



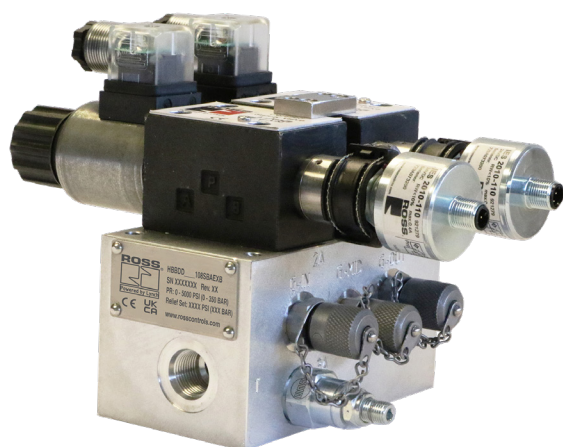
RC-HBB-OI EN

HBB Series

Redundant Valve Systems

Hydraulic Block and Bleed Safety Valves

Operating Instructions



PRODUCT CREDENTIALS

Performance Level
Per ISO 13849-1:2015



Safety Integrity Level
Per IEC 2061:2001



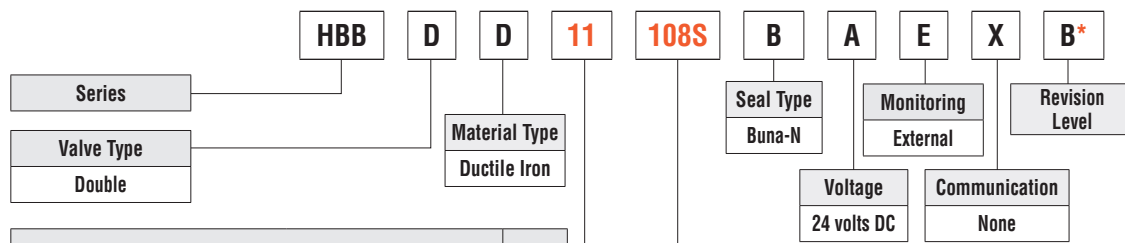
DGUV



Declaration of Conformity



PRODUCT KEY IDENTIFICATION



Pressure Relief Valve Settings (psi) #		
Maximum System Operating Pressure	Relief Valve Factory Preset	
1000	1100	11
1500	1700	17
2000	2200	22
2500	2800	28
3000	3300	33
3500	3900	39
4000	4400	44
4500	5000	50
5000	5500	55
No Pressure Relief Valve		XX

For system parameters outside of this range, please contact ROSS.

Size	Flow Rate	Port Size **		Port Thread/Type	
		P1 & P2	T		
D03	0 to 10 gpm	SAE-08	SAE-08	SAE	108S
D05	0 to 20 gpm	SAE-12	SAE-12	SAE	212S
D07	0 to 50 gpm	1-1/4	1-1/2***	Code 62 Flange (P1 & P2) Code 61 Flange (T)	372F

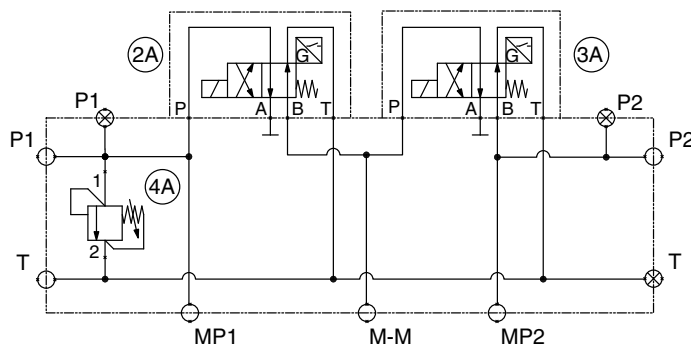
** Flanges for the P1, P2, and T ports on D07 size are not included - must be purchased separately.
 *** One of the T ports does include a flange with a blocking disk. This can be moved to the other T port if necessary for easier piping to the reservoir.

Size	Weight lb (kg)
D03	22.7 (10.3)
D05	53.4 (24.2)
D07	131.9 (59.8)

