Many military systems utilize infrared sensors which allow an operator to see targets at night. Many of these are either mid-wave or long-wave high resolution infrared sensors, which are expensive to manufacture. But compressive sensing, which has primarily been demonstrated in medical applications, can be used to minimize the number of measurements needed to represent a high resolution image. Using these techniques, a relatively low cost mid-wave infrared sensor can be realized which has a high effective resolution. In traditional military infrared sensing applications, like targeting systems, automatic targeting recognition algorithms are employed to locate and identify targets of interest to reduce the burden on the operator. The resolution of the sensor can increase the accuracy and operational range of a targeting system. When using a compressive sensing infrared sensor, traditional decompression techniques can be applied to form a spatial-domain infrared image, but most are iterative and not ideal for real-time environments. A more efficient method is to adapt the target recognition algorithms to operate directly on the compressed samples. In this work, we will present a target recognition algorithm which utilizes a compressed target detection method to identify potential target areas and then a specialized target recognition technique that operates directly on the compressed samples. We will demonstrate our method on the U.S. Army Night Vision and Electronic Sensors Directorate ATR Algorithm Development Image Database which has been made available by the Sensing Information Analysis Center.