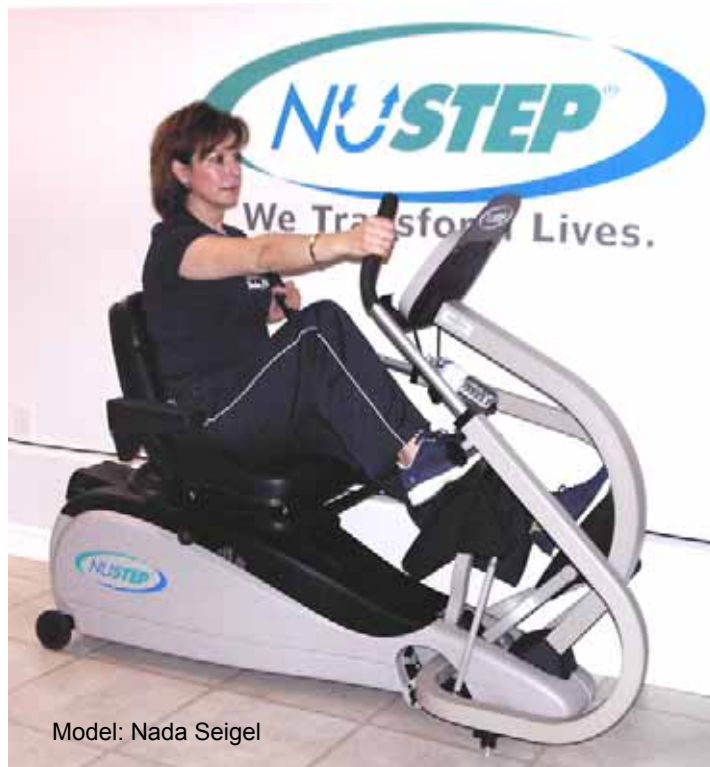


NuStep TRS 4000 Recumbent Cross trainer

An Industry Standard in Function and Diversity

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Should a person strength train or perform lower intensity steady-state exercise? Since the early 1970s, Arthur Jones has advocated full body training in a steady-state fashion, so that each muscle is worked anaerobically to fatigue for optimum strength and hypertrophy, yet the steady-state manner he prescribed kept heart rate at high levels, thus providing excellent metabolic and cardiovascular conditioning as well. However, few people can cope with such training demands, whether athletic or deconditioned/rehabilitative. Moreover, differences have been discovered between strength training and steady-state (aerobic) exercise.

One study¹ found that middle-aged men who strength trained had reduced central arterial compliance.² A second study³ found that endurance training increased arterial compliance even in those previously sedentary, and that endurance-based exercise either prevents or can reverse the effects of reduced arterial compliance and arterial stiffness.

¹ Miyachi M., et al. Greater age-related reductions in central arterial compliance in resistance trained men. *Hypertension* 41: 2003; 130-135.

² Arterial compliance refers to the ability of the arteries to expand and contract during the heart's contraction and relaxation.

³ Tanak H., et al. Aging, habitual exercise, and dynamic arterial compliance. *Circulation*. 2000; 102: 1270-1275.

The problem is that endurance-based exercise does not provide some of the benefits derived from weight training, including a significant increase in strength and hypertrophy; important factors in human function as we age. Although no studies as of yet have been conducted to determine if a combination of endurance and strength training exercise provides favorable arterial compliance (to counter the potential negative arterial effects of strength training), some researchers have noted that so long as aerobic exercise is limited to 2-3 times per week, and for no more than 50-minutes, that there is no negative effects in strength training results.⁴ Hence, to derive positive benefits from both forms of exercise, it appears that a combination of both forms (so long as neither is abused) is best for general well-being, longevity and function.

The goal, then, would be to develop an ideal program for a person in question, whether that person trains him or herself, or is instructed by another. Selecting the correct strength training exercises is a must, and the same is true in the selection of endurance-based equipment. A frail, elderly person, for example, would not walk a treadmill, and may even feel unstable on many recumbent exercise bicycles. And, how a strengthening component is to be integrated is the second issue (which can be done simultaneously and which I will address a little later).

To accommodate the most clients for endurance exercise, fitness facility owners should consider the NuStep, a low-impact exercise machine that has been in production for over 10 years. Such a consideration is imperative, particularly if the facility has limited space or budget, as is the case with appointment-only 1-2-1 training centers, but which equipment has proved itself in hundreds of leading medical centers, cardiac and stroke rehab institutions, chains of retirement residences, seniors wellness programs and even commercial fitness facilities.



