Chapter Four:

OPERATING GROOMING EQUIPMENT

As noted in Chapter Two, there are a very broad range of types and styles of grooming tractors, drags, and implements. Each has its own operating procedures and requirements, so it is important to become familiar with the peculiarities of all equipment by reading the equipment operating manual(s). The following tips provide valuable guidance for operators that should be followed, in addition to equipment specific guidelines and instructions provided by the manufacturer of the equipment.

General Operating Guidelines

How Much Snow is Required to Start Grooming Operations?

The amount of snow depth required to begin grooming operations will vary by area and is affected by the type of terrain and by the type of snow. Remember that it requires a lot more snow to safely and effectively operate a groomer than it does to operate a snowmobile. And it can be a good thing to let snowmobiles run on the snow first before you start grooming operations because it starts the de-aeration and compression process. Generally, at least 8 to 12 inches (20 to 30 centimeters) of wet snow on smooth terrain like a road is enough to begin grooming operations. However, if the snow is drier, or if the terrain is rough or uneven, at least 12 to 18 inches (30 to 45 centimeters) of snow (or more) may be required to safely begin effective grooming operations.

Best Grooming Temperatures

Generally when using a drag, grooming operations should be suspended when the temperature is below -25 degrees Fahrenheit (-32 degrees Celsius) or above +40 degrees Fahrenheit (+5 degrees Celsius) because it can cause snow to stick in the blades or build up on the packing pan enough of the time to make grooming a smooth trail impossible.

Wind and Shade Can be Beneficial for Grooming

Wind and the location or aspect of the trail to be groomed should also be considered. Wind, by blowing new snow into the trail, and overcast sky or shaded trail locations with cooler temperatures, can sometimes have a beneficial effect on grooming effectiveness.

Keep Blades Clean

It may be necessary to stop and scrape the frost or snow buildup off the blade(s) if they fail to scour (self-clean). {If this is a consistent problem, consider having the moldboard part of the blades – but not the cutting edge of the blades – covered with UHMW or a similar plastic material that will always scour and prevent frost or snow buildup.} If it appears that a good trail can no longer be produced, contact the Grooming Manager and consider shutting down until conditions improve. Night grooming can be the best way to minimize these types of effects from the weather.

Stay on the Trail!
It is essential to stay on the trail base at all times with the grooming equipment. If it is necessary to regroom a section of trail, find a place to turn around where there is ample turning room and it is known that the snow base will support the equipment. If in doubt, get out and walk to check the snow depth. If a turnaround is attempted in an area where the snow is deep and loose, there is a risk of becoming severely stuck. If possible, use areas where turnarounds have been made before.

Shut Down in Poor Visibility
There may be times when it becomes necessary to shut down on the trail because of poor visibility caused by high wind, heavy snowfall, fog, or a combination of these conditions. Simply stop the groomer right where it is and leave all lights on with the engine idling. If possible, contact the Grooming Manager or dispatcher to advise them of the situation and location. Always wait the situation out because it is easy to get off the trail in these situations which could result in trouble. Always stay with the equipment and wait for conditions to improve.

Watch for Snowmobiles
When operating grooming equipment, always watch for approaching snowmobiles. Particularly when the trail is narrow or winding, keep to the right, slow down, and, if necessary, stop when a large group is approaching. When approaching sharp or blind curves, always anticipate and plan for snowmobiles that may be approaching. Also watch for snowmobiles that overtake the groomer from behind. Again, keep to the right to allow them to pass. If the trail is narrow or winding, looks for places to safely pull off enough to allow them to pass. If necessary, stop in an area where it is safe for them to pass and signal for them to proceed.

Grooming Basics

Building Trail Base vs. Maintaining Trail Base
Anytime there is “new” snow to work with, either through new snowfall, blown in snow, or snow that is pulled in from the trail edges, grooming will build (increase) the trail’s base/depth. If “new” snow is not available, grooming will simply maintain the trail base, which is a much less desirable situation. Remember that a drag’s blades must always have snow in them to accomplish either trail building or maintenance.

Ideal Groomed Trail Width
In most areas, the ideal groomed trail width will be 1½ to 2 groomer widths (typically 12 to 18 feet or 3.7 to 5.5 meters). However, local conditions and equipment widths will dictate what this means on any given trail segment. The clearing width in some wooded areas may only accommodate a single drag width, while other trails located on improved roadways may provide as much as 60 feet (18 meters) of width. However in these situations on wide roads, do not try to groom too wide. Pick a route and stick to it to ensure that the trail base is built from the ground up. If varied routes are groomed on wide roadways, it can result in soft pockets of snow and rough trails because the same

designated trail route was not consistently compacted. By keeping the groomed route on these wide roads narrower, the middle of the road/trail can be hardened and result in a better quality trail.

Stay to the Right

Always groom on the right side of the trail with the direction of snowmobile traffic. Take the right side of the trail and stay there. Then reverse the grooming direction the next time in order to widen the trail, rather than grooming against snowmobile traffic on the wrong/left side of the trail. Never groom against traffic on a one-way trail.

Photo 4.1 Always groom on the right side of the trail

Constantly Watch Behind

Constantly watch in the rearview mirrors to monitor the finished product on the trail behind the groomer. When using a drag, this is particularly important since the drag blades can quickly empty out and go from totally full to totally empty within a few seconds or over less than 15 feet (4.5 meters) of trail. This can mean spending as much as 75% of the time monitoring more closely what is happening behind the tractor versus in front of it. Leave the tractor periodically and walk back to check the finished trail surface behind the groomer, especially at night.

