW1 of reference drawing number 5. The last was the volume control, component VR1 of reference drawing number 3. In addition, there is accidental uncoupling of the Nexus brand of connectors. These are the possible ignition points.

SECTION 2.2.2 – CONSTRUCTION AND TEMPERATURE: Construction details and temperatures are to be reviewed for compliance with Sections 3 and 4. Additionally, the samples will comply with the test procedures, as germane, in Section 7.

SECTION 2.2.3 – ARC IGNITION ANALYSIS: There are two methods to evaluate the possibility of having sufficient current under normal or fault conditions. One is comparing the calculated or measured normal and faulted values as apply to Sections 2.1 to 2.1.4 for the analysis method in Section 5. The normal and faulted values are to be below the lookup values obtained. The other is the application of normal and fault conditions to the spark test apparatus per the requirements in Section 8.

RESULTS: Overall rating for Division 1, Class I, are Group A, B, C and D

For Sample: The sample was comparison evaluated. The safe ignition current or voltage limits were obtained from Section 5.

For resistive circuits with less than 5μH, the intrinsically safe current was 4.00-amps. Since the maximum measured resistive current was 0.01-amps and was less than the calculated safe current, the sample meets resistive requirements for Groups A, B, C, & D.

For an inductive-resistive circuit, the safe current was 0.20-amps. Since the maximum inductive current measured 0.10-amps was less than the calculated safe current, the sample meets inductive requirements Groups A, B, C, & D.

For a capacitive-resistive circuit, the safe voltage was 16.1-volts. Since the maximum capacitive voltage measured was 9.68-volts was less than the safe voltage; the sample passes for Groups A, B, C, & D.

For Control Drawing Values on Sample Components: The control drawing, No. 963024 was comparison evaluated using the control drawing values to Section 5.

For resistive-inductive circuits with less than 5-μH, the intrinsically safe current was 4.00-amps. Since the maximum measured resistive current was 0.003-amps and was less than the calculated safe current, the control drawing meets resistive requirements for Groups A, B, C, and D.

For an inductive-resistive circuit, the safe current was 0.32-amps. Since the maximum inductive current measured 0.10-amps and was less than the calculated safe current, the sample meets inductive requirements Groups A, B, C, and D.

For a capacitive-resistive, the safe voltage was 18.3-volts. Since the maximum capacitive voltage measured was 8.00-volts and was less than the safe voltage, the sample passes for Groups A, B, C, and D.

SECTION 2.5 -- APPARATUS INDUCTANCE AND CAPACITANCE DETERMINATION: The maximum internal inductance or capacitance is to be determined for both normal and fault conditions by inspection, analytical computation, or verification of vendor values by testing to Section 7.14.

RESULTS: The maximum inductance was in the Knowles ear speaker circuit and its nominal value was 3.20-mH. The tolerance was ±5%. After application of its plus tolerance, the worst inductance was 3.36-mH.

The maximum capacitance was in the LS1 D.C. blocking capacitor circuit and its nominal value was 94-μF. The tolerance was ±20%. After application of its plus tolerance, the worst capacitance was 112.8-μF.

SECTION 3.1 TO 3.1.3 -- CREEPAGE & CLEARANCE SPACINGS AND INSULATION & CASTING COMPOUND THICKNESS: The supplied samples were measured for creepage, clearance, and thickness of all conductors, connecting wiring, and printed wiring board traces. Spacings and distances that meet values in Table 1 of the specification are not faultable.

Creepage, clearances, and thickness less than specified, but more than one-third the requirement, are to be considered connected if that connection is a more severe condition. Each such connection between conductors will be counted as a one fault.

If the spacing is less than one-third the requirement, and there are multiple adjacent conductors, the distance between each is to be added until the sum equals or exceeds one third. That number of conductors becomes a grouped set and is considered connected. One fault is counted for each set until all adjacent conductors have been evaluated.

When these creepage, clearances or thickness is not within tolerance they may still be acceptable. There are other applicable evaluation sections that apply, but are often more severe. See Section 3.1.7(3), dielectric voltage withstand, or Section 3.2, Encapsulation, or Section 3.4.1, AC Voltage Withstand.