Certainly there are well-designed steppers, ellipticals, stationary bicycles and treadmills, but none of those can accommodate the weak and frail, those who suffered a stroke, and other special populations. Yet the NuStep can do just that, and with 10 work levels (adjusted by a lever on the side of the seat) this machine will appease even the most athletic with an output of 20-800 watts, 1.2 to 30+ METs⁵, and upward of 250 steps per minute, all presented on an easy-to-read/use LCD display.

Other console display features include heart rate⁶ (optional Polar® transmitter integration, that measures 40-220 BPM), time (starts at 0 and counts up to 100 minutes), workload, Kcal (up to 999 Kcal), and all through a cordless design that uses battery power (an AC adapter can be substituted).

⁴ McCarthy JP, et. al. Neuromuscular adaptations to concurrent strength and endurance training. *Medicine and Science in Sports and Exercise*. 2002; 34:511-519.

⁵ A MET refers to a “metabolic equivalent,” a unit used to estimate the metabolic cost of physical activity. One MET equals the uptake of 3.5 ml of oxygen per kilogram of body weight per minute (*Taber’s Cyclopedic Medical Dictionary, 18th Edition*). 1.0 MET would be equivalent to sleeping or resting in bed; 3.0 would be equivalent to light manual chores (household chores/walking), and 8.0 would be equivalent to intense manual work or exercise. Consequently, a machine that can measure a MET of 30+ is a powerful workhorse that can accommodate even the strongest, most conditioned user.

⁶ With an accuracy of $\pm 2\%$, this is a necessary feature for clients who must not exceed a particular exertion level.

There also is a single-touch button that shows an average of how the workout is progressing (average values of METS, Watts, steps per minute, and heart rate), a single-touch button to reset all values, and a location to enter body weight in pounds or kilograms. When the trainee comes to a stop, the timing stops, and the machine turns off automatically after four minutes of disuse and starts automatically upon use. The console area also includes a reading rack and water bottle holder.

The METS and watts readout is highly useful for those needing to measure improvement and outcomes. Rather than simply focusing on kcal expenditure, as most fitness enthusiasts do, more emphasis can and should be placed on total work and conditioning relative to exercise time. This is what serves to enhance fitness, health and improvement in anaerobic threshold, whereas body fat reduction will follow accordingly (so long as the individual's nutrition plan is appropriate).

Several functional features make this machine the ideal first choice/consideration for a health club or rehabilitation center, besides its extreme ease of use. First, the machine allows for total body conditioning of the cardiovascular and muscular systems (and greater kcal expenditure as a result), or the trainee can choose to work only the arms (long, 15" arm adjustment range with an ergonomically correct hand position) or only the legs (with the arms propped on the retractable arm rests). The independent arm action makes it an ideal exercise method for those who need or prefer upper body activity, as is common with upper body bicycle ergometers. The problem with bicycle ergometers is that exercise involves mostly the shoulders as the arms rotate in circles. With the NuStep, upper body exercise involves pulling (back, biceps, deltoids) and pushing (pectorals, triceps, and deltoids).



Using arms only (left) and legs only with the work arms retracted (right)



The NuStep boasts a well-padded seat that rotates 90° for easy access, and with rotational arm rests that can be turned 180° to the back.

With its highly padded, supportive, contoured and ergonomically designed swivel seat that rotates and locks 90° to left or right, wheelchair bound or frail individuals are able to get into the machine and use it effectively. The legs and/or hands then can be strapped securely in order to receive passive exercise while the legs or arms work in a smooth contralateral movement (each arm is linked with the opposite leg to simulate walking, but with the benefit of *strengthening* the associated muscles), or while a dominant side of the body works, as with a stroke sufferer.⁷

As stated, the seat is heavily padded and likely the most comfortable in the industry with its contoured back support. The seat adjusts smoothly, simply by tripping a lever and moving forward or back as one would in an automobile. The seat slants slightly down toward the foot peddles for greater ergonomic use and a natural sitting position, and its swivel release lever works from the front, back, or sides.

The wide, beveled seat makes the user feel safe and secure as well. The overall design of the machine can be appreciated further when it is considered that the seat's 15" forward/backward travel automatically adjusts in height atop the frame to accommodate users of different sizes.

