



Processing Considerations for TSE Processing of Infrared Decoy Composition

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- **Program overview/Update**
- **Inert trials**
- **Safety Analysis Topics**
- **Road ahead**

- **Update to presentation given at 2002 CMEUG Meeting**
- **Crane Division TSE Impetus:**
 - **MTV flare composition production:**
 - **Coacervation coating process (batch mixer)**
 - **n-Hexane and Acetone~250 lb of solvent/100 lb MTV**
 - **Several recent incidents in production facilities**
 - **Mixing technological advancements**
 - **Twin screw mixer/extruder**



- **Demonstrate MTV TSE process**
 - Contract with ATK Thiokol
 - Produced 300 pounds of MTV
 - Tested at NSWC Crane and found no anomalies
- **Acquire & install TSE capability**
- **Define and implement process improvements**

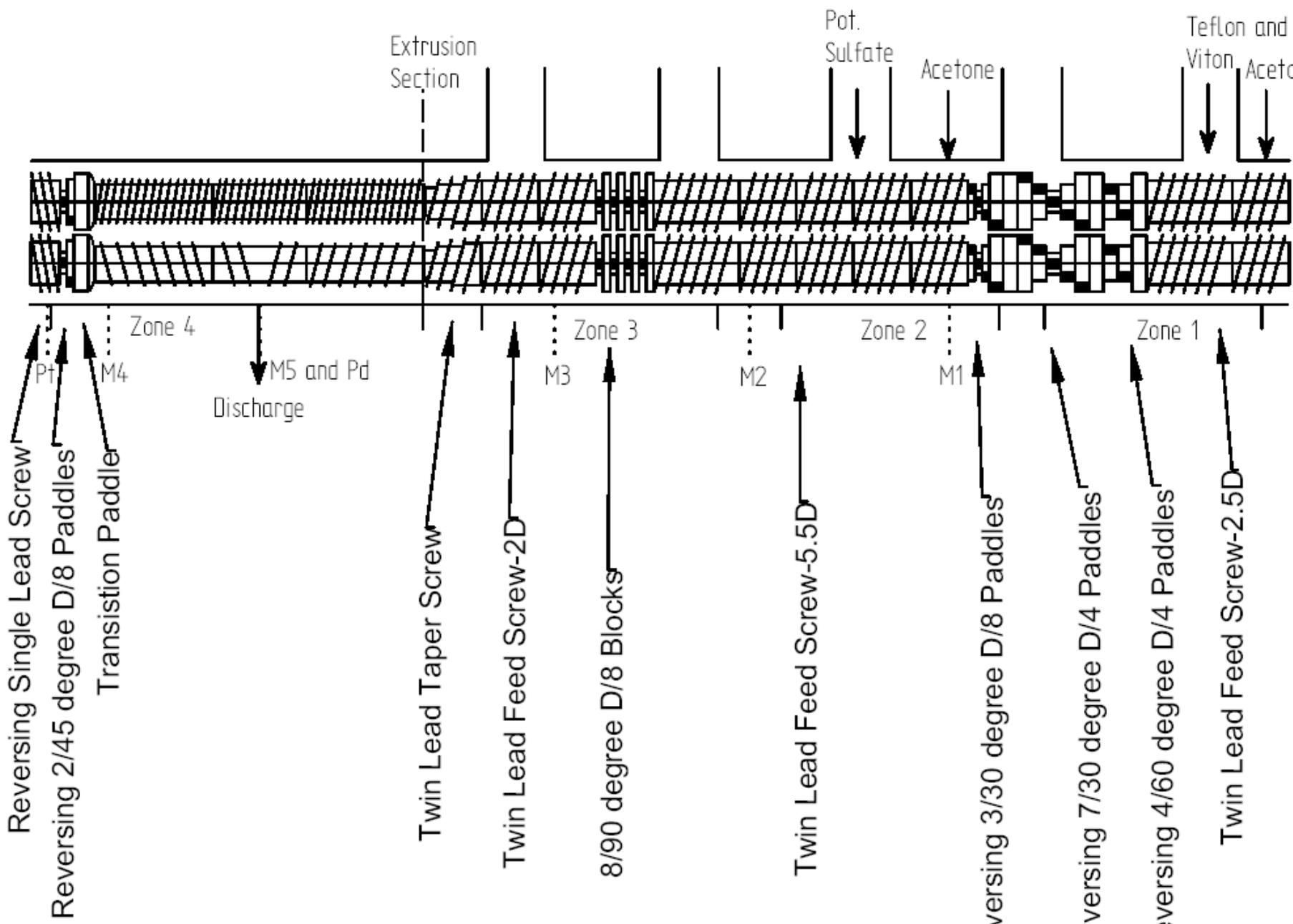


- **B&P Model SE-1600 40 mm TSE**
- **Co-rotating, vertically aligned**
- **Side discharge**
- **22:1 L/D**
- **Initial Installation completed in May 2002**