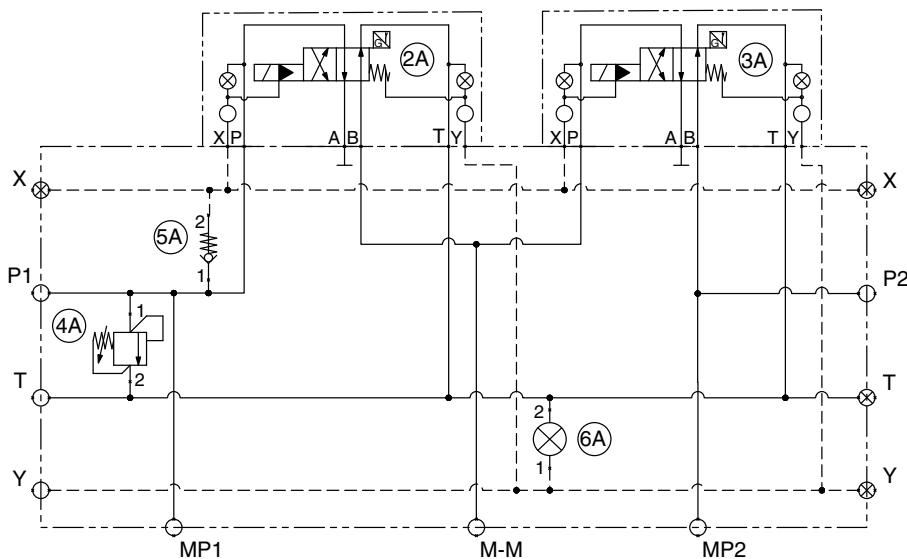
* Subject to change.

HBB VALVE SYSTEM SCHEMATICS

Size D03, D05
Direct Solenoid Operated with Pressure Relief Valve



Size D07
Solenoid Pilot Operated with Pressure Relief Valve



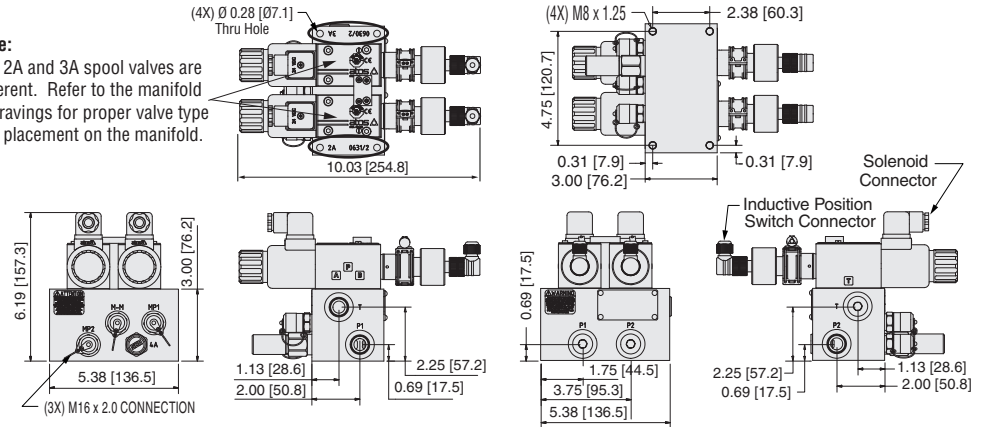
MOUNTING INFORMATION AND OVERALL DIMENSIONS (inches/mm)

Size D03

Ports List	
ID	Name
P1	SAE # 8
P2	SAE # 8
T	SAE # 8
MP1	SAE # 6
M-M	SAE # 6
MP2	SAE # 6

Note:

The 2A and 3A spool valves are different. Refer to the manifold engravings for proper valve type and placement on the manifold.

