Rocketry Safety Code v7.0

The United Kingdom Rocketry Association (UKRA) is a body of volunteers working to improve Rocketry for all in the UK. UKRA represents the rocketry community at a national level, striving to improve working relationships with the **CAA**, **HSE** and local police forces.

The Safety Code document is updated from time to time and published by the Council of UKRA. The document sets out the minimum expected standards for a safe environment when executing amateur rocket flights.

The Range Safety Officer (RSO) always has the final authority for the interpretation of this code.

The latest version of the Safety Code may be found at the UKRA website www.ukra.org.uk

1. Table of Contents

2. Scope

Refer to Appendix D (Definitions) for full definitions of capitalised terms within this document.

This Safety Code may be applied to all rocket launches up to and including O-class (see Appendix A, Rocket Motor Impulse Classes).

For Model Rockets section 7 (High Power Rocketry) and Section 8 (Research) do not apply.

For High Power Rocketry section 7 (High Power Rocketry) applies. Section 8 (Research) should be read to familiarise the reader with the constraints and concepts for Research and Experimental flights.

Any Rocket involving any of the following will automatically be classified as Research/Experimental and Section 8 (Research) applies:

- Thrust is provided by a Liquid Propellant Engine.
- Thrust is provided by a non-commercial Rocket Motor, including non-commercial Hybrid Motors.
- Total Impulse exceeds 40,960 Ns (O-Class).
- Active stabilisation.
- Any unproven design of Rocket.
- Any unproven design of recovery system.
- Rockets that are constructed of unnecessarily dense or non-deformable materials, for example metal nose-cones.

3. General Rules

3.1. Law

All fliers must comply with all relevant laws and bye-laws. Specific attention should be paid to:

- CAA/ANO regulations 96 (Rockets) and 240 (Endangering safety of an aircraft)
- Airspace restrictions
- Health and Safety Executive regulations regarding manufacture, acquisition, import, transfer, storage and handling of explosives as they pertain to Rocket Motors.

UKRA maintains guidance on the application of the above on the UKRA website. Further details may be found here: http://www.ukra.org.uk/

3.2. Safety

3.2.1. Shared Responsibility

Safety is the concern of all present and is the shared responsibility of all. Flights causing damage or injury whilst involved in rocketry should be reported to the Range Safety Officer, the club organiser/chair and/or UKRA.

Minor mishaps may also be reported, anonymously if preferred, to UKRA to guide future developments in policies and the Safety Code.

3.2.2. Range Safety Officer (RSO)

A Range Safety Officer must be appointed for each launch or launch session. For Model Rockets the RSO should be familiar with the concepts and risks associated with Model Rockets. For other rockets, including High Power Rockets, the RSO must be a club recognised RSO.

The RSO has full responsibility for the Launch Area and has final approval authority for all rocket related activities within the Launch Area.

The RSO is expected to inspect each Rocket prior to launch and deny launch approval if he/she is not confident that the Rocket flight may be made safely and in accordance with this Safety Code. The flier is expected to be able to answer any questions the RSO has regarding the design, assembly or operation of the Rocket.

Fliers and spectators must defer to the RSO for all activity within the Launch Area and must not launch any rocket without the explicit approval of the RSO.

3.3. Insurance

Insurance should be in place for all Rocket flights.

For individuals and clubs the British Model Flying Association (BMFA) provide a comprehensive insurance package covering rocketry activities following this Safety Code. Full details are available on the BMFA website: http://www.bmfa.org/

3.4. Disreputable Behaviour

The rocketry community, including UKRA, has worked tirelessly with government organisations to allow amateur and professional rockets to be launched with minimal government restriction.

Behaviour bringing rocketry into disrepute should be reported to the Range Safety Officer, the club and/or UKRA.

4. The Rocket

4.1. Construction

The Rocket must be constructed of components and materials appropriate to the forces expected during flight. Particular attention should be applied to the choice of materials, choice of construction, joints between components and secure attachment of recovery devices.

The Rocket must be constructed sufficiently to survive all reasonably expected events during flight and fliers are recommended to ground-test components where possible.

Rigidity expectations will vary depending on the exact rocket, however the following guidance should be considered:

- Avoid metal components except where strictly necessary, for example where required for structural integrity or heat dissipation at transonic speeds.
- Avoid sharp edges, particularly nose cones and sharp fin edges.
- Material choice and structural design are critical for all rockets.