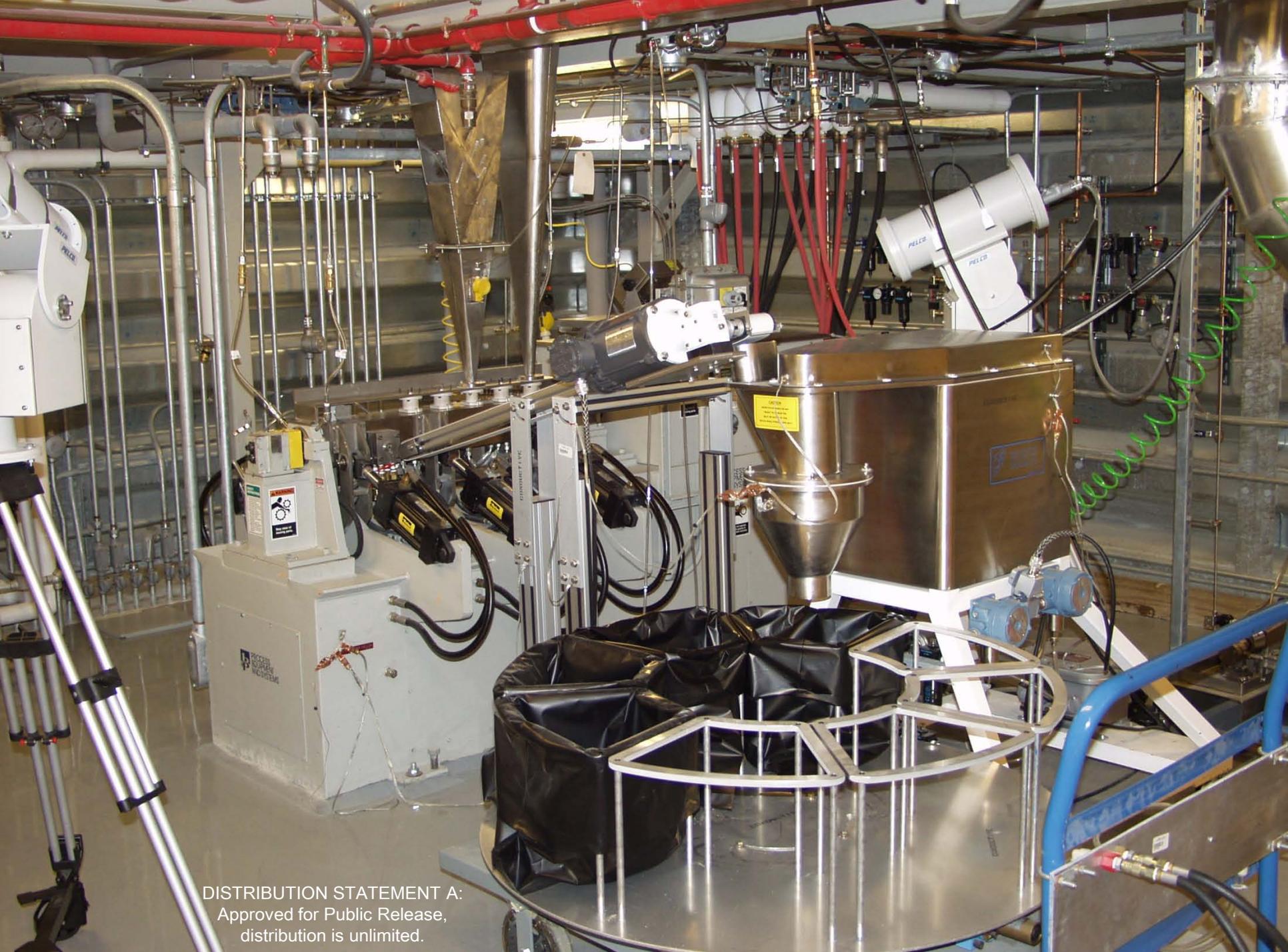


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- **Cone Mill manufactured by Kemutec Group (Bristol, PA)**
 - Designed and built for ARDEC
 - Adjustable speed of 300-5000 rpm
 - Multiple cones and spacers to vary clearance between agitator and cone
- **Conveyor belt manufactured by Auto-Kinetics (Oldsmar, FL)**
 - Explosion proof 0.5 hp motor (C, D, E, F, and G)
 - Anti-static conveyor belt





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- **18 Inert Trials Conducted**
 - **13 prior to Flolo installation**
 - **Begin safety analysis and determine desired processing conditions (solvate Viton pellets)**
 - **Unable to fully dissolve Viton (greater than 95%)**
 - **5 after installation**
 - **Use new screw elements and equipment**



- **Results and Findings**
 - **Cone Mill, conveyor belt, and solvent feed system worked well**
 - **Tighter clearance elements caused two problems:**
 - **Viton pellets deflected the screws enough to cause screw to barrel contact during start-up**
 - **Previous “best” screw design would not work due to pumping issues**
 - **Bridging occurred in K_2SO_4 /Mg funnel due to acetone evaporation**

