

Chapter Three:

MANAGING GROOMING OPERATIONS, EQUIPMENT, and SAFETY

Grooming operations are typically the largest part of an entity's budget in terms of the capital costs to purchase equipment, the ongoing operational costs of grooming, and the costs associated with repair and maintenance.

While there is no perfect way to manage grooming operations, this section provides basic guidelines for the management of trail grooming equipment and operations. What equipment to purchase, who will operate it, how will it be scheduled, where it will be stored, and how it will be maintained are all critically important decisions that must be made to properly manage grooming equipment. While some of these decisions are far-removed from the grooming equipment operator, a basic understanding of the "big picture" helps facilitate a better, more effective grooming operation.

The Grooming Program Manager

Good quality grooming doesn't just happen by chance and will not be assured simply because new, fancy, or expensive equipment has been acquired for the grooming program. Successful grooming programs require a great deal of planning and management. And good equipment isn't a substitute for poor operators.

Regardless of the size of a grooming operation, it is recommended that there be a qualified manager in charge of the day-to-day grooming operation who understands heavy equipment operation and maintenance, trail grooming principles and practices, and snow mechanics. The ability to work with a diverse group of volunteers or employees, while balancing leadership and authority, is also a definite plus for this position.

The title of "grooming program manager" is important since it clearly defines the role of the individual filling the position. "Grooming" clearly indicates the focus of the job. "Program" suggests that grooming is a planned and coordinated activity which cannot be left to chance. "Manager" defines the role as coordinating and directing all aspects of the overall grooming program.

Particularly with volunteer club grooming operations, if a suitable candidate is not available within the existing organization, one needs to be recruited or hired. Typically, qualified heavy equipment managers who often are not busy in the winter months can be good candidates to recruit for this responsibility. An individual within the volunteer organization simply "taking" this job "because no one else will" is a recipe for disaster and should be avoided.

Establishing Grooming Priorities

Snowmobilers would like to see every trail groomed tabletop smooth every day of the week. However grooming resources, in terms of available equipment and existing budget, are usually limited, so choices have to be made as to what the grooming priorities are. Grooming schedules should be developed that divide trail systems into manageable sections based upon what the budget and volunteer or labor resources will allow. Once priorities that consider traffic patterns have been determined for each trail section, a weekly schedule can be created by assigning grooming equipment and operators (Refer to the Appendix for a sample Weekly Grooming Schedule). Keep in mind that, while schedules are great for planning how to use resources, weather and changes in traffic patterns can upset the best laid plans. The Grooming Manager must stay engaged and flexible to ensure grooming is directed toward the highest priorities if conditions change.

Factors to Consider

A number of factors should be considered when determining priorities and schedules:

- Where is the “base of operations” for the grooming program located? Is it central to the trail system or is it located at one end of it? How many miles/kilometers of trail must be groomed?
- What is the normal use pattern on the trail system? Is the snowmobile traffic normally heavy only on weekends or is traffic heavy every day of the week? Is there typically heavy night riding or are snowmobilers generally off the trail by dark? How early in the morning do riders normally get on the trail?
- Are there lodges, motels, hotels, or other businesses located on the trail that contribute large numbers of riders on a daily or regular basis? Are there attractions on the trail system that draw more traffic than other parts of the trail system? Are there trailheads or parking areas that regularly draw more use than others on the trail system?
- How many groomers are available for the trail system? If there are two or more available in the area, can they be staged in different locations or must they all operate from the same base? How many miles/kilometers of trail can each unit effectively groom each day/night when considering the set up time required to avoid heavy snowmobile traffic, average grooming speed, and normal weather patterns and temperatures?
- How many weeks will there be enough snow and traffic to justify the expense of grooming operations in the area? Should the trails receive more grooming during some weeks (middle of the season or around holidays, for instance) than others?
- What is the cost to groom a mile/kilometer of trail one time (fuel, maintenance, repairs, equipment depreciation, and labor as applicable)? How many dollars are available to fund these costs for the season? Will all labor be “paid” labor or will there be volunteer labor to supplement operating costs? If there is volunteer labor, how many hours per week will be dependably and consistently available? How many total miles/kilometers of grooming effort will this fund each week?

The answers to these questions all contribute to establishing priorities and setting grooming schedules that will be as effective as possible to address grooming needs.

If areas have traffic levels that are generally low, with little night riding and low weekday traffic, there is typically much flexibility as to when grooming efforts can be effective and few grooming repetitions per week will generally be required to have good trails.

If traffic levels are high everyday of the week, areas must look closely at scheduling factors to be as effective as possible with grooming expenditures. It is likely that 3 to 5 or even 7 repetitions per week may be needed to have good trails. And multiple groomers, staged at multiple locations, may be required since 40 to 60 miles (65 to 95 kilometers) is about the maximum a single unit can effectively groom per night without getting into times/traffic/temperatures that may not be productive for grooming. While some high traffic areas choose to groom mid-day to keep moguls from getting too deep, such efforts should be secondary to regular grooming at night (also), or when there is less traffic, to provide proper time for trail set up since it will generally not occur mid-day with traffic.

Operator Selection and Training

For many of the same reasons that a skilled Grooming Program Manager needs to coordinate a grooming program, skilled grooming equipment operators need to be carefully selected and trained. Grooming Equipment Operators should be selected based upon their ability to operate heavy equipment and then be thoroughly instructed and tested on the operating features of grooming equipment, grooming principles and procedures, maintenance schedules, and safe operating procedures.

Operators should be knowledgeable of grooming practices and should have a fairly high degree of mechanical aptitude since on-the-trail repairs and adjustments are inevitable, even with the best and newest equipment.

An operator training checklist should be used to help deliver effective and consistent operator training. Training topics should be customized by the Grooming Manager to cover local issues, but should also cover general items such as grooming practices, vehicle characteristics, and vehicle operation. Following this process can help ensure that operator training is thorough and complete (Refer to the Appendix for a sample training checklist).



Photo 3.1 Operator training is important and should include hands-on in-shop maintenance instruction.

Operator Safety

Ensuring the safety of equipment operators must be the first priority of the grooming program. While the specific circumstances of every area's operation are different, there are a number of common safety practices that should be followed universally. The following is a list of common operator safety considerations. Local grooming entities are encouraged to add additional measures that fit their needs and local circumstances.

Always Wear Seat Belts

Operators and passengers should wear seat belts at all times since sudden stops caused by the grooming equipment hitting fixed objects, such as rocks and stumps, are not uncommon and can easily launch the operator or passenger headfirst into the windshield or dashboard. Always proceed cautiously when operating grooming equipment since abrupt, dangerous stops can result in serious injuries.

Be Visible to Snowmobilers

Ensure that the vehicle is highly visible in the daytime, as well as at night, by using reflective surfaces on the equipment and by always operating with cab marker lights, front and rear headlights, and an amber beacon turned "ON" at all times (day or night). Also operate a communicator radio beacon in the tractor at all times.