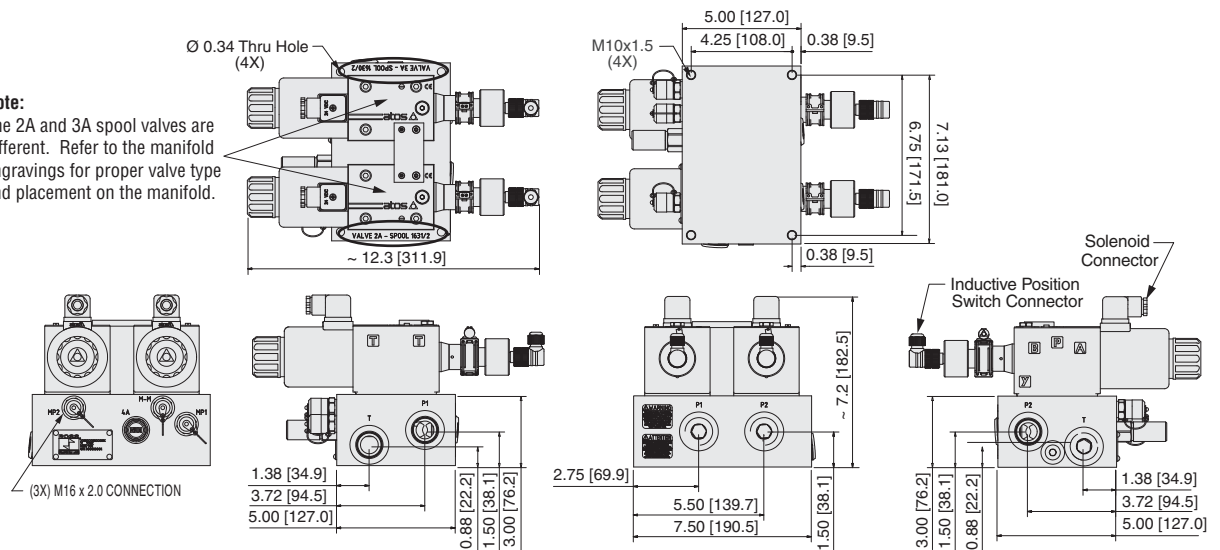


Size D05

Ports List	
ID	Name
P1	SAE # 12
P2	SAE # 12
T	SAE # 12
MP1	SAE # 6
M-M	SAE # 6
MP2	SAE # 6

Note:

The 2A and 3A spool valves are different. Refer to the manifold engravings for proper valve type and placement on the manifold.

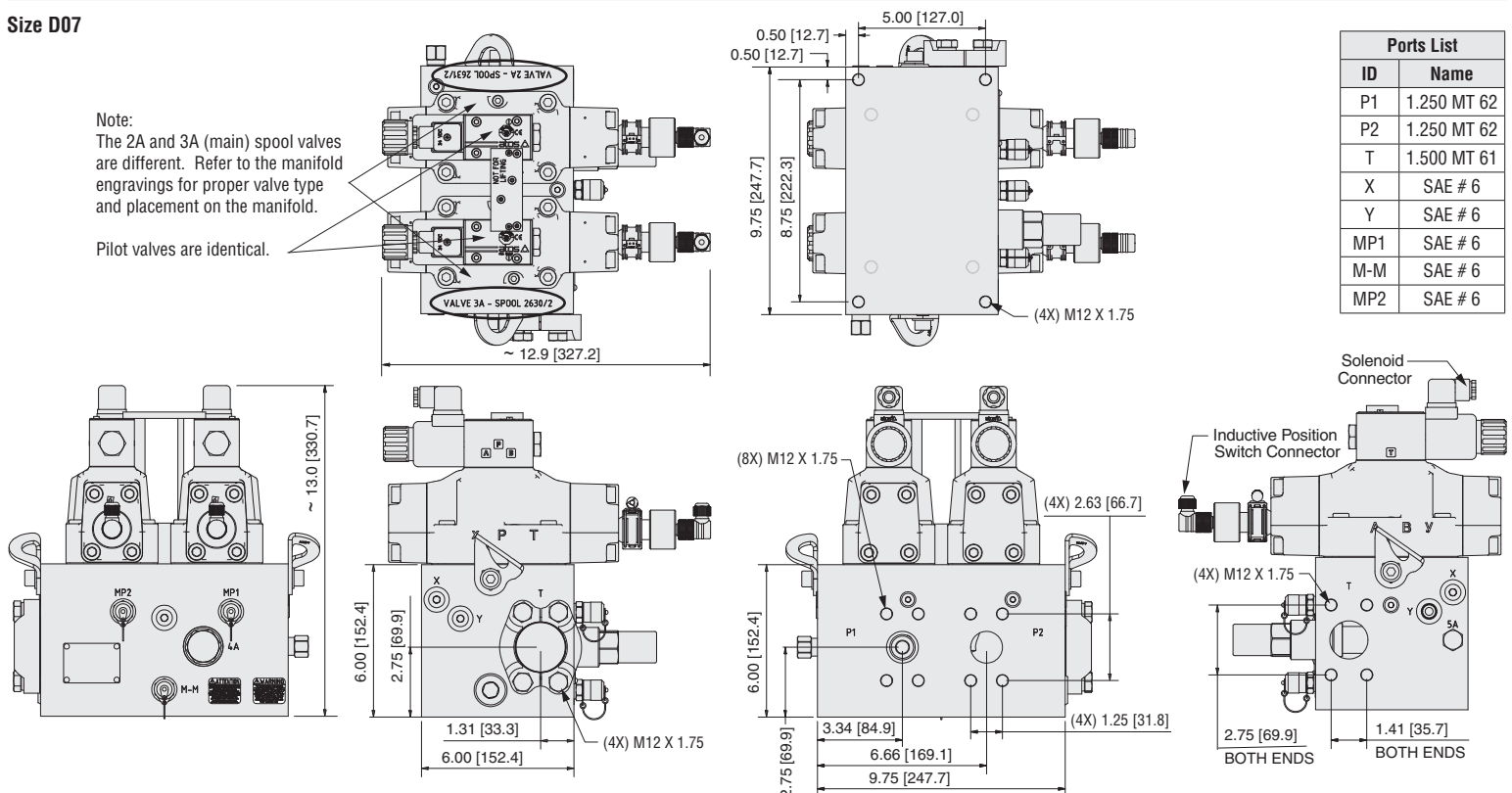


Size D07

Note:

The 2A and 3A (main) spool valves are different. Refer to the manifold engravings for proper valve type and placement on the manifold.

