a FQ shot. Suitable versus bogeys in Trail;

- Abeam: similar to a Stern Conversion or FQ intercept with the wingman holding a defensive spread;
- Sweep: similar to the intercept already discussed.

22.3.10 BREAK-AWAY

A "trick tactic" used to confuse the enemy fighters.

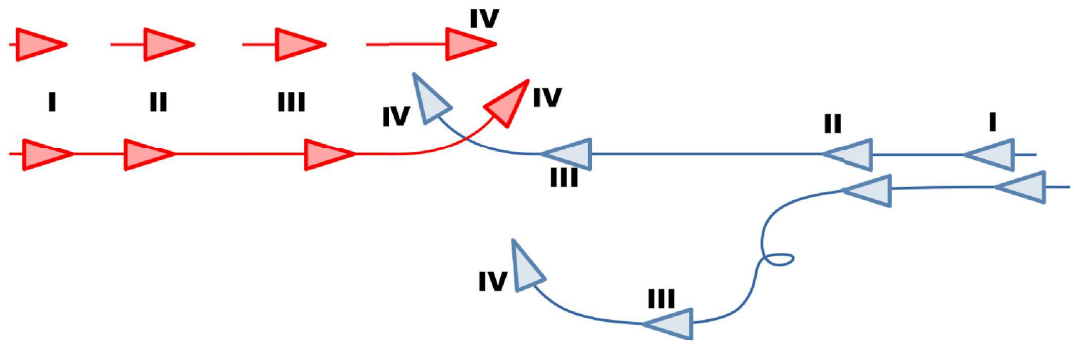


Figure 574: Break-away intercept.

PROS	CONS
• Very offensive manoeuvre, for the cases when offence is the only defence; • Apparently, if it works, it makes you cool at the bar, post debrief.	• Very hard to pull out; • Wingman is not supported;

CONSIDERATIONS

The initial tight formation serves the purpose of hiding the number of fighters, as they should appear as only one target.
The rest of the flow is quite simple: the fighters place the bogeys on collision and, when right outside the Within Visual Range boundary, the wingman pulls over and performs a Split-S until the aircraft is pointing downwards, with the goal of breaking the SA of the bogeys. By the time he pulls up, he should be outside of the enemy radars scan zone. The intercept then proceeds to the merge, with the wingman is in an advantageous position (basically a vertical hook).

22.3.11 CROSS-BLOCK

Also called "Weave", is another "trick tactic" often successful versus superior fighters that have a propensity for independent attacks.

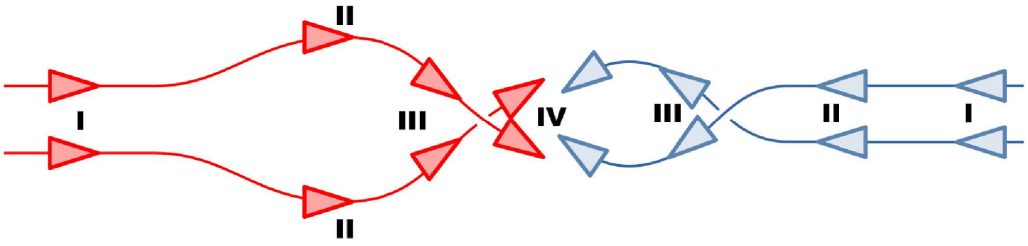


Figure 575: Cross-block intercept.

PROS	CONS
• Effective versus pincer attacks; • Fairly solid defensively;	• Require considerable training and practice; • If a fighter loses contact with its bogey, the Section can be in danger.

CONSIDERATIONS

The combat spread formation presses until the fighters can expect a radar lock from the bogeys. At *II*, the fighters cross-lock the bogeys (they lock the bogey in the opposite side), then turn into each other to distance from the bogey on their side of the airspace. If the bogey press on their original target, they may cross their flight paths, but the fighter answer by turning into each other again and entering the merge in a more advantageous position (Rear-Quarter shot).

22.4 FLIGHT/DIVISION INTERCEPTS

R. Shaw covers a couple of division intercept, where four aircraft manoeuvre to intercept a bogey Section. On top of that, any of the intercept tactics discussed so far and used by one or two fighters can be employed at Flight / Division level.

The following are a couple of examples of Section tactics applied to a Flight.

22.4.1 DOUBLE LEAD-AROUND

This intercept consists in two Lead-Around tactics applied by each Section on the bogey located on their side of the airspace.

Flow, pros and cons follow the same of the standard Lead-Around: the formation splits and each Section intercepts its bogey.

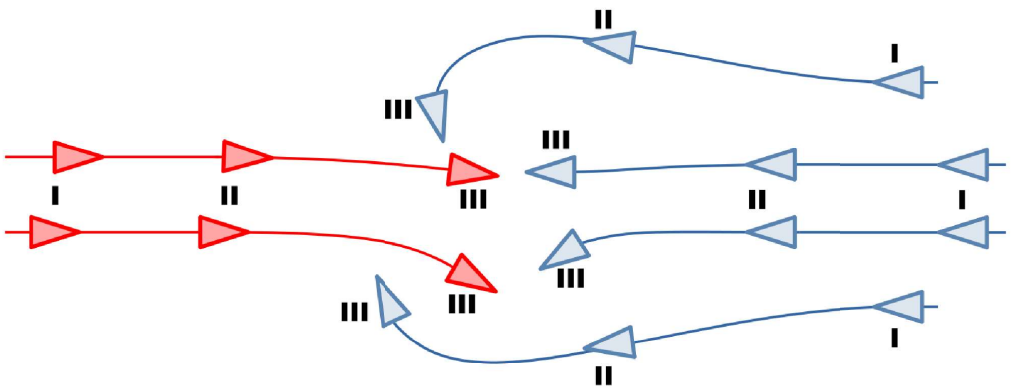


Figure 576: Double lead-around intercept.

22.4.2 DOUBLE PINCER / DOUBLE OPTION

Similarly to the Double Lead-Around, this intercept splits the formation into two Sections, each one conducting the intercept on the bogey located on their side of the airspace.

As per the standard Pincer and standard Option, there can be different way to conduct this intercept, depending on several parameters.

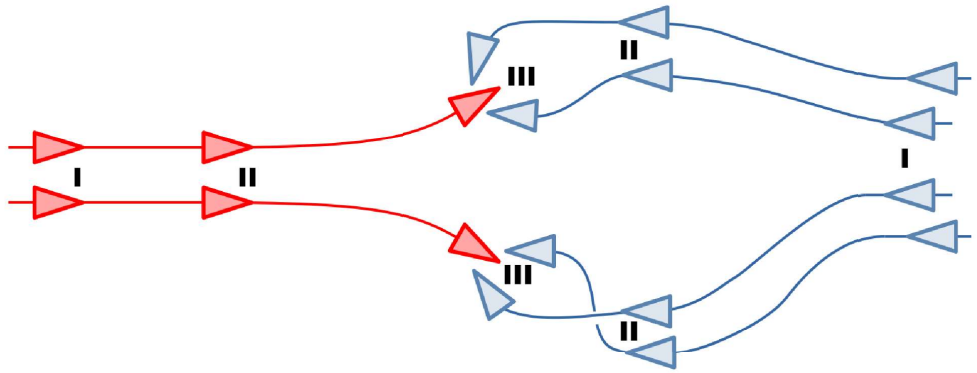


Figure 577: Double pincer / Double option intercept.

22.4.3 BOX FORMATION

This procedure is not explicitly covered by Robert Shaw, it was mentioned as a note to the Trail intercept but, as mentions, the Section Intercepts can be fairly easily applied at Flight / Division level.

This is a modification of the Trail intercept aiming to increase the safety of the fighters. The flow is identical, but rather than having a single fighter as the Leader, and a single fighter as the wingman, two Sections in combat spread replace them.

Another alternative, if three fighters are available, is forming an inverted “V”, with the Leander in front, and the two wingmen in combat spread behind.

That being said, intercepts can really look amazing, as Plate 32 shows![137]

Plate 32: F-15s intercepting MiG-29s over Alaska (credit USAF).

137 Credit USAF – Source Wikimedia.

23. APPENDIX III: AIRCRAFT AND ORDNANCE

23.1 FRIENDS AND FOES

The list of conflicts where the F-14 played its role of Fleet Defender / Air Superiority initially, then outstanding Air-to-Ground platform, is very long and includes[138]:

- American withdrawal from Saigon (1975)
- Cold War intercepts (1976–1991)
- Military operations directed at Libya (1980–1989)
- Iran – Iraq War (1980–1988)
- The Persian Gulf War (1990–1991)
- Interwar air operations over Iraq (1991–2003)
- Balkans (1994–1995 and 1999)
- Operation Enduring Freedom (2001–2003)
- Operation Iraqi Freedom (2003–2006)

During the 30+ years of deployment, the F-14 has faced a plethora of different aircraft. This is a short recap of those and other aircraft, with increased attention towards the versions available in DCS (or soon released).