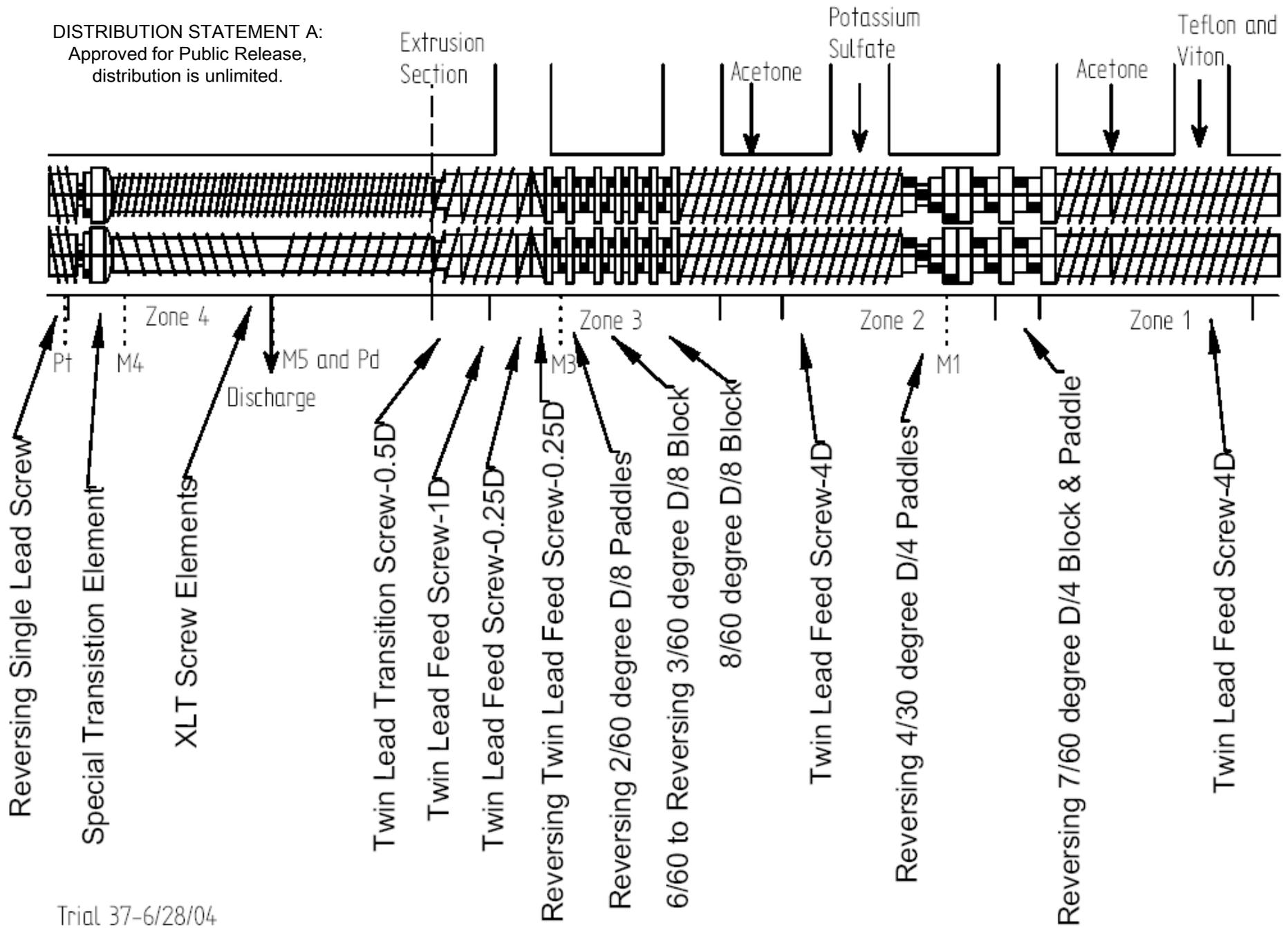


- **Reduce Viton pellet size to eliminate screw to barrel contact**
 - **Kemutec Group (Bristol, PA) cryogenically chopped Viton pellets**
 - **Universal 5H mill**
 - **Chopped material screened through number 5 screen to remove remaining “large” particles**

Screen Size	Virgin Viton (g)	Chopped Viton (g)
4	27.9	1.1
5	49.7	6.7
6	21.0	17.4
8	1.1	38.4
Pan	Trace	36.8



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- **MPERC Documentation Requirements**
 - PHA
 - O&SHA on entire process
 - Fault Tree Analysis on process
 - Fire Protection Requirements
 - Feeder Study Report
 - Software Hazard Analysis
 - Preventative Maintenance Plan
 - Configuration Management Plan
 - Inert Processing Summary Report
 - Grounding/Bonding Evaluation and Report
 - Electrostatic Discharge Evaluation and Report
 - PPE/Material Hazards Analysis



- **All process equipment must be grounded to less than 1 ohm**
- **Findings of Interest**
 - Vertical and horizontal agitators not grounded
 - Feed screws not grounded
- **Solutions**
 - Vertical agitator grounded by a bolt/spring/pin combination in the mounting plate on top of funnel
 - Bolt is grounded through mounting block
