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OWNER'S MANUAL

With *SPINEFORCE ™*

Efficient by design

Model 110

Scuba, Snorkeling, and Spearfishing Fin

www.**TRUEFIN**.com

Made in America

TRUEFIN ™

Model 110

INDEX

An updated downloadable PDF version of this Owner's Manual, containing the most recent recommendations and developments, may be available at: www.TRUEFIN.com.

QUICK REFERENCE

Care and Maintenance

Avoid prolonged exposure of fins to excessive heat.

Store fin flat - Do not store Truefin in the folded up travel configuration for an extended period of time.

Before entering water with Truefin

Inspect heel straps for wear or indications of failure.

Ensure red lock springs of spines are fully engaged with fin shoulders.

Entering water with Truefin

When entering from shore, it is suggested to install the fins on the user's feet after the user has entered water at least waist deep, and remove the fins from the user's feet before exiting from shallow water. In order to free the user's hands it is suggested to thread a cord or other flexible member through the heel straps and clip the cord to a 'D' ring secured to a vest or the Buoyancy Control Device (BCD). Alternatively, a wading entry procedure may be performed from a beach or shore, where the user wades out toward the dive site while backwards shuffling feet to avoid stepping on rocks.

When entering off boats, follow standard entry procedures known in the scuba industry, such as giant stride, back roll, seated entry method, or forward roll.

For all entries, regardless of the method, ensure your BCD is sufficiently inflated and have the regulator in your mouth and operating, and with at least one hand holding your regulator and mask in place when you strike the water.

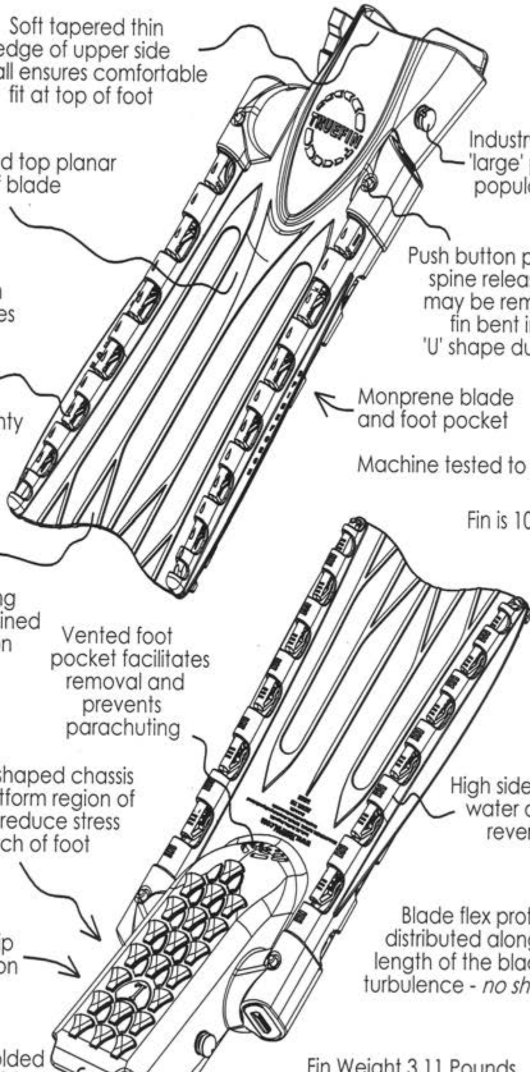
When entering from relatively high platforms or decks, giant stride entries may be performed, however a fin may be forced off of a user's foot while the heel strap spring extends and the foot slides out of the flexible foot pocket, although the fin will still be secured to the user's leg as the fin strap slides up the user's calf. If a user typically enters water off of high platforms, the user may wish to minimize the likelihood of a fin slipping off the user's foot by using non-elastic heel straps (ratcheting or universal style).

When snorkeling, all methods may be satisfactory because the user is not burdened with heavy tank(s) and other apparatus weight.

Avoid walking forward through shallow water while wearing fins.

TRUEFIN Model 110

Features



TRUEFIN ™

With ***SPINEFORCE***

Model 110

Snorkel, and Spearfishing Fin

Features:

* Highly flexible Monprene blade for efficiency and ease of kicking during low speed.
* For high kicking speeds, the 'angle of attack' is enforced by high tensile strength modular glass filled nylon articulating spines which provides more thrust and efficiency than spineless fins.
* Optimum angle of attack at all kicking speeds .
* Blade flex is not effected by water temperature, whereas traditional fins get stiffer in cold water.
* Blade flex profile is equally distributed along the entire length of the blade resulting in a streamlined angle of attack with no sharp 'hinged' bend which introduces turbulence and reduces efficiency.
* Replaceable spines are economically serviceable. Blue '412 spines articulate 60° 'toe down', and 20° 'toe up'.
* Green '012 spines which articulate 60° 'toe down' and 0° 'toe up', and Yellow '415 spines which articulate 75° 'toe down' and 20 'toe up', may be 'mix and matched' with Blue '412 spines.
* Streamlined top planar surface of fin above the foot pocket facilitates laminar flow during power flutter kick.
* Less blade wobble and fin twist during the kick stroke due to rigid enforcement of the predetermined blade flex angle at both right and left artificial spines.
* 3D blade scooping due to lateral articulation of the artificial spines.
* High side rails channel water during kick strokes, and also enable reverse kicking during side slicing of the fins while backing up.
* Highly maneuverable with overall length of 23.5".
* Soft tapered foot pocket upper wall ensures comfortable fit at the top of the user's foot.
* Bottom of foot pocket, including an extended heel region, is supported by an overmolded rigid chassis to reduce stress of medial arch of foot.
* Fin is 100% non-metal elliminating corrosion issues (primary materials: Monprene, polypropylene, nylon, and glass).
* Negative Buoyancy: 0.067 pounds (fresh water), 0.033 pounds (salt water) per complete fin excluding heel straps. Weight per fin excluding heel straps 3.11 pounds.
* Low profile non-skid foot pocket bottom sole.
* Industry standard heel strap 'large posts' accept different styles and brands of common fin straps.
* Machine endurance tested in water 1,000,000 kicks.
* Modular spines may be removed and disassembled, and fins bent in a 'U' shape lengthwise in half during transport to minimize luggage volume.
* Two year limited warranty.
* Made in USA.

Truefin is a company based in Oregon, USA, and has developed a new type of scuba, snorkel, and spearfishing fin which is highly engineered and incorporates replaceable modular artificial spines which readily articulate while enforcing a predetermined blade flex limit, and where an optimum 'angle of attack' at all kicking frequencies occurs.

The foot pocket is supported by a 'U' shaped overmolded chassis which receives the artificial spines in a removable manner, and where the chassis transmits the bending moment from the base of the spines to an extended rigid sole region which minimizes loss of power and reduces stress at the arch of the user's foot while kicking. The upper surface of the foot pocket is a tapered thin wall of flexible Monprene Shore 70A in order to maximize comfort at the top of the user's foot.

The flexible blade of Truefin in combination with the artificial spines performs very well during scuba and snorkel activities due to overall power, comfort, and efficiency. Truefin also has applications when spearfishing because Truefin is highly maneuverable, and the artificial spines prevent the blade from collapsing during shore diving and have fast acceleration when in surf, or while in rough seas with big swells and current around reefs.

Truefin is 100% non-metallic in order to reduce weight and eliminate concerns of corrosion.

Truefin is manufactured and assembled in USA with premium materials and tested over 1,000,000 kick cycles to ensure long service life.

U.S. patent #9,764,192, #10,071,288, #10,226,668, #10,525,307 and other US and China patents issued and/or pending.

Two year warranty.

Available in size Large (L) during this introductory period at: www.**amazon**.com

INSTRUCTIONS

CARE & MAINTENANCE

1. Avoid prolonged exposure to excessive heat.

2. Store fin flat - Do not store Truefin in the folded up travel configuration for an extended period of time.

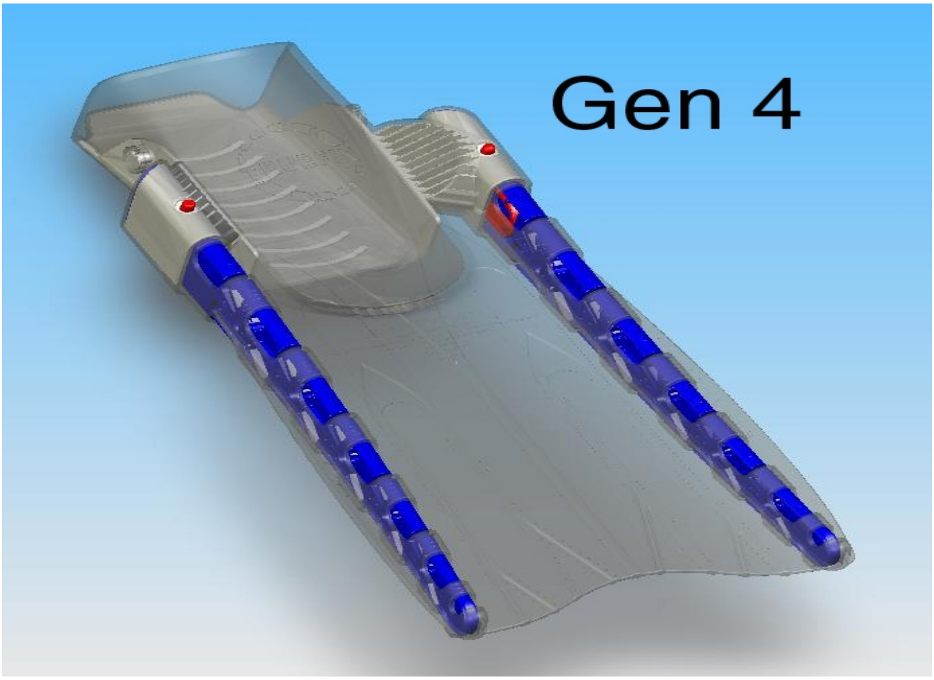
California Prop 65 Warning:

⚠ **WARNING**: This product can expose you to chemicals including lead and lead compounds and/or Bisphenol A(BPAs), which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

Products Liability Warnings:

⚠ **WARNING**: CHOKING HAZARD – SMALL PARTS. Not for children under three (3) years of age.

⚠ **WARNING**: THIS IS NOT A LIFE SAVING DEVICE. Do not leave children unattended while devise is in use.

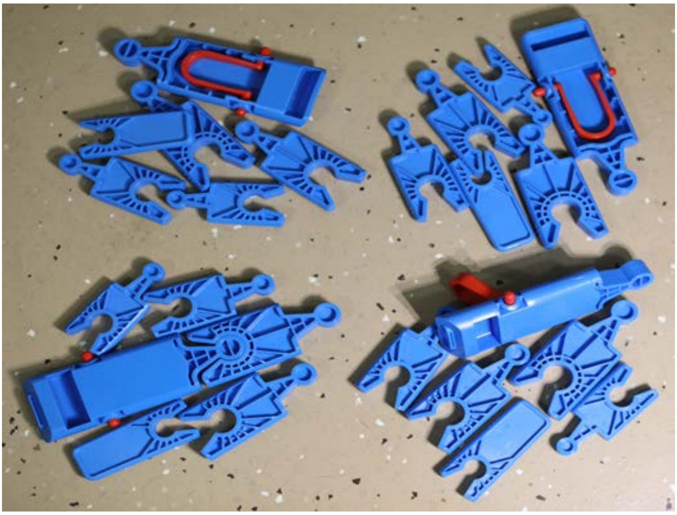


DISASSEMBLY

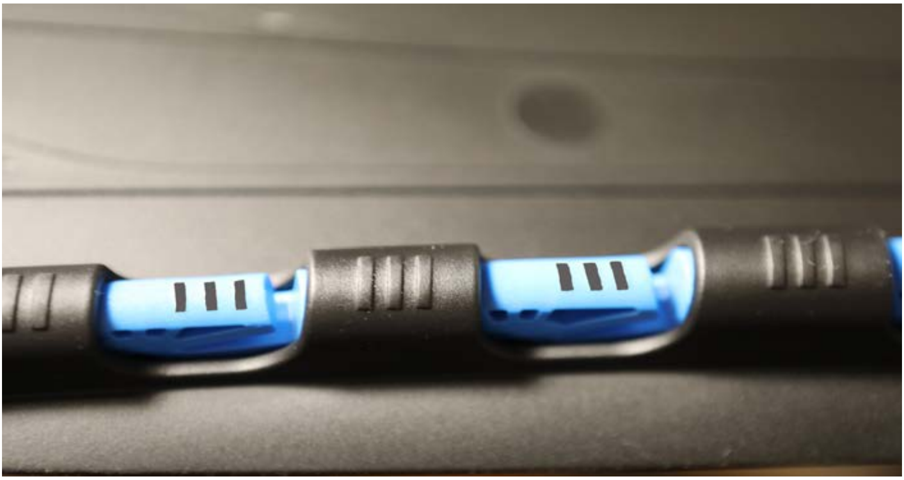
If the fins are to be disassembled for repair or for travel, each spine may be removed by pressing both red spring lock pins simultaneously with one hand, while pushing the end out with the index finger of the other hand as shown, and withdrawing the spine from the fin rail.

Truefin is provided with a spine removal tool which may be used to facilitate pressing the red spring pins.

Vertebrae blocks may be separated from spine as desired.



During reassembly, for a standard configuration ensure the three hash marks (**III**) at each vertebra are orientated down toward the platform of the fin adjacent to the bottom hash marks (**III**) molded at the fin rails, and with the tear drops (♦) of each vertebra orientated up adjacent to the top teardrops (♦) molded at the fin rails, and slide assembled spine into the fin rail until red lock pins engage fully with the fin shoulder holes.

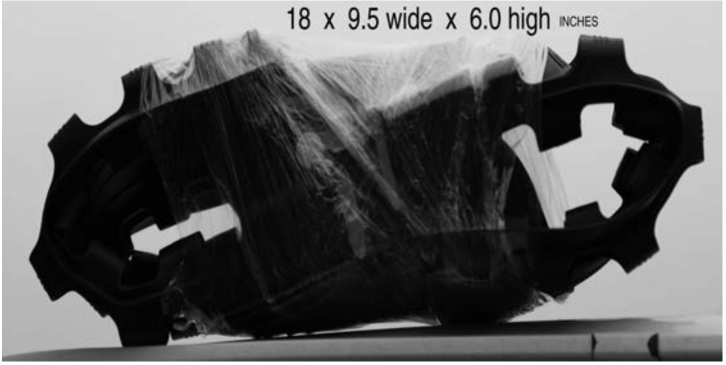


Note: The tooling for the individual vertebra of the Truefin spines, as well as the tooling for the substrate and Monprene fin of Truefin, are all provided with mold date wheel inserts in order to track the date of manufacture for quality control purposes.

TRAVEL PACKAGE

The spines may be unlocked and removed from the fin upon pressing the polymer red base spring pins, while pushing or pulling the spines out of each rail. Removal of the spines enables the user to bend Truefin into a 'U' shape when traveling if it is desired to minimize the volume of the shipping package.

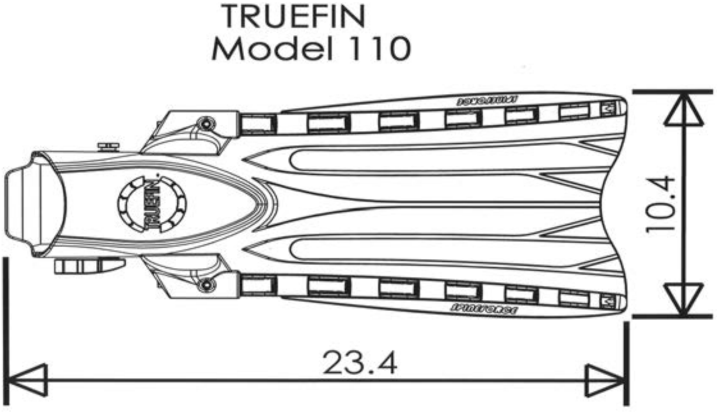
After removal of the spines, the size of a pair of Truefin (two fins) when folded up is: **18** inches long X **9.5** inches wide X **6.0** inches high.