Note 1: The voltage for assessing creepage distance is the nominal peak, and for assessing clearance is the nominal rms voltage with tolerance not considered. For VDC, circuits use the same value for creepage or clearance distances.

Note 2: For two separate circuits, the voltage is the sum of both or the largest when one is less than 20-percent of the other.

RESULTS: Considering the nominal voltage of 9.0-volts, the minimum required creepage distance is 1.35-mm and under a properly, double coated board is 0.45-mm. The clearance distance between any conductive parts will be 1.49-mm. Distances through casting compound will be a minimum of 0.45-mm and at least 0.45-mm through solid insulation.

The least creepage distance on the circuit board was 1.25-mm and the double-coated creepage was 0.3-mm. The battery cells had two layers of insulation between them with a 0.14-mm that does not meet thickness. The insulation material was subjected to a voltage withstand test of 1.39-kV and did not break down. The sample did not have any casting or insulation materials. These values meet the requirements of this section.

SECTION 3.1.7 to 3.1.7(3) -- PRINTED WIRING BOARDS: Coating(s) applied to printed wiring boards are to be an adherent insulating coating that is: (a) at least two layers thick that have a minimum dielectric voltage rating of 200 volts per 0.025 mm (0.001 in.) of thickness; or (b) a single layer not less than 0.7 mm (0.028 in.) thick, or, a single layer with a dielectric voltage withstand test of 1.37 kilovolts RMS.

RESULTS: The main circuit board was double coated including the solder pads. The traces were withstand tested at 1.39-kV from the coating surface to the trace without any breakdown. Samples pass this section.

SECTION 3.4 -- INTERNAL WIRING CONDUCTORS: Samples containing non-insulated internal wiring conductors are to be rigidly supported to maintain their spacing distances. For a nominal 9.0-VDC applied the minimum creepage distance is 1.35-mm and the clearance spacing is 1.49-mm. Internal wiring conductors that are not rigidly supported will be insulated. The insulation will have a dielectric strength greater than 500-volts rms or if larger twice the normal working voltage of the circuit which is 18-volts.

RESULTS: The sample had exposed conductors that were rigidly supported and met the requirements of Table 1 of the referenced standard. The creepage on Nexus receptacle wire leads and had a creepage 1.93-mm and a clearance of 1.93-mm. The wire from the connector/pins circuit board connectors had a creepage of 1.25 and a clearance of 1.42-mm. The insulation on the wires withstood a dielectric strength of 500-VAC. Samples pass the requirements of this section.

SECTION 3.5.3 -- CURRENT-LIMITING RESISTORS: Current-limiting resisters will not be faulted if they pass the following requirements. Resistor(s) will be film construction; wire-wound construction with restraints to hold its winding in place in case of breakage, or any other construction that controls the resistance element. The resistor(s) will have 1.5-times maximum voltage, as measured across it when the resistor is under maximum energy, applied to it. The voltage will be increased from zero to full value in approximately a minute and allowed to temperature stabilize. The resistor(s) under test will increase in resistance or open. When there is a decrease in resistance, as the resistor heats, that decrease will be within 1/3 of the starting value. After it cools, it will return to within 10% of its original value. If the resistor is protected by a fuse, the resistor will be tested by flowing 1.7-times the nominal fuse current value with the fuse defeated. It will meet the same requirement as in the voltage test. Note: A resistor operated at 2/3 of its power does not need testing.

RESULTS: Two resistors, R6 and R8 exceeded their 2/3 wattage rating by 20%. The resistors are metal film on a ceramic base and with a very low temperature coefficient. The temperature rise at maximum possible load was less than 30°C. Resistors are deemed non-faultable.

SECTION 3.7 -- PORTABLE APPARATUS ENCLOSURES: Exposed external surfaces of the enclosure and any external parts will consist of a non-sparking material such as plastic or brass, unless protected by a recess or a guard.

RESULTS: The external surfaces were thermal plastic and all metal hardware was made of brass or a non-sparking stainless steel.

SECTION 3.8 to 3.8.4 -- CELLS and BATTERIES: These requirements apply to the entire apparatus, when it is intended for use in a Division 1 hazardous location. Primary, non-rechargeable, or secondary rechargeable battery cells will not spill electrolytes or emit explosive gases if it poses a hazard. Batteries will maintain spacing and clearance between conductive parts of the batteries and other conductive parts per Section 3.1 to 3.1.3.

