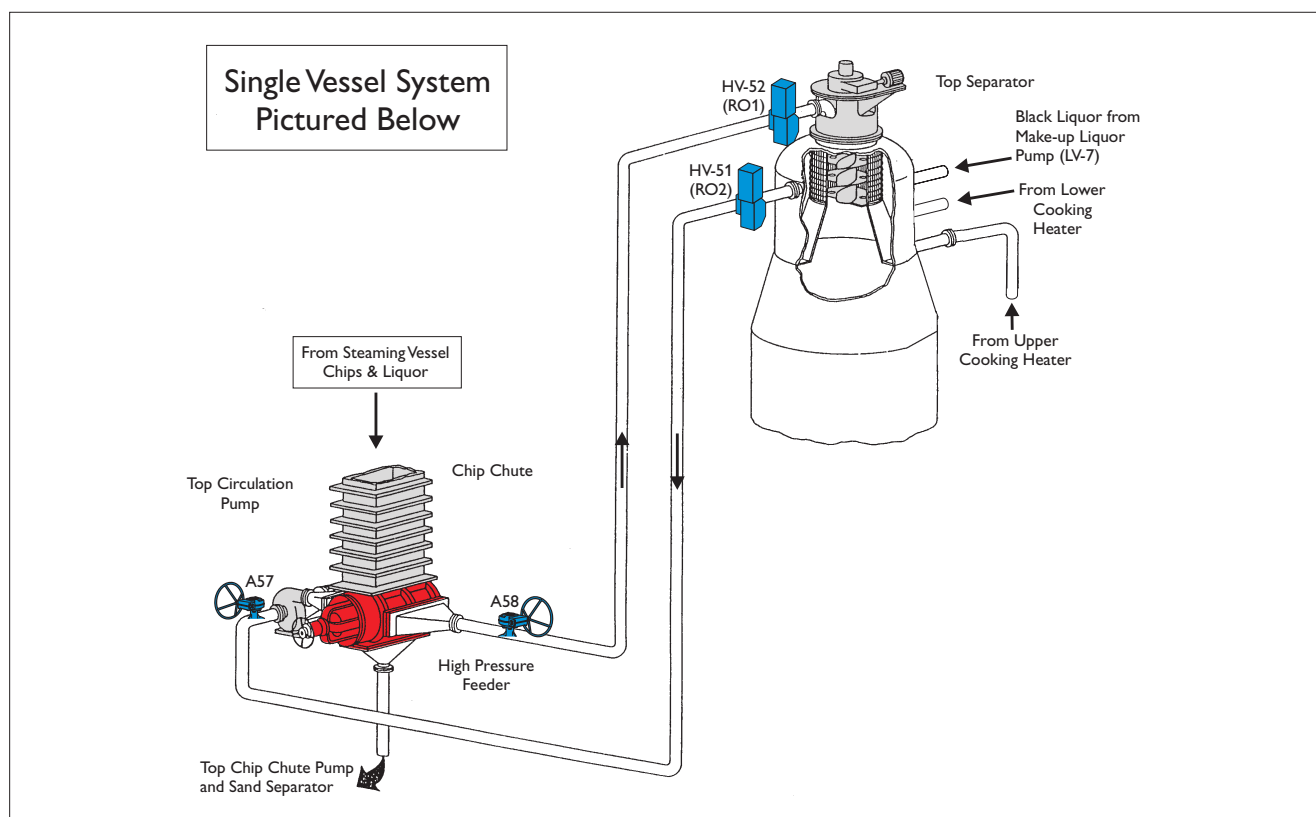


## Continuous digester ANDRITZ Continuous Pulp Cooking System Main Top Circulation



### Introduction and background

Continuous cooking is a method of chemical cooking in which wood chips and cooking liquors are fed at controlled rates into the pressurized digester, the chips move down through successive cooking zones within the digester and are continuously discharged at the bottom as pulp. Transfer of the chips from the feed system to the cooking vessel(s) and the application of valves from Valmet in this process will be addressed in this bulletin.

