



**Zamboni FastICE® Ice Making System
Operating Manual**

Table of Contents

Chapter 1 – System Description.....	5
Switch Bank 1	7
Switch Bank 2	7
Switch Bank 1	8
Test Mode OFF-ON.....	8
Test Speed (DEC)-HOLD-(INC).....	8
Malfunction Indicator Lamp (MIL) (lighted blank plate):.....	8
Switch Bank 2	9
Upper Boom Control (OFF-ON).....	9
Lower Boom Control (OFF-ON).....	9
Application Rate Scaling (DEC)-HOLD-(INC).....	9
Board Spray (OFF-ON).....	9
Blast (OFF-ON).....	10
DISPLAY CONTROLS.....	11
SCREEN NAVIGATION MAP	12
MACHINE MODES	14
Test Mode.....	14
Automatic Mode.....	14
Automatic Boom Shut-off.....	14
Safety and Functional Interlocks.....	15
OPERATOR INTERFACE	16
Boot Screen.....	16

FASTICE™ Operating Manual

Load Screen.....	17
Dashboard Screen	17
Summary Screen	18
Set-up Screen.....	19
Diagnostics Screen	19
Machine Parameters Screen (Technical Set-up, Hidden Screen)	20
Function Lockout on Parameters Screen.....	21
Fault Notification Pop-Ups on the Fast Ice Display	22
Display Pop-Up System Fault Messages.....	23
System Fault: Water Pressure Out Of Range: High!	23
System Fault: Water Pressure Out of Range: Low!.....	24
System Fault: Water Flow Out of Range: Low!.....	24
System Fault: Water Flow and Pressure Out of Range: Low!.....	25
System Fault: Water Level Sensor Disconnected!.....	26
System Fault: Water Valve Disconnected!	26
System Fault: Hydraulic Valve Disconnected!	27
Chapter 2 - System Subassembly Description	28
Water Pump Subassembly	28
Water Valve Manifold Assembly	29
Spray Boom Subassembly	30
Chapter 3 – Operating Procedures: Standard Ice Resurfacing	32
Chapter 4 – Operating Procedures: Ice Building.....	34
Chapter 5 – Recommended Regular System Maintenance.....	35
Chapter 6 - System Troubleshooting.....	36

FASTICE™ Operating Manual

Water flow and pressure fault criteria reference diagrams.....	40
Lower Boom ONLY Alarm Limit Diagram	40
Operating Region Identification Diagram.....	41
Upper Boom ONLY Alarm Limit Diagram	42
Both Booms ON Alarm Limit Diagram.....	43
Revisions	44

Chapter 1 – System Description

The FastICE® system is offered in two versions – a base package and a pro package. The pro package will be offered as an upgrade to the base package.

The FastICE base package consists of the following components;

- System master Off-On switch
- Electronic control module
- (2x) Programmable 4-switch CAN rocker switch panels • Dedicated hydraulic pump section added to main pump stack
- Hydraulically-driven centrifugal water pump
- Proportional hydraulic flow control valve for water pump motor control
- Ice-making water flow sensor
- Speed sensor
- Ice-making water level sensor
- Upper and lower spray booms
- Board spray valve
- Electrically controlled, diaphragm type water control valves
(1 each for the Upper boom, Lower boom, and Board Spray Valve)

FASTICE™ Operating Manual

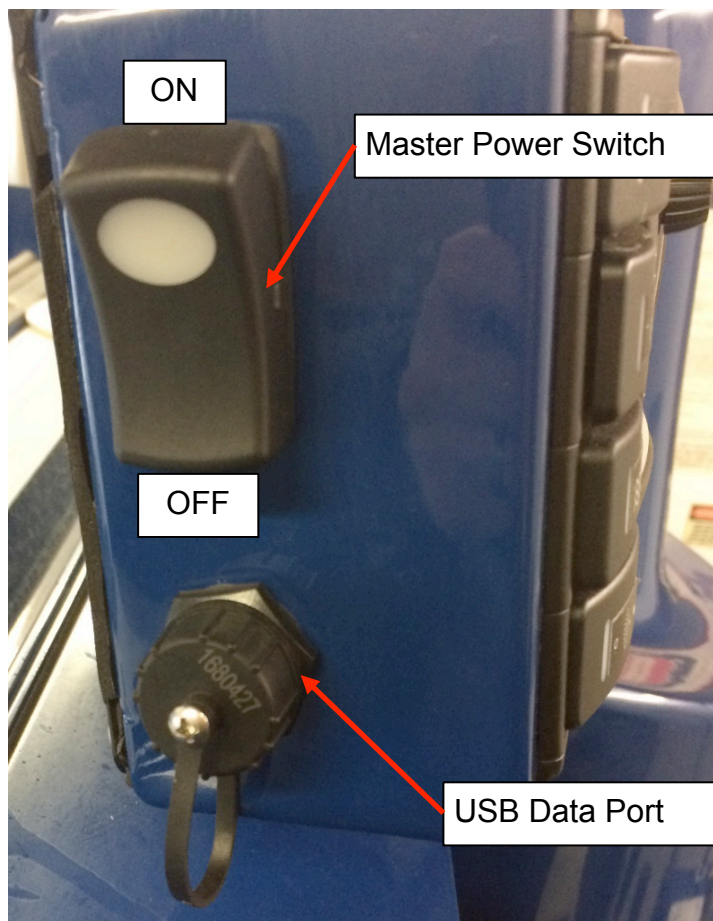


Figure 1: FastICE Pro package with switch banks and display

Switch Bank 1



TEST MODE

TEST SPEED ((DECREASE) – HOLD – (INCREASE))

MALFUNCTION INDICATOR LAMP
(MIL, LEFT GREEN, RIGHT YELLOW)

BOARD SPRAY VALVE CONTROL (ON-OFF)

Figure 2: FastICE Switch Bank 1 switch and LED identification

Switch Bank 2



UPPER BOOM WATER CONTROL (ON-OFF)

LOWER BOOM WATER CONTROL (ON-OFF)

WATER APPLICATION RATE SCALING
(DECREASE – HOLD – INCREASE)

WATER BLAST FUNCTION

Figure 3: FastICE Switch Bank 2 switch and LED identification

FASTICE™ Operating Manual

The **FastICE** base package uses two dash-mounted rocker switch panels to control the system. Switch bank 1 controls system test mode, test speed increment up or down, malfunction indicator lamp (MIL) and Board Spray Control Switch. These are infrequently used control functions.

Switch Bank 1

Test Mode OFF-ON

- Operation:
 - Illuminates the left light Red when in the **OFF** position
 - Illuminates the right light White when in the **ON** position, and blinks at 4 times per second when **ON**

Test Speed (DEC)-HOLD-(INC)

- Operation:
 - Off when in the HOLD position
 - Illuminates Red when **DEC** pressed
 - Illuminates Green when **INC** pressed

Malfunction Indicator Lamp (MIL) (lighted blank plate):

- Operation:
 - Left-hand light illuminates **Green** when the system has no malfunctions are detected
 - Left light illuminates **Red** when there is a malfunction detected. The right-hand light will be off when there is no fault active and flash the fault numeric code in a **White** blinking light when the left hand light is **Red**. The details of the blink codes are detailed in the "Troubleshooting" section of this manual.

Switch Bank 2

Upper Boom Control (OFF-ON)

- This switch controls water flow to the upper boom.
- Operation:
 - Left LED is illuminated **Red** when in the **OFF** position
 - Right LED is illuminated **White** when the in the **ON** position

Lower Boom Control (OFF-ON)

- This switch controls water flow to the lower boom.
- Operation
 - Left LED is illuminated **Red** when in the **OFF** position
 - Right LED is illuminated **White** when the in the **ON** position

Application Rate Scaling (DEC)-HOLD-(INC)

- This function allows the operator to increase or decrease a scaling factor applied to the default value of 100%, and allows for situations where a lesser or greater water application rate is desirable.
- Operation:
 - Off when in the HOLD position
 - Blinks **Blue** once for each single press of **DEC** (decrement) on the left of the switch
 - Blinks **Green** once for each single press of **INC** (increment) on the right of the switch
 - Each press of either DEC-INC switch will generate one blink for each press of the switch.
 - Each press of the switch will change the spray flow 5 percentage points to a maximum of 50% (10 presses). The switch will only blink when pushed.

Board Spray (OFF-ON)

- This switch controls water flow out of the Board Spray Valve.