Photo 4.2 Use the rearview mirrors to constantly watch behind the groomer to monitor the quality of the finished trail

Know the Trail and Anticipate

Operators must know their trail to be able to *anticipate* the need to carry extra snow, either with the front tractor blade or in the drag, as they approach areas that are bare or may be in need of additional snow to establish a good trail base. Such areas can include creek crossings, bare hill sides, windswept or sunny areas, areas of rough or rocky terrain, the crown of hills or approaches, the bottom of curves, etc. If the operator doesn't anticipate and plan ahead, it will be too late to improve the trail defect once they're at it. So when going through a dip, swale, or ditch that the drag spans or bridges, anticipate the need to lower the drag blades before getting there to gather snow. Conversely, when approaching a particularly drifted or

deep snow area, a steep hillside, a switchback, or a road crossing, anticipate the need to make upward adjustments to the blade depths (front and/or drag) in advance of the location to avoid getting in trouble by spinning out or getting stuck.

Pay Attention on Curves

Pay special attention to curve berms and try to work down the high outside edges. Be careful not to completely straddle these berms or the tractor may get high centered. A drag will not usually stay on the side of a sharp curve's snow berm. So the grooming drag must be either at the top or down in the bottom of the curve. It is often best to pull snow into the bottom of the curve with the front tractor blade and then work the new snow in the bottom of the curve with the drag or tiller.

Take the Time to Do It Right

Take the time necessary to get a smooth trail by regulating the speed of the tractor and cutting depth of the implement according to trail conditions and grooming needs. If there is a particularly rough area and a place to turn around, groom the trail a second time.

Remove Back Up Piles

Whenever it is necessary to back up on the trail, be sure to remove the pile of snow or tire ruts that backing up can often create since these piles can become extreme safety hazards for snowmobilers, particularly once they freeze. This requires either re-grooming that section of trail or removing the snow pile with a shovel.

Photo 4.3 Remove back up piles! Use SMV sign.

Think Visibility!

Grooming tractors should be operated with their warning beacon/strobe and lights on at all times to increase their visibility to snowmobilers approaching on the trail. A slow moving vehicle (SMV) sign should be displayed at the rear of all units since a groomer is nearly stationary when compared to a fast moving snowmobile.

Beware of Dirty Snow

Remember that dirty snow can deteriorate rapidly with any sunlight (solar radiation) which can affect the firmness and overall quality of the trail base. Try to pull snow from the sides of the trail to cover up dirt and to mix with the old snow on the trail. This can sometimes be done with the front blade. Oftentimes it can be accomplished by simply running the tracks of the tractor about four inches further to the right, onto the berm at the outside trail edge, which can cause "new" snow to fall onto the trail.

Don’t Leave Holes in the Trail

Never leave holes caused by being stuck, drag malfunction, or operator error in the middle of the trail since holes can be a hazard and can cause injury to unsuspecting snowmobilers.

Photo 4.4 Don’t leave holes in the trail

Cover Ice

Cover icy spots with snow if possible. Sometimes icy spots can be scored with a scarifier blade to aid in traction and steering and also to help try to process it into the snowpack.

Groom Bridges

Groom bridges! All too often operators fail to *groom* across bridges. This can lead to extremely rough and unsafe trail conditions before, across, and after bridges. Start by simply “panning” across the bridge at the beginning of the season to prevent damaging the bridge’s deck. Use the groomer to bring snow onto the bridge if needed and eventually build the trail base to a depth that can be regularly groomed.

Tips for Effective Grooming With a Drag

Remove Air from Hydraulics and Compensate for Leaks

After hooking the drag to the tractor, activate the hydraulic controls in the cab of the tractor to raise and lower the drag a few times to remove any air that may have entered the hydraulic hoses and cylinders. Inspect all connections for leaks. If there is even a slight leak, promptly fix it to prevent spilling hydraulic fluid into the snowpack and potentially harming the environment. Until the leak is fixed, remember that the loss of pressure can cause components to settle, which may require compensation by continually adjusting (raising) the drag component controlled by the leaking hydraulic.

Check for Clearance and Binding When Turning

Carefully inspect the hydraulic hoses for binding and interference as the tractor unit is turned. Check for clearance between the outside of the tracks and the outside front of the drag when the tractor unit is fully turned.

Pay Attention!

Operating trail grooming equipment is a demanding job that requires the operator’s undivided attention at all times. While it is important to be watching the trail ahead to observe changing conditions, it is almost more important to watch what the grooming drag behind is doing. Don’t simply drop the drag and forget it. Instead, it requires that the operator constantly respond and adjust to ever-changing trail and snow conditions.

Keep the Mirrors Clean and Use Them

Keep the rearview mirrors on the tractor clean in able to constantly monitor how the snow is processing in the drag blades, as well as the finished surface behind the groomer.

Get Out and Check the Trail

Get out of the tractor to occasionally to walk across the groomed surface. Check trail consistency by scuffing across the finished product with a boot. If the operator sinks, recheck groomer settings to ensure good processing and compression of the snow.

Remove the Entire Mogul

Moguls and drifts should be completely cut away from the trail's snow base. If only partial cutting occurs, the resulting uneven density can allow moguls to reform quickly. Typically, the greatest cutting depth is needed on curves and in other areas with deep moguls.

Watch the Speed

Photo 4.5 Keep processed snow inside the drag!

The effective grooming speed when using a drag is typically in the 5 to 7 miles per hour (8 to 11 kilometers per hour) range and is primarily governed by the way the snow is being processed by the drag. Too slow, and a rolling action in front of the blade will not be adequately established. Too fast, and the drag will bounce leaving a poorly groomed trail. It will also spray snow outside of the drag, wasting it. Excess speed can prevent the blades from properly cutting off the mogul and also not give snow the time it needs to fall out into a dip or hole. Slow down and take the time necessary to get a good finished product that will stand up better to traffic. Grooming too fast is a much more detrimental factor than most operators realize and can be a huge waste of grooming resources.

