The following information is created as an addition to the O.R.F.A./STAR Ice Making and Painting Technologies (IMPT) training course materials. Although there may seem to be a lack of information in some sections, it is important to note that much of the specific science and technological detail in creating a great sheet of ice is contained within the IMPT training modules. The O.R.F.A./STAR Alliance do not consider themselves experts in the field of curling ice – this document is created as an introductory resource for skating ice technicians to the curling ice environment. Please feel free to contact either O.R.F.A. or STAR for more information on IMPT training opportunities.

**The Skating/Curling Ice Technician**

Hockey players/skaters can usually adjust to changing ice conditions – usually four terms are used to describe skating ice – fast, slow or hard, soft. Curlers will use any combination of the following terms to describe their ice – flat, tricky, greasy, slow, fast, keen, frosty, sticky, swingy, straight, good, bad or terrible!

Conditions are usually determined by sending a rock down the ice and timing its progress between the two “hog lines”.

<table>
<thead>
<tr>
<th>Speed of Rock from Hog Line to Hog Line</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 seconds</td>
<td>Heavy, sticky</td>
</tr>
<tr>
<td>24-25 seconds</td>
<td>Keen</td>
</tr>
<tr>
<td>27-28 seconds</td>
<td>Super Keen</td>
</tr>
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</table>

**Considering a Dual Sheet of Ice**

An ice technician’s ability is one consideration – having the right “curling” equipment on site to perform the required tasks is the second most important element.

**Pre-Season Equipment and Inventory Checklist**

- Backpack sprayer
- Curling lines – tape or wool
- Hacks
- Curling ice scraper
- Pebbling can – both left and right handed cans should be considered - with special spray heads
- Curling stones
- Mechanical boot brush
- Clean mop and bucket for maintaining around hack areas
- Special 6-ft ice mop to pick up dirt between games – these must be kept clean and dry at all times – bring them out of the ice surface area and vacuum them regularly
Hockey and Curling Ice on the Same Sheet

- Ice “nipper” – a device that knocks the tips of the pebble
- A sharp hand scraper
- Flood stick
- Flood pipe

Curling Stones/Rocks
The curling rocks will be a large investment. Before moving forward in the offering of “curling” an investigation in to the cost of curling stones should be conducted. Once the cost and availability of curling stones are confirmed – on-site storage of these items must be considered. Most hockey rinks lack storage space. Having the curling stones secured between uses is a must!

Curling Stone Storage Tips
- Weight 20-kilos or 40-lbs – “junior rocks” are available for youth and senior programs
- Curling stones are unique and expensive – treat them with respect at all times!
- Two primary areas to be protected – the “striking band” and the “running surface”
- If a stone becomes frozen to the ice surface – do not bang it loose, apply a small amount of warm water to the area – best to store the stones on a piece of snow fence on the ice until they have cooled.
- The stone must be stored in a cool area or be allowed to cool down for up to 72-hours prior to use – the core of the stone will remain warm well after the outside of the stone feels cool – throw a rock prior to planned play – if it stops ½ way its probably still too warm
- It is best to store the stones on a piece of “clean” carpet – rubber has a tendency to trap dirt
- Maintaining the ice is vital to the game and the rocks – the faster the ice the more opportunity for “rock damage”

The Curling Ice Sheet
The primary difference between a curling facility and hockey rink is the height of the boards. The game of curling originated on outdoor ice – usually on a natural pond or lake. A sand or concrete refrigerated floor can be used to offer curling. The preferred floor system is sand. This is due to the fact that sand floors have less of an insulation factor when compared to a concrete floor. Less insulating value allows for quicker adjustments to the ice surface by adjusting the refrigeration system. For this discussion we will primarily focus on a typical community rink which is mechanically supported with a refrigeration system; with a concrete pad.

