

Running a Big Rocket Range

Mark Bundick
Trip Barber



Purpose

Provide recommendations on how to run a safe and efficient flying range at large model and/or high-power rocket launches

Guiding Principles

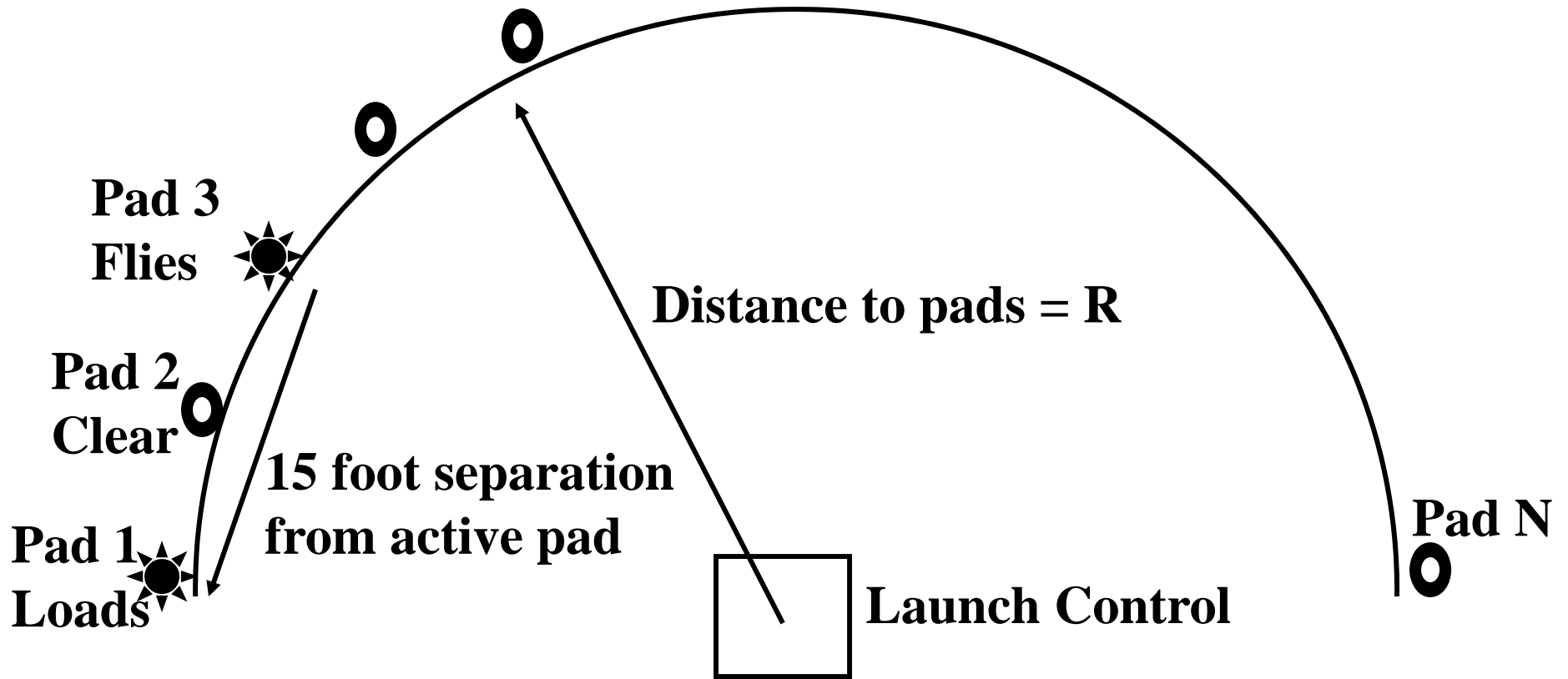
- Keep it safe
- Keep 'em flying, not waiting
- Rocketry is fun, bureaucracy isn't

Safety

- NAR Safety Codes and National Fire Protection Association (NFPA) Codes were designed to minimize safety risks – if they are followed
- NAR Trained Safety Officer program contains extensive recommendations and procedures for how to run a safe range – consult it
- You have to “just say NO” at a big launch: if a rocket does not look safe don’t let it fly, if a situation does not look safe take action to change it