Pilot valves are identical.



Ports List	
ID	Name
P1	1.250 MT 62
P2	1.250 MT 62
T	1.500 MT 61
X	SAE # 6
Y	SAE # 6
MP1	SAE # 6
M-M	SAE # 6
MP2	SAE # 6

1. About this Documentation

These instructions contain important information for the safe and appropriate assembly and commissioning of the product.

- Read these Instructions all the way through, particularly section 6 "Safety instructions," before working with the product.
For more information see last page for contact information, or visit www.rosscontrols.com.
- In addition, observe all applicable local and national regulations on accident prevention and on environmental protection.

1.1. Warning Notices in these Operating Instructions

In these operating instructions, warning notices precede sections with handling requirements which incur risks of personal injury or material damage.

Warnings are structured as follows:

 SIGNAL WORD
Type or source of hazard! Consequences ► Measures to avert danger

- **Warning triangle:** Indicates a risk of fatal or severe injuries.
- **Signal word:** Indicates the severity of the danger.
- **Type or source of hazard:** States the type of danger or the source of the hazard.
- **Consequences:** Describes possible consequences of ignoring the warning.
- **Measures to avert danger:** Indicates how to avoid the danger. It is essential that the measures to avert danger are complied with.

 DANGER	Indicates an imminent and serious danger that will result in severe or even fatal injury if you fail to avoid it.
 WARNING	Indicates a possible danger that could result in severe or even fatal injury if you fail to avoid it.
 CAUTION	Indicates a danger that may result in minor to moderate injuries if you fail to avoid it.
ATTENTION	Indicates potential property damage that may be incurred by the product or its surroundings if you fail to avoid it.

2. Notes on Safety

The product has been manufactured according to the accepted rules of current technology. There is risk of injury or damage if the following safety instructions and warnings given in this instruction manual are not observed.

2.1. Intended Use

The HBB Series Block and Bleed Control systems are safety components designed and manufactured in accordance with Machinery Directive 2006/42/EC.

The HBB system is comprised of two single valves (direct solenoid-operated spool valves on D03 and D05 sizes & solenoid pilot-operated valves on D07 size) which make it a redundant design for meeting the needs and requirements of safe hydraulic block and bleed applications. Typically, these systems are designed to meet Category 4, PL e, SIL 3 applications if properly implemented into the safety control & monitoring system.

The HBB Series Block and Bleed system is designed to allow the flow of hydraulic fluid into a hydraulic system and to block that flow and simultaneously bleed downstream energy when needed.

NOTE: Block and Bleed functions are intended to permit flow when switched on and to block supply and to bleed off downstream energy when switched off or in a faulted state. It is important to note that the ability to bleed may be affected by other components downstream of the HBB valve. PO checks, counterbalance, and closed-center valves are designed to block flow under certain conditions. Depending on the application, these devices may be detrimental or they may be beneficial to complete the needed safety function. Careful consideration of the required safety function and how to achieve that goal is absolutely necessary.

NOTE: HBB valves are intended to be used only for tasks that are routine, repetitive, and integral to production. Maintenance tasks require following full lock-out/tag-out procedures to relieve hazardous energy and prevent unexpected startup.

During normal operation the HBB system is held actuated, allowing the flow of hydraulic fluid through the HBB unit from inlet to outlet. In a situation when immediate pressure and flow shut-off is needed, the HBB Series Block and Bleed system can be turned off to provide an immediate flow and pressure blocking action, and provide a path to tank for downstream hydraulic fluid.

The HBB Series Block and Bleed systems are designed to be externally monitored by a safety control & monitoring system for safe, redundant operation of the valves. Each single valve is equipped with a PNP inductive position switch. Monitoring both of these switches on each actuation and de-actuation of the HBB Block and Bleed system

provides a diagnostic coverage of up to 99%. Monitoring of these switches must be done by an external monitoring system.

The unit cannot be used by itself. It is designed for installation in a machine. ROSS and its suppliers will assume no liability in the event that the system or parts thereof are not used in accordance with their designated use or if modifications are made in a non-authorized manner.

Any drawings, hydraulic or electric circuit diagrams, parts lists and acceptance certificates (inspection reports) supplied do not form a part of these operating instructions. They are supplied for the purpose of illustrating the unit or procuring parts.

2.1.1. Safety Function According to ISO 13849

HBB Series Block and Bleed systems are designed in accordance with the requirements listed in ISO 13849-1 and -2. Their "fail-to-safe" safety function is ensured even in case of a fault within the valve (e.g., caused by power loss, wear, contamination, or similar situations).