Tips
- Dirt must be stopped at the curling rink ice surface door – no street shoes; warm street shoes will hold dirt, when they cool on the curling ice the dirt will drop off; a mechanical boot brush is a must – salt in the parking lot will get tracked onto the ice if not controlled – both dirt and salt will affect the game and damage the rocks
- The surface needs to be as “level as possible” – dry scraping the hockey surface prior to starting the set-up for a curling event is recommended
- New ice resurfacing equipment allows an ice technician to “laser level” the surface – not having access to this type of technology requires the ice technician to clearly understand the dips and raises in their surface and to be able to compensate for same
- Levelness + temperature controls = consistent curling ice

Water
Found as a liquid, solid or a gas – it is always changing! When a sheet of water is frozen, it should be hard, allowing water applications to freeze quickly, leaving little snow development during the harshest use. Both ground sourced and municipally treated waters can contain dissolved minerals, organic matter or the ultimate enemy of ice, “air.” Ice quality will differ in all parts of North America, depending on the water source. Applying “hard” water or “soft”
Hockey and Curling Ice on the Same Sheet

Water will create two completely different styles of ice, which will perform differently under all conditions. By understanding the properties of water, the icemaker will be adequately prepared to clarify user concerns on ice consistency.

For good ice making, there are three general types of water contamination that must be considered:

- Organic matter
- Dissolved minerals
- Air

Rainwater will provide a hard durable sheet of ice whereas surface or well waters produce entirely different sheets of ice, due to mineral content. The actual kind of mineral content is vital to ice performance. Water is one of the few liquids that are lighter as a solid than as a liquid. This is due to a slight reduction in the degree of hydrogen bonding which holds its molecules together. Any further reduction in this bonding will degrade the ice. Highly mineralized water or some free alkalinity will contribute to this and coupled with a “salting out” effect will create a lower density or “slower” ice.

When raw water is freshly applied during the resurfacing process, the heat flow travels from the top down. The opposite transpires during an “outdoor” freezing which allows the mineral content to always stay in the liquid phase. During the ice resurfacing process, the film on the surface is the last to freeze, thus trapping the entire mineral content directly at the top of the air/ice surface. The effect is a lack of hydrogen bonding and in extreme instances; the dispersion of mineral salts is so concentrated that sometimes a white powder forms. As the season progresses the skating surface becomes more alkaline and its freezing point will continue to drop. High pH levels cause a freezing rate to slow, which in turn creates a poor ice surface. “Alkaline results in poor ice”...the higher the sodium content the more evident this becomes.

Tips
- Less than 100 ppm of all solids in the water content
- Less than 5-grains of hardness
- To determine the hardness of the water take the ppm and divided it by 17.1 to determine the “total grains of hardness”

- Anything above 5 in this calculation requires water treatment to make good ice

Water Treatment Systems
A ph level below 7.0 is strongly recommended for a quality ice surface. Water treatment methods are well standardized and each has its own advantages if it is properly used for the intended application in question. It is highly recommended that competent experienced suppliers be sought prior to any purchases being made. Decisions of purchase should be based on proven industry related testimonials with consideration to chemical costs, annual maintenance fees and return on investment through energy conservation calculations. Being an informed consumer is the best approach to any capital investment.

Tips
- As recommended in the IMPT training materials ice is best built up using small amounts of applied water – this allows for less to trapped during the freezing process
- Also, if untreated water is being used ongoing scrapes should be conducted to remove the impurities that will naturally float to the top

Expansion of Water During the Freezing Process
Water will expand approximately 9% during the freezing process. The more water that is applied at one time, the more it will expand. For the duration of the ice building process the high areas will become low and the low areas high – reversing each time a flood is applied until a level is achieved. Once level seems to have
been obtained several additional floods should be applied.