 - Bolt grounds spring and pin
 - Pin contacts agitator shaft
 - Horizontal agitator and feed screws grounded by replacing grease in bearings and gear box with conductive grease (Nyogel 756G)



- **Step by Step analysis using a Digital Stat Arc 2 Model 282 fieldmeter (Monroe Electronics)**
 - Explosion proof A, B, C, D, E, F, and G
- **Findings of Interest**
 - Charge measured on Teflon and Viton during loading and feeder calibration tests
 - Charges measured on Teflon as it exited funnel
 - Potential acetone vapors in funnel near TSE (LOC is 12%)
- **Solutions**
 - Load and test Teflon and Viton feeders prior to loading and testing Magnesium and Acetone feeders
 - Purge Teflon/Viton funnel with nitrogen
 - Nitrogen fed through TSE gland housings
 - Oxygen level reduced to 7% when feeders are running



Material Hazards Analysis

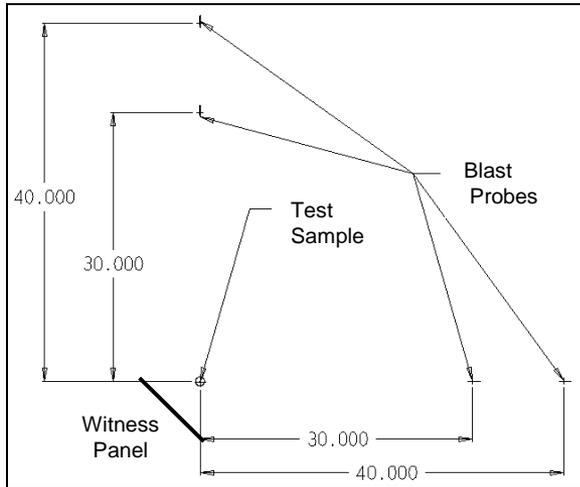
- **MTV**
 - W
 - D
 -
- **Cent**
 - 8
 - 15
- **Vary**
 - 20
- **Eigh**



tion



Test Setup



- **Instrumentation:**
 - Blast Probes
 - High Speed Video
 - Standard Video
- **Ignition**
 - M-100 Electric Match
 - From top
- **C4 shots conducted to verify setup**
- **Test 1 and 2 were at 20% and 15% wet**

