UPDATED AIR POWER RULES PROJECT

Alan Watson Forster

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Aims

This project aims to produce updated rules for *Air Power*.

Context

At the time of writing, there are several sets of rules available:

- The original *Air Superiority* and *Air Strike* rules from 1987, with extensions in *Desert Falcons* and *Eagles of the Gulf*. I understand that a limited number of copies of *Air Superiority* are still available. Nevertheless, these rules are considered obsolete.
- The first-edition *Air Power* rules, with official errata, published in 1992 with *The Speed of Heat*. There are two sets of errata: one page provided with *The Speed of Heat* and four pages published in *Air Power Journal* #24. Again, I understand that a very limited number of copies are still available.
- Several proposals for second-edition rules outlined by J.D. Webster mainly in *Air Power Journal* during the 1990s.
- The second-edition *Air Power* rules, edited by Malcolm Pipes and published in 2022 on the airpower email group site. The current text is labeled "v2.4".

Rationale

There is already a set of second-edition rules. Why is the project necessary?

- The second-edition rules do not fully incorporate previous errata, in particular Felix Hack's errata published by JD Webster in *Air Power Journal* 36, and have certain errors.
- Where they incorporate errata, it is often inserted literally rather than changing the text to include the sense of the errata.
- There is no traceability. Changes have been made, but there is no way to see what changed or why.
- There are no internal hyperlinks for cross references.
- Many of the diagrams have not been fixed.
- I think it would be helpful to incorporate diagrams and tables into the text (and also have them on the play-aid sheets). With printed rules, this separation reduced costs and, to a large degree, was more convenient. When viewed on the screen, these considerations are different.
- The text needs copy editing and, in certain places, could benefit from being rewritten or perhaps reorganized.
- There are few examples or explanations. Indeed, there is little effort to distinguish examples or explanations in the original text.
- The text still refers to pilots, crew, and players using masculine pronouns. That was understandable when the first-edition rules were written, but nevertheless it needs correcting.

Versions

I use "versions" to distinguish my efforts from the other "editions." There are several versions of the rules and play aids, each based on the previous one.

- Version 1A corresponds to the original first-edition rules without the official errata.
- Version 1B incorporates the errata from authoritative sources, including the pubished errata, statements by J.D. Webster, and Felix Hack's article in *Air Power Journal* 36.
- Version 1C has corrected and redrawn diagrams and incorporates these into the body of the text in addition to the play aid sheets.
- Version 2A incorporates second-edition changes from *Air Power Journal*, email messages from JD Webster, and Malcolm Pipe's second-edition rules. Not all changes have been adopted since some seem to have issues.
- Version 2B has additional minor non-authoritative changes to cover aspects missing from version 2A.
- Version 3A has major non-authoritative changes.
- Version 3B is a rewrite. Certain rules have been rewritten for clarity and conciseness. Parts of the text have been reorganized. However, the meaning of the version 3B rules should be the same as the 3A rules.

Having multiple versions allow us to more easily review changes. For example, the changes in 1B and 2A come from authoritative sources, but the changes in 2B and 3A are from non-authoritative sources.

Which version should you use?

- If you wish to play with second-edition rules with changes only from authoritative sources, I would suggest using version 2A. However, you will miss out on the minor, but non-authoritative, additions in version 2B that cover aspects missing from version 2A.
- If you wish to play with second-edition rules and are prepared to accept non-authoritative minor additions, I would suggest using version 2B.
- I use version 3B, as I consider it has significant improvements over 2B especially in turn drag, sighting in adverse weather, and vertical arcs. However, these changes are neither minor nor authoritative.

Products

I produce two PDF files for each version, one showing the changes with respect to the previous version (which aids

in understanding the origin of the changes and evolution of the rules) and one clean version (which is suitable for actual play).

Rules Changes

This section describes the rules changes between different versions.

Version 1B

Version 1B is an update to the text of version 1A according to authoritative sources. There are changes to the sense of some rules compared to version 1A, but the changes to the text are minimal. It incorporates the following errata:

– **Change: 1B-credits.**

  Additions to the credits.

– **Change: 1B-tsoh-errata.**

  All changes in the single sheet of errata included with TSOH.

– **Change: 1B-apj-22-damage-tables.**

  The optional advanced damage tables from APJ 22.

– **Change: 1B-original-play-aids.**

  All changes to the rules to agree with the original play aids.

– **Change: 1B-apj-23-errata.**

  All changes in the four sheets of errata published in APJ 23.

– **Change: 1B-apj-24-play-aids.**

  All changes in the revised play aids published in APJ 24.

– **Change: 1B-apj-36-errata.**

  All changes in Felix Hack's list of errata published in APJ 36, except for the change to sustained turning being assessed per 30 degrees of facing change, which was later clarified as a second-edition change.

