Finding the Right Words

It seems every snowmaking department has its own way of describing its snowy product. Here's an attempt to find a common set of terms.

by Yaroslav Stanchak

The Eskimos (correction: the Inuit) have a multitude of words to describe the various types and states of the natural snow that so greatly impacts their daily lives. In the scientific world, Ukichiro Nakaya, in his seminal work "Snow Crystals—Natural and Artificial," identified seven different classes of snow crystals with more than 40 sub types.

Unfortunately, in the case of snowmaking terminology, the descriptions of snow quality vary from resort to resort. Each snowmaking department has its own individual and unique language for describing machine-made snow.

How should we describe the various types of snow that we want to make at different times and for different purposes? A standardized vocabulary or system would benefit everyone. To knowledgeably identify the quality of snow being produced, a snowmaker needs to have a full understanding of not only the basics, such as wet bulb temperature and wind, but the more difficult variables such as snow gun type and the amount of retained unfrozen water in the actual snow crystal.

Sleeve and Snowball Tests

Measuring unfrozen water content is a tedious process requiring special equipment and instrumentation. However, there are two readily accessible methods to judge the quality of machine-made snow. One method, the much-maligned sleeve test, permits rapid snow quality evaluation. The other, the snowball test, is more time-consuming.

The object of both methods is to find the wettest snow crystals produced by the snow gun in order to make the appropriate adjustments. This is done by physically finding the area within the snow gun plume, usually where the snow deposition is the heaviest. This job is not as easy as it sounds, especially when the wind velocity and direction are constantly changing. And if the snowmaker does not follow this procedure properly and come up with an accurate snow quality evaluation, the ensuing water adjustments may well end up producing snow that is too wet or too dry.

The sleeve test, when used by an experienced snowmaker, will yield the desired snow quality quickly. This method requires considerable experience and practice time under the snow gun plume. In essence, the snowmaker observes the size of the snow crystals and watches their behavior as they hit the sleeve of his protective jacket. Completely frozen snow crystals will bounce off the sleeve, partially frozen crystals will stick to the sleeve, and totally unfrozen particles will splatter. The various types of snow quality will produce different combinations or percentages of bounce and stick. There are many subtleties to this method, and it is best learned when combined with the snowball test.

This procedure, which is easier to learn, still requires the evaluation of snow quality to take place in the area of heaviest and wettest snow deposition. This method uses the simple procedure of scooping up the snow and making a snowball. The characteristics of the snowball are then used to determine the quality of the machine-made snow. The basic characteristics are ability to form a snowball, texture, color and water content.

Snow quality can be described by the ability of machine-made snow to form or not form a snowball. We can further refine our characterization by describing the type and water content. For initial identification purposes, this simple chart describes three basic types of snow quality that we will continue to refine.

1	**Powder**	**Snowball cannot be formed**
2	**Production**	**Snowball can be formed**
3	**Slush**	**Snowball can barely be formed**

In most cases, machine-made snow is some version of Production-quality snow.

How Areas Define Snow Quality

To further refine our definitions we spoke with a number of experienced snowmakers across North America. They have very similar approaches, but use different vocabularies. For instance, Sid Badger, of Bromley Mountain, Vt., talks about the "Heavy Production" snow he wants for early season snowmaking. This forms a firm snowball that does not break apart, and exudes a drop or two of water when squeezed. In the sleeve test, this type of snow sticks to his protective jacket and does not easily fall off.

As the season progresses, Bromley shifts to a drier "Production" snow that forms a dry firm snowball. This snow sticks in the sleeve test but can be easily shaken off after a few moments. Badger said that machine-made snow that fully bounces off the surface of the jacket is produced only under special circumstances.

Bill LeClair, snowmaking manager at Keystone Resort, Colo., looks for the

same early season snow which he calls "Minus Production" snow. Once a base is formed he looks for what he calls "User-Friendly" snow and he also likes to make "Finish" (dry, bounce-on-the-sleeve) snow to finish a trail.

LeClair also believes that resorts should minimize the number of different types of snowmaking equipment used, to remove that variable from the snowmaking process and to reduce confusion among inexperienced snowmakers.