Although duplicated by some competitors, the NuStep is the original recumbent stepper that allows each user to adjust desired arm and leg range of motion (2" – 10"), and with far less shearing forces as experienced with bicycles. Reduced knee and hip strain is an important feature, as some of our clients have noted when changing from our recumbent bicycle to our NuStep.



⁷ In fact, the NuStep was designed with the cooperation of exercise physiologists, ergonomic specialists, and its leader Dick Sarns, an engineer who worked with cardiac surgeons in developing what is today's most noted heart-lung machine used in open heart surgeries (the Sarns Pump). Mr. Sarns' objective was to address the needs of older or deconditioned adults specifically, and those from heart attack and stroke. His company is an active participant with the International Council on Active Aging (www.icaa.cc).

This Cross Trainer also allows for a change in foot position to emphasize the muscles of the lower body in different ways. The large cast-aluminum and powder coated foot pedals, set at 45°, have a non-slip surface and raised edges that holds the feet securely in place while setting up and during exercise, factors which enhance the feeling of safety with the mature adult.

Another feature is the NuStep's all-belt drive, magnetic resistance with variable workload, which means a quiet machine that can be placed anywhere since it requires no AC power. The spring-loaded idlers automatically adjust belt tension, the freewheeling action stops pedal motion immediately (a safety feature that allows the user to stop when desired or required), and the high-grade bearings guarantee a long life.

The frame is constructed of durable, heavy-duty 14-gauge welded steel, powder-coated and with zinc-plated components to prevent rust and scratches, and covered by a strong, impact-resistant polystyrene cover that is easy to clean. Very stable, it has a four-point contact with the floor and leveling feet, yet easy to lift and move with the front handle and rear wheels. The NuStep's low step-through center (7-9") means less risk of tripping with an easy setup.



Cast aluminum, non-skid foot pedals



The sleek, low instep feature of the NuStep

The NuStep can accommodate a person up to 400 pounds, and who measures 4'6" to 6'5" in height, yet its overall dimensions are no larger than a standard recumbent bicycle. With maintenance-free operation, the NuStep also comes with a three-year limited warranty on parts and a one-year limited warranty on labor (full instructions are provided for the dismantling and change of machine parts).

Unique Use Features

One of the most obvious features of the NuStep is that full body endurance training is possible. Arthur Jones, of Nautilus and MedX fame, preferred full body exercise. His reasoning was that since the body recovered as a whole, it should be exercised as a whole. Regardless of the validity of that statement, it stands to reason that most 'endurance-based' exercise machines or methodologies only allow for lower or upper body activity. Rowing and cross country skiing are two examples of full body activity, but most methodologies do not allow for such integration. Even those machines that do activate both torso/arms and legs often involves lack-luster upper body work. With the NuStep, the user determines the extent to which the upper and lower body exercises.

The extent of upper or lower body exertion can be determined by increasing or decreasing muscle emphasis. Relaxing the legs, or having them perform less work means greater upper body emphasis, and the opposite would be true if the upper body were to work less, thereby emphasizing the lower body. For those who perform interval circuits, with 20-30 second sprints interspersed with less intense activity, upper and lower body can be emphasized alternately, and focus can be placed on pulling (back/biceps) and pushing (pectorals/triceps) alternately.

The contralateral feature of the NuStep further allows for specialized training. For example, as the left leg presses down (concentric motion), the superior eccentric ability of the right leg can provide added resistance. Then as the right leg presses down, the left leg will resist accordingly. The legs also can provide added resistance for the upper body. As the right arm pulls its handle back, the left leg resists. And if the right arm were to push its handle forward, the right leg resists. In effect, very intense strength training can be integrated with traditional aerobic-based training on the same machine, whether in the same workout or different workout! Such training combinations cannot be achieved with a treadmill, elliptical rider, or recumbent bicycle.