23.1.1 CAVEATS

1. Using the introduction date as the criteria for classifying the aircraft is not really meaningful. Therefore, I am considering a buffer for contemporaries (1972 – 1976), pre 1971 included for older, and from 1977 included for newer.
   For reference, the F-14A (early) was introduced in 1974, the F-14B in

138 Source: Wikipedia - F-14 Tomcat operational history.

~1987. The F-14D was delivered from the 1991.
When possible, I used versions flyable or usable as AI assets in DCS.

2. Another important factor to take into account is how aircraft are upgraded and evolve: the F-16A, for example, was initially a very different beast than what it is now replicated in DCS (for instance, it was a point-defence aircraft, not the multirole swiss-knife it is today).
   The F-14 we have instead, besides the engines, did not see any drastic improvement, especially from the point of view of the WCS / radar suite, until the installation of the new digital goodies.
   The differences between the four versions of the Grumman F-14 we have (or soon have) have been discussed in Chapter 3.1.
3. Most of the information reported below is from Wikipedia and other sources. Different sources often report different values. The goal here is providing an overview of these fighters, rather than dive into the details.
   The images may refer to versions different from the one discussed. Credits are listed on the linked pages.
4. The long-term plan of this Chapter sees the addition of the typical MAR and other details of the various types of weapons employed, but gathering those information take time and these infos won't be available initially.

23.1.2 PRE-TOMCAT INTRODUCTION

MIKOYAN-GUREVICH MIG-21BIS

Introduced: 1958
Introduced ("bis" version): 1970
Role: Interceptor
Country: USSR / Russia
Produced (all versions): 11,496
NATO designation: Fishbed

The MiG-21bis is an early seventies evolution of the venerable MiG-21, first introduced in 1959. Upgraded in almost any way, from the avionics to the R25-300 turbojet engine, the MiG-21bis is a superb interceptor.
Although not as manoeuvrable as other aircraft of the MiG family (for example, the MiG-17 or the MiG-29), the small size of the aircraft and its speed can surprise a crew not paying enough respect or attention to the Fishbed.

The Aircraft in DCS
Created by Leatherneck Simulations, the MiG-21bis is the first third-party module released to DCS (store page).

Weapons and Capabilities
The MiG-21bis carries up to 4x R-3, R13, R-13M and/or up to 8x R60 – R60M (two per rail)

on four different stations.

Additional Notes
As a testament of the quality of its design, the MiG-21 is still the most produced supersonic jet aircraft in history.

MIKOYAN-GUREVICH MIG-23MLA

Introduced: 1969
Introduced ("MLA" version): 1971
Role: Interceptor
Country: USSR / Russia
Produced (all versions): 5,047
NATO designation: Flogger

Sweep-wing interceptor, very fast and with good armament for the period, the MiG-23MLA is part of the second generation of the MiG-23s, featuring an improved radar, airframe, engine, datalink (different from the Western counterpart, as it's meant for ground-controlled intercepts and guidance). Compared to the previous versions, the second generation vastly improves the initial subpar manoeuvrability.
The Flogger is an underrated aircraft, often misunderstood by the crews that flew the exported versions, which tried to manoeuvre it. Instead, the MiG-23 is still very much close to the older concept of interceptor, playing everything on the speed, rather than the manoeuvrability.

The Aircraft in DCS
The AI version is the MiG-23MLD, one of the most recent versions. The MiG-23MLA is being developed by RAZBAM.

Weapons and Capabilities
The AI MiG-23MLD carries 2x R-24R or R-24T on pylon 2/6; and up to 4x R-60 on pylon 3 and 5; plus a centerline fuel tank.

Additional Notes
The F-14 encountered the MiG-23 in the second Sidra incident in 1989.
Two F-14 Tomcat from the USS John F. Kennedy destroyed two Libyan MiG-23s. One pilot ejected, the other was killed.
A good analysis of the engagement can be found on YouTube (by Ward Carroll, former F-14 RIO).
This is the unedited video of the incident. The comms are simple to follow even for new virtual RIOs.

23.1.3 F-14 TOMCAT CONTEMPORARIES

F-4E PHANTOM II

Introduced: 1958
Introduced ("E" version): 1973
Role: Interceptor / Fighter-Bomber
Country: USA
Produced (all versions): 5,195

The most iconic Western aircraft of the early Cold War, the F-4 flew in Vietnam and was still operated past 2010 by several countries (albeit drastically upgraded).
During its operational life, the F-4 has covered almost any possible role, from land-based fighter, naval fighter, capable air-to-ground platform, reconnaissance aircraft, wild-weasel and even nuclear ordnance delivery platform.
Some export versions were updated to carry the AIM-120 AMRAAM (F-4F for the German Air Force – Luftwaffe).

The aircraft in DCS
No flyable version is not present in DCS yet. The available AI version is the venerable F-4E. A flyable version was being developed by Belsimtek several years ago. ED has stated that they are not interested in it anymore, and a third-party dev may bring it to life. This third party developer is Heatblur. They plan to develop and release the F-4 in different modules, starting from the F-4E in 2022.

Weapons and Capabilities
The F-4E carries up to 4x AIM-9 (L/M/P) and 4x AIM-7 (E/M).

Additional Notes

NORTHROP F-5E TIGER II

Introduced: 1960
Introduced ("E" version): 1972
Role: Light Fighter / Light attack
Country: USA
Produced (all versions): 1987

Initially a private project, the F-5 was intended as a cheaper and simpler aircraft than the F-4, both to operate and maintain, and mainly developed for the export market.
The F-5E is a 70s upgrade of the F-5A, seeking better air-to-air performance against aircraft such as the MiG-21. The F-5E was improved in many ways, from the avionics (introduction of the AN/APQ-153 radar) to the engines (General Electric J-85-21).

The aircraft in DCS
The F-5E-3 is flyable in DCS, easy to fly and very popular in early cold-war servers.

On top of the features described above, it sports a AN/ALR-87 Radar Warning Receiver, based on AN/ALR-46.

Weapons and Capabilities
The F-5E-3 carries up to 2x AIM-9 (B/P/P5) on the wing-tips. The other stations are used by fuel tanks or air-to-ground ordnance.
The F-5 does not carry the popular M61, rather a pair of M39 cannons (20mm a single-barreled revolver cannon).

Additional Notes

DASSAULT MIRAGE F1

Introduced: 1973
Introduced ("C" version): 1973
Role: Fighter / Interceptor
Country: France
Produced (all versions): 720

Born an as interceptor with air-to-ground capabilities, Dassault opted for a swept-wing configuration, rather than the delta wing used in the Mirage III.
Compared to its predecessors, it featured a much more advanced avionics with multiple features, including terrain avoidance.
The Mirage F1 has seen conflicts all over the world, from the Irani-Iraq war of the 80s, to operations in North Africa and South Africa were it was employed against Soviet-provided fighters such as the MiG-21[139].

The aircraft in DCS
Aerges is creating the Spanish versions of the Mirage F1[140]:

- F1-CE: older version with simplified cockpit;
- F1-EE: multi-role version with ground-attack and with refuelling capability;
- F1-BE: two seater version of the F1. The modification affected the internal fuel capacity, the internal cannon was removed and the empty weight increased;
- F1-M: modernised version. Delivered between 1998 and 2001, it comprises a new LCD screen, smart HUD, INS with GPS, radar upgrades and other avionics improvements.

The first version to be released will be the F1-CE.

Weapons and Capabilities
The Mirage F1 was able to employ different weapons depending on the version and the country it was flown by. For example, the Spanish F1-CE was able to employ the AIM-9, on top of French equivalents.

139 In this regard, this is a great interview of a former ZA pilot of Mirage F1 vs a MiG-21. Source – Aircrew Interview.
140 More info: Announcement on Facebook.

Other weapons are, depending on the version, the R.530, R.550, Super 530, conventional and cluster bombs, and even the famous anti-ship missile Exocet.

Additional Notes
The first Iranian F-14 shot down during the Iran-Iraq war was claimed by an Iraqi Mirage F1with an R.530; with other Tomcats kills to follow.

MIKOYAN-GUREVICH MIG-25PD

Introduced: 1970
Introduced ("PD" version): 1976
Role: Interceptor
Country: USSR / Russia
Produced (all versions): 11,496
NATO designation: Foxbat

Originally introduced in 1970, the MiG-25 shocked the world when it was revealed and prompted the launch for a new program, eventually leading to the F-15.
The Foxbat is an incredibly powerful interceptor, built around its massive engines, robust but suffering from very poor manoeuvrability. Its typical intercept speed is Mach 2.5, but can fly much faster at the risk of damaging its engines (one was tracked flying at Mach 3.2 in the 70s in the Sinai).
The improved version, the MiG-25PD was introduced in 1976, following the defection of a Soviet pilot[141].