FASTICE™ Operating Manual

- Operation:
 - Illuminates the right light **Red** when in the **OFF** position
 - Illuminates the left light **White** when in the **ON** position

Blast (OFF-ON)

- This switch will produce the maximum water flow rate possible from the system.
- Operation:
 - Illuminates **Red** when in the **OFF** position
 - Illuminates **White** when in the **ON** position (activates both upper and lower booms and sets pump hydraulic control valve to I_{max} value for maximum water flow)

The FastICE system produces the best results with water at a temperature of 100 to 140 degrees F (40 to 60 degrees C).

The system uses (arena facilities sourced) warm water carried in a dedicated ice-making water tank on the machine. The ice-making water is supplied to the spray nozzles by means of a hydraulically driven, proportionally controlled centrifugal water pump. Hydraulic power is supplied by a dedicated single gear pump section added to the standard pump stack as part of the FastICE system.

Solenoid-actuated, diaphragm-type water valves (one each for the upper and lower conditioner booms and one for the board spray nozzle) are used to facilitate turning the water spray nozzles off/on, and are selected manually by the operator via the boom control switches on Switch Bank 2. No throttling is provided by the solenoid water valves. The water valves only provide off-on control. Nozzle flow is controlled by pump speed (RPM).

When the system is active, water flow to the booms and/or board spray nozzle is monitored by a water flow sensor located in the delivery piping between the centrifugal pump and the spray booms as well as a pressure transducer located in the delivery piping after the pump.

Ground speed is monitored from a speed sensor over the output shaft of the gearbox of the machine. The (speed) sensor signal is used to synchronize (adjust) water flow (water pump RPM) with the machine travel speed automatically, providing a consistent application of water across the entire ice surface, regardless of speed.

If the upper (spray) boom is active, automatic control of the boom valve will turn off water flow to the upper boom if ground speed drops below a preset value, which is adjustable within the SETUP screen, which will be discussed in a later section. The boom which turns off when the speed drops below the specified value can also be changed.

The target water flow rate for a given driving speed can be increased or decreased by up to 50% by turning the adjustment knob on the display or by depressing the rocker switch for flow scaling.

FASTICE™ Operating Manual

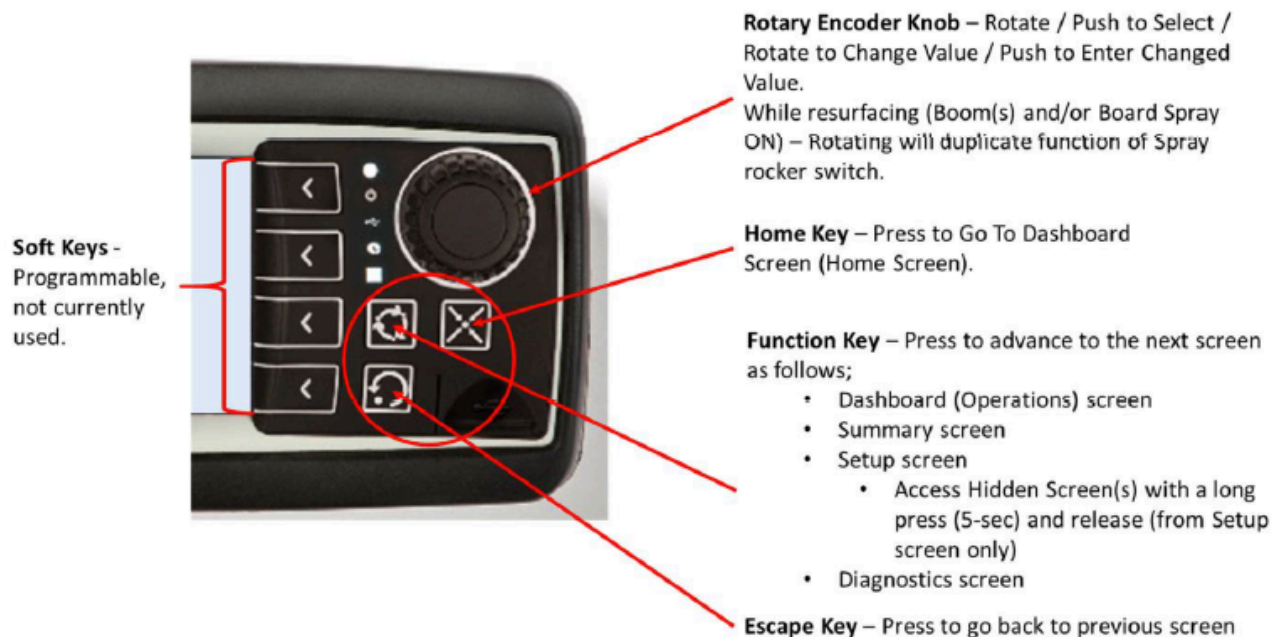
The “blast” function provides the opportunity for the operator to “blast” (apply water at the maximum application rate) water where needed. It is a momentary function that is activated when the switch is depressed, and can be activated for up to 10 seconds, after which time it will turn off and reset.

The FastICE display will provide for operator monitoring of the operational parameters, including ground speed, water flow, water usage, water spray pressure and water temperature. It will record operational data for later download (for record keeping or analysis) and provide troubleshooting diagnostic information. The display has four operational display screens: Dashboard, Summary, Set-up, and Diagnostic screens.

Navigation through the screens will be by button pushes of the Function key. An additional hidden screen(s) may be accessed only from the Set-up screen (by pressing the Function key for (5) seconds and releasing) and will be used for advanced technical set-up purposes.

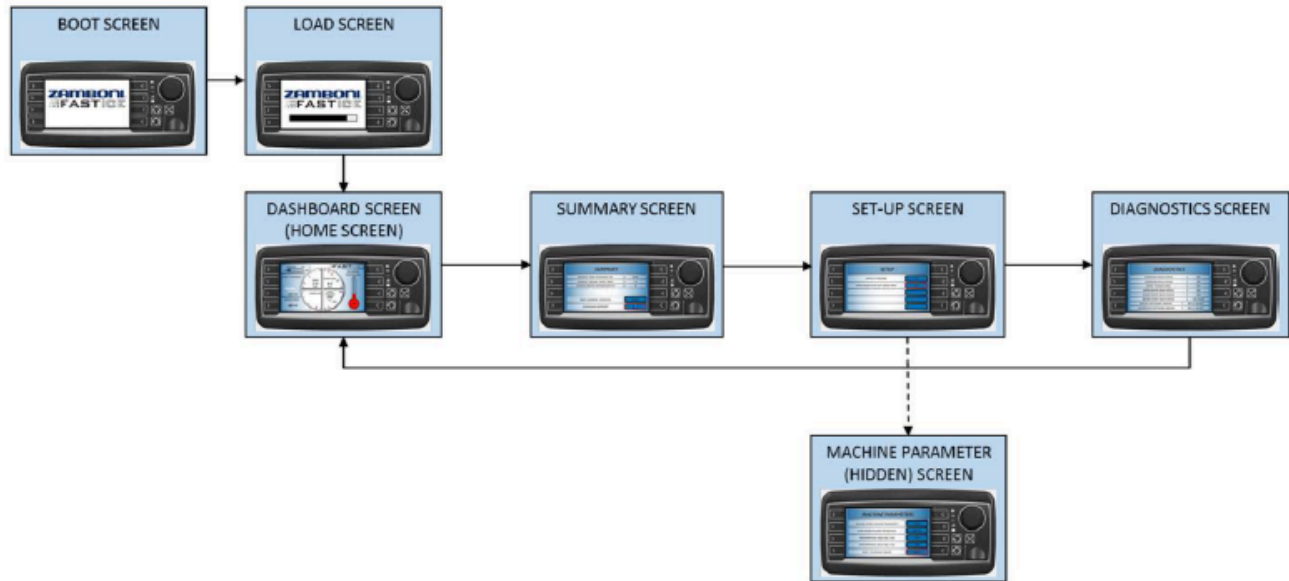
The encoder knob of the display will be used to enter/adjust screen based operational settings. The encoder knob will also provide alternate control of the Spray DEC-INC setting in conjunction with the Spray switch in Switch bank 2 (only when the display is on the Dashboard screen). Either the knob or switch may be used to make the adjustment based on the operator’s preference.

DISPLAY CONTROLS



FASTICE™ Operating Manual

SCREEN NAVIGATION MAP



The BOOT screen will display when power is initially turned on.

The LOAD screen will display while the unit is loading display software.

The DASHBOARD screen (home screen) will display (as passive read-out) when the unit is fully booted:

- Scaling - Water flow percentage sliding scale (+/- 10) of water flow
- Spray thickness – based on program algorithm
- Water Used – total amount of water used during the current application (US or Metric units)
- Speed – actual ground speed of the ice resurfacing machine
- Water Flow – total water flow being sprayed each minute (US or Metric units)
- Water Level – level of ice-making water in the tank
- Water Pressure – water pressure as indicated by the pressure transducer
- Ice Water Temperature – as indicated by the ice-making water temperature sensor

Active adjustment of the Scaling function using the encoder knob will be provided to the operator as an alternate means of adjustment to the switch panel. Either method may be used at any time during operation at the operator's discretion.

