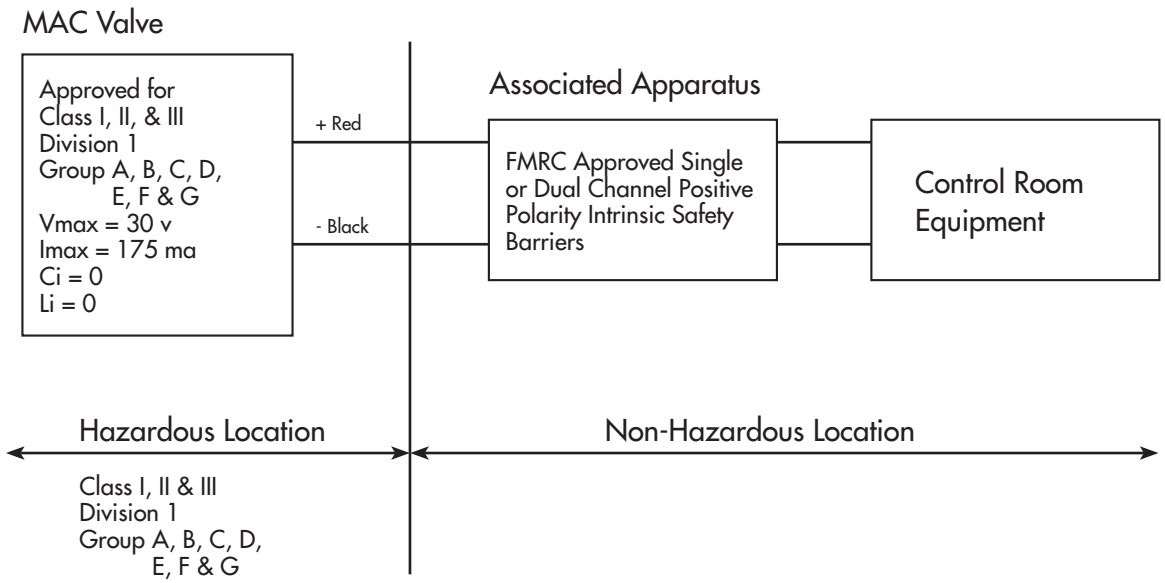
INTRINSICALLY SAFE CIRCUIT

In order to use an intrinsically safe valve in a hazardous location, the installation must be in accordance with the following installation diagram :



There are 3 basic parts to an intrinsically safe circuit :

1. FIELD DEVICE

This is defined as the device that will be used in the hazardous location. In this case, the field device will be the intrinsically safe valve.

2. ASSOCIATED APPARATUS

This will be an energy limiting device also known as a barrier.

3. FIELD WIRING

Wiring used to connect the two above devices.

When the MAC intrinsically safe valves were tested for approval, they were tested and approved for the following atmospheres.

Class I, II, III
Division 1
Groups ; A, B, C, D, E, F, G

under the following parameters :

Vmax : 30 VDC
Imax : 175 ma
Ci : 0
Li : 0

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What this means is that the intrinsically safe valves were tested against each atmosphere with up to 30 VDC and 175 ma of current across the solenoid and found to still be safe. The other two parameters are values to indicate how much energy can be stored or created by the valve :

Ci : Internal capacitance of the solenoid.
This indicates how much energy the solenoid is capable of storing.

Li : Internal inductance of the solenoid.
This indicates the solenoid's ability to create or increase energy beyond what is supplied.

When applying an intrinsically safe valve in a hazardous location, a proper barrier must first be selected. The barrier selection process must first take into account the parameters the valve was approved for and compared in the following way :

- Vmax must be greater than or equal to Voc of the barrier.
  Voc = Voltage open circuit or maximum allowed out of the barrier
- Imax must be greater than or equal to Isc of the barrier.
  Isc = Current short circuit or the maximum current allowed out of the barrier
- Ci plus field wiring must be less than Ca of the barrier.
  Ca = Allowed capacitance
- Li plus field wiring must be less than La of the barrier.
  La = Allowed inductance

When properly combined, the barrier will never allow more energy to the intrinsically safe valve than what it was tested and approved for.

The following page can be used as your guide to help ask the right questions when working with an intrinsically safe circuit. Also included is a partial list of intrinsically safe barriers that have been tested with the MAC intrinsically safe valves.

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Approval : Factory Mutual Research 2X7A8.AX (3610)
Approved as intrinsically safe apparatus and associated apparatus for use in Class I, II, III - Division 1, Group : A, B, C, D, E, F & G.

Parameters : Vmax : 30 VDC
Imax : 175 ma
Ci : 0
Li : 0
Operating voltage greater than 11.5 volts
Coil resistance : Approximately 250 ohms
Current draw : 50 ma
Wattage : 0.6 watts

Circuit Check Lists :

- Is Vmax greater than or equal to Voc ?
- Is Imax greater than or equal to Isc ?
- Is Ci less than Ca ?
- Is Li less than La ?
- Is the barrier capable of handing 50 ma draw ?
- Is the internal resistance of the barrier 250 ohms or less ?