### Process description

The chips need to be transferred from the 1.2 bar pressure of the steaming vessel to the 8-9 bar pressure of the cooking vessel(s). This is done via a liquor filled system. Chips fall from the steaming vessel into the chip chute; here they are mixed with liquor. The liquor/chip slurry flows into the high pressure feeder (HPF). The HPF is a rotary plug valve that transfers the chips to the top circulation line (TC) where they are slued from the HPF by the TC flow and transported to the top separator. The top separator is located in the top of the digester in a single vessel system or the top of the Impregnation vessel in a two vessel system. The top separator allows the chips to be separated from the TC transfer liquor. The chips fall into the cooking vessel and the liquor is recirculated back to the high pressure feeder to collect more chips.

| Tag #           | A103 & A104                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | X   | Two Vessel System                                                                                           | X | Single Vessel System |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------------------------------------------------------------------------------------------------------------|---|----------------------|
| Application:    | High Pressure feeder Isolation                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |                                                                                                             |   |                      |
|                 | Black Liquor and Chips – On-Off Valve                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |                                                                                                             |   |                      |
|                 | Tag #'s A103 and A104 are located in the main top-circulation lines on either side of the High Pressure Feeder. Tag # A103 is located in the high pressure feeder outlet line to the top of the impregnation vessel. Tag # A104 is located on the suction side of the Top Circulation Pump (TCP).<br>Tag #'s A103 & A104 are secondary isolation valves that are used only when the main isolation valves HV-51 and HV-52 are closed and the circulation lines are drained. |     |                                                                                                             |   |                      |
|                 | Shut-Off: 50 psid = 3,4 bar<br>Temp: 240 °F = 116 °C                                                                                                                                                                                                                                                                                                                                                                                                                        |     | Flow: 9000 gal/min = 34100 liters/min                                                                       |   |                      |
| Control valve   | ASME                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | DIN |                                                                                                             |   |                      |
| Class:          | 300                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     | PN 25                                                                                                       |   |                      |
| Size:           | 10", 12", 14", 16"                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     | DN 250, 300, 350, 400                                                                                       |   |                      |
| Recommendation: | M2DB_AS12-manual gear operator, 12=large 1/4" male<br>M2DB_AS13-manual gear operator, 13=large 1/4" female<br>Actuators:<br>10" M15, 12" M16                                                                                                                                                                                                                                                                                                                                |     | M1LB__AS/12-manual gear operator 12=large 1/4" male<br>M2DB_AS13-manual gear operator, 13=large 1/4" female |   |                      |

| Tag #           | A57 & A58                                                                                                                                                                                                                                                                        | X                                                                                                            | Two Vessel System                     | X | Single Vessel System |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|---------------------------------------|---|----------------------|
| Application:    | High Pressure Feeder Isolation Valve                                                                                                                                                                                                                                             |                                                                                                              |                                       |   |                      |
|                 | Black Liquor and Chips - On-off valve                                                                                                                                                                                                                                            |                                                                                                              |                                       |   |                      |
|                 | Tags A57 and A58 are located in the main “top circulation” lines on either side of the high pressure feeder. Tag A57 is located in the High Pressure Feeder outlet line to the top of the main vessel. Tag A58 is located on the suction side of the Top Circulation Pump (TCP). |                                                                                                              |                                       |   |                      |
|                 | These valves are secondary isolation valves to be used only when the main isolation valves HV-51 and HV-52 are closed and circulation lines drained.                                                                                                                             |                                                                                                              |                                       |   |                      |
|                 | Shut-Off: 50 psid = 3,4 bar<br>Temp: 240 °F = 116 °C                                                                                                                                                                                                                             |                                                                                                              | Flow: 9000 gal/min = 34100 liters/min |   |                      |
| Control valve   | ASME                                                                                                                                                                                                                                                                             | DIN                                                                                                          |                                       |   |                      |
| Class:          | 300                                                                                                                                                                                                                                                                              | PN 25                                                                                                        |                                       |   |                      |
| Size:           | 10”, 12”, 14”, 16”                                                                                                                                                                                                                                                               | DN 250, 300, 350, 400                                                                                        |                                       |   |                      |
| Recommendation: | M2DB_AS12-manual gear operator, 12=large 1/4” male<br>M2DB_AS13-manual gear operator, 13=large 1/4” female<br>Actuators:<br>10” M15, 12” M16                                                                                                                                     | M1LB_AS/12-manual gear operator, 12=large 1/4” male<br>M1LB_AS/13-manual gear operator, 13=large 1/4” female |                                       |   |                      |