The SUMMARY screen will display average readings (passive read-out):

FASTICE™ Operating Manual

- Average Spray Thickness
- Average Ground Speed (calculated only when one or more nozzles are active)
- Average Water Temperature – average ice-making water temperature

And active fields to:

- Reset Summary Statistics – this button is the only means of resetting the summary information.
- Download Summary

The SET-UP screen will display and allow selection of (using encoder knob):

- Units of Measure selection – US or Metric
- Spray thickness - US = Inches, Metric = mm
- Ground speed - US = MPH, Metric = km/h
- Water Flow – US = GPM, Metric = L/min
- Water Used – US = Gallons, Metric = Liters
- Upper Boom Shut-off Speed

The DIAGNOSTICS screen will display (passive read-out only):

- Hydraulic Valve Status – coil fault indication – open / short / okay
- Communication Status – okay or display to controller communication fault
- Supply Voltage (VDC) – system voltage
- Upper Boom Valve Status – coil fault indication – open / short / OK
- Lower Boom Valve Status – coil fault indication – open / short / OK
- Board Spray Valve Status – coil fault indication – open / short / OK
- Display Software Version
- Controller Software Version

The HIDDEN screen may be accessed only from the Set-Up screen and when the Function key is pressed for 5-seconds and released. When active, it will display and allow selection (using encoder knob) of:

- Ground Speed Scaling – sensor pulses per 10 meters
- Flow Meter Scaling – sensor pulses per 10 Liters
- Proportional Valve IMin (mA)
- Proportional Valve IMax (mA)
- Reset To Default Values – resets all parameters to factory values

MACHINE MODES

There will be two operational modes with both allowing full system functionality. No functional lock-outs are required other than pump flow interlock (defined in the Safety and Functional Interlocks section below).

Test Mode

Test mode will be used to test the spray nozzles prior to moving onto the ice surface and to purge cold water from the plumbing of the FastICE system prior to on-ice application. Test mode runs the system at a simulated ground speed while the machine is stationary (adjustable parameter within HF-Impulse), generated by the control module. The FastICE system will operate as though in actual use allowing for inspection of nozzle spray patterns will be carried out, identifying any plugged or partially plugged nozzle(s) resulting in a poor, uneven spray pattern and correcting any defects found. The operator may adjust the application amount setting according to ice conditions using the spray adjust rocker switch.

Automatic Mode

Automatic mode uses the ground speed sensor input to determine real-time ground speed of the ice resurfacing machine.

This is the standard operating mode for this system.

This 'live' ground speed signal is used by the controller to proportionally adjust the speed of the hydraulically driven ice making water pump, resulting in water flow (to the boom nozzles) delivered to the boom nozzles being proportional to ground speed. The result is an automatically controlled spray system providing uniform application thickness regardless of speed variations during the entire resurfacing event.

Automatic Boom Shut-off

Automated shut off of water flow to the upper spray boom (when it is ON) will occur when the ground speed of the machine falls below a pre-set threshold. The threshold speed is labelled UPPER BOOM SHUT-OFF SPEED and is set on the Set-up Screen. The boom will turn back on when ground speed exceeds the set threshold speed.

The boom that turns off when the speed setting is reached can be changed in either the hidden settings screen, or with the FastICE system programming tool and software.

Safety and Functional Interlocks

The hydraulically driven water pump is interlocked to the ice-making water tank level sensor to prevent the pump from running dry. When the level sensor indicates tank levels below 0% for 2 seconds, the ice making water pump will automatically shut off.

Likewise, if the control system does not sense a water level greater than 0%, the water pump will not start. A moving average calculation is performed on the water level sensor signal to prevent rapid off/on due to water sloshing in the tank.

Re-filling the tank so the level holds above 0% for at least 5 seconds will reset this interlock and allow the pump to start.

FASTICE™ Operating Manual

OPERATOR INTERFACE

See Machine Functions section for general details of operator interface and operation.

Boot Screen



The Boot Screen is displayed while the display is booting up. It is the first screen displayed. When the display program starts to load, the display will change to the Load Screen.

FASTICE™ Operating Manual

Load Screen



The Load Screen is displayed while the display program is loading. It will remain displayed until the display program has fully loaded, which takes 25 to 30 seconds). When the display program has fully loaded, the display will change to the Dashboard Screen.

Dashboard Screen



The Dashboard Screen provides a read-out of real time operational performance.

This is a mostly passive display – interaction is allowed only for Scaling (Water Flow Adjustment), using the encoder knob as an alternate to the control switch.

FASTICE™ Operating Manual

Summary Screen

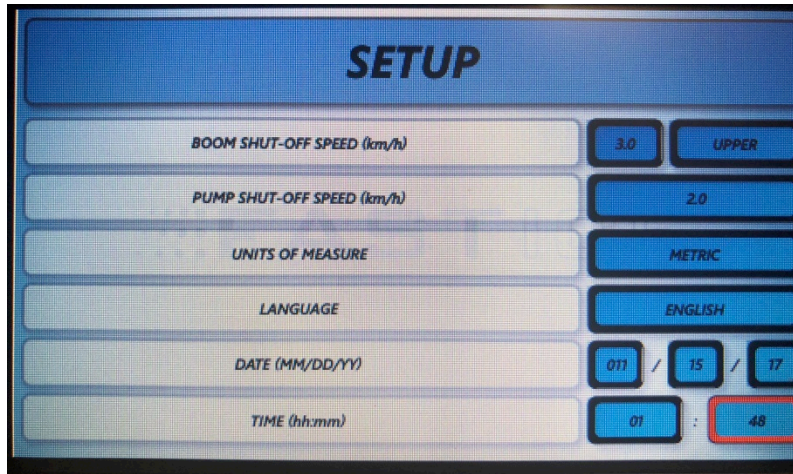


The Summary Screen provides a read-out of the average performance for the last refinishing event (since the last reset). Average performance for spray thickness, ground speed and ice making water temperatures are calculated and recorded during operation. These values are available to download via USB port mounted on the machine's dash.

Operator interaction is only allowed to reset summary statistics and to download summary information via USB.

FASTICE™ Operating Manual

Set-up Screen



The Set-up Screen allows the operator to select or set operational parameters of the control system. The operator will use the encoder knob to select the desired parameter - rotate the knob to move the red highlighted box to the desired parameter, press the encoder knob to make the selection (highlighting around the box will change to white), rotate the knob to change the highlighted value and press the encoder knob to enter the new value. Box highlighting will change back to red after entering the new value. Rotating the knob will move the highlighted box to another parameter.

Diagnostics Screen



The Diagnostics Screen provides a read-out of the current state of the solenoid valves, communication status (between the display and machine controller), supply voltage, display software version and controller software version. The Diagnostics Screen will display the status of the hydraulic valve coil and the three water valve coils regardless of whether or not the system is in use. Supply voltage will also be monitored for troubleshooting purposes.

Machine Parameters Screen (Technical Set-up, Hidden Screen)

The Machine Parameters Screen is used for factory set-up and tuning of the control system. It is accessible only when the display is on the Set-up Screen and the Function key is held for a 5-second interval and released.

Once accessed, the technician may adjust any of the control parameters using the encoder knob to select the desired parameter - rotate the knob to move the red highlighted box to the desired parameter, press the encoder knob to make the selection (highlighting around the box will change to white), rotate the knob to change the highlighted value and press the encoder knob to enter the new value.