4.2. Stability

The Rocket must be designed to be passively stable in all flight phases. Fliers must be able to demonstrate that the Centre of Pressure is a minimum of one body tube diameter behind the Centre of Gravity at all stages of flight.

It is recommended that, where possible, the Centre of Pressure is marked on the Rocket to ease stability verification during the Pre-Flight checks.

Active stabilisation systems may only be flown as Research/Experimental flights and section 8 applies.

4.3. Payload

The following may never be carried as a Rocket payload:

- Live animals
- Intentionally flammable, explosive or harmful substances, for example corrosives, pyrotechnics and smoke canisters except where necessary for flight or recovery.
- Active guidance systems except those intentionally returning the Rocket to the Launch Site during recovery.

4.4. Propulsion

Under UK law all solid Propellant Rocket Motors are classified as explosives and therefore must only be manufactured at registered sites meeting strict regulations. UK law permits most Hybrid and Liquid Rocket Motors to be designed, built and flown without being manufactured by registered entities, however the pressure vessels must comply with all relevant legislation. Non-commercially manufactured hybrid rocket motors must be flown as Research/Experimental under Section 8 (Research).

Motor classes and requirements are listed in Appendix A.

Considerations:

- No flier may attempt to launch a Rocket using a non-commercial solid Propellant Rocket Motor.
- All solid Propellant Rocket Motors must have been commercially manufactured and meet current legislation, including labelling constraints.
- Commercially manufactured Hybrid Rocket Motors may be used but require a UKRA RSO certified to Level 2 or higher to approve the flight.
- Non-commercial Hybrid Rocket Motors or Liquid Motors are considered Research/Experimental flights and section 8 applies.
- The average thrust of the Rocket Motor(s) must, at all stages in flight, exceed three times the weight of the propelled vehicle. UKRA recommends that the average thrust is between 5 and 10 times the weight of the propelled vehicle.

4.5. Recovery

Rockets must be designed to return all parts safely to the ground so that they may be flown again. Rockets must be designed and built so that the recovery systems are protected from the forces and thermal loads associated with flight.

Electronic or mechanical ejection or air-start systems must be constructed in such a manner as to permit arming and disarming of those systems without affecting the orientation or position of the Rocket.

Particular attention should be paid to:

- Including thermal insulation (e.g. wadding, flameproof materials or pistons) between an explosive ejection system and the recovery devices.
- Ground testing untested ejection systems to confirm adequate and safe performance for in-flight use.
- Assembly, installation and testing of electronic ejection systems.

- Choosing recovery devices appropriate to the expected landing location, for example floatation devices for water landings and high visibility parachutes/streamers for crop landings.
- Specific requirements for Night Flying, noted in section 6.2.2 (Visibility) below.

5. Launch Site

5.1. Site Suitability

Launch Sites should be a suitable open area for launching and recovering Rockets. It must conform to the minimum dimensions laid out in Appendix B. Permission must have been granted by the land-owner or occupier.

Launch Sites must:

- Be more than 5km from the nearest commercial airport or airfield.
- Be more than 1km from any area where distress flares may be used (for example large lakes, mountains or coastal areas) unless prior permission has been granted by the relevant authorities, for example the coast guard or mountain rescue organisation.

5.2. Site Layout

Launch Sites must:

- Offer a method of managing public access to the Launch Area, for example, it must be possible to manage public footpaths in the Launch Area so that launch activities are prevented while footpath traffic is present.
- Offer a method whereby the RSO can advise all personnel on-site of launches, heads-up flights and relevant events.
- Provide visibility for RSOs to validate clear skies prior to flight.
- Offer clear lines of sight between the launch area and the expected recovery areas.
- Offer a clear recovery area both downwind and upwind of the launch area.

5.3. Launch Rails

All Rockets must launch from a launchpad or launch rail which meets the following requirements:

- The Rocket is guided along the entire length of the guide rod or guide rail using an appropriate mounting system (e.g. launch lug or rail button).
- The guide rod or guide rail is long enough for the Rocket to achieve a stable flight speed before any guide device (launch lug or rail button) clears the rail.
- The guide rod or guide rail is rigid enough that the Rocket proceeds up its length without significant flex in the guide at any expected wind speed.
- Steps are taken to protect fliers and spectators from injury, particularly the top of launch rods being able to enter their eyes. Launch rod caps should be considered if the top of the launch rod is below eye level.