The accuracy of the NuStep to predict METS equivalents have been investigated through a cross-validation companion study⁸ that developed new regression across a wide range of workloads on the NuStep TRS 4000 and then compared to a separate sample. Subjects included 18 patients with either cardiac or pulmonary disease (mean age of 69.1 years), and 8 college students (mean age of 21.3 years). Each subject started at either 25 or 50 Watts and increased by 25-50 Watts per stage until an RPE of 15 was reached. Each stage was 5 minutes and VO_2 (METS) were measured continuously and it was found that no significant differences between measured and predicted MET values existed at any of the stages or overall, with 3.32 METS measured and 3.36 METS predicted. From this data it was concluded that the newly developed prediction equations used in the NuStep to estimate metabolic overload are accurate enough to allow cardiac and pulmonary rehabilitation (and fitness) professionals to prescribe workloads with confidence. Watts output for the NuStep reflects the original calibrated research model and is highly accurate.

Also, as stated previously, where the feet are positioned and how the trainee pushes with the feet can change muscular emphasis. Keeping the feet low and/or pressing on the balls of the feet places greater emphasis on the quadriceps and calves. Shifting the feet upward and/or pressing with the heels places greater emphasis on the gluteals and hamstrings. And emphasis also can be changed with the upper body. The handles can be pulled to work the back, biceps, and posterior shoulders, or they can be pushed to work the pectorals, triceps, and anterior shoulders. Rotation of the torso that occurs when working the upper body also affects the midsection and obliques.

Earlier I made reference to the value in measuring and tracking METS⁹ and Watts, i.e., to determine improvement and outcomes. Here is a sample directive: a trainee can warm-up at the intensity of 2.0 METS, which is equivalent to the energy expenditure of light activity while standing. After five minutes the intensity of effort can be increased to 3.0 METS for five minutes and then 4.5 METS (equivalent to activity found in recreational sports) for five minutes, followed by a reduction to 3.0 METS for five minutes and then a five-minute cool-down at 2.0 METS. Improvement would dictate a longer duration at 4.5 METS or an increase in METS, to whatever is tolerable relative to the individual's health and ideal/maximum heart rate. And increasing the machine's resistance or moving the limbs faster will increase METS output for variety and different combination potentials in training. The same direction can be taken if using Watts as a means of measurement, with improvement being made by maintaining a particular Watt output for longer or by increasing Watts for the same measure of time.

⁸ JCR • September 20, 2000 • Vol. 20 • No. 5

⁹ The NuStep equations are based upon a study conducted by Dr. John Porcari of the University of Wisconsin-LaCrosse during the fall of 1999 and winter of 2000.

The user then can coordinate heart rate with METS or Watts to determine improvement in cardiovascular function. For example, consider a normal, healthy trainee aged 55 (someone unhealthy or with above average conditioning would deviate in ability). In accordance to standard heart rate tables, such as the one below, this person’s sustained target heart rate, after a warm-up and excluding the cool-down, would be a recommended 85% maximum of 138 beats per minute (bpm). Being able to sustain a certain level of Watts or METS at that heart rate for longer, although within reason and without abusing exercise, indicates improved performance and function. Being able to maintain a heart rate of approximately 138 bpm while increasing Watts or METS also indicates improved performance and function.

Age	Training Heart Rates (10 second count) Based on Percent of Predicted Maximum Heart Rate					
	60%	65%	70%	75%	80%	85%
15-19	20	22	24	25	27	29
20-29	20	21	23	24	26	28
30-39	19	20	22	23	25	26
40-49	18	19	20	22	23	25
50-59	17	18	19	21	22	23
60-69	16	17	18	19	21	22
70+	15	16	17	18	19	21

Compliance and Satisfaction

The NuStep’s unparalleled seat comfort, comparable to a well-padded office chair, allows trainees to use the machine for longer, unlike traditional bicycle seats or high-density foam seats that are hard on the buttocks. Many of our center’s clients have commented on this aspect, and appreciated by those who find standing exercise awkward or undesirable.

But the seat is only one feature that has resulted in compliance. Our clients have noted that the general feel of the NuStep is superior to a treadmill, a NordicTrack ski machine, a recumbent bicycle, and an elliptical rider (as used or owned by different individuals), particularly with less strain experienced in the knee joints. And some clients have noted specifically that they prefer the upper and lower body coordinated activity as opposed to the predominance of lower-body-only steady-state exercise. Only one of our center’s patrons decided to alternate an elliptical rider with the NuStep, whereas all others have resorted only the NuStep since its integration in our performance and testing center.

