

## Warp Propulsion Systems

If one were to consider any of the USS Enterprise 1701-D's major components as its heart, the warp propulsion system would have to be the logical choice. The WPS, the single most complex and energetic element of the USS Enterprise, is the latest version of the device that at last afforded humanity access to deep interstellar space, facilitated contact with other life forms, and profoundly changed all preeminent technological civilizations in the Milky Way.

## Warp Field Theory and Application

Like those before him, Zefram Cochrane, the scientist generally credited with the development of modern warp physics, built his work upon the shoulders of giants. Beginning in the mid-twenty-first century, Cochrane, working with his legendary engineering team, labored to derive the basic mechanism of continuum distortion propulsion (CDP). Intellectually, he grasped the potential for higher energies and faster-than-light travel, which signified practical operations beyond the Solar system. The eventual promise of rapid interstellar travel saw his team take on the added task of an intensive review of the whole of the physical sciences. It was hoped that the effort would lead to better comprehension of known phenomena applicable to warp physics, as well as the possibility of "left field" ideas influenced by related disciplines.

## Warp Power Measurement

The cochrane is the unit used to measure subspace field stress. Cochranes are also used to measure field distortion generated by other spatial manipulation devices, including tractor beams, deflectors, and synthetic gravity fields. Fields below Warp 1 are measured in millicochranes.

A subspace field of one thousand millicochranes or greater becomes the familiar warp field. Field intensity for each warp factor increases geometrically and is a function of the total of the individual field layer values. Note that the cochrane value for a given warp factor corresponds to the apparent velocity of a spacecraft traveling at the warp factor. For example, a ship traveling at Warp Factor 3 is maintaining a warp field of at least 39 Cochranes and is therefore traveling at 39 times  $c$ , the speed of light. Approximate values for integer warp factors are:

The actual values are dependent upon interstellar conditions, e.g., gas density, electric and magnetic fields within the different regions of the Milky Way galaxy, and fluctuations in the subspace domain. Starships routinely travel at multiples of  $c$ , but they suffer from energy penalties resulting from quantum drag forces and motive power oscillation inefficiencies.

The amount of power required to maintain a given warp factor is a function of the cochrane value of the warp field. However, the energy required to initially establish the field is much greater, and is called the peak transitional threshold. Once that threshold has been crossed, the amount of power required to maintain a given warp factor is lessened. While the current engine designs allow for control of unprecedented amounts of energy, the warp driver coil electrodynamic efficiency decreases as the warp factor increases. Ongoing studies indicate, however, that no new materials break throughs are anticipated to produce increased high warp factor endurance.

Warp fields exceeding a given warp factor, but lacking the energy to cross the threshold to the next higher level, are called fractional warp factors. Travel at a given fractional warp factor can be significantly faster than travel at the next lower integral warp, but for extended travel, it is often more energy efficient to simply increase to the next higher integral warp factor.

## Theoretical Limits

Gene Rodenberry's limit allows for warp stress to increase asymptotically, approaching but never reaching a value corresponding to Warp Factor 10. As field values approach 10, power requirements rise geometrically, while the driver coil efficiency drops dramatically. The required force coupling and decoupling of the warp field layer rise to unattainable frequencies, exceeding not only the flights system's control capabilities, but more important the limit imposed by the Planck time. Even if it were possible to expend the theoretically infinite amount of energy required, an object at Warp 10 would be traveling infinitely fast, occupying all points in the universe simultaneously.

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from

# Star Trek

The Next Generation  
Technical Manual

by Rick Sternbach and Michael Okuda  
With a special introduction by Gene Roddenberry  
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