Once the spines are removed, the spine vertebrae may be separated and packaged as desired. It is currently suggested to not store the fin for an extended period of time (more than several weeks) in this travel configuration. Monprene is a very durable material, and Truefin's warranty includes fin replacement if 'folding cracks' occur in the fin blade or fin rails. Such 'folding cracks' have not been observed with Truefin as of this date, and it is thought if they occur the fin will still function normally. When bending Truefin into a 'U' shape, or alternatively when rolling Truefin up, try to maintain as large a bend radius as possible of the pass core fin rails when packing to fit inside luggage bags or containers.

Upon unrolling, there may be temporary set or deformation of the Monprene but the normal fin shape will be restored with time. Performance in water will not be effected during this 'relaxation' time period. If desired, to accelerate the return to normal shape, briefly fold or bend in the opposite direction before installing spines.

Size LARGE



Truefin Model 110 Large (Gen 4)

Weight for one pair without heel strap - **6.20** pounds (each fin **2.36** pounds, with two spines @ **0.375** lbs. each spine). Buoyancy in salt water – one pair, without heel strap - Negative **1.04** ounces per pair.

Note: When determining diving trim, consider booties, which are generally positively buoyant.

Weights and Buoyancy values

Note: The chart below corresponds to fins with the following structure:

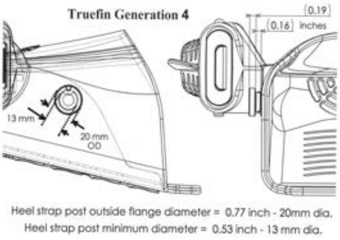
Fin overmold - Monprene 70 Shore A, Substrate - Polypropylene 50% glass, Spines - Nylon 30% glass, Spring - Polypropylene 20% glass.

	P E R F I N		
Item configuration	***Weight***	***Buoyancy in ocean water 1.024 g/ml***	***Buoyancy in fresh water 1.000 g/ml***
Fin without spines and without heel strap	**2.36** pounds	Positive (**floats**)	Positive (**floats**)
Fin and two spines No heel strap	**3.11** pounds	Negative **- 0.520** ounce	**- 1.075** ounces
Fin and spines with stainless steel spring strap	**3.56** pounds	Negative **- 3.000** ounces	**- 3.070** ounces
Fin and spines - Ratchet strap with ratchet strap	NA	Negative **- 1.175** ounces	NA
Fin and spines - Universal strap with universal simple strap	NA	Negative **- 1.020** ounces	**1.300** ounces
One spine (with leaf spring)	**0.375** pounds	Negative **- 0.860** ounce	NA

Buoyancy test - Ocean water

Weighing fin and spines underwater while being suspended with fishing line.

Heel Strap Post:



Entering water with Truefin

When entering from shore, it is suggested to install the fins on the user's feet after the user has entered water at least waist deep, and remove the fins from the user's feet before exiting from shallow water. In order to free the user's hands it is suggested to thread a cord or other flexible member through the heel straps and clip the cord to a 'D' ring secured to a vest or the Buoyancy Control Device (BCD). Alternatively, a wading entry procedure may be performed from a beach or shore, where the user wades out toward the dive site while backwards shuffling feet to avoid stepping on rocks.

Follow standard entry procedures known in the scuba industry, such as back roll or seated entry method when entering off of relatively low platforms, or from RIBs or Zodiacs.

For all entries off a boat, regardless of the method, ensure the BCD is sufficiently inflated and have the regulator in your mouth and operating, and with at least one hand holding your regulator and mask in place when you strike the water.

For relatively high platforms or decks, giant stride entries may be performed, however a fin may be forced off of a user's foot while the heel strap spring extends and the foot slides out of the flexible foot pocket, although the fin will still be secured to the user's leg as the fin strap slides up the user's calf. If a user typically enters water off of high platforms, the user may wish to minimize the likelihood of a fin slipping off the user's foot by using non-elastic heel straps (ratcheting or universal style).

For experienced users, when entering water off high platforms, the forward roll method may be performed. This generally involves standing at the edge of a boat deck, while having one hand on your mask and regulator, and your other arm around your other equipment to avoid these from hitting you as you enter the water, and bend completely forward while imagining touching your feet with your fingers, and tucking your body into a tight ball while pushing yourself away from the boat with you legs, and while allowing the tank or tank valve region to strike the water first.

When snorkeling, all methods may be satisfactory because the user is not burdened with heavy tank(s) and other apparatus weight.

Avoid walking forward through shallow water while wearing fins.

Other notes:

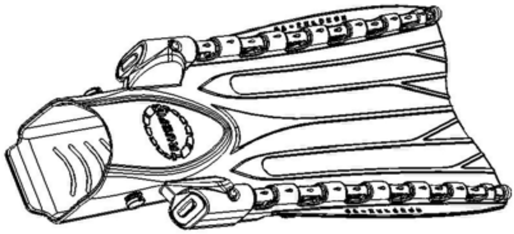
Truefin Model 110 includes: one pair of black fins with four installed Blue '412 spines and one pair of heel straps.

At this time it is recommended that the spines be replaced every 1,000,000 aggressive kicks or every 500 (verify) dives, whichever occurs first. Replacement cost for a complete set of four Blue '412 spines is currently $40 (estimated cost subject to change: $10 per spine).

Avoid causing premature failure of the spines by prying or kicking the spines against an immovable object both in water or on land because the spines are made out of plastic. Note that if a spine breaks due to accident or abuse, the fin will generally perform as a traditional fin while only having one spine to enforce a compromized 'angle of attack'.

INTRODUCTION TO TRUEFIN

Mermaid art by Jennifer



GEN 4

BACKGROUND

Apart from a breathing apparatus, foot fins may be considered the most important piece of gear to a snorkel or scuba diver.

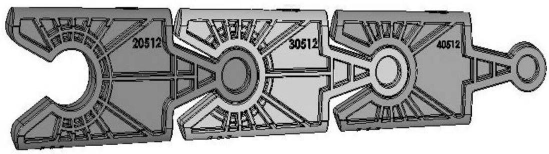
Swim fins are a category that has not changed much over the years, and the user chooses between a flexible fin or a stiff fin according to the task to be performed. More recent changes involve: (1) venting the blade, (2) splitting the blade, (3) allowing a paddle blade to deform and form a scoop shape, and/or (4) employing a localized flex or hinge zone between the foot pocket and the fin blade.

Swim fins are available in both open heel designs as well as closed heel designs. Open heel fins are generally more popular than closed 'full foot' fins due to the preference of many users to wear booties which are warmer in cold water, and booties are also safer for shore diving while walking on rough shore terrain prior to entering the water, and while walking on hot decks. Also, open foot or open heel fins may be adjusted to exactly fit the user's feet. Closed heel fins are generally worn barefoot or with socks and have high comfort if properly fitted, as well as having less drag resistance than open heel fins while kicking or moving though water.

Efficiency of swim fins is a function of the average forward velocity in water and the power required to achieve that speed. The diver must overcome drag while swimming, where active drag (drag from a diver swimming through water) is generally greater than passive drag (drag from a diver being towed through water), and in order to reduce active drag while flutter kicking for example, short kicks are advised over long kicks in order to minimize the projected area profile of the diver. However, to further confuse the matter, for a given velocity greater energy may be required to perform short kicks at high frequency versus long kicks at a lower frequency because moving a small mass of water rapidly is less efficient than moving a large mass of water slowly, so efficiency comparisons between long stroke kicking versus short stroke kicking are not apparent.

Regardless of the kick stroke length, during high frequency flutter kicking Truefin performs exceptionally well and high swim velocities are achieved, whereas during rapid kicking, traditional flexible fin blades collapse or 'go flat' as known in the industry, and for this reason very stiff traditional fins have been chosen in the past in order to minimize the likelihood of a stiff fin blade collapsing during moderate to high kicking frequencies. Furthermore, a disadvantage with a traditional stiff fin is that muscle fatigue and relatively high oxygen consumption occurs for the amount of speed achieved during low kicking frequencies with stiff fins, and as a result traditional stiff fins are inefficient and uncomfortable to use when kicking at slow to moderate speeds due to abnormally high strain at the user's ankle for the low amount of thrust generated. Furthermore, at low kicking frequencies, with traditional stiff fins much energy is lost with water spilling over the sides which increases resistance and produces no useful work. If a traditional fin is considered stiff enough that it can not be 'over kicked', then at low kicking frequencies the fin will perform unsatisfactorily and may cause muscle cramps.

The fin blade flex characteristics of Truefin equipped with Blue '412 spines is twenty degrees (20°) in the 'toe up' direction, and sixty degree (60°) in the 'toe down' flex direction (45° 'toe down' effective flex) and is effected by the articulation limit between each of the collision sites between a series of artificial vertebrae. With the Blue '412 spines the articulation limit between successive vertebrae is four degrees (4°) in the toe up direction and twelve degrees (12°) in the toe down direction. **Illustrated below are '512 vertebrae** ('512 vertebrae not available):



The fin blade flex characteristics are also effected by the elasticity of the pass core bands, where as the blade flexes the bands tighten against each vertebra which results in a slight 'springiness' when the blade is fully flexed. Note that when the spines are removed from the fin, negligible blade flex 'springiness' is exhibited when the blade is flexed 'toe down' to sixty degree (60°) because the spine vertebrae are not present to create tension in the pass core rail bands. As a side benefit, with the spines removed, the fin may be bent to a 'U' shape during travel in order to minimize luggage volume.

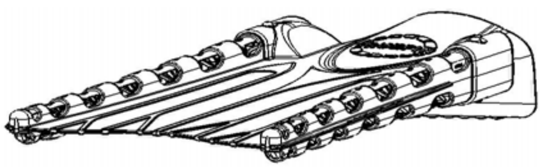
As further background in this regard, based upon machine testing the elastic rails of traditional fins do not improve efficiency as compared to the generally non elastic rails of Truefin. This may be because if you consider the full kick cycle, and regardless as to how much rail spring bending resistance the fins has, the user of traditional spineless fins first has to load up the 'rail spring' at the beginning of the kick stroke which takes energy away from the diver, followed by the 'rail spring' returning energy to the diver's kick at the end of the kick stroke, which is a net zero in energy expenditure during those events in a given kick cycle while the rail spring is loaded and then unloaded. By the way, in an analogous manner, fins having higher mass do not necessarily require more overall effort to kick, because although such fins require greater force to initiate a kick, the greater inertia of the fin due to the higher mass carries the fin kick further during completion of the kick, thereby allowing 'coasting' at the end of the kick stroke. Although Truefin is a relatively heavy fin at around 6 ½ pounds per pair if non metallic fin straps are used, it is not the heaviest fin on the market, and whatever extra force may be required due to the inertial load while initiating a kick with Truefin is inconsequential because the user is not exerting wasted energy flexing self dampening elastomeric side rails of spineless fins while achieving an 'angle of attack' of the fin blade. Although Truefin has negligible self dampening characteristics and the angle of attack rapidly changes upon fin blade reversal, Truefin does exhibit a very minor rail spring rate as the rail bands are loaded in tension immediately prior to vertebrae collisions, and this is considered a benefit at low kicking frequencies.

An addition comment should be made with regard to what is commonly referred to as 'snap' of a fin. Snap is technically the relaxation modulus (E(t)) of a material. Based upon testing by Truefin, a popular argument that a fin of traditional length should have a high relaxation modulus in order to deliver a 'snap' of propulsive thrust toward the end of the kick stroke again is not demonstrable when machine testing for efficiency because Truefin simply does not have any 'snap'. Having said that, very long fins such as freediving fins are a different category and may benefit from 'snap'. Freediving fins have a large surface area which displaces more water thereby offering more power, and the elastic 'snap' may be more noticeable and beneficial. The elastic 'snap' or relaxation modulus (E(t)) of the blade material is highest with carbon fiber blades. Fiberglass, plastic, and rubber have decreasing moduli and consequently less 'snap'. 'Snap' is a property that defines the response rate or elastic rebound rate, and is independent of blade stiffness. Typically, the relaxation modulus (E(t)) of a material is measured by holding the material at a given strain, and then measure the rate at which the internal stress of the material decreases with time as it relaxes.

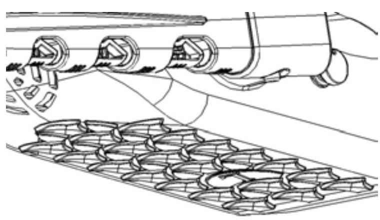
The flexible blade of Truefin in combination with the artificial spines of Truefin results in a new type of swim fin that performs very well during scuba and snorkel activities due to overall comfort and efficiency. Truefin also has applications when spearfishing because Truefin is highly maneuverable, and the artificial spines prevent the blade from collapsing when shorediving and during fast acceleration when in surf, or while in rough seas with big swells and current around reefs.

Note that freediving fins (with blade lengths between 31-40 inches for example) are more efficient then Truefin and scuba fins in general, so spearfishing is typically performed with long, flexible freediving fins, and most often in deep open water where the diver is not concerned about critical maneuvers, and it is unlikely that collisions will occur between the fin blades and underwater obstructions.

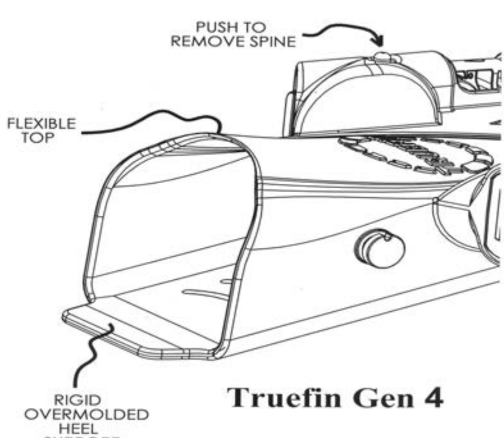
Truefin has chosen to incorporate a non-vented and highly streamlined paddle style blade with an upper planar surface extending over the foot pocket in order to facilitate laminar flow.



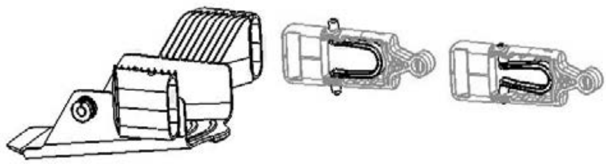
The bottom sole or platform of Truefin is provided with a non-slip surface of low profile design.



The extended overmolded bottom region rigidly supports the user's heel, and the top is tapered thin for comfort.



Polymer spring locks base of spine to chassis. To release spine squeeze spring together.

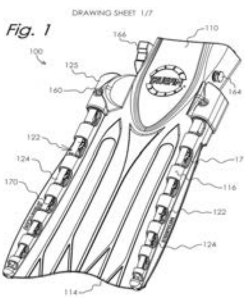


PADDLE BLADE

More will be discussed about vented blades in EFFICIENCY AND GEOMETRY. Based upon research involving subjective testing as well as machine testing by Truefin, the benefit of a vented fin blade is not supported and in fact may disadvantageously reduce the volume of water directed rearward at all kicking frequencies. However, for relatively stiff prior art technical fins, blade venting may offer a benefit in order to reduce kicking resistance at low kicking speeds when the optimal 'angle of attack' is not possible and it is desired for water to flow or spill through the blade vents (in an inefficient manner) in order to reduce low frequency kicking resistance. Note that with the design of Truefin the optimum 'angle of attack' readily occurs at low kicking frequencies as well as at high kicking frequencies so such spilling of water through the blade is unnecessary and reduces efficiency.