– **Change: 1B-apj-10-qa.**

– **Change: 1B-apj-20-qa.**

– **Change: 1B-apj-21-qa.**

– **Change: 1B-apj-22-qa.**

– **Change: 1B-apj-23-qa.**

– **Change: 1B-apj-25-qa.**

– **Change: 1B-apj-26-qa.**

– **Change: 1B-apj-27-qa.**

– **Change: 1B-apj-28-qa.**

– **Change: 1B-apj-30-qa.**

– **Change: 1B-apj-34-qa.**

– **Change: 1B-apj-35-qa.**

– **Change: 1B-apj-37-qa.**

– **Change: 1B-apj-38-qa.**

– **Change: 1B-apj-39-qa.**

  Changes and clarifications from JD Webster's Q&A articles in *Air Power Journal* 10, 20, 21, 22, 23, 25, 26, 27, 28, 30, 34, 35, 37, 38, and 39.

– **Change: 1B-tailing.**

  A correction to the rule on tailing following an email message by JD Webster to the airpower group.

– **Change: 1B-missile-launch-speed.**

  I have specified that a missile's start speed on its first game turn of flight is based on the launching aircraft's start speed on the game turn of launch. This was confirmed by Tony Valle in an email message to the airpower group.

Version 1C

Version 1C incorporates the following changes. There should be no changes to the sense of the rules compared to version 1B.

– **Change: 1C-credits.**

  Additions to the credits.

– **Change: 1C-figures.**

  All figures have been redrawn.

  Figures 2 (the game map), 6 (level flight), 11 (angle-off on a hexside) have been corrected according to the comments in corresponding the errata incorporated in 1B. Figure 12 (SSGT) now shows a range of 6 hexes. Figure 12 (Genie scatter) now shows the scatter for a Genie centered on a hex and pointing to a hex corner.

  All figures have been incorporated into the body of the rules. Certain figures also continue to appear in the play aids.

  Reference to figures now follow the pattern "Figure 1" rather than "Angle-Off Diagrams".

– **Change: 1C-tables.**

  All tables have been have been incorporated into the body of the rules and also appear in the play aids.

  Reference to tables now follow the pattern "Table 1" rather than "IRM Seeker Head Table".

– **Change: 1C-cover.**

  The rule have a cover featuring a USN photograph of an A-7A. This appears to have been the inspiration for the line drawing on the cover of the *The Speed of Heat* rules.

Version 2A

Version 2A incorporates the following changes. There are changes to the sense of the rules compared to version 1C,

but these changes come from authoritative sources. The changes to the text are minimal.

– **Change: 2A-credits.**

Additions to the credits.

– **Change: 2A-adc.**

The first-edition F-4B/C ADC is replaced with the second-edition F-4F ADC from *Air Power Journal* 44.Also, an appendix gives instructions for converting ADCs from first-edition to second-edition.

– **Change: 2A-idle.**

An aircraft that selects idle power no longer has its start speed reduced. Instead, the aircraft incurs DPs for normal power plus the additional DPs listed in the ADC. This change is taken from the Origins rules in *Air Power Journal* 39, 41, 44, and 53 and the v2.4 rules.

– **Change: 2A-spbr.**

Similarly, an aircraft that uses speedbrakes no longer loses FPs. Instead, the aircraft incurs DPs up to the value shown in the ADC. If the aircraft is supersonic, the maximum is increased by 1 DP. This change is taken from the Origins rules in *Air Power Journal* 39, 41, 44, and 53 and the v2.4 rules.

– **Change: 2A-fp-to-dp.**

The conversion factor from FPs to DPs for the new idle power and speedbrake rules is 2. This change appears in the Origins rules in *Air Power Journal* 41 and the v2.4 rules.

– **Change: 2A-supersonic-flame-out.**

An aircraft that selects idle or military power at supersonic speeds automatically and immediately suffers a flame-out. This change appears the 1995 GEnie post by JD Webster and the v2.4 rules.

– **Change: 2A-cruise.**

The cruise speed in the ADC is for CL configuration and is 0.5 less for 1/2 configuration and 1.0 less for DT configuration. This change was initially suggested by Guy Acala in *Air Power Journal* 24, and appears in the Origins rules in *Air Power Journal* 44 and 53 and the v2.4 rules.

– **Change: 2A-snap.**

Aircraft and missiles can no longer execute snap turns. This change appears in the 1995 GEnie post by JD Webster, the Origins rules in *Air Power Journal* 41, and the v2.4 rules.

– **Change: 2A-sustained.**

Sustained turning penalties are now assessed per 30 degrees of facing change for second and subsequent facing changes. This change was included by Felix Hack in the errata in *Air Power Journal* 36 but was clarified as applying to 2nd edition rules by JD Webster in the *Air Power Journal* 38 QA. It was included in the Origins rules in *Air Power Journal* 39, 44, and 53 and the v2.4 rules.

For aircraft with low and high bleed rates, the sustained turning penalties are 0.5 and 1.5 DP. This change was included in the "Props against Jets" article in *Air Power Journal* 32 and the Origins rules *Air Power Journal* 39, 44, and 53 and the v2.4 rules.

– **Change: 2A-zoom-climbs.**

The deceleration for zoom climbs (and sustained climbs that gain more than the CC) is now always 1.0 DP per level. See the 1995 GEnie post by JD Webster, the Origins rules in *Air Power Journal* 44 and 53, and the v2.4 rules.