Be Prepared for Trouble

Grooming equipment *will* malfunction, break, and get stuck. Contemplate all potential problems and provide procedures, tools, spare parts, and supplies to deal with them. Provide first aid kits and training for operators. Remember that they may also encounter members of the public who need help. A GPS unit is valuable to provide guidance during whiteouts and to provide rescue coordinates. Operators should be prepared to put winter survival techniques into effect in the event they become disabled in a remote area and must stay overnight. An avalanche beacon and probe (to assist with a rescue) should also be considered if operating in mountainous areas.

Essential tools that should always be carried include: axe, chainsaw, jack, snow shovel, chain/tow strap, rope, and flashlight.

A list of standard safety/emergency equipment should be carried in the groomer. Items to consider include:

First Aid Kit	Spare Batteries	Fire Extinguisher
Foil Blanket	Weatherproof Matches	Chains
Flares	Hydraulic Hoses/Fittings	Pry Bar
Spare Clothing	Tools	Paper
Towels	Snow Scraper	Plate for Jack
Hand Cleaner	Hi-Lift Jack	Tree Strap
Oil	Extra Fuel	Stakes
Sledge Hammer	Orange Spray Paint	Butane Torch/Heater

It is recommended that every grooming tractor carry a minimum of four 14-inch (36 cm), reflective, high visibility traffic cones. Use them to identify potential hazards such as a disabled groomer or winching cables, chains, or ropes temporarily strung across the trail.

Groomer operators should always be prepared by having a supply of high energy food, as well as a supply of drinking water, with in the tractor in the event they become stranded. Never leave home without packing a good sized lunch!

Avoid Grooming Across Ice

Some State or Provincial trail programs do not allow groomed trails to cross lakes or other major ice crossings. If it is necessary to groom across ice, procedures (how thick, how is it checked, monitored, etc.) must be established to ensure that ice quality is adequate in thickness and quality before crossing. Some manufacturers install escape hatches (sun roofs) in their units to facilitate emergency operator exit from the cab should the unit go through the ice.

Stay in Communication and Work the Plan

Modern FM radios and cellular or satellite telephones make it easier for operators to stay in frequent contact with their home base. Always file a “trip plan” before leaving on a grooming run. Agree upon a regular schedule of contact between the groomer operator and home base and the procedure that will be followed if contact is lost. Ensure that a plan is in place should contact be overdue or an actual emergency is reported, and then stick to the plan.



Carry Extra Signs for Replacement

A supply of extra trail signs, stakes, and fasteners should be carried on the grooming tractor to replace missing signs or stakes since the groomer operator is often the most familiar with where these signs should be along the trail. Replacing the missing signs, particularly safety and regulatory signs, helps ensure that the route will be safe for snowmobilers, as well as for the groomer the next time it must pass through that area.

Routine Preventive Maintenance

The importance of an effective preventive maintenance program to safety should not be underestimated. Well maintained equipment is far less likely to injure an operator or to strand an operator in a dangerous situation. Failure to perform preventive maintenance procedures should be treated as a safety violation rather than an operational oversight.

Check Equipment Prior to Departure

Thoroughly check the tractor over *prior* to departure on a grooming run. Check the fuel and fluid levels. Check for cracked or broken parts. Check the tracks. Check the hydraulic lines. Check the flashlight and be sure the tool and emergency kits are together. Be sure to have adequate clothing along in case the heater or tractor quit. **DO NOT** leave unless everything checks out okay and is in place.

Use Caution When Stopping or Parking on the Trail

Always use caution when stopping or parking on the trail, so the groomer does not become a hazard for approaching snowmobilers. There are essentially two types of stops, planned and unplanned.

Planned Stops: A “planned stop” is one made by a groomer operator when there is full control over when and where to stop.

Always use good judgment in where stops are made on the trail and be certain the groomer is well off the main traveled portion of the trail, if at all possible, when the machine is parked. Plan ahead and pull over in an area that minimizes risk to traffic on the trail. Pull completely off the trail on a straightaway, at an intersection, or in a parking lot whenever possible to prevent having to stop on the trail and potentially create a hazard.

It is good to develop areas on the trail system where planned stops and/or turnarounds can be made safely, and then keep these areas packed throughout the winter season.

An example of when it is beneficial to try to use a planned stop is when snowmobilers approach from the rear of the groomer on a narrow or winding trail. Signal for them to wait to pass the groomer until you’ve found a safe location to stop the groomer. Once the groomer has stopped and it is clear ahead, signal for them to go by.

Unplanned Full Stops: An unplanned full stop is one made by a groomer operator when there isn’t control over the location of the stop. This can include meeting snowmobiles on a very narrow trail, having snowmobilers stop the groomer to ask for information, encountering blow-downs or other situations requiring trail maintenance, mechanical failure of the groomer, encountering a disabled snowmobile, or encountering an accident on the trail. Operators must use their best judgment to size up the location of the unplanned stop. Is the site safe or unsafe to stop with the groomer?

If you believe the location has good visibility, that the expected time to get underway again will not be lengthy, and that it overall is safe to stop at the site, stop briefly to correct the problem, handle the situation, or give information, but do it as quickly as possible and then get underway again.

If you believe the site is unsafe due to the location and/or visibility, look for other options and if possible use extreme caution while proceeding to a safer location to stop.

General guidelines for unplanned stops include:

Snowmobiles Approaching the Groomer from the Front: When snowmobilers approach the groomer from the front on a narrow trail, move the groomer to the far right side of the trail as quickly as possible and stop. After checking to see that no traffic is coming from the opposite direction, signal to the snowmobilers to proceed past the groomer.

Informational Stop by Snowmobiler: Tell the snowmobiler that it is not a safe location to stop. Request that they follow the groomer down the trail to a safer location where you'll stop and answer their questions.

Repairs to the Trail or Removing Blow-Downs: If you anticipate the time needed to stop to remove debris or deadfall or to repair the trail will be relatively short, make sure all of warning lights remain on, and quickly make the necessary corrections to the trail, then get underway again. If the stop is anticipated to take a longer period of time, consider placing warning devices, like what are shown in Figure 3.1, on the trail to warn snowmobiles of the groomer's presence.



Photo 3.2 Stop only where there is good sight distance



Figure 3.1 Use warning devices like traffic cones, flares, crossed poles, or flagging to warn snowmobilers of parked groomers and on-trail hazards.



Mechanical Failure of Groomer or Stuck on the Trail: If the groomer becomes disabled or stuck on the trail and cannot be moved, take action quickly by placing warning devices in the front and rear of the groomer to warn approaching snowmobiles of the hazard. If the groomer needs to be left on the trail for an extended period of time, place additional warning signs or devices to mark the groomer's presence.



Photo 3.3 Place cones or other warning devices around and in advance of a groomer that has broken down on the trail and must remain there for an extended period.

Assistance to Disabled Snowmobiler: If you anticipate that there will be a need to be in the location for an extended period of time, park the groomer as far right on the trail as is safely possible and place warning devices in front and back of the groomer. If communications are available, call for assistance for the snowmobiler and get underway again as quickly as possible.

Crash Related Stop: If you come upon the site of any crash, presume that it is most likely an “Unsafe Site.” DO NOT proceed until the site is made safe!