**Tips**
- Dry scrap the ice – if you feel or see “pock marks” you are trapping air during the ice making process
- Curling ice makers aim for:
  - A an ice surface temperature of 23-24.5F
  - A secondary refrigerant temperature difference of 3-4 degrees of the ice surface temperature
  - A dew point of 45-55F
  - An air ice interface of 39F
  - Humidity of 55-60%

**Flood Stick/ Pipe**
Curling ice technicians use a “flood stick” that applies water smoothly and evenly. The “stick” is designed to allow water to released smoothly and evenly – water should not rush out of the stick, it should “fallout quite gently”, while delivering an equal amount of water to the surface.

The “flood pipe” is called this because it is actual designed to look like a “smoking pipe”. It is designed to provide a mass amount of water a few inches above the ice surface.

The speed of which water is applied from both of these tools is referred to as a “slow walking speed – while walking in as straight as line as possible – from one side of the sheet to the other.

These tools and techniques may be considered as part of a hockey/curling ice technician’s tool kit.

**The “Hack”**
A “hack” is located at the end of each curling sheet. They are set in the ice as starting point for the curler to hurl the stone down the ice sheet. This document will discuss “removable hacks” as they will be installed and removed during each transformation. A variety of “curling hacks” are available. They can be purchased or built on site. Common construction methods include; wood with a rubber cup attached or aluminium with a rubber cup attached. The best selection is the aluminium system as they are durable and quick freezing.

The hack is 18-inches in length and usually has pins that protrude from the bottom of the plate to allow them to be secured to the ice surface. By “pre-drilling” the ice to allow ease of insertion of these pins an ice technician will be able to quickly set the hack in place and freeze it with some warm water. To remove the hack, merely add more warm water to the aluminium plate and carefully pry it off the ice.

The hack area will attract dirt and as such requires regular cleaning so that this material does not migrate onto the playing surface affecting the game.

**Ice Marking Layout**
As previously indicated – curling is an old sport. Measurements were originally defined in feet and inches – metric equivalencies will be shown along side of the imperial measurements.

It is important to recognize that some curling measurements are taken from a painted edge while others are from a centre point.

A skating ice technician is encouraged to identify and permanently identify key sport marking measurement points on the dasherboard or ice surface. Adding permanent focal points for
curling should be given consideration once a dual surface ice technician feels comfortable with their knowledge base.

Icemakers must obtain current league requirements and are encouraged to regularly update the rulebook and ice chart.

**Significant Curling Event Ice Layout**

Whether it is a dual ice sheet that is to be used all year long or a special curling event that may last a few days or weeks the layout of the area remains the same however, preparation and installation may slightly vary.

Hockey rinks that are used for significant curling events would not require permanent layout markings. The process of transforming a hockey skating rink to a curling venue would begin with a scanning of the ice sheet for ice and low spots. It is acceptable to mark out these areas with a magic marker for the ice resurfacer driver. Placing a large “H” or “L” in the high and low areas will help the ice resurfacer driver level the ice surface. A planned ice maintenance pattern should be conducted with the goal of removing skating grooves and ice leveling guiding the process. Any large holes should be repaired by packing them with slush and allowing them to freeze.

The ice technician will need to scrape out the curling markings after play has concluded so there should be an adequate amount ice protecting existing ice markings prior to starting the curling rink installation. The ice technician should pre-mix white ice paint in a 20-lt pail. Once dissolved this mixture would be transferred to a backpack sprayer to allow for the whitening of existing ice markings. Once the white ice paint is complete, white ice paint should be applied as per the manufacturer’s directions to the entire surface. Once the surface is painted white the layout process may begin. Markings are usually identified with a magic marker.

**Note:** Curling paint that is scraped out must be disposed of in an environmentally friendly manner. Please see the O.R.F.A.’s Potential Environmental Impact from Ontario’s Recreation Facilities document for further guidance on this issue.

