

FIELD MANUAL

A Portable Burn Pan for the Disposal of Excess Propellants

ESTCP Project ER-201323

NOVEMBER 2015

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REPORT DOCUMENTATION PAGE					Form Approved OMB No. 0704-0188	
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1. REPORT DATE (DD-MM-YYYY) 01/11/2015		2. REPORT TYPE Manual			3. DATES COVERED (From - To) April 2013 - November 2015	
4. TITLE AND SUBTITLE A Portable Burn Pan for the Disposal of Excess Propellants				5a. CONTRACT NUMBER		
				5b. GRANT NUMBER		
				5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S) Michael R. Walsh USA CRREL				5d. PROJECT NUMBER ER-201313		
				5e. TASK NUMBER		
				5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) USA CRREL 72 Lyme Road Hanover, NH 03755-1290				8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Environmental Security Technology Certification Program Program Office 4800 Mark Center Drive Suite 17D03 Alexandria, VA 22350-3605				10. SPONSOR/MONITOR'S ACRONYM(S) ESTCP		
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.						
13. SUPPLEMENTARY NOTES N/A						
14. ABSTRACT The US Army Cold Regions Research and Engineering Laboratory (CRREL) has developed a portable burn pan that can be transported to the firing points where training occurs. In 2013, CRREL was awarded project funding by the US Department of Defense Environmental Security Technical Certification Program through Project ER-20323 for the completion of the development and the demonstration of the portable burn pan concept. A pan designed for howitzer training units has been designed and tested, meeting all the criteria set out by CRREL and ESTCP.						
15. SUBJECT TERMS Portable burn pan, excess propellant disposal, field manual.						
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON	
a. REPORT	b. ABSTRACT	c. THIS PAGE			Michael Walsh	
Unclassified	Unclassified	UU	UL	17	19b. TELEPHONE NUMBER (Include area code) 603-646-4363	

FIELD MANUAL

CRREL PORTABLE PROPELLANT BURN PAN HOWITZER AND MORTAR TRAINING SYSTEMS



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Cover image: Placing burn pan bonnet on howitzer training unit system, Firing Point Sally, Donnelly Training Range, Ft. Wainwright (Delta Junction), AK, 14 August 2015. (*MR Walsh, USA CRREL*)

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CRREL PORTABLE PROPELLANT BURN PAN

Background

Munitions for indirect fire weapon systems are issued with a full complement of propellant charges, ranging from four to over ten individual charges per round. Charge loads are varied in accordance to the desired ballistics of the fired projectile and the state of the weapon system. Excess, unused propellant charges result from firing at less than maximum range or the reduced charge load required for operation of a “cold” weapon system. Excess charges are typically not turned in and are destroyed by open burning as part of the training mission.

The US Army Cold Regions Research and Engineering Laboratory (CRREL) has developed a portable burn pan that can be transported to the firing points where training occurs. In 2013, CRREL was awarded project funding by the US Department of Defense Environmental Security Technical Certification Program through Project ER-20323 for the completion of the development and the demonstration of the portable burn pan concept. A pan designed for howitzer training units has been designed and tested, meeting all the criteria set out by CRREL and ESTCP. A smaller burn pan was designed for mortar training units and has also been successfully demonstrated. This Field Manual describes the concept, use, and care of the CRREL Portable Burn Pan systems.

Concept

A CRREL burn pan was designed to provide field artillery training units with a tool that will enable them to develop the necessary skills to burn excess propellants during training missions. The portability of the pan allows the troops to conduct this training in close proximity to the artillery firing points, thus eliminating the sometimes long drive to isolated fixed field pans found on many ranges. By providing a structure in which to burn the propellant, more control can be applied to the training. The burn pan benefits both the training units and the range managers by being very efficient in the burn process, virtually eliminating contamination of the soil at the pan location and ensuring range sustainment as well as soldiers' health.