Slow Down When Using Wheels Kits

Use the wheel kit on the drag to cross sections of trail where bare ground is showing. Be sure to travel at a slow rate of speed since the drag frame can do a lot of twisting if on rough ground. Traveling too fast with the wheels down can cause stress fractures in the hitch assembly and frame or twist the drag frame so that it will no longer be square.

Groom at Night or When Traffic Is Low

Always try to groom when traffic volumes are at their lowest, which is typically at night. This helps allow adequate time for the trail to set up properly and can also enhance grooming and snowmobiling safety. On heavily traveled trails, this could be a window of

time as narrow as 2:00 AM to 6:00 AM on weekends. Grooming at night will generally produce the best quality trail since temperatures are typically colder which can help the snow flow better and set up harder. However, the greatest single key to effective grooming is low traffic. So if traffic is heavy, consider an alternate time to groom.

Early Season Cautions

If the grooming program has more than one drag, use an old drag for early season trail set up to avoid damage to the better equipment. Go slower than usual because of the possibility of hitting hidden hazards. Sometimes it is better to "ride the pan" or use a compactor bar in these conditions rather than try to cut much with drag blades.

Pull Snow to the Middle of Trail

If there is a lack of snow in the middle of the trail, which is often the case since that is where snowmobiles most often operate, use the front blade to pull snow in from the trail's outer edge or operate the drag on the outer edge of the trail. The outside two to three feet (0.6 to 0.9 meter) of a trail will often be softer than the middle of the trail due to the compaction that snowmobile traffic contributes in the middle of the trail.

Remove Debris from the Trail

Stop to remove significant rocks, logs, limbs, or other debris that is laying on or in the trail surface. Debris can not only be a hazard, but can also attract heat which can have a thawing effect on the surrounding snow trail surface.

Photo 4.6 Remove debris from trail.

Watch the Temperature

The best temperature for grooming with a drag is generally in the +5 to +25 degrees Fahrenheit (-15 to -4 degrees Celsius) range. Generally, wet snow grooms best at night and dry snow best during the day, ***if*** the traffic level is low. Oftentimes, early evening has the best temperatures for effective grooming.

Use Wax or Silicone Spray to Help Blades Scour

In warm weather, consider using snowplow wax or silicon spray on the drag blades to temporarily prevent the snow from sticking to the blade. Air that is significantly colder than the snow can also cause frost to form on the blades and prevent them from scouring (self-cleaning). This is a greater problem with single blade drags since the blade *must* scour for the drag to work. Multi-blade drags also have a greater tendency to self-scour. If this is a continual problem in the area, consider covering the moldboard portion of the blades with UHMW or a similar plastic covering which will prevent snow sticking to the blades. If it is either so warm or so cold that snow continually sticks to the blades and they will not scour, grooming operations should be suspended.

Don’t Dump Snow on Road Crossings or Driveways

Use care to avoid dragging or dumping snow on roads or driveways when crossing them with grooming equipment. Frozen piles of snow deposited on roads can be hazardous to motorists and cause ill will toward snowmobiling. Likewise, piles of snow deposited in driveways can strain relationships with adjacent landowners by making access to their property difficult.

Photo 4.7 Never leave piles of snow on roads

Always cross roads and driveways with care and use caution for oncoming vehicles. Wheels on a drag should always be DOWN when crossing roadways. If a pile of snow is left on the road, it may require the operator to stop and clear the road or driveway with a shovel, but they should be cautious of oncoming traffic.

Photo 4.8 Always raise the drag to cross roads

Don’t Dump Snow on Railroad Crossings or Railroad Tracks

Use care to avoid dragging or dumping snow on railroad crossings or on railroad tracks when crossing them with grooming equipment. Frozen piles of snow/ice on the tracks can derail a train and result in significant property damage. It may require the operator to stop and clear the tracks with a shovel. Always cross railroad tracks with care and use caution for approaching trains since the groomer is likely very slow moving in respect to high speed trains.

Photo 4.9 Use care to not create snow/ice buildup on railroad tracks

Don’t Set the Drag Blades Too Low on Smooth Trails

When grooming a trail with little fresh snow cover and only minimal moguling, care should be taken to not have the drag adjusted too low because it would unnecessarily process the hard-packed trail base. Cut only as deep as the bottom of the “dip” of the moguls. If the trail is relatively smooth, only cut or “skim” with the rear set of blades. Following this method can help build/increase the depth of the hard-packed trail base.

Photo 4.10 Use only the rear set of blades to groom minimally moguled trails.

Deep New Snowfall Can Mean Starting Over

Moguls under a deep new snowfall cannot usually be completely removed. Process the fresh snow and compact it so a smooth finish is established as a new base on top of the moguls. Two passes may be required to achieve sufficient processing and compression when there is extremely deep new snowfall. A longer set up time will be required.

Grooming Wet Snow

Processing wet, heavy snow is more difficult and requires more operator finesse since it has more surface tension and will not flow as well as cold, dry snow. To groom in wet conditions, adjust the drag somewhat higher than if in below freezing conditions and pick up the speed of the tractor slightly. Monitor the snow to ensure it flows freely. If the snow begins to collect in the drag, raise it high enough to clear the snow and lower it again, but make sure not to deposit a hazardous pile of snow on the trail when doing so.

Photo 4.11 Don’t leave a hazardous pile of snow in the trail when adjusting a drag

Continually Monitor the Drag Blades

Particularly when grooming trails that are relatively smooth and only lightly moguled, operators must continually adjust the drag's cutting height. This need is different for multi-blade versus single blade drags:

Multi-Blade Drags: The weight of the drag causes natural settling which forces the cutting blades deeper as the frame and side rails settle. This requires that the operator must pay attention to monitor the height and readjust the drag *upward* as needed.

Single Blade Drags: The blade must exert constant down pressure on the snow surface. When the trail is relatively smooth, this can result in the lone cutting blade being forced upward. As a result, the operator must monitor the setting and readjust the blade *downward* as needed. Additionally, when using a single blade drag the operator must understand that the typically concave shape, (, of the blade lends itself to drafting and being sucked downward, particularly when encountering a soft pocket of snow in the trail base. Beware that this can cause springs to trip and create humps in the trail.