The aircraft in DCS
Two AI versions are available in DCS: the MiG-25RBT (air-to-ground) and the MiG-25PD (air-to-air). Unfortunately the AI in DCS is not able to take advantage of the impressive characteristics of the aircraft.

Weapons and Capabilities
The MiG-25PD have four stations available, it can carry a total or four missiles (4x R-40R or T; or 2x R-40 and 2x R-60).

Additional Notes
Some said, it was one of the main reasons why the F-14 was adopted by the IIAF[142].
During the 1991 Gulf War, a MiG-25 destroyed an American F/A-18, killing the pilot. In another battle, a MiG-25 damaged an F-15C[143]. Both were hit by R-40 missiles.

141 Lt. Viktor Belenko defected to Japan in 1976. Source: Wikipedia – Mikoyan-Gurevich MiG-25.
142 Iranian F-14 Tomcat Units in Combat – Tom Cooper and Farzad Bishop (Osprey Publishing). Page 7.
143 Source: Wikipedia – Samurra Air Battle.

23.1.4 POST F-14 TOMCAT AIRCRAFT

MCDONNELL DOUGLAS F-15C EAGLE

Introduced: 1976
Introduced ("C" version): 1979
Role: Fighter
Country: US
Produced (all versions): 1,198

The F-15C has a single purpose: air superiority. The F-15A, introduced in 1976, suffered from a number of issues, such as the early radar or the F100 engine, which even forced the USAAF to accept engine-less airframes[144].
The F-15C, had its maiden flight on 26/02/1979, and sees major upgrades to the radar suite and avionics and, since early 90s, the ability to carry and employ the successor of the AIM-7 Sparrow, the AIM-120 AMRAAM.
As a testament of the quality of the design, the F-15 is still being upgraded and flown by several countries.

The aircraft in DCS
The version flyable in DCS is "FC3 standard", without clickable cockpit, and using a simplified avionics and so on. The F-15A would be a great addition to DCS.

Weapons and Capabilities
Initially, AIM-9J (first post-Vietnam upgrade) and AIM-7F. Later the AIM-120.

Additional Notes
Besides an Iraqi claim during the 1991 Gulf War (mentioned in the MiG-25 card), no F-15s have ever been destroyed in an air-to-air engagement.

DASSAULT MIRAGE 2000C

Introduced: 1982
Introduced ("C" version): 1983
Role: Multirole Fighter
Country: France
Produced (all versions): 601

An aircraft with good low-speed characteristics but also speed, the Mirage 2000 comes from the prolific French manufacturer Dassault.
The Mirage 2000 differs from the Mirage F1 by reverting back to the delta-wing design, rather than the shoulder-mounted swept wing.

144 Source: Joseph F. Baugher's website.

The aircraft in DCS
One of the first DCS modules released by a third party dev, the Mirage 2000C was released in 2015 by RAZBAM. Through the years it has seen major improvements, especially after the cooperation with the Armée de l'Air.
The Mirage 2000C is one of the most capable multirole fighters in DCS of its era.

Weapons and Capabilities
4x air-to-air pylons, for a total of up to 4x Matra Magic II and 2x Matra Super 530D and 2x Matra Magic II.
The Mirage 2000C can use up to 9 stations for air-to-ground ordnance, from rockets to dumb bombs and laser-guided bombs.

Additional Notes

MIKOYAN MIG-29A

Introduced: 1982
Role: Fighter
Country: USSR / Russia
Produced (all versions): 1600+
NATO designation: Fulcrum

The MiG-29, iconic and beautiful product of the legendary Mikoyan design bureau was the Soviet answer to the new F-15 and F-16.
A drastic changed from the previous pure interceptors, the MiG-23 and MiG-21, the MiG-29 is very agile, albeit short-ranged, multirole air superiority fighter.
The operational history of the MiG-29 had considerable success in the export market, although it was not as popular as the aforementioned predecessors, partially due to its higher cost and maintenance complexity. In terms of operative results, in the hands of non-Soviet / Russian pilot, the Fulcrum did not meet the expected performance, a theme common to the MiG-23.
The MiG-29 has a carrier-based version, the MiG-29K. It is used primarily by the Indian Naval Air Arm, whilst the Russian Navy preferred the Su-33 over the MiG until recent years.

The aircraft in DCS
A high-fidelity MiG-29A has been somewhat announced (pending rights and legal stuff) by Eagle Dynamics[145].
Three versions are available in Flaming Cliff 3 (having lower fidelity, simplified avionics and non-clickable cockpits): MiG-29A, MiG-29G and MiG-29S.

Weapons and Capabilities
The six stations aboard the MiG-29 carry different payload depending on the version considered. At least in DCS, the common missiles are the usual R-60, R-73, R-27 in different flavours. Only the MiG-29S carries the R-77 Active Radar Homing Missile.

145 Discussion on ED Forum.

Additional Notes

MIKOYAN MIG-31

Introduced: 1981
Role: Interceptor
Country: USSR / Russia
Produced (all versions): 519
NATO designation: Foxhound

Spiritual successor of the MiG-25, the MiG-31 Foxhound is one of the fastest aircraft in the world, but retains the poor manoeuvrability especially when flying supersonic. A notable difference instead, is the presence of a second crew member behind the pilot, a role similar to our beloved Radar Intercept Officer.
Peculiarity of the MiG-31 is the radar: it mounted one of the very first Phased Array Radar, capable of guiding more than one long-range missile at the same time.

The aircraft in DCS
The MiG-31 is available only as an AI aircraft. It is renown for the lethality of its long range missiles. Unfortunately, the AI is not minimally capable of taking advantage of the strengths of the MiG-31.

Weapons and Capabilities
The six stations of the MiG-31 somewhat recall the F-14. Station #2 to #5 are the corresponding of the pancake, since they arranged in tandem couples, whereas station #1 and #6 are located under the wings, and recall pylon #1 and #8 of the F-14.
The MiG-31 can carry pairs of the ubiquitous R-60 under the wing or a single R-40 (R or T) in each. Under the belly of the aircraft, up to R-33 long range, SARH missiles are mounted.

Additional Notes

SUKHOI SU-27

Introduced: 1985
Role: Fighter
Country: USSR / Russia
Produced (all versions): 680
NATO designation: Flanker

If the MiG-29 resembles the F-16, the Su-27 is the equivalent of the F-15 and the F-14 Tomcat. Much heavier and bigger than the MiG-29, the Flanker was conceived as an air superiority fighter, later adapted to satisfy multiple roles.
The Su-27 is incredibly manoeuvrable and agile considering its size. It is famous for the air-show manoeuvre Pugachev's Cobra (albeit this kind of manoeuvre works only in movies..

or DCS).
The Flanker has a carrier-based version as well, with a few modifications to allow it to better operate from the sea (such as a shorter tail).

The aircraft in DCS
The Su-27 and the Su-33 are available in DCS both as AI and as “FC3-level”. Unfortunately, no “DCS-level” version has been announced so far.

Weapons and Capabilities
The Flanker carries and incredible internal fuel load, up to 20,700 lbs, and it does not require big and draggy external fuel tanks. Therefore, all its 10 stations can be used for pods, missiles and air-to-ground ordnance.
The missiles carried are the usual mix of R-73 and R-24 in different flavours. The Su-27 cannot carry any Active Radar Homing missile (in DCS).

Additional Notes

SHENYANG J-11A

Introduced: 1988
Role: Fighter
Country: Russia / China
Produced (all versions): 440
NATO designation: Flanker-L

This aircraft is the Chinese versions of the Su-27 Flanker.

The aircraft in DCS
The J-11A is available in DCS with Flaming Cliff 3. It shares the low-fidelity cockpit with the Su-27 and the Su-33. It is therefore a very limited module but brings the R-77 ARH missile to the table.

Weapons and Capabilities
Similar to the Su-27, with the addition of the R-77 Active Radar Homing missile.

Additional Notes

GENERAL DYNAMICS F-16C BLK50 FIGHTING FALCON / VIPER

Introduced: 1978
Introduced ("C blk 50" version): 1994
Role: Multirole Fighter
Country: US
Produced (all versions): 4604

Almost as iconic (but nowhere near as cool) as the F-4 Phantom II, the F-16 is a common sight in many Western air forces. Born from the same program that created the F/A-18C, it is a tentative to cut costs and increase the number of aircraft produced.
The F-16 incorporates many innovations, from the advanced fly-by-wire and flight control system, able to fully take advantage of the aerodynamic instability of the aircraft, to the bubble canopy designed to grant an almost unobstructed view.
The F-16 has seen an incredible evolution through the years, from an almost point-defence aircraft, to the great multirole asset it is now. The evolution has been so wide and drastic that, when trying to understand the capabilities of the aircraft, rather than considering the versions of the F-16, the single Blocks should be discussed.

