Using **Sleds** for Sports Performance

While pushing a sled loaded with multiple 45lb plates might make for a popular Instagram picture, utilizing an excessively heavy load is one of the most common errors associated with sled training for sport performance. Sled training actually falls under a category of sports performance called drag training. It can be used for short-burst reactive strength as well as improvements in strength endurance. The two most common sled uses are: 1) dragging a weighted sled at near-maximum velocity, and 2) explosively pushing a heavier sled over short distances. Both styles of sled training add intensity to a training regimen, but serve totally different purposes. Recall the principle of specificity, which states *"for a desired adaptation to occur, a stress demand must be appropriately and specifically applied to the systems responsible"*. This concept should be used when working with sleds for the purposes of improving speed and performance.

With specificity in mind, it makes sense that lighter loads at near-maximal velocity will place advanced stress on repeat sprint performance, promote measures of peak power, and enhance neural properties of local musculature. The lighter weight used for drag training allows for normal sprint mechanics; consequently enhancing the potential for repeat sprint capabilities at high speed referred to as speed strength/endurance. Pushing a sled is completely different. Its purpose is optimizing the strength-to-power conversion in the hip extensor musculature. The forward lean position changes normal mechanics associated with high-speed locomotion but increases hip drive. If the target goal is improving sprint velocity, the velocity must remain high. Commonly, coaches get bogged down with the idea that heavier is better – but that is the opposite of correct. Velocity is improved with maximal and near-maximal training drills at velocities above 90% of max speed. Another key concept to remember is that sport training is not about burning calories, it is about conserving calories through improved movement efficiency, neuromuscular, and metabolic enhancements

so appropriate work-to-rest ratios should be employed.

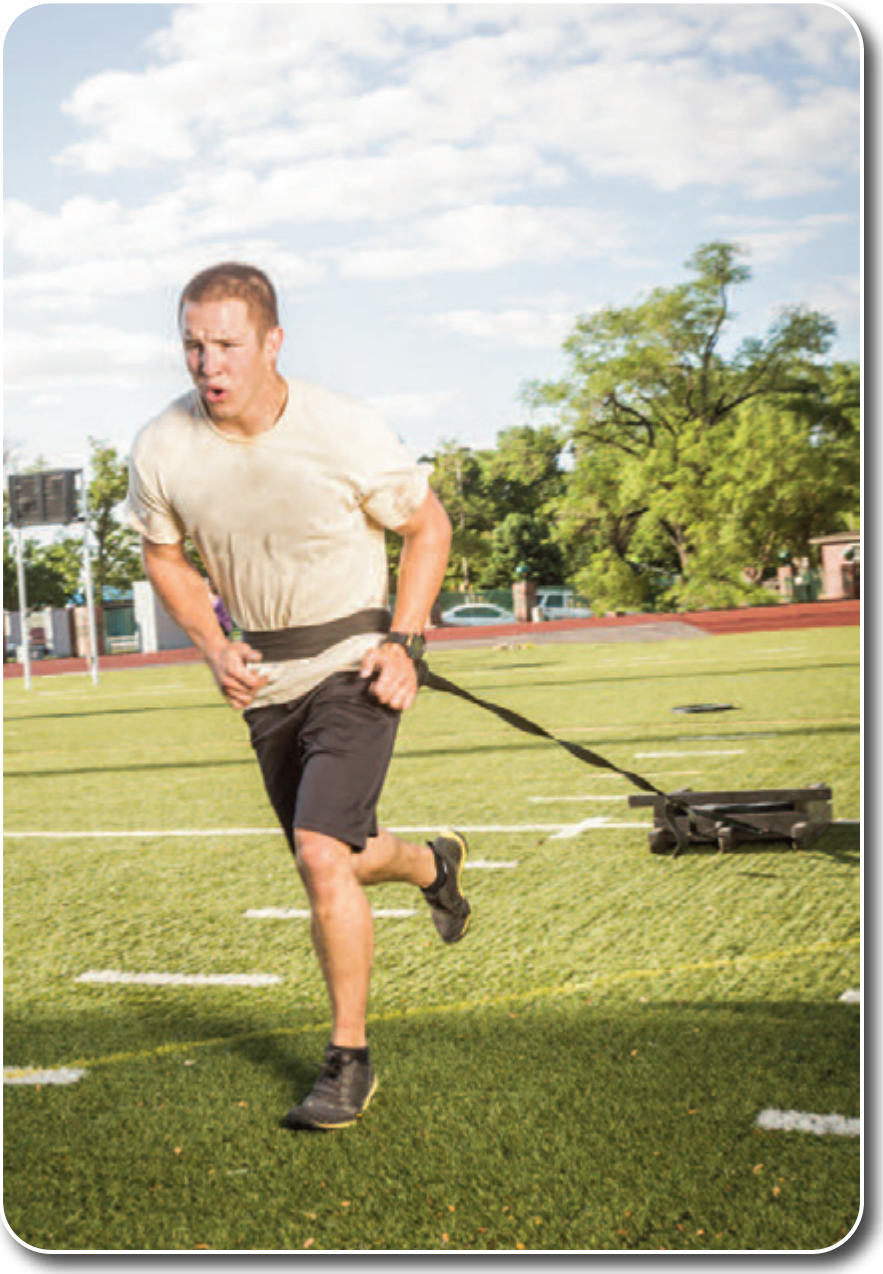
Because linear speed requires a constantly-elevated center of mass (COM), dragging the body down is detrimental. Therefore, the loading should be employed to enhance the stabilizing system of the trunk to further promote control over both vertical and horizontal forces, but not change its activity by promoting a forward lean. The higher the COM = the less force needed to move the mass. Therefore, any coach implementing sled training must be constantly vigilant to avoid changes in running technique. When a sled is too heavy or an athlete is too weak to maintain desirable running mechanics, the first tendency is to flex the hips, thus shortening stride length and frequency and lowering the COM – both of which are counter-intuitive to maximal velocity training.