Adjusting Blade Height

The procedure for making adjustments to the blade height varies slightly between a multi and single blade drag:

Single Blade Drag: Set the drag blade to cut or dig enough to keep the area in front of the pan full of snow, but not so much that snow is spilling out the sides of the drag and being wasted. The snow in front of the blade should be kept rolling or moving constantly. The blade depth will typically vary from ¼ inch (0.6 cm) to a maximum of about 2 inches (5 cm). A quick, short bump of the hydraulic control lever is all that is needed to raise or lower the blade ¼ inch (0.6 cm) to ½ inch (1.3 cm), which will often be sufficient. Raising the blade too much, too quickly, can leave a bump in the trail. Also remember that the single blade drag's packer pan will ride up and over whatever goes under the rear blade. So be cautious to not inadvertently create humps in the trail by raising the blade too quickly.

Multi-Blade Drag: It takes even less than a "quick, short bump" to adjust the cutting height of a multi-blade drag. Essentially all that is needed is to barely crack the hydraulic spool open, to when it just barely "squeals," to likely have all the adjustment that will be needed. Since the cutting depth of the blades are preset and stepped down from the front to rear of the drag, it requires lowering or raising the side rails only a fraction of an inch/centimeter to substantially change the cutting depth of the drag. Additionally, since the side rails keep snow contained within the drag versus allowing it to spill out the sides, it is good to keep a significant supply of snow in front of the rear spreader pan because it helps to continually build/increase trail base and will not create "humps" like a single blade will.

Spilling Snow Equals Carrying Too Much

Particularly with single blade drags, when the snow that has been built up in front of the drag blade isn't rolling or churning or is spilling out the sides, the drag is carrying too

much snow and is not working effectively. In most cases, a very slight tap of the control lever is all it takes to make a significant change in the amount of trail base the drag is cutting and will correct this situation.

Grooming Hills

Hills can create another special challenge for groomer operators. There is likely to be a lack of snow at the crest/top of the hill and an abundance of snow at the bottom. Oftentimes, the hillside may be either icy, or even bare, from snowmobiles spinning their tracks while climbing it. It may also be bare due to southern exposure to the sun. As much as anywhere, hills are an area where the operator *must* anticipate and plan ahead. Also, always keep to the right so the groomer is not a hazard.

Photo 4.12 The crest of a hill often needs snow

The drag may need to be raised as the groomer begins climbing a hill. In Photo 4.11, the tracks of the tractor have spun and dug trenches, which the drag can fall into unless it is wider than the tractor. Note that the side rails of the drag have nearly disappeared below the surface of the trail, which can result in the tractor quickly becoming stuck while trying to pull the drag uphill. Anticipate this ahead of time and adjust the drag's cutting height upward to lighten the load.

Photo 4.13 Beware of trenches dug by spinning tracks

Grooming Curves

Curves can create special challenges since there is typically low snow or no snow in the bottom of a sharp curve. At the same time, berms three to five feet (0.9 to1.5 meters) high (or more) can form on the outside edge if the curve is not regularly groomed and reformed. First, always beware that dropping too far down into the center of a sharp or blind curve can be dangerous for approaching snowmobile traffic. Therefore, never deviate over/inside the mythical centerline of the trail by more than a couple of feet so as to still allow room for an oncoming snowmobile to meet and pass the groomer in the curve. Second, if the groomer gets too high on the outside edge of the berm, it risks

becoming high centered and stuck. Use the front blade on the tractor to pull snow from the outside berm into the bottom of the curve. At the same time understand that it is difficult to "carry" much snow into the curve with a multi-blade drag because of its tendency to build trail depth versus "carrying and dumping" snow like what can be done with a single blade drag.

Photo 4.14 Sharp **c**urves typically have little snow available at the inside/bottom

One other thing to keep in mind about grooming curves is that there is only one location in a curve where there is ever "extra" snow that may be available for the drag to move into the snow-deprived bottom of the curve. That location is the outside end of the curve and, sometimes, some of it can be tapped on the next reverse direction grooming pass. This is further explained as follows: Imagine the curve as an upside down U, like this: ∩. The direction of travel and grooming is counterclockwise, on the outside/top edge of the curve, which means any "extra" snow will be deposited on this grooming pass by the drag at the *end* of the upper left corner of the ∩, where it transitions from curve to straightway. If the grooming direction is reversed on the next shift (by grooming clockwise on the trail loop), the groomer will be on the inside/bottom of the curve as it enters the curve. By moving over to the left a couple of feet/half a meter (but no more so as to not create a safety hazard!) as the groomer approaches the curve, the drag can be swung slightly into the area with the extra snow, which is slightly *before* the outside left corner of the ∩. Then, by dropping back into the bottom of the curve, the groomer can deposit any snow that was picked up with the drag into the bottom of the curve. This is a slow process, but by keeping at it, trail conditions on curves can be slowly improved.

Making a Double Pass

If there is a safe, firm place to turn around, it can be desirable to groom a "double pass" on a particularly rough, moguled area. Since this means the trail section will essentially receive three grooming repetitions during the double pass, use the following procedure to make this effort as efficient and effective as possible: On pass number one (the normal route/repetition through the section), go a little faster than normal, drop into the bottom of curves, and don't spend extra time grooming. On pass number two (the return route after the turnaround), again make it quick without a lot of extra grooming effort. On pass number three (the return/second repetition on the original rough section), really slow down, work the trail carefully, and vary the position of the groomer as needed to take advantage of windrows/berms of snow that were created by passes number one and two.