The aircraft in DCS
The F-16A, F-16C block 50 and the F-16C block 52d are present in DCS as an AI asset.
The flyable version is the F-16CM Block 50.

Weapons and Capabilities
On top of the plethora of pods and air-to-ground ordnance, the F-16 carriers, depending on the version, from the AIM-9L to the AIM-9X, and from the AIM-120B to the AIM-120C5.
The F-16A can carry the AIM-7M Sparrow as well.

Additional Notes
The Iranian Shah, Mohammad Reza Pahlavi, placed an order for a considerable amount of F-16A before the revolution, in an effort to modernize the IIAF, back then mostly composed by F-5 A/B/E/F and F-4D/E. The 1979 revolution blocked the order.

MCDONNELL DOUGLAS F/A-18C

Introduced: 1983
Introduced ("C" version): 1987*
Role: Multirole Fighter
Country: US
Produced (all versions): 1,480

The naval cousin of the F-16, it was derived from the same set of requirements.
The major upgrades of the aircraft were the C/D version, from the initial A/B (B and D are

two-seaters), which saw the adoption of the new AIM-120 missile and several other air-to-ground weapons (e.g. AGM-65 and AGM-88).
The most important overhaul resulted in the F/A-18E Super Hornet, and its dual-seater brethren, the F/A-18F. The redesign includes a larger airframe, more powerful engine and upgraded avionics.
The EA-18G instead replaced the venerable EA-6B Prowler in the electronic warfare role.

The aircraft in DCS
F/A-18A and F/A-18C are available as AI assets.
The F/A-18C Lot 20 is flyable in DCS. Launched in 2018, it is a common sight in the DCS skies.

Weapons and Capabilities
The Hornet, similarly to the F-16, carries a vast variety of ordnance, from air to ground missiles to GPS/laser guided bombs.
Air-to-air wise, the Hornet carries from the AIM-9L to the AIM-9X, from the AIM-7F to the AIM-7M and AIM-7MH and the AIM-120, versions from the B to the C-5.

Additional Notes

EUROFIGHTER TYPHOON

Introduced: 2003
Role: Fighter
Country: EU
Produced (all versions): 571

The Eurofighter is an incredible multirole aircraft, but with a long and somewhat troubled history. The original pool of European nations developing it split, as the Cold War ended, the demands for a new aircraft waned, leading to delays and the introduction only in 2003. Nevertheless, the Eurofighter features impressive performance in every aspect of flight, and an arsenal (depending on the nation considered) that allows it to cover a wide range of missions.

The aircraft in DCS
The Eurofighter was announced by TrueGrit Virtual Technologies. They recently partnered with Heatblur to bring the Eurofighter to (virtual) life.

Weapons and Capabilities
The payload carried by the Eurofighter varied heavily depending on the country it was used by and the Tranche.

Additional Notes

CAC/PAC JF-17 THUNDER

Introduced: 2007
Role: Multirole Fighter
Country: Pakistan / China
Produced (all versions): 132

Designed to replace obsolete French and Chinese aircraft in the Pakistan Air Force, the JF-17 is a lightweight multirole aircraft. Although flexible and somewhat similar to the F-16 aesthetics-wise, it is not particularly fast or manoeuvrable: its top speed is mach ~1.6, and the thrust-to-weight ratio is below 1, whereas the F-16 is higher (then depends on the version considered). On the other hand, it is much cheaper, with an estimated cost of ~$30m, less than half the price of a Viper.
The JF-17 is capable of conducting air-to-air sorties, but also air-to-ground and anti-ship missions.

The aircraft in DCS
The Thunder is the first full-fidelity module created by Deka Ironworks. It is an excellent module, characterized by being the first DCS aircraft with glass cockpit.

Weapons and Capabilities
Being a multirole aircraft, the JF-17 carries a wide array of ordnance. Besides bombs, air-to-surface and anti-ship missiles, the air-to-air selection is primarily a mix of indigenous and Soviet / Russian technology:

- The PL-5E is based on the AA-2 Atoll, which in turns resembles an AIM-9;
- the PL-12 (SD-10) is an Active Radar Homing missile, developed by the Chinese military, and comparable to the AIM-120 and the R-77.

Additional Notes

23.2 ***AIR-TO-AIR AND SURFACE-TO-AIR MISSILES IN DCS

Notes:

- Images are taken from DCS' encyclopedia;
- Images are not to scale;
- Guidance is simplified (for instance, an AIM-54 would have ARH guidance, although this is not the case when the whole envelope is considered).

This Chapter is a quick overview of the most common missile threats in DCS.
At the moment, it includes only the designation and the guidance of a few missiles. The

objective, later on, is the creation of an empirical study to better appreciate the performance of the different missiles.

A now outdated study is available in Chapter 23.2.2 . I stopped the work when ED announced the overhaul of the AIM-120 and the missile API a couple of years ago.

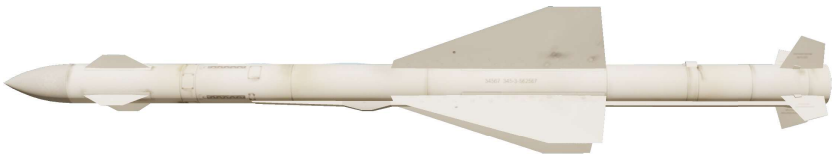
23.2.1 COMMON AIR-TO-AIR MISSILES

R-60
Introduced: 1974
NATO: AA-8 “Aphid”
Guidance: IR

R-73
Introduced: 1984
NATO: AA-11 “Archer”
Guidance: IR

R-23 / R-24
Introduced: 1974 / 1984
NATO: AA-7 “Apex”
Guidance:

- R-23R/24R: SARH
- R-23T/24T: IR



R-40
Introduced: 1960
NATO: AA-6 “Acrid”
Guidance:

- R-40R: SARH
- R-40T: IR

R-33
Introduced: 1981
NATO: AA-6 “Acrid”
Guidance: SARH/ARH

R-77
Introduced: 2002
NATO: AA-12 “Adder”
Guidance: ARH

AIM-120
Introduced: 1991
Guidance: ARH

R.530
Introduced: 1991
Guidance: SARH

R.550
Introduced: 1975
Guidance: IR

PL-5
Introduced: -
Guidance: IR

PL-12
Introduced: -
Guidance: ARH

23.2.2 DCS AIR-TO-AIR MISSILES: STUDY (OUTDATED)

Knowing the WEZ of the possible missile threats allows the RIO to better understand, prioritize and counter different possible air threats.

The following are the initial steps of a series of WEZ diagrams I was putting together in early 2020 but never finished, since ED announced the overhaul of the AIM-120 and other missiles. I will produce a new study when the ED completes the new missile API.

SCENARIO

The goal is monitoring the peak speed and at what range it decades, so the envelope of the missile can be better understood, along a basic idea of the MAR.

- Altitude: 25,000 ft
- Launch speed: 0.9 Mach. Gate disabled.

- Distance: non-factor

For consistency reasons, each missile is launched by the AI using the same parameters. Their target is “lingering” in the air not moving. This allowed to gather more accurate data about the missiles and in greater number. However, the AI does not optimize their launch parameters, so these values, although indicative of the missile behaviour, must be taken with a gran of salt.