Range Layout

- Space model rocket pads so that only 1 on either side needs to be cleared when a pad is flying
- Space HPR pad lines and access lanes so each pad line can still load safely while the other lines fly
- Pay attention to the NFPA Code 1127 requirements for distances/dimensions on HPR ranges:
 - Minimum site dimensions and restrictions on buildings/roads within this site
 - Launch standoff distances from ALL people
 - Cleared-area distances around pads

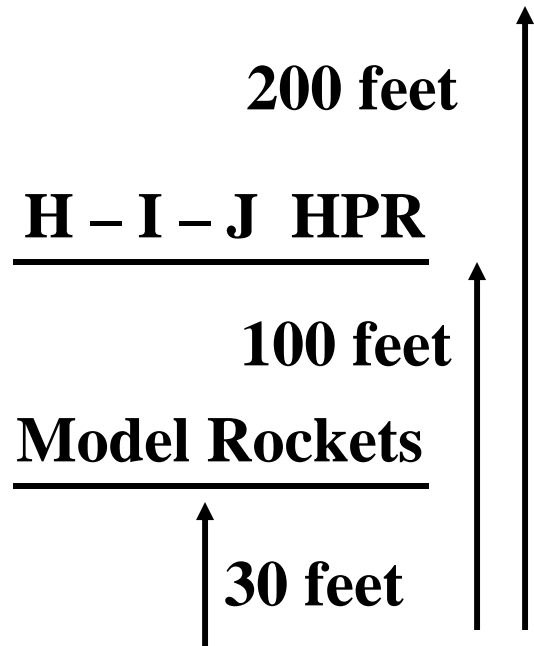


**Maximizing throughput
by efficient model
rocket pad layout**

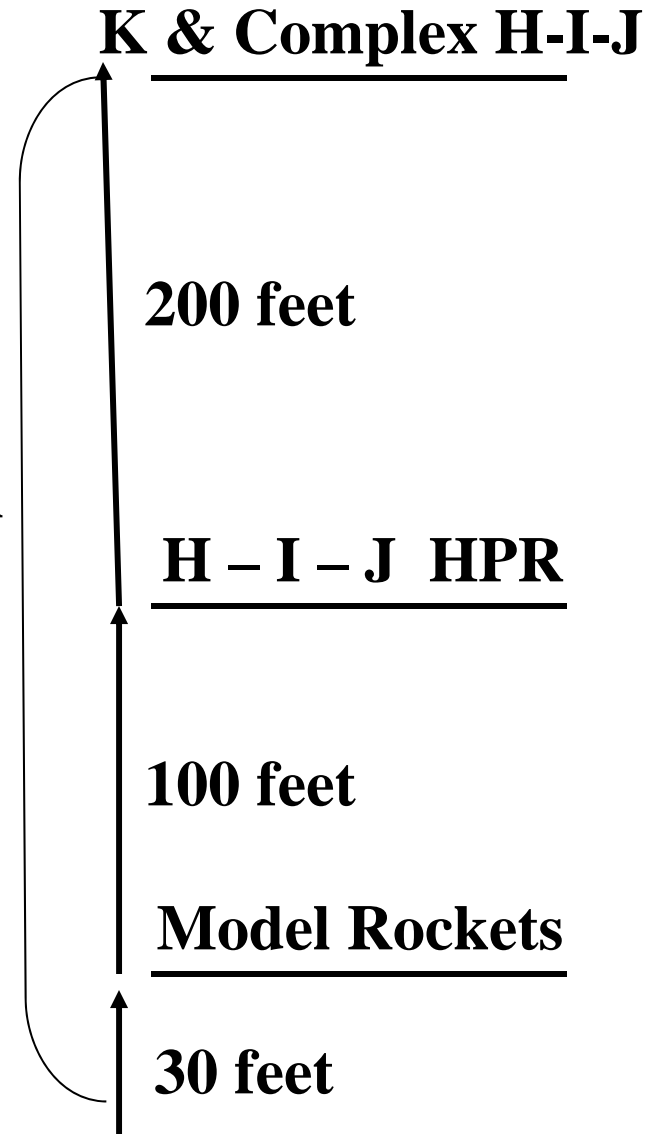
$$R = \frac{7.5 \text{ ft}}{\text{Sin} \left[\frac{180}{N - 1} \right]}$$