Randy Barrows, snowmaking manager at Mount Snow, Vt., uses the ASC Snow Link, a pressure gauge-based water flow adjustment system, makes a range of snows from "Powder" to "Heavy Production." "Powder" is a snow that does not form a snowball, while Barrows describes "Heavy Production" as "almost too heavy." It is gray and requires a long cure time. The in-between qualities are called "Snowball Stick" (producing a firm white snowball that cannot easily be broken) and "Stick" (yielding an easily broken snowball).

Barrows also mentioned that temperature affects the size of the snow crystal produced for a given snow quality: Snow crystals tend to increase in size as the snowmaking temperature drops.

Mike Mueller, snowmaking manager at Massanutten Resort in Virginia, uses a "Base Production" snow the majority of the time (80 percent) during seasonal snowmaking operations. He describes this snow as a firm white snowball that releases a drop or two of water when squeezed. In the sleeve test, the snow sticks to the jacket sleeve, yet it can still be brushed off. There are instances in mid-season when a "Production" snow is used—in the sleeve test, this snow sticks to the jacket but can be easily shaken off. To dry out the snow for ski-under situations, the area shifts to a snow quality where the majority of the ice crystals bounce off the jacket sleeve. He emphasized that "Powder" snow is a luxury this far south, where it is a struggle just to keep the surface properly covered.

Mueller also noted that he uses the "Boot Kick Test" to judge the finished snow product—the snow is displaced and easily falls apart without clumping of large snow pieces. Mueller says, "In Virginia, you want to lay down the most effective snow product that will stick to the surface."

Lance Miles, snowmaking manager at Steamboat in Colorado, uses three basic types of snow quality for snowmaking operations. He describes "Land Fill" snow as the quality used for filling in large areas during early season and for forming racecourses. This snow quality forms a white snowball that produces a couple of drops of water when squeezed. The majority of time during the season, "Durable Snow" is used for high wear areas and snowboard parks – this quality yields a firm white snowball not easily broken—"it will hurt if it whacks you." If a trail is to be groomed immediately after snowmaking, the snow quality is upgraded to an "easily crumbled snowball." He mentioned that for ski-under purposes they shift to a "Ski Quality" snow that does not form a snowball and bounces off the jacket sleeve.

In addition to helping staff in-house, common snowmaking terminology could also help mountain resort buyers make informed decisions about what snowmaking equipment their area needs.

Common Ground

The above comments all show a thread of similarity through the various quality descriptions. These descriptions have some commonality with a snow chart system that was first developed by Sno-Max of York Snow for use during snowmaking testing. This chart contains all the basics within a numbering system of 0 to 10. The numbering system and names are related to snow density or unfrozen water content.

0/1 Very Dry Snow: A snowball cannot be formed.
2/3 Dry snow: A snowball can be formed, returns to its initial state after breaking.
4/5 Medium Snow: A snowball can be formed, but does not return to its initial state after breaking.
6/7 Wet Snow: The snowball is icy, grey and does not break.
8/9 Very Wet Snow: Numerous droplets are expelled during the compression.
10 Slush: So much unfrozen water that a snowball can barely be formed.

The snow quality issue has been taken forward an additional step by the Intrawest corporation. Tony Osborne, VP of project management, indicated that Intrawest has conducted research on this issue since the winter of 1996-97. It has developed a comprehensive description of snow quality that has been fleshed out with the grooming aspects that are important for the final snow surface. (This marriage of snowmaking and grooming has been noted by other areas, and underscores the need for proper snow quality descriptors in order to produce the desired skiing surface.) Below is the Intrawest snow quality chart and associated comments on grooming and cure time.

1 Very dry; snowball cannot be made; low resistance to traffic; no cure required.
2 Dry; cannot squeeze out water; snowball

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easily broken; no leaching; white; not stick to goggles; not high traffic; 24 hr. cure.
3 Moist; no squeeze water but snowball difficult to break; some leaching; white snow; good blade & tiller teeth required; 48 hr cure.
4 Wet; can squeeze out water and significant leaching; if groom early will go to gray ice with skiing; 72 hr. cure.
5 Wet, slush, will freeze to gray ice; water drips from handful, extensive cat work to make skiable; wait for freeze for cure.