- Steps are taken to protect the ground and any supporting launch equipment from the hot gases expelled by the Rocket Motor. A blast deflector should be considered.
- The launch rod or launch rail is within 20 degrees of vertical except in the case of Rocket vehicles obtaining lift through wing surfaces, e.g. boosted gliders.
- Clear of flammable materials, for example dry grass, dry crop, to a radius of three metres.

5.4. Launch Controller

The launch controller must ignite the motors electrically in a manner permitting ignition to occur outside the safe distances in Appendix C.

The launch controller must feature:

- A safety key/firing key which, when removed, prevents ignition.
- A momentary (return to off) launch button which, when released, isolates the ignition circuit.
- Protection against ignition due to misuse, for example:
    - Inadvertent connection of igniter circuits to battery circuits.
    - Connection of igniters to controller while the ignition circuit is live.
- Protection against ignition due to interference, for example:
    - Insulated wires preventing accidental short.
    - Cryptographic or secure authentication for wireless triggers.

5.5. Preparing the site

Launch sessions must only occur with the permission of both the land occupier and any flying clubs normally launching at the Launch Site.

A NOTAM (Notice to Airmen) must be issued if flying may pose a hazard to other airspace users, typically if flights exceed an expected altitude of 120 metres (400 feet) above ground level. NOTAMs should be submitted to the CAA a minimum of 28 days in advance of the launch session. A template NOTAM may be found on the UKRA website.

The launch area, launch rod, launch rails and launch controllers must be prepared according to the requirements in section 5.

5.6. Managing Personnel

The launch organiser and RSO should work together to ensure that all attending personnel can be adequately managed throughout the session. Attention should be paid to:

- Ensuring that the launch area only contains required personnel before, during and immediately after launch. Safe distances in Appendix C must be adhered to.

- Ensuring that spectators do not tamper with, modify, handle or recover rockets without the explicit approval of the flier.
- Ensuring that children are adequately managed by responsible personnel. Special arrangements may need to be made depending on the individual or group requirements.
- Teams associated with group launches, ensuring that the launch area and the launch can be managed safely. Only the minimum necessary number of personnel should be permitted near the rocket for final preparation.

5.7. Emergency Management

5.7.1. Fire Prevention

Rocket Motors inherently pose a fire risk. Launch organisers should plan for both fire prevention (e.g. removing flammable materials from the launch area, wetting dry vegetation) and fire extinguishing facilities (fire buckets, fire extinguishers).

5.7.2. First Aid

First aid kit and personnel familiar with its use must be available and immediately accessible from the Launch Area. Attention should be paid to ensuring that the first aid kit contents are suitable for:

- Injuries associated with the rocket and launch equipment, for example cuts.
- Injuries associated with the site, for example slips and falls.
- Injuries associated with propellants, for example burns, corrosion and eye cleaning.

5.7.3. Emergency Escalation process

Plans should be made to ensure any emergency callout can be made with all relevant information readily available, for example:

- Exact site location and directions.
- Site access requirements.
- Details of affected parties and any specific requirements (e.g. allergies, medical conditions).
- Site contact numbers.

6. Flying

6.1. Launch Area

The RSO is responsible for the Launch Area and has authority over all activities within it. The RSO must explicitly approve all flights and may withhold flight approval at any point should he/she not have confidence that the flight may be undertaken safely and with predictable outcomes.

6.2. Flying Conditions

6.2.1. Airspace

The flier must ensure that the flight does not enter controlled airspace except as permitted by the current Civil Aviation Authority Air Navigation Order. Fliers must review aviation charts, controlled airspace locations and NOTAMs from other airspace users prior to each flying session. Flying clubs and RSOs should consider having these documents readily available for inspection by fliers, members, visitors or officials representing government organisations.

6.2.2. Visibility

Cloud cover must be clear to sufficient altitude so that:

- The Rocket may be recovered safely.
- The Rocket may be launched without posing any risk to aircraft. Rockets launched deliberately into or above the cloud layer must be flown with the safety of other airspace users assured, for example:
    - Radar coverage
    - Air traffic control clearance

Night Flights must not occur unless:

- The Rocket is suitably illuminated over the entire course of the flight including launch, ascent and recovery.
- The flight occurs in an area where the flight cannot be mistaken for a distress flare.

6.2.3. Wind speeds

At wind speeds exceeding 10mph the flier should choose the Rocket Motor carefully to ensure that stable flight is achieved before the Rocket leaves the Launch Rail, particularly paying attention to the possibility of weather-cocking, where the Rocket rotates into the wind due to the wind applying a rotational force through the fins.

