

CHALLENGER OF RECORD & DEFENDER

AMERICA'S CUP 36

Draft AC75 Interpretation 009

of

AC75 Class Rule Version 1.1 issued 29 June 2018

Rule References:

- 22.5 The only devices permitted for controlling the flow of hydraulic fluid through an HCC are:
- (a) **force input devices**, only as expressly permitted in Rule 21.2;
 - (b) **mechanically** operated valves;
 - (c) valves actuated by an ECC;
 - (d) two-port devices, not controlled by an ECC, that limit flow to one direction, regulate flow and/or regulate pressure, such as:
 - (i) two-port pressure relief valves;
 - (ii) two-port check valves;
 - (iii) two-port pressure-compensated flow control valves; and
 - (iv) two-port devices with fixed or adjustable orifices; and
 - (e) devices, not controlled by an ECC, that limit flow to one direction, regulate flow and/or regulate pressure, providing that such a device is subject to the pressure of no more than one **actuator chamber**, which shall always be the same **actuator chamber**, and is always isolated from all other **actuator chambers**.
- 22.6 For the avoidance of doubt, the following types of components are prohibited as they are capable of using feedback from the **yacht state** and are not listed within the permitted exceptions of Rules 22.5 (d) and 22.5 (e):
- (a) external pilot-operated sequence valves;
 - (b) external pilot-operated counter balance valves;
 - (c) external pilot-operated pressure relief valves;
 - (d) valves that use internal feedback to control flow rate in proportion to an electrical input;
 - (e) hydraulic devices with more than two ports that provide logic between:
 - (i) different **control functions**;
 - (ii) different **hydraulic actuators** of the same **control function**;
 - (iii) different **actuator chambers** of the same **hydraulic actuator**; and
 - (iv) different pressure supply lines; and
 - (f) variable displacement pumps that change their characteristics automatically in response to pressure, unless that automation is achieved using only those devices that are permitted by Rules 22.5 (d) and 22.5 (e).
- 35.3 **Actuator chamber**
- A volume occupied by hydraulic fluid within a **hydraulic actuator** and extending until the first valves in connected lines.

We are seeking clarification of Rules 22.5 and 22.6 with regard to:

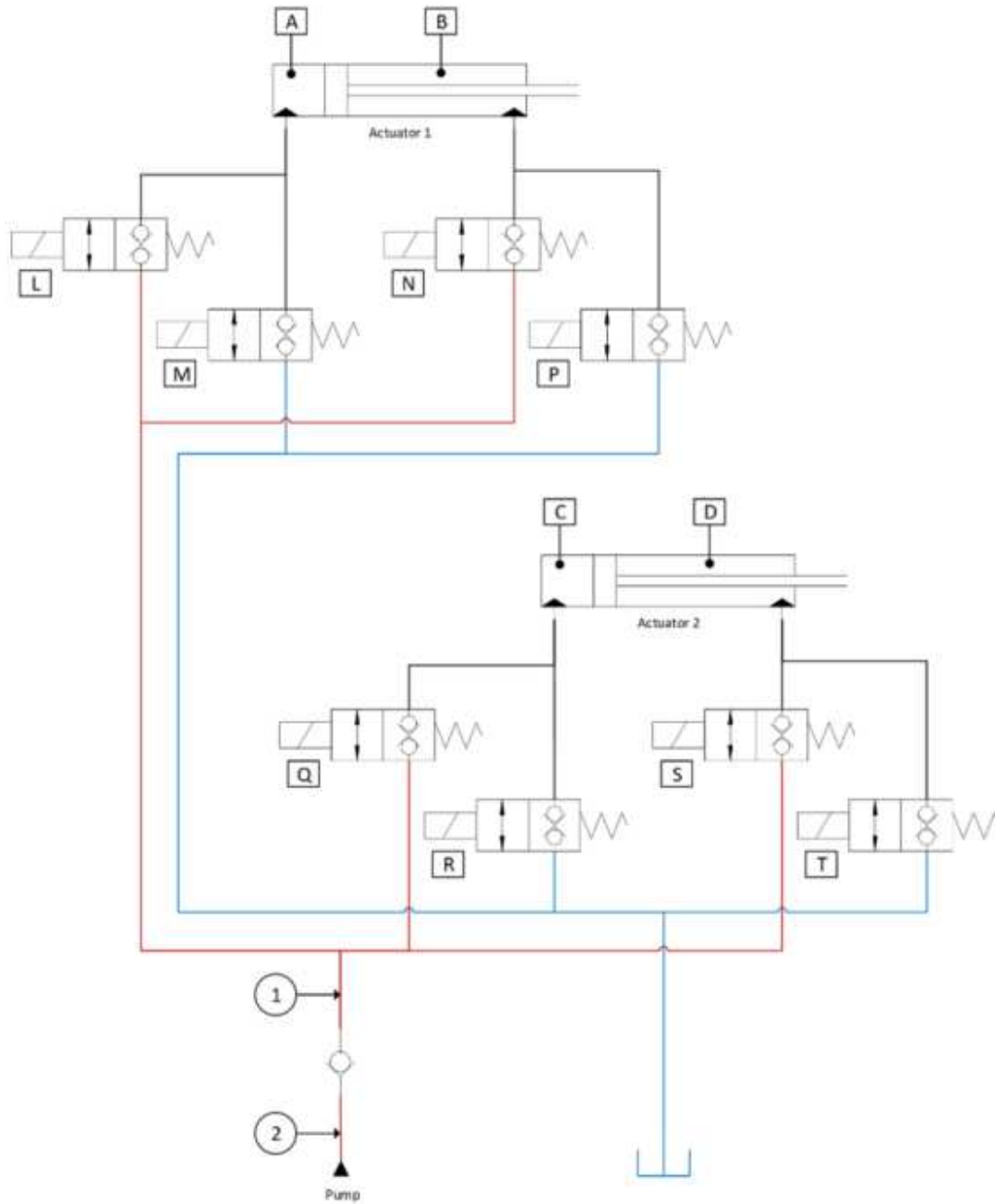
- the extent of the effect of an actuator within a hydraulic circuit;
- the meaning and limits of “subject to pressure” in the context of these particular Rules;
- the meaning of “isolated from” in the context of these Rules.

