



Factory Mutual Research

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OR6A0.AX
(3610)

November 13, 1989

TYPE J AND K SOLENOID OPERATORS FOR PNEUMATIC VALVE EQUIPMENT

FOR

HAZARDOUS LOCATIONS

from

TELEKTRON LIMITED
ARMFIELD CLOSE
EAST MOLESEY, SURREY KT8 ORJ
ENGLAND

I. INTRODUCTION

1.1. Telektron Limited requested approval of type J and K Solenoid Operators to be in compliance with the applicable requirements of the following standard:

<u>Title</u>	<u>No.</u>	<u>Issue Date</u>
Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1 Hazardous Locations	Class No. 3610	October 1988

Note: 1.5 factor applied to voltage or current rather than energy.

1.2. The following was evaluated as intrinsically safe apparatus for Class I, Division 1, Groups A, B, C, and D hazardous locations in accordance with Entity requirements per Telektron Installation Drawing No. SD954 Issue 02, and will appear in the Approval Guide as follows:

IS/I/1/ABCD - SD954 / 02; Entity

Max Entity Parameters: V_{max} = 31V, I_{max} = 160mA, C_i = 0 uF, L_i = 0 mH

Solenoid Operator. Series J, K. Model abcdefg

- a - voltage: 1 or 2
- b - Electrical connections: 1 or 2
- c - FMR Approval Reference: J or K
- d - Port Block Material: Stainless Steel, Aluminium, or Brass

- e - Connection size: 1/4 NPT, API or 1/4 BSP ISO
- f - Valve functions: 2/2, 3/2, 4/2 or 4/3
- g - Manifold: Common or separate supply/exhaust

1.3. This report examines the apparatus' entity parameters as requested. Entity requirements previously approved under J.I.OC7A4.AX remain in effect, however, at Telektron's request, the listing for type R and S Solenoid Operators will be deleted from the Approval Guide. The product will be listed in the Approval Guide as shown in section 1.2.

II. DESCRIPTION

Type J and K Solenoid Operators are control valve assemblies used in pneumatic systems. An electromechanical solenoid sub-assembly is fastened on top of a valve body. The solenoid causes the valve to function by either opening or closing pilot bleed ports. The solenoid sub-assembly consists of one or two sets of solenoid coils with respective full wave diode bridge rectifiers, optional light emitting diode (LED) indicators in series with respective coils, mounted in a plastic housing and potted.

III. EXAMINATION AND TESTS

3.1. Representative samples of type J and K Solenoid Operators were examined and tested by Factory Mutual Research Corp. to determine the acceptability for use in the specified hazardous location. The examination included circuit analysis, component tests, temperature measurements, and ignition tests, as well as a review of the manufacturer's documentation and the unit's physical construction and fabrication materials. All were satisfactory and are summarized in the following sections.

3.2. Entity - Under "entity" requirements, the concept allows interconnection of intrinsically safe apparatus to associated apparatus, not specifically examined in such combination. The criteria for interconnection is that the voltage (V_{max}) and the current (I_{max}) which intrinsically safe apparatus can receive and remain intrinsically safe, considering faults, must be equal to or greater than the voltage (V_{oc}) and current (I_{sc}) levels which can be delivered by the associated apparatus, considering faults and applicable factors. In addition, the maximum unprotected capacitance (C_i) and inductance (L_i) of the intrinsically safe apparatus, including interconnecting wiring, must be equal or less than the capacitance (C_a) and inductance (L_a) which can be safely connected to the associated apparatus. If these criteria are met then the combination may be connected.

3.3. Intrinsically Safe Evaluation - The following tests verify the suitability of Type J and K Solenoid Operators as intrinsically safe for Class I, Division 1, Groups A, B, C and D hazardous locations. Telektron Ltd. specified the maximum entity parameters, which are to be used for the intrinsic safety evaluation of Type J and K Solenoid Operators, to be the following;

$V_{max} = 31 \text{ V}$, $I_{max} = 160 \text{ mA}$, $C_i = 0 \text{ uF}$, $L_i = 0 \text{ mH}$

Note that for Type K (ac systems) Solenoid Operators, V_{max} is the maximum peak ac entity voltage which can be applied. The rms voltage must not exceed 0.707 of 31 V or; 21.9Vrms max.