Rockets must not be flown in winds exceeding 20mph. UKRA recommends that rockets are not flown in winds exceeding 15mph.

The flier and RSO should each verify the wind speed at the expected flight altitude permits a safe and predictable flight, dispersal and recovery.

6.3. Pre-flight

6.3.1. Rocket

The Rocket must be inspected for condition, integrity and degradation due to storage, transport or age. Attention should be given to all aspects of construction.

Prior to installation on the launch rail the Centre of Gravity of the Rocket should be confirmed to be a minimum of one calibre (body tube diameter) forward of the Centre of Pressure.

6.3.2. Igniters

Igniters for solid propellant Rocket Motors must be installed in the Rocket Motor:

- At a location designated specifically for installation of igniters in motors, usually the launch pad, immediately prior to launch.
- With the Rocket Motor exhaust facing away from personnel and volatile/flammable items/equipment.

Igniters for pyrotechnic ejection or pyrotechnic ignition systems must be installed in the Rocket with all electronic systems unpowered. Electronic ignition circuits must not be powered until the Rocket is either:

- On the launch pad, immediately prior to launch.
- In a test area specifically designated for the purposes of testing pyrotechnic charges.

Ignition of any igniters must not occur except as designated above. In case of abandonment or failure of the launch/test the igniters must be removed from the motors prior to the removal of the Rocket from the designated area.

6.4. Launching

When ready to launch the following process must be observed. Each step is described in further detail in the following sections:

1. Entering the Launch Area
2. Installation of Rocket on Launch Rail
3. Retirement to safe distance
4. Approval for Launch

5. Countdown
6. Launch

6.4.1. Entering the Launch Area

Approval must be obtained from the RSO prior to entering the Launch Area. The RSO is expected to validate the pre-flight checks and deny approval if he/she is not confident that the flight may be undertaken safely and with predictable outcomes.

Children must be accompanied by a responsible adult. The RSO must not be the responsible adult while also on RSO duty.

6.4.2. Installation of Rocket on Launch Rail

Installation of the Rocket on the Launch Rail may occur immediately before or immediately after installation of the igniters in the motor in accordance with the pre-flight conditions. The Rocket must slide easily along the length of the Launch Rail.

The Launch Rail must not be adjusted to an angle beyond 20 degrees from vertical unless the Rocket obtains lift from wing surfaces, for example a boosted glider.

6.4.3. Retirement to safe distance

All persons not required for the launch must leave the Launch Area prior to the launch. Persons required for the launch should retire to the launch controller or to an area directed by the RSO.

6.4.4. Approval for Launch

The RSO has final approval for the launch and must make final weather conditions, airspace and safety checks prior to permitting the launch.

The RSO should decline approval for the launch if they feel that the flier has not taken all reasonable steps to ensure that the rocket lands and may be recovered within the launch site.

6.4.5. Countdown

A clear countdown, audible to all relevant persons, must be made prior to launch. This countdown should start from a count of at least five and be counted at a cadence sufficiently slow for observers to advise the RSO of any areas of concern prior to actual launch.

6.4.6. Launch

The relevant launch controller buttons should be applied promptly after completion of the countdown and released immediately after ignition or after a count of three seconds, whichever occurs sooner. The safety key should be removed as soon as practical after launch.

In case of misfire, failure to ignite, catastrophic motor combustion or other unexpected outcome the safety key must be immediately removed from the launch controller. In case of fire or other event requiring immediate attention, no-one may approach the Rocket except the minimum necessary to resolve the incident. In other circumstances no-one may approach the Rocket before a fixed time has elapsed according to the following conditions:

- In case of catastrophic motor combustion or a Low Power Rocket, a minimum of one minute.
- In all other cases three minutes.

The RSO may, at their discretion, discern that alternative actions may be taken if safety may be affected by waiting for the times above, for example in the case of fire.

In the case of abandonment or failure of the launch for any reason, including those above, only the flier or a flier-nominated representative may approach the Rocket until all onboard electronics are disarmed. The electronics must be disarmed without affecting the orientation or position of the Rocket to avoid accidental triggering of charges or air-start events.

6.5. Recovery

Recovery of the Rocket must not be attempted until the descent is fully complete.

No attempt may be made to recover Rockets landing in dangerous places or places where permission has not been sought to recover the Rocket. Attention must be given to power lines and no flier or recovery team may approach a power line to recover a Rocket entangled in the power line or supporting infrastructure.