The safety function of the HBB Series Block and Bleed system is to only supply flow and pressure into the machine/system when the two valve elements are actuated simultaneously, but to shut-off the supply and to bleed the downstream pressure back to tank when both valves are shut off or if only one of the two valves is de-actuated.

A fault in the system where only one valve actuates when switching on or only one de-actuates when switching off prevents flow of hydraulic fluid from being supplied downstream. Monitoring of the two inductive position switches by the user's external safety control & monitoring system makes it possible to detect these fault situations and to shut off and prevent further electrical energization of the solenoids until the fault is cleared.

Port identification on the manifold according to ISO 16874

The HBB Series Block and Bleed system is designed and manufactured in accordance with the identification requirements laid out in the ISO 16874:2004 standard.

2.1.2. Common Cause Failure – CCF

The product has been engineered and manufactured according to the fundamental and proven safety principles of ISO 13849-1 and -2.

Common Cause Failures (CCF) are failures of different components, resulting from a single event. CCF are not to be confused with cascading faults or common mode faults. Common cause failures can cause loss of the safety function, especially in dual channel circuits where both channels could fail simultaneously due to a single event.

- Maintain hydraulic fluid quality, i.e., proper filtration.
- Operate within prescribed temperature limits.
- Install the valve such that the normal stroke travel of the valve elements is perpendicular to the main direction of machine vibration and/or mechanical shock.
- Avoid external magnetic fields.
- Do not use a test pulse longer than suggested in the Integration Guide.
- Do not plug the T port or Y port (where provided). These ports should be piped to the reservoir.

2.1.3. Diagnostic Coverage

A diagnostic coverage of 99% is achievable through appropriate integration of the HBB Series Block and Bleed system into the safety control system. The monitoring system must constantly compare the state of each valve's inductive position switch (Switch 2A & Switch 3A) with the state of the safety control system outputs to the valve solenoids (Sol 2A & Sol 3A). Detection of a fault by the safety control & monitoring system must trigger a shut-off of the safety controller's outputs to the valve solenoids (Sol 2A & Sol 3A).

2.1.4. Fault Modes

Note that normal operation requires that Sol 2A & Sol 3A be energized simultaneously for switching the HBB Series Block and Bleed system on, and de-energizing both Sol 2A and Sol 3A simultaneously for switching the HBB Series Block and Bleed system off.

NOTE: The switches are supplied with both NC and NO contacts. The statements below only refer to whether or not the switches are actuated.

Faults that could occur during normal operation are:

Sol 2A & Sol 3A energized simultaneously

Switch 2A ON, Switch 3A OFF

Switch 2A OFF, Switch 3A ON

Switch 2A OFF, Switch 3A OFF

Sol 2A & Sol 3A de-energized simultaneously

Switch 2A ON, Switch 3A OFF

Switch 2A OFF, Switch 3A ON

Switch 2A ON, Switch 3A ON

2.1.5. Foreseeable Misuse

WARNING

Risk of Injury!

Misuse may result in injury or damage.

- The product must be used exclusively as intended.

Foreseeable misuse includes:

- Bypassing the safety function or diagnostics.
- Replacing the safety valves with unauthorized valves.
- Tampering with the position switches.
- Tampering with the pressure relief valve sealed cap and adjustment.
- Failing to utilize the position switches to verify valve operation on every cycle when energizing and de-energizing.
- Allowing continued operation of the valve when a fault is detected.
- Operating at pressures outside maximum and minimum operating pressures.

2.2. Responsibilities of the System Owner

Observation of general requirements pertaining to hazards:

- Unusual noises, vibration, defects or damage is to be remedied immediately as it may point to potential hazards.
- No maintenance work may be done on the hydraulic system and power units as long as they are under hydraulic pressure or the power supply has not been switched off.
- Prior to performing any maintenance work, pressure accumulators are to be depressurized.
- Note the load pressures present. Also note any loads applied. If necessary, make sure that the loads are secured or properly supported.
- Hydraulic systems may only be operated by properly trained and instructed personnel.
- All safety devices and equipment are to be checked to see that they function properly.
- The setting of pressure relief valves featuring a tamper-resistant seal may not be changed.
- Safety devices and equipment must not be removed or bypassed.
- General safety and accident prevention regulations pertaining to operating the unit/system are to be adhered to.
- Comply with the further requirements of ISO 13849 (e. g., MTTFD, CCF, DC, PLr,) if you intend to use the product in higher categories (2 to 4).
- Check the valve at least once a month to ensure its proper operation.
- Make sure that the fundamental and proven safety principles in accordance with ISO 13849 for implementation and operation of the component are complied with.
- Selection and installation of replacement valves must take place in accordance with the manufacturer's specifications.

2.3. Safety Instructions

The HBB Block and Bleed System features a state-of-the-art design. Reliable and safe operation cannot be ensured unless all the instructions, settings and output limits applicable to the unit supplied are adhered to.