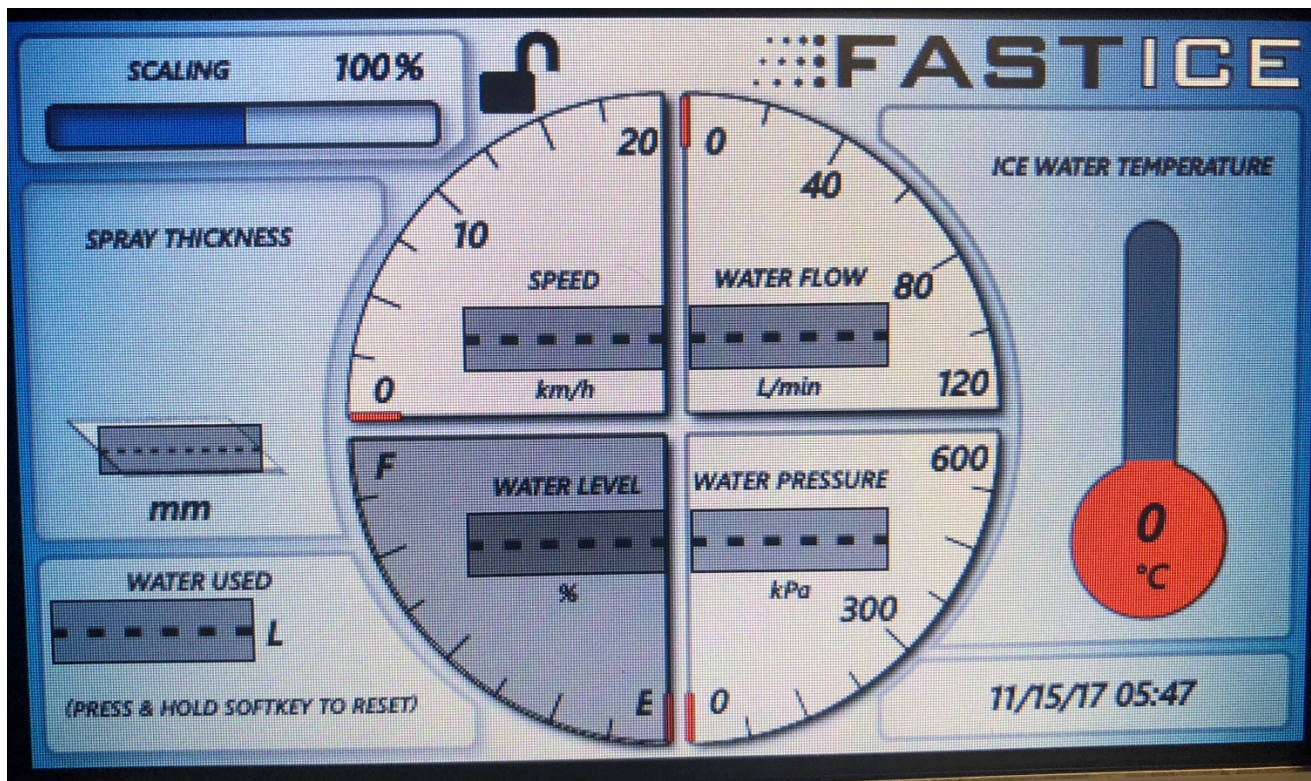
Box highlighting will change back to red after entering the new value and rotating the knob will move the box to the next parameter.

Exit the Machine Parameters screen by pressing the Home key (returns to the Dashboard screen).

FASTICE™ Operating Manual

Function Lockout on Parameters Screen

For rink managers who desire to prevent their operators from accessing the parameters on the set-up screen or hidden screen, a “lock-out” feature exists. To utilize this lock-out feature, navigate the system to the Operating Screen, and hold down the Function key on the display for 5 seconds. The pad lock icon on the screen will change from an “unlocked” appearance to a “locked” appearance, as shown here:



To unlock a system that has been locked, press and hold the Function key for 5 seconds, after which time the pad lock symbol will change from “locked” to “unlocked”.

Fault Notification Pop-Ups on the FastICE Display



Pop-ups will display over all operational screens when a fault is detected. The pop-ups are intended to alert the operator of an operational problem when the system is operating. Popups related to water flow or spray pressure will only display when the system is active with one or more nozzles are switched on. Fault codes for water valve or hydraulic valve disconnection or water level sensor disconnection are displayed on the screen, with or without the water valve control switches being in the “on” position.

When a pop-up displays, the operator may clear the screen by pressing the ESC key.



Display Pop-Up System Fault Messages

Detailed information related to system troubleshooting can be found in the “Troubleshooting” section of this manual.

If a fault condition is activated, the fault can be cleared by cycling the main power switch on the side of the display enclosure off and then on again. Since the system was already fully booted up when the power was turned off, the system will immediately turn back on when the power switch is turned back to the “on” position.

System Fault: Water Pressure Out Of Range: High!



This pop-up will display when there is a problem with the water system related to the water system being clogged.

This pop-up will display when there is a problem with output pressure from the pump being lower than the target pressure by an amount that exceeds the allowable deviation setting.

Causes may include:

- Clogged spray orifice
- Clogged spray orifice strainer
- Clogged inlet screen on the boom spray water control valve
- Damaged spray orifice or spray nozzle body
- Restriction in the water hose downstream of the pressure sensor

The default setting for this is 70 kPa (~10 PSI) above the target value for at least 10 seconds. For reference, the spray pressure for a traveling speed of 8 km/hr (5 MPH) and a flow rate of 54.1 L/min (14.3 GPM) is 138 kPa (20 PSI).

System Fault: Water Pressure Out of Range: Low!



This pop-up will display when there is a problem with output pressure from the pump being lower than the target pressure by an amount that exceeds the allowable deviation setting. A range of the target pressure

Problems may include

- broken or missing nozzle
- leaking hose connection downstream of the flow meter
- broken plumbing fitting between the pump and spray booms

The default setting for this is 70 kPa below the target range for at least 10 seconds. For reference, the spray pressure for a traveling speed of 8 km/hr (5 MPH) and a flow rate of 54.1 L/min (14.3 GPM) is 138 kPa (20 PSI).

System Fault: Water Flow Out of Range: Low!



This pop-up will display when there is a problem with output flow from the pump being lower than the target flow rate, by an amount that exceeds the allowable deviation setting.

Problems may include:

- Hydraulic control valve contamination in the FastICE hydraulic manifold
- Damaged water flow meter

FASTICE™ Operating Manual

- Incorrect flow coefficient entered within the hidden setting screen (disregard this if the value has not been changed from its factory setting)
- Worn hydraulic motor that drives the water pump
- Worn hydraulic pump section that supplies hydraulic oil to the hydraulic manifold

The default setting for this is 8 L/min (2 GPM) below the target flow value for at least 10 seconds. For reference, the flow rate for the Upper spray boom for a traveling speed of 8 km/hr (5 MPH) is 41 L/min (10.5 GPM), and the flow rate for the Lower spray boom is 14 L/min (3.8 GPM) .

System Fault: Water Flow and Pressure Out of Range: Low!



This pop-up will display when there is a problem with output flow and pressure from the pump being lower than expected by an amount that exceeds both deviation settings related to water flow and pressure.

Problems may include:

- Clogged water filter
- An issue with the flow sensor
- Plugged water supply line between the water pump and the water flow meter
- Leaking hose connection between the pump and flow meter
- Insufficient pump speed and maximum command signal is being sent to hydraulic valve but water flow is too low

System Fault: Water Level Sensor Disconnected!

This pop-up will display when either the water level sensor is disconnected, or the wiring to the sensor is damaged.

**WATER LEVEL SENSOR
DISCONNECTED!**



System Fault: Water Valve Disconnected!

This pop-up will display when the system ECU detects that one of the water valves is disconnected. The ECU applies a small voltage to the solenoid coil of each of the water control valves when they are not in use. If it measures a current within a certain range, it detects that the water control valves are connected properly. If it does not detect a return current flow, it will activate a VALVE DISCONNECTED fault. There are (3) water control valves in the system: Upper Boom, Lower Boom and Board Spray.

**WATER VALVE
DISCONNECTED!**



System Fault: Hydraulic Valve Disconnected!

This pop-up will display when the system ECU detects that one of the water valves is disconnected. The ECU applies a small voltage to the solenoid coil of the hydraulic valve installed in the hydraulic manifold. If it measures a current within a certain range, it detects that the hydraulic valve is connected properly. If it does not detect a return current flow, it will activate a VALVE DISCONNECTED fault. There are (3) water control valves in the system: Upper Boom, Lower Boom and Board Spray.