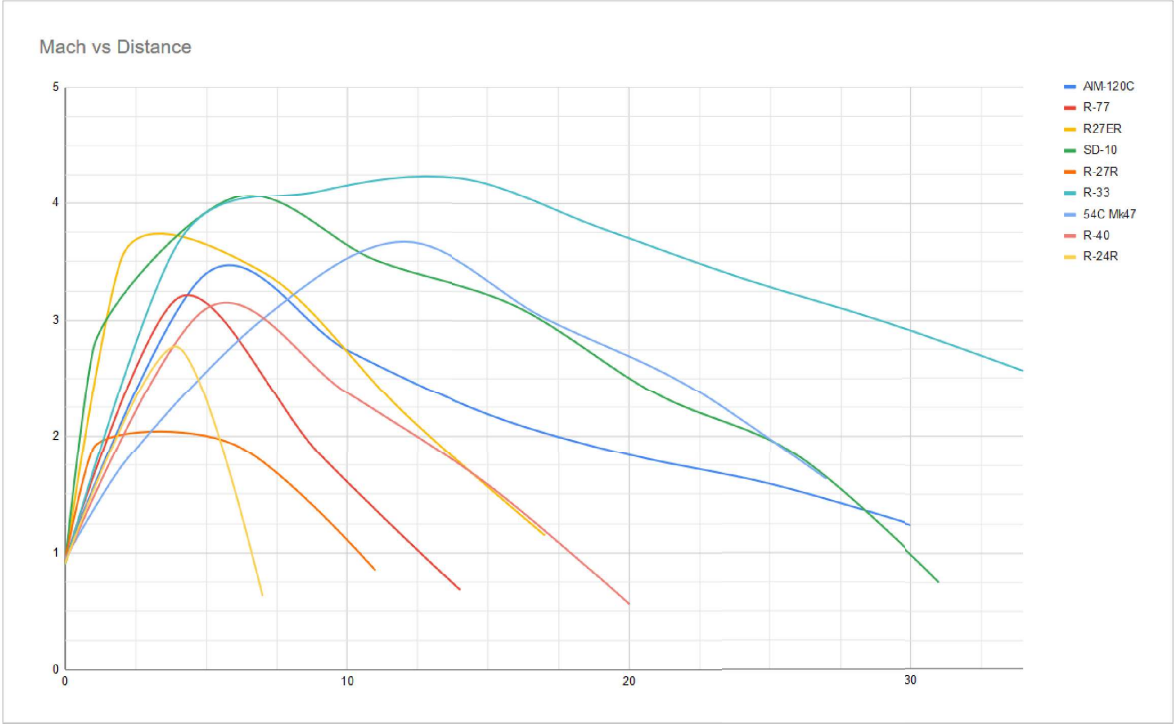


Figure 578: Missiles Mach vs Distance chart.

Figure 578 shows the first steps of the data-collection necessary to gather enough values to design the WEZ diagram for some of the common missiles in DCS. Although just the first step (furthermore, outdated), it provides a glance of the behaviour of the missiles, and which missile is a threat at which distance.

Some interesting observations can be drawn: for example, at close range (less than 10 nm), the AIM-120 accelerates faster, which can result in the missile connecting before an AIM-7 or AIM-54 (albeit the latter is active off the rail at such a short range). Similarly, the R-77 and most of the Soviet/Russian missiles are less than a threat at ranges where the AIM-120 is: in a NATO vs Russia/China scenario, the main threats at range are the SD-10 of the JF-17, the R-24 of the MiG-25 and the R-33 of the MiG-31.

Note that R27 and others have been improved recently and after the creation of these charts.

Figure 579 shows the different loft trajectory for the AIM-120C, the SD-10 and the AIM-54C Mk47. It is interesting to note how, at medium ranges, the AIM-54 barely lofts, whereas the two others “climb” well over 42,000 ft. Crossing the charts in Figure 579 and Figure 578, we can obtain a quite detailed picture of the excess of energy of the AIM-54 versus the AMRAAM and the Thunder.

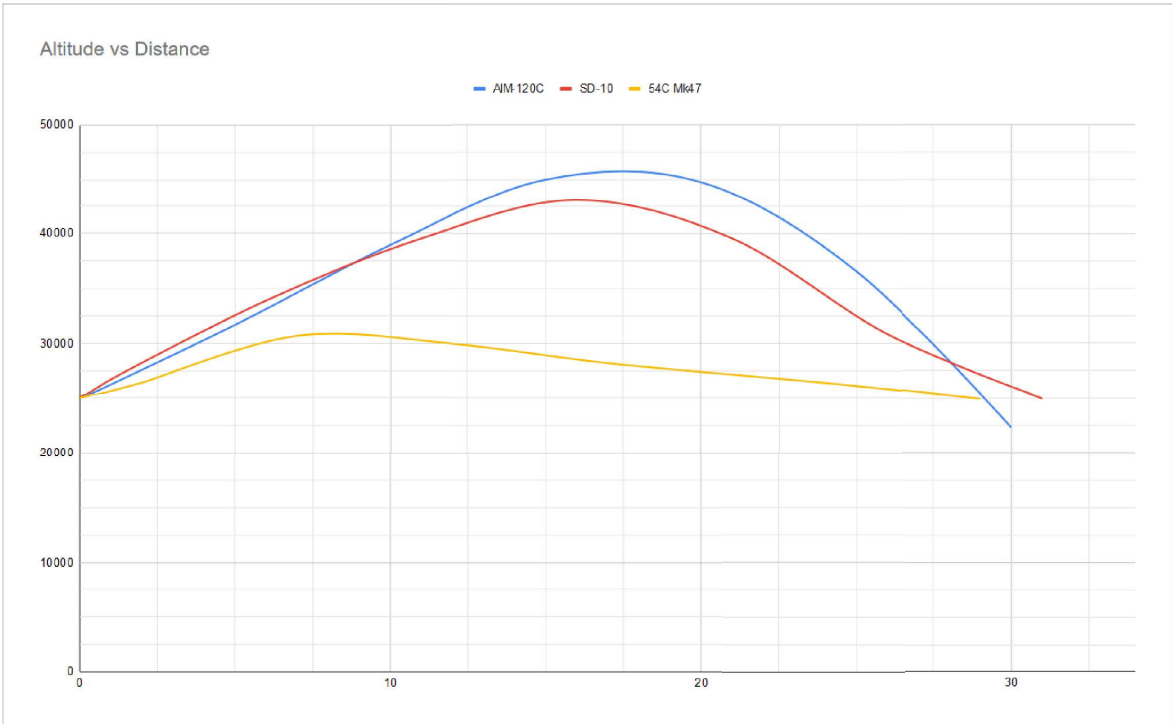


Figure 579: AIM-120, SD-10 and AIM-54C Mk47 – Loft Altitude vs Distance

The plan, once the new missile finalized by ED and implemented by Heatblur[146], is working on a new P_K model for the Phoenix and create a proper study about the other missiles.

146 Unfortunately, it may take a while, as the changes are not superficial, but part of the core of the sim. Source: IronMike's comment - ED Forum.

24. APPENDICES IV – TEMPLATES AND TABLES

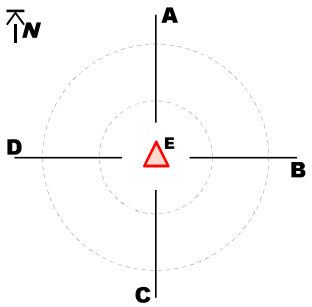
The following are a series of printable templates and tables,

For example:

- Air-to-Ground CAS Check-in and 9-Line brief: the check-in part is not as necessary when playing as the CAS Asset (most of the information should be reported in your mission briefing), but handy when playing as the FAC(A) or to better organize the details to send to the Controller.
  The 9-Line brief is useful to write down the information sent by the JTAC / FAC(A).
  Compared to the standard 9-line template that can be found in the official sources, I added the keyhole and an area to add notes or a simple ETD sketch. However, I also removed parts used only in more simulative groups (e.g. BDA).
- Ripple Interval Tables: as discussed in Chapter 12.1.1, the F-14 does not automatically calculates the spacing between the rippled ordinance by adjusting the release interval.
  The Radar Intercept Office can set the release interval in milliseconds for a certain delivery profile (based on dive angle, TAS, altitude) in the Armament Panel (see Chapter 3.3.2). The correct value calculated by using a constant obtained from a reference table.
  This appendix contains two tables with pre-calculated values for the Mk-82 LD and Mk-82HD, for a ripple spacing of 15ft (~5m) and 60ft (~20m). I choose the two values after discussing with our AG veterans in the 132nd Virtual Wing.
  Note that the values have been calculated by using a script I wrote that iteratively went through the possible combinations of parameters and spit out the closest appropriate values. As a rule of thumb, the lower the speed and the higher the dive angle, the more precise the values are.
  Lastly, the values are also part of my in-game Kneeboard Pack, freely available on FlyAndWire.com.

- Air-to-Air Intercepts: a series of reference values useful to practice an Intercept or rejoining a tanker. For example, timeline flow chart, Displacement Turn and Counterturn gates, useful procedures such as the CCC formulas.