– **Change: 2A-vertical-climbs.**

The deceleration for vertical climbs is now always 1.5 DP per level. See the 1995 GEnie post by JD Webster, the Origins rules in *Air Power Journal* 44 and 53, and the v2.4 rules.

– **Change: 2A-super-climbs.**

Aircraft with a CC of 6.0 or more in a ZC or SC can use one of their VFPs to climb three levels. This change appeared in the 1995 GEnie post by JD Webster and the v2.4 rules.

– **Change: 2A-steep-dives.**

The acceleration for steep dives is now always 1.0 AP per level. This change appeared in the 1995 GEnie post by JD Webster, the Origins rules in *Air Power Journal* 44 and 53, and the v2.4 rules.

– **Change: 2A-unloaded-dives.**

The unloaded dives rule is changed to follow the Origins rules in *Air Power Journal* 44 and 53 and the v2.4 rules.

The proposed wording is not completely clear, and in an attempt to state the rule more clearly, I have added that the VFPs are unloaded, too.

Two things cause me to pause. First, with this rule, unloaded dives do not give any advantage over steep dives in terms of acceleration of horizontal distance. Indeed, a steep dive is better since one VFP can lose two altitude levels, whereas in an unloaded dive, each VFP can only lose one altitude level. Second, the rule appears to state that unloaded dives are a form of level flight, in which case other rules need modifying (e.g., an aircraft cannot recover from a vertical dive into an unloaded dive, and unloaded dives do not count as diving for barrel rolls). If unloaded dives are a form of level flight, treating them separately from diving flight would probably be better.

– **Change: 2A-missile-sighting.**

The sighting rules are changed so that attempts to sight missiles come before attempts to sight aircraft, and the modifiers are changed. This change appeared in the Origins rules in *Air Power Journal* 44 and 53.

The Origins rules mention that missiles launched from sighted aircraft are no longer sighted, but I can't find

this in the original rules.

– **Change: 2A-irsts-c.**

IRSTS-C, from the v2.4 rules, is added.

– **Change: 2A-advantage.**

An aircraft in a vertical climb may disadvantage aircraft at the same level or lower. This change appeared in the Origins rules in *Air Power Journal* 39, 41, 44, and 53 and the v2.4 rules.

– **Change: 2A-tailing.**

Complete a sentence in the rule on tailing: No more than three aircraf *tmay be part of a multi- aircraft tailing*. This change appeared in the v2.4 rules.

– **Change: 2A-roll-preparatory-fps.**

Lag and displacement rolls now require preparatory FPs equal to 1/3 of the aircraft's speed (rounded down). The preparatory FPs may be HFPs or VFPs. These change appeared in the 1995 GEnie post by JD Webster and the v2.4 rules.

– **Change: 2A-high-aoa-maneuvers.**

I have added high AoA maneuvers from the v2.4 rules.

– **Change: 2A-missile-launch-modifiers.**

The modifiers for being a combat hero and tactics master are now cummulative (i.e., a pilot who is both gets a −2 modifier). This change appeared in the tables for the v2.4 rules.

– **Change: 2A-missile-launch-failure.**

The missile launch rules are changed so that if the launch roll fails by exactly one and is not an unmodified ten, the missile fails to launch but remains on the rail and can be used in the future. This change appeared in the Origins rules in *Air Power Journal* 39, 31, 44 and 53.

– **Change: 2A-missile-flight.**

Air-to-air missiles always move before their target. This change appeared in the Origins rules in *Air Power Journal* 44 and 53.

– **Change: 2A-missile-attacks.**

Missile attacks occur when the missile has the same position and altitude as the target or when it has the same altitude, at least one FP left in its proportional move, and the target is one of the seven positions immediately in front of the missile. This change appeared in the Origins rules in *Air Power Journal* 44 and 53.

– **Change: 2A-missile-speed.**

The missile speed attenuation factors are changed. In all cases, they now increase or stay the same with time, which makes physical sense. These changes appeared in the v2.4 tables.

– **Change: 2A-ew-coverage.**

RWR-A now detects air-to-air target illumination, not air-to-air locks. RWR-B can no longer detect VF FCR. These changes appear in the v2.4 tables.

– **Change: 2A-identifying-at-night.**

Identifying an aircraft at night requires matching its position, facing, and speed. This appears in the v1 sheets, but not in the v1 rules.

The rule for pylon drag (suggested originally by Mark Bovankovich in *Air Power Journal* 18 and adopted in the Origins rules in *Air Power Journal* 41, 44, and 53) is not incorporated simply because applying it uniformly would require extensive research and modifications to almost all ADCs.

Version 2B

Version 2B contains unauthoritaive minor changes.

– **Change: 2B-credits.**

Additions to the credits.

– **Change: 2B-missile-counters.**

I have explicitly stated that each missile counter represents a single missile.

– **Change: 2B-directions.**

ENE, ESE, WSW, and WNW are used in preference to NE, SE, SW, and NW. The original directions fall evenly between two 30° facings, whereas the new ones are unambiguously closer to one.

– **Change: 2B-stacking.**

Collisions are only possible if the aircraft are at the same altitude. They are also possible if four or more aircraft are stacked at the same altitude, even if they are in a close formation.