First, park the groomer as far right on the trail as is safely possible and place warning devices on the trail to warn snowmobilers of the hazard. After securing the site, assess the situation to determine if there are any injuries and, if so, the type of injuries and the number of people injured.

If the accident is because a snowmobile collided with the groomer, do not move the equipment – just secure the scene and assess the needs.



Photo 3.4 Beware that collisions may be with the groomer!

As you assess the situation at the accident scene, determine if current resources at the site are sufficient to handle the emergency. If the answer is “Yes” – offer any assistance you can give and stay at the site until the trail has been cleared.

If the answer is “No” – the current resources at the site are not sufficient to handle the emergency, take control and:

- A. Call local dispatch or 911 if phone or radio service is available. If not, send someone for help.
- B. State the problem or situation.
- C. Give the number of injured, if any.
- D. Give the location, trail number, or trail name.
- E. If known, state the best way for rescue to arrive.
- F. Stay calm and do not talk too much.
- G. Don’t move the injured, but protect all victims at the scene and keep the injured warm.
- H. If there are bystanders, ask them to either close the trail or direct traffic until other help arrives.
- I. Update emergency personnel upon their arrival.
- J. **DOCUMENT, DOCUMENT, DOCUMENT!** After the scene has been turned over to emergency personnel, write down everything that you observed and that transpired while you were at the accident scene.



Common Operator Guidelines and Policies

For the benefit of the operator and/or grooming program, many areas have formal guidelines or policies related to operator safety, practices, or behavior that include:

No Alcohol or Drugs

Many areas have a Zero Tolerance policy regarding the use of alcohol or drugs when on duty. Other areas also specify a period of time prior to a grooming shift where alcohol cannot be consumed to prevent operators from showing up for their shift under the influence of or impaired by alcohol or drugs. Some areas go as far as to not allow groomer operators to run their shift if they have a hangover since the Grooming Managers believe this also constitutes an “impaired” and therefore unsafe situation. Zero Tolerance means there is no second chance – operators are terminated for their first infraction since the safety risks and liability associated with impaired groomer operators can be extremely significant.



Photo 3.5 The operators of this groomer were smoking marijuana and drove off the bridge.

No Smoking

Many areas prohibit smoking while in grooming equipment, in their shop, and in maintenance areas. Certainly, smoking must be prohibited around all refueling areas. Smoking bans are due to operator health and safety. Smoking in the cab of grooming tractors can also decrease the unit’s resale value.

Firearms

Many areas prohibit an operator from carrying a firearm in the grooming tractor as a safety as well as a liability issue. Additionally, many government agencies involved with trail grooming have policies that prohibit employees from hunting while on duty.

Passengers in Groomer

While some areas routinely groom with two people in the grooming tractor (a driver and an assistant), other areas prohibit the operator from carrying passengers not involved with the grooming operation. The most important aspect of whether or not to allow passengers is a safety issue. First, is the operator competent enough to not be distracted by a passenger? Second, the Manager should know beforehand that there is a passenger so, in the event of an emergency, rescuers know how many people they need to retrieve.

Communications

Communications are so important to the success of any grooming program that many areas have established formal communication policies and procedures. All are based on the need to communicate, communicate, and communicate some more! Operators must communicate the condition of equipment to other operators and the Manager. They must communicate the condition of the trails they have been over to relief operators and the Manager. They must communicate anything (weather, large groups, trail conditions, hazards, etc.) they even slightly suspect to be pertinent to the overall grooming program to the Manager. They must communicate to someone (dispatcher, family, or Manager) when they depart on a grooming run, their planned route, as well as their safe return. And when in doubt, they must feel safe to ASK, because there is no dumb question!

Grooming programs should invest in good communications equipment – whether cell phones, satellite phones, or two-way radios – to help ensure successful and effective communications within the program.

Preparing the Trail

Remove Bumps, Holes, and Debris Prior to Snowfall

Trail preparation prior to freeze-up and snowfall can be the single most important item to help provide a smooth and stable winter trail. The trail base should be made as smooth as practical since bumps and holes in the ground will also produce bumps in the trail after snowfall. Therefore, bumps and holes in the ground should be improved or removed prior to snowfall, with whatever equipment is practical and available, since removal after the ground is frozen or snow covered is much more difficult. Bumps located under the snow trail can reappear as bumps/moguls on heavily traveled trails almost immediately after grooming.



Photo 3.6 Trail maintenance prior to snowfall can help make trails smoother in the winter.

Brush, stumps, and debris should also be removed from the trail, as well as along the trail, in areas where it could be a hazard to traffic or block visibility. A wide, smooth, brush-free trail makes grooming easier. Keeping debris off the trail helps prevent hazards as well as premature thawing of the trail base since debris can attract heat that can accelerate thawing the snow around it. It is also good to set trail markers and signs that must be driven into the ground before the ground freezes.



Photo 3.7 It is easier to remove stumps, brush, and debris before snowfall accumulates.

Early Season Trail Preparation

The first snowfalls that are processed on the trail often create the base for the remainder of the winter. An early solid, smooth base of snow will help keep the trail smoother throughout the rest of the winter. Early winter snowfalls can contain more free water and can compact well. Therefore, vigorous smoothing and heavy compaction is often important for early snows. Newly fallen snow layers should ideally be cut to 6 inches (15 centimeters) or less before compacting to ensure full compaction throughout the layer. Thick layers of newly fallen snow typically do not compact well.

In areas prone to wetness, such as low swampy crossings, it is advantageous to keep the snow thickness to a minimum in the early part of the winter. This allows the underlying soil to freeze and become stable. This frozen layer of earth will also help to keep the trail solid later into the spring season. Since snow is an excellent insulator, these areas should be kept thin so the ground remains frozen. Banked snow can be pulled onto these areas later in the season if bare spots occur.

Some wet areas, such as springs or seeps, never freeze to any degree and should be of concern throughout the season, particularly if they result in ice flows. Sometimes these areas can be covered with wood chips or similar material to minimize the carryover of mud and dirt onto the adjacent trail surface. However, before using wood chips or similar materials, be sure to check with the land managing agency for their approval. The best scenario is to avoid these types of areas if at all possible with the trail route.

CHAPTER QUIZ

1. Ensuring the safety of groomer operators includes:
 - a) making sure they are prepared for trouble by carrying safety and emergency equipment
 - b) providing them with communication equipment and requiring them to file a “trip plan”
 - c) a good preventative maintenance program
 - d) requiring that they wear seat belts
 - e) a and b above
 - f) a, b, c, and d above

2. New equipment helps compensate for poor equipment operators. True False

3. Budget, weather, and traffic patterns should be considered when developing and managing weekly grooming schedules. True False

4. Groomer operators should never operate equipment while under the influence of drugs or alcohol because their abilities and judgment will be impaired. True False

5. When parked on the trail, always shut the groomer’s lights off to avoid blinding or distracting oncoming snowmobile traffic. True False

6. A Grooming Manager:
 - a) is someone who directs all aspects of a grooming program and establishes priorities and schedules
 - b) is an important position for a successful grooming program
 - c) is anyone who wants to be in charge
 - d) should understand heavy equipment operation and maintenance, understand snow mechanics, and be able to work with people
 - e) a, b and d above
 - f) all of the above

7. A mid-day grooming in high traffic areas may be useful to keep moguls from getting too deep, but a second grooming should be scheduled that same night to provide better conditions and proper time for effective trail set up. True False

8. The following factors should be considered when establishing grooming priorities:
 - a) available labor and operating budget
 - b) number of groomers available
 - c) total miles/kilometers of trail to be groomed
 - d) snowmobile traffic patterns
 - e) locations of businesses, parking areas, and attractions
 - f) length of season, snow conditions, and weather patterns
 - g) all of the above

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, look 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

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.