I. CLOSE AIR SUPPORT: CHECK-IN AND 9-LINE BRIEF



ECHO POINT

Lat	Lon

ROUTING / NOTES
A – Routing / Holding Instructions
B – Other AC on station
C – Immediate threats
D – Significant WX / terrain

JTAC / Mark:							ID/Mission N.
N./Type of Aircraft							Position and Altitude
Ordnance	1B	3	4	5	6	8B	Gun
Time on Station							Abort Code
Capabilities	□ NVG	□ LANTIRN	□ GRG+Version				

SITUATION UPDATE
A – Situation
B – Intent
C – Threats
D – Targets
E – Friendlies
F – Clearance
G – Ordnance
H – Restrictions
I – Hazards
J – Remarks

GAMEPLAN / NOTES / ETD Sketch

Plan ID / Control Type / Notes	
1. IP/BP	
2. Heading	(Offset)
3. Distance	
4. TGT ELEVATION	
5. TGT Description	
6. TGT LOCATION	
7. Mark	(Code)
8. FRIENDLIES	(Mark)
9. Egress	

REMARKS
A – LTL
B – Ordnance
C– Threats
D – GTL
E – Weather
F – Hazards

RESTRICTIONS
A – FAH
B – Danger Close
C – Airspace coordination
D – TOT / TTT

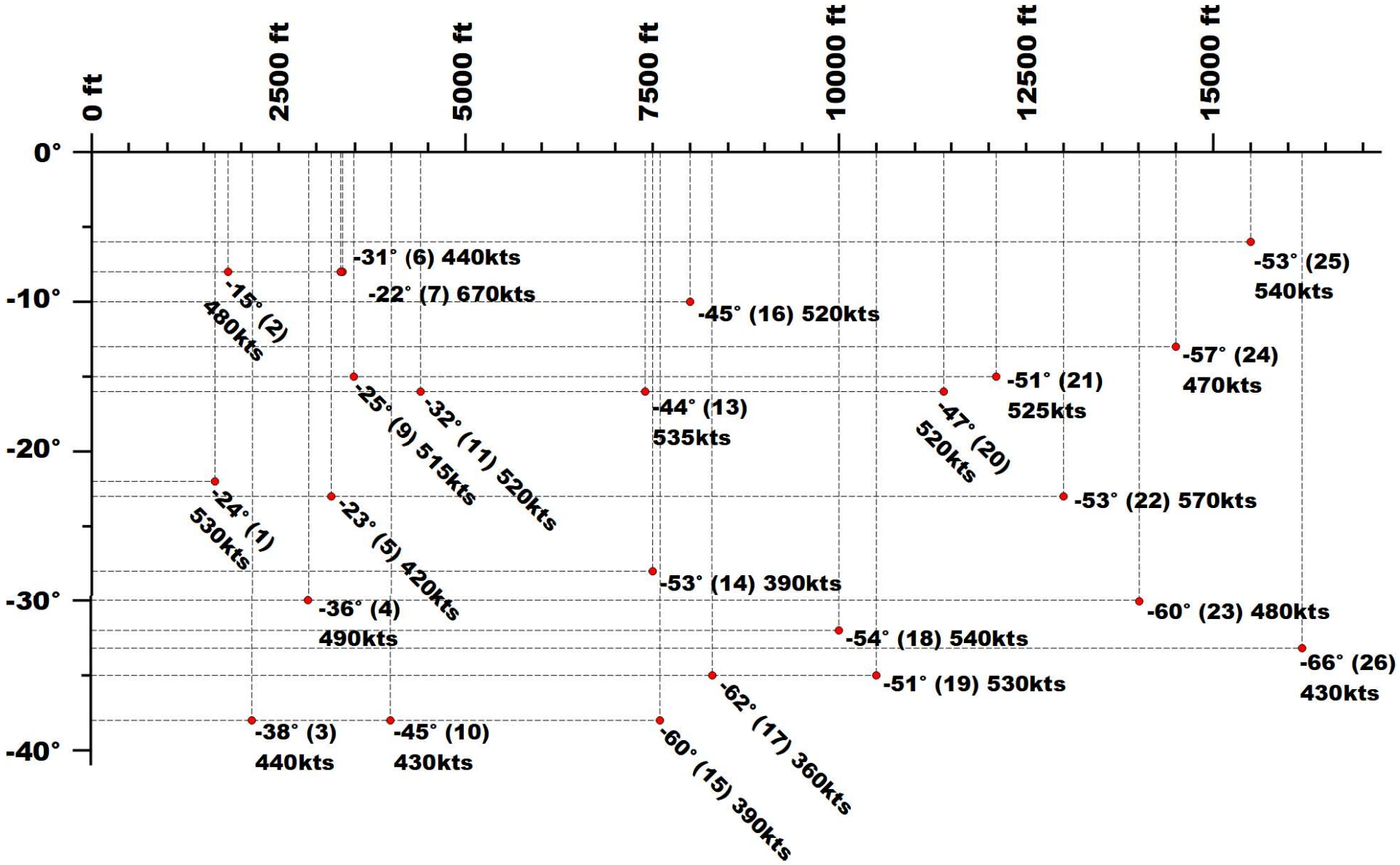
~ ♠ ~

Plan ID / Control Type / Notes	
1. IP/BP	
2. Heading	(Offset)
3. Distance	
4. TGT ELEVATION	
5. TGT Description	
6. TGT LOCATION	
7. Mark	(Code)
8. FRIENDLIES	(Mark)
9. Egress	

REMARKS
A – LTL
B – Ordnance
C– Threats
D – GTL
E – Weather
F – Hazards

RESTRICTIONS
A – FAH
B – Danger Close
C – Airspace coordination
D – TOT / TTT

II. MK-20 ROCKEYE – DISTRIBUTION OF BOMB PITCH ANGLE VS RELEASE ALTITUDE (ORDINATE) AND ATTACKER'S PITCH (ABSCISSA).



III. RIPPLE INTERVAL TABLE – MK82 LOW DRAG

1200 ft		0°	-10°
450	15ft	20	30
	60ft	80	140
500	15ft	20	30
	60ft	70	130
550	15ft	20	30
	60ft	70	130
600	15ft	20	40
	60ft	70	140
650	15ft	10	40
	60ft	60	140

1500 ft		0°	-10°
450	15ft	20	30
	60ft	80	140
500	15ft	20	30
	60ft	70	130
550	15ft	20	30
	60ft	70	130
600	15ft	20	40
	60ft	70	140
650	15ft	10	40
	60ft	60	140

2000 ft		0°	-10°	-15°	-20°
450	15ft	20	30	40	50
	60ft	80	120	150	190
500	15ft	20	30	40	50
	60ft	70	120	150	190
550	15ft	20	30	40	50
	60ft	70	110	150	190
600	15ft	20	30	40	50
	60ft	70	110	140	190
650	15ft	10	30	40	
	60ft	60	110	140	

4000 ft		0°	-10°	-15°	-20°	-30°	-40°	-45°
450	15ft	20	30	30	40	50	70	90
	60ft	80	110	120	150	210	300	370
500	15ft	20	20	30	40	50	80	90
	60ft	70	100	120	140	210	310	370
550	15ft	20	20	30	30	50	80	90
	60ft	70	100	120	140	210	310	370
600	15ft	20	20	30	30	50		
	60ft	70	90	110	140	210		
650	15ft	10	20	30	30	50		
	60ft	60	90	110	140	210		

2500 ft		0°	-10°	-15°	-20°	-30°
450	15ft	20	30	30	40	70
	60ft	80	110	140	180	270
500	15ft	20	30	30	40	70
	60ft	70	110	140	170	270
550	15ft	20	30	30	40	
	60ft	70	110	130	170	
600	15ft	20	30	30	40	
	60ft	70	100	130	170	
650	15ft	10	20	30	40	
	60ft	60	100	130	170	

3000 ft		0°	-10°	-15°	-20°	-30°	-40°
450	15ft	20	30	30	40	60	90
	60ft	80	110	130	160	240	350
500	15ft	20	30	30	40	60	
	60ft	70	110	130	160	240	
550	15ft	20	30	30	40	60	
	60ft	70	100	130	160	240	
600	15ft	20	20	30	40	60	
	60ft	70	100	130	160	240	
650	15ft	10	20	30	40	60	
	60ft	60	100	120	160	250	

3500 ft		0°	-10°	-15°	-20°	-30°	-40°	-45°
450	15ft	20	30	30	40	50	80	100
	60ft	80	110	130	150	220	330	400
500	15ft	20	20	30	40	50	80	100
	60ft	70	100	120	150	220	330	400
550	15ft	20	20	30	40	60	80	
	60ft	70	100	120	150	230	340	
600	15ft	20	20	30	40	60		
	60ft	70	100	120	150	230		
650	15ft	10	20	30	40	60		
	60ft	60	90	120	150	230		

4500 ft (A)		0°	-10°	-15°	-20°	-30°	-40°	-45°
450	15ft	20	30	30	40	50	70	80
	60ft	80	100	120	140	200	290	330
500	15ft	20	20	30	30	50	70	80
	60ft	70	100	120	140	200	290	340
550	15ft	20	20	30	30	50	70	80
	60ft	70	90	110	140	200	290	340

4500 ft (B)		0°	-10°	-15°	-20°	-30°	-40°	-45°
600	15ft	20	20	30	30	50	70	80
	60ft	70	90	110	140	200	290	340
650	15ft	10	20	30	30	50	70	
	60ft	60	90	110	130	200	290	

IV. RIPPLE INTERVAL TABLE – MK82 HIGH DRAG

0°		200 ft	300 ft	400 ft	500 ft
450	15ft		20	20	20
	60ft		80	80	80
500	15ft	20	20	20	20
	60ft	70	70	70	70
550	15ft	20	20	20	20
	60ft	60	60	60	60
600	15ft	10	10	10	10
	60ft	60	60	60	60

