

### Introduction



The Edgewood Chemical Biological Center (ECBC) has been developing hand held colorimetric sensors to screen for chemical hazards for over 80 years. The Chemical Reconnaissance and Explosives Screening Set (CRESS) was a successful colorimetric screener used to screen specific homemade explosive (HME) fuels and oxidizers. The Chemical Reconnaissance and Explosives Screening Set Drug Variant (CRESS-D) uses the CRESS form factor to screen six drugs with four different reagent chemistries.

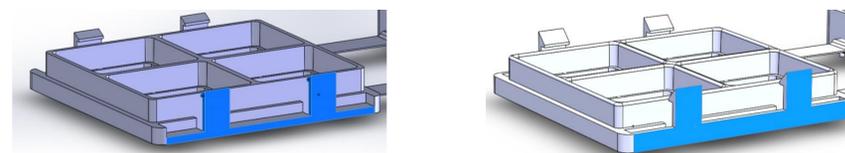
The CRESS-D is a handheld, single-use, disposable screener that does not require a power source. Chemical reagents stored in ampoules produce color changes for specific identification of six drugs: morphine, methylenedioxypropylamphetamine (MDPV), methamphetamine, chloral hydrate, cocaine and fentanyl. Within two minutes of sampling and activation, reactions are complete, and the resulting colors are compared by the user to an integrated color comparison chart. Each of the four detection windows features distinct colors for either a positive or negative result. This simple to use field test enables the user to rapidly identify drugs with accuracy and confidence after minimal training.

### System Description

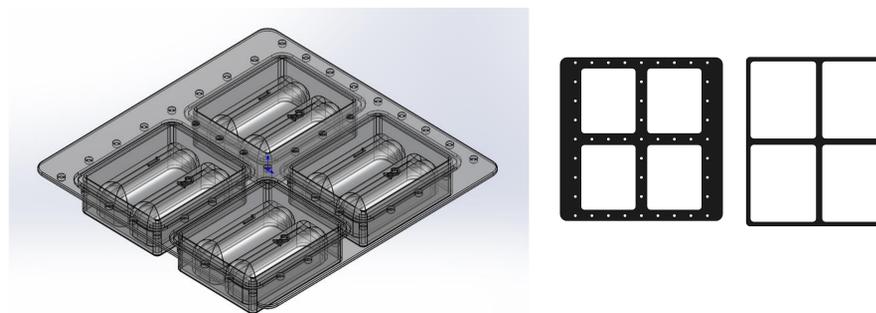
The CRESS platform has been modified to reduce costs and accommodate large scale production. In order to adapt the CRESS Mod 3 kit for screening of drugs, several aspects of the design had to be addressed: design challenges that are unique to the drug variant of the kit and improvements to the kit that will benefit both the CRESS-D and the CRESS Mod 3 HME variant.

### Development Approach

**Clip Changes:** The cross sectional area was increased to reduce clip failure and the mating surface area of the clip with the body was increased and gussets were added to the base of the clip for added strength. Highlighted area shows the design of the CRESS Mod 3 (left) CRESS-D clip (right).



**Ampoule Retainer:** For the CRESS-D reagents, the order of breaking ampoules became critical to the function of the kit. An additional concern stemming from the CRESS Mod 3 ampoule retainer was thickness. The median thickness of the CRESS Mod 3 ampoule retainer was 0.020". At a thickness of 0.040", the item became easier to mold and safer, but became too difficult to use. For future CRESS productions, the ideal median thickness should be 0.030".



**Gasket:** Many of the reagents used for the CRESS-D included strong acids and it became essential to ensure that users not come in direct contact with the reagents. Viton was selected for the chemical resistant rubber/gasket material for both sealing surfaces: surface between top of the CRESS body and the ampoule retainer and the surface where the top side of the kit mates with the bottom side of the kit dividing the 4 quadrants. It was known early in development that a range of thicknesses from 0.010"-0.040" would be required. The specification for this gasket is 0.032" with a tolerance range of -0.000" and +0.008".

**Colorimetric Sticker:** Initial attempts using solid colors for identification (below left), as in the HME kit, were unsuccessful. It was noticed that several variables, the most significant of which being the amount of sample collected, could have an impact on the color change reactions. In order to compensate for this, gradients were added to the colorimetric sticker (below right). This worked in some cases, but from a systems level it could be argued that this sticker was too difficult to read.



**Ampoule Filling Machine:** The "plug-and-play" design of the CRESS kit allows for different colorimetric chemistries to be utilized by simply changing the reagent ampoules within the kit. ECBC procured an ampoule filling machine to make ampoules in house for testing, however issues were noted with the sealing height and head space limitations for various chemicals.

**Screening Chemistries:** For the CRESS-D kit, six prominent drugs (morphine, methamphetamine, cocaine, fentanyl, chloral hydrate and methylenedioxypropylamphetamine (MDPV)) were chosen based on being readily available and being found in multiple theaters of operation. To screen these analytes, four UN approved reagent chemistries were chosen: Marquis reagent, Simon reagent, 30% NaOH/ Pyridine and Cobalt (II) thiocyanate.

### Results

The CRESS-D completed two System Level tests, one First Article test and a demo at ECBC. These assessments concluded that the kit successfully allowed users to rapidly screen samples presented to them as randomized blind trials with accuracy and confidence after minimal training. The goal of this initiative was to prove that the six drugs selected could be screened by the CRESS form factor. Lessons learned can be incorporated into future variants.