– **Change: 2B-collisions.**

Potential collisions from head-on attacks are resolved after the attack. Other collisions are resolved at the end of the flight phase.

– **Change: 2B-range.**

I have written a rule to clarify how to calculate range when counters are on hex sides. The new rule gives the correct result, for example, when two counters are on hex sides on the opposite sides of a hex.

– **Change: 2B-closeness.**

I have defined closeness in terms of range. This is important since it is possible to define closeness in other terms, for example, taking into account half hexes and odd altitude level differences.

– **Change: 2B-fractions-of-half.**

We sometimes need to take 1/3 or 2/3 of 0.5 in order to determine the reduced thrust at high altitude. I have added appropriate entries to the fractions table.

– **Change: 2B-ground-fac-marking.**

The text of the original rules states that ground FACs mark targets in the AAA planning phase. This phase does not exist. The extended sequence of play indicates

that this occurs during the visual sighting phase. I have changed the text of the rules to match this.

– **Change: 2B-ra-speed-limits.**

RA aircraft at their maximum or dive speed, as appropriate, may only carry forward 1.0 APs.

– **Change: 2B-military.**

Aircraft can select 0.0 APs when using military power. This gives no acceleration, but allows them to maintain a steady speed above cruise speed

– **Change: 2B-propeller-aircraft.**

I've added rules for the HT and FT settings. The only difference is the fuel consumption. I've also noted that propeller aircraft never suffer flame outs.

– **Change: 2B-raa-fp-carry.**

RAA aircraft can carry up to 1.0 APs.

– **Change: 2B-when-supersonic.**

Purposes other than turns or maneuvers, an aircraft is supersonic if its speed is greater than or equal to the M1 speed in the altitude band in which it started the game turn.

– **Change: 2B-stall-recovery.**

Aircraft recover from a stall to a wings-level attitude.

– **Change: 2B-departures.**

Aircraft lose any carried APs or DPs when they recover from departure.

– **Change: 2B-idle-after-relight.**

A relit engine is considered to be in idle power. This is important if the engine does not have RPR and AB is selected on the next game turn.

– **Change: 2B-pssm-maneuvering-departures.**

A PSSM aircraft that is supersonic and is carrying a prohibited turn suffers a maneuvering departure. This follows the consensus on the Air Power mailing list.

– **Change: 2B-low.**

The low altitude band extends down to level 0, to account for aircraft at level 0 in TFF.

– **Change: 2B-steep-climb.**

An SC must use at least one VFP.

– **Change: 2B-unloaded-dives.**

The UD rules in version 2A gives no advantage over an SD. I have changed the rule so that all FPs are HFPs, one altitude level is lost if half of the FPs are spent unloaded, and two if all are spent unloaded. This gives one additional HFP over an otherwise similar SD.

– **Change: 2B-free-descent.**

After a VC, an aircraft in level flight must expend 1/3 of its FPs (not speed) before taking a free descent. This is for consistency with other similar limits on flight, which are in terms of FPs.

– **Change: 2B-half-vfps.**

The rules in section 8.4 on half VFPs seem to be incompatible with the rules in 5.4. Perhaps they are left over from when speedbrakes eliminated FPs? I have deleted this rule.

– **Change: 2B-recovery.**

I have changed the rules for recovery for ET turns to be that the aircraft must not turn at the ET rate and must not prepare for or execute rolling maneuvers. This allows slides and eliminates the potentially confusing reference to being wings level.

– **Change: 2B-vertical-attacks.**

If an aircraft has not yet moved, use its flight type from the previous turn for determining the vertical attack modifier.

– **Change: 2B-head-on-attacks.**

I have changed the rule for head-on attacks to include all of the prerequisites except sighting. (If you are being fired at, you will probably notice.) A head-on attack and any response are resolved simultaneously. If the target has not moved, its flight type from the previous game turn is used to determine vertical limits and same-location vertical modifiers.

– **Change: 2B-angle-off-on-hex-side.**

I have changed the angle-off diagram for an aircraft on a hex side so that the boundaries between the arcs radiate from the aircraft. The previous version makes sense in the context of the Genie scatter diagram, where one wants the lines to trace valid locations, but not for simply determining geometry.

– **Change: 2B-rocket-restrictions.**

I have applied the errata to the restrictions to rocket attacks on aircraft at different altitudes to those applied to gun attacks ("An aircraft *in level flight* may fire at a target in another hex only if it is at the same altitude level or at an adjacent altitude level").

– **Change: 2B-rocket-modifiers.**

The TSOH sheets say all gun attack modifiers apply to rocket attacks, but the TSOH rules after APJ 23 errata exclude snap shots (obviously) and damage. I am going to include damage, for simplicity.

– **Change: 2B-optional-damage-tables.**

The actual damage (and not the cumulative damage) is used to determine the appropriate section of the optional damage table.

– **Change: 2B-sighting-higher.**

The TSOH errata are slightly inconsistent on whether the rule that four levels of altitude count as one hex of range when sighting a higher target applies just to aircraft (page 2) or also to missiles (page 3) and whether it only applies in daylight (page 2) or all of the time. I assume it applies to both aircraft and missiles, but only in daylight.

