Hydraulic Safety Interlock Manifold Systems

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As the need to apply Hydraulic Safety Interlock Systems to machinery in Australia becomes more prevalent we need to be able to respond quickly to our customers with concise answers and technical information.

In order to achieve this it is important to understand the requirements of the relevant Australian standards and how we can use our products to allow system integrators to achieve the safety system compliance.
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- Designers of Safety Systems must comply with local laws and standards

- In Australia, AS4024.1 – Safe Guarding of Machinery is the standard that needs to be adhered to (also currently under review to be updated)

- In Europe, EN954 – is the standard that needs to be adhered to AS 4024.1 is based on this standard.

- The question is what information do we need from our customer to proceed with our design and offer a solution?
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The customer must first detail for us the “Determination of Machine Category”. This will then allow us to offer the appropriate design.

AS 4024 – Determination of Machine Category

Legend
S = Severity of Injury
S1 = Slight (normally reversible) injury
S2 = Serious (normally irreversible) injury, incl. Death
P = Possibility of avoiding the hazard
P1 = Possible under specific conditions
P2 = Scarcely possible
F = Frequency of exposure/ or exposure time
F1 = Seldom to quite often/exposure time short
F2 = Frequent to continuous/exposure time long

Preferred
Possible
Over dimensioned
The determination of the machine category is critical in determining what hydraulic circuit option you can offer. The Australian Standard AS4024.1 is specific. It states “The designer must consider the flow of power in the system and the action of the stored energy. If the flow of power can be reliability blocked and the stored energy dissipated or controlled a machine is considered safe”.

It is not for us to decide the machine category. This is to be done by either a Risk Management Consultant or a System Integrator.
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- Once the Category of the “Safety Required” is determined what does it mean to us?

- What do we have to supply to comply with the rules as detailed in AS4024.1?
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- Category 1. Single valve without indication of failure

- Category 2. Two independent valves each with position monitoring must be used to block the flow of power.

- Category 3. Two independent valves each with position monitoring must be used to block the flow of power. Indication of a failure is required.

- Category 4. Two independent valves each with position monitoring must be used to block the flow of power and the control system must incorporate cross monitoring of the signals.
AS4024.1 has 2 charts

- Interlock Category has 6 levels and the Safety category has 4 levels
- We should be using the 4 Safety Levels
- Safety Category 1 would most likely never apply to hydraulics
  - This level 1 needs Interlocks as shown on the chart to categories 1 & 2
- Safety Category 2 needs two isolating valves in series. No indication is required by Interlock Category 3
- Safety Category 3 & 4 needs two isolating valves in series with indication is required by Interlock Category 4, 5 & 6. There is no difference between the hydraulics of Safety Category 3 & 4 only the electrical control changes.
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- Typically most applications using hydraulics will fall into the Category 3 or 4.

- As we move further through the presentation you will realize that the valves we offer can be used in either Category 3 or Category 4. The system integrator can use self monitoring PLC equipment to indicate failure of any of the hydraulic safety valves thus the system meets Category 4.

- We (Bosch Rexroth) are not system integrators we are offering valves & manifolds for use by system integrators. It is important to note the hydraulic valving is only part of the safety system. Controls need to be in place to stop the machine and take the energy source away as well as indicating a fault should a valve indicate a problem during the cycle.

- So what questions can we be asked by the customer and how can we best answer them?
Some customers may ask you questions like

- Q1. Does your Hydraulic Safety Interlock Manifold meet AS4024.1?
- Q2. Do you have CE Certification?
- Q3. Have your valves been assessed independently?
- Q4. What valve options are available
- Q5. Do you meet the Machinery Directive: 98/37/EC – EN292-1, EN292-2, EN982, EN954-1 and EN1050 (European Standards)
Q1. Does your Hydraulic Safety Interlock Manifold meet AS4024.1?

Answer – No, our valves have been design and tested and meet particular EN standards. These individual standards have been meet and we have the documentation proving this. It means that our safety interlock valves are suitable to be used by a system integrator in an application that is required to meet AS4024.1. We have here a statement/declaration that should be used to give to a customer with every quote to explain exactly specifically what RR Australia has to offer.
Subject: Hydraulic Safety Manifold Declaration

Bosch Rexroth have independent certification from BG-PRUFZERT in Germany. Attached with this fax is certification from BG-PRUFZERT for the logic elements/directional valves that we have offered in your manifolds that have achieved the Test Certificate Type BM. This certificate indicates that we have been assessed independently by BG-PRUFZERT. We have chosen to use BG-PRUFZERT to assess our valves instead of applying our own assessment and Declaration of Conformity. This has been done in order to give our customers total confidence that the parts we are offering comply with fundamental health and safety requirements in accordance with the EN standards. Should you wish to check this BG-PRUFZERT’s web site is http://www.hvbg.de/d/bgp/index.html
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The standard AS4024.1 is based on EN954-1. We understand that in Australia you need to base your machine design and rework on AS4024.1. Our system meets the standard for hydraulic systems up to category 4.
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Bosch Rexroth the manufacturer, declares that the components/sub-assemblies delivered have been manufactured in accordance with the stated harmonized standards/specifications. The components/sub-assemblies must not be operated until the machine into which these components/sub-assemblies are to be incorporated has been declared in conformity with the provisions of the directive.
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Applied Harmonized Standards:

EN 292-1 (11.1991) Safety of Machines

EN 292-2 (06.1995) Basic concepts, general principles for design

EN 982 (09.1996) Safety requirements on fluid power installations and components

EN 60 204-1 (06.1993) Safety of machinery: electrical equipment of machines

And thus considered suitable for use with interlock systems to AS4024.1
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In Australia the system must meet the standard AS4024.1, however should you wish to have our system assessed independently further locally, this can be arranged at an additional cost.