Pushing a sled is different. The height of the push may be adjusted based on the purpose of the exercise, and arms may be flexed or extended depending on spine-angle goals. Again, loading the sled with too much weight or driving the sled too far are both counterintuitive to the goals of the activity. The ballistic hip cycle used for sled drives promotes improved reaction time during quick-burst starts and adds to extension force. Short distances at maximal speed should be used.

Load Selection

As described previously, dragging a sled with excess weight will diminish adaptations and can negatively impact running mechanics. Therefore, selecting the appropriate load is integral to successfully implementing drag training. A review of literature on the topic recommends external loading of 3.8% BW to maintain sprinting kinematics at peak velocity. Empirical data suggests 5% is effective for distances of 40yds or greater (40yds to allow for maximum running speed). It is clear that high loads of 15-20% BW negatively affect sprint kinematics as indicated by decreased step lengths and frequency. Loading at that level also increases stance-phase duration as well as trunk and knee angles while also decreasing swing phase duration when compared to un-resisted sprinting.

In order to identify an appropriate load, it is recommended that max sprint velocity be tested first as the velocity of drag training sprints should not fall below 90% of the athlete's maximum velocity.



In order to find the optimal load for resisted sprinting using sleds, equations have been developed for the acceleration and maximum velocity phases of a sprint:

Acceleration Phase Sled Load:

%Body Mass = (-1.96 × %Velocity) + 188.99

Maximum Velocity Sled Load:

%Body Mass = (-0.8674 × %Velocity) + 87.99

Where % velocity = the required velocity as a percentage of maximum velocity

Taking into account the sled load, the load that should be added to the sled can be quantified as follows:

Load = (Body Mass × %Body Mass) – Sled Weight

For example, a coach wants to identify the appropriate loading for a **220lb** athlete during a **maximum velocity** phase while maintaining **95% maximal velocity** with a **sled that weighs 10lbs** unloaded.