The Type J and K Solenoid Operators were evaluated to determine the unprotected capacitance and inductance present at the terminals.

3.3.1. Unprotected capacitance - Analysis revealed that the Type J and K Solenoid Operators contain no inherent capacitive components. Construction, wiring and spacing of the Operators are such that the capacitance at the terminals is 0 uF under normal and fault conditions. Therefore, the unprotected capacitance, C_1 , present at the terminals is 0 uF and the maximum specified voltage, V_{max} , of 31 V is acceptable.

3.3.2. Unprotected inductance - Analysis revealed that the only inductance present in Type J and K Solenoid Operators is the 8.75 H inductance of the relay coil, SD952 with a coil resistance of 1.5K ohms (one or two relay coils, depending on the configuration). The relay coils are adequately protected under normal and fault conditions by full wave rectifier diode bridges, SD953. Therefore, the unprotected inductance, L_1 , present at the terminals is 0 mH. Based on this analysis and the results of ignition tests in section 3.3.6., current value I_{max} of 160 mA is acceptable.

3.3.3. Creepage and Clearance Evaluation - The bridge rectifier, solenoid coils and wire leads are encapsulated together and the creepage and clearance distances which affect intrinsic safety meet the minimum requirement of 1 mm (.039 in) creepage/distance through casting compound for circuits up to 60 V.

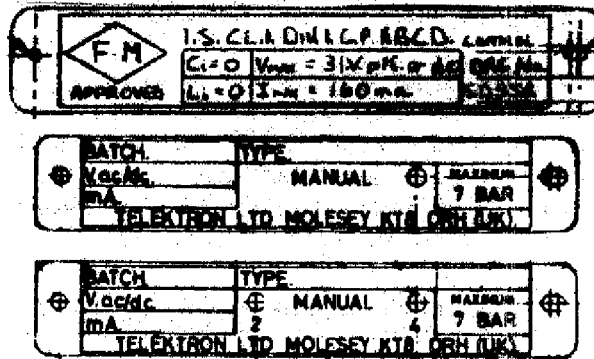
3.3.4. Protective Component Derating - The protective full wave rectifier diode bridges are adequately derated to operate within 2/3 their forward current rating under normal and fault conditions.

3.3.5. Temperature tests - Tests revealed that no component produced temperatures in excess of 100°C, under normal or fault conditions, based on an ambient of 40°C (104°F). Where the maximum temperature does not exceed 100°C (212°F), a temperature rating code is not required to appear on the label.

3.3.6. Spark Ignition tests - Repeated spark ignition tests were performed on type J and K Solenoid operators under worst case voltage and current of entity parameters in the combustible mixtures specified for the stated groups. The absence of ignition confirms that type J and K Solenoid Operators are incapable of causing ignition of specified gas mixtures.

IV. MARKING

Marking meets standard requirements as illustrated below:



Note: labels not to scale.

V. REMARKS

5.1. Manufacturer's instructions supplied with the protective assemblies as well as the system installation instructions and the National Electric Code should be followed when installing this equipment.

5.2. Control room equipment connected to associated apparatus should not use or generate more than the maximum voltage specified for the barrier.

5.3. Tampering or replacement with non-factory components may adversely affect the safe use of the system.

5.4. The resistance between the shunt diode barrier ground and earth ground must be less than 0.1 ohm.

5.5. For guidance on installation, see ANSI/ISA RP12.6, "Installation of Intrinsically Safe Instrument Systems in Class I Hazardous Locations."

VI. FACILITIES AND PROCEDURES AUDIT

The manufacturing site at East Molesey, Surrey UK was examined on January 11, 1989 with regard to facilities and quality control procedures and results were satisfactory in that the level of performance which produced the item which was tested was maintained.

VII. MANUFACTURERS RESPONSIBILITIES

7.1. The documentation listed in Section IX is applicable to this Approval and is on file at Factory Mutual Research Corp. No changes of any nature shall be made unless notice of the proposed change has been given and written authorization obtained from Factory Mutual Research Corp. The Approved Product - Revision Report, FMRC Form 797 shall be forwarded to Factory Mutual Research Corp. as notice of proposed changes.