The systems involved are pressure-generating systems whose components feature pressurized liquid; consequently, the systems may pose a hazard if not dealt with properly.

2.3.1. Additional Safety Considerations

- When implementing surge suppression measures, be sure to check whether or not this extends the valve system shut off response time which could extend the machine stopping time.
- In case of high levels of machine vibration, use appropriate vibration-reducing elements when installing the valve system.
- Operate only with the proper supply voltage. Improper voltage supply can damage solenoids and switches.
- Excessive hydraulic fluid temperature can damage valve seals as well as cause premature degradation of hydraulic fluid. Both of these situations can cause improper operation of the hydraulic system.

3. Prerequisites for Use of the Product

- Make these operating instructions available to the engineer and assembly technician of the machine/system in which the product will be used.
- Keep these operating instructions for the entire product life cycle.

3.1. Qualified Personnel

Assembly, installation, commissioning, maintenance, and decommissioning should only be carried out by qualified personnel that have the required knowledge of and experience in dealing with electrical and hydraulic control technology.

All work may be performed only by properly trained and qualified individuals who have been specifically instructed for the tasks assigned to them. The levels of responsibility of personnel are to be clearly delineated by the owner/operator. Protective clothing and gear is to be worn when performing all work. The relevant safety and accident prevention regulations are to be adhered to. Any special safety requirements specified in the documentation for the unit/system are to be complied with.

4. Package Contents

Items included:

- Block and bleed valve system
- Operating instructions

5. Service, Repair, and Maintenance

- In case of technical problems or a required repair, please contact your local ROSS® representative.
- Checks should be conducted once a month to ensure valves are in functioning order.

5.1 Maintenance

WARNING

- All activities of maintenance must be conducted by competent and qualified staff.
- Always depressurize the relevant part of the system before any maintenance operation on the hydraulic system.
- Always ensure cleanliness when working on the HBB valve.
- Do not perform maintenance with the equipment functioning!
- Penetrating dirt and liquids will cause faults!
- Safe function of the HBB valve is not ensured when operated with contaminated fluid.
- Never use solvents or aggressive detergents as these can cause damage to the hydraulic system and seals!
- Pay attention to prevent detergent penetration into the HBB valve.
- Check that all seals and electrical plug connections are firmly fitted to prevent the penetration of detergents.
- Do not use a high-pressure cleaner. The water pressure of a high pressure cleaner can damage the seals of the HBB valve.

When/if a valve is replaced; a basic functional test should be performed (see 8.1 Test Procedure).

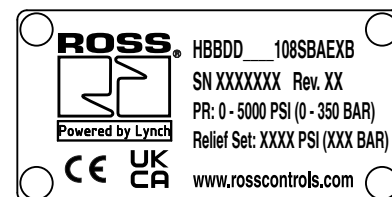
It is important that all the check-up operations, even if simple, are programmed and reported on specific maintenance program schedules.

Before the inspection, cleaning should be undertaken if necessary.

6. Product Identification

The valve assembly is marked with Model Number, Revision level, and a serial number which can be used to identify date of manufacture and location. Please contact ROSS Controls for further information.

Product label identification & product key identification example.



7. Assembly and Installation

CAUTIONS

Risk of injury due to installation while pressurized or with live parts!

Installation while pressurized or with electrical power switched on can result in injuries due to sudden pressure build-up or electric shock.

- Installation while pressurized or with electrical power switched on can result in injuries due to sudden pressure build-up or electric shock.
- De-energize and de-pressurize the relevant system parts before installing the valves.
- Secure the system to prevent it from being switched back on again.

ATTENTION

Destruction of components!

Chemical substances can damage the surface, the markings and the seals of the device.
► Install the valve such that it is protected against the effects of chemicals.

7.1. Installation Instructions

Secure the system using the through holes in the manifold. Refer to pattern for the required dimensions, - see dimensional drawings on page 3.

7.1.1. Component Inspection: Prior to use, a careful examination of the HBB valve system must be performed. The HBB valve system must be checked for correct style, size, catalog number and external condition, and must be examined for cleanliness, absence of external defects or gouges or otherwise deformed parts or other imperfections. DO NOT use any item that displays any signs of nonconformance. Any accessory including, but not limited to, fittings, bolt kits, hoses, in-line mounting kits, and electrical connectors must be subjected to the same examination.

7.1.2. Filtration: Fluid cleanliness is a necessity in any hydraulic system. Fluid filters need to be installed and maintained in the system to provide the required level of cleanliness. Filters can be placed in the inlets. See Maximum Fluid Contamination under Specifications, page 7.

7.1.3. Accessory Ratings: All accessories used in combination with the selected or intended HBB valve system must be used in accordance with the HBB specifications.

7.1.4. Spool Valve Replacement



WARNING

Risk of Injury!