STRUCTURE:

Fig. 1

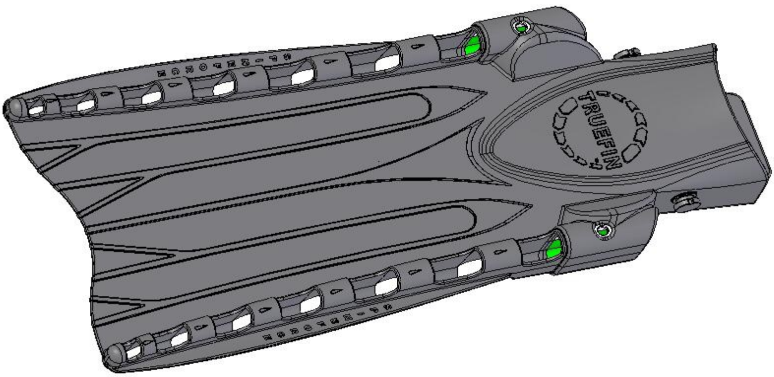


Truefin is 100% nonmetallic in order to ensure rust and/or corrosion can never be an issue in fresh or salt water.

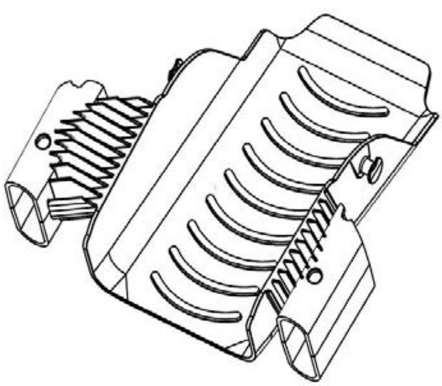
Generally, there are four components in the design of Truefin: Fin, Chassis, Assembled Spines, and Spring pins.

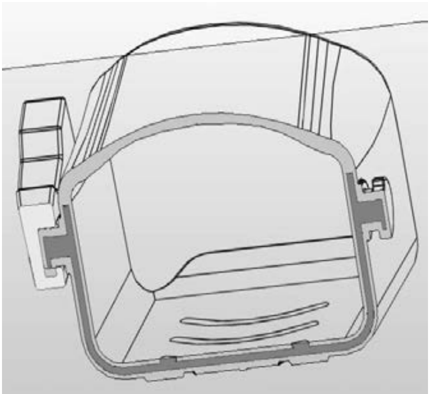
Fin - (black) injection molded Monprene (Shore 70A). The bottom and sides of the foot pocket is over molded with a substrate chassis and is relatively rigid. Upper surface of foot pocket is not over molded, and is highly flexible and tapered thin (down to 0.140") to the center top edge which improves comfort and reduces concentrated forces at the top of the user's foot. Foot pocket includes a circular array of toe vent holes in order to minimize parachuting while moving through the water and also to minimize suction and allow drainage while facilitating removal of the fin from the user's foot. The external sole or power plate of the fin includes relatively complex geometry of a low profile non-slip design to both maximize traction while wearing the fin out of water, yet minimize turbulence or drag forces while finning in water.

Fin with over molded chassis, and with artificial spines removed:



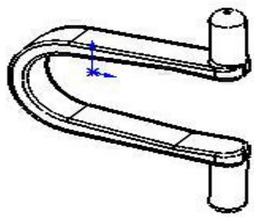
Over molded chassis (substrate) - injection molded 50% glass filled polypropylene.
Heel strap posts are part of chassis and are also overmolded.





Artificial vertebrae: 30% glass filled injection molded nylon (21,000psi tensile)
Hardness approximately 84 Shore D. (Note bone = 90D)

Polymer leaf spring pin (red) - secures removable spines.

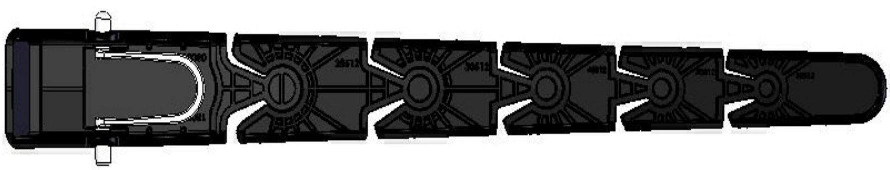


The spines are locked into chassis substrate with polymer leaf springs.

SPINE GEOMETRY

Each fully assembled Blue '412 spine has six blocks or six artificial vertebrae, and there are five 'head and socket' collision angle sites between the blocks. Blue '412 vertebrae part numbers: 10000, 20412, 30412, 40412, 50412, and 60412 each have collision angles of four degrees (4°) in the 'toe up' direction, and twelve degrees (12°) in the 'toe down' direction, resulting in the assembled spine articulation at each side of the neutral axis of the fin rails to be twenty degrees (20°) in the 'toe up' direction, and sixty degrees (60°) in the 'toe down' direction [note: 5 x 4° = 20°, and 5 x 12° = 60°].

The trailing or terminal vertebra 60412 is relatively long, and this is to create an 'unswept' trailing edge of the blade which is preferred when considering vortex sheet shedding. Traditional fins, and particularly flexible traditional fins, to a certain degree have 'swept' trailing edges due to the yielding elastomeric properties of the fin rails, and where small regions of the trailing edge of the blade may flex nearly perpendicularly to the longitudinal direction of the fin resulting in a portion of the water exiting off of the trailing edge of the blade to be directed toward inefficient directions.



During spine installation, the hash marks (**III**) on the vertebrae are assembled next to the hash marks (**III**) at the bottom of the fin rail, and the tear drop marks (♦) on the vertebrae are assembled next to the tear drop marks (♦) at the top of the fin rail.

FINNING

The standard Blue '412 artificial spines flex 'toe up' approximately twenty degrees (20°), and flex toe down approximately sixty degrees (60°) *['4°/12°' vertebrae = 20°/60° blade flex']*. These spine flex characteristics allow for a conventional feel of the fin during kicking, with easy flutter return kicks due to the 'toe up' flex allowance, yet during the forward power stroke of the flutter kick the fin will never collapse or 'go flat'.

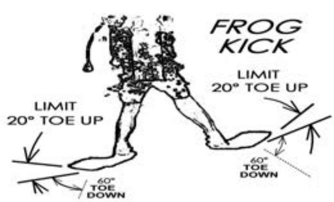
KICKING STYLES

Flutter kicking:

In general, the faster the user kicks Truefin during the flutter power and/or power and return stroke, the greater the propulsion speed, although note that drag resistance increases with the square of the velocity of the user's body moving through water so diminishing benefits occur with increased exertion. A 'modified flutter kick' is suggested in order to minimize silt disturbance. During slow to moderate flutter kicking frequencies, it is recommended to relax the user’s ankles during the flutter return stroke as this promotes blood circulation in the foot and ankle and minimizes muscle cramps.

Frog kicking:

Flutter kicking typically involves constant movement which may be undesirable because there is no rest phase for Scuba divers, and also flutter kicking tends to disturb sediment at the bottom of a sea floor or inside a cave. For this reason many divers prefer to frog kick where a kick and glide phase occurs.



During frog kicking, Truefin Blue '412 spines flex up twenty degrees (20°) during the power 'pushing away' phase, and during the return stroke the fin blade flexes 'toe down' up to a sixty degree (60°) angle.

Dolphin kicking:

During dolphin kicking with Blue '412 spines Truefin is highly efficient and significant thrust is possible while pushing water down during the power stroke while the blade flexes 'toe down' sixty degrees (60°).

The twenty degree (20°) blade flex in the 'toe up' direction during the return or recovery kick phase of the dolphin kick may also contribute to propulsion if the user has sufficient strength.

Side kicking:

During side kicking or breast stroke kicking, the twenty degrees (20°) 'toe up' blade flex limitation with Truefin Blue '412 spines improves efficiency during the power away kick, while during the forward return phase of the side kick the blade advantageously flexes 'toe down' sixty degrees (60°) while minimizing return kick resistance.

Reverse kicking:

You can reverse kick without fins simply by backwards movement generated by your legs only. In fact, many instructors will first teach reverse or back kicking while not wearing fins. During reverse kicking while wearing fins, generally the traditional recommendation is for the side walls or side rails of scuba fins to be used for backward propulsion while the fin blades are generally kept parallel with the water surface or the sea floor, and while a relatively rapid backward side slicing motion of the fin occurs. Truefin also recommends this technique. The side rails of Truefin are similar in size or side projected area as the relatively large side rails of traditional stiff technical fins. Note that the side rails of Truefin also offer a benefit when helicopter turning.

Surface swimming:

During surface swimming with Blue '412 spines, and particularly while swimming face up while on the user's back, the highly flexible nature of Truefin toward the sixty degrees (60°) 'toe down' flex limit is efficient and minimizes splashes, while blade flex in the twenty degrees (20°) 'toe up' direction enables the user to exert limited propulsive forces if desired during the rearward return direction of a surface flutter kick. In most circumstances of endurance surface swimming however, during the flutter return kick the user is encouraged to relax the user's ankle and allow the fin blade to follow the streamline of the water.

It may be noted that while instructing students, dive masters may prefer to swim 'on their back', face up, while staying ahead of a student, and the ability of Truefin to exert thrust while flexing only twenty degrees (20°) during the return stroke offers a benefit in propulsion effect.

As a side note, with respect to dive masters observing students, often dive masters or divers in general may kneel on an ocean floor with their fin tips behind them embedded in sand and silt while taking caution not to damage habitat and coral life. While in this kneeling position and while wearing Truefin, the artificial spine tips in contact with the floor terrain provide very stable support. When this practice occurs, popular scuba fins which have relatively rigid plastic stakes, stabilizers, and/or battens bonded to 'rubber-like' low durometer elastomeric blades or rails may experience separation and failure at the bond zone between the plastic and the low durometer elastomer after periods of use where divers kneel and allow the blade and rail tips to be stabbed or embedded into the sand or sea floor silt (without damaging habitat). With Truefin this is not an issue because the overmold is of a homogeneous design, and the user may spike the artificial spines into the sand without concern of any separation failure (again without damaging habitat, or coral, etc.). Also, although the artificial spines may be embedded in silt or sand, due to the pass core bands the fin rails and the artificial spines are self cleaning and readily shed silt and sand once the diver exerts propulsive forces.

Alternate Configurations

Note Green '012 spines and Yellow '415 spines are optional, where Green '012 spines are optimized for frog kicking, and Yellow '415 spines are optimized for easy flutter kicking. Green '012 or Yellow '415 vertebrae may be used exclusively, or may be 'mix and matched' in order to customize the fin to perform best with a preferred kicking style. Note that although Yellow '415 spines provide the easiest kicking resistance, for a given velocity Yellow '415 spines would need to be kicked faster.

Individual vertebra may be intentionally installed up-side-down to define additional predetermined blade flex profiles, or inside and outside asymmetrical blade flex may be configured such as having the inside rails flex more or less than the outside rails during canted frog kicks.

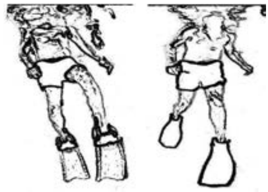
EFFICIENCY and GEOMETRY:

High efficiency of operation in the case where scuba fins are studied ultimately correlates with the greatest distance traveled under water while consuming the least amount of air. Such test results with Truefin are not available at this time.

When designing a swim fin, an optimum angle of attack is generally around forty five degrees (45°). The standard '412 Blue spines of Truefin articulate sixty degrees (60°) during the flutter power stroke, and this generally correlates to an effective angle of attack of forty five degrees (45°) due to the dynamic orientation of the fin while moving forward in the water streamline while kicking at a moderate velocity.

With Truefin, the allowed articulation of the artificial spine and consequent blade flex is generally similar regardless whether the user is kicking slowly or rapidly, and thrust is proportional to the kicking frequency and foot range of motion.

An anecdotal observation to be noted while comparing performance of Truefin versus other fins recently tested, is that if a user treads water while wearing Truefin, then he/she is generally able to tread water while maintaining his/her head higher above the water surface compared to traditional fins. This generally indicates (and as supported by machine test data) that for a given amount of physical exertion a user would be expected to tread higher with Truefin, and therefore one may infer that less air may be consumed at a given head height above water while treading water with Truefin as compared to other fins. Such air consumption test results while treading water have not been performed.



PRIOR RESEARCH:

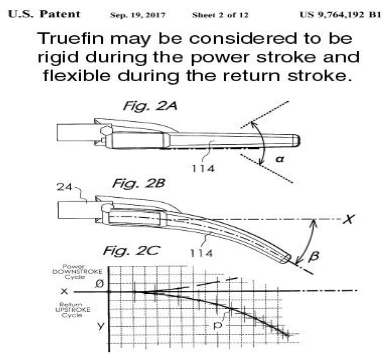
As further background regarding the history and research of traditional swim fins, over the past few decades various studies have been performed and general conclusions regarding efficiencies of various (spineless) fins have been offered. For example, in a first case, Zamparo et al. tested fins, during attempts to determine efficiency of operation, as discussed in: *'How Fins Affect the Economy and Efficiency of Human Swimming (The Journal of Experimental Biology, 2002, by Zamparo, Pendergast, Termin and Minetti)*, where it was stated "large, rigid fins are energetically demanding but improve the maximum attainable speed, whereas flexible fins improve the economy of swimming at 'submaximal cruising' speeds" *(Lewis and Lorch, 1979; McMurray, 1977; Pendergast et al., 1996)*. Continuing, Zamparo et al. indicated that during "submaximal cruising" kicking speeds and low thrust situations while swimming underwater, a traditional flexible fin will perform very well. Truefin is as flexible (up to a predetermined angle of attack) as the traditional flexible fins Zamparo was referring to, and therefore Truefin may be considered to have "economy of swimming" at slow "submaximal cruising" speeds.

In other research regarding fins (*Bergmann, Iollo and Mittal, year 2014 in: Influence of Caudal Fin Rigidity On Swimmer propulsion Efficiency),* found that "The model shows that optimal efficiency is obtained for an intermediate flexibility of the caudal fin and that neither excessive rigidity nor compliance are conductive to efficient propulsion." The Bergmann research was limited to computational models only which "...couples a penalization method based Navier-Stokes solver with a simple model of flow induced deformation and self-propelled motion at an intermediate Reynolds number of about 1000." Bergmann concluded (without having considered the inclusion of Truefin artificial spines which enforce a bending limit of a flexible blade) that: "We observe that rigid caudal fins lead to excessive lateral forces that increase power consumption without generating thrust, whereas highly flexible caudal fins produce negative thrust during significant portions of the stroke. These results may lead to significant improvements in the design of underwater robots and suggest bioinspired designs for flexible fin propulsors." In summary, Bergmann simply concluded that the best overall performing fin is one of medium stiffness, which is currently the most popular type of swim fin in use today, and generally swim fins having "intermediate flexibility" perform similarly yet with distinctions between appearance and comfort level of the foot pocket.

In addition to Truefin exhibiting rigid characteristics, Truefin is also considered to be highly flexible, however the "negative thrust during significant portions of the stroke" does not occur with Truefin because the Truefin blade will not collapse during Bergmann's computational analysis. Truefin, as well as a traditional flexible fin, may include the use of natural rubber or low durometer Monprene of 70 Shore A for example, where Truefin is flexible and there is less likelihood for muscle cramps to occur during low propulsion effort. At low propulsion efforts or low kicking frequencies the optimum blade angle of attack is possible with flexible traditional fins, and the optimum blade angle of attack always occurs with Truefin.