The howitzer training system will be described first (**Figure 1**). The burn pan consists of three assemblies. The base is the main component. It is a welded aluminum fabrication approximately 1-m x 2-m x 0.3-m deep on 30-cm high legs. It has handles placed on both sides of all four corners for lifting and placement of the assembled unit. A stainless steel false bottom fits into the base. It has perforated stainless sides that contain the charge bags and act as a guide for loading the charges. The false bottom serves to protect the aluminum base from the heat of deflagration of the propellant charges. The stainless bonnet fits onto the top of the pan and helps contain the burn and any debris, such as charge bag fragments, from being ejected from the pan without

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constricting the burn. The base has a retractable ignition trough (slider) at one end that is used to prime the propellant charges for ignition. Auxiliary equipment for the burn pan includes a tarp with tie-downs for storage and a flat-bottomed scoop for collection of the burn residues. Fire suppression equipment such as fire extinguishers or a backpack firefighting pump should be supplied by the appropriate entity.



Figure 1: Briefing artillery unit on burn pan theory and operation.

The mortar training system is a shortened version of the burn pan (**Figure 2**). The size of the mortar training system is 1-m x 1.2-m x 0.3-m deep on 30-cm high legs. Other than the length of the pan components, the composition of the pan is the same as for the howitzer system.



Figure 2: Mortar squad members loading excess propellant charges into a mortar training system burn pan. The bonnet is to the right of the pan.

Configuration

As outlined above, the burn pan system is composed of three major components – a stainless steel open bonnet, a stainless steel false bottom, and a lightweight aluminum pan (**Figure 3**). The fourth component shown, the ignition slider, is removable to enable removal of the false bottom. The slider can be moved into the pan for transport and storage and then extended out for the propellant burns. The bonnet will be removed to allow open access to the false bottom, where the charges are loaded, then replaced prior to the burn. Removal of the false bottom for complete cleaning of the aluminum pan only needs to be done during periodic maintenance.