7.2. On 100% of production, the manufacturer shall conduct routine dielectric tests. The unit shall withstand for one minute, with no insulation breakdown, the application of 500 Vac or 707 Vac between the Intrinsically safe terminals connected together with respect to the metallic valve body at the base of the Solenoid Operator. Alternately, tests potentials of 600 Vac or 860 Vac may be applied for at least one second.

VIII. CONCLUSION

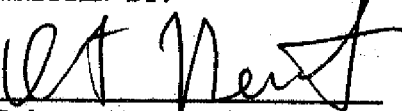
The apparatus described in Section 1.2 meets Factory Mutual Research Corp. requirements. Approval is effective when the Approval Agreement is signed and received by Factory Mutual Research Corp.

EXAMINATION AND TESTS BY: Robert Menot


ATTACHMENTS: Manufacturer's Drawings SD954 issue 02

ORIGINAL TEST DATA: Test Notebook No. 89-479

WRITTEN BY:


Robert Menot, Engineer
Instrumentation Section
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REVIEWED BY:


R. H. Lelievre, Assistant Manager
Instrumentation Section
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IX. DOCUMENTATION

The following documentation is applicable to this Approval and is on file at Factory Mutual Research Corp.

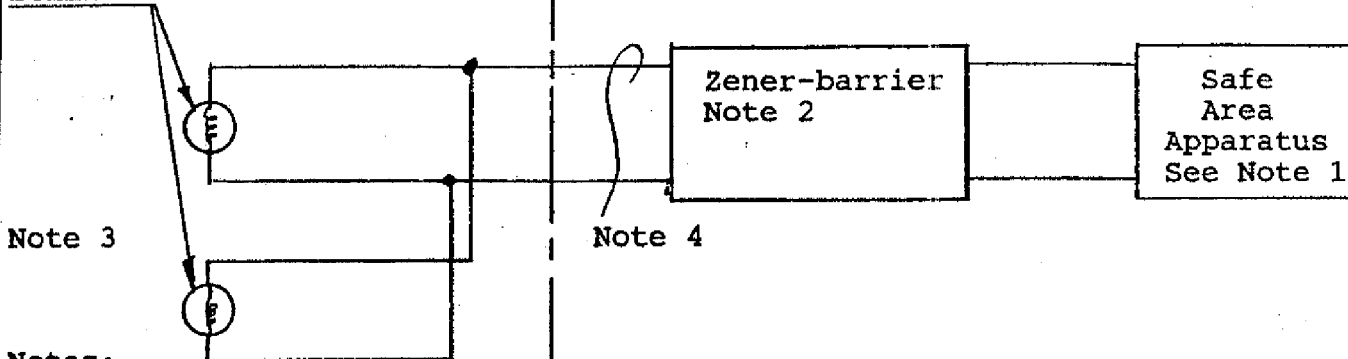
<u>Document No.</u>	<u>Revision or Issue Date</u>	<u>Title</u>
SKVE 24 IS/FMR (ENTITY) -issue 02	10-10-89	Intrinsically Safe Solenoid Housing
SD 953 -issue 01	08-15-89	Silicon Bridge Rectifier
SD 952 -issue 01	08-15-89	Relay Coil Encapsulation
SD 954 -issue 02	10-10-89	Installation for Type J & K Solenoid
SD 951 -issue 02	11-13-89	Label IS Type FMR (ENTITY)
8150 -issue 07	11-23-79	Label, STD

ZENER BARRIERS

HAZARDOUS AREA
CLASS 1. DIV. 1.
GROUPS, **A** B C & D

NON HAZARDOUS AREA

TYPE **J** OR **K**
SOLENOID



Notes:

- 1) The safe area apparatus must not be supplied from nor contain a potential with respect to ground exceeding 250V RMS or DC.
- 2) Any FM approved Zener barrier or combination of Zener barriers can be used where entity concept parameters do not exceed those given in (5) below.
- 3) Up to a maximum of 5 solenoids can be operated from one barrier.
- 4) Cable parameters.