It is interesting that the bending or blade flexing characteristics of Truefin may have been vaguely speculated to be a preferred characteristic of a foot fin blade, where Pendergast et al. wrote: "Swimming with a rigid fin in the down stroke and a flexible fin in the up stroke may be advantageous; however this type of fin was not avaiable for testing". *(UHM 2004, Vol 30, No.*

1 - Evaluation of Fins Used In Underwater Swimming, page 69 by Pendergast, Mollendorf, Logue, and Samimy). During the time period Pendergast performed fin tests, Truefin had not been invented, and Truefin may have been considered "advantageous' by Pendergast because the artificial spines of Truefin are rigid at the optimum angle of attack in the downward power stroke, and highly flexible toward an optimum angle of attack in the upward return stroke. Furthermore, in practice, during a flutter kick a swim fin blade does not fully flex in the 'toe up' direction during the return stroke (because the user lacks sufficient strength), but rather during the return kick the blade becomes parallel to the streamline of the water flow as the user moves forward, and therefore Pendergast may have considered the Truefin blade to be "flexible in the up stroke".



In this regard, previous research *(for example: Lighthill model / Note of the Swimming of Slender Fish. J Fluid Mechanics 1960; 10: 321-344; and Hydromechanics of Aquatic Animal Propulsion. In: Mathematical Biofluidodynamics: Society for Industrial and Applied Mathematics, 1975:11-43)* pertaining to prior art swim fins is somewhat irrelevant since the advent of Truefin, where Lighthill's research generally involves essentially all other fins on the market today, where fins in the current market place have fin blades supported by rails (or ribs) having flexural stiffness which may be approximated as thin elastic beams according to Euler-Bernoulli's beam theory, and Truefin departs from such prior art by introducing articulating rigid spines that lock up at predetermined angles of attack, and where the artificial spines of Truefin prevent over-flex of a highly flexible and hydrodynamically streamlined fin blade. The predetermined articulation of Truefin spines ensures the optimum 'angle of attack' at both low kicking frequencies as well as at high kicking frequencies, and consequently muscle fatigue and oxygen consumption is generally minimized at all levels of exertion. Truefin is very efficient and used by divers to extend bottom time because divers are not using as much energy and generally able to move through the water with less fatigue on the legs.

As further background with regard to efficiency, and with regard to vented fins, prior research by Pendergast et al.(*UHM 2004, Vol 30, No. 1 - Evaluation of Fins Used In Underwater Swimming, page 69 by Pendergast, Mollendorf, Logue, and Samimy)"* stated: "The use of vents, either forward or reward facing or venturis does not improve economy as was seen in this study and previous studies *(McMurray referenced below)*, apparently as water does not pass through the vents, thus they do not relieve the negative thrust in the recovery phase. Also, the vents would presumably 'leak' water, and hence reduce the pressure difference that results in thrust, during the power phase of the kick cycle".

Also to be noted with regard to questionable benefits of fins which have features such as vents or venturis, in a study conducted by McMurray *(McMurray - Comparative Efficiencies of Conventional and Super-Swimfin Designs, Human Factors 1977; 19:495-501)* where five fins in 1977 were tested: Turbofin, Scubamaster, Venturi, Spoiler, and Otarie, "The vents in the Scubamaster would allow a small portion of the water to pass through the fin unobstructed and thus decrease the effort placed on the Achilles tendon and hamstrings. It would seem that the venturi design of the Spoilers does not improve their performance as much as the vented design. This is somewhat substantiated by one trial in which the venturi of the Spoiler Fin was taped over and the oxygen consumption test repeated. No apparent difference in oxygen consumption were noted between this trial and the normal trial using the Spoilers [12.29 vs. 11.63 ml O_2/kg min^{-1}, respectively]". Furthermore, McMurray continues: "Trials using Venturi Fins were not significantly different in mean oxygen consumption than that obtained using any of the other fins. There may be two possible reasons for this failure to find a difference. First, the fins may be too flexible. Second, the value of the design of the venturi in the fin may be questionable. In order for a venturi to be effective, the fluid must enter a larger opening than that from which it exits. Therefore, the speed of the fluid moving through the tube will be increased, thus adding to the forward propulsion. The design of the Venturi Fin is such that the water enters a smaller opening than from which it exits, thus allowing for a dissipation of the forces within the tube. A similar trial to that of the Spoilers was completed in which the venturi was taped over. The results indicated no difference in oxygen uptake between the normal Venturis and the non-vented Venturis".

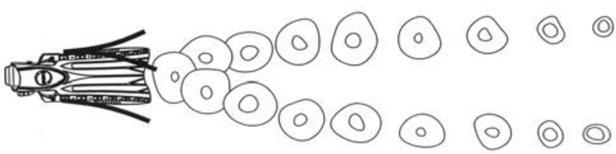
With regard to split fins, Pendergast et al. stated: After "the split fin's split was duct taped closed for one trial" and Pendergast et al. continued: "The longitudinal splits in the Apollo fin do not appear to improve thrust nor did they lower $VdotO_2$, thus it is reasonable to speculate that the water either leaked over the splits or its backward velocity was decreased by the splits, resulting in less thrust. These fins were kicked at high frequencies, thus the relatively small amount of water accelerated rapidly leads to low efficiency." Pendergast et al. continued: "The lack of improvement in thrust or economy of fins with venturis, vents, troughs, etc. would be expected from the Lighthill model *(Lighthill referenced below)* as they would not increase the velocity of water down the fin, and in fact may decrease it, this leading to lower thrust during the power phase." Pendergast et al. continued on *(page 66)*: "The Apollo fin possesses the lowest Froude efficiency, probably due to the split in the fin's blade. The split allows water to 'pass through' it instead of having the water pass over the surface to produce the desired pressure gradient between the attacking and leeward surfaces. The Apollo (taped) and the Quattro fins each have Froude efficiencies well above 60%. The common characteristic between these two configurations is that both have flanges along the lateral edges of the blade to direct flow to the fin tip which acts as dykes to channel the flow along the fin's surface and ultimately being ejected from the TE". It may be noted that Pendergast et al. may have been performing the wrong kick style with split fins, where many users have found acceptable performance of split fins when flutter kicking at high frequencies with short strokes, and where the full leg of the user is not utilized and the user kicks only by flexing one's ankle, or knee and ankle. Note that the Truefin test apparatus simulates full leg flutter kicking from the user's hip, so Truefin machine efficiency test results while kicking split fins may also not be optimally representing split fins, although it should be added that a shorter kick at higher frequencies may benefit all fins styles. Future Truefin machine tests may plot efficiency as a function of range of foot movement while ignoring the increased drag on a scuba diver as the range of foot movement is increased. In order to factor in drag of a diver, a test apparatus similar to the HERMES test equipment (refer to TESTING) would have to be utilized.

TRUEFIN TESTING:

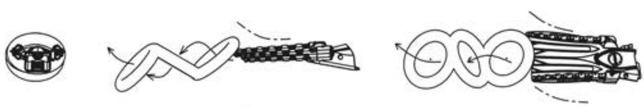
Truefin Model 110 (Generation 4) is introduced with '412 Blue spines.

Truefin has machine tested fins incorporating artificial spines used in conjunction with a split fin blade (Truefin 'Generation 1') and/or a blade having venturis or vents, and at this time a simple paddle style fin blade utilized without such features have demonstrated to have the greatest overall performance and efficiency.

As an additional note with regard to the paddle style fin blade utilized with Truefin, the trailing blade edge of Truefin is configured to a slight crescent shape or what is known as a lunate tail, and Lighthill *(Lighthill - Hydromechanics of Aquatic Animal Propulsion. In: Mathematical Biofluidodynamics. Philadelphia: Society for Industrial and Applied Mathematics, 1975:11-43)* noted that such a shape generally offers efficiency benefits, where Lighthill stated of fish such as "tunnyfishes, albacores, wahoo, skipjacks, and bonitos": "...have caudal fins so scooped out internally as to make a V shape, the two arms of the V being 'sweptback' by an angle of 50° and 60°". Lighthill continued: "This sweepback is, however, just large enough to make the estimation of propulsive efficiency by elongated body theory a reasonable rough approximation, and that theory confirms that, when such a fin moves as a whole, the scooped-out area works (through properties of the vortex sheet that fills it) just as effectively as the rest of the tail". Lighthill continued: "It is just possible, then, that the lunate tail is a favorable form because, at convenient frequencies of oscillation for fast movement, it can especially readily shed vortex rings of approximately circular shape. These characteristically carry a large amount of momentum in relation to their energy, and so rate of shedding of wake energy might be minimized as a proportion of



Fins of swimmer generating a vortex street composed of two oblique rows of vortex rings



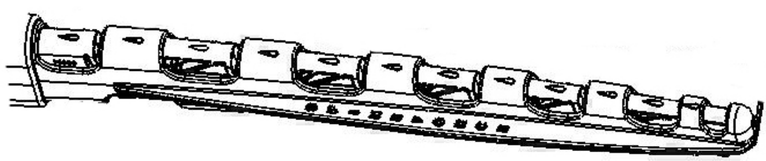
Circular vortex rings from Truefin lunate tail

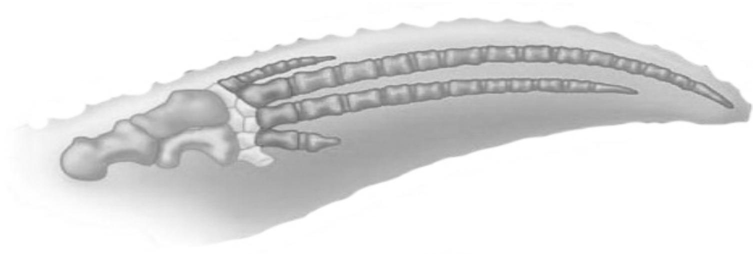
effective power exerted, which is related to W times the maximum rate of shedding of cross-stream momentum into the wake". Using the terminology above, the artificial spines which function as the rails or ribs of Truefin are analogous with the sweptback bony 'arms' referred to by Lighthill, and the slight crescent shape of the Truefin trailing blade edge is analogous with the lunate tail or internally scooped-out caudal fin also referred to by Lighthill.

With regard to the side rails which support the blade, the present Truefin 'Generation 4' (as well as 'Generation 3') utilize a pass core design where a series of alternating bands contain the artificial spines, and where the artificial spines define a smooth curve or streamlined flex of the blade in a distributed manner along the spine axis in order that no sharp kink in the blade flex occurs during the 'angle of attack'. Note that prior art 'hinged' fins generally do not have a streamlined arcuate flex profile of the blade while being kicked, and consequently such fins are less efficient and produce more turbulence.

The alternating pass core bands of Truefin offers several important functional advantages over the tubular rails utilized in Truefin 'Generation 1' and Truefin 'Generation 2'. For example, the bands (1) facilitate the self cleaning of spines which may have been exposed to silt and sand, (2) enable the fin - with spines removed - to readily bend or fold prior to travel, and (3) make possible the molding of curved and divergent fin rails which improves 3D blade scooping performance. By happenstance, the bands may resemble the pattern of bumps or 'tubercles' present on the leading edge of pectoral fins of humpback whales. Truefin has not been able to measure any positive effect on efficiency with the presence of these bands (they are not on the leading edge), and any negative effect on efficiency with the presence of these bands is infinitesimally small due the relatively small surface area of the pass core bands and the low Renolds number (Re<2300) where the water flow past the bands is laminar.

Artificial Spine



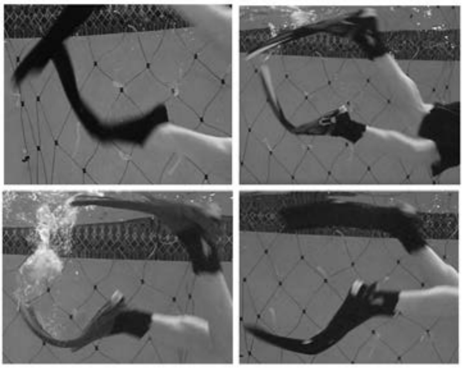


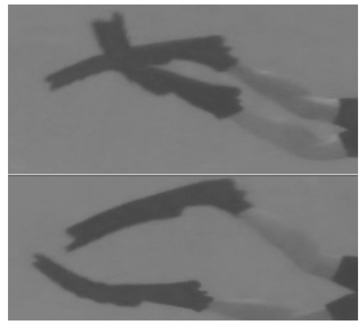
Biological Spine

Fish can self adjust the stiffness of an active fin according to their needs, and humans must select a passive fin as a compromize over nature according to the task to be performed. Traditional swim fins may perhaps best be described as mimicking fish of the order Synentognathi (an order of fishes having spineless fins, wormlike), whereas Truefin swim fins with their artificial spines are designed to be functional and perform optimally at all kicking frequencies, while being comfortable, durable, lightweight, and without utilizing metal in order to eliminate the possibilities of corrosion.

Truefin Blade Flex Profile:

Examples of popular fins 'going flat' resulting in inefficient propulsion as compared to Truefin on the right.

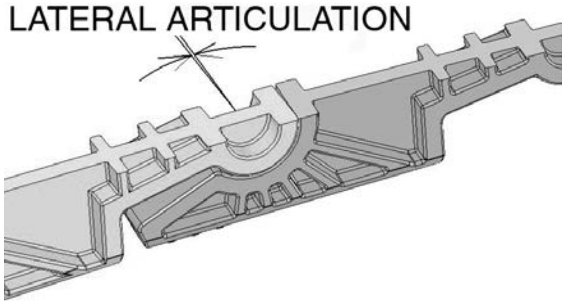




Three Dimensional Blade Scooping:

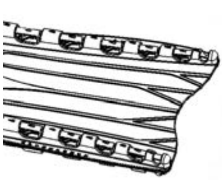
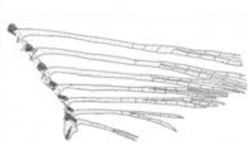
The lateral articulation of the Truefin spines are designed to allow the webbed blade to flex minimally and in a predetermined manner in three dimensions during kicking.

This 'scooping' action, or concave blade shape toward it's direction of lateral deflection is achieved by designing the artificial spine to flex approximately up to five degrees (10° inclusive angle) laterally toward the center while the sixty degree (60°) power stroke 'toe down' angle of attack is enforced.



This scooping or cupping action focuses the propulsive flow stream rearward in a more direct and efficient manner, with less water spilling over the sides of the fin. Note that when Truefin is at rest or relaxed, the blade lies in a flat plane and the spines also lie in that same flat plane while being laterally divergent, however as the blade 'scoops' to a concave shape each of the spines laterally articulate in a convergent manner approximately five degrees (5° or 10° inclusive) while the blade flexes down sixty degrees (60°), thus allowing 3D blade cupping or scooping during the kicking event. Based upon research by Lighthill *(Mathematical Biofluiddynamics, Lighthill - ISBN 0-89871-014-6, 1975, page 99)*, the magnitude of 3D scooping should be held to a minimum, where Lighthill states "...good thrust and good efficiency would best be achieved if the axis of yaw were close to the trailing edge of each section. This requires that the trailing edge as a whole stretch almost straight along the axis of yaw". Lighthill continues "Any bowing of the trailing edge should be small by comparison." A reasonable compromise is thought to be achieved with Truefin, which is only possible because the artificial spines enable predetermined lateral constraints to be placed upon the blade (or fin rails) when the face of the blade is subjected to water pressure. Traditional scuba and snorkel fins, having elastic rails, are not able to enforce predetermined lateral constraints at the fin rails, and in some instances have excessive blade scooping under load which reduces efficiency and also reduces the projected area of the blade during thrust.

