Workout Variations Revealed

What Your Personal Trainer Doesn’t Want You to Know

By Pete Sisco
Productive strength training involves a systematic progression of muscular overload that can lead to lifting very heavy weights. Proper warm up of muscles, tendon, ligaments and joints is mandatory at the beginning of every workout. Although exercise is very beneficial, the potential for injury does exist. Pete Sisco, his agents, affiliates and employees will not be held liable for injuries sustained while lifting, using or moving weights and exercise equipment in a gym or elsewhere. Always consult with your physician before beginning any program of progressive weight training or other exercise. If you feel any strain or pain when you are exercising, stop immediately and consult your physician.
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Have you ever wondered why technology races ahead in virtually every area of human endeavor but people still go into gyms to improve their health by lifting iron barbells invented in the 19th century? Moreover, they receive advice to lift with lighter weights, or heavier weights, or more sets, or fewer. And nobody really knows which works better. Or what combination generates more intensity. Or what would serve your personal priorities better. The truth is, it’s pretty much all guesswork. Yet there really is no good reason for it to be guesswork. The simple application of basic arithmetic yields enormous insight into what happens when we blend the variables of weight, sets, reps and time.

Why We Tested

We wanted to know the level of intensity that is generated by doing one, two or three sets of an exercise or other variations of sets and reps. We wanted to see the results side by side so we could make educated conclusions. Such information would stand in stark contrast to the gym lore that pervades every medium of fitness information. “Use this technique to go to positive failure and then do some quality sets to fully hit the muscle.” Huh? Exactly how was that quality measured? How fully does it ‘hit’ the muscle compared to other options? And what is the definition of “hit”?

The truth is there is almost zero measurement in gyms. How many professional trainers do you see at your gym who are using a stopwatch to time how long it takes their clients to perform an exercise? It is mathematically impossible to know the intensity of a person’s exercise performance without knowing the time it takes him or her to complete that exercise. Doing 12 reps with 100 lbs in one minute is twice as intense as doing it in two minutes. But you never see a personal trainer calculating intensity? What was I saying about the 19th century?
What We Tested

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<th>VARIATION</th>
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<td>One set to failure</td>
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<td>Two sets to failure</td>
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<tr>
<td>Three sets to failure</td>
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<tr>
<td>Strip sets (reducing weight on consecutive sets)</td>
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<td>Pyramid sets (increasing weight on consecutive sets)</td>
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<tr>
<td>Timed sets (3 minutes of lifting one weight)</td>
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<td>Fixed sets (100 reps with one weight)</td>
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We tested the most common variations used in the gym.

We measured the weights lifted, the number of sets and reps and the time it took to complete each exercise. This data was used to calculate the intensity of muscular output.

There are two forms of strength that humans manifest and they require two different units of measurement. The strength to lift a heavy object can be called momentary strength and the exercises that build that strength need to have maximum momentary intensity. That can be measured by the formula of weight/time. If you lift a total of 2,000 pounds in one minute your intensity is 2,000 lbs/min. I call that unit of measurement the Power Factor. It measures momentary intensity.

A biceps exercise that permits you to generate a Power Factor of 1,300 lbs/min is better than a biceps exercise that generates 900 lbs/min. And it’s a better exercise because it can be mathematically verified by anyone - not
because Joe Bodybuilder said it’s better and Joe won a state championship one year.

There is also a second form of muscle strength; the ability to maintain high intensity for a long period of time. This is the capacity to run ten miles instead of having your legs give out after three miles. No matter how much you can leg press, this is a different form of strength. We can measure this by quantifying both the intensity and how long it is sustained. I call this unit of measure the Power Index.

Although I am an advocate of using only the strongest and safest range of motion when doing heavy exercise, we chose to run these tests using the same full range, conventional method used by 99% of people in a gym.

Subjects performed conventional, full range bench presses and leg presses. These are both common exercises and were done in the common manner.
Who We Tested

We asked for volunteers from our e-mailing list. We selected eight men who happened to live in four different countries and averaged 52.3 years of age. (Youngest 42, oldest 60.) The subjects performed only the exercises in our tests and did not do other strength training workouts during the weeks of the testing. One protocol (e.g. Pyramid sets) was performed at a time and each protocol was approximately eight days apart to allow for full recovery.