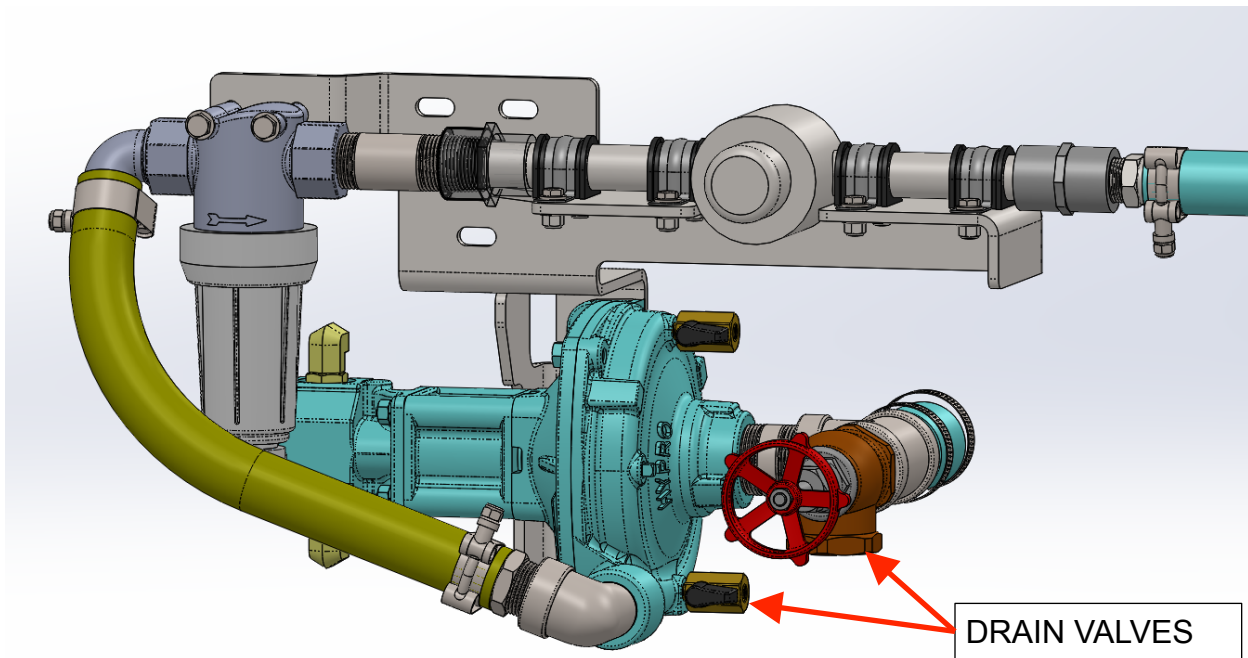
**HYDRAULIC VALVE
DISCONNECTED!**



Chapter 2 - System Subassembly Description

Water Pump Subassembly

The following is an illustration of the hydraulically driven water pump, the water filter and flow meter subassembly, which is located near the board brush, on the left side of the machine:



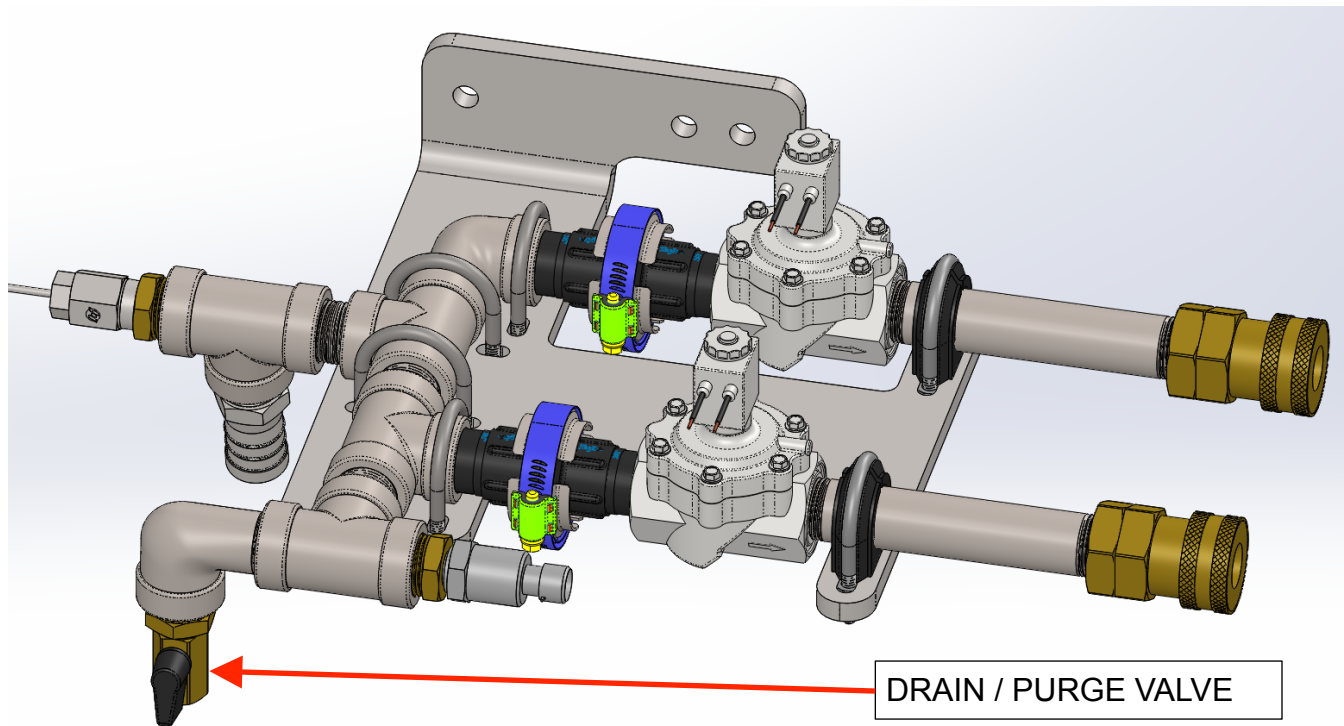
The filter contains a number 100 mesh, and features a removable cap at the bottom that allows for some amount of element flushing while the system is running and the cap is removed. If the water tank is filled partially or fully when the cap is removed, it is possible that the flow rate from that alone will be sufficient to flush the filter element without running the water pump.

The bronze gate valve shown in the illustration above allows operators who are planning to store the machine overnight in freezing ambient conditions to completely and efficiently drain the Ice Making Water tank.

The lower-most ball valve in the pump housing allows the pump housing to be fully drained, thereby preventing against pump damage due to freezing and expanding water.

Water Valve Manifold Assembly

The following is an illustration of the water control valve assembly, which is located under the operator's feet, under the brake master cylinder:



This subassembly contains the water control valves, the water pressure sensor, the water temperature sensor, and an air purge valve.

The air purge valve should also be used to completely drain the valve manifold assembly in cases where the machine will be stored in freezing conditions.

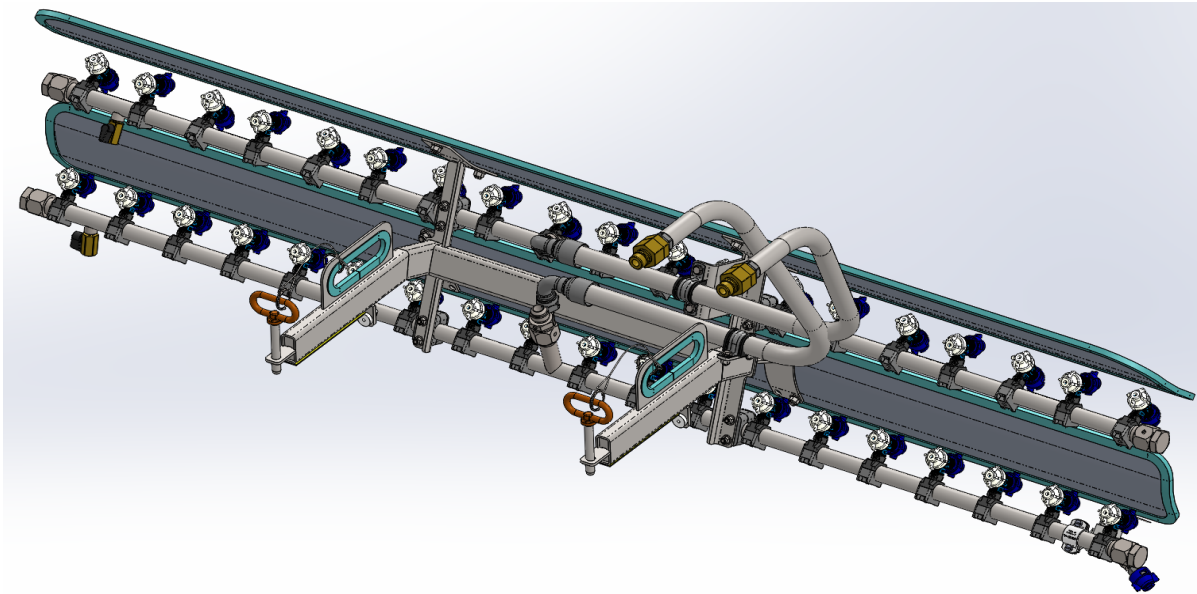
The water valve subassembly features a flange connection that allows for ease of servicing the inlet filter element in the event that it become clogged with debris.