Attention should be paid to footfall and vehicle use during recovery. Care should be taken to minimise crop damage, ground erosion and worrying livestock.

Care should be taken to only recover Rockets or their parts if their design and implementation is familiar and well understood. Recovery team members must not attempt to collect Rockets or their parts if unfamiliar with their construction. Instead the Rocket should be left untouched and the location should be identified to the flier or their recovery team.

6.6. Post-flight

Flight events should be noted and understood for future learning. Any unexpected behaviours during flight or recovery should be investigated and discussed to determine the cause.

In the case of adverse behaviour the flier should consider discussing the flight with the RSO, club representatives or UKRA to further understand how to avoid similar incidents.

The RSO should report any unsafe, unexpected, dangerous or undesirable outcomes to the club and/or UKRA as appropriate. Unsafe outcomes should be reported to UKRA at the first available opportunity to direct future improvements to this Safety Code.

7. High Power Rocketry (HPR)

7.1. Requirements

Fliers flying Rockets with a Total Impulse greater than 160 Ns (G-class) must:

- If an individual flier: Follow the UKRA certification process, detailed on the UKRA website: http://www.ukra.org.uk/
- If a team of fliers (e.g. University team): Follow the UKRA Team Project Support process, detailed on the UKRA website: http://www.ukra.org.uk/
- Either:
    - Have already achieved the certification listed in Appendix A (Rocket Motor Impulse Classes) OR
    - Be in the process of attempting the certification listed in Appendix A (Rocket Motor Impulse Classes) as per the certification requirements listed on the UKRA website: http://www.ukra.org.uk/

Fliers flying Rockets with a Total Impulse greater than 10,240 Ns (M-class) using BMFA insurance must follow the UKRA Large Rocket Scheme, detailed on the UKRA website: http://www.ukra.org.uk/

Fliers should note that CAA permission is always required to fly Rockets with a Total Impulse exceeding 10,240 Ns. Details may be found in the CAA ANO regulation 96 (correct at the time of writing) and related documents. UKRA recommends that fliers follow the UKRA Large Rocket Scheme noted above to benefit from the shared knowledge from previous flights, minimise the chance of errors and maximise the chance of the flight being approved.

The RSO for an HPR flight must be certified to a level equal or greater to the flight being attempted and have appropriate proof of this certification, usually the UKRA membership card showing their certification level.

7.2. Documentation

The following documentation must be made available by the flier for inspection by the RSO, site officials or government officials (e.g. the police, CAA):

- Proof of certification level, typically the UKRA membership card, unless attempting level 1 HPR certification.
- Proof of insurance, typically the BMFA membership card.
- Any required motor documentation (e.g. Explosives Certificate, RCA or Registered Store certificate).

7.3. Rocket Construction

HPR fliers are expected to have a good understanding of Rocket construction and to have applied a high construction standard throughout the Rocket build and preparation.

HPR fliers are expected to be able to answer any questions posed to them by the RSO, including details of construction methods, adhesive use, recovery methods, failure modes, stability calculations, expected flight events and likely dispersal during descent and recovery.. The RSO is expected to refuse flight permission if he/she suspects that the flier does not understand the above principles or the Rocket may not be flown safely.

8. Research

Requirements

Rockets matching any of the specified conditions in Section 2 (Applicability) will be considered Research/Experimental flights and this section applies in full. The RSO is expected to refuse flight approval if this process has not been followed.

The flier or team lead must notify the UKRA Safety and Technical committee a minimum of thirty days before the intended flight. Approval must be received from UKRA Safety and Technical before the flight is attempted and this approval must be provided to the RSO in advance of the launch.

To permit approval by UKRA S&T the flier should include:

- Details of the Rocket construction, including the design, construction method, build considerations and recovery strategies.
- Details of the expected flight profile.
- Details of relevant testing and previous flights.
- Details of expected failure modes and safety considerations.

Hybrid Motors and Liquid Engines

Special consideration must be given to the increased risks associated with Rockets containing pressure vessels. UK law applies strict regulations and guidance to pressure vessels and non-commercially manufactured systems must be able to demonstrate compliance with these regulations.

All Research Rocket Motors must have a demonstrable ground testing record to include performance data, expected flight characteristics and expected performance variation.