Test 3 Results-Steel Can



- **22.5 lbs Composition**
- **10% Acetone Wetted**
- **Burntime: 9 Seconds**
- **Some comp. expelled from can**
- **Burned within ~ 15 ft radius of can**
- **No audible report**
- **Heat induced response of pressure transducer**

Test 4 Results-Steel Can



- **22.5 lbs Composition**
- **5% Acetone Wetted**
- **Burntime: ~ 0.5 Second**
- **Loud audible report**
- **Measurable pressure wave**

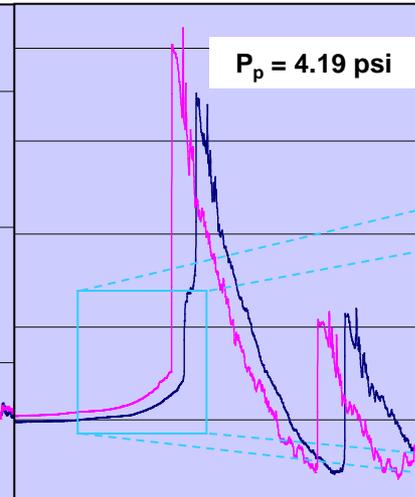
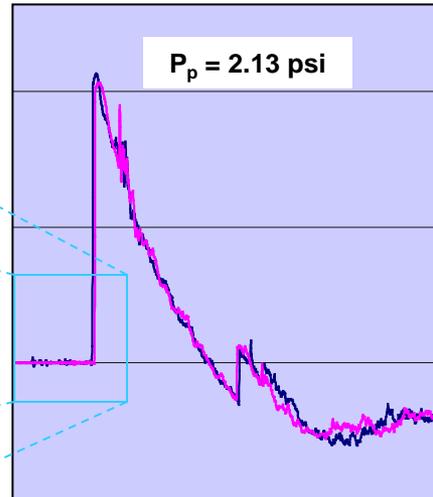
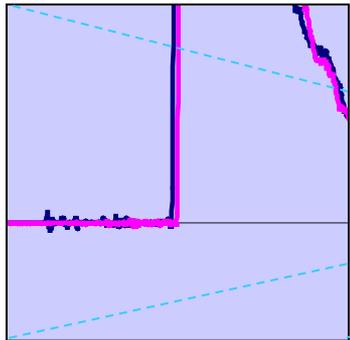
Test 5 Results-Steel Can



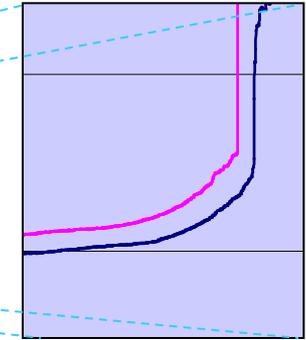
- **22.5 lbs Composition**
- **Dry**
- **Burntime: ~ 0.3 Second**
- **Loud audible report**
- **Significantly more vigorous than wetted composition**
- **Batch can fragmented**
- **Witness panel deformed**
- **Significant pressure wave recorded**

C4 vs Dry Confined MTV

**C4 = 1.25 lbs
30 Feet**



**MTV = 22.5 lbs
30 Feet**



- **Instantaneous steep slope**
- **Detonation wave**

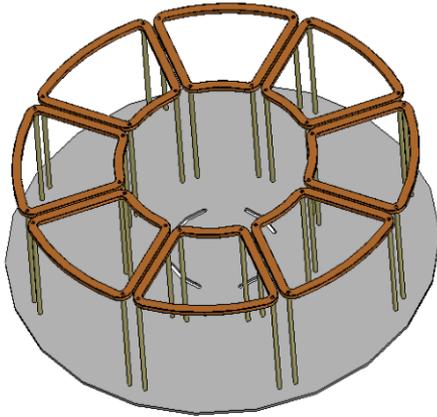
- **Gradually increasing slope**
- **“Shocking Up” to steep slope consistent with a detonation**