Regarding the water control valves, it is worth noting that the control signals sent to the water control valves have a distinct operating characteristic:

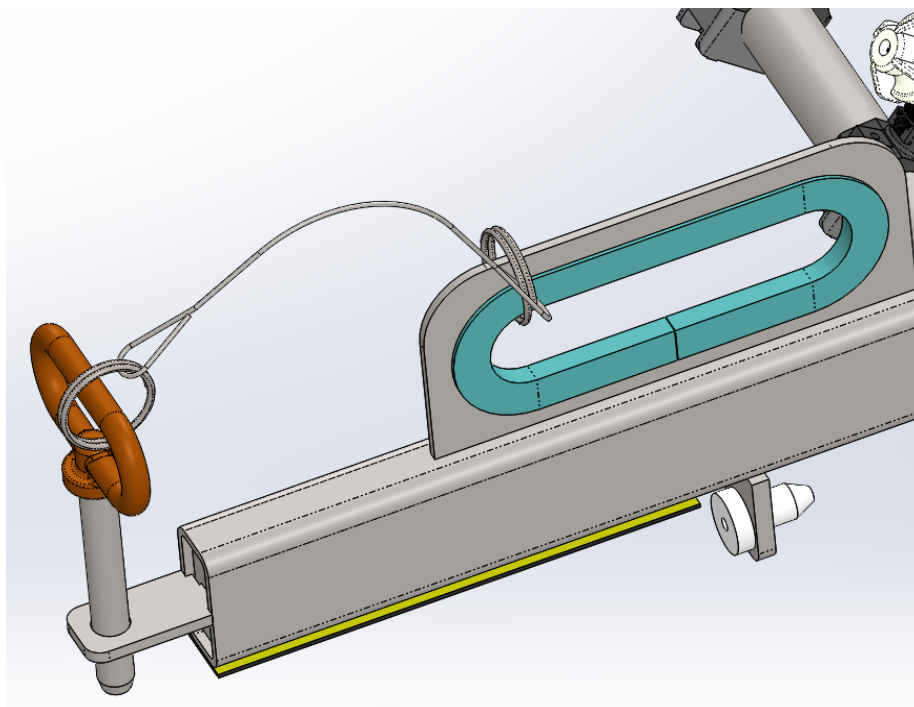
- For the sake of energy conservation, the water valves are controlled using a method known as a “digital hot-shot”. In this control method, the current required to open the valve is applied for ½ of 1 second, and after this 1 second period, the current is reduced to an amount that is sufficient to keep the valve open. This method of controlling the valves reduces the overall energy requirements of the system.

Spray Boom Subassembly

The spray boom subassembly is secured to the conditioner by 2 receiver brackets that are mounted inside the conditioner. The entire spray boom subassembly can be removed by 1 technician by disconnecting the (2) quick disconnect couplings for the water hoses, disconnecting the connector for the board spray valve, and pulling the (2) orange handle pull pins that are secured to the spray boom support structure with clip rings:



Here is a closer illustration of the pull-pins:



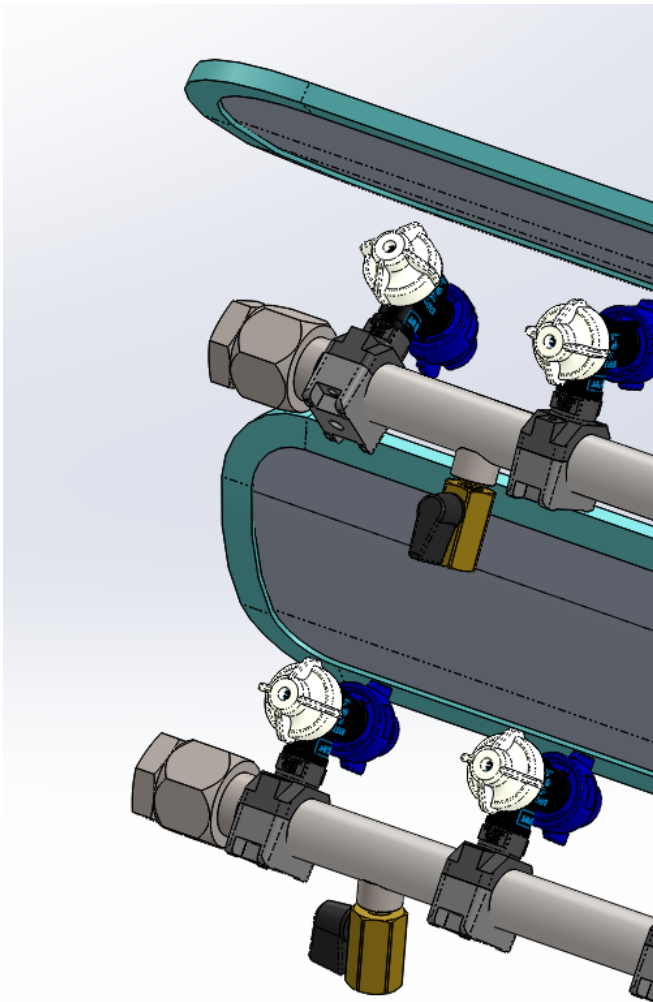
FASTICE™ Operating Manual

The removal procedure takes less than 30 seconds.

This quick removal and installation feature of the FastICE system allows the spray boom subassembly to be removed for standard maintenance items, such as changing the blade.

Both the Upper and the Lower spray boom feature a drain valve that allows for efficient air purging when a system is being started for the first time, or being started after being fully drained.

Likewise, these valves allow a fully filled spray boom to be drained for overnight storage in cold environments:



Chapter 3 – Operating Procedures: Standard Ice Resurfacing

The following provides direction on how to use the Zamboni FastICE system to perform a standard ice resurfacing.

1. Fill the Ice Making Water tank to between 50% and 100% full. The amount of water in the tank should be determined by how much ice thickness you plan to build.
2. Turn on the machine
 - 2.a. If the machine is fuel powered, increase the engine speed to 2500 RPM
 - 2.b. If your machine is a Model 546, turn on the FastICE PTO switch before increasing the engine speed (recommended).
3. Turn on FastICE system
 - 3.a. Turn the Master Power Switch to the ON position. If the machine was turned off since the last FastICE session, then the restart process will take a little less than 30 seconds.
4. Set the blade cutting depth
 - 4.a. Drive onto the ice, lower the conditioner, and set the blade depth into the ice before turning on the spray booms.
 - 4.a.i. If the machine is battery-powered, turn on the augers
 - 4.b. Once the blade depth into the ice is set, turn on the upper and lower spray booms.
5. Adjust ice water spray scaling factor to set the target ice thickness
 - 5.a. Adjust desired spray thickness according to ice conditions.
6. Recommended resurfacing speed
 - 6.a. We recommended a speed for FastICE Sessions of 5 MPH (8 km/h). This speed should be maintained throughout the ice resurfacing session, both in the straights and in the turns.
7. Turn Upper spray boom OFF in the crease area
 - 7.a. We recommended turning off the Upper boom OFF in the goal crease area, and behind the goal line, as this will avoid putting too much water in these areas.
 - 7.b. We recommend experimenting with the system to determine which boom you prefer to turn off while going through these areas.

FASTICE™ Operating Manual

- 7.c. Note that there is an automatic setting within the SETUP screen that allows you to select which boom is turned off once your speed drops below a certain value. This feature can be helpful to operators who prefer to drive more slowly in the crease and behind the goal line, and to have the boom shutoff process be automatic.
 8. Turn the Upper and Lower spray boom switches off
 - 8.a. Turn the FastICE spray booms off once the ice resurfacing session is complete.
 9. Drain Ice Making Water Tank
 - 9.a. Drain the Ice Making Water tank at the end of the ice resurfacing session. We recommend that the tank be filled only to what will be used during the resurfacing session to guarantee that only hot water is used to make ice.

Chapter 4 – Operating Procedures: Ice Building

The following provides direction on how to use the Zamboni FastICE system to perform an Ice Building operation.

1. Fill the Ice Making Water tank to 100% full.
2. Turn Master Power Switch ON
3. Leave Conditioner Raised in the Air
 - 3.a. For best ice building results, we recommend that you leave the conditioner raised during an ice-building session.
4. Turn Ice Making Water Spray ON
 - 4.a. Turn on the Ice Making Water Flow for both the Upper and Lower Boom.
5. Set Desired Spray Thickness
 - 5.a. Adjust the spray thickness according to ice making conditions.

Note:

- For best results, and to reduce spray “drifting”, we recommend a consistent ground speed during resurfacing of 5 MPH (8 km/h).
 - Turn the boom control switches OFF when driving over applied areas to avoid uneven ice thickness resulting from multiple spray passes over the same area.
-

6. Use BLAST Switch for Leveling
 - 6.a. To apply additional spray to low areas, press the Blast button while passing over the target area.
7. Turn Ice Making Water Spray OFF
 - 7.a. Turn the spray switch to the OFF position when all areas of the ice have water applied and the resurfacing session is complete.
8. Drain Ice Making Water Tank
 - 8.a. To ensure that only hot water is used for ice making, we recommend that the ice making water tank be emptied follow each ice resurfacing session.