In looking at these two good examples in combination with individual area descriptions, some commonalities start to emerge. It's clear that the principal snow qualities used for the majority of snowmaking operations in North America can be simply described by four basic categories, based on the snowball test, with two extreme categories for contrast purposes. With that in mind, here's a proposed system:

P++ or 1 Skiers' Nirvana Powder, or "dollars out the door."
P+ or 2 Powder Snow that cannot be packed into a snowball.
P* or 3 Snow that can be packed into an easily crumbled snowball.
P or 4 Snow that produces a firm white snowball.
P- or 5 Snow that produces a wet gray snowball.
P- - or 6 Better than dirt; Snow that is wet, sloppy, gray and generally ugly.

These categories provide most beginning personnel and neophyte snowmakers with a common starting point to understand snow quality. The letters or numbers can be used interchangeably.

More precise descriptions of these snow quality types are as follows:

P++, or 1—Dry snow that is light and fluffy; snowball cannot be formed; generally high in energy cost in marginal temperature ranges and more reasonable in cost during cold weather. Not used very often except by snowmaker error or inexperience.

P+, or 2—Effective powder snow that cannot form a snowball. Used for ski-under snowmaking operations. Experienced snowmakers can produce this type of snow with a minimal impact on operational efficiency.

P*, or 3—Snow that can be formed into an easily crumbled snowball. Requires very minimal cure time and can be readily groomed. Requires some skill to duplicate consistently.

P, or 4—Snow that produces a firm white snowball; most common type of machine-made snow. The damper side of this category is probably the most productive type of snow. No losses from water leaching out of the snow. The majority of snow made during snowmaking operations at many resorts.

P-, or 5—Snow that produces a gray wet snowball; readily drips water. Requires a lengthy cure time and will leach unfrozen water into surrounding downhill snow. Used at times during early season to bond to underlying rock or dirt.

P--, or 6—Better than dirt; Snow that is wet, sloppy, gray and ugly.

This attempt to provide a common basis for describing snow quality is meant to be a simple starting point for a more serious and comprehensive descriptive system. Your comments and feedback are most welcome and will be crucial to the process. Please address comments to slavko@saminfo.com or snail mail *SAM* (address on masthead).

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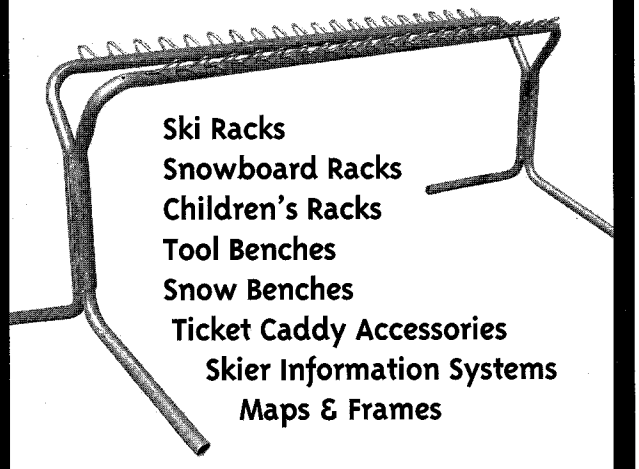

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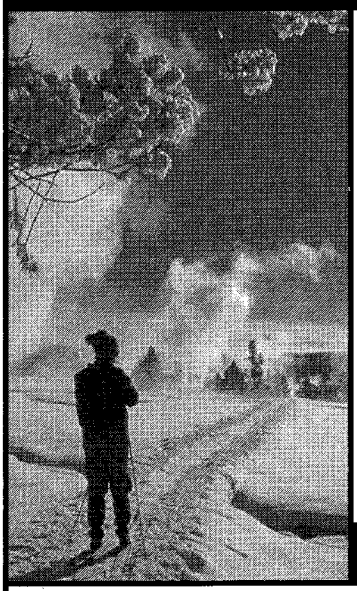

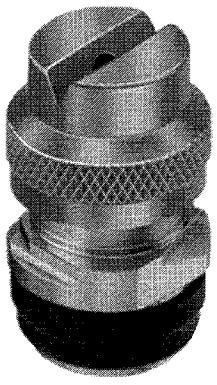

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