Photo 4.5 Keep processed snow inside the drag!

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 to 1.5 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.



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: \cap . 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 \cap , 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 \cap . 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.

Photo 4.14 Sharp curves typically have little snow available at the inside/bottom

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* when using a drag, 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 losing 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 to 10 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

Chapter Five:

MAINTAINING GROOMING EQUIPMENT

Preventative Maintenance

The place for grooming equipment is out on the trails working – not sitting in a service shop waiting for parts or broken down out on the trail with a failed component that was not properly maintained. There are enough things that can go wrong through normal grooming operations without aggravating the problems with a lack of due care.

The key to ensuring that downtime and emergency repairs are kept to an absolute minimum, and that the equipment remains safe to operate, is establishing a comprehensive preventative maintenance program. As noted earlier, it is far easier to preserve what you have than to restore what you've lost.

Regardless of the type of maintenance being performed, there are four elements to the work that need to be addressed:

Four Elements to Preventative Maintenance

1. Inspection.

A great deal can be learned about the condition of a vehicle by carefully looking, listening, smelling, and feeling. While general overall surveillance is important, the areas where failures commonly occur should be identified and the inspection criteria and methods detailed. A good operator does not necessarily have to be a good mechanic. But a good operator does need to be observant and aware of their machine's sounds and appearances.

2. Lubrication.

Ensuring that lubricating fluids are fresh and full is extremely important for tracked vehicles. As well as lubricating, installing fresh lubricants will displace water, dirt, and spent lubricant which has accumulated in places it shouldn't be.

3. Adjustment.

Tracked vehicles have a number of adjustments that can compensate for wear and changes in alignment. Ensuring that mechanical adjustments are made to maintain specific characteristics is the best way to prevent nuisance failures in the field that can have serious consequences for the operator.

4. Repair.

Any part or system found to be damaged, worn out, or otherwise not doing its job must be promptly and fully repaired by a qualified individual.

Types of Maintenance

There are a number of types of maintenance performed at different times for different purposes. A good overall maintenance program should include the following:

- First-Time Operation of a New Unit Inspection
- Pre-Season Inspection and Maintenance
- Pre-Operation Inspection and Maintenance
- Post-Operation Inspection and Maintenance
- Routine Shop Inspection and Maintenance
- Off-Season Storage Procedures

Each type of maintenance has a different purpose, so procedures should be developed for each one based upon the type of equipment. And since there are such a wide variety of grooming tractors, drags, tillers, and attachments currently available, it is impossible to provide generic preventive maintenance procedures that fit all situations. Therefore, general guidelines as to what each type of maintenance procedure should address include:

First-Time Operation of a New Unit

It is important to both the condition of the vehicle and safety of the operator to proceed slowly when operating a new vehicle (or a “new used” vehicle) for the first time.

While the Owner’s Manual should have detailed procedures, the following basic procedures should be followed prior to operating any vehicle for the first time:

- Visual inspection of entire vehicle, inside and outside.
- Check fuel and oil levels and fill as necessary.
- Familiarization with all controls and functions including Owner’s Manual recommendations.
- With engine running, verify that all gauges are operating and within specified limits.
- Proceed very slowly, getting the feel of the vehicle and its characteristics.
- After the first 10 hours or as specified in the manual, check for loose bolts, nuts, fittings, etc.

Pre-Season Inspection and Maintenance

If the off-season recommendations below have been followed, readying the vehicle at the start of a new season should be relatively easy:

- Refer to maintenance records and be sure that all required work was performed.
- Check all fluid levels and look for signs of leaks.
- Install and/or adjust tracks.
- Inspect all welded joints and stress areas for cracks.
- Inspect bearings, joints, and all moving parts.

Pre-Grooming Operation Inspection and Maintenance

Before starting operations for a new day, the operator should be required to perform a pre-operation inspection. A set program should be developed for each piece of equipment based upon the manufacturer's recommendations. See the sample Daily Grooming Log in the Appendix for a sample Pre-Operation Checklist.

Post-Grooming Operation Inspection and Maintenance

As discussed earlier, many tracked vehicles should not be simply turned off at the end of a work session or engine damage can occur. Develop a routine for shutting down the vehicle at the end of the run, based upon the manufacturer's recommendations. This shut-down/cool-down period is also an excellent time to walk around the equipment to perform a visual inspection, as well as to refuel. Oftentimes, it is also a good idea to remove excess snow and ice that may have accumulated on the equipment during the grooming run. See the Daily Grooming Log in the Appendix for a sample Post-Operation Checklist.

Routine Shop Inspection and Maintenance

In addition to the ongoing operational maintenance described in the two previous sections, most tracked vehicles require regular and frequent shop inspection and maintenance. A regular program should be developed for each machine and operators should be instructed as to when shop maintenance is required. A maintenance log can make this easier to remember and track. See the sample Vehicle and Equipment Report, the Vehicle/Equipment Maintenance Records form and the Grooming Equipment Maintenance Requests form in the Appendix for checklists useful for tractors. Table 5.1 provides a sample checklist that can be used for grooming drag maintenance.

Grooming Drag – Example Service Item Description	Frequency
Walk Around Inspection	Daily
Remove and Inspect Shear Bolt	Daily
Inspect Hydraulic System for Leaks	Daily
Check Blade Spring Tension	Daily
Check Cutting Blade Condition	Daily
Clean Ice and Snow Buildup from Face of Blades and Packing Pan	Daily
Clean Snow from Rear of Packing Pan	Daily
Check Rear Wheel Tire Pressure (22psi)	Daily
Inspect Wear Strips Under Side Rails	Weekly
Check Rear Skegs	Weekly
Torque Blade Mounting Bolts (150 Ft. Lbs.)	Monthly
Torque Wheel Nuts (70 Ft. Lbs.)	Monthly
Grease Blade Pivot Points	Monthly
Remove, Clean, and Lube Draw Bar	Monthly
Check and Re-Pack Rear Wheel Bearings	Yearly
Touch Up Paint as Necessary	Yearly
Check Blade Height Adjustment (refer to Owner's Manual)	Yearly

Table 5.1 Sample Grooming Drag Maintenance Checklist

Off-Season Storage Procedures

Most tracked vehicles spend a significant part of the year sitting completely idle. Taking the time to properly store them simply makes sense in terms of protecting a major investment. While an off-season maintenance program unique to each vehicle should be developed based upon the manufacturer's recommendations, the following general guidelines should be followed universally:

- Clean and service the battery and battery compartment.
- Change the oil, transmission fluid, hydraulic fluids, and filters.
- Lube all fittings to displace water and spent grease.
- Check for wear points: track belts and related components, wheel wear, cracks in carrier and frame, hydraulic assemblies, etc.
- Check engine compartment for belt wear, tension, and alignment; throttle linkages and springs; broken or worn wiring; etc.
- Clean interior and exterior.
- Park in a garage if possible. If exposed to weather, remove or cover tracks to prevent Ultra Violet (UV) light damage to the rubber. If stored with tracks on, release tension.
- All engines (gas and diesel) should be started monthly and operated for at least 15 minutes to keep valve stems coated and to put moving parts in a different position.