Misuse may result in injury or damage.

- The product must be used exclusively as intended.
- The individual spool valves must only be replaced with the appropriate type and model number and installed only in the proper manifold position. The individual spool valves designated as 2A and 3A have different spool configurations. The 2A valve spool has a closed cross-over condition while the valve is shifting and the 3A valve spool has an open cross-over condition while shifting. After any disassembly, care should be taken to ensure the correct valves are re-installed or replaced at the correct position on the manifold. Refer to the engravings on the top of the manifold for proper valve positioning. On the size D07, this note refers only to the main spool valves - the pilot valves are identical.

7.2. Electrical Connections

Use two DIN EN 175301-803, Form A type electrical connectors to connect to the valve solenoids.

Use a female M12 cord set (4-pin or 5-pin, A-coded) to connect to each inductive position switch according to the electrical wiring schematic of the switches on page 7.

8. Commissioning and Operation

Before commissioning, the installation must be carefully inspected by a qualified, trained professional.

Make sure that the technical specifications match the operating criteria of the machine and/or the hydraulic system.

8.1. Test Procedure

NOTE 1: This valve test procedure only checks for proper function of the HBB valve system. Please refer to the HBB Integration Guide for the External Monitoring Validation Procedure.

NOTE 2: The valve test procedure requires fault simulation. It will be necessary to induce faults electrically by disabling a different solenoid or switch at different times. This will be most easily done by disconnecting solenoid or switch cables at the valve.

NOTE 3: The PNP position switches are supplied with both NC and NO contacts.

NOTE 4: “-” indicates no change from the previous step.

D03 & D05 Test Procedure

Step	Action	Sol 2A	Sol 3A	Flow P1 to P2	Switch Conditions (ref. Output Signal Status For Each Valve pg 7)				Pass/Fail
					Switch 2A		Switch 3A		
				YES/NO?	(NC)	(NO)	(NC)	(NO)	(P/F)
1	Energize solenoid 2A	ON	OFF	NO	OPEN	CLOSED	CLOSED	OPEN	
2	De-energize both solenoids	OFF	OFF	NO	CLOSED	OPEN	-	-	
3	Energize solenoid 3A	OFF	ON	NO	-	-	OPEN	CLOSED	
4	De-energize both solenoids	OFF	OFF	NO	-	-	CLOSED	OPEN	
5	Energize both solenoids 2A & 3A	ON	ON	YES	OPEN	CLOSED	OPEN	CLOSED	
6	De-energize both solenoids	OFF	OFF	NO	CLOSED	OPEN	CLOSED	OPEN	

D07 Test Procedure

Step	Action	Sol 2A	Sol 3A	Flow P1 to P2	Switch Conditions (ref. Output Signal Status For Each Valve pg 7)				Pass/Fail
					Switch 2A		Switch 3A		
				YES/NO?	(NO)	(NC)	(NO)	(NC)	(P/F)
1	Energize solenoid 2A	ON	OFF	NO	OPEN	CLOSED	CLOSED	OPEN	
2	De-energize both solenoids	OFF	OFF	NO	CLOSED	OPEN	-	-	
3	Energize solenoid 3A	OFF	ON	NO	-	-	OPEN	CLOSED	
4	De-energize both solenoids	OFF	OFF	NO	-	-	CLOSED	OPEN	
5	Energize both solenoids 2A & 3A	ON	ON	YES	OPEN	CLOSED	OPEN	CLOSED	
6	De-energize both solenoids	OFF	OFF	NO	CLOSED	OPEN	CLOSED	OPEN	

9. Disconnecting and Removal



WARNING

Risk of injury due to installation while pressurized or with live parts!

- Disconnecting a hydraulic component while the system is pressurized or while electrical power is supplied can result in injury or death due to sudden pressure release, unexpected movement, or electric shock.
- Isolate and lock out the electrical and hydraulic systems before disconnecting the unit.

⚠ WARNING

Risk of Injury!

Misuse may result in injury or damage.

► The product must be used exclusively as intended.

1. Failure to observe the prescribed procedures and cautions may represent a risk for personal injury.
2. Safety valves must only be installed by qualified personnel.
3. Safety valves must not be disassembled.
4. The inductive position switches can only be adjusted by the valve manufacturer.
5. Valve components cannot be interchanged.