All of the above said, these results represent what I would call a first approximation. When we want to discover new knowledge in science we probe in different directions to see if we find something promising. As you will soon see, we have found many interesting things that clearly illustrate some lifting techniques yield better results than others. This is very useful information. But more of this investigation is needed so that we learn the results with different age groups or different muscle groups or different ratios of weights lifted to bodyweight. Over time science will provide this knowledge but there has to be some demand for it. As long as people blindly work out using any exercise and any methodology without ever asking for proof of its effectiveness there won’t be much demand for better exercise science so the additional studies won’t get done.
The Testing

**One set to failure:** Subjects performed one set to failure using a conventional full range of motion. For the bench press they used 50% of their bodyweight and for the leg press they used 100% of their bodyweight.

**Two sets to failure:** Subjects performed one set to failure using a conventional full range of motion. They took as brief a rest as possible to recover then performed a second set the same way. They left the watch running through the rest period and measured the time from the first rep of the first set to the last rep of the second set. For the bench press they used 50% of their bodyweight and for the leg press they used 100% of their bodyweight.

**Three sets to failure:** Subjects performed one set to failure using a conventional full range of motion. They took as brief a rest as possible to recover then performed a second set the same way. They took as brief a rest as possible to recover then performed a third set. They measured the time from the first rep of the first set to the last rep of the third set. For the bench press they used 50% of their bodyweight and for the leg press they used 100% of their bodyweight.

**Strip sets:** Strip sets go by other names but the principle is to remove weight from the bar so that additional sets and reps are possible. Subjects started with a heavy weight with which they could only perform about 10 reps. After lifting it to failure they removed 20% of the weight and did another set to failure. Then they stripped off the same amount of weight (20% of the original) and did another set to failure. Finally, they stripped off the same amount and did a fourth set to failure.
**Pyramid sets:** Pyramid sets go by other names, like ladder sets, but the principle is to increase weight on the bar so that additional sets have fewer reps. Subjects started with a weight with which they could perform 30 or more reps. After lifting it to failure they added 20% of the weight and did another set to failure. Then they added the same amount of weight (20% of the original) and did another set to failure. Finally, they added the same amount and did a fourth set to failure.

**Timed sets:** In this test subjects had three minutes of total time to perform as many reps as possible. It did not matter how many sets or rest periods it took. It could be one set or five sets. This test was to measure the intensity generated by subjects lifting for three minutes on the clock. For the bench press they used 50% of their bodyweight and for the leg press they used 100% of their bodyweight.

**Fixed sets:** In this test subjects performed exactly 100 reps. It did not matter how many sets or rest periods it took. It could be one set or five sets. This test was to measure the intensity of performing 100 reps with the same weight. For the bench press they used 50% of their bodyweight and for the leg press they used 100% of their bodyweight.
Analysis of Momentary Intensity

Momentary intensity (total weight lifted per minute) is critically important to muscle building. It is literally the “intensity” people talk about when they say, “high intensity training.”

The graph below shows the average Power Factor numbers, indicating the momentary intensity of each of the tested variations.

As you can see, the highest intensity was achieved using **one set to failure**. On average the test subjects lifted **2,257 pounds per minute** during their bench press. What is also interesting is how many fewer reps they performed in order to score the highest intensity. (see chart below)
So does that mean one set to failure is the best technique in all cases? Unfortunately it is more complex than that. Let’s take a look at what happened when performing a heavier exercise with a bigger muscle group - leg presses.

<table>
<thead>
<tr>
<th>VARIATION</th>
<th>TOTAL REPS</th>
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<tbody>
<tr>
<td>Leg Press</td>
<td></td>
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<tr>
<td>One set to failure</td>
<td>37.6</td>
</tr>
<tr>
<td>Two sets to failure</td>
<td>60.6</td>
</tr>
<tr>
<td>Three sets to failure</td>
<td>82.3</td>
</tr>
<tr>
<td>Strip sets</td>
<td>68.4</td>
</tr>
<tr>
<td>Pyramid sets</td>
<td>72.6</td>
</tr>
<tr>
<td>Timed sets</td>
<td>75.7</td>
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<tr>
<td>Fixed sets (100 reps)</td>
<td>100</td>
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As you can see, two variations achieved a higher Power Factor than one set to failure. **Three sets to failure** scored 9% higher intensity and **timed sets** scored 17.6% higher.