Additional considerations include:

- Providing a method whereby flight tanks may be pressurised remotely, without a flier entering the Safe Distance.
- Providing a method whereby flight tanks may be depressurised remotely, without a flier entering the Safe Distance.
- Ensuring that pressurised gases are handled correctly, temperature considerations are observed and depressurisation risks (including burns and frostbite) are considered.
- Ensuring that the Rocket and the Rocket Motor are designed and constructed to accommodate the physical characteristics of launch, flight and recovery, including forces, acceleration, vibration, sound barrier pressure waves and temperature variations.

- Providing a safe and proven ignition method.

9. Appendix A: Rocket Motor Impulse Classes

The **Total Impulse** of a **Rocket** or **Rocket Motor** is typically measured in Newton seconds and is calculated as the product of the average thrust (in Newtons) and the duration (in seconds).

Total Impulse may be used in the context of an individual **Rocket Motor** or in the context of a whole rocket. In the latter case the **Total Impulse** of a **Rocket** is the sum of the **Total Impulse** of each individual **Rocket Motor**.

Class	Total Impulse	Comments
A	Up to 2.5 Ns	
B	2.5 - 5 Ns	
C	5 - 10 Ns	
D	10 - 20 Ns	
E	20 - 40 Ns	
F	40 - 80 Ns	
G	80 - 160 Ns	
H	160 - 320 Ns	Level 1 Certification Required
I	320 - 640 Ns	Level 1 Certification Required
J	640 - 1,280 Ns	Level 2 Certification Required
K	1,280 - 2,560 Ns	Level 2 Certification Required
L	2,560 - 5,120 Ns	Level 2 Certification Required
M	5,120 - 10,240 Ns	Level 3 Certification Required
N	10,240 - 20,480 Ns	Large Rocket requiring CAA approval
O	20,480 - 40,960 Ns	Large Rocket requiring CAA approval

10. Appendix B: Launch Site Dimensions

It is important that the launch site is sized appropriately for the motor impulse being used.

The table below lists the minimum site dimensions for each motor impulse class. The distances stated are the diameter of a circle centred at the location of the launch pad. The rocket flight should be planned such that all reasonable steps are taken to ensure that the rocket lands and may be recovered in this area.

For flights with increased safety considerations, the next largest distance must be used after the row associated with the Total Impulse. Examples of such flights where these considerations come into play are:

- The flight involves a boosted glider or winged recovery.
- The flight is considered Research or Experimental.

The site minimum dimension should be the maximum of:

- The distance from the table below, noting the previous statement regarding special flights.
- Half the maximum expected flight altitude of any Rocket to be flown.

Examples:

- An M impulse-class rocket flying to 2,500 feet would require a minimum site dimension of 1492 feet (the greater of the dimension from the table below and half the expected flight altitude).
- A J impulse-class rocket flying to 12,000 feet would require a minimum site dimension of 6,000 feet (2,000 yards, approximately 1.4 miles) being half the expected flight altitude and greater than the distance from the table below.
- An experimental helicopter recovery rocket propelled by motors equivalent to G impulse-class flying to 1,500 feet would require a minimum site dimension of 1,476 feet. As an experimental flight the distance from the ‘H’ impulse-class is taken from the table below.

Site dimension table

Total Impulse (equivalent Impulse Class)	Minimum site dimensions	
	Metric	**Imperial**
Up to 2.5 Ns (A)	30 metres	98 feet / 33 yards
2.5 - 5 Ns (B)	60 metres	197 feet / 66 yards
5 - 10 Ns (C)	120 metres	394 feet / 130 yards
10 - 20 Ns (D)	150 metres	492 feet / 164 yards
20 - 40 Ns (E)	300 metres	984 feet / 328 yards
40 - 80 Ns (F)	300 metres	984 feet / 328 yards
80 - 160 Ns (G)	300 metres	984 feet / 328 yards
160 - 320 Ns (H)	450 metres	1476 feet / 492 yards
320 - 640 Ns (I)	450 metres	1476 feet / 492 yards
640 - 1,280 Ns (J)	450 metres	1476 feet / 492 yards
1,280 - 2,560 Ns (K)	450 metres	1476 feet / 492 yards
2,560 - 5,120 Ns (L)	450 metres	1476 feet / 492 yards
5,120 - 10,240 (M)	450 metres	1476 feet / 492 yards
10,240 - 20,480 Ns (N)	600 metres	1968 feet / 656 yards
20,480 - 40,960 (O)	900 metres	2952 feet / 984 yards

11. Appendix C: Launch Area Safe Distance

The next largest distance in the table must be used where any of the following conditions are met:

- The flight involves a boosted glider or winged recovery.
- The flight is considered Research or Experimental.