Apparatus with energy-limiting components will have them placed as close as practicable to the battery terminals, they will be insulated where needed, and all spacings will be per Section 3.1 to 3.1.3. Batteries or battery packs will not short-circuit the battery when removed or replaced, nor will they apply the battery output to the load side of the energy-limiting components. Movement of battery cells and/or energy limiting components, because of the drop test, Section 7.9.1, will not impair intrinsic safety.

For hand-held portable apparatus, such as radio receivers and transceivers, the construction will prevent the ejection or separation of the batteries from the apparatus when it poses a hazard under rough-use conditions as represented by the drop test described in Section 7.9.1.

RESULTS: The sample has a 6-cell alkaline-manganese battery with a nominal value of 9.0-volts and will not leak gas or liquid unless subject to fire or extraordinarily high heat. When the battery is replaced, it does not short nor improperly apply energy to the sample. The sample was inspected after the drop test, in Section 7.9.1. The components remained properly in place during the drop test. Intrinsic safety was not degraded. Sample passes this section. Note that nine-volt batteries must have an internal resistance greater than 1-ohm or they may not be safe for all Classes and Groups found in this report. Batteries tested in this report, Energizer 522, and Duracell Ultra MN1604. These are known to be safe as of this date. As manufacturers are always improving batteries, unit shall not be powered with a battery having less than one-ohm internal resistance.

SECTION 4.1 to 4.1.3 -- MAXIMUM TEMPERATURE: The maximum, stabilized temperature rise of any surface exposed to flammable or combustible materials, normal or fault conditions, will not exceed marked value or temperature code rating on the label. All temperature rises are normalized to an ambient temperature of 40° C (104° F). If any stabilized temperature rise exceeds 100° C (212° F), a temperature code is required on the label. When checking wires 0.5 mm or smaller, refer to ANSI/UL 913-88 Table 2. For larger wires use equation in Section 4.1.2 of ANSI/UL 913-88.

Exception: Instead of measuring temperature directly for large or small component(s), the method in ANSI/UL 913-88 Section 7.6, Small Component Ignition Test, may be used. Passing this Section yields a temperature code of T4.

Temperatures higher than marked will be permitted for small components, such as transistors, resistors, small gage wires, or surface mount components, if it is shown by test, ANSI/UL 913-88 Section 7.6, or Section 7.11.3, that the temperature is insufficient to cause ignition or charring.

RESULTS: Sample or the Control Drawing does not require a temperature code on the label

For Sample: The worst-case temperature rise was on the current limiting for LED & U2. The temperature rose to 43.8°C when normalized to 40°. Sample does not require a temperature code on the label.

For Control Drawing Values on Sample Components: The values found on the control drawing do not require a temperature code on the label.

SECTION 4.2 to 4.2.4 -- MARKING REQUIREMENTS: ANSI/UL 913 requires the following information on an apparatus label: identification of the apparatus including manufacturers' name or trademark and type or model designation, hazardous location division, class and group(s), maximum surface temperature or temperature identification number based on operation at 40° C (104° F) ambient temperature, and control drawing number.

If sample is battery powered, the battery type, size, and voltage may be specified by manufacturer and model number, or by electrical equivalent. When battery energy varies greatly from manufacturer to manufacturer, it will be labeled by manufacturer and model type only, no equivalents. These markings can be on the main label or in the battery compartment. If battery is not intrinsically safe, label will carry a warning to change batteries in areas known to be non-hazardous.

RESULTS: The sample was not marked with their final label. The proposed label meets the requirements and when applied, the sample will meet the requirements of this section.

SECTION 5.1 to 5.2.2.2 – DETERMINATION OF SAFE CURRENT OR VOLTAGE: Circuits that can be readily assessed may be considered intrinsically safe, without spark ignition testing, by comparison to the ignition curves found on Figures 1 though 8, in the referenced Standard(s). All figures assume Groups A, B, C, D, or methane, as marked, and that the gas or vapors are in air at normal atmospheric conditions. Values found above and to the right of the curves will cause ignition of the gas or vapor under evaluation. The circuit values are for all normal and fault conditions but do not include the 1.5-times energy factor. Values of current or voltage must be dc or peak ac. For linear resistive circuits with less than 5-H inductance: For normal or a single-fault, the circuit under evaluation must not exceed 80 percent of the current value determined from Figure 1 or 2, or for a two-fault condition, the current must not exceed 90 percent of the determined current value.