There are some interesting reason why these differences emerge:

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<thead>
<tr>
<th>VARIATION</th>
<th>TOTAL REPS</th>
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<tr>
<td></td>
<td>Bench Press</td>
</tr>
<tr>
<td>One set to failure</td>
<td>27.4</td>
</tr>
<tr>
<td>Two sets to failure</td>
<td>41.9</td>
</tr>
<tr>
<td>Three sets to failure</td>
<td>52.9</td>
</tr>
<tr>
<td>Strip sets</td>
<td>58.5</td>
</tr>
<tr>
<td>Pyramid sets</td>
<td>54</td>
</tr>
<tr>
<td>Timed sets</td>
<td>55.5</td>
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<tr>
<td>Fixed sets (100 reps)</td>
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First of all, the subjects performed 119% and 101% more reps to achieve their 9% and 17.6% increase in intensity beyond performing one set. That’s doing a lot to gain a little. But it might be worth it to a younger trainee who is not concerned about extra wear and tear on tendons, ligaments and joints or about total metabolic costs of a longer, harder workout.

<table>
<thead>
<tr>
<th>VARIATION</th>
<th>TOTAL TIME In Seconds</th>
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<tr>
<td>Timed sets</td>
<td>180</td>
</tr>
<tr>
<td>Strip sets</td>
<td>365</td>
</tr>
<tr>
<td>Pyramid sets</td>
<td>384</td>
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Secondly, and more interesting, is that having a clock ticking down the allotted three minutes seems to have had a motivating effect. Of course, it also helps to not need to stop and change weights. You can see that although the rep numbers are very close the total time is very different. And intensity is all about the weight to time ratio so reducing the time to lift the same total weight is a win.

Observations

For momentary intensity it appears that one set to failure works very well for smaller muscle groups and gives the best bang for the buck for larger muscles. Perhaps surprisingly, the variations in workouts did not create much difference in momentary intensity when performing leg presses. So when all else is roughly equal it makes sense to use the easiest, shortest, most efficient method and that appears to be one set to failure for leg press.
Analysis of Sustained Intensity

The other form of strength is not just the intensity of lifting but how long that intensity is sustained. For example, if last week you could bench press at a rate of 1,500 lbs/min and continue doing it for two minutes but this week you could bench press 1,500 lbs/min and keep going for three minutes, it means you are 50% stronger. The weight on the bar might not have increased, the intensity of lifting might not have increased, yet the fact that you could keep going longer has to be reflected in some measurement. I called that measurement the Power Index. (Formula: $W^2 \div \text{time} \times 10^{-6}$)

Now we see that one set to failure did not score the highest intensity. This is to be expected as because the Power Index measures how long you sustain your muscular output and one set does not take much time.
The obvious winners here are the **timed set** and the **fixed set**. But it helps to know that the timed set took an average of 180 seconds to complete and the fixed set took 669 seconds. That’s 3 minutes versus 11+ minutes. The subjects who did 3 minutes of work garnered the same intensity score as the guys who did 11 minutes of work. So why do the extra?

![Graph showing leg press results](image)

When we analyze the results of the leg press exercise for sustained intensity we see very similar results except for the first time the pyramid sets generated a good score.
But again, it took an average of 384 seconds of lifting compared to 180 seconds to garner just 5.5% higher intensity. More than double the effort for only a slight improvement.

But there is even more to the story. When performing the pyramid sets and strip sets the subjects had discretion with the weight they started with. Then they either added or subtracted weights for a total of four sets. When they chose a weight (instead of using the prescribed 100% of bodyweight) they averaged a minimum weight that was 137% of their bodyweight and then worked their way up to an average maximum of 224% of their bodyweight.

So when the subjects performed their pyramid set workouts they exercised for more than twice the total time and lifted up to 224% heavier weights. Yet their results were barely improved.