With regard to 3D blade scooping, an interesting event or phenomena occurred on early prototypes of Truefin as the blade was flexed underwater, where a three dimensional blade kink formed which was focused at a laterally centered point, and this phenomena was due to the intentionally rigid 10° lateral inclusive articulation angle limit of the artificial spines referred to above. Traditional fins having elastic rails do not have this kinking issue because a traditional fin simply distorts overall while flexing which prevents a 3D blade kink from being formed. In order to resolve this issue, surface features such as fin rays were added to the blade, and a circular array of ventilation holes were added which allow the blade region adjacent to the vents to more readily flex and eliminate 3D blade kinking.


GENERAL NOTE:

When comparing Truefin to traditional (spineless) fins, it is acknowledged the efficiency and/or thrust of a swim fin may compare similar to Truefin while flutter kicking as long as the (1) the projected area of the blade is similar to Truefin, (2) the fin blade is at the optimum angle of attack, and (3) the flex profile is fully distributed along the blade. Note that 'hinged' fins do not have distributed bending of the blade and consequently generate turbulence at the sharp hinged bend which introduces inefficiencies. The streamlined and distributed blade flex profile of Truefin results in highly laminar and efficient flow. As evident from machine testing, traditional 'highly flexible' spineless fins may perform similar to Truefin at very slow kicking frequencies (refer to comparison graphs pages: 35, 36, and 37) such as at kicking frequencies between one to fifteen kicks per minute (0-15 kicks/min). Furthermore, the blade flex profile of traditional fins may be effected by water temperature, where the rubber or plastic rails of traditional spineless fins can become stiffer as the water temperature is reduced. The blade flex profile of Truefin is generally not effected by water temperature.

During frog kicking, only Truefin or stiff technical fins perform satisfactorily.

TESTING

Truefin conducted underwater speed tests with divers utilizing Truefin as well as with premium fins of different manufactures, where the premium fins tested are known for high performance, and while realizing human physical variables exist which are not generally repeatable. Fins which were considered highly flexible and which have low thrust capability were not tested.

Human speed tests:

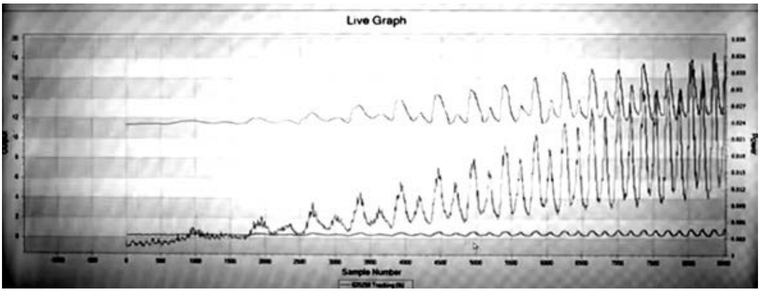
Kicking Truefin at low frequencies and slow speeds is as comfortable and efficient as any traditional highly flexible fin, yet while kicking Truefin at high frequencies exceptional thrust was experienced without fin collapse. Also note that the spines of Truefin enables emergency maneuvers which involve rapidly extending the user's leg(s) while pushing the fin blade broadly away at high acceleration without having the fin blade collapse.

Note that although Truefin excelled in these subjective human tests when comparing the speed of divers against various premium spineless fins, a couple exceptions occurred where the differences in velocity data was not statistically significant with several of the traditional 'stiff' fins when at the limits of the muscle strength or available power of the divers. However, if the divers had greater strength there is no question that Truefin would have easily outpaced all spineless fins during subjective diver tests because all spineless fins ultimately collapse. It is for this reason that machine testing which plots thrust verses input power for all fins tested is considered an important method when objectively evaluating thrust and efficiency.

Machine tests:

The first series of machine efficiency test were conducted with Truefin equipped with Green '012 spines. Flutter kicking efficiency comparisons between Green '012, Blue '412, and Yellow '415 spines have not been performed as of this date although it is expected the efficiency between Green '012 and Blue '412 would be similar because the angle of attack is the same. The efficiency values of the 'easy kicking' Yellow '415 spines are not known at this time, but it is known Yellow '415 spines require higher kicking frequencies for a given amount of thrust.

Live efficiency data example while flutter kicking Truefin



The 'live graph' screen shot shown above is taken during the start-up phase as the controller ramps up the speed of the motor while measuring power at a torque sensor, and thrust at a load cell, to determine the efficiency of Truefin and other fins.

History, Research, and Testing:

An interesting and relatively sophisticated test apparatus known as HERMES (Hydrodynamic Equipment for Research on Mechanical Deficiency of Swim-fins) *[A new system for analyzing swim fin propulsion based on human kinematic data - Journal of Biomechanics, 2010, Nicolas, Bideau, Colobert, Guerroue, and Delamarche]* found that traditional fins having rails or ribs having flexural stiffness which may be approximated as thin elastic beams according to Euler Bernoulli's method had efficiencies ranging from 45% - 70% at Strouhal numbers around 0.35 depending upon the fin. Generally, long freediving fins had the highest efficiencies and shorter fins had the lowest efficiencies. Such studies do not include a fin such as Truefin (Truefin did not exist) where the rails or ribs of Truefin do not have bending characteristics which behave as a thin elastic beams, but rather the Truefin blade may readily flex up to an optimum blade angle of attack which occurs upon collision of surfaces between successive vertebrae of the Truefin artificial spines. In the HERMES apparatus, sensors are provided to measure various parameters while a carriage is propelled through the water due to thrust generated at the fin. As indicated above, the Truefin test apparatus measured effective thrust by a load cell at the main pivot of a mechanical leg (corresponding to a hip joint) while a fin is kicked by an electric motor (without a moving carriage), and the thrust value is correlated with both input power measured with a torque sensor, and kicking frequency variably changed with controller.

Historically, comparative machine efficiency testing data of swim fins from different manufactures is either not made available, or the industry in general simply does not conduct such objective machine tests. It is known that at least one swim fin manufacturing company has a test apparatus which also includes a motorized kicking mechanism installed on a carriage which is propelled through a tank due to fin thrust forces, but again test data indicating motor input power versus thrust or carriage speed while demonstrating efficiency between different fin manufactures is not available. Numerous subjective tests with humans have been performed, however such tests are generally not reliable because as Nicolas et al. (referenced above) indicates, "a reproducible swimming technique is difficult (or impossible) to obtain on a human body and lead to discrepancies in data acquired between trials."

Regarding the Truefin machine efficiency test results, all tests were conducted and reports prepared by an independent engineering consulting company (Nualach Design & Engineering LLC, Sandy, Oregon). Also, at least one efficiency test was supervised by a different engineering consulting company (update/pending).

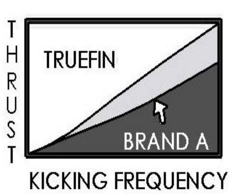
With Truefin, if the user has sufficient strength, Truefin will produce increasing thrust proportional to an increase in kicking frequency and/or kick stroke length as compared to all other traditional fins on the market. Traditional fins are defined as fins having a flexible blade connected to elastomeric rails and a foot pocket, and excludes long free diving fins. It may be noted that some of the technical stiff fins tested had a very good 'angle of attack' at very high kicking effort and had speeds approaching Truefin, however the divers who tested these technical stiff fins were only able to achieve the optimum angle of attack of such stiff fins for a very short period of time (presumably due to greater work to flex the stiff rails). This speed capability of traditional 'stiff' technical fins comes at the sacrifice of causing muscle fatigue or muscle cramps at slow speeds because the blade of a traditional 'stiff' fin does not readily flex, and has an inefficient minimal 'angle of attack' at slow kicking frequencies. As indicated above, Truefin is designed to be efficient at all kicking frequencies, and traditional fins on the market are only most efficient at a single given kicking frequency while such fins are producing the optimum 'angle of attack'. Freediving fins having very long blades are highly efficient, and were not machine tested or diver tested and are currently beyond the scope of Truefin testing.

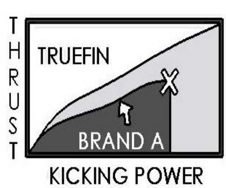
During machine instrumented power/thrust testing in the Truefin test apparatus, all fins tested with the exception of Truefin and a few very stiff technical fins became highly inefficient and/or at least partially collapsed or 'went flat' as power input increased and kicking frequency approached 100 kicks per minute.

An example of machine testing (mechanical leg reciprocates @ 25 degrees - mechanical ankle unlocked and free to pivot up to 30 degrees) of Truefin 'Gen 3' with '012' spines versus Brand 'A' (a $235 stiff 'hinged' fin size Large of modern design) is shown in the two graphs below. In the left graph, thrust versus kicking frequency is plotted, and generally Truefin produced twice the thrust at a given kicking frequency (refer to page 32 test graph of Truefin versus Brand 'A'). In the right graph below, fin thrust is plotted against muscle exertion for Truefin versus Brand 'A'. As shown, at a given level of muscle exertion more thrust is generated with Truefin versus Brand 'A'. Brand 'A' ultimately collapses, after which kicking faster produces no increase in thrust. In fact, the torque sensor at the output shaft of the motor senses essentially zero additional torque delivered to the mechanical leg after Brand 'A' fin blade has collapsed or 'gone flat'. The majority of the traditional fins tested produced similar results.

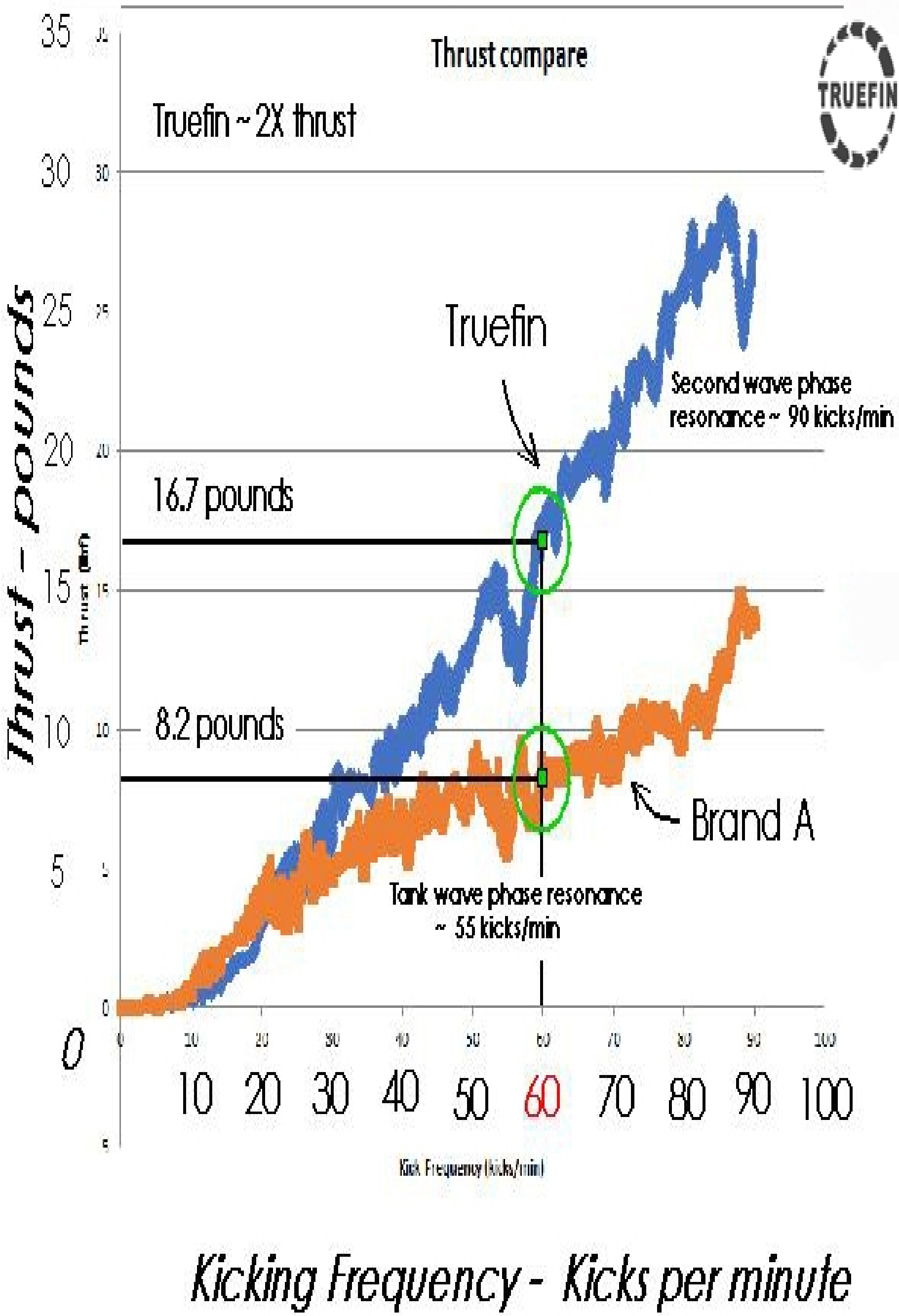
Additional tests of Truefin are ongoing and include Truefin compared against the most expensive and highest tech fins currently available, as well as popular stiff technical fins, split fins, scooped fins, hinged fins, and/or vented blade fins.

Graphical representation of the advantage of a spine..... ...Brand 'A' is a 'spineless fin'.

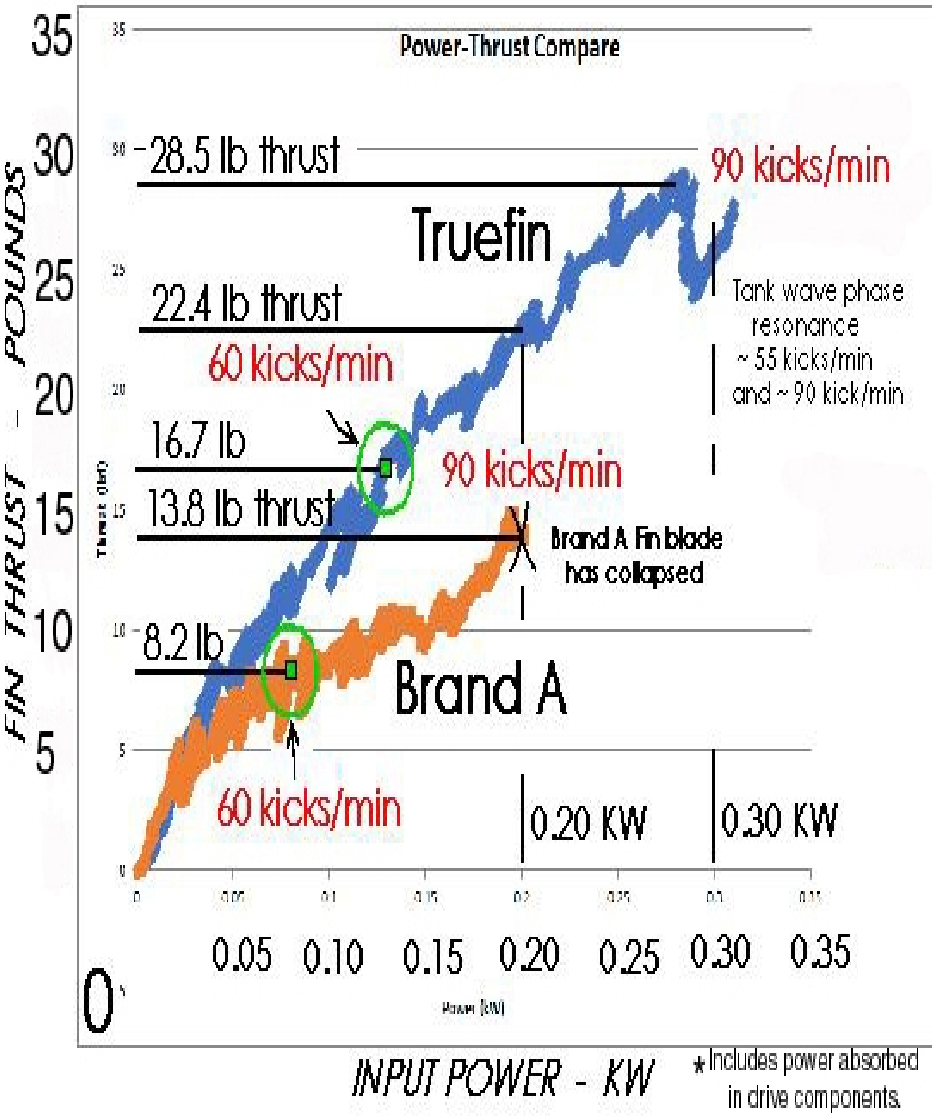




MACHINE TEST RESULTS



At 200 W (0.27 Horsepower) of muscle exertion Truefin generates 22.4 pounds of thrust while Brand A generates 13.8 pounds of thrust.
Also note that Brand A has to be kicked at a higher frequency than Truefin at this value of 200 W (0.27 Horsepower).*



*Includes power absorbed in drive components.