| Tag #           | HV-51 (RO2)                                                                                                                                                                                                                                                                                                   | X | Two Vessel System                                                                         | X | Single Vessel System |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-------------------------------------------------------------------------------------------|---|----------------------|
| Application:    | Top Circulation Line Isolation                                                                                                                                                                                                                                                                                |   |                                                                                           |   |                      |
|                 | Strong Black Liquor – On-Off Valve                                                                                                                                                                                                                                                                            |   |                                                                                           |   |                      |
|                 | HV-51 is also known as RO2 (Remote Operated Valve # 2) Tag HV-51 is the isolation valve for the main digester return line for both single and double vessel systems. The main digester return line recirculates liquor back to the top circulation pump (TCP) and high pressure feeder for sluicing of chips. |   |                                                                                           |   |                      |
|                 | Shut-Off: 250 psid = 3,4 bar                                                                                                                                                                                                                                                                                  |   | Temp: 240 °F = 116 °C                                                                     |   |                      |
| Control valve   | ASME                                                                                                                                                                                                                                                                                                          |   | DIN                                                                                       |   |                      |
| Class:          | 300                                                                                                                                                                                                                                                                                                           |   | PN 25                                                                                     |   |                      |
| Size:           | 10", 12", 14", 16"                                                                                                                                                                                                                                                                                            |   | DN 300, 350, 400                                                                          |   |                      |
| Recommendation: | M2DB_AS12-B1C40-SV,<br>12=large 1/4" male<br>M2DB_AS13-B1C40-SV,<br>13=large 1/4" female                                                                                                                                                                                                                      |   | M1LB_AS/12-B1C_-SV,<br>12=large 1/4" male,<br>M1LB_AS/13-B1C_-SV,<br>13=large 1/4" female |   |                      |
| Comments:       | HV-51 is normally open and only closed when the digester vessel (single vessel system) or impregnation vessel (two vessel system) must be isolated from the top circulation pump and high pressure feeder.                                                                                                    |   |                                                                                           |   |                      |

Valves sizes and process data that are shown on this page are for REFERENCE ONLY.

To appropriately size a valve, use actual process data obtained from the system.

| Tag #           | HV-52 (RO1)                                                                                                                                                                                                                                                                                                                      | X                                                                                         | Two Vessel System     | X | Single Vessel System |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-----------------------|---|----------------------|
| Application:    | Top Circulation Line Isolation Valve<br>Strong Black Liquor and Chips – On-Off Valve<br>HV-52 is the main digester feed line isolation valve for both single and double vessel systems. HV-52 is normally open and only closed when the digester vessel (or impregnation vessel) must be isolated from the high pressure feeder. |                                                                                           |                       |   |                      |
|                 | Shut-Off: 250 psid = 3,4 bar<br>Flow: 9000 gal/min = 34100 liters/min                                                                                                                                                                                                                                                            |                                                                                           | Temp: 240 °F = 116 °C |   |                      |
| Control valve   | ASME                                                                                                                                                                                                                                                                                                                             | DIN                                                                                       |                       |   |                      |
| Class:          | 300                                                                                                                                                                                                                                                                                                                              | PN 25                                                                                     |                       |   |                      |
| Size:           | 12", 14", 16"                                                                                                                                                                                                                                                                                                                    | DN 300, 350, 400                                                                          |                       |   |                      |
| Recommendation: | M2DB_AS12-B1C40-SV,<br>12=large 1/4" male<br>M2DB_AS13-B1C40-SV,<br>13=large 1/4" female                                                                                                                                                                                                                                         | M1LB_AS/12-B1C_-SV,<br>12=large 1/4" male,<br>M1LB_AS/13-B1C_-SV,<br>13=large 1/4" female |                       |   |                      |
| Comments:       | HV-52 is also known as "RO1" (Remote Operated Valve #1).                                                                                                                                                                                                                                                                         |                                                                                           |                       |   |                      |