However, the subjects did demonstrate that arbitrarily limiting the weight we use on the leg press to 100% of bodyweight is likely below the optimal weight for maximum intensity.
Observations

We learned something about generating better **sustained intensity**. It appears that the best all-around technique for a Beta Strength workout - or high Power Index - is a **timed set**. Three minutes appears to work well but further experimentation might result in tweaking that time somewhat. From this point forward we will recommend that people who perform well in endurance sports like running, cycling, swimming and martial arts and want to build their endurance strength, should perform three minute timed sets. (see page 26)

Notice also how strip sets did not perform well by any measure of momentary or sustained intensity in bench press or leg press. Neither did two sets. There does not seem to be any compelling reason to use those variations. They don’t deliver peak momentary or peak sustained intensity.

Once we measure things we can make meaningful comparisons and avoid less intense and less efficient methods.
A Word About Static Contraction Training

When it comes to generating high intensity, momentary strength we have never found a technique to rival Static Contraction Training (SCT). SCT uses a combination of the heaviest weight a person can possibly lift under ideal and safe conditions and statically holding that weight for only five seconds. In fact, if a trainee can hold the weight for more than five seconds it is deemed too light and must be increased.

That combination of ultra-heavy weight and ultra-brief time is the very definition of high intensity. We asked the same test subjects what they could lift using SCT on the bench press and leg press. The following two graphs show the intensity of SCT method compared to the other variations.

![Graph showing intensity comparison]

Variations in Sets & Reps + Static Contraction
As you can see, the intensity of the SCT rep is more than double the next best variation.

In the case of the leg press exercise the subjects could generate more than two and a half times the intensity by using SCT.

The main reason SCT scores higher is because conventional, full range training forces lifters to select a weight that they can move in their weakest range. By contrast, SCT uses the heaviest possible weight in the optimum range of motion, safely contained inside a power rack or smith machine.
When allowed to select their own weights these trainees averaged a maximum full range bench press weight of 143 lbs and an average maximum leg press weight of 372 lbs. In the world of conventional training those are respectable weights representing 81% and 211% of bodyweight.

But when these trainees switched to an SCT exercise they hoisted a whopping 380 for their bench press and 997 for their leg press. That’s 216% of bodyweight instead of 81% on the bench and 560% instead of 211% on the leg press. Night and day differences.

Muscle fibers create all movement. When a person lifts an extra 600 lbs it must require extra muscle fibers and that means those otherwise dormant fibers are stimulated to grow.

It’s important to know that individual muscle fibers either contract fully or they do not contract at all. Logically, you might think that to lift 20% of their capacity all muscle fibers might contract 20%. But it happens to not work that way. When you lift 20% of your maximum 80% of your muscle fibers do nothing and 20% of them contract fully. So lifting twice as much weight requires twice as many muscle fibers.

We wanted to look at this a little further so we recruited a different group of volunteers from our e-mail list and did some testing with them.
Another Experiment

We measured the maximum weight trainees could statically hold on the bench press for 5 seconds. Then selected a lighter weight and measured how long they could hold it.

As you might intuitively expect, the lighter the weight, the longer they could hold it. But the proportion is what was astounding. When the weight was reduced by 50% the amount of time they could hold it was not twice as long, it was a whopping 10.2 times longer. That is interesting on its own, but more amazing was that when we calculated the difference in intensity (weight held per second) we found that this 50% weight reduction meant the intensity dropped to only 5.2% of maximum.
So a 50% reduction in weight means a 900% increase in hold time. Which gives you a very strong clue as to how much less intensity there is when you reduce the weight.

The results are even more fascinating than the graph reveals. Notice how reducing the weight from 100% of what can be held for 5 seconds to approximately 90% results in being able to statically hold the weight 3.6 times longer.

When trainees perform conventional, full range exercises they are forced to use weights that are approximately 50% of what they are capable of lifting. They hold a light weight for a long time instead of a heavy weight for a short time. Thus, their intensity plummets.
More Data on Maximum Lifting

Yet another group of nine trainees did a second informal study. They performed lat pulldowns with 40% of the weight they could hold for 5 seconds. They did full range reps to failure, just like most people in the gym would do. They lifted until they could not complete another rep.

At the end of the set using 40% of their 5-second maximum weight – and so completely fatigued they could not do another full rep - they immediately doubled the weight and attempted a 5-second static hold in their strongest range of motion.
What happened when these “exhausted” muscles that had just “gone to failure” tried to hoist double the weight? One hundred percent of the trainees were able to lift the increased weight. Only one of the nine subjects was not able to hit 5 seconds, the other eight achieved from 9 to 20 seconds, averaging 12.4 seconds.