General Tractor Maintenance Tips

- If at all possible, completely thaw out the grooming tractor for every scheduled maintenance session regardless of the mess and time involved. It's the only way to discover cracks in welds, missing small parts like nuts and screws, etc., and will save on valuable downtime later.
- Always jack up each track for journal bearing lubrication, for checking track tension, and for track adjustment. When greasing track journals, a very thorough greasing is required – it's easy to under grease but nearly impossible to over-grease them.
- Aluminum or steel track cleats are often over tightened when fastened to track belts, which can lead to premature belt failure. A torque wrench should always be used for this task since manufacturer guidelines typically stipulate tightening the nuts to as low as 25 foot-pounds (34 Newton-meters).
- Always refuel the grooming tractor at the end of a grooming run. This ensures the unit is ready to go the next time it is needed or in the event of an emergency. It also helps avoid condensation buildup in the empty fuel tank, which could lead to fuel line freeze up and/or engine problems.

CHAPTER QUIZ

1. Preventative maintenance can help prevent downtime and keep equipment safe to operate. The four main elements of a good preventative maintenance program include:
 - a) measurement, fueling, tinkering and replacement
 - b) monitoring, greasing, tuning and overhauls
 - c) inspection, lubrication, adjustment and repair
 - d) surveillance, servicing, alignment and rebuild

2. Before operating any grooming equipment, always check all fluid levels and check for leaks. True False

3. If you identify a repair that needs to be made while doing a pre-operation inspection, go ahead and do the scheduled grooming run and report the condition to the Grooming Manager when you return. True False

4. When operating a vehicle for the first time, run it as fast as it will go to see if it has enough power. True False

5. A tractor should be shut off as quickly as possible after a grooming shift to conserve fuel. True False

6. Never remove ice or snow that has built up on grooming equipment since it might damage the equipment; plus the added weight is good for trail compaction. True False

7. Grooming tractors should be stored inside or have their tracks removed during the off-season to avoid UV light damage to rubber tracks and belts. True False

Chapter Six:

RECORD KEEPING

The importance of keeping accurate and complete records of all aspects of a grooming program cannot be overemphasized. Good records are an important management tool, promote adherence to procedures, and may help limit liability should problems occur.

It is the responsibility of everyone to keep records. As pointed out in Chapter Five, a good preventive maintenance program is an important safety management tool, so keeping good records is a must. A cavalier attitude by any person toward not performing good recordkeeping that facilitates preventative maintenance should not be tolerated.

At the same time, if records are kept they should be used! Be sure that records are used to analyze the performance of the grooming program and as a yardstick to measure improvements. Don't just "file'em and forget'em."

Recommended Forms

All grooming programs are encouraged to develop forms to suit their particular needs. The following is a brief description of various forms that can be important to the management of a successful grooming program. Samples can be found in the Appendix.

Daily Groomer Operator's Log Form

It's important to the management of the grooming program that a running log is kept for each vehicle showing where and when it was used. Hour and odometer readings provide useful data and the remarks sections can be used to record any unusual events during the run for future reference. Some daily logs also incorporate a daily pre- and post-operation checklist, such as is shown on the sample Log in the Appendix. It is also recommended that a trail map, on which the trail segments groomed that day have been highlighted, is attached to the daily log to visually document what trails were groomed.

Grooming Equipment Maintenance Requests

The groomer operator has an important role in the overall preventive maintenance of the equipment. However, groomer operators may not be mechanics and need clear instructions as to what to check and how to tell if it's good or bad. Checklists such as the sample in the Appendix provide an easy format for operators to communicate the maintenance needs of the equipment to grooming managers and mechanics.

Vehicle/Equipment Reports and Maintenance Records

Every vehicle or piece of equipment should have its own log to track daily hours, miles/kilometers, fuel consumption, maintenance, and repairs. The examples in the Appendix can be combined on the front and back of one page to easily log monthly use and maintenance.

Corrective Action Form

Groomer operators are often the best “eyes and ears” for the trail system given the regularity and frequency that they travel the area’s trails. During grooming operations, operators may identify conditions on or directly adjacent to the trail that need correcting. A form like this provides a mechanism to report these situations, can document when they are corrected, and is important to overall trail safety and risk management.

CHAPTER QUIZ

1. Groomer operators’ only purpose is to groom trails and therefore should not concern themselves with watching for unsafe situations or missing signs along the trails or reporting these situations to the Grooming Manager.
True False
2. Record keeping is a nice thing to do and should be done only when an operator has time for it.
True False
3. It is important to track fuel, labor, maintenance, and other operating costs, along with the number of hours that are required to groom an area’s trails, to determine per hour or per mile/kilometer grooming costs. True False
4. A Daily Operator’s Log can:
 - e) be a waste of time
 - f) help document trails groomed, unusual events, and equipment use
 - g) increase liability
 - h) none of the above

Chapter Seven:

RECOMMENDATIONS for GROOMER OPERATOR CERTIFICATION

Purpose

It is recommended that groomer operators be certified to help ensure the proper operation and maintenance of snowmobile trail grooming equipment. Certification should consist of a combination of training and testing to help ensure equipment operators understand correct grooming principals, techniques, procedures and other pertinent subject matter. Certification can also help ensure that the expenditure of grooming funds results in smooth trails that are safe and hold up to snowmobile traffic as long as possible.

Who Should Be Certified?

While groomer operator certification requirements are ultimately a local decision by each state, province, territory, or subunits thereof, it is recommended that all groomer operators receive a minimum level of training and certification. In some areas, groomer operator certification may be mandatory in order for the grooming area to qualify for liability insurance. In all instances operator certification can serve as an excellent risk management tool, so it should be universally encouraged.

Since even experienced groomer operators can benefit from periodic training and refresher courses, it is recommended that, if an area adopts certification requirements, all operators receive the initial training as well as the initial certification, irrespective of their experience level or if they are an employee, volunteer, or contractor.

How Long Should A Certification Valid?

While the length of time a groomer operator certification is valid is a local decision, it is recommended that they be valid for no more than four years if the operator continues to operate the same type of equipment. If the grooming equipment is replaced with either newer models or a different type of tractor and/or implement, the operator's training and certification should be updated at that time to include training and certification for the new equipment.

Levels of Operator Certification

It is recommended that two levels be used for a Groomer Operator Certification Program:

- Level 1 – Trainee:** for those operators who have completed a minimum of four (4) hours of classroom training and successfully passed a written test.

Level 2 – Certified Groomer Operator: for those operators who have completed Level 1 requirements plus a minimum of 16 hours of supervised on-trail equipment checkout and operation.