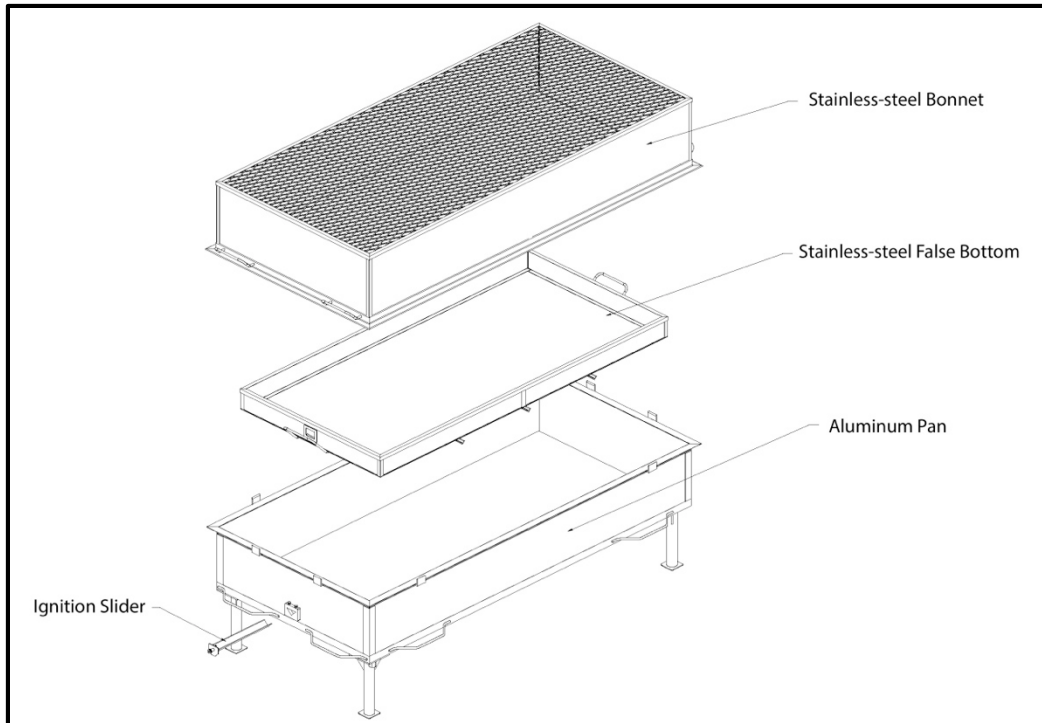


Figure 3: Drawing of the CRREL Burn Pan system showing major components

Weights of the components and the overall systems are shown in **Table 1**. For the howitzer unit, 4-6 personnel can move the assembled system. For the mortar unit, two to four personnel can handle the assembled system. The bonnet can be handled easily by two artillerymen for both systems.

Table 1: Component masses (kg) for burn pan systems

System	Pan	False Bottom	Bonnet	Total
Mortar	29	24	26	79
Howitzer	43	40	40	123

For shipping and storage, the systems are provided with a tarp, tie-downs (bungee cords), and straps (**Figure 4**). The pallet and steel strapping shown in the image will not be on the unit for field deployment. The shipping and storage materials should be placed in the transport vehicle when the burn pans are in use.



Figure 4: Burn pan configured for long-distance shipping.

Using the Pan

Current portable burn pans fielded by the military are owned by the facility range manager. Their access, placement, and use will be under Range Control's guidance. The training unit or Range will transport the pan to the burn point (**Figure 5**). Range will site the location of the pan.



Figure 5: Howitzer burn pan in Range Control vehicle at designated burn site

The charge capacity of the howitzer burn pan is designed to accept a maximum propellant load of 125 kg. The mortar training system burn pan is designed to accept a maximum of 50 kg of charges. Smaller loads are recommended, especially for the initial burns, to acclimate the troops to the equipment and determine if the site will withstand the heat of combustion. In general, a first burn at half capacity and subsequent burns at $\frac{3}{4}$ capacity is prudent for both systems (Figure 6). **Under no circumstances should the pans be loaded with charges over capacity as this may result in a transition from burning to detonation of the propellant load.**



Figure 6: Howitzer propellant burn at $\frac{3}{4}$ capacity. Note grass burning from radiant heat.

The following checklist describes the recommended procedure for conducting training on the burning of propellants in the burn pan. Range or the unit commander in conjunction with Range may modify this procedure as they see fit. Images of a training exercise with a howitzer training unit burn pan follow the checklist.

Suggested Procedure for the Utilization of the Portable Burn Pan on Ranges

1. Burn pan signed out and transported from holding facility to firing point.
2. Location of burn pan demarcated based on input from Range or RSO/OIC (Factors: Safety, fire hazard, levelness).
3. Burn pan placed at demarcated location (Cover with tarp if raining or rain predicted).
4. Fire suppression equipment placed 50 m from burn pan.
5. Excess propellant charges are generated through training (Keep all charges dry).
6. At a break in firing or cessation of training, assign propellant burn duties to two or more soldiers. Consolidate excess propellant bags from prior training.
7. Move excess propellant bags from firing positions to >100 m from burn pan.
8. Remove the tarp (if present) and place over excess propellant bags. Remove perforated bonnet from the base of the burn pan and set to one side.
9. Load the burn pan with charges. Maximum height of the charges is the top of the inner perforated screen on the false bottom. Spread the charges out evenly **(Figure 7)**
10. Extend ignition slider.
11. Cut open one charge. Pour propellant grains into slider until bottom is covered all the way to the propellant charges in the burn pan. **(Figure 8)**
12. Cut open sufficient propellant bags (3 or more) and pour the propellant grains over the end of the slider, covering the slider and the adjacent propellant charges. **(Figure 9)**
13. Replace the bonnet on the pan. Inspect to ensure bonnet is in place. **(Figure 10)**
14. Position one soldier at slider end of burn pan. The second soldier should be positioned 25 m behind soldier who will ignite the grains in the slider. The second soldier will act to monitor the safety of the burn procedure. All other personnel to be 100 m from burn pan.
15. Soldier at slider lights the propellant grains (butane lighter works well). **(Figure 11a)**
16. Confirm ignition of the propellant grains. **(Figure 11b)**
17. Two soldiers walk a minimum of 50 m away from the burn pan: Observe the burn.
18. When the burn is complete, wait one minute and approach the pan to verify.
19. Extinguish any fire external to the pan. Wait for cool down ($\approx$ 8 minutes) before Step 20.
20. Inspect the interior of the pan when the bonnet is cool enough to handle. **(Figure 12)**
21. If there are more propellant charges to burn, reinitiate the sequence at Step 9.
22. If this is the final burn, remove the bonnet and scrape up the residues (Optional-See Range). Place the residues in a heavy polyethylene bag. Label, tag, and ty-wrap the residues bag (Date, type of propellant, training unit, OIC). **(Figure 13)**
23. Check the temperature of the pan. Replace the bonnet and tarp on the burn pan.
24. Return the burn pan and residues to the transport vehicle
25. Inspect area for any residual embers or evidence of active burning. **(Figure 14)**
26. Transport and turn in the residues and burn pan to the holding facility