It should be noted that a significant portion of the measured torque at the torque sensor was due to friction losses in the drive components such as bushings, roller bearings and synchronous belts. These friction losses may be considered to be the same for all tests conducted and may be ignored for purposes of comparison. As a consequence, the absolute 'muscle exertion' in kW (and horsepower) values given at the THRUST versus INPUT POWER comparison graphs is high. For example, although 700 Watts is within the range of capability for a very highly conditioned athlete, it is practically well beyond what the vast majority of divers would be able to deliver to a fin. In order to determine the power loss in the drive components, the water was removed and the mechanical leg kicked at frequencies 1-115 kicks per minute while measuring torque delivered to the drive system with the torque sensor. The power as measured by the torque sensor which is absorbed by the drive components at different kicking frequencies may be seen at: (*Error - Data not available)*. This data will be measured again during Truefin Gen 4 comparison tests *(pending)*, and comparison graphs will omit the friction losses in order to get a more accurate value of net power driving the different fins tested. As indicated, such losses are the same for all fins tested and therefore cancel out, and where the Truefin Gen 3 efficiency comparison graphs show overall power delivered through the torque sensor. The comparison graphs which plot THRUST versus KICKING FREQUENCY are numerically correct and ignore power input.

The Truefin test apparatus controller ramps up the kicking frequency at the same rate for all tests. Stroke lengths of 27 inches and 36 inches as measured at the tip of the blade have been tested.

At this time Truefin is conducting additional tests, and the graphs below are nine examples considered representative of traditional or conventional spineless fins versus Truefin.

Data was generally not collected above 90 kicks per minute due to premature blade collapse of spineless fins, as well as excessive turbulence and bubble entrainment in the limited tank volume being generated with Truefin at such high frequencies. Except during emergency situations, typical human kicking frequencies rarely exceeds 60 kicks per minute. A kicking frequency of 60 kicks per minute (1.0 Hz) has been suggested as the optimum rate for Type 1 muscle fibers (*in cycling; Sargeant and Jones, 1995)*.

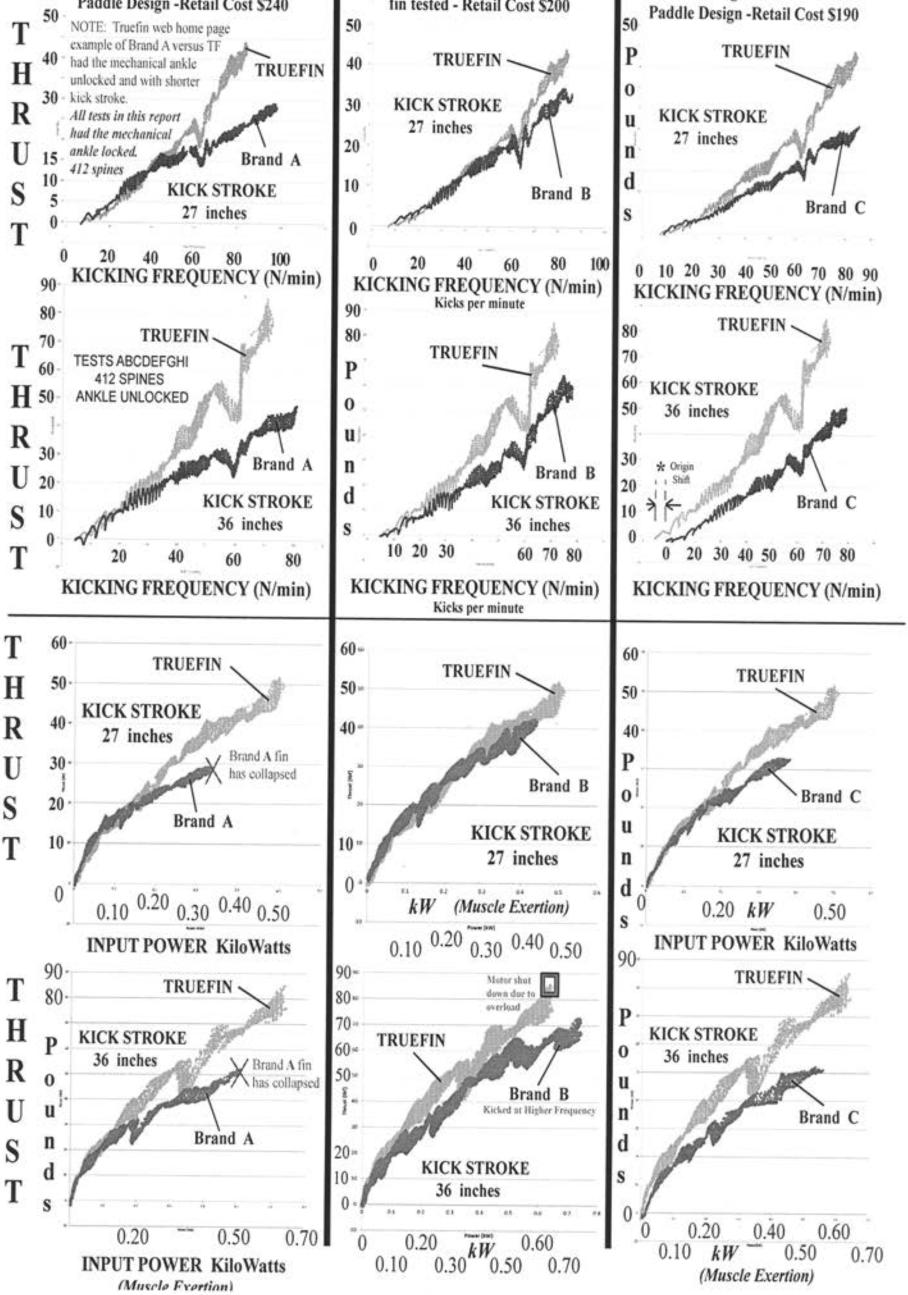
Upon review of the machine test data of fin thrust versus input power for all fins tested, one can generally conclude that greater propulsion thrust at a given amount of muscle exertion occurs with Truefin versus traditional spineless fins. For example, by inference at 0.20kw (or 0.27 horsepower muscle exertion) exerted by the user's leg, the premium Brand 'A' fin would develop 13.8 pounds of thrust, while at the same value of muscle exertion Truefin would develop 22.4 pounds of thrust where Truefin is at least 62% more efficient then the $240 Brand 'A' fin. In other examples of traditional fins tested, the thrust was as little as 56% the thrust of Truefin at a given horsepower. The machine data perhaps yields the best approximation of efficiency of fins tested, however oxygen consumption tests would be advisable to help determine fin efficiency, and such tests have not been performed by Truefin as of this date (9/2020).

*Efficiency Comparison -Machine Tests-*TRUEFIN *'GEN3'*

Current Production is **GEN 4** with 12 degree 'toe down' Monprene neutral mold profile for improved thrust and efficiency. Refer to web site - Efficiency and Geometry.
Test results will be updated later.

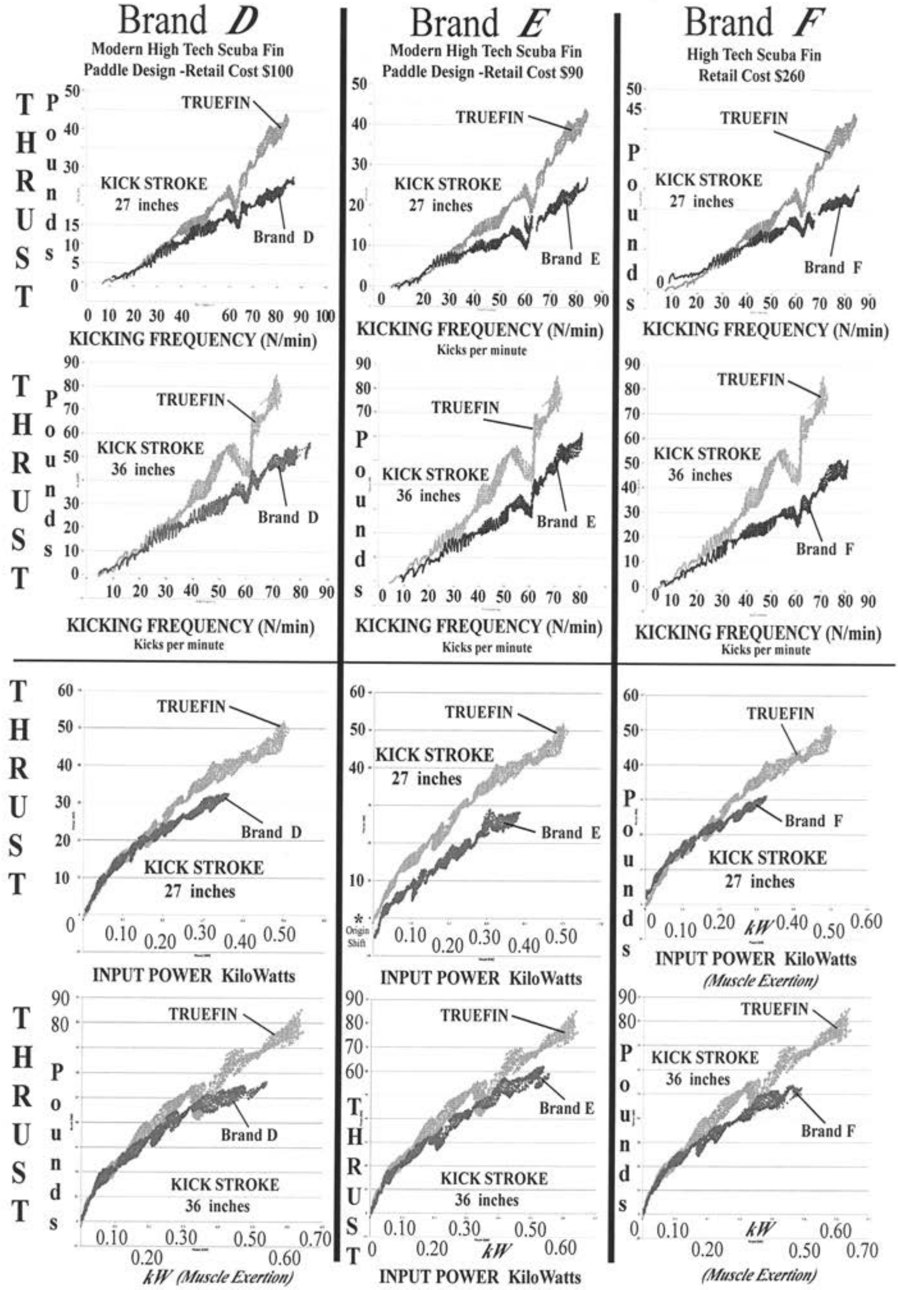
Date 7 / 2020 *NOTE -Origins of graphical data may not be coincident on all graphs. Flutter Kick Simulation

Brand *A*	Brand *B*	Brand *C*
Modern High Tech Scuba Fin Paddle Design -Retail Cost $240	**Highest preforming split fin tested - Retail Cost $200**	**Modern High Tech Scuba Fin Paddle Design -Retail Cost $190**



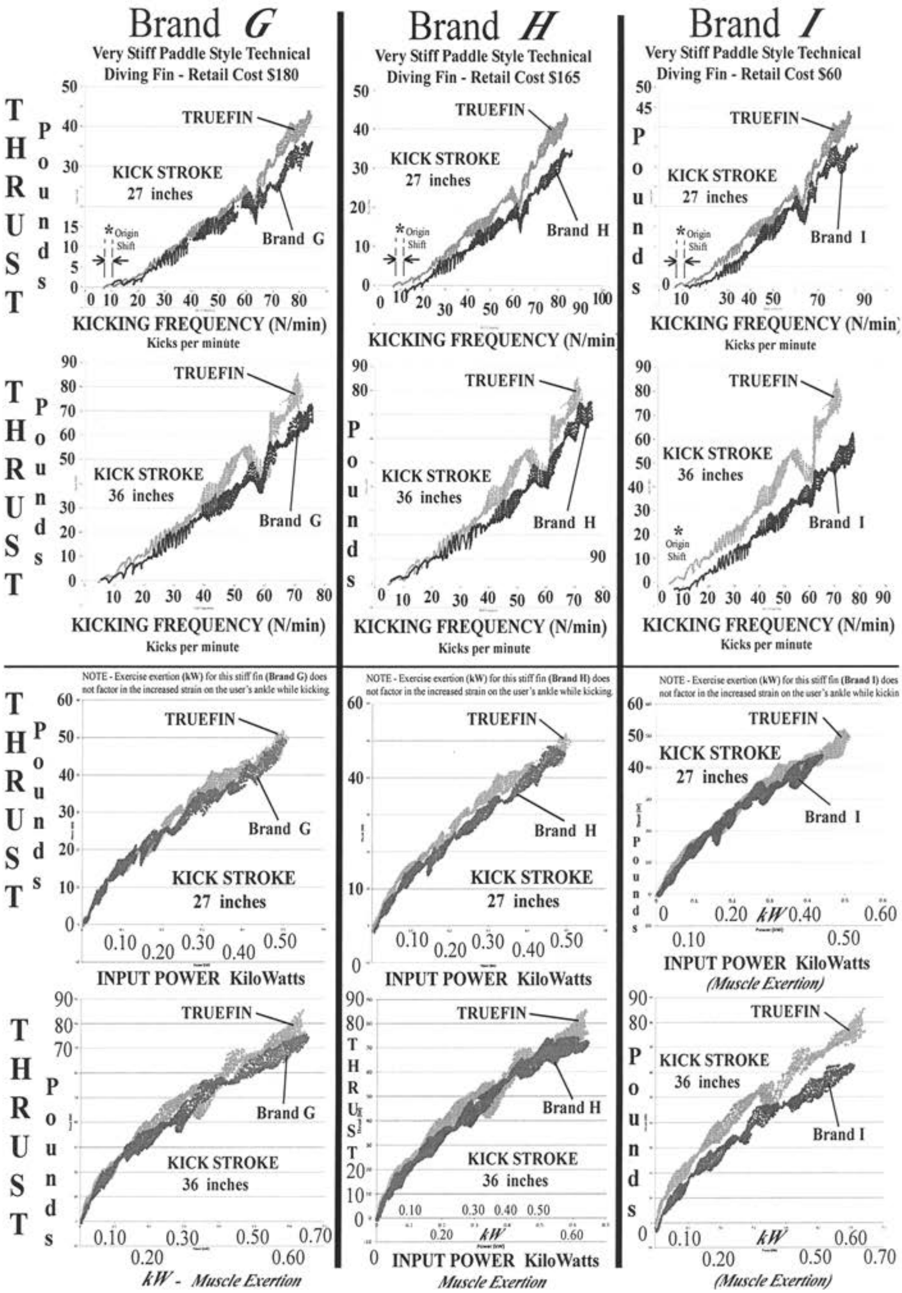
Efficiency Comparison - Machine Tests - TRUEFIN *'GEN3'*

* NOTE -Origins of graphical data may not be coincident on all graphs.