Proper Use of the Front Blade

Don't Over Use the Front Blade

When using a drag, the front blade of the grooming tractor is best used to level drifts or to pull new snow into the trail. Snow worked by the front blade is then processed, compressed, and leveled out by the drag. Operators are cautioned to not "over groom" by continually raising and lowering the front blade which can lead to accentuating dips and rolling trail surfaces. Rather, trail leveling is best accomplished by the planer effect of a drag pulled behind the tractor. When using a tiller, the front blade must perform the important process of removing moguls, so the front blade needs to be in use nearly fulltime. Still, overworking (too frequently raising and lowering) the front blade can lead to uneven trail surfaces and should be avoided. Try to use the tilt adjustment instead.

Beware of Hazards

Be extremely careful to watch for rocks and tree stumps when working with the front blade. Hitting these hazards can put a great deal of stress on the tractor, particularly on the steering mechanisms of some units. If the vehicle's blade or tracks hit something, let go of the steering wheel momentarily – this can reduce stress on critical parts by allowing some give in the steering system.

Cutting Tracks across a Side Hill

The front blade on a tractor can be used to cut a new track across deep snow on an inclined slope. The most effective method is to approach the upper steeply inclined slope transversely and to use the laterally swiveled blade to push snow, thereby creating a flat track in front of the tractor. Start by using a small amount of snow and then use more and more snow as the tractor progresses. The snow pushed downhill will broaden the track and provide greater safety.

Blade Use at Grooming Speed

While operating the tractor *at grooming speed* <u>when using a drag</u>, it is recommended to run with the bottom of the front blade set about 4 inches (10 cm) above the bottom of the tracks, not at ground level. This can allow it to be used for day-lighting out finger or pillow drifts, while at the same time keeping it a safe distance above the trail bed and away from rocks, stumps, and other hazards. Watch *behind* the front blade to monitor the blade height in relation to the bottom of the tracks. If there is a

Photo 4.15 Watch *behind* the front blade to monitor blade height relative to track location

need to use the front blade for heavy dozing or for building trail across a drifted side slope, slow down and operate with caution.

When using a tiller, it is recommended that the front blade should always have snow in it since it must cut the moguls away. The blade then feeds snow to the tiller for processing. It is important to know the trail and the snow depth. If snowfall is low or if there is uncertainty about the trail location or potential hazards, slow down and operate with caution.
To flatten low moguls or ripples, the vehicle should be driven with the front blade in what is commonly known as the “float” position. In this position, the blade is open with its own weight on the ground and hydraulic down pressure is not created.

Larger moguls should be approached at approximately half the mogul height and not in the float position so that snow falls forward into the dip behind the mogul. If possible, the cutting depth should be set using the tilt cylinder on the blade and preferably not using the up and down motion of the blade. The former method will help produce a smooth surface while an “up-down” adjustment can contribute to rough or undulating surfaces.

Using the Front Blade to Assist with Climbing

When working with fresh, deep snowfall, the front blade can be important to obtaining good weight distribution, particularly if using a tiller, as well as to obtaining good contact pressure on the snow with the grooming unit. The front blade can be used as a climbing aid when traveling up steep slopes when the operator stops just *before* the unit digs itself in. The operator then drives backwards with the blade lowered which helps smooth out the step. When starting off again with the blade raised, the driver can typically get a little further thereby helping to overcome uphill gradients that might otherwise be difficult to handle.

When descending steep slopes, the front blade may also be useful as a braking device.

Tips for Grooming With a Tiller

Preparing Fresh Snow

Fresh snow initially creates a generous crystalline microstructure that is more or less jagged. Fresh snow should be worked as gently as possible since snow crystals are destroyed if a tiller is used too aggressively, causing snow crystals to no longer bond with one another and to become slush. Fresh snow/powder snow consists of snow crystals which hang together loosely and thereby enclose a lot of air. When preparing this type of snow, part of the air is driven out and the crystals are pressed closer together, which gives the snow a load bearing coating.

Processing Moguls

Moguls are sometimes formed as snow crystals melt as a result of water film formation occurring from traffic on trails. This can result in a combination of ice slabs and also

softer areas (moguls) as snowmobiles break the top layer of snow. Ideally, old and relatively “fresh” snows (snow crystals) are mixed to produce a durable trail. When temperatures are sufficiently low, the snow freezes into chunks.

The tiller’s teeth smash the chunks of snow into slush, which fills the gaps on the surface of the trail. This processed snow/slush is then shaped by the finisher/comb and bound together by water film formation. As the chunks are smashed, the snow crystals are also destroyed so bonding only takes place to a limited extent. This is why slush can only be created from ice and never from powder snow.

A durable snow surface is only produced as a result of mixing the processed snow with fresh snow and/or by mixing the snow on top of the trail with old snow which is lying at lower levels, beneath the top of the trail surface, and has not yet been used.

Processing Icy Surfaces

Icy trail surfaces should only be broken open if the snow coating is strong enough or if fresh snow has fallen. Slush created in this way will only bond with fresh snow or water – again forming ice. Ice slabs formed in snow surfaces which are otherwise good can be processed by mixing them with snow crystals lying deeper in the snow. However, the more frequently the snow is turned over and the crystals are destroyed, the less the crystals will bond together.

Processing Wet Snow

A relatively hard surface may be formed on the snow surface as the result of high humidity which can cause a film of water to develop on the finisher/comb. Sometimes tilt options on tillers can be used to cope with this to help break up this glazing effect.

Processing Extreme Sugar Snow

When grooming in conditions where there is extreme sugar (very fine, dry) snow, particularly in the spring, it may be desirable to use only a smoothing board. Operating the tiller in these conditions can create “side walls” caused by banks of snow spilling out the sides of the tiller. When sugar snow has fallen, it is difficult to create a durable snow surface. Therefore it is a good idea to leave the snow alone for two or three hours, until the temperature changes, so that crystals can form.