Hydraulic lines shown in these schematics are of a length, diameter, and material suited only for the delivery of hydraulic oil, and cannot in themselves store measurable usable energy.

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Figure 1:



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Consider Figure 1:

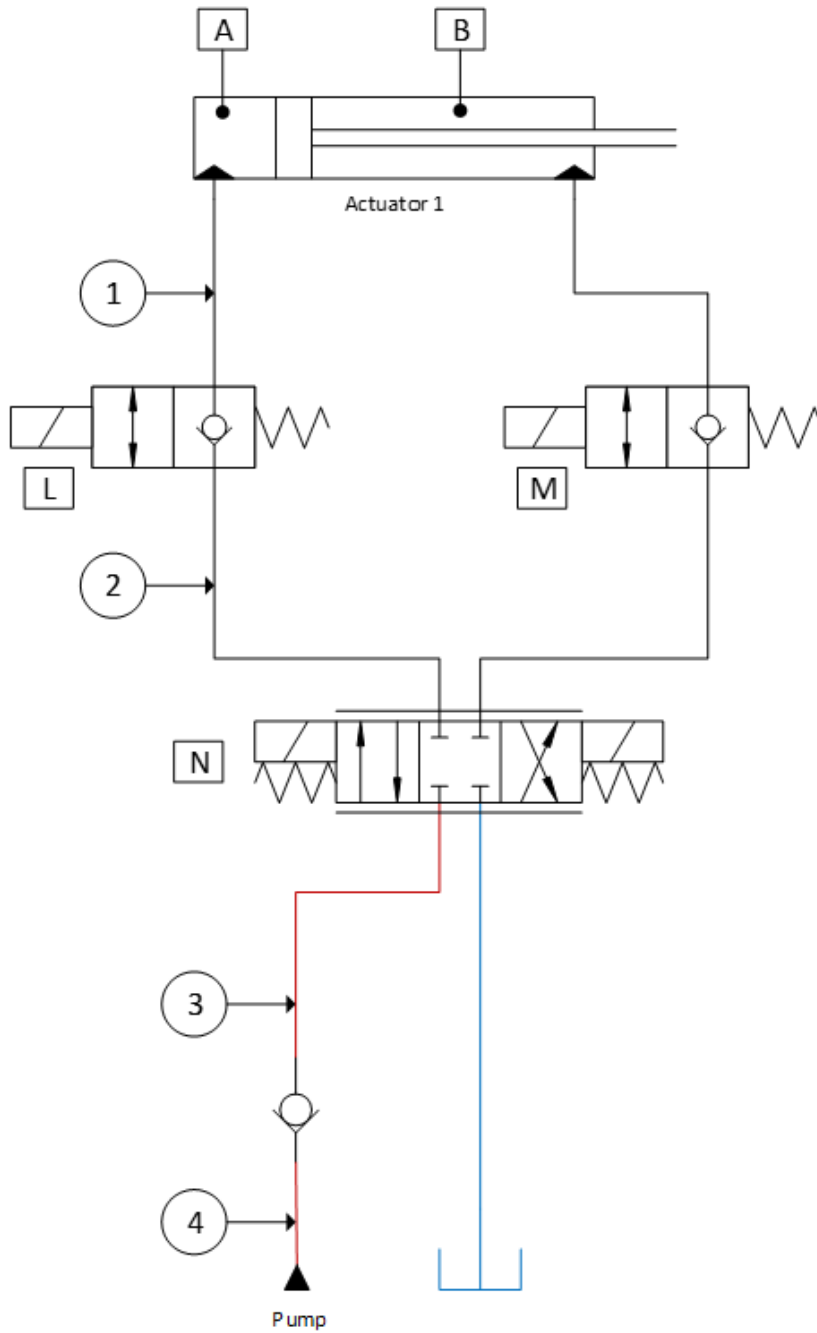
Actuators 1 and 2 are connected to a common control surface. Valves L, M, N, P, Q, R, S, T are double-blocking normally-closed poppet valves controlled by an ECC.

