AC75 Interpretation 011

of

AC75 Class Rule Version 1.2 issued 10th December 2018

Rule References:

21.2 No **control system** or part thereof shall be capable of using feedback from the **yacht state** to control a **control surface**, except:

(a) motion of a **control function** may be restricted where permitted by Rule 21.3;

(b) one or more **force input devices** may be connected **mechanically** and/or through an **HCC** to a single **control surface**; forces acting on that **control surface** can only be transmitted to those **force input devices**;

(c) one or more **force input devices** may be connected **mechanically** and/or through an **HCC** to common mechanical drive trains or common pressure supply lines that provide power to multiple **control surfaces**; forces acting on those **control surfaces** can be transmitted through those mechanical drive trains or pressure supply lines to those **force input devices**;

21.3 A **control system** may restrict a **control function** as follows:

(a) fixed stops, or stops engaged and disengaged **mechanically**, may limit the travel of a **control function**;

(b) locks that engage **mechanically** at (or very nearly at) either end of the extent of motion of a **control function** may be disengaged by an **ECC** and/or **HCC**, providing those extents of motion are not adjustable; and

(c) locks that limit the direction of motion of a **control function** at discrete points, e.g. ratchets, may engage **mechanically**.

However, stops and locks permitted herein shall not be combined to provide greater control of a **control function**, and shall not be used in mechanisms such as, but not limited to, escapements, to achieve the effect of indexed control or position control.

Background:

Consider the following hydraulic control system (Fig 1):