Control the Ground Speed

The goal of trail grooming is to create a snow surface that is smooth and even. If the tractor is driven too fast, the tracks will throw snow out to the side and also over the top of the tiller onto the snow surface which has already been prepared. Too fast of a speed can also cause the tiller to bounce and sway, resulting in an uneven surface.

Operate Only with Sufficient Snow Cover

Never operate the tiller until snow cover is deep enough to prevent damage to under-lying turf and to the grooming unit. When possible, create snow reserves in critical areas where snow may melt back and expose bare ground.

Proper Tiller Depth

Indications that the tiller depth is set correctly include:

- perfectly clean snow surface behind the tiller
- the snow surface retains a firm base
- economical operation of the grooming unit
- favorable loading for the tractor and tiller

Indications that the tiller depth is set incorrectly include:

- rotary shaft set too high: no output visible behind the tiller
- no marking at hard points on snow surface
- rotary shaft set too deep: too little snow through-flow, so snow flows out of the side of the tiller and forms a side wall
- snow crystal bonding and the base quality deteriorate
- large amounts of power required – not economical

Side Walls Being Formed by Tiller

Side walls being formed to the left and right of the tiller indicate:

- excessive groundspeed
- excessive engine speed
- tiller depth set too deep
- contact pressure position switched “ON” rather than in “Float” position
- cylinder equipment carrier has been adjusted
- rotary shaft is at a standstill
- the lateral finisher/comb must overlap the prepared track to ensure that the transition between tracks occurs in a clean manner

Don’t Leave Holes or Piles of Snow

Any holes in the trail surface and/or piles of snow created when driving or turning the unit should be flattened out again as quickly as possible.

Trail Surface Does Not Look Good

When parts of the trail do not look good, like they were not processed and finished okay, it may indicate:

- the tiller is set too high – check shaft depth adjustment
- engine speed too slow
- lever not in engaged (float) position
- excessive groundspeed
- failure to use front tractor blade to create an even surface area on the trail, so the tiller is lying “open” on moguls

Photo 4.16 Properly finished trail

Remove Snow from the Unit

Regularly remove snow that can build up on the loading/cargo area of the tractor since the increased weight will cause increased levels of fuel consumption, as well as affect the unit's center of gravity.

Groomer is Almost at a Standstill

If the vehicle is almost at a standstill, it may indicate:

- tiller is set too deep – check shaft depth adjustment
- excessive engine speed
- cylinder equipment carrier adjusted by mistake
- direction of tiller rotation set to contra-rotation
- rotary shaft at a standstill (jammed, crushed, frozen)

Violent Vibration When Tiller Turned On

If there are violent vibrations in the vehicle when the tiller is turned "ON," it may indicate:

- the shaft is unbalanced
- a gear is missing as a result of improper maintenance
- snow is frozen on the shaft

Unbalanced means vibration – screws unfasten themselves and bearing can be destroyed. This is unsafe, so ALWAYS rectify imbalance immediately.

Operating on Hills or Steep Slopes

When driving uphill, always only drive with the amount of power necessary and watch out for track engagement/traction. If excessive power is used, the tracks will spin and/or the entire machine will dig itself in. If the tracks begin to dig themselves in, stop immediately and look for a new route.

When driving downhill, always drive at a moderate speed to ensure the engine does not over-rev, the unit does not drift sideways in an uncontrolled manner, and that it does not pull snow down the slope behind it. Drive with as few steering movements as possible while ensuring that both tracks are turning. Speed must be reduced when driving over hilltops to ensure the machine tilts forward in a controlled manner to ensure the front blade does not "stick in the ground" and the tracks do not slip.

If, when driving downhill, the tractor should start to slip and drift sideways to the left or right (vehicle's longitudinal axle at right angles to the fall line of the hill), immediately counter-steer up to the point where the tracks contra-rotate (by turning steering wheel to the left or right until it locks) to ensure that the vehicle's longitudinal axle is again pointing in the direction of the fall line. Briefly increase speed to do this. When the vehicle is slipping in the fall line, reduce the slipping movement by changing over (reversing) the rotary shaft direction of the tiller and by carefully using the front blade as an anchor point. Continue to do so until the vehicle is stabilized.

Tips for Operating Tracked Vehicles

Keep the Vehicle on Top of the Snow

Snow can have a top crust that is harder than the underlying base due to various melt-freeze or wind-packing conditions. It is to the operator's advantage to try to keep the groomer on top. Try to not spin the tracks through that crust if at all possible.

If Stuck, Don't Spin

If the groomer gets stuck, DO NOT spin the tracks. It is important to remember that a tractor is rarely stuck in a level position, unless it has spun out while climbing a hill on a hard packed, icy trail. Raising the implement and backing the unit down the hill will often remedy this situation. If not, the groomer is stuck, so proceed with caution.

More often than not, the tractor will be tilted to the right / outside edge of the trail because it fell off the compacted trail base. The first thing to do is get the tractor level. This is particularly true with gear drive tractors since the lubricants can run out of the differential into the axle tubes that are lower, which can leave the ring gear and pinion empty or low of grease. In such cases, spinning the tracks is the last thing that should be done since it can severely damage the tractor. Get the tractor level to protect it. At this point, a long handled, plastic scoop shovel is the operator's best friend, and they should start digging. The tractor will most likely be high-centered, so snow must be removed from beneath the tractor's front blade, frame, and undercarriage.

Once the tractor is level, the vehicle should be rocked *gently* back and forth which can help pack the snow. It is better to unhook a drag sooner versus later – it can save a lot of time, effort, or even damage to the equipment. If that doesn't work, a winch or come-along may be needed to free the vehicle. Otherwise the operator must shovel some more.

Use the Contour of a Hill or Winch It

If uphill travel is too steep, try to travel at an angle around the hill that uses ground contour to your advantage. Look ahead and plan the route. If the vehicle has a front blade, tilt the blade to the uphill side to move snow to the downhill side. This will place snow under the downhill track and build a bench to travel upon. If this is not possible, a winch may be needed to assist the groomer with climbing the hill.