Chapter 5 – Recommended Regular System Maintenance

We recommend that the system be operated in Test Mode at least once per week, to check for proper spray nozzle atomization, correct overall spray pattern, and for any fault code activations. For reference, the following is a reference for using Test Mode to verify correct system operation:

Test Speed:	8 km/hr (5 MPH)
Flow Rate (both spray booms on):	54 L/min (14.3 GPM)
Spray Pressure:	138 kPa (20 PSI)
Scaling Factor:	100%

The water filter should be purged using the removable cap once per week, and the filter element should be inspected for debris once every 2 weeks.

Also, we recommend that the Ice Making Water tank be fully drained and rinsed out once every 2 weeks to ensure proper system performance.

Chapter 6 - System Troubleshooting

The Zamboni FastICE system features ability for self-diagnosis in the event that it is not performing as expected.

If a fault condition is activated, the fault can be cleared by cycling the main power switch on the side of the display enclosure off and then on again. Since the system was already fully booted up when the power was turned off, the system will immediately turn back on when the power switch is turned back to the “on” position.

System Faults, Fault Codes and Self-diagnostic Capabilities:

Fault Pop-up	Cause	Remedy
Upper Boom Valve Fault	<ol style="list-style-type: none"> Solenoid coil for the valve that controls water flow to the upper boom is not connected Wiring to upper boom valve is damaged or severed Solenoid coil on the valve exposed to over-voltage / over-current and is damaged 	<ol style="list-style-type: none"> Verify that valve electrical connector is connected properly Inspect valve electrical connector for damage Inspect valve wiring for damage Inspect valve solenoid coil for damage Verify valve solenoid coil resistance to be 22.0 Ohms
Lower Boom Valve Fault	<ol style="list-style-type: none"> Solenoid coil for the valve that controls water flow to the upper boom is not connected Wiring to upper boom valve is damaged or severed Solenoid coil on the valve exposed to over-voltage / over-current and is damaged 	<ol style="list-style-type: none"> Verify that valve electrical connector is connected properly Inspect valve electrical connector for damage Inspect valve wiring for damage Inspect valve solenoid coil for damage Verify valve solenoid coil resistance to be 22.0 Ohms

FASTICE™ Operating Manual

Fault Pop-up	Cause	Remedy
Board Spray Valve Fault	<ol style="list-style-type: none"> 1. Solenoid coil for the valve that controls water flow to the upper boom is not connected 2. Wiring to upper boom valve is damaged or severed 3. Solenoid coil on the valve exposed to over-voltage / over-current and is damaged 	<ol style="list-style-type: none"> 1. Verify that valve electrical connector is connected properly 2. Inspect valve electrical connector for damage 3. Inspect valve wiring for damage 4. Inspect valve solenoid coil for damage 5. Verify valve solenoid coil resistance to be 14.7 Ohms
Hydraulic Valve Fault	<ol style="list-style-type: none"> 1. Solenoid coil for the valve that controls water flow to the upper boom is not connected 2. Wiring to upper boom valve is damaged or severed 3. Solenoid coil on the valve exposed to over-voltage / over-current and is damaged 	<ol style="list-style-type: none"> 1. Verify that valve electrical connector is connected properly 2. Inspect valve electrical connector for damage 3. Inspect valve wiring for damage 4. Inspect valve solenoid coil for damage 5. Verify valve solenoid coil resistance to be 4.5 Ohms

Operating Manual

Fault Pop-up	Cause	Remedy
Water Pressure High	Water pressure exceeds high pressure alarm limit at operating point for at least 10 seconds	<ol style="list-style-type: none"> 1. Determine whether the Upper or Lower boom is activating the fault; operate each boom in Test Mode independently for 12-15 seconds and note which boom produces the fault; focus troubleshooting efforts on only the boom that produces the fault 2. Spray nozzles are clogged; turn off machine and clean out each spray nozzle individually 3. Water valve filter screens are clogged; turn off machine, remove each water valve and clean out filter screen 4. Water flow meter is damaged or contaminated; turn off machine, disconnect flow meter electrical connector, pull flow meter retaining pin, remove and inspect flow sensing element
Water Pressure Low	Water pressure exceeds low pressure limit at operating point for at least 10 seconds	<ol style="list-style-type: none"> 1. Spray nozzles are worn and require replacement 2. Spray nozzles are broken and require replacement 3. Leak in water system between flow meter and spray nozzles
Water Flow High	Water flow is higher than the target operating point flow by the alarm limit for at least 10 seconds	Spray nozzles are broken or missing
Water Flow and Pressure Low	Water flow and pressure are lower than the target operating point by the alarm limit for at least 10 seconds, but the spray pressure is within range	

FASTICE™ Operating Manual

Fault Pop-up	Cause	Remedy
Water Level Sensor Disconnected	The system detects that the water level sensor is disconnected. The decision period for this is 2 seconds, and is shorter than other decision periods to avoid potential damage to the water pump.	

*Any of the system faults in the above table will result in the display of a fault code on the display and the water valves turning off

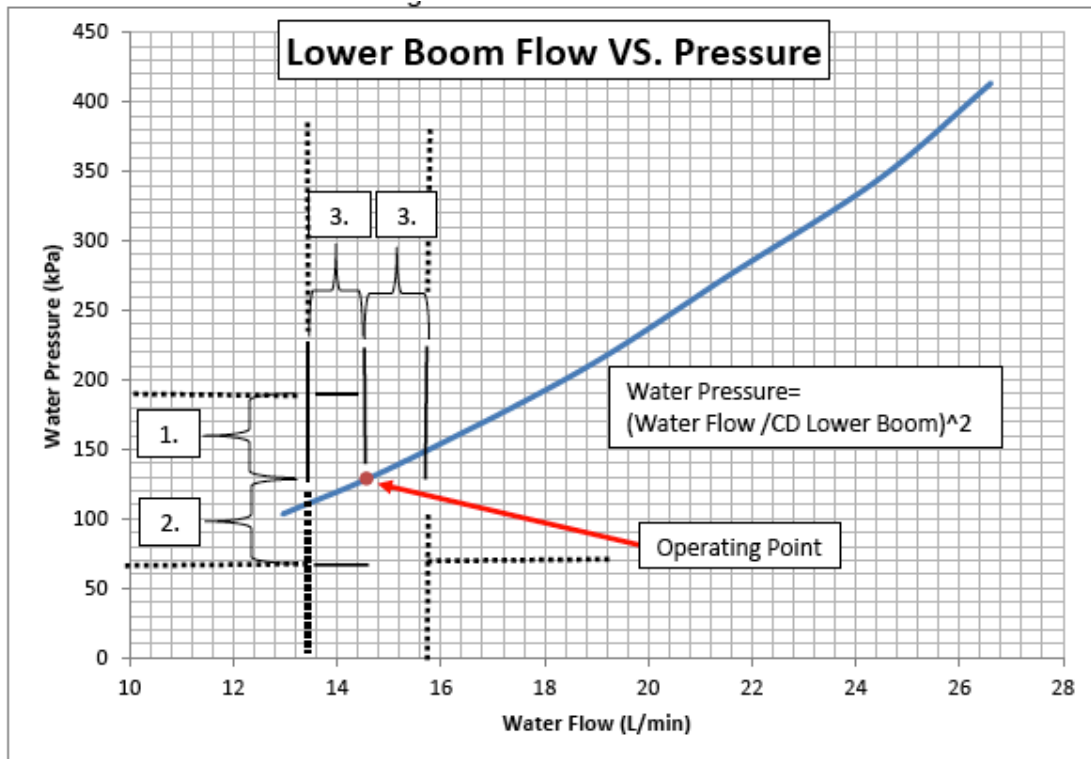
The water pump will not start unless the control system detects a water level in the tank greater than 0%.

The ability for self-diagnosis is not comprehensive, so some failures may require proper troubleshooting practices, such as “divide and conquer”, “ruling out”, and “elimination”.

Water flow and pressure fault criteria reference diagrams

The following provides some graphical illustration for the criteria that the control system uses to determine whether or not the water side of the system is performing in a sub-standard manner.