– **Change: 2B-sighting-detections.**

The version 1A rules give a −1 modifier for a RWR detection, but not other types of detections. In 2B this is changed to be a −1 modifier for any type of detection or lock-on.

– **Change: 2B-sighting-and-hud.**

The version 1A rules give a −1 modifier for an IRSTS lock-on and HUD interface technology, but not for a radar lock-on. In 2B this is changed to be a −1 modifier for any type of lock-on with HUD interface technology.

– **Change: 2B-sighting-and-engaging-missiles.**

The TSOH rules give requirements for engaging missiles include the missile being sighted (a) by the target when the missile starts its move or (b) by a friendly aircraft when the defender starts its move. However, the decision to engage or not occurs in the aircraft decisions phase, not the flight phase. I have changed both requirements to be "in the aircraft decisions phase."

– **Change: 2B-sighting-and-pre-emption.**

The sighting restrictions in the original rules state that a defender can pre-empt a moving aircraft if both are sighted by a third aircraft at the start of the *defender's* movement. I have changed this to the start of the *attacker's* movement.

– **Change: 2B-padlocking-ground-units.**

Aircraft can padlock ground units.

– **Change: 2B-vas-identification.**

VAS can only be used for identification in the 180°+ arc.

– **Change: 2B-vas-and-padlocks.**

If VAS is used, then the pilot may not padlock, but other crew members can still padlock.

– **Change: 2B-irsts-c.**

IRSTS-C may attempt to lock on to any six detected targets, not just the closest. IRSTS-C allows IR Uncage on tracked targets, like IRSTS-B.

– **Change: 2B-irsts.**

IRSTS detections are lost if any lock-on succeeds (i.e., IRSTS does not have a capability similar to TWS.) IRSTS detections and lock-ons are maintained provided the target satisfies the arc and range requirements at the start of the radar phase and, for single pilot aircraft, provided the pilot does not use radar.

– **Change: 2B-same-location-advantage.**

Change 1B-apj-23-errata added that aircraft "in the same hex" do not have any effect on the other's advantage. I have changed "hex" to "map location" to include hex sides.

– **Change: 2B-preemptions.**

I have explicitly added that a preempting aircraft may not itself be preempted. There is no point, since preempting aircraft cannot make gun attacks, but making this statement is clearer.

– **Change: 2B-limited-arcs.**

I changed the limited arcs to be consistent with each other. See the discussion in the airpower.io group starting on 28 February 2024.

– **Change: 2B-maneuver-consecutive.**

I have added a statement that FPs for maneuvers must be consecutive.

– **Change: 2B-maneuver-carry.**

I have added a statement that preparatory FPs for maneuvers can be carried from one turn to the next.

– **Change: 2B-additional-HFPs-for-slides.**

I have added the statement that additional preparatory FPs for slides must be HFPs.

– **Change: 2B-slides-VFPs.**

I have added that the use of a VFP implicitly aborts a slide maneuver.

– **Change: 2B-viff-vertical-pitch.**

I have added that when a VIFF vertical pitch is used to enter a vertical dive from a vertical climb, all of the HFPs must be used before any VFPs. This parallels the requirement for using a HRD to enter a vertical dive from a zoom or sustained climb.

– **Change: 2B-missile-launch-modifiers.**

In the missile launch modifier table, I have changed the launch modifier for a critically damaged aiircraft from +2 to +3 to match the damage tables.

– **Change: 2B-launch-restrictions.**

I have changed the restriction on missile launches from "firing guns during its last FP" to "firing guns or rockets after its last FP."

– **Change: 2B-follow-up-missiles.**

I have slightly changed how the FPs regained by a follow-on missile are assigned. I have stated that they are added to the initial complete proportional segments rather than the initial proportional segments. This is relevant when the missile has a life of only one game turn; we do not want an additional FP added to the incomplete proportional moves with the launch delay.

– **Change: 2B-missile-launch-speed.**

The aircraft speed used to determine a missile's initial speed is its end speed on the turn of launch.

– **Change: 2B-irm-vertical-fov.**

I have added that the vertical limits for the limited, 180°+, and 150°+ arcs are used according to the horizontal field-of-view.

– **Change: 2B-irm-envelopes.**

The rules on out-of-envelope IRM launches state that type A seekers may be launched at "large" targets, but I have changed this to "not large" targets (those with a visibility of less than 10), as this makes more sense from the context.

– **Change: 2B-radar-requirements.**

I have changed the requirement for radar work from "made an air to air gun attack" to "made an air to air gun or rocket attack".

– **Change: 2B-limited-look-down.**

In the first edition rules, are two incompatible statements on the capabilities of radar with of limited look-down. Section 16.3 states that they can potentially detect aircraft from levels 5 to 10 from above provided the target is closer to the radar than to the ground. Section 16.4 states that they can do this from levels 2 to 10. I have adopted the latter.

– **Change: 2B-declaring-special-radar-modes.**

I have changed the text that states that boresight and auto-track modes are declared "when an aircraft begins its flight" to "in the aircraft decisions phase" (following the expanded sequence of play).