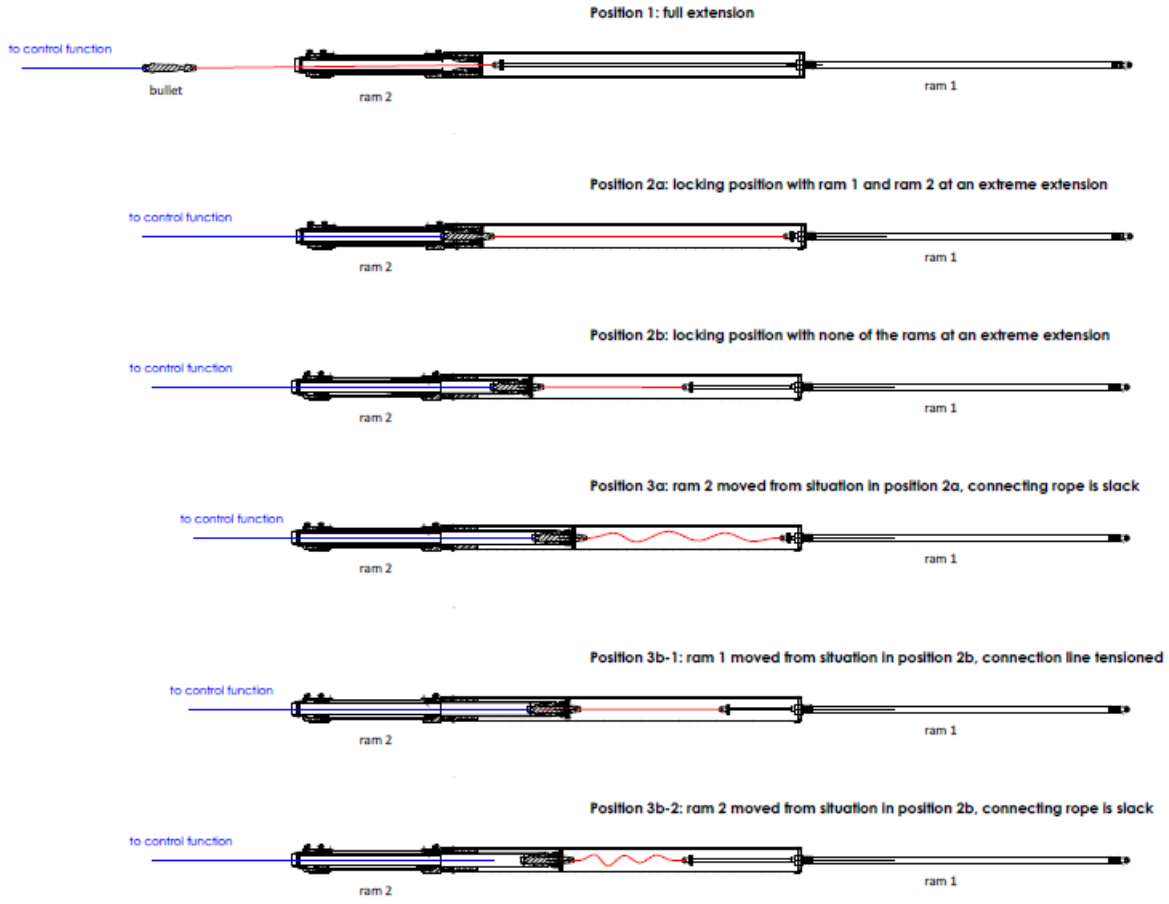

Figure 1: Hydraulic control system in various positions.

Figure 1 shows the system in various positions / configurations. A bullet – not unlike the bullet of a halyard lock for a head sail - is connected to a rope that allows movement or adjusting of a control function (blue). The control function is located on the left hand side of the bullet in Fig 1. This bullet is then connected to ram 1 via another rope (red, no compressive strength).

Ram 2 incorporates a locking mechanism – similar to a halyard lock – that allows the bullet to be engaged and disengaged. Inside ram 2 is a channel that provides space for the bullet and the ropes attached to the bullet to pass through.

Figure 1 describes the following positions / situations:

- Position 1: Ram 1 and ram 2 are at their maximum and minimum extension, respectively. The system is at the end of its extent of motion of the control function. The bullet is not engaged to ram 2. The position of the bullet – and hence the state of the control function – can only be changed by changing the extension of ram 1. A change of the extension of ram 2 will not modify the position of the bullet or the state of the control function.

- Position 2a: When the bullet reaches the position shown in the second sketch in figure 1 the bullet can be engaged or disengaged to/from the lock that is attached to ram 2. In figure 1 this position, - we call it here "locking position" - corresponds to the end of the stroke of ram 1 (minimal extension) and of ram 2 (minimal extension).

- Position 2b: The "locking position" does not correspond with the extreme extensions of ram 1 and ram 2. By shortening (with respect to 2a) the connection rope (red), the "locking position" can be somewhere along the stroke ranges of ram 1 and ram 2. The bullet can be engaged or disengaged when the difference between the extensions of ram 1 and ram 2 fit the length of the connection rope. In this position there is an infinite number of "locking positions".

- Position 3a: Once the bullet is engaged – and hence attached to ram 2 - its position and thus the state of the control function - can be changed by changing the extension of ram 2. In this case the connection line (red) becomes slack.

- Position 3b-1: When starting from configuration 2b we assume that valves controlling ram 2 are open (oil can freely flow through ram 2) and thus the control function can still be adjusted by changing the extension of ram 1, even if the bullet is locked. The connection line continues carrying load.

- Position 3b-2: When starting from configuration 2b the control function can, as in case 3a, be adjusted by changing the extension of ram 2. The connection line no longer carries any load and becomes slack.

Below we use the following definitions:

i. Manual: The bullet always disengages when the crew pulls a rope (or similar) independently of its position. The bullet engages when the crew pulls a rope (or similar), provided it is in the right position relative to the piston position of ram 2.

ii. Feedback and manual action: The bullet always engages/disengages when reaching a position relative to the position of the piston of ram 2, provided the crew is pulling a line (or similar) at that moment.

iii. Feedback and manual state: The bullet always engages/disengages when reaching a position relative to the position of the piston of ram 2, provided the crew pulled a line (or similar) before.

iv. Feedback only: The bullet always engages/disengages when reaching a position relative to the position of the piston of ram 2, independently of any crew action.

