

# The Evolution of High-Tech Racing Suits in Swimming

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## Key Points:

- **Technology in swimming has advanced drastically in the last 25 years, causing some to question whether increases in performance are natural or a product of high-tech suits.**
- **Despite coaches and rival manufacturers claiming that some suits are giving unfair advantages, data evaluating percent improvements across Olympiads suggests otherwise.**
- **Today, racing suits are manufactured with rules governing their coverage and materials.**

Like many other sports, swimming technology can facilitate large improvements in performance in the athletes that utilize the advancements. For example, at the highest level it can be difficult for swimmers to compete without a high-tech racing suit. Over the years, advancements in performance that have been attributed to high-tech racing suits have resulted in rules being implemented to govern body coverage of the suits and materials used in production. To better understand the current rules, it is valuable to consider the storied history of suit manufacturing.

### *In the Beginning*

At the inception of competitive swimming, one of the foundational principles for suit manufacturing was “less is more”.<sup>1</sup> In the 1928 Olympics, one of the most successful athletes, Arne Borg, won the Olympic gold in the 1500-meter freestyle wearing a suit from Speedo, known as the “racer-back”, a suit created using Speedo’s foundational tenet of “less is more” (Figure 1). Fast forward 44 years and Mark Spitz won seven gold medals in Munich wearing the “briefest of briefs” (Figure 2).<sup>2</sup> Then, in the 1980’s, the philosophy changed and the phrase was flipped on its head; now Speedo and TYR were subscribing to “more is less” due to research and testing.<sup>1</sup>

### *The Tech Suit Era*

Thanks to the work of biomechanists from NASA, universities, and sports institutes, bodysuits came onto the scene made with textured fibers that could reduce turbulence and drag. This fabric covered the whole body under the premise that the more drag-producing skin that was covered by the far more drag-resistant fabric, the less drag you would have to fight against. Records continued to fall as time went by and in 1992, 53% of athletes who were awarded a medal in swimming wore Speedo’s “S2000 suit”.<sup>1</sup> Over a decade later, a suit was released that was said to change the sport of swimming monumentally. On February 13th, 2008, the LZR Racer was launched as “the world’s fastest swimsuit”. Years in the making, the fabric was made to be an extremely tight fit, compressing muscles and reducing muscle vibration (thereby reducing drag). Gripper fabric was inserted into the forearm to mimic the skin and maximize



**Figure 1:** Arne Borg (1928) in the original Speedo Racer-back.<sup>1</sup>

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the swimmer's "feel for the water" and some athletes even utilized body scanning technologies to determine the placement of seams and contours on the suit. The bodily compression and the buoyancy that the suit gave were unlike anything many swimmers ever experienced and even the great Michael Phelps claimed, "When I hit the water [in the LZR swimsuit] I feel like a rocket" (Figure 2).<sup>1</sup> That same year, 94% of Olympic races were won by athletes wearing the LZR Racer.



**Figure 2:** From left to right: Mark Spitz wearing the Speedo brief (1972)<sup>1</sup>, Michael Phelps wearing the LZR Racer (2008)<sup>1</sup>, and Caeleb Dressel wearing the LZR Racer X (2021)<sup>4</sup>.

Unsurprisingly, one of Speedo's leading rivals, Arena, claimed that the suit was "technological doping". On the other hand, Speedo argued that the suit helped with "management of existing forces rather than generating active forces"<sup>2</sup>. In addition to Arena denouncing the suit, other brands were creating similar models and rules were eventually implemented around suit manufacturing. Though FINA (International Swimming Federation, the governing body of competitive swimming) approved the LZR Racer before it was used in the 2008 Olympics, they also acknowledged that the suits provided "an artificial advantage by increasing buoyancy and reducing drag". In 2010, FINA banned full-length and/or made-from polyurethane suits while still permitting waist-to-knee suits for men and shoulder-to-knee suits for women made from "allowable textiles".

## *Hype vs. Results*

As shown in table 1, all four of the major high-tech swimsuits prior to the Speedo LZR Racer led to an overall decrease in the percent change in improvement compared to the average improvement per Olympiad. Alternatively, the Speedo LZR Racer showed a four percent increase in the rate of change in improvement. However, it is important to note that even after the Speedo LZR Racer was banned there was still a 2.45% increase in improvement per Olympiad (including World Championships). Thus, swimmers continued to get faster even without the LZR Racer full-body suit. Overall, the level of improvement observed with the LZR Racer is not unparalleled when considering the progression of swimming performance over time.

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Of course, high-tech suits continue to be made under the new rules from FINA. These aren't the full-body suits of 2008, but Speedo and other brands continue to advance technology and aim for a competitive advantage for athletes that wear their suits. Wearing the LZR Racer X by Speedo, Caeleb Dressel won five gold medals for the USA at the 2020 Tokyo Olympics (Figure 2). Even so, while racing in a high-tech suit might help to improve performance, the era of "less is more" and Mark Spitz winning seven gold medals in the "briefest of briefs" serves as a reminder that many other variables factor into performance outcomes.

**Table 1:** The percent of change in improvement over the course of the five different models of tech suits from 1992-2008<sup>1</sup>.

Technological change	Olympics after 1952 and before first use	Average %I/O	First use	%I/O on first use	% Change
Fibreglass pole	1956-1960	1.64	1964	8.51	419
Fosbury flop	1956-1964 (M)	2.25	1968 (M)	4.12	83
	1956-1968 (W)		1972 (W)		
Clap skate	1956-1994	1.82	1998	2.88	58
Javelin centre of gravity moved forward	1956-1984 (M)	2.55	1988 (M)	-0.72	-128
	1956-1996 (W)		2000 (W)		
Speedo S2000	1956-1988	1.62	1992	0.58	-64
Speedo AQUABLADE	1956-1988	1.62	1996	-0.10	-106
Speedo FASTSKIN	1956-1988	1.62	2000	1.15	-29
Speedo FASTSKIN II TYR Aqua Shift	1956-1988	1.62	2004	0.64	-61
Speedo LZR Racer	1956-1988	1.62	2008	1.69	4

%I/O indicates percentage improvement per Olympiad (4 years). Swimsuit evaluation is for men's competition.

## References

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