– **Change: 2B-auto-track-selection.**

I have added that a visually sighted aircraft may be selected for detection in auto-track mode of a 7− (in accordance with the charts). If the roll fails, no detection occurs.

– **Change: 2B-flight-type-disorientation.**

I have changed the moment at which disorientation is determined for risky flight types from the end of the game turn to the end of flight. This allows disorientation to interfere with missile launches and radar work.

– **Change: 2B-shot-down-combat-hero.**

I have clarified that all members of a shot-down combat hero's *original* formation suffer a −1 modifier to their initiative.

– **Change: 2B-disorientation-fbw-modifier.**

The FBW modifier for recovering from departed flight should not apply to disoriented flight.

– **Change: 2B-gloc-bail-out.**

Some propellor-driven fighters can ET and hence cause GLOC, but do not have ejection seats. I have added that a crewmember suffering GLOC cannot bail out.

– **Change: 2B-undamaged-egress.**

GLOC or disoriented flight may cause a crew to attempt to egress an undamaged aircraft. I have treated an undamaged aircraft the same as an aircraft with L or 2L damage.

– **Change: 2B-ajms.**

The AJM rating (not the BJM rating) is used for jamming rolls with AJMs.

– **Change: 2B-infrared-jammers.**

I have added a rule on infrared jammers. These appear as external stores in *The Speed of Heat*.

– **Change: 2B-merging-cloud-layers.**

Two dense layers that overlap or are adjacent are merged. A stratus layer that overlaps with a dense layer (but not one that is adjacent) is ignored.

– **Change: 2B-stratus.**

Aircraft and ground units may not visually sight, use VAS, use IRSTS, use TV/IR Optics, use Night IR sights, launch IRMs (even with radar assist), launch IR SAMs, launch or track OG/LG SAMs, use laser designators, or use laser spots on targets on the opposite side of stratus cloud layers. Also, the requirements on IRM and IR SAM tracking concerning stratus cloud layers apply only at the end of the missile's proportional move and also apply to OG/LG SAMs.

– **Change: 2B-generating-night-conditions.**

I have added a simple means to determine randomly if a scenario occurs at night. Stating this explicitly in the scenario notes is probably a more satisfactory approach.

– **Change: 2B-aaa-sun-clutter.**

AAA units stacked with a FCR or with an integrated W-type FCR are not penalized for firing when in the Sun clutter of their target.

– **Change: 2B-contrails-at-night.**

Missiles, as well as aircraft, that are contrailing and below the highest cloud layer can also be sighted to a range of 6. In both cases, sighting is automatic.

– **Change: 2B-tvir-optics.**

Haze does not reduce the sighting range for TV/IR optics or OPs. They may be used during the day (to see through haze) and at night.

– **Change: 2B-radar-bombing.**

The navigation range (or half the air-to-air search range) is used for the detection range. The attack range (or half the air-to-air tracking range) is used for the tracking range. I have added a procedure for lock-ons. I have added that a radar cannot simultaneously be used in the air-to-ground mode and air-to-air mode, and detections and tracks are lost when it switches from one mode to the other. I apply the same restrictions to the use of air-to-ground radar as air-to-air radar in normal mode (e.g., pilot-only aircraft cannot search if they used a HT or more).

Version 3A

Version 3A contains unauthoritaive major changes.

– **Change: 3A-credits.**

Additions to the credits.

– **Change: 3A-same-hex-arcs.**

For gun attacks, the arc at the same location is the same as if the attacker were to be moved backwards one hex.

– **Change: 3A-horizontal-arcs.**

The rules for disambiguating the arc for missile attacks has been changed (to consider first relative speed and then choose the wider arc).

The rules for borderline cases for missile launch requirements and IRM target aspect requirements have been clarified to match those for missile attacks.

– **Change: 3A-combined-arcs.**

I have added combined (horizontal and vertical) arcs to the new chapter on ranges and arcs. The rule is adapted from Tony Valle's proposal in APJ 39.

– **Change: 3A-limited-arcs.**

The description of limited arcs has been moved into the new chapter on ranges and arcs.

– **Change: 3A-AP-carry-at-speed-limits.**

Aircraft whose speed is equal to their maximum speed or maximum dive speed carry no APs forward. Aircraft that suffer a fadeback carry neither APs not DPs forward.

– **Change: 3A-speedbrakes.**

DPs from speedbrakes must be chosen at the start of flight, just like APs from engine thrust.

– **Change: 3A-turns.**

Each turn now gives DPs when it is declared. Sustained turns are gone.

The turn drag given by ADCs for earlier versions of these rules can be updated as follows: take half of the old turn drag and add 0.5 for normal aircraft, 0.25 for aircraft with the low bleed rate (LBR) property, or 0.75 for aircraft with the high bleed rate (HBR) property. This is equivalent to averaging the old turn drag over two turns.

Subsonic EZ turns still have zero drag, since at most speeds an aircraft can only execute at most one per game turn and so would not accrue the old penalty for sustained turns.

We average the old DPs per game turn for supersonic turns over two turns.