Below several configurations (A to C) and sub-configurations (1 to 4) of the proposed system are explored.

Configuration A:

The locking position of the bullet corresponds (closely) to the minimum extension of ram 1 and to the minimum extension of ram 2 (Position 2a in Fig.1). The bullet is always in the same position to enable it to engage and to disengage.

1. To engage and to disengage the bullet, manual action from the crew is required (pulling a rope or similar)
2. The locking of the bullet uses feedback (ii, iii, or iv), unlocking requires manual action from the crew (pulling a rope or similar)
3. The unlocking of the bullet uses feedback (ii, iii, or iv), locking requires manual action from the crew (pulling a rope or similar)
4. The locking and unlocking of the bullet uses feedback (ii, iii, or iv)

Configuration B:

The locking of the bullet can be done when neither ram 1 nor ram 2 are at any of their respective extreme extensions (Position 2b in Fig.1). The bullet is in varying positions to engage or to disengage.

1. To engage and to disengage the bullet, manual action from the crew is required (pulling a rope or similar)
2. The locking of the bullet uses feedback (ii, iii, or iv), unlocking requires manual action from the crew (pulling a rope or similar)
3. The unlocking of the bullet uses feedback (ii, iii, or iv), locking requires manual action from the crew (pulling a rope or similar)
4. The locking and unlocking of the bullet uses feedback (ii, iii, or iv)

Configuration C:

The locking of the bullet can be done when neither ram 1 or ram 2 are at any of their respective extreme extensions. The length of the (red) rope connecting the bullet with ram 1 is variable and can be set by a manual stopper that connects the connection rope to ram 1. The bullet is in varying positions to engage or to disengage.

1. To engage and to disengage the bullet, manual action from the crew is required (pulling a rope or similar)
2. The locking of the bullet uses feedback (ii, iii, or iv), unlocking requires manual action from the crew (pulling a rope or similar)
3. The unlocking of the bullet uses feedback (ii, iii, or iv), locking requires manual action from the crew (pulling a rope or similar)
4. The locking and unlocking of the bullet uses feedback (ii, iii, or iv)

Questions:

1. Would the Rules Committee advise whether each of the configurations A1, A2, A3, A4, B1, B2, B3, B4, C1, C2, C3 and C4 are rule compliant or, if not advise the rules infringed?

2. Would the Rules Committee advise with regard to Rule compliance of each configuration if the bullet lock is replaced by a ratchet (limiting motion only in one direction) which can be activated and deactivated manually? If this arrangement is not permitted, please advise the rules infringed.

3. Would the Rules Committee advise with regard to Rule compliance of each configuration if the bullet lock is replaced by a jammer (not locking in a fixed position relative to ram 2). If this arrangement is not permitted, please advise the rules infringed.

4. In Questions 1 to 3 we have assumed that the bullet engages and disengages mechanically. Do any of the answers to Q1 to Q3 change if the bullet engages and disengages through a hydraulic system? If so, please advise the rules infringed.

5. In configuration B and C we have assumed that once the bullet is locked it is still possible to adjust the control function using ram 1. Hence ram 1 is pulling ram 2 and thus moving the bullet and adjusting the control function. Do any of the answers to Q1 to Q4 change if the control function can only be adjusted via ram 2 once the bullet is locked? If so, please advice the rules.

Interpretation:

1. All configurations shown allow indexed control of a **control function**, and are therefore in infringement of last paragraph of rule 21.3. The lock can act as a limit on the travel of ram 1, and that lock can then be hydraulically moved by ram 2, hence creating additional index points.

2. See answer 1.

3. See answer 1.

4. No, answers to Q1 through Q3 do not change in this case.

5. No, answers to Q1 through Q4 do not change in this case.