600 ft		0°	-10°
450	15ft	20	30
	60ft	80	130
500	15ft	20	30
	60ft	70	120
550	15ft	20	30
	60ft	60	110
600	15ft	10	
	60ft	60	

800 ft		0°	-10°	-15°
450	15ft	20	30	40
	60ft	80	110	150
500	15ft	20	30	
	60ft	70	100	
550	15ft	20	20	
	60ft	60	100	
600	15ft	10	20	
	60ft	60	90	

1000 ft		0°	-10°	-15°
450	15ft	20	30	30
	60ft	80	100	130
500	15ft	20	20	30
	60ft	70	100	120
550	15ft	20	20	30
	60ft	60	90	110
600	15ft	10	20	30
	60ft	60	80	110

1200 ft		0°	-10°	-15°	-20°
450	15ft	20	20	30	40
	60ft	80	100	120	150
500	15ft	20	20	30	40
	60ft	70	90	110	140
550	15ft	20	20	30	
	60ft	60	80	100	
600	15ft	10	20	20	
	60ft	60	80	100	

1500 ft		0°	-10°	-15°	-20°
450	15ft	20	20	30	30
	60ft	80	100	110	130
500	15ft	20	20	20	30
	60ft	70	90	100	120
550	15ft	20	20	20	30
	60ft	60	80	90	110
600	15ft	10	20	20	30
	60ft	60	70	80	110

2000 ft		0°	-10°	-15°	-20°	-30°
450	15ft	20	20	20	30	40
	60ft	80	90	100	110	160
500	15ft	20	20	20	30	
	60ft	70	80	90	100	
550	15ft	20	20	20	20	
	60ft	60	70	80	100	
600	15ft	10	20	20	20	
	60ft	60	70	80	90	

2500 ft		0°	-10°	-15°	-20°	-30°
450	15ft	20	20	20	30	30
	60ft	80	90	100	100	140
500	15ft	20	20	20	20	30
	60ft	70	80	90	100	130
550	15ft	20	20	20	20	30
	60ft	60	70	80	90	120
600	15ft	10	20	20	20	30
	60ft	60	70	70	80	110

3000 ft		0°	-10°	-15°	-20°	-30°
450	15ft	20	20	20	20	30
	60ft	80	90	90	100	130
500	15ft	20	20	20	20	30
	60ft	70	80	80	90	110
550	15ft	20	20	20	20	30
	60ft	60	70	80	80	100
600	15ft	10	20	20	20	20
	60ft	60	60	70	80	100

3500 ft		0°	-10°	-15°	-20°	-30°
450	15ft	20	20	20	20	30
	60ft	80	90	90	100	120
500	15ft	20	20	20	20	30
	60ft	70	80	80	90	110
550	15ft	20	20	20	20	20
	60ft	60	70	70	80	100
600	15ft	10	20	20	20	20
	60ft	60	60	70	70	90

V. MAXIMUM BOMB FRAGMENT TRAVEL

MUNITION	ALTITUDE (FEET) TDA		HORIZONTAL RANGE (FEET) TDA		TIME OF FLIGHT (SECONDS) TDA	
	SEA LEVEL	5000’	SEA LEVEL	5000’	SEA LEVEL	5000’
UNITARY WARHEADS						
MK-82 All Types	2140’	2500’	2550’	2900’	24.4”	25.9”
MK-84 All Types	2770’	3150’	3260’	3715’	28.0”	29.7”
BLU-109 All Types	3465’	3915’	4230’	4795’	30.3”	32.1”
INTACT CLUSTERS						
MK-20 Rockeye	1380’	1575’	1645’	1850’	19.4”	20.6”
CBU-24B/B; CBU-9B/B; CBU-52B/B; CBU-58/B, A/B; CBU-71/B, A/B	1895’	2140’	2290’	2595’	23.0”	24.4”
CBU-87/B	1895’	2140’	2290’	2595’	23.0”	24.4”
CBU-89B	2340’	2655’	2780’	3165’	26.2”	27.6”
CLUSTER SUBMUNITIONS						
BLU-26/B (CBU-24B/B); BLU-59/B (CBU-49B/B)	960’	1085’	1160’	1310’	16.3”	17.3”
BLU-61A/B (CBU-52B/B)	665’	755’	775’	880’	14.2”	15.0”
BLU-63/B, A/B; (CBU-58/B, A/B); BLU-86/B, A/B (CBU-71/B, A/B)	430’	490’	490’	560’	11.6”	12.3”
BLU-118 (MK-20 Rockeye)	695’	790’	800’	915’	14.7”	15.5”
BLU-97/B (CBU-87/B)	545’	620’	635’	725’	12.8”	13.7”

VI. ***SIGHT ANGLE CHARTS: LEGEND AND NOTES

The following charts (altitude vs mils) are used to determine the Mils setting of the sight as a function of the big three parameters: altitude, speed and diving angle.

Each charts uses a speed value at the delivery, whereas the sight angle in Mils is represented on the abscissa and the altitude (in feet AGL) on the ordinate. The bold curves each represent a diving angle, and the dashed curves the time of fall.
The area filled with hatching pattern represents cases where the combination of the parameters result in an unsafe delivery (e.g. diving angle too steep, altitude not sufficient and so on). Some charts may indicated that the speed at release is above the limits below a certain value (indicated by a specific horizontal line). This limitation may be not implemented in DCS.

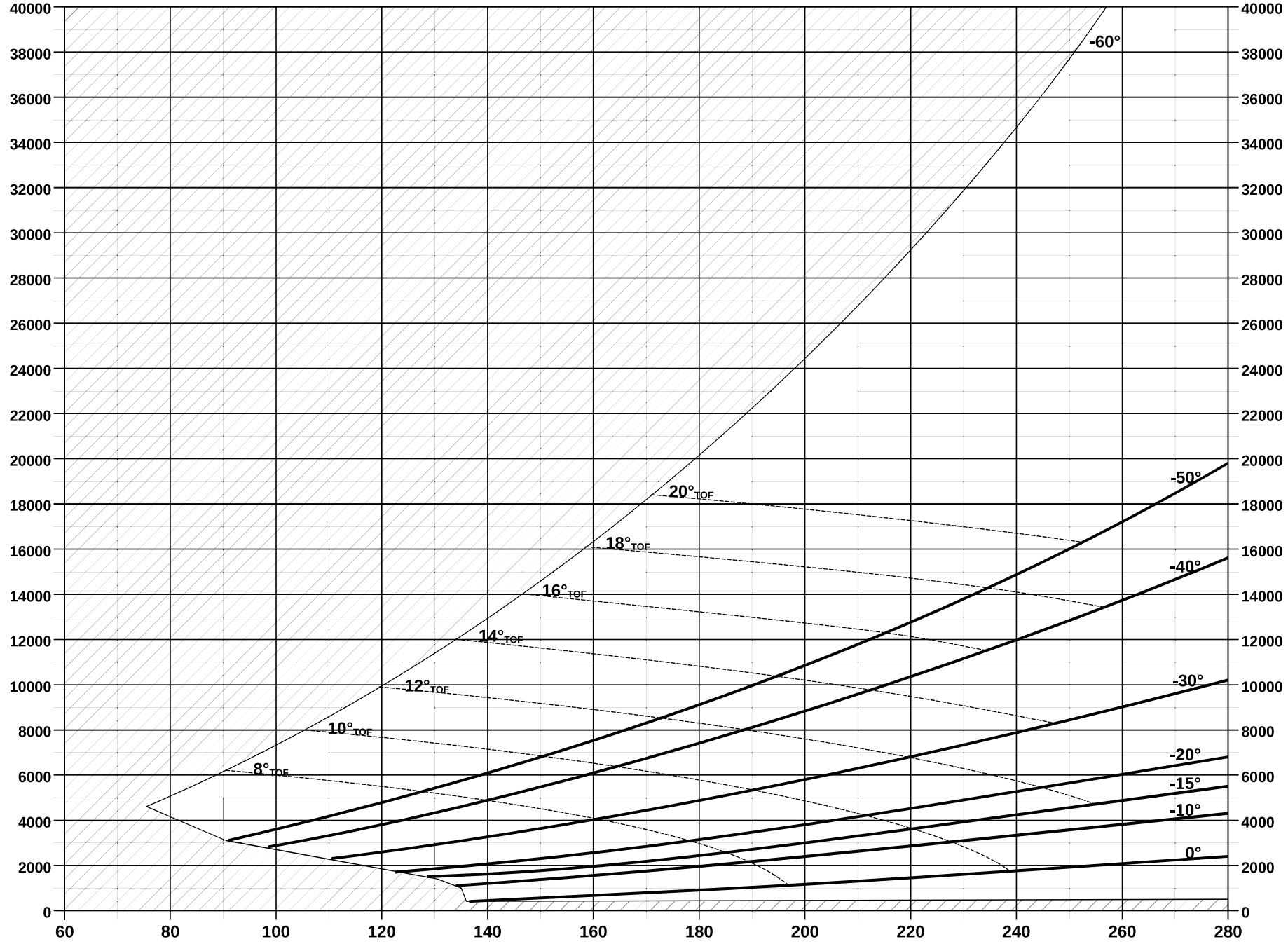
The parameters for the release are:

- delivery: single weapon;
- aircraft gross weight: 60,000 lbs;
- ejection velocity: 21.1 ft/sec;
- recovery: 5G wings level pullup recovery.