Descend in Low Gear

When descending steep grades, use a sufficiently low gear and always keep the tracks revolving to permit steering. A good rule of thumb for descending steep grades is to use the same gear as is required for climbing the hill.

Raise the Drag in Deep Snow

In deep snow or in drifts such as can occur along fence lines or in a road ditch, raise the drag to prevent too much snow buildup. Also remove accumulated snow from the pan. If track slippage occurs, try to wriggle the unit through the excessively deep area of snow.

Steer Clear of Tree Wells

Beware that snow next to tree wells can be soft due to thawing and lack of stability on the sidewalls. The groomer can quickly become stuck if it slips into one, so stay as far away as practical from them. It may be best to test the edge first by a "walk around."

Tips for Avoiding Equipment Damage

Always Follow the Manufacturer's Recommendations

Always check and follow the manufacturer's guidelines for operation and maintenance. The fact is it's easier to preserve what you have than to restore what you've lost.

Proper Track Tension

There is always potential to have a track come off any tracked vehicle. This most commonly occurs during aggressive side hill operations or from hitting the edge of a stump, rock, or ditch with the track. Proper track tension adjustment is particularly important and can help prevent loosing a track.

Warm Up the Engine

When starting a turbocharged diesel engine, use the hand throttle to run it at *just above idle* for a few minutes before beginning to work the machine. (A diesel engine will not warm up properly at just idle, so ensure it's just *above* idle.) Never go from cold start to high power immediately. Also, always allow the engine to operate at an idle for ten minutes before turning it off to allow the turbocharger bearings to be cooled by the circulation of the engine's oil. Also allow the engine to operate at a fast idle, without lights and electrical load, before shutdown to recharge the batteries.

Respect the Torque

Tracked vehicles are designed to be as lightweight as possible to maintain correct ground pressure. However, they also produce a substantial amount of torque in order to pull the required loads. The availability of significant torque must be respected as it is quite possible to overstress the unit and create hairline fractures or misalignments. Be especially careful when stuck or when moving rocks or trees off the trail. (Remember – the tractor is not a bulldozer so this is NOT recommended. If it is necessary to do this, use extreme caution to ensure the tractor is not damaged.)

Don't Run Hydraulics Over the Relief Pressure

Do not keep hydraulics running over the relief pressure during normal operations. If the hydraulics squeals, back off the control. Running hydraulics past the limit (exceeding relief pressure) causes excess heat and can lead to various mechanical problems.

Come to a Full Stop Before Shifting to Reverse

Do not shift from forward to reverse while still in motion. This type of shifting can cause failure of the transmission, driveline, U-joints, tracks, or differentials. Always allow the engine RPM to return to idle before shifting from forward to reverse.

Manually Shift Automatic Transmissions

Don't lug the tractor engine. For best performance, it is best to operate at the peak of the horsepower and torque power curves. One way to ensure this is to manually shift automatic transmissions so that an engine RPM of at least 2000 to 2200 is consistently maintained.

USE IT, DON'T ABUSE IT!
Ten Common Operator Abuses

The following are ten common operator abuses of tracked snow grooming vehicles that can lead to premature equipment wear and equipment failure:

1. **Failure to Perform Proper Warm Up**.
   Neglecting warm up procedures can impair control responses and cut down on the life of the engine and transmission. Start the vehicle and check the steering, hydraulics, brakes, tracks, frame, attachments, etc. while it's warming up for at least 5 to 10 minutes.

2. **Failure to Perform Walk-Around Inspection**.
   There is no replacement for an operator's daily start up inspection. The operator must be very familiar with the machine. With daily inspections, the operator has the opportunity to check for loose fittings, bolts, oil leaks, and other problems that can be easily corrected and help prevent a major problem from developing. Have a checklist for each unit. Also stop each hour during operation and walk around the machine for a general visual inspection.

3. **Operating When Repairs are Needed**.
   If a vehicle is operated with known problems, even minor ones, it unnecessarily risks the vehicle's integrity and the operator's safety.

4. **Operation Without Proper Training**.
   Untrained operators, or even experienced equipment operators who are unfamiliar with the vehicle, may overload the equipment which can cause stress and damage the vehicle. An important part of every operator's training should be to read and understand the operator's manual before operating the equipment. Operators must always be attentive to odd sounds and the vehicle's response to controls.

5. **Misapplication of Equipment to Job**.
   All too often, tracked vehicles are used for purposes they were not designed for. A grooming vehicle is not a bulldozer and should not be used as one. Knowing and respecting the limits of the vehicle's capabilities is important to protecting the life and usefulness of the tractor, as well as the safety of the operator.

6. Going Too Fast.

Tracked vehicles are designed to pull heavy loads at relatively low speeds. Operation at a high speed over rough terrain can damage the tracks or drive train and can also cause excessive vibration that can harm the tractor's frame and components. Additionally, working in too high of a gear overworks and overheats the transmission. It also generally produces a poorly groomed trail. Operators who chronically groom too fast should be replaced since they put the equipment at risk and produce poor quality trails that do not stand up well to traffic.

7. Unauthorized Modifications.

Some operators believe that modifications to their equipment, like resetting hydraulic pressures or recalibrating the fuel pump for more horsepower, are smart moves. In reality, unauthorized modifications like these will often stress the vehicle beyond its limits. This can result in warranties being voided if a failure occurs or shorten the normal life cycle of the vehicle. Always check with the manufacturer before making any modifications to grooming equipment.

8. High Temperature Shutdown.

Not allowing the engine temperature to stabilize before shutdown can damage turbochargers and cause premature engine wear. Always allow the engine to idle for 5 to10 minutes before shutdown. This also provides an excellent time to perform a walk-around "shutdown inspection," as well as a time to warm up the operator's vehicle for the drive home.