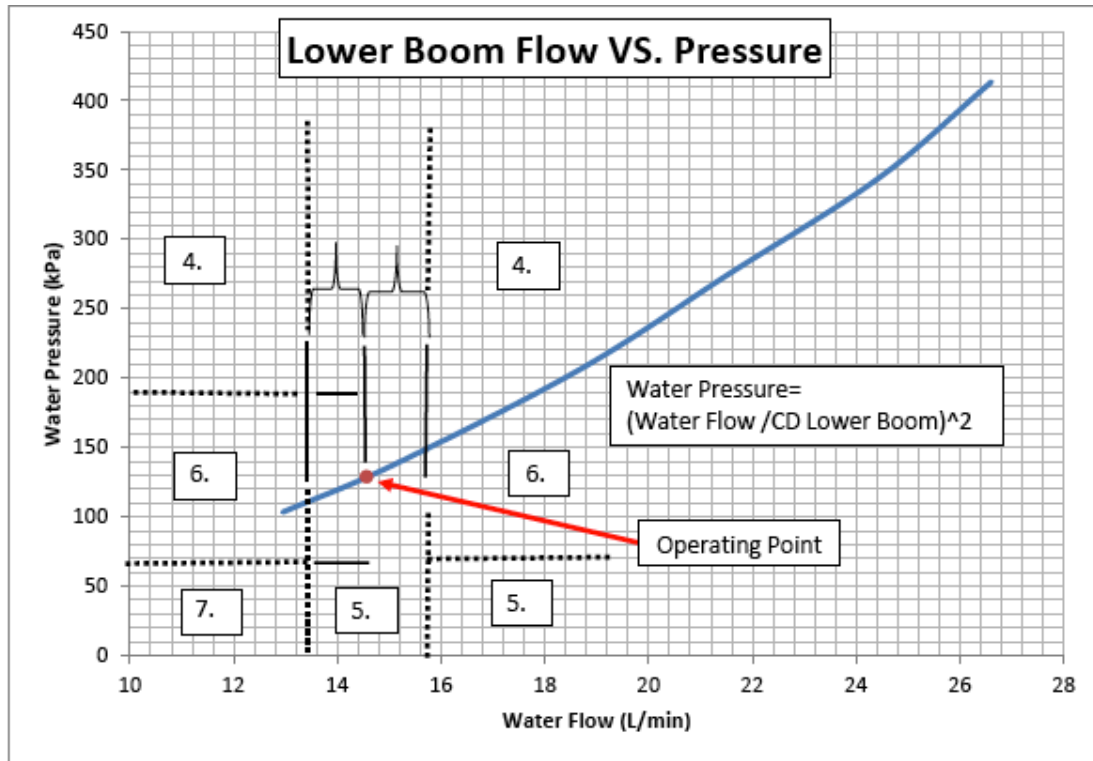
Lower Boom ONLY Alarm Limit Diagram



1. Water Pressure High Alarm Limit
2. Water Pressure Low Alarm Limit
3. Water Flow Low or High Alarm Limit

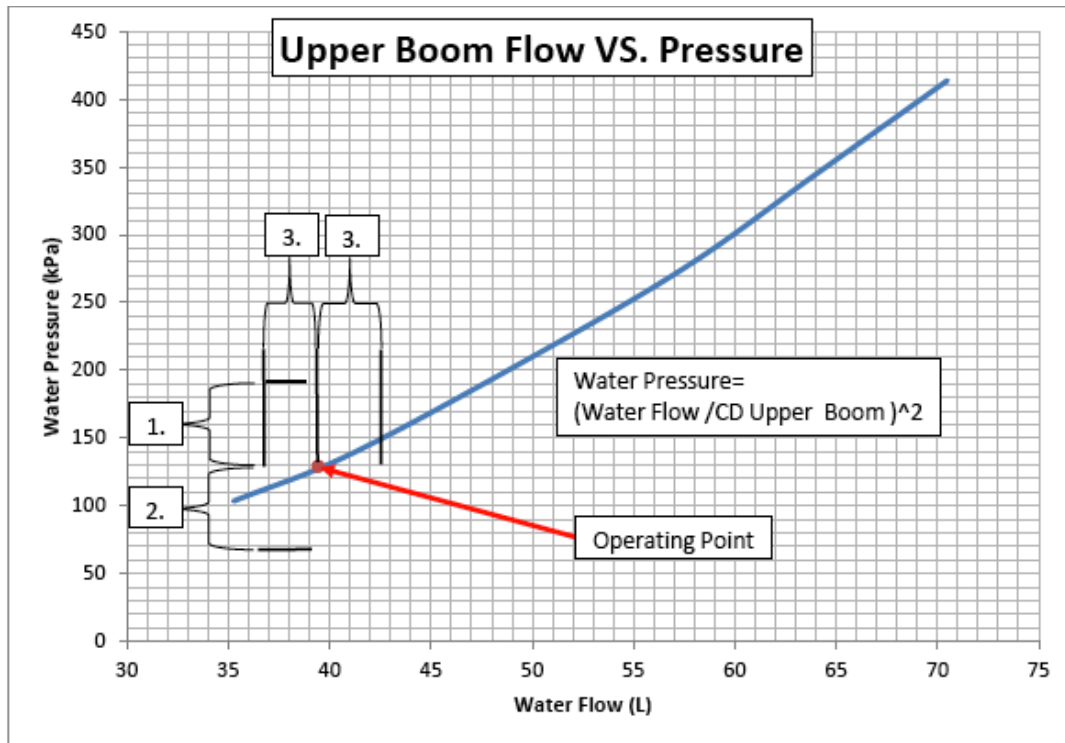
Operating Region Identification Diagram

(using the lower boom flow curve as the example)



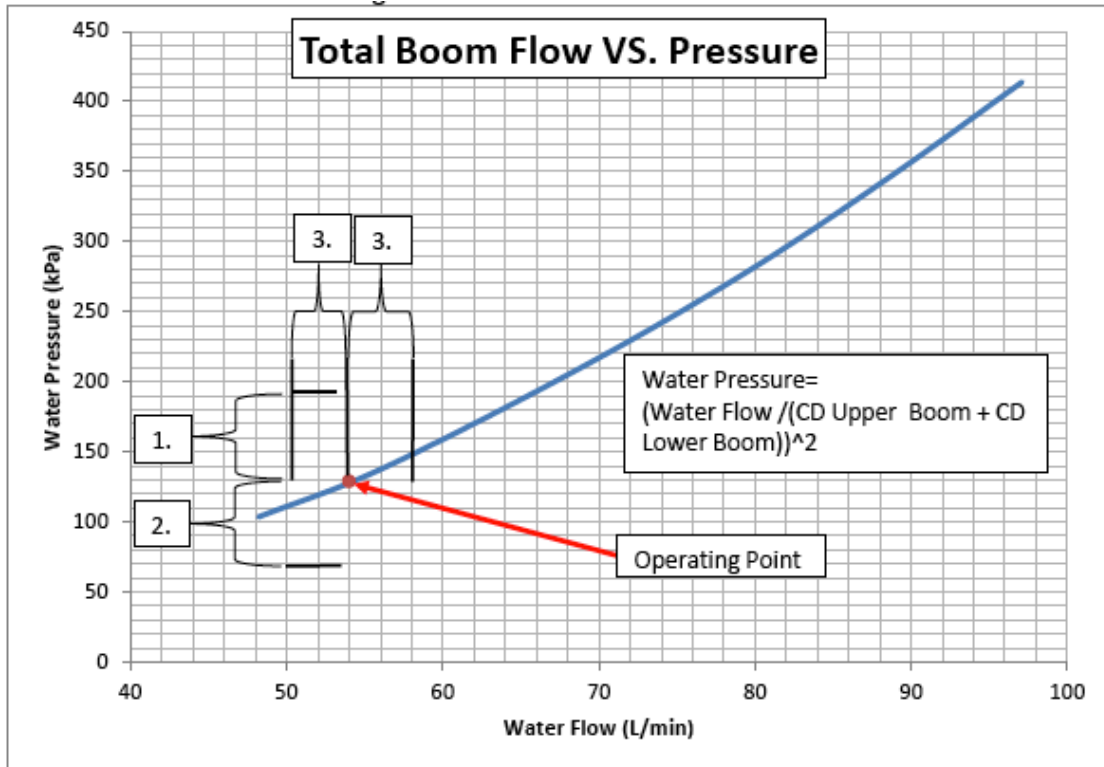
- 4. Water Pressure High operating region
- 5. Water Pressure Low operating region
- 6. Water Flow Low or High operating region
- 7. Water Flow and Pressure Low

Upper Boom ONLY Alarm Limit Diagram



1. Water Pressure High Alarm Limit
2. Water Pressure Low Alarm Limit
3. Water Flow Low or High Alarm Limit

Both Booms ON Alarm Limit Diagram



1. Water Pressure High Alarm Limit
2. Water Pressure Low Alarm Limit
3. Water Flow Low or High Alarm Limit

FASTICE™ Operating Manual

Revisions

Revision	Date	Revision Description
0	31/7/2018	Initial production release