Efficiency Comparison - Machine Tests - TRUEFIN *'GEN3'*

* NOTE -Origins of graphical data may not be coincident on all graphs.



Determination of Fin Efficiency During Machine Testing:

For all fins machine tested, the kick stroke length was constant at either 27 inches or 36 inches as measured at the swept tip of an unflexed blade. Note that some fins such as split fins may perform better with a very short kick stroke at very high kicking frequencies, and the maximum kicking frequency of the test apparatus is limited to 115 kicks per minute, so the test results may not be demonstrating the optimum performance of all fins tested.

The scope of the testing was relatively narrow and involved measuring thrust (load cell) as a function of torque (torque sensor) delivered to motor output shaft, and kicking frequency (controller) while the fin was kicked at a moderate kick stroke length (on average 32 inch swept blade tip length, depending on the length of the fin tested). Test data was generally collected at kicking frequencies ranging from 0-100 kicks per minute.

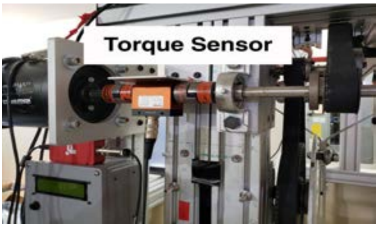
In the opinion of Truefin, the automatically accumulated machine testing data derived from a test tank apparatus which includes a motor torque sensor which is correlated with a load cell that measures fin thrust at different kicking frequencies, generally supports the conclusion that Truefin Model 110 demonstrated the highest overall propulsive efficiency of all fins tested during a machine simulated flutter kick. In this regard, note in the example graph above of Truefin versus Brand 'A' (Pounds Fin Thrust versus Motor Output delivered in KW and measured with a torque sensor at different motor speeds) that Truefin generally produced greater fin thrust at a wide range of delivered power (power is analogous with muscle exertion).

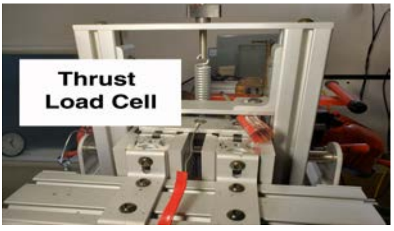
The factors listed below were not tested, although subjective opinions indicate Truefin would perform satisfactorily in each of the following:

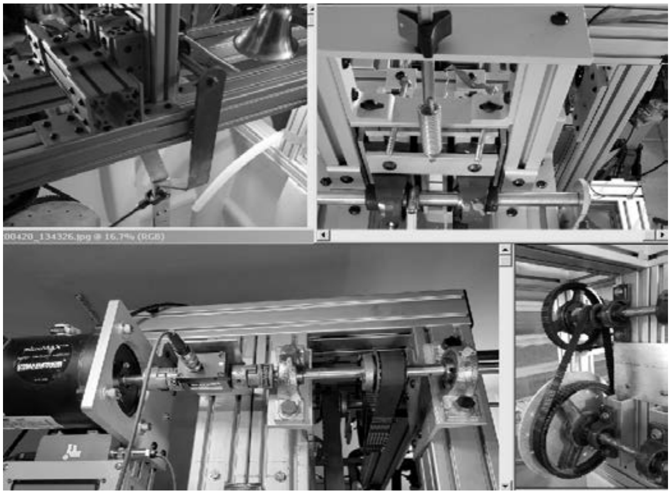
Ease of Donning, adjusting, and removing fin,
Overall comfort,
Stability (wobble, slice side to side, or strike each other while kicking)
Maneuverability,
Surface swimming capability,

MACHINE TESTING

The testing apparatus consists of a one horsepower motor which reciprocates a mechanical leg at variable frequencies, and where during early efficiency tests a mechanical ankle of the mechanical leg was unlocked and free to pivot within a predetermined angular range. A solid 3D printed plastic foot was secured to the ankle member and immersed in a 4' x 4' x 4' tank filled with fresh water. During efficiency tests a torque sensor was installed at the motor output shaft to measure power delivered to the fin, and a load cell was installed at the mechanical leg 'hip joint' to measure kicking thrust. The test apparatus was utilized to compare efficiency of a group of fins, and also the test apparatus was utilized to endurance test Truefin.







The limited water volume in this test tank apparatus creates significant turbulence at high kicking frequencies which may have a noticeable effect in the thrust data generated. For example, during tank wave resonance at approximately 55 and 90 kicks per minute, thrust data declined when water movement in the tank moved in phase with a kicking fin and while water was being splashed over the tank rim. Conversely, when water moved out of phase and collided with a kicking fin the thrust values detected at the load cell increased. Both of these instances are noticeable in the graphical representations of the test data at around 55 and 90 kicks/minute.

Also note that at high kicking frequencies bubble entrainment becomes a concern, and it is possible thrust values decreased slightly due to a reduction in the density of the water in the tank. This phenomenon primarily occurred with Truefin at 80 kicks per minute and higher.

Furthermore, during machine kicking the tip of the fin 'sweeps' within six inches of the bottom of the tank which is expected to introduce ground effect conditions which may increase thrust in a sinusoidal manner as the tip of the fin blade approaches the bottom of the tank, and as both ground effect conditions as well as freestream conditions may be encountered by the subject fin during simulated flutter kicking.

Regarding machine endurance tests conducted with Truefin, both the turbulence in the tank and the proximity of the fin blade tip adjacent to the tank bottom creates higher or worst case forces on the artificial spines then would be experienced in an open body of water, and in that respect endurance/fatigue tests of Truefin are considered conservative estimates. Furthermore, during endurance tests the mechanical ankle was locked which again is a worst case situation. Efficiency tests have been conducted both with the mechanical ankle locked and unlocked. When unlocked, the mechanical ankle was allowed to freely pivot twenty five degrees (25°) which is considered a close approximation to the rotation of a human ankle during real life propulsion conditions while flutter kicking at low to moderate kicking frequencies.

In the future, instrumentation may be installed on a small boat in order for motor driven open water laminar flow fin kicking to occur, which would more accurately simulate thrust in real world conditions and eliminate phase resonance effects in the test data. Such a test apparatus would also be helpful during endurance/fatigue tests of Truefin while providing supporting data in order to make recommendations about suggested intervals between routine spine replacement as part of a regular maintenance schedule. For professional use, current recommendations are to replace the artificial spines after 1,000,000 aggressive kicks, or every 500 dives, whichever occurs first.

Truefin machine test results attempt to objectively compare efficiency between various fins, and the user can decide whether the data provided is meaningful, and whether or not there are more important factors to consider before purchasing a set of fins. In the opinion of Truefin, the automatically accumulated machine testing data derived from a test tank apparatus which includes a motor torque sensor which is correlated with a load cell that measures fin thrust at different kicking frequencies supports the conclusion that Truefin Model 110 demonstrated the highest overall propulsive efficiency during machine simulated flutter kicking.

TEST TANK EQUIPMENT:
Motor – Marathon – microMAX AC Inverter-Duty Motor, 1 hp
Controller – Automation Direct – GS2 Series AC Drive
Torque sensor – FUTEK - Rotary Torque Sensor – TRD/TRH/TRS 600/605/705 Series
Adapter – FUTEK – Model USB520 – External USB Kit (mV/V, amplified and encoder input)
Load cell – FUTEK Model LLB350 – Miniature Load Button
Software – SENSIT by FUTEK – Version 2.2.4000.0

EFFICIENCY TESTS:

The custom built machine test apparatus utilized during development of Truefin is capable of 0-115 kicks per minute and is rated at one horsepower. A mechanical leg reciprocates up to thirty degrees (30°), and a 3D printed foot translates a maximum of 22 inches, with a sweeping arc at the tip of the fin blade approximately 36 inches long depending upon the length of the fin blade. A mechanical ankle is pivotally secured between the mechanical leg and the foot, where the mechanical ankle has an adjustable pivot range which is allowed to pivot during thrust and efficiency tests. During most efficiency tests the mechanical ankle was locked, and during all endurance tests the mechanical ankle was locked to the mechanical leg in order to create abnormally high artificial spine loads as a worst case scenario.

For a given flutter kick stroke length the instantaneous motor power output versus propulsive thrust generated is plotted at a wide range of kicking frequencies. Maximum kicking frequency during data collection was typically limited to 90-100 kicks per minute.

During machine testing, as the kicking frequency was increased the fin blades of all traditional flexible fins as well as all traditional moderately stiff fins (spineless) flexed up to ninety degrees (90°) when the fin blade collapsed or 'went flat'. Typically, this phenomena occurred around 35-75 kicks per minute, depending on the stiffness of the traditional fin, when the thrust forces generated leveled off and remained constant. Truefin inherently can not collapse, and an efficient angle of attack was maintained at all kicking frequencies.

With Truefin, testing indicated that thrust increased with kick frequency in a somewhat linear manner. The artificial spines of Truefin theoretically would continue to provide increased thrust until cavitation occurs or spine breakage occurs, or the artificial foot is stretched out of the foot pocket. A limitation of the test tank apparatus currently used results in high turbulence and bubble entrainment in the tank water volume when Truefin Model 110 kicking speed exceeded 80-90 kicks per minute. At these relatively high kicking frequencies of Truefin it is thought that thrust forces would have increased if there were fewer bubbles in the water, and future open water tests may be conducted to propel a small boat where bubble entrainment can be eliminated.

Stress testing of Truefin in water tank:

In addition to efficiency testing of Truefin with the test tank, the test tank was also utilized for stress testing spines at kicking frequencies up to 115 kicks per minute.

Endurance testing of Truefin:

Machine endurance tests were conducted with Green '012' spines and with the mechanical ankle locked, which is a worst case situation because during the flutter return kick the '0/60° articulation of the artificial spines causes the artificial spines to remain straight during the flutter return kick. A cost versus benefit analysis concludes that Truefin should survive 1,000,000 kicks at 60 kicks per minute in the test tank apparatus while utilizing the lowest cost spine materials. This enables the spines to be economically replaced without creating an initial high investment. A first endurance test at 40 kicks per minute has been completed and subsequent endurance tests will be ongoing. Endurance tests are time consuming and require 300 hours of supervised machine operation.

Bench break test of the spines:

In addition to endurance or fatigue tests, bending moment break tests (bench tests) were also performed.

The bending moment bench break tests indicate that when the spine is rigidly supported at the base link (part number 10000), a new spine is rated at approximately NA inch pounds (verify).

Note: It is estimated the spines will not break when the moment at the fin chassis is NA inch pounds (verify). Note that attempts to break the spine when the spine is not installed in the fin is met with difficulty because the smooth surface texture of the vertebrae combined with the part draft causes the assembled spine to side slip apart. Note that when the spines are installed, the rail bands compress and provide support to the female socket forks (prevents the forks from spreading) of the vertebrae when moment is applied to the tip of the spine. As of 1/2021 a suitable test fixture has not been constructed which will allow breaking of the spine while the spine is installed in the fin.

The screen capture below was taken prior to clamp system failure and table movement which occurred in a spine moment test video available at:
www.Truefin.com/testing

Tests indicate that the spines should never break if the spines are simply subjected to a human kicking the fin in water, however it is understood that breakage of an artificial vertebra may occur during accident or abuse because they are made of plastic (high strength glass filled nylon 612). Note that if one of the two spines of a given fin breaks, the single intact spine remaining will enable the fin to perform similarly to a traditional 'moderately stiff' fin, and even with both spines broken in a fin, Truefin may perform similar to a traditional flexible fin. Typically, it is expected that during an unusual high force collision event of the trailing edge of the fin blade or tip of a fin rail with an underwater object, that an artificial vertebra such as link 50412 or 60412 may side slip out of position (without causing any damage, and which may then be reassembled later), or the upper wall of the foot pocket may deform resulting in the foot/boot escaping out of the foot pocket.

Continued attempts to optimize the artificial vertebrae are ongoing to produce the lowest cost and acceptably functional links. It is expected vertebrae links may fail after their service life has expired, however it is not known what the normal service life of the vertebrae links will be during normal scuba diving use because real life tests would involve thousands of hours with scuba equipment. Current recommendations are to replace the spines after 1,000,000 aggressive kicks or every 500 scuba dives, whichever occurs first. As of 4/2021, estimated replacement cost for each spine is $10.00, or $40.00 (verify) for a complete set of four spines.

ORDER

Please note, initial injection mold tooling will only provide a size LARGE fin, which generally corresponds to men's size 9-11. A full range of sizes will become available in the future if sufficient sales enable additional investment in injection mold tooling (injection mold cost ranges from $200,000 to $500,000 for each fin size, depending on where machining of the injection mold occurs). If Truefin manufactures additional sizes, the next size expected would be Extra Large (XL), where a size Extra Large would accept the same spines. Current color scheme is for a black fin with Blue '412 spines. Other fin colors may be provided in the future because the fin is currently injection molded (overmolded) from Monprene, a thermoplastic elastomer (TPE).

The heel straps provided with Truefin are obtained through third parties and the strap style may change due to strap availability. Preference is given to ship the fins with stainless steel spring style heel straps. The heel strap posts provided on Truefin are 13mm post (throat) diameter with 20mm flange diameter which accept heel straps from popular manufacturers.

***Truefin Model* 110**

Truefin Model 110 sizes- Small, Medium, and Extra Large not currently available.

Size LARGE Available from Amazon **Price $289.00** estimate

This size chart is for **Truefin Model 110 Large (L)** and is for general reference only.

Size:	When used with:
Mens 9, Womens 10, Mens UK 8½, EU 43	**Dry Suit Boot**
Mens 10, Womens 11, Mens UK 9, EU 43-44	**5mm Boot / Dry Suit Boot**
Mens 11, Womens 12, Mens UK 10, EU 45	**3mm Boot / 5mm Boot**

Spines are covered with the two year warranty.

In the unlikely event that replacement spines are needed, please email: **info@Truefin.com** for instructions, or call 347-878-3346 (347-TRUEFIN)

Although Blue '412 spines are available for purchase, they are provided as standard equipment and they are not expected to break during normal use. The service interval of 500 dives or 1,000,000 aggressive kicks is a conservative estimate.

For those that wish to customize their fin to a particular kicking style, optional Green '012 spines and Yellow '415 spines may be purchased separately.

PART # 710412 - ***Includes four complete BLUE spines*** **(Included as Standard Equipment)**
Four complete Blue '412 spines includes: **$40.00** estimate
(4) Red lock springs part #900,
(4) Blue Spine Bases part #10000,
(4) Blue part #20412
(4) Blue part #30412
(4) Blue part #40412
(4) Blue part #50412
(4) Blue part #60412

PART # 711012 - ***Includes four complete GREEN spines*** **$40.00** estimate
Four complete Green '012 spines includes:
(4) Red lock springs part #900,
(4) Green Spine Bases part #11000,
(4) Green part #20012
(4) Green part #30012
(4) Green part #40012
(4) Green part #50012
(4) Green part #60012

PART # 712415 - ***Includes four complete YELLOW spines*** **$40.00** estimate
Four complete Yellow '415 spines includes:
(4) Red lock springs part #900,
(4) Yellow Spine Bases part #12000,
(4) Yellow part #20415,
(4) Yellow part #30415,
(4) Yellow part #40415,
(4) Yellow part #50415,
(4) Yellow part #60415.