That gives us a good idea how ineffective light weights are at generating the maximum overload your muscles are capable of. One hundred percent of subjects had dormant muscle fibers that were not being taxed during reps to failure, and could therefore generate many times the intensity (measured in pounds per second) immediately after the low-intensity set.

This is quite shocking in light of what virtually everyone is told in the gym. It’s an enormous waste of time and energy to play around with sub-maximal weights. How can you stimulate new muscle growth by taxing your muscles at 5% of their capacity? You can’t. Yet, remember, the test subjects first statically held that lighter weight as long as they could. Their arms were tired, their chest was tired, they couldn’t hold the weight another second . . . yet they were exercising at a measly 5.2% of their peak output.

And the second group of test subjects went to “failure” using full range reps just like everyone in the gym does. And after so-called “total muscular failure” they could immediately double the weight and do a static hold. So those full range reps obviously were not taxing all the muscle fibers, were they? Nor, obviously, were they stimulating maximum muscle fiber growth. The so-called “need” for full range is a huge falsehood.

I’ll say that again: the so-called “need” for full range is a huge falsehood.
You Can Verify All of This

One of the good things about all these measurements and data is you can easily go into your gym today and test the veracity of all of it.

Many studies in the realm of health and fitness involve testing the effects of experimental drugs, hormones or other medicines. Since some of these could have grave consequences, elaborate and careful procedures must be designed and adhered to.

People are used to reading about such experiments and often assume any testing that does not include techniques such as ‘double blind’ testing has little value. But lifting weights is a pretty simple business. Virtually anyone can test whether lifting 100 lbs for a full range is easier or harder than lifting 400 lbs for one quarter of their range. Or whether lifting 100 lbs three times is easier or harder than lifting 300 lbs once.

And it’s doubtful you need to test against a helium-weight ‘placebo’ to make sure you are not fooling yourself that 1,000 leg presses are actually just as easy as lifting the ‘placebo.’

As I have said before, strength training is a science but it isn’t rocket science. It’s comparatively easy to determine what methods deliver the most overload to the muscles. Isaac Newton settled those issues in 1687 and lifting 800 lbs per minute will always require more effort and energy than lifting 200 lbs per minute.
Summary of Implications

The above section notwithstanding, we are using the word “implications” here because an informal study such as this can point us in a promising direction, but it takes a lot of money and a lot of better controlled studies to get to incontrovertible conclusions.

We are not claiming the following are incontrovertible findings but they do seem to demonstrate that there are significant differences in the intensity of the tested variations of exercises.

1. To generate a high momentary intensity (Alpha Strength) one set to failure provided the best option.

2. Certain other variations could slightly exceed the momentary intensity of one set to failure but they required a disproportionately greater time and effort for small increases in intensity, thus being inherently inefficient.

3. Timed sets seemed to offer motivation to complete reps and sets in an efficient manner.

4. Not needing to change weights during the timed sets was inherently more efficient than variations that changed weights between sets.

5. To generate high sustained intensity (Beta Strength) timed sets lasting three minutes provided the best option.
6. Three sets to failure, pyramid sets and fixed sets of 100 reps sometimes yielded slightly higher intensity but required double or more time and effort, thus being inherently inefficient.

7. Performing full range leg presses using 100% of bodyweight appeared to be a sub-optimal weight as higher intensities were achieved using heavier weights. This would vary with individuals at different levels of fitness but a rule of thumb might be possible with further experimentation.

8. Strip sets and two sets to failure did not distinguish themselves on any measure of peak intensity.

9. Static Contraction training (SCT) reps delivered a higher momentary intensity by a wide margin.

10. When performing SCT reps a slight reduction in weight lifted yielded a dramatic decrease in momentary intensity.

11. When performing full range reps to total failure with 40% of peak weight, at fatigue there remained sufficient muscle fibers to lift twice as much weight using SCT.
How to Use This in Your Training

The great thing about all this new knowledge is some or all of it can be incorporated into virtually any type of training that you are doing. Even the lowest-tech conventional workout can benefit substantially from this information.

Conventional Workouts

Some people will always perform only conventional workouts, either because they have no access to very heavy weights, or no way to limit range of motion with a power rack or smith machine, or because of social pressure to not do something different than what other people in the gym are doing.