It is recommended that a Level 1 Trainee Operator should not operate the grooming tractor without a Level 2 Operator or Grooming Manager/Instructor in the tractor with them. It is recommended that a Level 2 Operator be used to provide the minimum 16 hours of in-tractor equipment operation instruction to Level 1 Trainees.

Operator Certification Core Subjects

It is recommended that groomer operator certification relate to core subjects listed in Chapter One and covered by this Resource Guide, along with topics pertinent to local area conditions and procedures. The sample Groomer Operator Training Record checklist in the Appendix also provides a detailed list of potential training and certification topics. Additionally, the chapter quizzes in this Guide may be used by jurisdictions as a basis from which to develop local certification tests as applicable. Recommended core subjects for certification could include:

- **Introduction to Grooming:** glossary of terms; grooming objectives, principles and steps; basic snow physics; grooming manager and schedules; and the source of funding for the local grooming program.
- **Grooming Equipment Features:** general overview of tractors; tractor components and characteristics; front blades; general overview of implements; drag features; tillers; compactor bars; and snowmobiles as groomers.
- **Equipment Operation Guidelines:** operator safety; general operating guidelines; grooming basics; effective grooming tips for a drag; proper use of the front blade; tips for operating tracked vehicles; tips to avoid equipment damage; and Ten Common Operator Abuses.
- **Equipment Maintenance:** Four Elements of Preventative Maintenance; first time operation of new units; pre-season inspection and maintenance; pre- and post-operation/shift inspection; regularly scheduled maintenance; and off-season storage.
- **Record Keeping:** cover all logs and reports required by the local grooming program.
- **Local Issues:** local trail maps, trail routes, special closures or sensitive areas, local laws and regulations, emergency contacts and procedures.
- **Hands-On Equipment Operation and Check Out:** in-cab instruments and gauges, backing up the tractor, hooking implements to the tractor, starting and stopping, operating on the right side of the trail, side hill operation, front blade operation, implement operation, proper fueling procedures, pre- and post-operation visual inspections.

GLOSSARY OF TERMS

Compactor Bar: (Packer Bar)	A rear mounted bar with a plastic comb used to compress deep new snowfall (over 18 in. / 46 cm) prior to grooming the trail with a drag or for early season trail set-up.
Dead-Head Miles:	Return trip over the same trail because of a dead end trail.
Front Blade:	A front mounted blade used to doze snow drifts, to help pull new snow in from the sides of the trail, and to provide rear grooming implements a properly prepared surface to process the snow.
Groom:	To get into a state of readiness for a specific objective; to take care of the appearance of; to make neat and tidy = trail maintenance; the mechanical alteration of the snow to provide a safe, smooth surface for travel.
Groomed Miles:	Total miles put on the groomer during the process of grooming the entire trail system.
Groomer:	A grooming tractor equipped with grooming implements (drag, tiller, or compactor bar).
Groomer Operator:	An employee or volunteer that is in physical control of and operates the grooming tractor.
Grooming Drag: (Drag)	An implement pulled behind the grooming tractor which does the actual grooming of the snow on the trail bed. Also called a planer or surfacer by some manufacturers.
Grooming Manager:	A local official or club member charged with coordinating grooming activities, including establishing schedules and priorities. Some areas call this person the Trail Master or the Grooming Coordinator.
Grooming Speed:	The speed the groomer travels over the trail while performing the grooming operation (typically recommended to be 5 to 7 mph / 8 to 11 kph).
Grooming Tractor: (Tractor)	A heavy-duty, two or four-tracked vehicle for which the primary purpose is to provide the pulling power for grooming implements. Also called a Prime Mover.

Hours of Operation:	The time that the grooming tractor actually spends grooming the trails, not necessarily as recorded by the hour meter.
IASA:	The International Association of Snowmobile Administrators, which consists of state, provincial, territorial and federal government officials with responsibility for administering snowmobile trail, safety, and/or enforcement programs.
Miles of Trail:	One-way miles of trail in the system, including loops and dead-ends.
Moguls:	A pattern of mounds, dips, and ruts in a trail.
Operation Log:	Used to record the date, the hours of operation, miles of trail groomed as recorded by the vehicle odometer, time in and out, parts of the trail system groomed, and general comments regarding repairs and maintenance records.
Scarifier:	A blade used to scar icy surfaces to rough them up, usually mounted in the front row of multi-blade drags or on the bottom of the front tractor blade.
Snowmobile Trail:	A compacted snow road for use by snowmobiles and other authorized over-snow vehicles.
Tiller:	A hydraulically driven, rear mounted implement similar to a roto-tiller that mechanically processes and mixes snow.
Trail Bed:	The compacted snow surface or trail.
Trail Grooming:	The activity of producing a smooth, uniformly compacted snow surface with a uniform high density through the use of mechanical equipment.
Track Packing:	Using the tracks of the grooming tractor to pack the snow without the use of any grooming implements.

RESOURCES

A.F.M. Industrial – manufacturer of Trailmaker Drag and supplier of John Deere conversions and used equipment. Smith Falls, Ontario; toll free 800-325-7929 or 613-283-4001. www.afmi.ca

Aspen Equipment – new Bombardier groomers and used equipment. Upper Midwest USA: Bloomington, MN – 952-888-2525; Duluth, MN – 218-624-1111; Ankeny, IA – 515-965-1000; Omaha, NE – 402-894-9300. www.aspenequipment.com

ASV – manufacturer of Track Truck, DX, and Posi-Track vehicles. Grand Rapids, MN; toll free 800-346-5954 or 218-327-3434. www.asvi.com

Camoplast Industrial (formerly Bombardier Industrial) – manufacturer of Bombardier groomers. Headquarters – Granby, Quebec 450-776-3600; Northeast US and Canada – Granby, Quebec 612-759-0405; Western Canada – Calgary, Alberta 403-279-7271; Inter-Mountain US – Salt Lake City, UT 801-364-8266; Rocky Mountain US – Grand Junction, CO 970-242-7150; Far West US – Reno, NV 775-359-7517. www.industrial.camoplast.com

Charles Vogel Enterprises – manufacturer of Arrowhead Groomers and Ultra Arrow Track. St. Germain, WI; toll free 888-412-1722 or 715-479-4200. www.charlesvogelent.com/groomers

Cook's Equipment – Tucker Sno-Cat dealer, used equipment, and parts. Newport, VT; 802-334-7779. www.cooksequipment.com

Custom Snow Cat, Thiokol, DMC and LMC Parts – by machinist Pat Foster. Wallace, ID; 208-556-0153. <http://wallace-id.com/foster.html>

Ebert Welding – manufacturer of Sur-Trac Groomers. New Liskeard, Ontario; toll free 866-476-6899 or 705-647-6896. www.ebertwelding.com

Easy Pull Trail Groomer – pull behind snowmobile groomer. Two Harbors, MN; 218-834-2485. www.angelfire.com/biz/easypull/

Fall Line Corporation – aftermarket parts and drive sprocket recovering. Reno, NV; toll free 800-325-5463 or 775-827-6400. www.fallline.com