1. With all valves shut, is:
 - a. Point 1 isolated from all actuator chambers?
 - b. Point 2 isolated from all actuator chambers?
2. If chambers A,C are energised by opening valves L,P,Q,T, but there is no flow into or out of the actuators (therefore no pressure drop across each of these valves), is point 1:
 - a. Part of actuator chamber A?
 - b. Subject to the pressure of actuator chamber A?
 - c. Part of actuator chamber C?
 - d. Subject to the pressure of actuator chamber C?
 - e. Considered to be part of a single actuator chamber?
3. If chambers A,C are energised by opening valves L,P,Q,T, causing flow into actuators 1 and 2 (and therefore a pressure drop across each of these valves), is point 1:
 - a. Part of actuator chamber A?
 - b. Subject to the pressure of actuator chamber A?
 - c. Part of actuator chamber C?
 - d. Subject to the pressure of actuator chamber C?
 - e. Considered to be part of a single actuator chamber?
4. If chambers A,C are energised by opening valves L,P,Q,T, but there is no flow into or out of the actuators (therefore no pressure drop across each of these valves) and additionally no flow from the pump (so the check valve remains closed), is point 2:
 - a. Part of actuator chamber A?
 - b. Subject to the pressure of actuator chamber A?
 - c. Part of actuator chamber C?
 - d. Subject to the pressure of actuator chamber C?
 - e. Considered to be part of a single actuator chamber?
5. If chambers A,C are energised by opening valves L,P,Q,T, causing flow into actuators 1 and 2 (and therefore a pressure drop across each of these valves) and flow from the pump (so the check valve opens), is point 2:
 - a. Part of actuator chamber A?
 - b. Subject to the pressure of actuator chamber A?
 - c. Part of actuator chamber C?
 - d. Subject to the pressure of actuator chamber C?
 - e. Considered to be part of a single actuator chamber?

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Figure 2:



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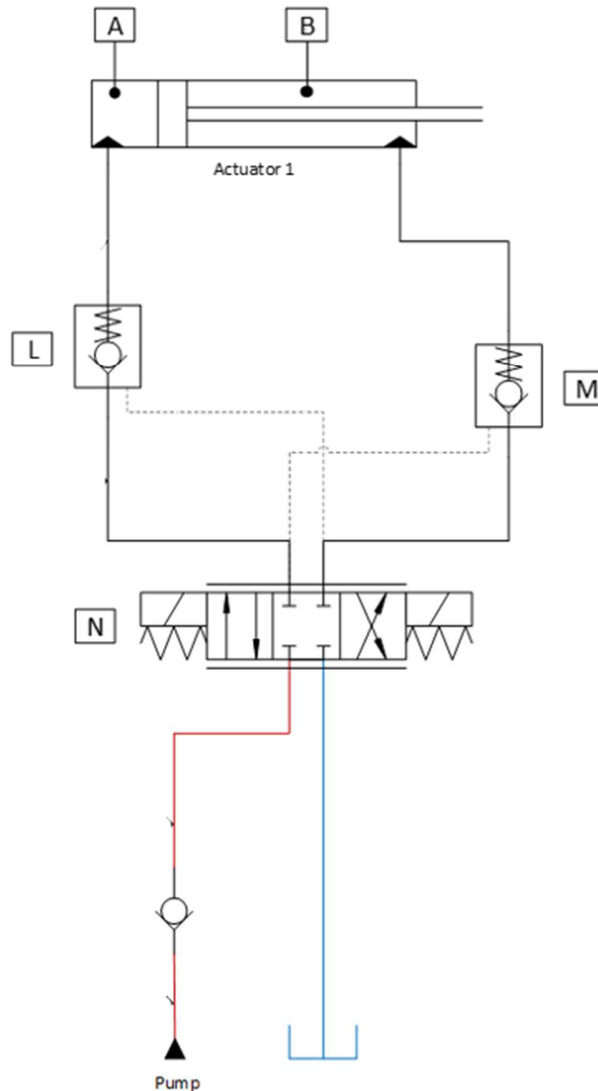
Consider Figure 2:

6. The only way of achieving flow from the actuator to tank through valves L or M is to actuate each valve via an ECC, and to allow flow through Valve N. Flow is possible in the reverse direction passively due to the check valve if Valve N is appropriately positioned by the ECC.
 - a. Are valves L and M controlled by an ECC?
 - b. Does this arrangement comply with the **AC75 Class Rule**?
 - c. Is valve M ever subject to the pressure of chamber A?
 - d. Is valve M always isolated from chamber A?
 - e. If the answer to (b) is NO, may the Rules committee provide reasoning?
7. Is point 1:
 - a. Ever part of the actuator chamber labelled A?
 - b. Ever subject to the pressure of the actuator chamber labelled A?
 - c. Always isolated from the actuator chamber labelled A?
 - d. Ever part of the actuator chamber labelled B?
 - e. Ever subject to the pressure of the actuator chamber labelled B?
 - f. Always isolated from the actuator chamber labelled B?
8. Given that valves L and M can be opened, is point 2:
 - a. Ever part of the actuator chamber labelled A?
 - b. Ever subject to the pressure of the actuator chamber labelled A?
 - c. Always isolated from the actuator chamber labelled A?
 - d. Ever part of the actuator chamber labelled B?
 - e. Ever subject to the pressure of actuator chamber labelled B?
 - f. Always isolated from the actuator chamber labelled B?
9. Given that valves L, M and N can be opened, is point 3:
 - a. Ever part of the actuator chamber labelled A?
 - b. Ever subject to the pressure of the actuator chamber labelled A?
 - c. Always isolated from the actuator chamber labelled A?
 - d. Ever part of the actuator chamber labelled B?
 - e. Ever subject to the pressure of the actuator chamber labelled B?
 - f. Always isolated from the actuator chamber labelled B?
10. Given that valves L, M and N can be actuated, and there may be flow through the check valve to the system, is point 4:
 - a. Ever part of the actuator chamber labelled A?
 - b. Ever subject to the pressure of the actuator chamber labelled A?
 - c. Always isolated from the actuator chamber labelled A?
 - d. Ever part of the actuator chamber labelled B?
 - e. Ever subject to the pressure of the actuator chamber labelled B?
 - f. Always isolated from the actuator chamber labelled B?

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Figure 3:



Consider Figure 3:

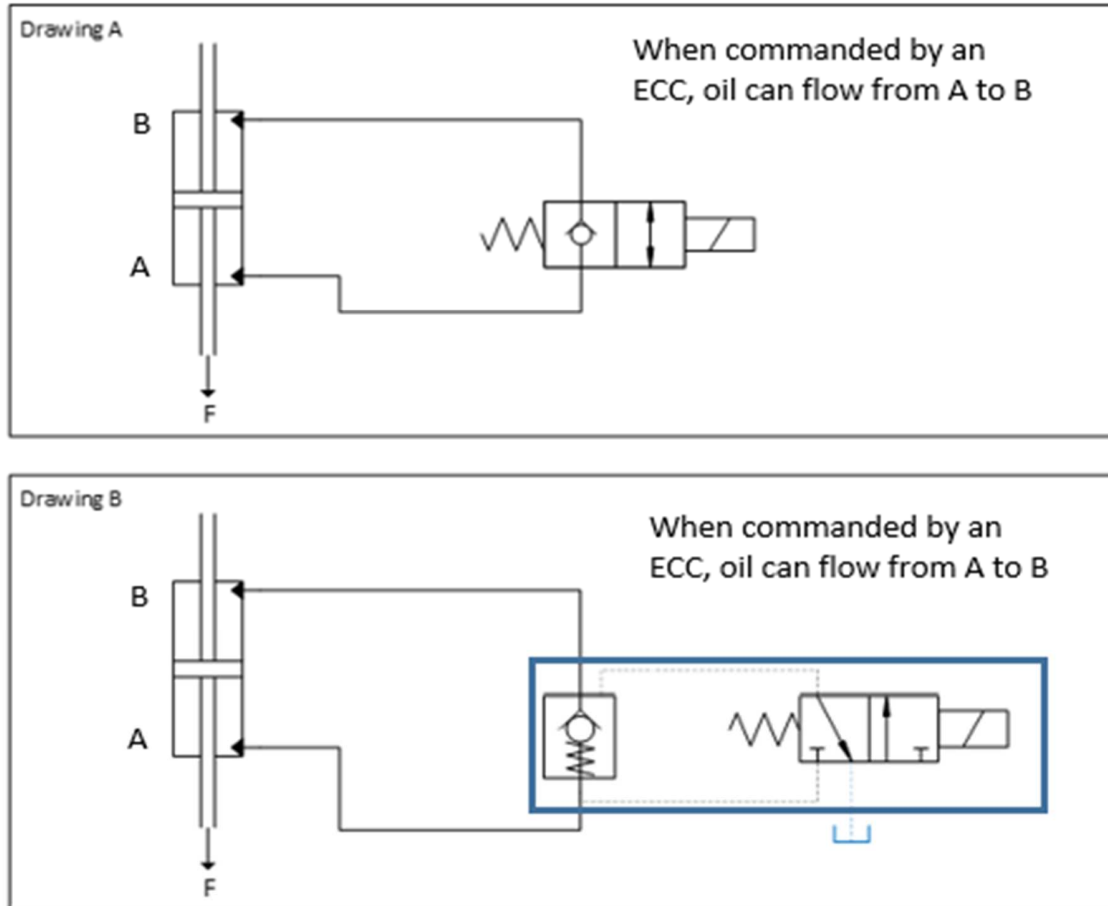
- I I. Valves L and M are pilot operated check valves. The only way of achieving flow from the actuator to tank through valves L or M is to actuate the proportional valve N via an ECC in a particular direction. Flow is possible in the reverse direction through valves L and M passively due to the check valve.
 - a. Are valves L and M controlled by an ECC?
 - b. Is valve M ever subject to the pressure of chamber A?
 - c. Is valve M always isolated from chamber A?
 - d. Does this arrangement comply with the **AC75 Class Rule**?

If the answer to (d) is NO, please can the Rules committee provide reasoning?

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Figure 4:



Consider Figure 4:

12. The valve in drawing A is an ECC controlled poppet valve with a reverse flow check. Is this legal according to the AC Class rule?
13. The valve in drawing B is a Pilot operated check valve controlled by a valve actuated by an ECC.
 - a. Is the Pilot operated check valve as drawn actuated by an ECC?
 - b. Does this arrangement comply with the **AC75 Class Rule**?
 - c. If the valve shown in the blue box is supplied in a single body rather than as two individual components, does this arrangement comply with the **AC75 Class Rule**?

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Interpretation:

Not applicable.

Answers:

1.

- a. Yes.
- b. Yes.

2.

- a. No.
- b. Yes.
- c. No.
- d. Yes.
- e. No.

3.

- a. No.
- b. Yes, because point I is affected by the pressure in chamber A and C.
- c. No.
- d. Yes, because point I is affected by the pressure in chamber A and C.
- e. No.

4.

- a. No.
- b. No.
- c. No.
- d. No.
- e. No.

5.

- a. No.
- b. No.
- c. No.
- d. No.
- e. No.

6.

- a. Yes.
- b. Yes.
- c. No.
- d. Yes.
- e. Not applicable.

7.

- a. Yes.
- b. Yes.
- c. No.
- d. No.
- e. No.
- f. Yes.

8.

- a. No.
- b. Yes.

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- c. No.
 - d. No.
 - e. No.
 - f. Yes.
- 9.
- a. No
 - b. Yes. Symbol for valve N does not indicate check valve abilities. Therefore, valves L and N can be controlled to connect Chamber A to point 3.
 - c. No. Symbol for valve N does not indicate check valve abilities. Therefore, valves L and N can be controlled to connect Chamber A to point 3.
 - d. No
 - e. Yes. Symbol for valve N does not indicate check valve abilities. Therefore, valves L and N can be controlled to connect Chamber A to point 3.
 - f. No. Symbol for valve N does not indicate check valve abilities. Therefore, valves L and N can be controlled to connect Chamber A to point 3.
- 10.
- a. No.
 - b. No.
 - c. Yes.
 - d. No.
 - e. No.
 - f. Yes.
11. Not applicable. Valves L and M are not permitted as per Rule 22.5 and 22.6 e). The Rules Committee does not consider relevant or useful the interpretation of non-compliant features under the AC75 Class Rule.
12. Yes.
13. Not applicable. The valves shown in the blue box do not comply with Rules 22.5 and 22.6 e). See answer 11 above.