At the RSO's discretion the minimum safe distance may be reduced for those required to facilitate the launch of the rocket providing that:

- Safety of the flier, spectators and the public can be assured.
- The distance between the launch rail and anyone not directly involved in the launch is greater than or equal to the distances in the table below.

Safe distance table

Total Impulse (equivalent Impulse Class)	**Safe Distance from launch rail**	
	Single Motor metres (feet)	**Multiple Motors metres (feet)**
Up to 2.5 Ns (A)	2 (7)	3 (10)
2.5 - 10 Ns (B, C)	3 (10)	6 (20)
10 - 20 Ns (D)	5 (16)	10 (33)
20 - 40 Ns (E)	7 (23)	15 (50)
40 - 160 Ns (F, G)	10 (33)	20 (66)
160 - 320 Ns (H)	15 (49)	30 (98)
320 - 1,280 Ns (I, J)	45 (148)	60 (197)
1,280 - 2,560 Ns (K)	60 (197)	90 (295)
2,560 - 10,240 Ns (L, M)	90 (295)	150 (492)
10,240 - 40,960 Ns (N, O)	150 (492)	300 (984)

12. Appendix D: Definitions

Throughout this document terms in bold refer to the definitions listed below.

Term	Definition
Amateur	Carried out for pleasure, leisure without financial gain. See also: **Professional**.
ANO	The Air Navigation Order comprises a series of regulations issued by the **CAA** regulating the use of UK airspace. Specific attention should be paid to articles 96 (Rockets) and 240 (Endangering safety of an aircraft). http://www.legislation.gov.uk/uksi/2016/765/article/96/made http://www.legislation.gov.uk/uksi/2016/765/article/240/made
CAA	Civil Aviation Authority, the organisation with Governmental authority over airspace and aircraft.
CE Mark	The European Conformity mark identifies a product tested by a manufacturer or importer to comply with European regulations.
Centre of Gravity (CoG)	Also known as Centre of Mass. The Centre of Gravity is the point at which weight is evenly dispersed and all sides are in balance. The Centre of Gravity may vary during flight and is often approximated by simulation or mathematical analysis.
Centre of Pressure (CoP)	The point at which the airflow related pressure forces are considered to act. The Centre of Pressure may vary during flight and is often approximated by simulation or mathematical analysis.
High Power Rocket	A **Rocket** other than one meeting the definition of **Model Rocket**. See also: **Small Rocket**, **Large Rocket**.
HSE	The Health and Safety Executive is the government organisation with responsibility for health and safety across all amateur and professional activities.
Hybrid Rocket Motor	A **Rocket Motor** utilising fuel and oxidiser in different states of matter, typically a solid fuel with a liquid or gaseous oxidiser.
Large Rocket	A **High Power Rocket** whose **Total Impulse** is greater or equal to 10,240 Newton Seconds.
Launch Area	The open area within the **Safe Distance** of the launch rails.
Launch Site	An open area suitable for the launching and recovery of **Rockets**.

	The **Launch Site** should conform to the minimum dimensions in **Appendix B**. A **Launch Site** may contain multiple **Launch Areas**.
Low Power Rocket	A **Rocket** where the **Total Impulse** is less than 40 Ns.
Mid Power Rocket	A **Rocket** where the **Total Impulse** is greater or equal to 40Ns but less than 160 Ns.
Model Rocket	A **Rocket** meeting all of the following definitions: ● The total **Propellant** mass is less than 125 grams. ● The **Total Impulse** is less than 160 Newton Seconds ● No aerodynamic components are made of metal.
NOTAM	A NOTAM (Notice To Airmen) is filed with the **CAA** to identify potential hazards in UK airspace. In rocketry a NOTAM is issued to advise pilots to avoid the airspace around a **Launch Site**. A NOTAM is not an entitlement to utilise or reserve airspace and fliers must consider other airspace users at all times.
Professional	Carried out for financial gain or return. See also: **Amateur**, Definition of **Work** in the **CAA ANO**.
Propellant	The combination of fuel and oxidiser within the **Rocket Motor**, the reaction of which causes the expulsion of exhaust gases, propelling the **Rocket** forward.
Range Safety Officer	The individual with responsibility for a **Launch Area** and approval of **Rocket** launches.
Rocket	A vehicle propelled in flight by a **Rocket Motor**, including any parts thereof which separate before, during or after flight.
Rocket Motor (also Motor)	The device which propels any rocket vehicle or part thereof by ejecting expanding gases from self contained **Propellant** and not dependent on the intake of outside substances, whether utilizing solid propellant, liquid propellant, gaseous propellant or any combination of each. See also: **Hybrid Rocket Motor**, **Rocket Motor Class**
Rocket Motor Class	A single-letter label given to **Total Impulse** to indicate the overall thrust output of a **Rocket Motor**. See also: **Appendix A**.
Safe Distance	The minimum distance from the launch rail where persons not required for the launch must remain. The area within this distance is the **Launch Area**. See also: **Appendix C**.