9. Unfamiliarity with the Trail.

Operators who are unfamiliar with a trail can run into sudden hidden dangers such as rocks, trees, wet areas, and steep grades that can pose a threat to themselves and the vehicle. Operators who helped construct the trail or who performed summer maintenance on the trail are a valuable asset since they know what the area looks like without snow cover. They are also the best people to have set the outer edges of the groomed trail at the beginning of the season. Know the trail and stay on it. Groom with a plan and stick with the plan. Operators should follow the trail signs and NEVER follow snowmobile tracks through open areas unless they're absolutely certain that is exactly where the trail is located. Snowmobilers often shortcut bends in the trail and can get the groomer into extreme trouble if it follows them off-trail.

10. Using Attachments Improperly.

Even if the front blade can remove a large drift in one pass, make several passes and do it in smaller, less stressful cuts. Saw limbs into several small pieces before pushing them off the trail with the front blade. Use it, but don't abuse it!

CHAPTER QUIZ

1. The ground pressure and weight of a grooming tractor allows it to safely cross frozen bodies of water. True False

2. The faster the grooming speed, the better the trail quality and durability will be. True False

3. The amount of snow depth required to begin grooming operations will vary by area and is affected by the type of terrain and by the type of snow. Generally, there should be at least ____ of snow to begin grooming operations that are effective and worth the cost of grooming.
    a. 2 inches (5 centimeters)
    b. 6 inches (15 centimeters)
    c. 12 inches (30 centimeters)
    d. 18 inches (45 centimeters)

4. The faster the grooming speed, the better the trail quality and durability will be. True False

5. Groomer operators should pay special attention to curve berms and try to work down the high outside edges. True False

6. It is okay to groom against snowmobile traffic on the left side of the trail if that side is rougher than the right side of the trail. True False

7. The best temperature for grooming with a drag is between 5 and 25 degrees F (-15 and -4 degrees C). True False

8. The most effective grooming speed with a drag is:
    a. 3 to 4 mph (5 to 6.5 kph)
    b. 5 to 7 mph (8 to 11 kph)
    c. 8 to 10 mph (13 to 16 kph)
    d. 10 to 12 mph (16 to 19 kph)

9. Grooming at night will generally produce the best quality trail because temperatures are typically colder so the snow will flow better and set up harder; traffic volumes are also typically at their lowest which helps provide set up time. True False

10. Mirrors on a tractor are typically useless and aren't important since there isn't a need to see behind the tractor. True False

11. It is okay to dump snow from the groomer on roads and driveways because it helps warn motorists and landowners that they are crossing a snowmobile trail. True False

12. A tractor should descend steep hills in the same gear that is used to climb the hill.
True False

13. Normally, roads should never be groomed wider than twice the width of the grooming equipment. True False

14. If the grooming tractor becomes stuck:
    a. quickly give it more throttle and spin the tracks
    b. don't spin the tracks
    c. gently rock the vehicle back and forth, packing the snow
    d. consider unhooking the drag – sooner versus later
    e. a shovel may be needed
    f. all of the above except a
    g. a, c, d, e, and f above

15. When backing up with a grooming drag on the trail, a pile of snow is often created. It is okay to leave this pile of snow on the trail since snowmobiles will knock it down.
True False

16. When grooming trails, always:
    a. stay on the trail with the grooming equipment
    b. feel free to pick new routes to provide variety since the groomer will go through anything
    c. turn around only where there is ample turning room and it is known that the snow base will support the equipment, preferably using areas where turn-a-rounds have been made before
    d. a and c above
    e. a, b, and c above

17. If there is a lack of new snow in the middle of the trail, the options could include:
    a. set the drag blades to pull snow in from the trail edges
    b. use the front blade on the tractor to pull snow in from the right edge of the trail
    c. don't bother grooming – put the wheels down until you find snow
    d. operate the groomer on the outside edge of the trail
    e. a, b and d above
    f. b and d above

18. Never stop to remove rocks, logs, limbs or other debris that is lying on or in the trail surface because they provide a solid filler that helps the trail last longer.
True False

19. When snow is spilling out the side of a drag, it means that the drag is carrying too much snow, likely set too low, and is not working effectively. True False

20. A groomer operator should be cautious about following a snowmobile track across an open area. True False

21. Common operator abuses of tracked equipment include:
    a. going too slow
    b. spending too much time warming up the engine
    c. performing unwarranted pre-operation inspections
    d. unauthorized modifications
    e. none of the above
    f. a, b, c, and d above

22. Proper use of a tiller for snowmobile trail grooming requires:
    a. a tractor with sufficiently large horsepower
    b. a good front blade operator
    c. deep snow cover
    d. none of the above
    e. a, b, and c above

23. If groomer operators encounter poor visibility caused by high wind, heavy snowfall, fog, or a combination of these conditions when grooming, and it is difficult to see where to groom, they should:
    a. simply stop right where they are, leave all lights on with the engine idling
    b. contact their grooming manager or a dispatcher to advise them of the situation and location
    c. stay with the equipment and wait for visibility to improve
    d. get out and walk
    e. a, b, and c above
    f. none of the above

24. It is never a good idea to get out of the tractor and walk back to check the trail, particularly when alone at night. True False

25. When using a tiller and parts of the trail do not look good, like they were not processed and finished okay, it may indicate:
    a. the tiller depth is set too high
    b. engine speed on the tractor is too slow
    c. the tiller isn't engaged in the float position
    d. excessive groundspeed with the tractor
    e. the front tractor blade wasn't used to cut moguls and create an even surface area on the trail, so the tiller is "open" over the moguls
    f. all of the above

26. If the tractor is driven too fast while operating a tiller, the tracks will throw snow out to the side and also over the top of the tiller onto the snow surface which has already been prepared. True False