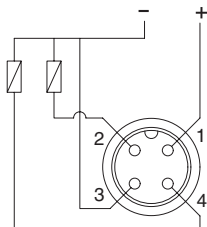
10. Technical Specifications

Construction Design	Spool type
Actuation	One solenoid per valve element Solenoids must be operated synchronously
	Size D03, D05: Direct Solenoid Operated, spring return Size D07: Solenoid Pilot Operated, spring return
Mounting	Type: In-line with SAE threaded ports on D03 & D05 sizes. Flange ports on D07 (flanges sold separately). Flexible Piping: Redundant Inlets, Outlets, and Tank ports provide piping options to help fit the application. (Plugs for unused ports included.) Orientation: Any, preferably horizontal
Connection	Size D03, D05: SAE Size D07: Code 62 Flange (P1 & P2), Code 61 Flange (T), SAE (X, Y, MP1, M-M, MP2)
Solenoids	Version as per VDE 0580; Rated for continuous duty Electrical connection according to EN 175301-803 Form A Enclosure rating according to DIN 400 50 IP 65
Standard Voltages	24 volts DC
Power Consumption (each solenoid)	Size D03, D07: 30 watts Size D05: 36 watts
Inductive Position Switch (2 per system)	PNP (M12, 4-pin, A-coded, male); works with both 4-pin & 5-pin female cord sets
Temperature Range (recommended)	Ambient: -22° to 158°F (-30° to 70°C) Media: -4° to 176°F (-20° to 80°C)
Flow Media	Hydraulic Fluids: Mineral Oil HLP, HL-DIN 51524 Vegetable Oil HETG - VDMA 24568
Flow	Size D03: 10 gpm Size D05: 20 gpm Size D07: 50 gpm
Inlet Pressure	D03 & D05: 5000 psi (350 bar) maximum D07: 116 psi to 5000 psi (8 bar to 350 bar)
Construction Material	Manifold: Ductile Iron Valve Body: Cast Steel Spool: Steel Seals: Buna-N

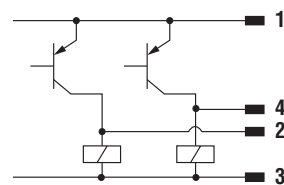
Technical Characteristics Of PNP Inductive Position Switch

Type Of Switch	Contactless inductive position switch with integrated amplifier
Supply Voltage [V]	20-32 V DC
Ripple Max [%]	≤ 10
Max Current [mA]	400
Reaction Time [ms]	15
Max Peak Pressure [bar]	400
Mechanical Life	Virtually Infinite
Switch Logic	PNP

Position Switch Connector Pinout



PNP Inductive Position Switch



Size D03 & D05

1 = Supply +24 volts DC
2 = Output Signal NC
3 = Ground
4 = Output Signal NO

Size D07

1 = Supply +24 volts DC
2 = Output Signal NO
3 = Ground
4 = Output Signal NC

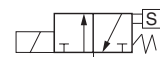
NOTE: PNP (M12, 4-pin, A-coded, male); works with both 4-pin & 5-pin female cord sets.

Please note that the function of the switch varies depending on valve size. As a result, in the normal valve off condition, the D03 & D05 valves utilize pin 2 of the switches as NC outputs and pin 4 as NO outputs. On the D07 size valves pin 4 is used as the NC output and pin 2 is used as the NO output. This is due to the fact that in the valve off condition on the size D07, the switches are in the actuated condition when the valve is off.

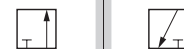
OUTPUT SIGNAL STATUS FOR EACH VALVE IN THE HBB SYSTEM

Size D03 & D05

Hydraulic configuration



Spool position



Pin 2

ON

OFF

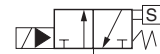
Pin 4

ON

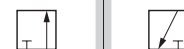
OFF

Size D07

Hydraulic configuration



Spool position



Pin 2

ON

OFF

Pin 4

ON

OFF

Note: PNP Position Switch can be electrically wired by the consumer as NO or NC and then the status of the output signal will be in accordance to the selected configuration.

■ = Intermediate spool position corresponding to the hydraulic configuration change.

11. Disposal

Dispose of the valve in accordance with the applicable statutory regulations in your country.



EU declaration of conformity

(Original Version)

This declaration of conformity is issued under the sole responsibility of the manufacturer

ROSS* hydraulic double valve series **HBB** is in full accordance with the following Directives:

Machinery Directive 2006/42/EC

Applied harmonized standards:

EN ISO 13849-1: 2015: Safety of Machinery- Safety related parts of a control system -Part 1

EN ISO 13849-2: 2012: Safety of Machinery- Safety related parts of a control system -Part 2

EN 60204-1: 2018: Safety of Machinery- Electrical equipment of machines -Part 1

EN IEC 60947-5-2: 2020 Low-voltage switchgear and control gear - Part 5-2: Control circuit devices and switching elements - Proximity switches

EN ISO 4413: 2010-11: Hydraulic fluid power - General rules and safety requirements for systems and their components

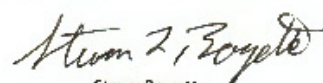
Tested in accordance to: GS-IFA-M13:2021-03 (as applicable)

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Ferndale, MI, 2022-07-19

Signed for and on behalf of ROSS*



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