Safety and Technical Committee (also S&T)	The specialist sub-committee of **UKRA** dealing with matters pertaining to Safety or Technical issues.
Small Rocket	A **High Power Rocket** whose **Total Impulse** is less than 10,240 Newton Seconds.
Total Impulse	The total thrust output of all **Rocket Motors** in the **Rocket** measured as the product of the thrust and duration of that thrust. For example a **Rocket Motor** with a **Total Impulse** of 20 Ns may produce one Newton for twenty seconds, ten Newtons for two seconds or forty Newtons for half a second. See also: **Rocket Motor Class**.
UKRA	United Kingdom Rocketry Association, a body of volunteers working to improve Rocketry for all in the UK. UKRA represents the rocketry community at a national level, striving to improve working relationships with the **CAA**, **HSE** and local police forces.

13. Revision History

Revision	Date	Changes
7.0	June 2019 through June 2020	Moved document authoring to Google Docs. Moved revision history to end of document. Removed publishing comment from Revision History section. Promoted Definitions to its own section, outside General Rules. Added additional definitions and reordered definitions to alphabetical order. Updated definitions. Revised Model Rocket and High Power Rocket to simpler definitions. Added definition for Launch Area and Range Safety Officer. Added Applicability section. Moved distance tables to Appendices. Removed duplication and simplified the wording of General Rules. Placed the Law section first and referenced the UKRA website. Consolidated RSO guidance into single RSO section. Consolidated rocketry construction into single construction section. Moved Payload section to Rocket Construction and updated for active guidance as per CAA advice. Consolidated Rocket sections into one Rocket section and Launch Equipment into Launch Site section. Created a specific Flying section for content related to flight day. Removed the visual rule, consolidating intent into other sections. Added emergency management sections. Consolidated flying conditions into new section comprising visibility, wind conditions and night flying. Consolidated controlled airspace and aircraft sections into Flying section. Moved flight sections into clear Pre-flight, Flight and Post-flight sections. Added recommendation for Centre of Pressure to be marked on the Rocket. Consolidated HPR sections into single HPR section.

		Consolidated Research section into more concise guidelines. Added references to updated CAA ANO regulations. Included iterative revisions suggested by UKRA Council. Clarified RSO responsibilities for pre-flight checks. Significant overhaul and redefinitions of distance tables.
6.1	January 2018	Addition to section 3.2, clarifying the requirement for, responsibilities of and who should be an RSO.
6.0	September 2017	Amendment to multiple sections, reference to UKRA insurance changed to BMFA insurance Amendment to section 1.3, ANO sections pertinent to Rocketry Amendments to section 2.1.1, guidance on Rocket construction materials Amendment to section 2.2.1, clarification of rules for high impulse flights Simplification of section 2.3.2, hybrid ignition systems Minor clarification in section 2.6, pad base moment. Amendment to section 3.2, emphasizing the authority of the RSO Addition to section 4.3, making safe electronic devices in the event of a misfire Addition to section 5.1, definitions of research projects New Section 7 Special Projects Revision of Annex B, revised ANO 2016
5.1	January 2010	Amended to show revised ANO
5.0	March 2008	General update to style and layout. Rationalized the section numbering scheme, for easier reference by section. Significant updates to sections 2.1.9, 2.2.1, 2.2.3, 2.3.1, and 2.3.2 Additions to sections 1.1, 2.1.4,2.2.2.1, 2.6, 4.5 and 4.11. Addition of sections 2.2.2.2, 2.2.2.3,5.2.6.2 and 6.2 item 11 Amended Section 5 to read “Research”Amended 3.4 to “appropriate” scale maps, to enable additional detailed scale mapping sources Published as Rev 5.0
4.21	February 2004	Changed model and high power rocket definitions.
1.0-4.2	June 1998 - August 2003	No revision history available.