Inductance-Resistance - Circuits: Figures 3 or 4 apply to inductance-resistance circuits: Figures 5 and 6 apply to inductance-resistance circuits at stepped voltages for values of inductance versus current that ignite gases or vapors for Groups B and methane, respectively. Interpolation is required for groups C and D that are not on these figures. For normal or a single-fault, the circuit under evaluation must not exceed 80 percent of the current value determined from Figures 3 through 6, or for a two-fault condition, the current must not exceed 90 percent of the determined current value.

Capacitance-Resistance Circuits: Figures 7 and 8 apply to resistance-capacitance circuits and show ignitable combinations Groups A and B or methane for capacitance, voltage, and resistance that ignite gases or vapors in air. Interpolation is required for groups C and D that are not on these figures. These curves only address the discharge of the capacitor under evaluation. For normal or a single-fault, the circuit under evaluation must not exceed 80 percent of the voltage value determined from Figures 7 or 8, or for a two-fault condition, the voltage must not exceed 90 percent of the determined voltage value.

RESULTS:

For Sample: The values were calculated using data from Section 2.1.1.2. These were used to derive the safe current and voltage levels from the appropriate graphs from Figures 1 through 8.

Linear-Resistive Circuits With Less Than 5-μH Inductance: The maximum resistive current was in the current limiting for LED & U2 circuit with an applied 9.68-volts and a current of 0.010-amps. Considering Figure 1, Resistance Circuits containing aluminum, cadmium, magnesium, and zinc, a chart value of 12.1-volts yields an initial safe current of 5.00-amps. Applying the 0.8-factor for a zero to one fault yields a final safe current of 4.00-A.

Inductance-Resistance Circuits: The maximum inductance was the Knowles ear speaker circuit and its value was 3.36-mH at a current of 0.10-amps. Considering Figure 3, Inductance Circuits containing aluminum, cadmium, magnesium, and zinc, an initial value of 3.36-mH inductance yields a safe current of 0.20-amps. Applying the 0.8-factor for a zero to one fault yields a final safe current of 0.16-amps.

Capacitance-Resistance Circuits: The maximum capacitance was in the LS1 D.C. blocking capacitor circuit and its value was 112.8-μF at a voltage of 9.68-volts. Considering Figure 8, Capacitance Circuits containing aluminum, cadmium, magnesium, and zinc, the 112.8-μF capacitance yields an initial safe voltage of 16.1-volts. Applying the 0.8-factor for a zero to one fault yields a final safe voltage of 12.9-volts.

For Control Drawing Values on Sample Components: The values were calculated using data from the Control Drawing. These were used to derive the safe current and voltage levels from the appropriate graphs from Figures 1 through 8.

Linear-Resistive Circuits With Less Than 5-μH Inductance: The maximum resistive current was in the control drawing radio PTT circuit with an applied 11.20-volts and a current of 0.003-amps. Considering Figure 1, Resistance Circuits containing aluminum, cadmium, magnesium, and zinc, an initial chart value of 12.1-volts and yields an initial safe current of 5.00-amps. Applying the 0.8-factor for a zero to one fault yields a final safe current of 4.00-A.

Inductance-Resistance Circuits: The maximum inductance was the circuit and its value was 0.5-mH at a current of 0.10-amps. Considering Figure 3, Inductance Circuits containing aluminum, cadmium, magnesium, and zinc, a value of 0.5-mH inductance yields an initial safe current of 0.40-amps. Applying the 0.8-factor for a zero to one fault yields a final safe current of 0.32-amps.

Capacitance-Resistance Circuits: The maximum capacitance was in the control drawing radio speaker circuit and its value was 100-µF at a voltage of 8.00-volts. Considering Figure 8, Capacitance Circuits containing aluminum, cadmium, magnesium, and zinc, the 100-µF capacitance yields an initial safe voltage of 18.27-volts. Applying the .0.8-factor for a zero to one fault yields a final safe voltage of 13.15-volts.