The capacitance C_a and Induction L_a of the Hazardous area cables must not exceed the values given in the Entity Certificate for the barrier in use.

5) Entity Parameters. Solenoid Type **J** & **K**

Vmax.V.	I _{max} mA	C _i μ f	L _i m H
31	160	0	0

- 6) For guidance on the installation see ANSI/ISA RP 12.6
- 7) Apparatus must be installed in accordance with the manufactures guidelines.

NOTE: Certified drawing. No change permitted without reference to Telektron Ltd. and certification authority F.M.R.

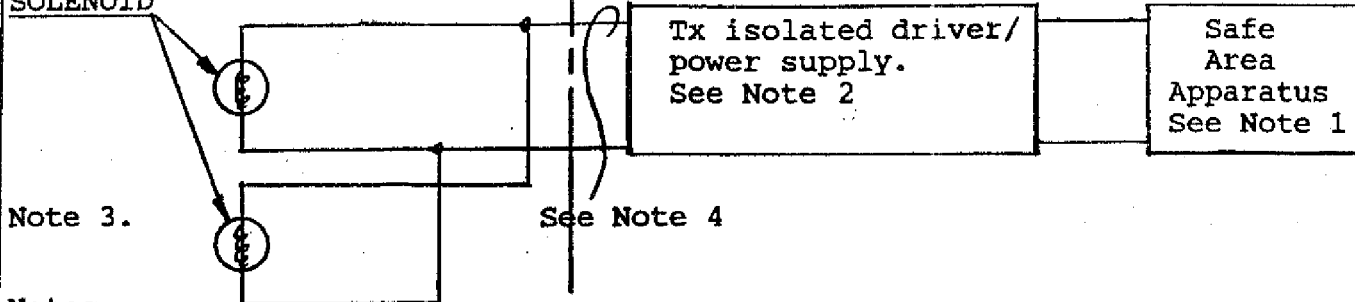
ISSUE	1	2		MATERIAL	FINISH
MOD. No.	/	SP.1654		/	/
DATE	15-8-89	10-10-89.			
APP'D.	MLP	MM			
APP'D.	MLP	TELEKTRON LTD.			SCALE
CHK'D.	MLP	TITLE INSTALLATION DRAWING FOR TYPE J & K SOLENOID W. (ZENER BARRIERS)			DRG. No.
DRN.	DJW				SD. 954. SHT. 1 OF 2.

TX ISOLATED DRIVER/POWER SUPPLY

HAZARDOUS AREA
CLASS 1. DIV.1.
GROUPS A B C & D

NON-HAZARDOUS AREA

TYPE J OR K
SOLENOID



Notes:

- 1) The safe area apparatus must not be supplied from nor contain a potential with respect to ground exceeding 250V RMS or DC.
- 2) Any F.M. approved Tx-isolated driver/power supply or combination can be used where entity concept parameters do not exceed those given in (5) below.
- 3) Up to a maximum of 4 solenoids can be operated from one Tx. isolated driver/power supply.

4) Cable parameters.

The capacitance C_a and Induction L_a of the Hazardous area cables must not exceed the values given to the Entity Certificate for the Tx isolated driver power supply in use.

5) Entity Parameters Solenoid Type J & K

V _{max}	I _{max} mA	C _i μF	L _i mH
31	160	0	0

- 6) For guidance on the installation see ANSI/ISARP 12.6.
- 7) Apparatus must be installed in accordance with manufacturers guidelines.

NOTE: Certified drawing. No change permitted without reference to Telektron Ltd. and certification authority F.M.R.

ISSUE	1	2	MATERIAL	FINISH
MOD.No.	/	SP.1654	/	/
DATE	15-8-89	10-10-89		
APP'D.	MVF	MVF		
APP'D.	MVF	TELEKTRON LTD.		SCALE
CHK'D.	MVF	TITLE INSTALLATION DRAWING FOR TYPE J & K SOLENOID W (Tx. isolated driver/power supply).		DRG.No.
DRN.	D.V.			S.D. 954, SHT. 2 OF 2.