During the introduction of Truefin, Amazon will be the primary source where Truefin products are available for purchase.

Link: www.amazon.com

Two Year Limited Warranty

TrueFin, LLC (“TrueFin”) warrants that all new TrueFin products and equipment manufactured and sold by TrueFin (the “Equipment”) shall be free from material and manufacturing defects and capable, under ordinary conditions, of doing the work for which the Equipment is designed for a period of two (2) years after original purchase. This limited warranty is extended only to the original purchaser and is non-transferable. If written notice is received by TrueFin from the original purchaser within the two (2) year limited warranty period, TrueFin will repair or replace the Equipment free of charge, as TrueFin so elects in its sole discretion.

Warranty coverage does not extend to damages caused by improper use, improper maintenance, alteration, unauthorized repairs, accident, misuse, abuse, neglect, or normal wear or aging. Cosmetic damage(s) such as scratches, nicks, and discoloration is not covered under this limited warranty except when the Equipment is new, out of the original packaging. This warranty covers normal use of the Equipment which has been properly set up, adjusted, and operated by competent persons.

This limited warranty does not extend to Equipment used for commercial or military purposes. TrueFin will not be liable for any loss, injury, special or consequential damages, or direct or indirect damages to any person, entity, or property due to a defect in any material, product, or installation, including lost profits damages, regardless of whether the material or Equipment was manufactured or delivered by TrueFin or a third-party.

TrueFin provides no warranty as to materials or Equipment not manufactured and sold by TrueFin. As to materials or Equipment not manufactured by TrueFin, TrueFin will deliver the manufacturer’s warranty, if any, but makes no additional warranty.

The warranty described in this Limited Warranty is in lieu of all other warranties. Except as stated herein, The implied warranties of merchantability and fitness for a particular purpose and all other warranties, express or implied, are excluded from this limited warranty. This Limited Warranty states the sole and exclusive remedy available from TrueFin, namely repair or replacement, at TrueFin’s sole discretion.

California Prop 65 Warning:

⚠ **WARNING**: This product can expose you to chemicals including lead and lead compounds and/or Bisphenol A(BPAs), which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

Products Liability Warnings:

⚠ **WARNING**: CHOKING HAZARD – SMALL PARTS. Not for children under three (3) years of age.

⚠ **WARNING**: THIS IS NOT A LIFE SAVING DEVICE. Do not leave children unattended while devise is in use.

PATENT INFORMATION:
U.S. patent # 9,764,192
U.S. patent # 10,071,288
U.S. patent # 10,226,668
U.S. patent # 10,525,307
Others US and China patents issued and/or pending.

NOTE:

Generally, the spines will sustain whatever force a user may possibly exert while kicking in water, and without limit stronger kicking results in increased speed. Machine testing has been conducted in a water tank at up to 115 kicks per minute at up to 1 meter swept tip distance without spine breakage (1 hp motor, 1725 max motor speed, 15:1 reduction ratio). Truefin has also been subjected to endurance tests up to 1,000,000 kick cycles.

Truefin is shipped with four complete standard Blue '412 spines installed, and one pair of heel straps.

All components of Truefin (excluding heel strap considerations) are nonmetallic in order to eliminate corrosion and minimize weight. Truefin Model 110 Large is slightly negatively buoyant in salt water at approximately negative 0.50 ounces (per fin) excluding the heel strap. Negatively buoyant fins are generally suggested, particularly when wearing dry suits, or if a diver wants to be able to change trim in the water by moving feet to effect their center of gravity.

Currently Truefin is shipped with either a universal strap, a ratchet strap, or preferably a stainless steel spring strap, based upon availabilty from third party manufactures. Heel straps are secured to fin chassis at 'large' heel posts (20mm flange dia. / 13mm throat dia.). This size heel post is popular in the industry.

TRUEFIN Model 110

INSTRUCCIONES EN ESPAÑOL

Cuidado y mantenimiento

Evite la exposición prolongada de las aletas al calor excesivo. Almacene la aleta plana: no almacene Truefin en la configuración de viaje plegada durante un período de tiempo prolongado.

Antes de entrar al agua con Truefin

Inspeccione la correa del talón en busca de desgaste o indicios de falla. Asegúrese de que los resortes de bloqueo rojos de las espinas estén completamente acoplados con los hombros de las aletas.

Entrar en el agua con Truefin durante el buceo

Al entrar desde la orilla, se sugiere instalar las aletas en los pies del usuario después de que el usuario haya entrado en el agua por lo menos hasta la cintura, y quitar las aletas de los pies del usuario antes de salir de aguas poco profundas. Para liberar las manos del usuario, se sugiere pasar un cordón u otro miembro flexible a través de las correas del talón y sujetar el cordón a un anillo en "D" asegurado a un chaleco o al dispositivo de control de flotabilidad (BCD).

Alternativamente, se puede realizar un procedimiento de entrada de vadeo desde una playa o orilla, donde el usuario vadea hacia el sitio de buceo mientras arrastra los pies hacia atrás para evitar pisar rocas.

Al entrar desde los botes, siga los procedimientos de entrada estándar conocidos en la industria del buceo, como paso gigante, giro hacia atrás, método de entrada sentado o giro hacia adelante.

Para todas las entradas, independientemente del método, asegúrese de que el BCD esté lo suficientemente inflado y tenga el regulador en la boca y en funcionamiento, y con al menos una mano sujetando el regulador y la máscara en su lugar cuando golpee el agua.

Al entrar desde plataformas o cubiertas relativamente altas, se pueden realizar entradas a zancadas gigantes, sin embargo, se puede forzar una aleta fuera del pie de un usuario mientras el resorte de la correa del talón se extiende y el pie se desliza fuera del calzante flexible, aunque la aleta aún se mantendrá. asegurado a la pierna del usuario mientras la correa de la aleta se desliza hacia arriba por la pierna del usuario. Si un usuario normalmente entra al agua desde plataformas altas, el usuario puede desear minimizar la probabilidad de que una aleta se resbale del pie del usuario mediante el uso de correas de talón no elásticas (de trinquete o estilo universal).

Al bucear, todos los métodos pueden resultar satisfactorios porque el usuario no tiene que cargar con tanques pesados ni con el peso de otros aparatos.

Evite caminar hacia adelante en aguas poco profundas mientras usa aletas.

DESMONTAJE

Si las aletas se van a desmontar para repararlas o para viajar, cada espina se puede quitar presionando ambos pasadores de bloqueo de resorte rojos simultáneamente con una mano, mientras empuja el extremo hacia afuera con el dedo índice de la otra mano y retirando la espina de la carril de la aleta.

Los bloques de vértebras se pueden separar de la columna como se desee.

Durante el reensamblaje, para una configuración estándar, asegúrese de que las tres marcas de control (**III**) en cada vértebra estén orientadas hacia la plataforma de la aleta adyacente a las marcas de control inferiores (**III**) moldeadas en los rieles de la aleta y con las gotas de lágrima (💧) de cada vértebra orientada hacia arriba adyacente a las lágrimas superiores (💧) moldeadas en los rieles de la aleta, y deslice la columna montada en el riel de la aleta hasta que los pasadores de bloqueo rojos encajen completamente con los orificios del hombro de la aleta.

Otras notas:

En este momento, se recomienda reemplazar las espinas cada 1,000,000 de patadas agresivas o cada 500 (verificar) inmersiones, lo que ocurra primero.

Evite causar una falla prematura de las espinas haciendo palanca o pateando la espina contra un objeto inamovible tanto en el agua como en la tierra porque las espinas están hechas de plástico. Tenga en cuenta que si una columna vertebral se rompe debido a un accidente o abuso, la aleta generalmente funcionará como una aleta tradicional y solo tendrá una columna vertebral para hacer cumplir un 'ángulo de ataque' comprometido.

TRUEFIN Model 110

MODE D'EMPLOI EN FRANÇAIS

Entretien et maintenance

Éviter l'exposition prolongée des ailettes à une chaleur excessive. Rangez l'aileron à plat - Ne rangez pas Truefin dans la configuration de voyage repliée pendant une période prolongée.

Avant d'entrer dans l'eau avec Truefin

Inspectez la sangle de talon pour l'usure ou des indications de défaillance.

Assurez-vous que les ressorts de verrouillage rouges des épines sont complètement engagés avec les épaules des nageoires.

Entrer dans l'eau avec Truefin pendant la plongée sous-marine

Lors de l'entrée depuis le rivage, il est suggéré d'installer les palmes sur les pieds de l'utilisateur après que l'utilisateur soit entré dans l'eau au moins jusqu'à la taille, et de retirer les palmes des pieds de l'utilisateur avant de sortir de l'eau peu profonde. Afin de libérer les mains de l'utilisateur, il est suggéré d'enfiler un cordon ou un autre élément flexible à travers les sangles du talon et d'attacher le cordon à un anneau en 'D' fixé à un gilet ou au dispositif de contrôle de la flottabilité (BCD). Alternativement, une procédure d'entrée à gué peut être effectuée depuis une plage ou un rivage, où l'utilisateur patauge vers le site de plongée tout en reculant les pieds pour éviter de marcher sur les rochers.

Lorsque vous entrez hors des bateaux, suivez les procédures d'entrée standard connues dans l'industrie de la plongée, telles que la foulée de géant, le roulis arrière, la méthode d'entrée assise ou le roulis avant.

Pour toutes les entrées, quelle que soit la méthode, assurez-vous que le (BCD) gilet est suffisamment gonflé et que le détendeur est dans votre bouche et qu'il fonctionne, et avec au moins une main tenant votre détendeur et votre masque en place lorsque vous frappez l'eau.

Lors de l'entrée depuis des plates-formes ou des ponts relativement hauts, des entrées à pas de géant peuvent être effectuées, mais une palme peut être retirée du pied d'un utilisateur pendant que le ressort de la sangle du talon s'étend et que le pied glisse hors de la poche de pied flexible, bien que la palme soit toujours fixé à la jambe de l'utilisateur lorsque la sangle de la palme glisse le long de la jambe de l'utilisateur. Si un utilisateur pénètre généralement dans l'eau à partir de plates-formes élevées, l'utilisateur peut souhaiter minimiser la probabilité qu'une aileron glisse du pied de l'utilisateur en utilisant des sangles de talon non élastiques (à cliquet ou de style universel).

Lors de la plongée en apnée, toutes les méthodes peuvent être satisfaisantes car l'utilisateur n'est pas chargé de réservoirs lourds et d'autres poids d'appareils.

Évitez d'avancer dans des eaux peu profondes en portant des palmes.

DÉMONTAGE

Si les ailerons doivent être démontés pour réparation ou voyage, chaque épine peut être retirée en appuyant simultanément sur les deux goupilles de verrouillage à ressort rouges d'une main, tout en poussant l'extrémité avec l'index de l'autre main, et en retirant l'épine de la rail d'aileron.

Les blocs vertébraux peuvent être séparés de la colonne vertébrale à volonté.

Lors du remontage, pour une configuration standard, assurez-vous que les trois hachures (III) de chaque vertèbre sont orientées vers la plate-forme de la nageoire adjacente aux hachures inférieures (III) moulées au niveau des rails des ailettes et avec les larmes (💧) de chaque vertèbre orientée vers le haut à côté des larmes supérieures (💧) moulées au niveau des rails de nageoire, et faites glisser la colonne vertébrale assemblée dans le rail de nageoire jusqu'à ce que les goupilles de verrouillage rouges s'engagent complètement dans les trous d'épaule de la nageoire.

Autres notes:

À ce stade, il est recommandé de remplacer les épines tous les 1,000,000 de coups de pied agressifs ou tous les 500 plongeons (vérifier), selon la première éventualité.

Évitez de provoquer une défaillance prématurée des épines en soulevant ou en frappant la colonne vertébrale contre un objet immobile dans l'eau ou sur terre, car les épines sont en plastique. Notez que si une colonne vertébrale se brise en raison d'un accident ou d'un abus, la palme fonctionnera généralement comme une palme traditionnelle tout en n'ayant qu'une seule colonne vertébrale pour imposer un «angle d'attaque» compromis.

ABOUT TRUEFIN

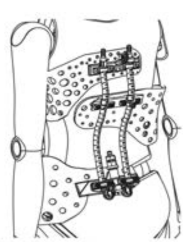
Truefin LLC is a company based in West Linn, Oregon, USA.

The genesis of the Truefin swim fin came from earlier theoretical applications regarding titanium spinal implant devices for treating biological spine deformities, and also included an implantable artificial spine to stabilize and strengthen the biological spine. For non-operative treatment of scoliosis, experimental back braces were also constructed which utilized artificial spine technology, where a back brace is biased toward centering lateral alignment to attempt to correct bending of the biological spine in the coronal plane, while allowing the biological spine to articulate and flex nearly unrestricted in the sagittal plane. This was accomplished with artificial spines which include a linear configuration of bushings having concave and convex surfaces under compression which allow a central tensile member to flex in only one plane.

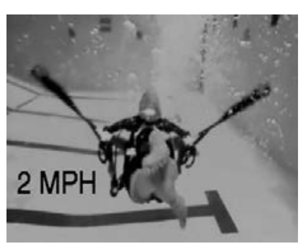
Simultaneously, an efficient oscillating fin upper body propulsion apparatus was developed for handicapped users (adaptive divers) in order to take advantage of the therapudic benefits of a body's increased output of serotonin which occurs at depth while scuba diving.

Recognizing the potential to improve the efficiency of lower body propulsion, efforts began to advance the design of traditional swim fins. Generally, the most important property of a swim fin is the angle of attack, and after several evolutions of design a variation of the original artificial spine was developed specifically for Truefin swim fins thereby offering multiple advantages of speed, efficiency, and comfort over traditional spineless fins.

Implantable Artificial Spine
US 10,702,312



Scoliosis Brace
US Pending



Upper Body Oscillating Fin Apparatus
US 10,343,754
and others.

Swim fin
US 9,764,192
and others.

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For inquiries related to Truefin swim fins please email to: info@truefin.com

TRUEFIN™ is manufactured in the state of Washington, USA

Made in America

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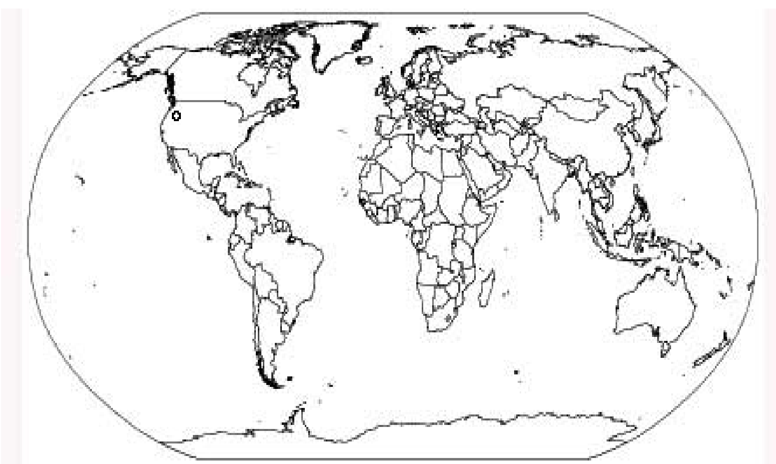

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