**Dual Surface that is to be in all Year**

A sheet of skating ice with curling markings and logos must be carefully considered prior to undertaking the painting of the surface. Adding 4 or 5 12ft curling rings as well as logos will make for a crowded sheet of ice. To avoid confusion; skating leagues should be advised in advance of their arrival at the rink that curling markings are to be added to the ice sheet. The final product should not overpower anyone sport. Review the logo installation information in the IMPT course materials to be sure that you are installing any logos correctly.

The ice pad area will be prepared as discussed in the IMPT course materials. The application of a whiting product is strongly recommended if curling is to take place on a traditional hockey sheet. The hockey markings are not to be adjusted in any manner. They need to be installed as recommended by local leagues.

Paint the hockey markings and then protect these markings by applying a few light sprays of water. This barrier provides protection from mistakes when installing the curling markings. Should paint be split or markings needed to be moved an ice technician will avoid the necessity of correcting both sets of sport ice markings.

Once the curling markings are in place they too should be protected with several light sprays of water. Any logos being installed should then be measured and placed in the ice. Once this has been completed they too should be frozen in with several light sprays of water. Ice building should then be conducted by the ice crew.

**Curling Markings/Layout**

A standard community rink is approximately 85-feet wide and 185-feet long. A curling sheet can
Hockey and Curling Ice on the Same Sheet

be 14ft 6in to 15ft 7in in width and 144-150-feet long. In this area it is possible to install 5 sheets of curling ice however a 4-sheet installation is a more feasible system.

It is important to note that hockey rink layouts are rarely perfect. Ensuring that the curling sheet is straight will begin with the identification of "centre ice". The traditional hockey face-off dot may not be installed exactly at centre ice nor, should it be expected that the dasherboards are perfectly straight.

1. Markings will be applied using paint, tape or wool - following the supplier's recommendations on how and when to install ice ribbon will ensure installation success.
2. Two (2) 12-foot circles known as the "house" will be installed at each end of the curling sheet – usually paint is used to identify this area however, there are plastic, fibre and paper materials available.
3. These circles will be broken down to a 12-foot ring, 8-foot ring, 4-foot ring and "the button" 1ft. – a horse hair curling brush can speed the process of painting these areas.
4. Rings can be hand scribed by using a board with screws projecting through the board at the identified ring sizes
5. More advanced curling ice makers will use a series of electric rotors to scribe the rings in the ice.
   a. Note: Both scribing methods will leave snow and ice chips on the surface – these will make the work area very slippery. They should be continually swept-up using a good clean corn broom
6. It is acceptable to raise the ice temperature to 25-26 degrees F to soften the ice for scribing in the house rinks to avoid chipping. It should then be reduced to 20-degrees F to paint the house rings.
7. The playing area is broken down into five (5) distinct zones – all measurements are taken from the centre of the sheet – known as the "centre line".
   a. Hogline 36ft
   b. Teeline 57ft
   c. Backline 63ft
   d. Footline 69ft
   e. Backboard 75ft
8. The centre of the "house is the measurement taken from the centre of the "centre line" to the "teeline"
9. An area is often defined at the back of the sheet to hold the curling stones.
10. Once all markings are in place they should be “freeze in” using light sprays of water.

Note: See curling play area layout at the end of this document.

Pebbling a Curling Surface
Pebbling technique, equipment and application are paramount to the game of curling. What is
“pebble”? The pebble is droplets of water that freeze to the surface thus reducing the friction between the rock and the ice. It is also the element that allows the rock to curl. Using the right equipment, procedure and water will help ensure the “pebble” will withstand an entire game of curling.

