thread contamination with particulates especially sand, soil, cement and granules of polymer concrete. As these installations are in soil or sidewalks, particulates are almost always contaminating the threads and the addition of anti-seize compounds give the particulates a grease-like compound to adhere to and carry them into the bolt/nut thread interface. Thus, most of the failures are due to contamination of the threads and the current solutions do not address this problem.

Therefore a need exists for an improved fastening system for attaching a lid or cover to an underground or buried vault, pit, chamber or box which addresses the drawbacks of previous fastening systems and which allow for gaining entry into the chamber of the box without damaging the lid or cover.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, there is provided a fastening system for attaching a cover to an underground vault comprising: a bolt having threads; and a composite fiber reinforced polymer nut having a thread engagement portion extending through at least a portion of the nut, wherein the thread engagement portion fails in shear after receiving the bolt before the nut and bolt seize.

According to a second aspect of the present invention, there is provided a fastening system for attaching a lid to an underground box comprising: a threaded bolt; and a fiber reinforced composite nut having a thread engagement portion wherein particulates trapped between the bolt and the thread engagement portion of the nut are pressed into the nut or crushed and driven out of the bottom of the nut.

Embodiments of the present invention provide a fastening system for a cover or lid for an underground or buried vault, pit, chamber or box which addresses the problems of prior fastening systems and can easily and inexpensively provide for entry into the chamber of the box without damaging the lid.

Embodiments of the present invention provide a fastening system, comprising a nut and bolt arrangement that may reduce the chance of failure, and when failure occurs the failure mode is changed such that the vault can still be entered into without damage to the cover or the box, and the failed component can be easily and cheaply replaced. The fastening system according to embodiments of the present invention provides for two types of nut retention designs deployed within underground boxes and covers wherein one is a fixed nut attachment to the box where the nut remains stationary, and the second is a floating nut design where the nut is allowed to move within a track or cage in the box to compensate for some degree of misalignment.

The failure mode of the fastening system according to embodiments of the present invention has been moved to the threads contained by the nut such that the bolt, nut retainer and nut attachment points remain intact. In this embodiment the nut strips out without damaging anything else. By careful selection of materials for the nut, bolt and retainer from which the fastener is made, the desired mode of failure is realized and the

properties of the failure mode are designed to affect useful outcomes, specifically the threads and the nut strip prior to any other failure mode.

The materials used for the nut are of a composite type such as, but not limited to, glass-filled nylon which exhibits good strength but allows the nut threads to shear prior to any other mode of failure. By controlling the length of thread engagement and the hole diameter relative to the bolt diameter, the fastener may be able to meet torque requirements and may still allow the nut threads to fail first. By adjustment of material, hole diameter and thread engagement the desired failure mode may be achieved. Due to the high-stress risers in the nut during thread formation, appropriate lead chamfers are required to prevent fracture of the nuts, typically a 45 degree chamfer of 1/16th inch to 1/8th inch across the flat.

In conjunction with the material selection for the component, certain geometries especially at component interfaces are optimized to assure failure occurs in the desired mode and in the desired component. A very course lag-bolt type thread can be used as they are good at forming threads in the composites and allow the nut material to achieve the required high-torque limits that ultimately fail in shear. These and other aspects of the present invention will be more clearly understood by reference to the following detailed description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 the top view of the fastening system of the present invention;

FIG. 2 is a partial cross-sectional view of the fastenings system of FIG. 1;

FIG. 3 is a partial cross-sectional view of an alternative embodiment fastening system;

FIG. 4 is a perspective view of an underground vault, pit, chamber or box having a lid or cover attached by the fastening system of FIGS. 1 or 3; and

FIG. 5 is a cross sectional view of FIG. 4.