Test 6 Results-Paper Can



- **22.5 lbs Composition**
- **Dry**
- **Minimal Confinement**
 - Paper Cylinder
 - Shape Consistent with Steel Can
- **Burntime: ~ 1 Second**
- **No audible report**
- **Pressure wave recorded – temperature response only**
- **Less severe than reaction confined in batch can**

Test 9 - Modified Collection Table



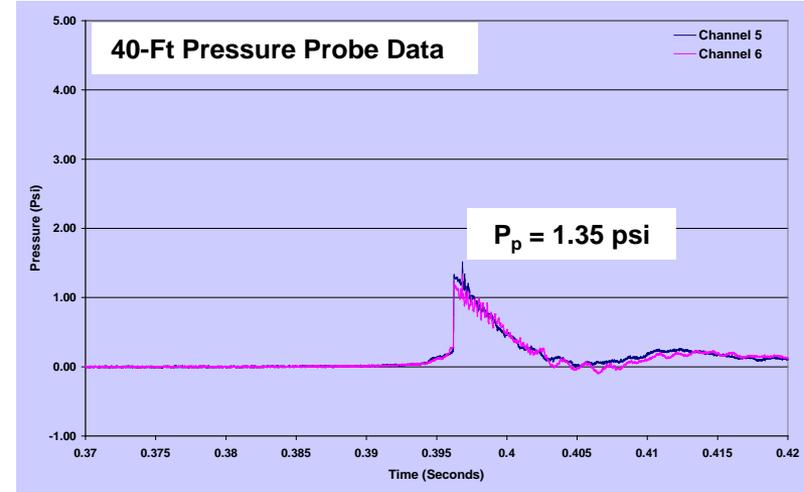
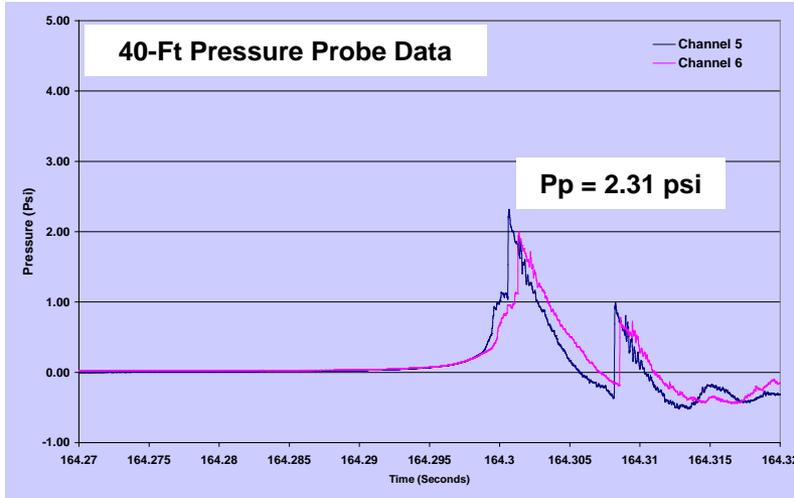
- **Frames support Velostat™ bags**
 - Reduces confinement of composition
- **75 lbs comp. total**
- **Eight Velostat™ Bags**
 - Four with 18.75 lbs comp. per bag
 - Four with equal volume of sand
- **Ignition in Center Bag**

Test 9 Results - Modified Table



- **Large fireball ~ 20-ft diameter**
- **Loud audible report**
- **No fragments**
- **Significant pressure wave recorded**

Batch Can vs Suspended Bags



- **22.5 lb dry in batch can**

- **75 lb dry in new collection table**



Test Conclusions

- **Burning**
 - Always present
- **Fragments possible with:**
 - Dry composition and confinement
 - Low acetone levels
 - Strength of confining structure?
- **Blast possible with:**
 - Dry composition with confinement
 - Small quantities (TNT equivalency 25-30%)
 - Dry composition without confinement
 - Larger quantities (TNT equivalency 1-2%)
 - Low acetone levels and confinement



- **Process is fully defined**
- **Obtain safety board approval**
- **Live processing**
 - **Short runs to characterize composition**
- **Material qualification**
- **Process refinement/documentation**