Some of our competitors declare that they conform with EN954-1 and EN1050.

In reference to EN954-1 and EN1050 it should be noted that these are not the governing standards.

EN1050 is simply a standard for principles of risk assessment and as we and our German engineers understand a manifold assembly cannot comply with principles for risk assessment.

EN954-1 is generally covered in AS4024.1
Q2. Do you have CE Certification?

Answer – Yes, and we also have independent certification from BG-Prufzert in Germany.

However, the following points can be made.

- AS4024.1 does not require that any equipment “must” have the CE marking.
- AS4024.1 does not state that independent certification of any assemblies including manifold assemblies is required.
- AS4024.1 places the responsibility squarely on the system integrator to ensure that the total system meets the requirements of the Australian Standard.
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▲ CE Marking
▶ RE00 042/11/00 is available and explains the CE mark and its meaning.
▶ The features of the CE mark:
    ▶ Does not stand for the compliance with special quality and safety requirements
    ▶ Usually does not signal testing by a neutral inspectorate
    ▶ Expresses the assessment of the manufacturer

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Typical Current BG Certificate
Q3. Have your valves been assessed independently?

Answer - Yes, we have up to date independent certification from BG-Prufzert in Germany for our NG6, NG10, SL Check Valves, LFA…E-7X and LFA…QR10-6X/CA20 & 40D Logic Elements. These certificates are available and are in German. They are not available in English. BG Prufzert (testing and certification system) brings together the 19 test and certification bodies of Germany’s statutory accident insurance and prevention institutions. A BG Prufzert Information Sheet is available detailing exactly what this organization does.

4WEH, LFA…EWA, EWB & EH2 are not certified by BG Prufzert

The BG Prufzert mark awarded to certified products holds a higher accreditation that the self assessed CE Marking.
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Q4. What valve options are available, what do we stock.

We stock valves in NG6 and NG10. Monitoring is available on NG16 up to NG102 however these are not certified by BG Prufzert. For the larger flows we think using the logic elements is a better option. These are not in MR range.

For the NG6 & NG10 valves we stock QMA option and QMB option.
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QMB senses the spool when it has completely returned to the de-energized position.

QMA senses when the spool has moved from the fully energized position and is moving back to the rest position. The oil path is not blocked when the switch shows a change of state and is therefore in some applications maybe unsuitable or unsafe.
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Q5. Do you meet the Machinery Directive: 98/37/EC – EN292-1, EN292-2, EN982, EN954-1 and EN1050

Answer – Yes as detailed on the certificate (next page) that can be supplied for system integrators using our valves and requiring documentation
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- Typical Circuits we use that meet the requirements.
- NG6 Cat 3 or 4 Block Only
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- Typical Circuits we use that meet the requirements.
- NG10 Cat 3 or 4 Block Only
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- Typical Circuits we use that meet the requirements.
- NG10 Cat 3 or 4 Block and Bleed
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- Typical Circuits we use that meet the requirements.
- Logic Element 3 or 4 Block and Bleed
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- Typical Circuits we use that meet the requirements.
- Logic Element with active piston 3 or 4 Block and Bleed
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1. What is Dual Flow Path and why do we use it?
2. What is a Logic Element with Active Piston and why do we use it?
What is Dual Flow Path and why do we use it?

Dual flow path means that we connect the P & A ports together in the manifold and the B & T ports together in the manifold. How this helps us is to allow high flow rates through the DCV without causing unbalanced Bernoulli forces on the spool within the DCV. The data sheet states that single flow path through any DCV will result in significantly less flow capacity than specified on the tables. The data sheet only allows for “Dual Flow paths through the valve”
What is Dual Flow Path and why do we use it?

In the de-energized position the valve provides a safe blocked condition. When energized the flow is allowed to pass from P to B and from A to T. The maximum pressures need to be checked to ensure that the tank port pressure as specified by the data sheet is not exceeded. Otherwise this circuit works perfectly well. Using this circuit we can easily pass 60lpm (NG6) and 120lpm (NG10) at no more than 5 bar pressure drop through the valve.
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What is a Logic Element with Active Piston and why do we use it?

Our logic element with active piston has advantages that can be used to overcome particular circuit problems.

The piston assembly mounted to the top of the logic element has an area much greater than any area on the actual poppet element of the assembly. This offers to distinct advantages.
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What is a Logic Element with Active Piston and why do we use it?

1. Using the pressure from the inlet side (P port) of the manifold to drive the poppet shut in the de-energized safe position you can always be assured that the poppet will be driven home as the force generated always exceeds any downstream pressures.

2. If the system requires the poppet to be driven open for response of flow rate reasons it can easily be done by connecting the Z1 port to the pilot DCV instead of to tank.