SECTION 6.2 to 6.2.4 -- SPECIFIC REQUIREMENTS FOR INTRINSIC SAFETY: Intrinsically safe and associated apparatus intended for use in Division 1, Class II and Class III hazardous locations will comply with all applicable requirements found in ANSI/UL 913-88, sections 1 through 5.

Sample cases or enclosures that are not dust-tight, per ANSI/UL 913-88 Section 6.3.1 through 6.3.1.2, will have internal spacings faulted to produce the most unfavorable condition without consideration to the number of induced faults. Parts encapsulated to a depth of 1-mm or more are considered dust-tight. Only the external surfaces of dust-tight cases or enclosures are considered exposed. Dust-tight cases must remain so after the drop test in Section 7.9.1. The maximum temperature rises of any exposed surface, when normalized to an ambient temperature of 40°C will comply with permissible temperatures below. For compliance to Class II, Groups E & G, and Class III, samples must also meet spark ignition requirements for Division 1, Class I, Groups D, or methane.

The maximum temperature of an exposed surface for compliance to Class II, Group E, atmospheres containing combustible metal dusts, will not exceed 200°C (392°F). For Class II Group F, atmospheres containing combustible carbonaceous dusts, the maximum temperature will not exceed 200°C (392°F). For Class II, Group G, atmospheres containing combustible dust not included in Groups E or F, the surface temperatures will not exceed (329°F). For Class III, atmospheres containing easily ignitable fibers or flyings, the surface temperatures will not exceed 165°C (329°F).

Exception: Temperature excursions of small, exposed components, when under fault conditions, may exceed these limits if it is shown by test that these components will not char or ignite test wheat or corn dust (or a mixture of both) that will pass through a 100-mesh screen.

RESULTS: Overall, the sample and control drawing are intrinsically safe and are in compliance with the requirements of ANSI/UL913-1988 for Division 1, Class II, E, F, G, and Class III.

For Sample: The maximum temperature rise was taken from Section 4.1, which was 44°C when, normalized to 40°C. As 44°C was lower than 165°C and 200°C, the sample meets the required for Class II, E, F, G, and Class III. In addition, they are permitted in Division 2, Class II, Groups F, G, and Class III.

For Control Drawing Values on Sample Components: The maximum temperature rise was taken from Section 4.1 that was 44°C when normalized to 40°. As 44°C was lower than 165°C and 200°C Class II, E, F, G, and Class III. In addition, they are permitted in Division 2, Class II, Groups F, G, and Class III.

SECTION 7.9.1 Drop Test: Portable equipment or apparatus is subjected to six (6) drop impacts onto a concrete floor from a height of 1 meter. The apparatus will not impact more than once on each side, corner, or edge. The drop test will not affect the intrinsic safety because of being dropped.

RESULTS: The sample was dropped six times from 1-m onto a concrete floor. Dropped sample was inspected for internal changes resulting from the drop test that would degrade intrinsic safety. All connections, conductors, and components were intact and intrinsic safety was not degraded due to the drop test.

CLIENT: SURVIVAIR

COMMENTS: Compliance with UL 1604 is according to "Section 500-3(a) of ANSI/NFPA 70-1987, National Electrical Code, which states that equipment which has been approved for a Division 1 location shall be permitted in a Division 2 location of the same class and group.

CONCLUSION: Considering the results of the tests and evaluations that were conducted, the Survivair Twenty/Twenty consisting of RCS Kit, P/N 963050, SmallTalk Plus Kit P/N 963070, RCS/SmallTtalk Plus Kit P/N 963080, RCS/RPTT Kit P/N 963073, RCS/SmallTalk Plus/RPTT Kit P/N 963074 were found to comply with the requirements of ANSI/UL 913-88, for Division 1, Class I, Groups A, B, C and D, Class II, Groups E, F, G, and Class III hazardous locations. In addition, they are permitted in Division 2, Class I, Groups A, B, C and D, Class II, Groups F, G, and Class III. The unit is recommended for inclusion into the SGS U.S. Testing Company.

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End of Report