**Maximizing throughput by
efficient HPR range layout**

**Efficient in space,
but not throughput:
K & Complex H-I-J**



**All can
load at
once:**



Launch Control / Spectators

Crowd Safety

- Launch standoff ranges apply to spectators, photographers, and to people returning with rockets
 - Use flag line liberally
- Make sure launch rods and flight paths (with weathercocking) point away from the crowd
 - Pay attention to where HPR rockets are landing, too
- Use RSO “heads up” calls, but don’t abuse them
 - Ensure they are audible in the spectator area
- Know who to call and what to do if an accident or injury (of any kind or cause) happens

Launch Control

- Test every pad with an igniter before a big launch, measure battery charge, and clean/replace all clips
 - Know if the launch system is “electric match” safe
- Pay attention to safety keys/interlocks – it is very dangerous to fire one pad on a system when other pads fired by that system are still loading
 - Make sure LCO’s understand the system each shift
- Make sure each rocket’s owner is aware of his rocket’s impending launch
 - Public address and/or FM radio announcement, or (for contests) by having them raise a numbered “paddle”

Check-In Procedures

- Put your most experienced and safety-conscious range crew at check-in
 - Critical point for judging safety and rules compliance
- Provide check-in staff with the tools they need, clear guidance on procedures, and full support
 - Waiver table (or Pink Book), scales, motor certification list
 - NAR TSO checklist
- Don't "stack" rocket assignments on already-occupied pads, wait until they clear

Key Efficiency Points

- Match pad quantities & rod sizes to customer demand
 - Be ready to switch out launch rod sizes during the launch
- Lay out the range so that fliers can reach most pads safely while other pads are flying
- Have enough people on range duty to support keeping the pads full and flying
 - Check-in/safety check is usually the first place to saturate
 - Flight card managers to assist the LCO improve his speed

Key Efficiency Points

- Have clear established procedures for handling flight cards and dealing with misfires
 - Write them down & talk them through before launch
 - Keep someone who knows them on the range
- Make achieving rapid flight rates your RSO's second priority (after safety)
 - Keep the LCO and RSO away from check-in noise
 - Talk less on the public address system, fly more
 - Usually OK to fly next flight before previous one lands

Key Administration Points

- For big model rocket contests, pre-print flight card labels and make the cards single-use
 - Pre-printing ensures completeness & accuracy
- Don't let fliers (contest or HPR) handle or move their flight cards after initial check-in
 - Use “runners” to move cards from point to point
- Require all fliers to wear badges with their NAR number and certification level at check-in

Key Administration Points

- Keep sport launch flight cards simple
 - Must include motor type, rod size, and (for HPR) method of recovery system activation
 - Should include what the RSO should tell the crowd
 - Use check blocks wherever practical
- Don't ask for volunteers for range crew duty, make this duty a pre-requisite to flying
 - Have a range crew roster/sign-up list at registration
 - If everyone does one shift, no one can say it's unfair
 - If this is too hard, offer a discounted fee for range crew

Flight Cards

Data	Who Provides	Who Uses	How Used
Flyer Name	Flyer	RSO	Make pre-launch PA announcement
Engine	Flyer	Checkin & RSO	Check certification, PA announcement
Model Name	Flyer	RSO	Make pre-launch PA announcement
Recovery Type	Flyer	Checkin & RSO	Safety check, PA announcement
Electronics	Flyer	Checkin & RSO	Safety check & RSO flight following
Certification Flt?	Flyer	Checkin & RSO	Flight approval, RSO alert to cert team
Model Weight	Checkin	Checkin	Safety check for liftoff safety & waiver
Safety Checked	Checkin	RSO	Verify that rocket has been checked
Pad assignment	Checkin	LCO & Flyer	Ensure identity of rocket being flown
Rod Size	Flyer	Checkin	Ensure rocket assigned to appropriate pad
Club Affiliation	Flyer	RSO	Optional: if desired for PA announcement
NAR/TRA Number	Flyer	Checkin	Optional: needed if flyer badges not used
Cert Level	Flyer	Checkin	Optional: needed if flyer badges not used
Model features	Flyer	RSO	Optional: useful for PA announcement

Summary

- Good rocket ranges keep the customers safe, happy, and flying
- Being good is not accidental; it takes good planning, people, procedures, and equipment