Hans-Hall – supplier for track belting, cleats, guides, and other parts. Murray, UT; 801-747-1110. www.hans-hall.com

HICO (Hydraulic Industries Corporation) – supplier of all types of snow groomer parts. Vaudreuil, Quebec; 450-424-5411. www.hico.ca

Institute for Snow Research – Michigan Technological University, Keweenaw Research Center; research on Snow Paver. Houghton, MI; 906-487-2750.
www.mtukrc.org

JACA – pull behind snowmobile grooming equipment. Jemseg, New Brunswick; 506-488-2075. www.jacatrax.com

LaCross Enterprises – manufacturer of LaCross Groomers and Front Blades. East Jordan, MI; 231-536-7142. www.lacrossgroomer.com

Lamtrac, Inc. – manufacturer of Lamtrac Groomers. Haut-Lameque, New Brunswick; toll free 888-526-8722 or 506-344-1130. www.lamtrac.com

Marcel Grooming Equipment – tractor conversion groomers and used equipment. New Liskeard, Ontario; 705-647-5444. www.marcelgrooming.com

Mattracks – rubber track conversion systems. Karlstad, MN; 218-436-7000.
www.mattracks.com

Maxey Manufacturing – manufacturer of Maxey drags. Fort Collins, CO; toll free 800-456-2939 or 970-482-1202. www.maxeymfg.com

Minnesota Outdoor Sports Specialties – used equipment. Brainerd, MN; 218-828-7876. www.mn-outdoors.com

Mohawk, Ltd. – dealer for Pisten Bully and used equipment. Chadwicks, NY; 315-737-5456. www.mohawk ltd.com

Mountain Grooming – manufacturer of Mtn. Snow Drag and dealer for Sur-Trac Groomers and used equipment. Waitsfield, VT; 802-496-3836.
<http://mountaingrooming.com>

Oak Creek Golf & Turf, Inc. – Pisten Bully dealer. Calgary, Alberta; toll free 888-773-7335 or 403-279-2907. www.oakcreekgolf.com

Okner's Supply Company, Inc. – replacement parts for snow groomers. Denver, CO; toll free 800-294-3579 or 303-294-9291. www.okners.com

Permagroomer Snowgrooming Products (Industrial Tires Limited) – custom urethane products for snow groomers. Mississauga, Ontario; toll free 800-668-4725 or 905-625-1600. www.industrialtires.com/products/permagroomer.html

Peterson Equipment – dealer for Pisten Bully and used equipment. Logan, UT – 435-752-5110 and Seattle, WA – 253-815-6899. www.petersonequipment.com

Pisten Bully / Kassbohrer All Terrain Vehicles – manufacturer of Pisten Bully grooming equipment. Offices: Grand Junction, CO 970-245-9331; Lewiston, ME – 207-777-7300; Burnsville, MN – 952-345-3330; Reno, NV – 775-857-5014.

www.katvpb.com

Ski Tech Products (Engineered Filtration, Inc.) – snow vehicle maintenance products supplier. Manchester, CT; 860-432-0248. www.skitech-products.com

Sno Boss Groomers (Olson Manufacturing, Inc.) – manufacturer of Sno Boss drags. St. Germain, WI; 715-479-3006.

Snow Country Groomers – dealer for Arrowhead drags, Arrow Trak, Marcel drags, tractor conversion kits, and used equipment. Lena, WI; 920-829-5196.

www.snowcountrygroomers.com

Snow Groomers.Net – manufacturer of Sno-Master pull behind snowmobile groomer. Harbor Springs, MI; toll free 800-430-7120 or 231-526-7120. www.snowgroomers.net

Snow Track, LLC – dealer for Sur-Trac grooming equipment. Wausau, WI; 715-675-7554. www.ebertwelding.com

Spooner Machine, Inc. – manufacturer of Spooner Drag. Spooner, WI; toll free 888-552-0835 or 715-635-3220. www.spoonermachine.com

Team Track – manufacturer of quad tractor conversion kits, front blades, and the Team Track Drag. Plessisville, Quebec; toll free 866-363-1688 or 819-362-2221.

www.go-track.com

The Resort Bone Yard – used grooming equipment. Chadwicks, NY; toll free 800-225-6642 ext. 265. www.resortboneyard.com

The Shop Industrial – manufacturer of Mogul Master drags and the TSI Compactor Bar; also dealer for Tucker Sno-Cat, Bombardier, Argo, and Centaur grooming equipment, as well as used equipment. Lively, Ontario; toll free 800-663-DRAG or 705-682-1522.

www.mogulmaster.ca

Track, Inc. – Tucker Sno-Cat dealer, used equipment, parts, and service. Bloomington, MN; 952-888-7372. www.trackinc.com

Tucker Sno-Cat Corporation – manufacturer of Tucker Sno-Cat groomers. Medford, OR; toll free 866-SNO-CAT1 or 541-779-3731. www.sno-cat.com

VMC Right Track, Inc. – manufacturer of VMC groomers. Lachine, Quebec; toll free 800-985-8665. www.vmcrighttrack.com

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Black Hills Snowmobile Program Operations Manual; South Dakota Department of Game, Fish & Parks – Division of Parks & Recreation. 2004.

California Snowmobile Trail Grooming; California Department of Parks and Recreation – Off-Highway Motor Vehicle Recreation Division. 1997.

California Trail Grooming Operator Certification and Training Handbook; California Dept. of Parks and Recreation – Off-Highway Motor Vehicle Rec. Division. Nov. 1999.

General Guidelines for Snowmobile Trails Grooming – Training Manual and Workbook; New York State Office of Parks, Recreation & Historic Preservation – Bureau of Marine & Recreational Vehicles. May 1999.

Groomer Operations Manual and Trail Signing Guide; Colorado State Parks and the Colorado Snowmobile Association. 2003.

Gullett, W. (Tony); Wyoming State Trails Program, personal communication – grooming equipment operation, practices, and tips. March 2005.

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Pisten Bully 100 Operating Manual; Kassbohrer All Terrain Vehicles. 2004.

Snowmobile Groomer Operator Awareness Program; New Hampshire Dept. of Resources and Economic Development, Div. of Parks and Recreation – Bureau of Trails. 2004.

Snowmobile Trail Development Manual – Chapter 6: Trail Grooming; Alberta Snowmobile Association. October 1999.

Snowmobile Trail Development Manual – Chapter 7: Trail Grooming; Ontario Federation of Snowmobile Clubs. 1996.

Snowmobile Trail Grooming Guidelines; New Hampshire Department of Resources and Economic Development, Division of Parks and Recreation – Bureau of Trails. November 2002.

Snowmobile Trail Grooming Handbook; Michigan Department of Natural Resources. September 2000.

The Shop Industrial – Mogul Master Multi-Blade Planer Operating Manual. 2001.

Wells, Chuck; Idaho Department of Parks and Recreation, personal communication – tillers. February 2005.

Wyoming Snowmobile Program Operating Manual; Wyoming Division of State Parks & Historic Sites – Trails Program. 2002.