| Tag #           | HV-54                                                                                                                                                                                                                                                         | X                  | Two Vessel System | X | Single Vessel System |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------|---|----------------------|
| Application:    | Pressurization of Top Circulation Line<br>Black Liquor – Control Valve<br>HV-54 is used only during start-up to pressurize the main feed top circulation line prior to starting the top circulation pump (TCP). This valve is closed during normal operation. |                    |                   |   |                      |
|                 | Differential: 40-50 psid = 2,8-3,4 bar      Shut-Off: 320 psid = 22,1 bar<br>Temp: 170 °F = 77 °C      Flow: 400 gal/min = 1500 liters/min                                                                                                                    |                    |                   |   |                      |
| Control valve   | ASME                                                                                                                                                                                                                                                          | DIN                |                   |   |                      |
| Class:          | 300                                                                                                                                                                                                                                                           | PN 25              |                   |   |                      |
| Size:           | 3"                                                                                                                                                                                                                                                            | DN 80              |                   |   |                      |
| Recommendation: | M2DA03AP-B1C11-ND                                                                                                                                                                                                                                             | M1LA080AP-B1C11-ND |                   |   |                      |

| Tag #           | PV-30                                                                                                                                                                                                                                                                                                                        | X                  | Two Vessel System | X | Single Vessel System |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------|---|----------------------|
| Application:    | Impregnation Vessel Pressure Relief Valve<br>Black Liquor – Control Valve<br>This valve acts as a pressure relief device by drawing off excess liquor from the upper impregnation zone, and feeding it to the inlet of the no. 2 flash tank.<br>Pressure relief is required when the inlet separator screens become plugged. |                    |                   |   |                      |
|                 | Differential: 80-160 psid = 5,5-11 bar      Shut-Off: 230 psid = 16 bar<br>Temp: 260 °F = 130 °C      Flow: 2800 gal/min = 10600 liters/min                                                                                                                                                                                  |                    |                   |   |                      |
| Control valve   | ASME                                                                                                                                                                                                                                                                                                                         | DIN                |                   |   |                      |
| Class:          | 300                                                                                                                                                                                                                                                                                                                          | PN 25              |                   |   |                      |
| Size:           | 4"                                                                                                                                                                                                                                                                                                                           | DN 100             |                   |   |                      |
| Recommendation: | M2DA04AP-B1J12-ND                                                                                                                                                                                                                                                                                                            | M1LA100AP-B1J12-ND |                   |   |                      |

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To appropriately size a valve, use actual process data obtained from the system.

| Tag #           | FV-3A                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | X | Two Vessel System | X | Single Vessel System |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-------------------|---|----------------------|
| Application:    | White Liquor Purge of High Pressure Feeder<br>White Liquor – Control Valve<br>A white liquor purge line was added to the high pressure feeder through the end bell equalization header. The continuous white liquor purge helps to keep the end bells free of fines and acts as a lubricant between the bell and housing.<br>Differential: 50-90 psid = 3,4-6,2 bar      Shut-Off: 280 psid = 19,3 bar<br>Temp: 160 °F = 71 °C      Flow: 50-125 gal/min = 190-475 liters/min |   |                   |   |                      |
| Control valve   | ASME                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   | DIN               |   |                      |
| Class:          | 300                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   | PN 25             |   |                      |
| Size:           | 1 1/2"                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   | DN 40             |   |                      |
| Recommendation: | M2DA1HAP-B1C6-ND                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   | M1LA040AP-B1C6-ND |   |                      |
| Comments:       | This is very difficult control application because of the scaling potential of the white liquor. A metal seated ball valve with scraper style locked seats is required to remove scale build-up. The actuator should be sized with a generous safety margin due to the potential orque requirements. On older systems, this valve was designated as HV-3A or HV-35.                                                                                                           |   |                   |   |                      |

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#### Valmet Flow Control Oy

Vanha Porvoontie 229, 01380 Vantaa, Finland.

Tel. +358 10 417 5000.

[www.valmet.com/flowcontrol](http://www.valmet.com/flowcontrol)