Results

In regard to what has been presented thus far, overall effect and results are a concern to the end-user. Although we did not have a method to measure VO_{2max} at the time of testing the NuStep, it is obvious that utilizing both upper and lower body musculature will necessitate greater oxygen uptake, kcal expenditure, heart rate, and enhance general conditioning faster. This does not mean that the NuStep will produce results that are better than other equipment, but that it does so more efficiently. However, if we do consider the strengthening benefits that can be achieved on the NuStep, it can be concluded further that it is superior to other endurance-based equipment.

As per body composition, a person’s individuality (age, somatotype, etc.), nutrition quality and extent of exercise are the governing factors. Consequently, favorable claims can be made for the least expensive exercise bike or the most expensive treadmill. What is most important in long-term health and conditioning is the issue of compliance and usability. If a person does not like a mode of exercise or the choice of equipment, it is difficult to make and maintain positive change. If a person cannot use the equipment, then said equipment has no value.

In regard to the latter point, we have two older individuals, both in their sixties, exercising at our facility. One has pain and problems associated with one heel and knee, the other with one knee. Neither notice any discomfort¹⁰ using the NuStep for upward of 20-minutes (12-15 of which are quite vigorous), either during or after, whereas the opposite was

¹⁰ No increase in pain, and on some days a decrease in pain because of the enhanced blow flow and improved mobility of the joint.

true when working with a recumbent bicycle, or when implementing most strength training exercises, e.g., squat or leg press type exercises.

As a result of preference, comfort, and usability, we have noted compliance and satisfaction with the NuStep not found with other endurance-based equipment, and the fact that both highly athletic and very deconditioned individuals (including those restricted to a wheelchair) can use the NuStep makes it the most user-friendly and diverse general conditioning equipment available.

Competition Comparison

An important part of marketing is to observe and determine trends and innovative ideas. NuStep has been around for nearly a decade and the competition has stood up and taken notice. The result has been inferior knock-offs that no longer maintain the NuStep concept, and inferior designs currently integrated into two competitive recumbent steppers and one recumbent elliptical/stepper. I will provide an overview of the NuStep's features and how the competition compares.

Several issues need to be considered with comfort. The NuStep has an ideal, ergonomically correct seating position and with the lowest seat to the ground (necessary for wheelchair access), whereas the competitions' seats are higher and in some instances this will cause more bend in the knees and hips. The NuStep is the only model of its kind to provide an optimum ergonomic position for both arm and leg adjustments, and with a non-slip foot pedal surface spaced appropriately apart. The distance between handlebars also is a concern, and with some other companies they are nearly two-feet apart, whereas a more ideal distance should be closer to 17-inches.

The display on the NuStep is unique in the industry in that it is easy to use, the buttons are easy to press, and everything runs on autopilot during use. The competitors' displays are far more intimidating, confusing to get going, or contain too many colors and buttons to make it user friendly. Moreover, one competitor's display will not work on Levels 1-4 unless plugged in. Also, the NuStep's display saves its data for four minutes after workout, or during it, whereas the competitors' displays do not. If a fitness instructor decides to integrate and alternate traditional strength training with endurance sprints on endurance equipment (as I do at times), then this feature is a must.

The low pivot location of the NuStep allows for optimum ergonomics, as the arms are out in front and up, and the legs placed in a slight decline. Conversely, one competitor's foot pedal flips (to mimic a type of elliptical motion) and feels unnatural, whereas another competitor's handles are too far out in front, and yet another provides a limited step length, an extreme bend in the knees, and limited resistance for the arms.

When considering safety, the NuStep has 'chair-height' seating, a swivel seat (only one other competitor's seat swivels, but is limited to 45° and has no lockout feature), rounded corners, no sharp edges, and no pinch points. NuStep's competitors have higher than chair-height seats, sharp edges, mechanical levers that can catch clothing, and some severe pinch points and exposed metal. Only one other company included armrests, but they fold 90°, and so the arms can hit them during arm motion and cause bruising and minor injury.

Several other comparative features could be disclosed, but the point should be clear: Some of NuStep's competitors do have some similar and possibly equal features, but none of them have all of NuStep's features in one package, as detailed throughout this report.

To reiterate my initial sentiment: if limited in space or capital, or looking for equipment that will receive the most use by the most people, NuStep should be your first consideration. Visit a fitness tradeshow to test drive a NuStep or, if in the Sudbury, Ontario area, visit our performance and testing center, *Fitness Logistics*. Also visit <http://www.NuStep.com> or call (800) 322-2209 for details.