**Tips**

- Know your pebble heads – there are several different types of pebble heads available – copper is the proffered pebble head material
  - Extra fine
  - Fine
  - Medium
  - Large
  - Course
  - XF/Fine combination

Each will provide a different amount of water
- A back pack system is the best
- Control the pebbling equipment water flow – the flow from the tank to the pebble head is gravity feed – merely lift the head above your shoulder to stop the flow of water
  - The gravity feed will force the water to spray upwards – a good pebble lift of 30-40cm high before it falls toward the ice works best
  - Water temperature of 145F is best for creating a pebble
- The pebble water is should be pure, clean and at the right temperature – some rinks have a specific water supply for their pebbling tank
- If tap water is to be used a filtering system should be considered – a silk stocking may help remove some of the impurities or a residential water purification system may be considered for the small amount of pebble water that is required – avoid salt type purification systems
- 20-litres of water will usually pebble – 4 curling sheets
- The temperature and humidity in the building will affect the final pebble creation

**Pebbling Technique**
The goal is to apply an even amount of water droplets to the entire curling surface – with no over lap or built-up areas occurring. An ice technician should practice their technique to ensure they have captured the required process.

**Tips**

- The pebble head should always point upwards when pebbling
- The head must be level to allow an equal amount of water to be released at the same time
- Aim the pebble head upwards and slightly angled away from your body
- The pebble head is moved side to side at a reasonable pace – be sure that the head does not go higher on any one side
- 17-18 swings every 10-seconds will give a good pebble
- Travel from one end of the ice to the other is a constant pace – always walk backwards – take a break between ice sheets so that you can be sure to maintain the same pace throughout the process
- It is standard practice to protect the hacks when pebbling.

**Nipping Curling Ice**
To help ensure that all pebble heights are the same before play a curling ice technician might consider nipping the tops of the pebble.

12 curling stones are corralled in a rack with a handle and moved up and down the ice – this knocks off the tops of the pebble allowing the curling game to be consistent from start to finish.

**Skating Ice to Curling Ice**
Changing the ice sheet from a skating to curling will take a detailed planned approach. We have discussed the need for a level sheet as well as a piece of ice with little impurities and air trapped in it. Changing from skating to curling will take the following steps.

1. Provide adequate time and staff for the task at hand – 6-hours should be scheduled to change from skating to curling ice
2. Know your ice layout – use a laser level to identify high and low spots and take corrective action to level the surface a. A skating ice technician should continually make an effort to keep the ice as level as possible
b. throughout the week – this will lessen the time required to perform the transition
3. Correct all ice damage by slushing in larger holes in the ice and allowing them to freeze
4. Edge the boards – the edge of the ice will naturally build throughout each resurfacing and as such must be maintained
5. Perform a “feather edging” along the dasherboards to collect the edging snow as well as leveling the ice along this area
6. It is recommended that an ice technician then perform a series of ice maintenance patterns with the ice resurfacer. Two (2) loads of ice shavings should be removed – this will help eliminate ice impurities and ice leveling.
7. Two floods of hot water from the ice resurfacer should then be dropped onto the surface to help build the ice.
8. Put the curling stones on the ice in the corner of the rink to start to draw down their core temperature.
9. Scraping with a curling “Ice King” styled piece of equipment may now be considered. Hand scrapers are labour intensive but an economical solution to this requirement.
10. Install the “hacks”
11. Depending if adequate time has been scheduled or the caliber of competition a flooding with a curling flood stick/pipe may be considered.
12. A pebble then should be applied.
13. Ice should be cleaned after every game with an 8’ sheepskin dust mop to remove any dust, dirt, and straw or brush hair, which may have found its way onto the surface.
14. A fresh pebble should be then re-applied to the surface.

Conclusion
The game of curling can be an exciting sport to watch and participate in – just how exciting is left to the skill of the behind the scenes workers. Preparation, equipment and knowledge are all important elements of ensuring the game of curling is enjoyed by all!

Contact your local curling Association to discover other curling ice professional development opportunities.

Resources:
Teo Frans – Master Curling Ice Technician
Dave Loverock – Jet Ice Ltd.
Curl Ontario
The Town of Petawawa, Ontario Canada
Curling Ice Explained – WCF
O.R.F.A. IMPT Materials
O.R.F.A. Arena Committee - 2007
Terry Piche – O.R.F.A. Technical Director

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