– **Change: 3A-rolls.**

Each roll now gives the DPs in the ADC when it is declared. The additional drag for more than one roll is gone.

The turn drag for rolls is the same as on the previous version. This is somewhat inconsistent with the approach taken for turns, were we average the old turn drag over two turns, and for supersonic rolls, where we average the old roll drag over two rolls.

We average the old DPs per game turn for supersonic rolls over two rolls.

– **Change: 3A-vertical-attacks.**

The +1 same-location vertical attack modifier also applies if the attacker is in level flight and the target is climbing or diving.

– **Change: 3A-head-on-attacks.**

A non-moving target may declare a head-on attack even if the moving aircraft does not.

– **Change: 3A-sighting.**

This tag covers several changes:

- The searcher is designated by the player and need not be the closest aircraft.
- The position modifier is replaced by a single background modifier. If the target is in stratus or is a smoker, an additional modifier is applied. The "dark uncamouflaged" paint scheme and "water" background are introduced.

  The modifiers for light are the same as the original modifiers for uncamouflaged. The modifiers for "against land" and "against sea" are the same as the original modifiers for lower except that dark over sea is +1 (the same as camouflaged over land), dark over land is +0, and camouflaged over sea is −1.
- If the searcher or target is in haze, the search range is considered to be doubled.
- A +2 modifier applies if the target is in the restricted arc of the searcher, not all participating aircraft.
- A +1 modifier applies if the target is below the highest dense cloud layer.

– **Change: 3A-slides.**

We clarify that an aircraft may only declare one or two slides per game turn. The second slide now gives no DPs. Aircraft have to be appropriately banked for a slide and can come out banked in the sense of the slide or wings-level.

Version 3B

Version 3B is a rewrite of version 3A.

Language Changes

Uniformity

I use "AP" and "DP" to refer to acceleration and deceleration points. This follows the uniform use of FP, HFP, and VPF.

New Terminology

I have adopted the following terminology:

- Individually sighted. This means sighted or friendly, within sighting range of a specific aircraft, and not in the blind arc of that aircraft.
- Neutral. This replaces the nonadvantaged category.
- Superior and Inferior Aircraft. These replace positions of advantage and disadvantage.

– Advantage Categories. This replace position of advantage categories.
– Threatening and threatened. These are used to describe aircraft involved in preemptions.

Replacing Ambiguous Terms

– **Turn.** The original rules use "turn" to refer to both a game turn and turning flight. I use "game turn" to refer to a game turn and "turn" to refer to turning flight.
– **Within.** The original rules use "within" regarding ranges and other quantities. This is ambiguous.

  For example, an aircraft must be "within four hexes" to conduct a rocket attack. Is this inclusive (i.e., "at a range of no more than four hexes" or range ≤ 4) or exclusive (i.e., "at a range of less than four hexes" or range < 4)? In the case of rocket attacks, the rocketry table resolves the ambiguity, which shows hit rolls for ranges of 1, 2, 3, and 4 hexes. Thus, here, within is inclusive. It is also apparently inclusive when used in the context of look-down limitations, which are expressed as "within four altitude levels" and "within 5 to 10 levels".

  In the original rules, within is used in the context of:

  – Aircraft horizontal and vertical separations in tactical formations.
  – AP limits in military and afterburner power.
  – The maximum range for rocket attacks.
  – The maximum range for SSGT.
  – The maximum range for visual sighting.
  – When considering distances to determine if a line of sight is blocked by terrain.
  – The maximum horizontal range to gain advantage.
  – The relative facing of a tailed and tailing aircraft.
  – The maximum range for defensive preemptions.
  – The minimum and maximum ranges for missile launch envelopes.
  – The maximum radar range.
  – The altitude ranges for look-down limitations.
  – The altitude difference for ground clutter for BRMs, RHMs, and AHMs.
  – The range from the target at which an AIM-26A can be detonated.
  – The altitude difference limits for jamming cell formations.
  – Sun clutter.
  – Parachute flares.

  In all of these cases, I believe the use is inclusive.

Process

I typeset the rules using LaTeX on Overleaf and track the source text using GitHub.

The source text for version 1A was generated by taking Malcolm Pipe's second-edition text, manually comparing it to the first-edition rules, and making any changes necessary to obtain agreement. (I believe permission to do this is implicit in his statement, "Edit as desired after download." on 2021-02-05 to the airpower.io group.)

I use custom LaTeX commands to introduce changes into the source text. These changes are be tagged and the tags described in this document. This gives traceability.

Design

Air Superiority and *Air Strike* were published in GDW's house style, with the main text is set in Univers and the page having two columns with a rule between the columns and below the header. *The Speed of Heat* followed this style to a large degree, but appears to have been set in Helvetica

I want the rules to be readable and beautiful, but I also wish to preserve some of the design heritage of the earlier rules.

Therefore, I have maintained a layout with a two-column design, with a rule separating the columns and under the header, adapted the header from the GDW editions, and adapted the section format from the first-edition rules.

However, I have replaced the san serif font with a serif font designed for readability. After considering several options, I have chosen the Schola font, based on the URW Century Schoolbook font and adapted for LaTeX by the GUST foundry as part of the TeX Gyre project. Schola has a version for math, which is useful for text like "$1 \leq CC \leq 2$".