%Body Mass = (–0.8674 × **95**) + 87.99
%Body Mass = –82.403 + 87.99
%Body Mass = 5.587

Load = (**220lbs × 5.587%**) – 10lbs
Load = 12.914lbs – 10lbs
Load = 2.914lbs

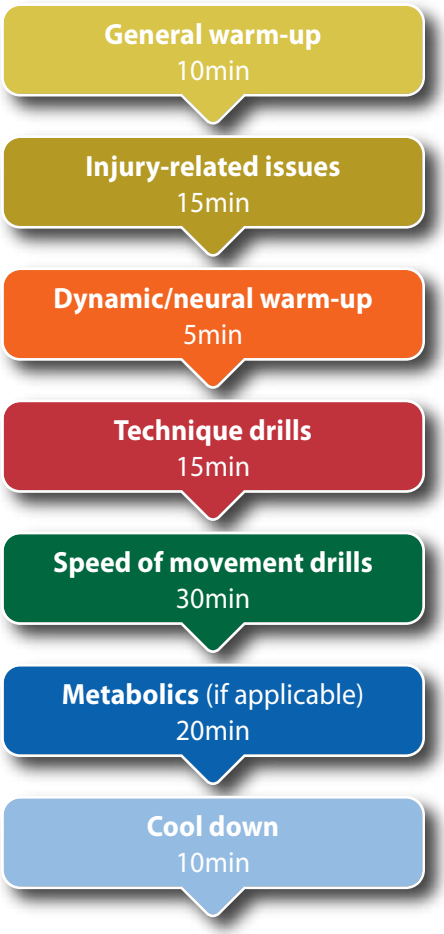
Therefore, the coach should use 5.587% (12.914lbs) of the athlete's weight to maintain 95% velocity during a sprint session, or roughly 3lbs added on to a 10lb sled.

Phasic Programming

Creation of the speed program requires progressive application of stressors to stimulate each component of speed as integral building blocks; this suggests an overlap of adaptation occurs. During the speed strength/endurance phase, longer drag training of 40-50m may be appropriate. Ensure that athletes are loaded appropriately to the desired velocity using the above equations.

An 8-week study of sled sprinting versus un-resisted training using 4x20m and 4x50m distances identified that the two training styles target different goals. Subjects who performed drag training with a sled+5kg had increased velocity in the first 20m of a 50m sprint and increased stride rate overall (speed-specific strength). The un-resisted subject group increased the velocity during the max velocity phase of the sprint (20-50m) as well as stride length. The sled training also improved acceleration and leg power performance as identified by squat and drop jump testing.

A single speed session can be composed of roughly 7 individual sections. Not all sections need to be included as duration and inclusion of each depends on the goal of the session. Furthermore, the length of the section is dependent on goal and work-to-rest ratio (more is not better). The general structure of a speed session including rest is as follows:



Durations are maximal estimations and each section is not necessarily used every bout with the exceptions of the warm-up and cooldown.

Sled Pushing

A Different Style of Training

Pushing the sled functions as a resisted locomotion drill that can be used to increase hip strength/endurance, reactive strength and speed power. Sled pushes are not technically considered drag training but still function as a utility for power training. Sleds pushes can be loaded to form, but should be used conservatively over 5-10m. The spinal position should be monitored as fatigue can cause changes in pushing mechanics and the head should not drop. Therefore, using a low position is not as desirable as a mid-height drive as the hips are in a better position to drive forward and the spine remains un-flexed. The technique of "knee punching" should be taught to athletes to effectively produce optimal force but hip extension bounding is a necessary pre-requisite.

Sled pushes allow for greater loading than sleds pulls or drags; generally up to 30% BW depending on the speed of movement desired. When progressing athletes, focus on turnover speed, not increased loading. Over the course of a multi-week speed development program, heavy drag training (5-10m) should be included during the later phases.

Other Considerations

Sled training is one style of drag training. Other tools that can be used to achieve similar adaptations include parachutes, bungee cords, and sand (increased drag on each contact). Furthermore, sled construction material and surface will also affect loading due to fluctuations of the frictional coefficient. For example, pulling a sled across slightly damp turf will have far less friction (resistance) than pulling a sled across a poorly maintained grass field.

Conclusion

The key concept to take away from this article is that sled training, whether as a push or a pull should be focused on speed and technique over loading. Sled pulls performed 40-50m should be kept at 90% of maximal velocity and above, thus warranting total drag loading of roughly 5% BW. Sled push distances need to be much more conservative, around 5-10m with maximal loading at or around 30% BW. While the information provided in this article covers sled training in general, not all sports warrant the same exact style of training. It will be the responsibility of the strength coach or exercise professional to apply their speed development program to the needs of their athletes.