Even if you perform conventional workouts using weights light enough to lift through a full range of motion (and are thus limited to what your weak range can safely handle) and even if you take no measurements of time and intensity whatsoever, you can still improve your workouts with this information. Namely;

- Perform one set to failure on every exercise to ensure you are generating the highest momentary intensity you can. On subsequent workouts perform one set to failure with a progressively heavier weight.

- If you have abilities that imply superior sustained strength, such as distance running, cycling, martial arts or similar, you should consider a Beta Strength workout. Perform a three minute timed set for every exercise to ensure you are generating the highest sustained intensity you can. On subsequent workouts perform a three minute timed set with a progressively
heavier weight. When performing a timed set use a continuous counting method even after a rest between sets. For example, you might perform 23 reps before you have to pause for a rest. Take as brief a rest as possible then resume the count at 24. At the end of three minutes your count might be 65 reps.


If ultra-high efficiency is not your #1 priority in your training you might be using the *Power Factor Workout*. ([http://bit.ly/PowerFactorWorkout](http://bit.ly/PowerFactorWorkout)) If so, both your *Workout A* and *Workout B* can be adapted to capitalize on the information in this report.

- Perform one set to failure on every exercise to ensure you are generating the highest momentary intensity you can. On subsequent workouts perform one set to failure with a progressively heavier weight. Because you are not training in the blind, conventional manner you can
calculate your exact **Power Factor** numbers for every exercise and calculate the amount of increase in momentary intensity your are achieving from workout to workout. By adjusting your training frequency to ensure adequate rest, you can continue to see improvement in your numbers or spot overtraining the first time it occurs.

- If you have abilities that imply superior sustained strength, such as distance running, cycling, martial arts or similar, you should consider a **Beta Strength** workout. Perform a three minute timed set for every exercise in **Workout A** and **Workout B** to ensure you are generating the highest **Power Index** numbers you can. Your **Power Index** numbers will reflect the amount of increase in sustained intensity from workout to workout. By adjusting your training frequency to ensure adequate rest, you can continue to see improvement in your numbers or spot overtraining the first time it occurs. On subsequent workouts perform a three minute timed set with a progressively heavier weight. When performing a timed set use a continuous counting method even after a rest between sets. For example, you might perform 23 reps before you have to pause for a rest. Take as brief a rest as possible then resume the count at 24. At the end of three minutes your count might be 65 reps.

**Static Contraction Workouts**

If ultra-high efficiency and the absolute minimum wear and tear on your body and minimum time in the the gym every month is a priority in your training you should be using the Static Contraction ([http://bit.ly/StaticContractionWorkout](http://bit.ly/StaticContractionWorkout)) workout in the **Train Smart!** e-book. To capitalize on the information in this report:
• Perform one 5-second static hold for every exercise in **Workout A** and **Workout B** to ensure you are generating the highest momentary intensity you can. On subsequent workouts perform the holds with a progressively heavier weight. Whenever you can hold a weight more than 5 seconds it is too light and should be increased so your hold time is reduced to 5 seconds. By adjusting your training frequency to ensure adequate rest, you can continue to see improvement in your numbers or spot overtraining the first time it occurs.

• If you have abilities that imply superior sustained strength, such as distance running, cycling, martial arts or similar, you should consider a Static Contraction **Beta Strength** workout. Perform a three minute timed set for every exercise in **Workout A** and **Workout B**. To start, I suggest selecting a weight equal to 80-90% of the weight you can use in your Alpha Strength workouts. Perform as many 5-second static holds as you can in the three minute period. For example, you might perform 8 holds before you have to pause for a rest. Take as brief a rest as possible then resume the count at 9. At the end of three minutes your count might be 18 holds. By adjusting your training frequency to ensure adequate rest, you can continue
to see improvement or spot overtraining the first time it occurs. On subsequent workouts perform a three minute timed set with a progressively heavier weight.

If any human endeavor wants to call itself a science it must use measurement. We have been working for nearly twenty years to find ways to measure elements of strength training. My thanks to all the trainees who helped us with these experiments. They helped move strength training closer to a science and farther from macho gym hype.

Train with your brain,


Want to train smarter? Talk one-on-one with Pete!

(http://bit.ly/TalkToPete)

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