Image Sequence of a Propellant Burn Training Exercise



a) Placing excess charges in pan



b) Spreading out charges

Figure 7: Loading propellant charges in burn pan



Figure 8: Propellant grains in ignition slider. Note the quantity of grains in slider.

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Figure 9: Placing propellant grains at the end of the slider to initiate burn



Figure 10: Inspecting the pan prior to initiation



a) Initiating propellant in slider



b) Confirming ignition.

Figure 11: Lighting propellant in burn pan



Figure 12: Post-burn inspection of pan prior to reload or cleaning

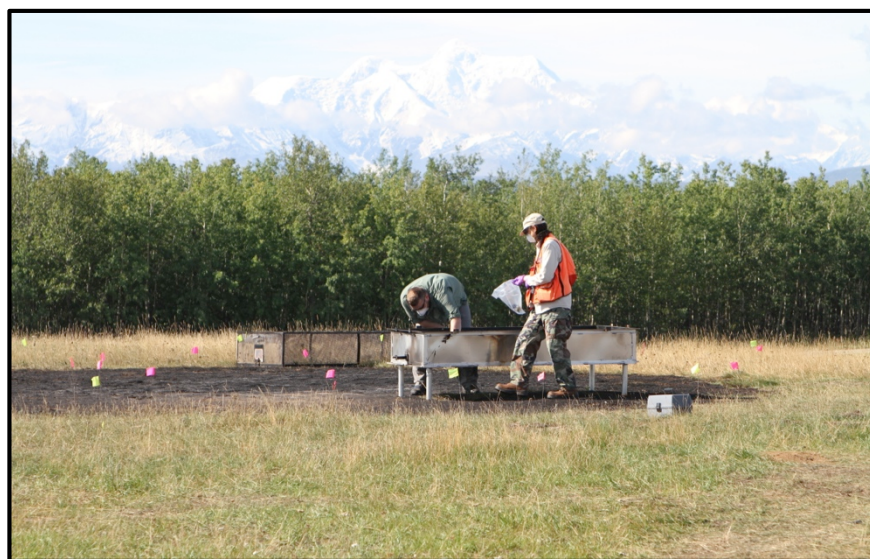


Figure 13: Post-burn training exercise removal of debris.



Figure 14. Burn pan location (green grass) surrounded by area affected by the heat of the burns.

Best Practices

Adhering to the following list of best practices will help ensure a safe, smooth training mission with the CRREL Portable Propellant Burn Pan. This list is not all-inclusive and may be modified by the unit RSO or Range Manager.