Appendix:

SAMPLE FORMS

Several sample forms are provided in this Appendix to help grooming managers and operators with the important task of record keeping. Every form has a specific purpose, although not every example may be pertinent to every area. The samples should be used by grooming managers to build a form that best fits their area and needs. The following sample forms are included in this Appendix:

- Weekly Grooming Schedule
- Daily Grooming Log
- Vehicle/Equipment Report
- Monthly Maintenance Records (can be copied on back side of Vehicle Report)
- Grooming Equipment Maintenance Requests
- Corrective Action Request
- Groomer Operator Training Record

DAILY GROOMING LOG

Date _____ Area _____ Operator _____

Sequence of Trails Groomed _____

Tractor _____ Implements _____ Width _____

Operator's Time: In _____ Out _____ Total Operator Hours _____

Odometer Begin _____ Odometer End _____ Total Miles Groomed _____

Hour Meter Begin _____ Hour Meter End _____ Total Tractor Hours _____

Temperature Range _____ Inches of New Snow _____ Traffic _____

Weather (circle all that apply): Clear Cloudy Sunny Windy Snowing Raining Other: _____

Remarks: _____

Pre-Shift Check List (Warm Up tractor for a minimum of 10 minutes)

Fuel Tank Full _____ amt. added Belts Gauges Track Grousers
 Engine Oil _____ amt. added Lights Wipers Track Belts
 Hydraulic Oil _____ amt. added Battery Mirrors Track Tension
 Anti-Freeze _____ amt. added Beacon Radio/Phone Track Wheels
 Wiper Fluid _____ amt. added Tools Shovel Hydraulic Hoses
 Fire Extinguisher Ice Scraper Flashlight Implements Survival Gear

Checked Out By: _____

End of Shift / Shut-Down Checklist (Idle tractor for a minimum of 10 minutes)

Fill Fuel Tank _____ amt. added Water Separator Checked Shoveled Off
 Implements in Down Position Brake On Plugged In Key Off
 Radio/Phone Off Maintenance Needs Recorded Daily Log Completed

Average Gauge Readings During Run: Engine RPM _____ Engine Temperature _____

Oil Pressure _____ Hydraulic Temperature _____

Checked In By: _____

Special Notes, General Comments, Repair Work Needed, Explain Any Downtime, etc. in space below:

VEHICLE & EQUIPMENT REPORT

Report Month/Year _____ Vehicle/Equipment Description _____
 Make _____ Model _____ Year _____ Unit # _____

DATE	OPERATOR	GALLONS OF FUEL	BEGIN HOURS	END HOURS	DESCRIPTION OF ACTIVITIES
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
Totals:	Gallons of Fuel:		Hours:		

VEHICLE/EQUIPMENT MONTHLY MAINTENANCE RECORDS – record dates, quantity, costs

Engine Oil: Change & Add						
ATF						
Grease & Lube						
Anti-Freeze						
Washer Fluid						
	Fluids – Total Cost \$:					
Oil Filter						
Transmission Filter						
Air Filter Cleaned						
Air Filter Replaced						
Fuel Filter						
	Filters – Total Cost \$:					
Axle						
Bearing/set						
Washers	Small		Large			
Bogie Wheel – small						
Bogie Wheel – large						
Ice Breaker Wheel						
Drive Sprocket						
Track Belt						
Track Cleat						
Tightner Bolt						
Track Bolts						
Connector Bolts						
Spring Bolt						
	Tracks – Total Cost \$:					
Tie Rod Ends						
Trunion						
Nylon Block	Small		Large			
Drive Shaft & U-Joints						
	Steering and Drive Train – Total Cost \$:					
Water Pump						
Thermostat						
Alternator						
	Engine Components – Total Cost \$:					
Lights	Flood		Spot			
Strobe Light						
Switch						
Wipers & Blades						
Transmission Heater						
Battery						
	Electrical – Total Cost \$:					
Hydraulic Pump						
Hoses & Fittings						
	Hydraulics – Total Cost \$:					
Major Service/Overhaul						Cost \$
Other						Cost \$
Labor						Cost \$
	Total Monthly Maintenance Cost:					

GROOMING EQUIPMENT MAINTENANCE REQUESTS

Equipment Name/#: _____ Date: _____ Requested By: _____

Hour Meter Reading at time of Request _____ Odometer Reading at time of Request _____

ITEM	OK	NO	COMMENTS	ITEM	OK	NO	COMMENTS
Fuel				Steering			
Motor Oil				Brakes			
Hydraulic Oil				Controls			
Transmission Fluid				Heater/AC			
Anti-Freeze				Mirrors			
Washer Fluid				Wipers			
Brake Fluid				Controls			
Hydraulics				Beacon			
Transmission				Backup Alarm			
Rear End				Windows			
Tracks/Tires				Engine Temperature			
Front Blade				Hydraulic Temperature			
Drive Belts				Transmission Temperature			
Alternator				Gauges			
Hoses				Radio/Phone			
Exhaust				Air Filter			
Leaks				Horn			
Loose Bolts				SMV Sign			
Loose Objects				Cab Interior			
Teeth/Edges				Remove Snow/Ice			
Linkage/Tie Rods				Shovel			
Hinge Pins				Fire Extinguisher			
Hitch				First Aid & Survival Kits			
Lights				Tools, Tow Ropes, Etc.			
Seat Belts				Other			

CORRECTIVE ACTION REQUEST

PART 1 – Condition Needing Attention:

Location:

Recommended Action:

Reported By: _____ Date: _____

PART 2 – Corrective Action Taken:

Verified By:

Date:

GROOMER OPERATOR TRAINING RECORD

Operator's Name _____ Date _____

Trainer _____ Equipment Certified _____

Signature of Operator – Acknowledgement of Training _____

Introduction to Grooming	√	Equipment Operation	√
Glossary of Terms		Operator Safety	
Grooming Objectives		General Operating Guidelines	
Grooming Principles		Grooming Basics	
Grooming Practices		Effective Grooming Tips / Drag	
Basic Snow Mechanics		Operating Tracked Vehicles Tips	
Grooming Manager		Tips to Avoid Equipment Damage	
Grooming Schedules		10 Common Operator Abuses	
Source of Funding		Front Blade Tips	
Grooming Equipment Features	√	Equipment Maintenance	√
General Overview of Tractors		4 Elements of Prevent. Maintenance	
Tractor Components		1 st Time Operation of New Unit	
Tractor Characteristics		Pre-Season Inspection & Maintenance	
Front Blades		Pre-Operation/Shift Inspection	
General Overview of Implements		Post-Operation/Shift Inspection	
Grooming Drag Features		Regularly Scheduled Maintenance	
Tillers		Off-Season Storage	
Compactor Bars			
Snowmobiles as Groomers			
		Record Keeping	√
		All Required Logs & Reports	
Local Issues	√	Vehicle Check-Out Run	√
Trails Routes & Maps		In-Cab Instruments & Gauges	
Signing Guidelines		Backing & Hooking Up Implement	
Special Closures or Sensitive Areas		Start and Stop	
Local Laws		Operation on Right Side of Trail	
Emergency Procedures		Front Blade Operation	
		Implement Operation	
		Fueling	
		Pre & Post Visual Inspection	