Overview of FIT 2500's scientific research

In a 30-second test, PMI's FIT 2500 Fatigue Analyzer measures the speed with which the eye jumps through a defined arc, or saccade ("saccadic velocity")

The effectiveness and accuracy of saccadic velocity in assessing changes in alertness levels has been validated by a number of leading U.S. research laboratories for human impairment. To summarize their research:

- Changes in saccadic velocity correlate significantly to degraded alertness due to factors such as sleep deprivation and time-on-duty
- Saccadic velocity shows strong-to-moderate correlation with other fatigue-measuring techniques (which, themselves, also show strong-to-moderate correlation to each other)
- The presence of alcohol, impairing medications and illegal drugs can also affect saccadic velocity

What FIT can do	What FIT cannot do
Track changes over time in an individual's alertness levels	Compare one individual's alertness level against another's
Create a profile of how fatigue is generated within a particular operating schedule	Determine whether a particular operating schedule is acceptably safe
Measure the overall impact of fatigue countermeasures on alertness levels	Be dropped into a setting to quickly determine whether fatigue countermeasures are working

Validation

Various research studies have validated the accuracy of the FIT's measurements of fatigue and impairment, including:

- Rowland L, Krichmar J, et al, "Pupil dynamics and eye movements as indicators of fatigue and sleepiness," *Sleep Res. 1997* 26:626.
- Russo M, Thomas M, et al, "Saccadic velocity and pupil constriction latency changes in partial sleep deprivation, and correlations with simulated motor vehicle crashes," *Sleep 1999*: 22 (Suppl. 1): S297-298.
- Stampi C, Aguirre A, et al, *Evaluation of Pulse FIT parameters for detection of fatigue (reduced alertness)*, Institute for Circadian Physiology (1994).
- Addiction Research Center (Johns Hopkins), Controlled-dose FIT tests for cocaine, unpublished, 1993.
- Addiction Research Center (Johns Hopkins), Controlled-dose FIT tests for marijuana, unpublished, 1993.
- Perrine B, et al, "Controlled-dose FIT tests for alcohol," unpublished, VT Alcohol Research Center, 1993.
- Thomas, Maria L. et al; (Division of Neuropsychiatry, Walter Reed Army Institute of Research), "Neural basis of alertness and cognitive performance impairments during sleepiness," *Elsevier /Thalamus & Related Systems* 2 (2003) 199-229.
- Russo, M, Thomas, M, et al; "Oculomotor impairment during chronic partial sleep deprivation," *Elsevier Science Ireland, Ltd. for the International Federation of Clinical Neurophysiology* 114 (2003) 723-736.

Additional research not involving the FIT instrument has corroborated the relation between saccadic velocity and degraded alertness. Some studies include:

- De Gennaro L, Ferrara M, et al, "Oculomotor impairment after 1 night of total sleep deprivation: a dissociation between measures of speed and accuracy," *Clin Neurophysiol* 2000;111(10):1771-8.
- Paut O, Vercher, JL, et al, "Evaluation of saccadic eye movements as an objective test of recovery from anesthesia," *Acta Anaesthesiol Scand* 38(8): 1117-24 (1995)

- Roy-Byrne PP, Cowley DS, et al; *Psychopharmacology (Berl) 1993* 110:85-91 "Benzodiazepine pharmacodynamics: utility of eye movement measures"
- Continuous sleep deprivation study; Rowland, Krichmar, et al; *Sleep Res*. 1997 26:626.

Research uses

Because of the FIT's accuracy and field-practicality, a variety of research studies have incorporated the FIT into their protocols in order to collect data on physiological changes under different conditions:

- Submarine watchstanding schedules; Miller; Air Force Research Laboratories (2001)
- Locomotive alerter evaluation; Popkin; Volpe for Federal Railroad Administration (2001)
- Caffeine and sleep deprivation study; Kamimori, Walter Reed Army Institute of Research (1999)
- Police officer fatigue study; Vila for Police Executive Research Forum (1999)
- Canalert; Moore-Ede for Canadian railroads (1996)
- Engineman Stress and Fatigue II tests; Volpe for Federal Railroad Administration (1995)
- Measures Over 30-Hours of Continuous Wake with and Without Caffeine; Yu, Russo, Johnson and Kamimori; USA Aeromedical Research Lab and Walter Reed Army Institute of Research (WRAIR) (2004)