- Always work in a buddy system with at least two soldiers participating in each burn
- Do not attempt to conduct a training burn while high winds (>8 kph/5 mph) or precipitation are occurring
- Ensure your powder is dry
- Store all powder in a dry location at least 100 m from burn pan. Keep covered!
- Do not overfill false bottom with propellant charges
- Always check ash in pan from previous burn before loading new charges. There should be no evidence of burning or embers in the ash.
- Be careful of handling bonnet after burn. The handles may be hot.
- Always handle propellant charges with gloves on your hands
- Use a dust mask when removing ash from pan
- Have fire suppression equipment on hand in at least two places 50 m from the pan
- Keep observers at least 100 m from pan during a burn

Time Between Burns

Individual burns were timed to determine cycle times for burning large amounts of propellant (**Table 2**). The first burn was an instructional event, so only the finish time for that burn was recorded. The limiting factor for the cycle time for these tests was the temperature of the lifting handles of the bonnet. The total time to burn six lifts of propellant totaling 460 kg was about 1h10m minutes, or about 12 minutes per burn. Of the 12 minutes, seven minutes were consumed in allowing the pan to cool down so the bonnet could be safely removed without incurring discomfort on bare hands.

Table 2: Timing of burn events on 14 August 2015

Load	Mass (kg)	Loading	Burn	Finished
1	39.4	—	—	10:06 h
2	88.9	10:15 h	10:17 h	10:20 h
3	83.4	10:25 h	10:27 h	10:30 h
4	79.1	10:40 h	10:41 h	10:45 h
5	86.5	10:52 h	10:56 h	10:56 h
6	81.1	11:05 h	11:07 h	11:10 h

Summary

The portable burn pan is efficient, easy to use, and can be used as a training aid, all the while helping maintain range sustainability by greatly reducing ground contamination and allowing the efficient collection and control of toxic residues. Following tests and demonstrations at three sites, all parties agreed that it is a welcome addition to their range and environmental toolbox.

Points of Contact

For more information on the burn pan system or assistance in utilizing the pan, please contact the following:

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Appendix A: Photo sequence of a burn

The following sequence of images depicts the training burn of 89 kg of M1 howitzer propellant at the Donnelly Training Area, Fort Greely, AK, in 2015. The sequence occurred over about 8 seconds from the charges becoming engaged to burnout. The surrounding grass was ignited by the radiant heat of the burn, an indication of the high temperatures achieved during the deflagration of the charges. As the pan load burned out, the grass ceased to burn. However, this phenomenon should be kept in mind when locating the burn pan for training.

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A.1) Initiation slider grains burning



A.2) Opened propellant charges burning



A.5) Propellant charges fully engaged



A.6) Start of burn out

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A.3) Propellant charges initiating



A.4) Propellant charges burning



A.7) Propellant load burning out



A.8) End of burn (≈ 8 seconds)

Acknowledgements

The burn pan was developed under the SERDP/ESTCP Environmental Restoration Program, Dr. Andrea Leeson, Director, through SERDP Project ER-1481 and ESTCP Project ER-210323. Testing of the pan occurred at Defence Research and Development Canada's (DRDC) Valcartier, QC, test range; JBER-Richardson in Anchorage, AK; Camp Grayling, MI; Fort Indiantown Gap, PA; and Donnelly Training Area, Delta Junction, AK. Scores of individuals helped in the development and testing of the pan. Dr. Bonnie Packer of the Army National Guard Bureau; John Hunt, formerly at Camp Grayling; Jo Anderson, formerly at Ft. Indiantown Gap; and Steve Thurmond, formerly at US Army Alaska Range were especially helpful in arranging access to training lands and coordinating with training units to enable testing. The Ohio Army National Guard, Pennsylvania Army National Guard, and the 2/377th Parachute Field Artillery allowed us to partake in their training exercises to test the pans. Finally at CRREL, Marianne Walsh, Charlie Smith, Tommie Hall, Matt Bigl, Chris Donnelly, and Jordan Hodge all played major roles in the success of the burn pan.