If all answers to the above questions are "yes" the barrier may be a good choice in combination with the MAC intrinsically safe valve.

To calculate voltage across the solenoid, plug values into the following equations :

$$\text{ITOTAL} = \text{Plug } I_{\text{TOTAL in below}} \quad I_{TOTAL} = \frac{\text{SUPPLY VOLTAGE}}{250 + \text{BARRIER RESISTANCE}} = \underline{\qquad\qquad}$$

← Plug ITOTAL in below _____

Voltage at Solenoid = I_{TOTAL} x 250 ohms = _____ volts

Manufacturer	Model #	Barrier Res.	Voltage w/o Light	Voltage w/Light	Groups	Type
Turck	MK72-S01-EX		11.2 v	10.2 v*	A-G	T.I.B.
Crouse-Hinds	SB19140-M2410		13.2 v	12.6 v	C-G	Zener
IMO Industries (Gems Sensors)	114072	234 OHMS	12.0 v	11.4 v	C-G	Zener
Pepperl & Fuchs	KHZ-922/EX-1	270 OHMS	11.6 v	11.06 v	A-G	Zener
	KHZ-922/EX-2	270 OHMS	11.6 v	11.06 v	A-G	Zener
	KHZ-922/EX-3	270 OHMS	11.6 v	11.06 v	A-G	Zener
Stahl	9001/01-280-165-10		13.5 v	12.9 v	C-G	Zener
	9351/10-14-10	80 OHMS	13.7 v	13.4 v	A-G	T.I.B.
Ronan	X57-229P	200 OHMS	12.7 v	12.05 v	C-G	Zener
Measurement Technology	MTL728P+	250 OHMS	11.9 v	11.4 v	A-G	Zener
	MTL3022		15.0 v	14.5 v	C-G	T.I.B.

Above data is based on a 24 v DC supply voltage to the input of the barrier. A 12 v DC, 243 OHM, .6 watt intrinsically safe solenoid is used. The measurement with light is an LED with a current limiting resistor.
Groups indicate what atmosphere the barrier has been approved for. All MAC intrinsically safe valves have been approved for Class I, II and III, Division 1, Groups A, B, C, D, E, F and G indoor hazardous locations.

T.I.B. = Transformer Isolated Barrier
* = Not a recommended combination

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HOW TO ORDER

VALVE OPTIONS

MAC125A - VXXX - XX - XXYDA - 9 **VALVE ASSEMBLED TO BASE**
MAC250A

SEE BELOW

SERIES
REVISION LEVEL

FUNCTION		ELECTRICAL CONN. IN TOP PLATE		PILOT	
1	Single Operator, 2 Position, Single Pressure	A	5 Pin (Ford Wiring)	1	Internal Pilot
2	Double Operator, 2 Position, Single Pressure	B	5 Pin (Chrysler Wiring)	3	External Pilot
3	Single Operator, 2 Position, Dual Pressure	G	4 Pin Micro		
4	Double Operator, 2 Position, Dual Pressure	E	3 Pin (Ford Wiring)		
5	3 Position, Closed Center	F	5 Pin Micro (Chrysler Wiring)		
6	3 Position, Open Center				
7	3 Position, Dual Pressure, Pressure Center				

SOLENOID PILOT OPTIONS

XX - XX - YDA

XX	PILOT EXHAUST	XX	DC VOLTAGE	Y	MANUAL OPERATOR
FM	Muffled exhaust	A5	12 VDC (0.6 W)	0	No operator
FP	Piped exhaust	A6	24 VDC (0.6 W)	1	Non-locking Recessed (std.)
				2	Locking Recessed
				3	Non-locking Extended
				4	Locking Extended

ORDERING EXAMPLE: MAC125A-V1A1-FM-A51DA

BASE/MANIFOLD TABLE

TYPE	PORT SIZE	INDIVIDUAL BASE	MANIFOLD BASE (btm. cyl. ports)	MANIFOLD BASE** (side & btm. cyl. ports)
MAC125	1/4"	MAC125A-B21A	MAC125A-M21B	MAC125A-M21C
	3/8"	MAC125A-B31A	MAC125A-M31B	MAC125A-M31C
MAC250	1/2"	MAC250A-B21A	MAC250A-M21B	MAC250A-M21C
	3/4"	MAC250A-B31A	MAC250A-M31B	MAC250A-M31C
	1"	MAC250A-B41A	N/A	N/A

Individual base available with side ports only.
**Requires End Plate Kit M-12002-01 (125 Series), M-25002-01 (250 Series)
Bases & manifolds coded for internal pilot. For external pilot, last number of code is 2. **ORDERING EXAMPLE:** MAC125A-B22A.

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