Of the other TeX Gyre fonts, the Palatino version would also be suitable, but Palatino is heavily used in *Birds of Prey*, and I wish to maintain a clear distinction.

Rewriting and Reorganization

This section collects my ideas for rewriting and reorganization.

– Move the rules on formations to their own section.
– Move the modifications to the rules for aircraft with properties (e.g., LRR, HPR) to their own appendix.
– Move the rule on loss of thrust with altitude to the section on speed.
– I think the following sections in particular could benefit from rewriting:

  1. Recovery periods.
  2. Visual sighting.

3. Electronic warefare.

Outstanding Issues

Rule Interpretations

– If a free aircraft under attack by an IRM selects idle power and fails the roll, what modifier does it use? The one for the previous power setting or the one for normal power? The consensus in the group is that it uses the modifier for normal power.

– If a free aircraft under attack by an IRM selects normal power, does it automatically gain the corresponding modifier? The consensus in the group is that it can.

– "If an aircraft's speed includes a fraction; say it is 4.5 instead of 5.0, round it up to simplify determining proportions but use its actual speed when moving. This would give the same result as in the above paragraph (5 into 17). The difference comes in the execution of the segments. The moves would be 4 for 1, 4 for 1, 3 for 1, 3 for 1, and then 3 for the aircraft's half FP."

  What the heck does "3 for the aircraft's half FP" mean?

  If the aircraft has a speed of 4.5, then it has either 4 or 5 FPs, depending on whether it has 0.5 FP carry. If the aircraft has 5 FPs, than I can understand the above as meaning the missile moves 4, 4, 3, 3, and 3 FPs before each aircraft FP. If the aircraft has 4 FPs, then does it mean the missile moves 4, 4, 3, and 3 FPs before each aircraft FP and then 3 FPs after the last aircraft FP?

  This issue would not occur if the proportional moves were calculated in terms of available FPs instead of speed. If the aircraft has 4 FPs and the missile 17 FPs, then the proportional moves would be 5, 4, 4, and 4 FPs. If the aircraft has 5 FPs and the missile 17 FPs, then the proportional moves would be 4, 4, 3, 3, and 3 FPs.

– It seems to be an anomaly in that the missile has to be at the same altitude and one of the positions shown in the diagrams in order to attack, since in most circumstances a missile can use free descent. However, a missile with a turn rate of less than BT/2 cannot use free descent when it is transitioning from climbing to diving flight.

  It might make sense to say a missile attacks in one of four cases:

  1. The target moves to the same position (location and altitude) as the missile.
  2. The missile moves to the same position (location and altitude) as the target.
  3. The missile moves to one of the locations shown in the diagrams, has the same altitude as the target, and has at least one FP left in its proportional movement.
  4. The missile moves to one of the locations shown in the diagrams, is one altitude level above the target, has at least one FP left in its proportional movement, and can use free descent.

  The last case can be generalized to: can use the remaining FPs in its proportional move to move forward one hex and reach the same altitude as the target (using any allowed combination of climbs, dives, and free descents).

Rule Changes

– In Malcolm Pipe's second-edition text, VFPs can be used as preparatory FPs for rolls but not for slides. This follows JD Webster's Genie post in 1995.

– The rules state that a second slide may be "performed" if the aircraft speed if 9.5 or more provided 4 FPs are expended between the two slides.

  An aircraft with a speed of 9.5 or more is supersonic and requires at least three preparatory FPs for each slide, so *declaring and completing* two slide maneuvers requires at least 12 FPs (4 FPs for the first, 4 FPs waiting, and 4 FPs for the second). This requires a speed of at least 11.5 (allowing for 0.5 FP carry).

  I note that in the original *Air Superiority* rules, supersonic aircraft are not required to expend an additional preparatory FP and so require only 10 FPs (3 FPs for the first slide, 4 FPs waiting, and 3 FPs for the second). This requires a speed of at least 9.5 (allowing for 0.5 FP carry). Thus, the limit does not seem to have been updated in the change from *Air Superiority* to *Air Power*.

  The above ignores maneuver carry, which is not explicitly mentioned in the rules but seems to be widely adopted. If we ignore the explicit speed requirement and simply obey the waiting period of 4 FPs, then a first slide can be *declared and completed* and a second slide can be *declared* in 8 FPs (3 FPs for the first slide, 4 waiting, and 1 FP to declare the first slide). Furthermore, if sufficient preparatory FPs are carried in, the first slide can be *completed* and the second *declared* in only 6 FPs (1 FP to execute the slide, 4 FPs waiting, and 1 FP to begin the second slide).

– Now that preparatory FPs for displacement and lag rolls can be VFPs, does it make sense to have the additional complication of the rule for climbing and diving barrel rolls? I suspect not.

– Are the two DPs for VIFF-assisted turns in addition to the normal turn cost?

– In the v2.4 rules, RWR-C+/D+ gives a +1 modifier to missile attacks and towed jammers give a +1 or +2 modifier to BRM/RHM/AHM attacks.