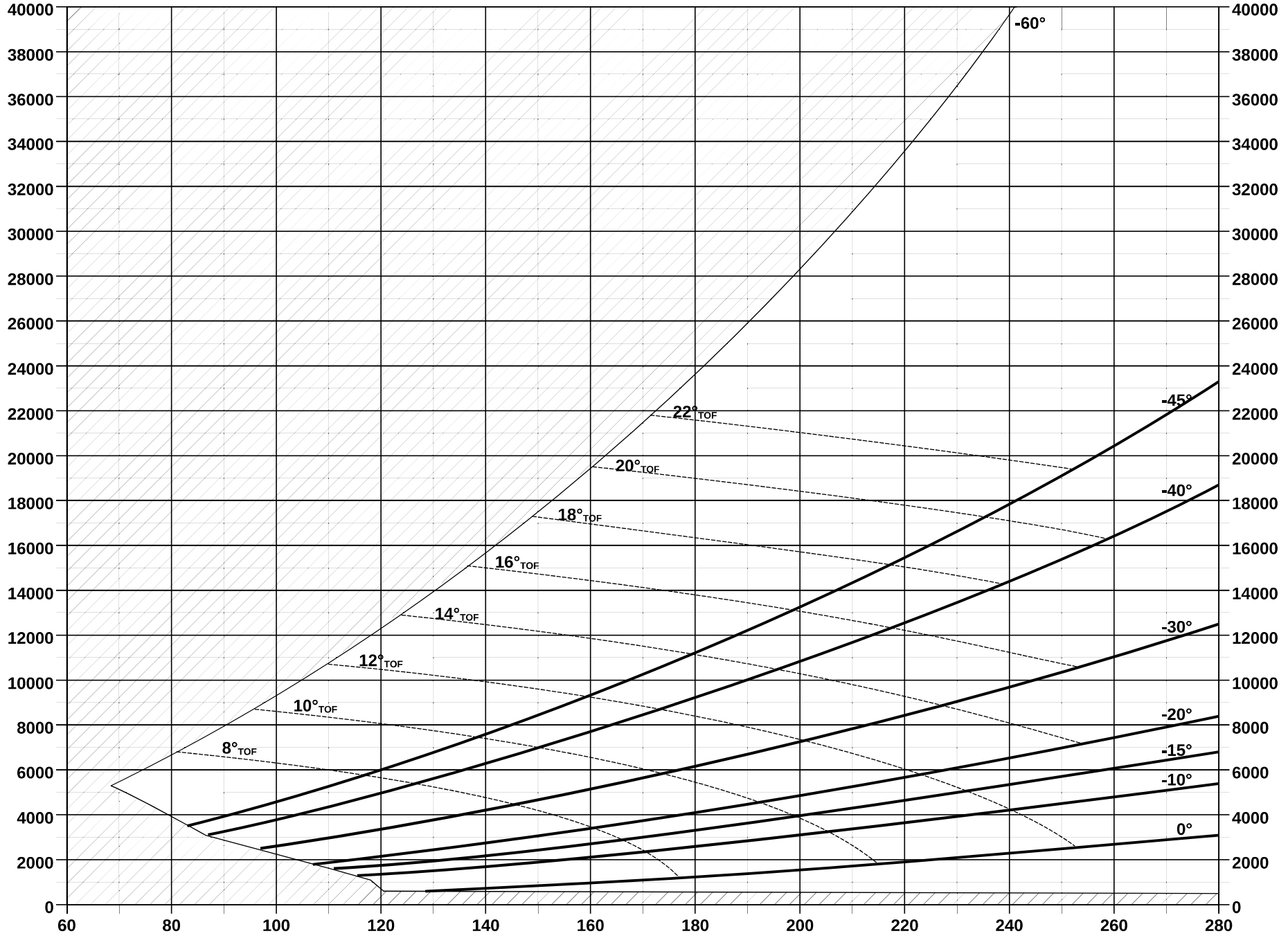
Note that the following charts are reported as examples for the RIO to double check the parameters set for the bombing. Pilots should have more detailed tables and charts to plan their approach and manual delivery.

Example

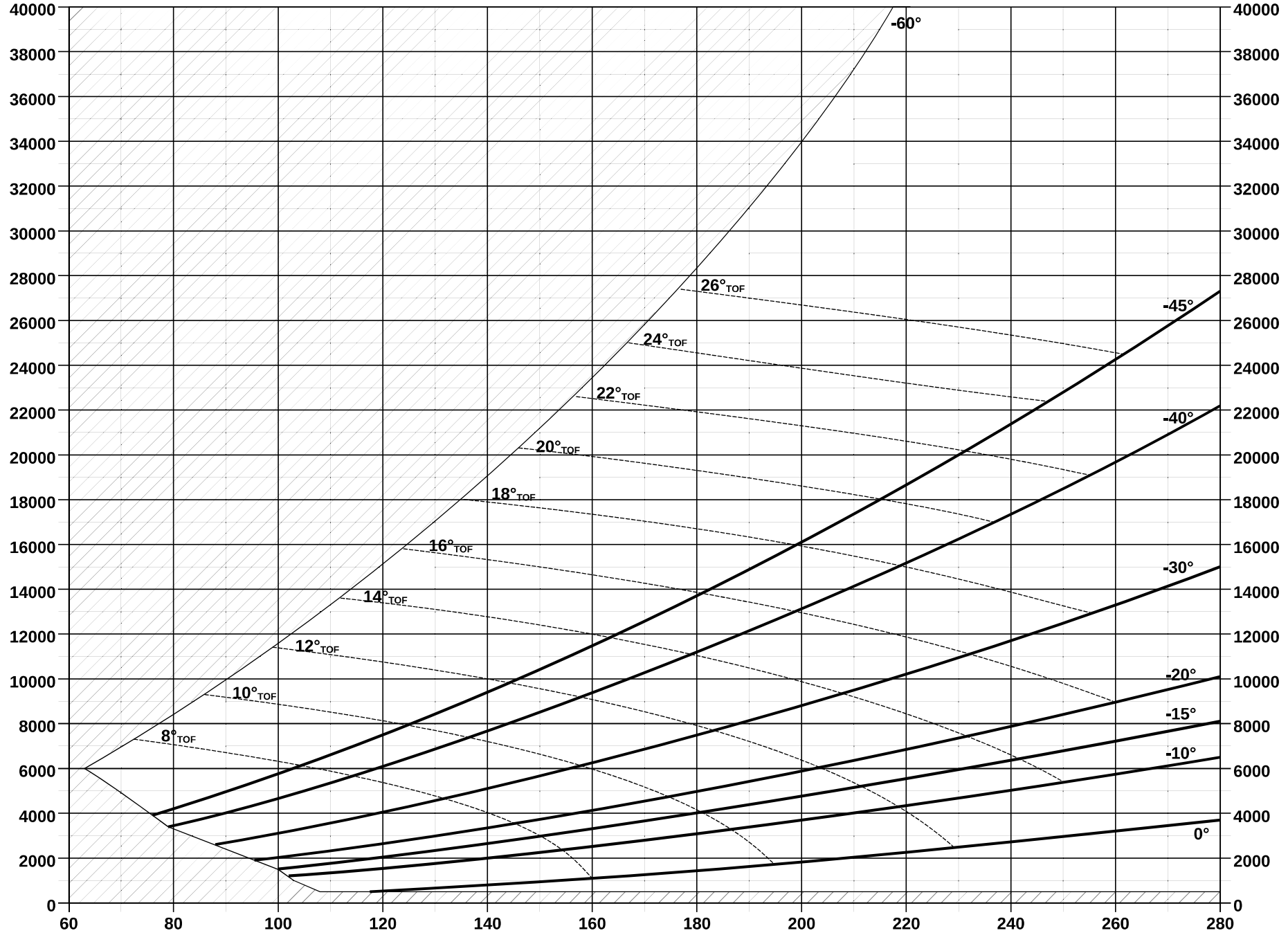
VII. SIGHT ANGLE CHARTS: MK-82, GBU-12 | 450 KTAS



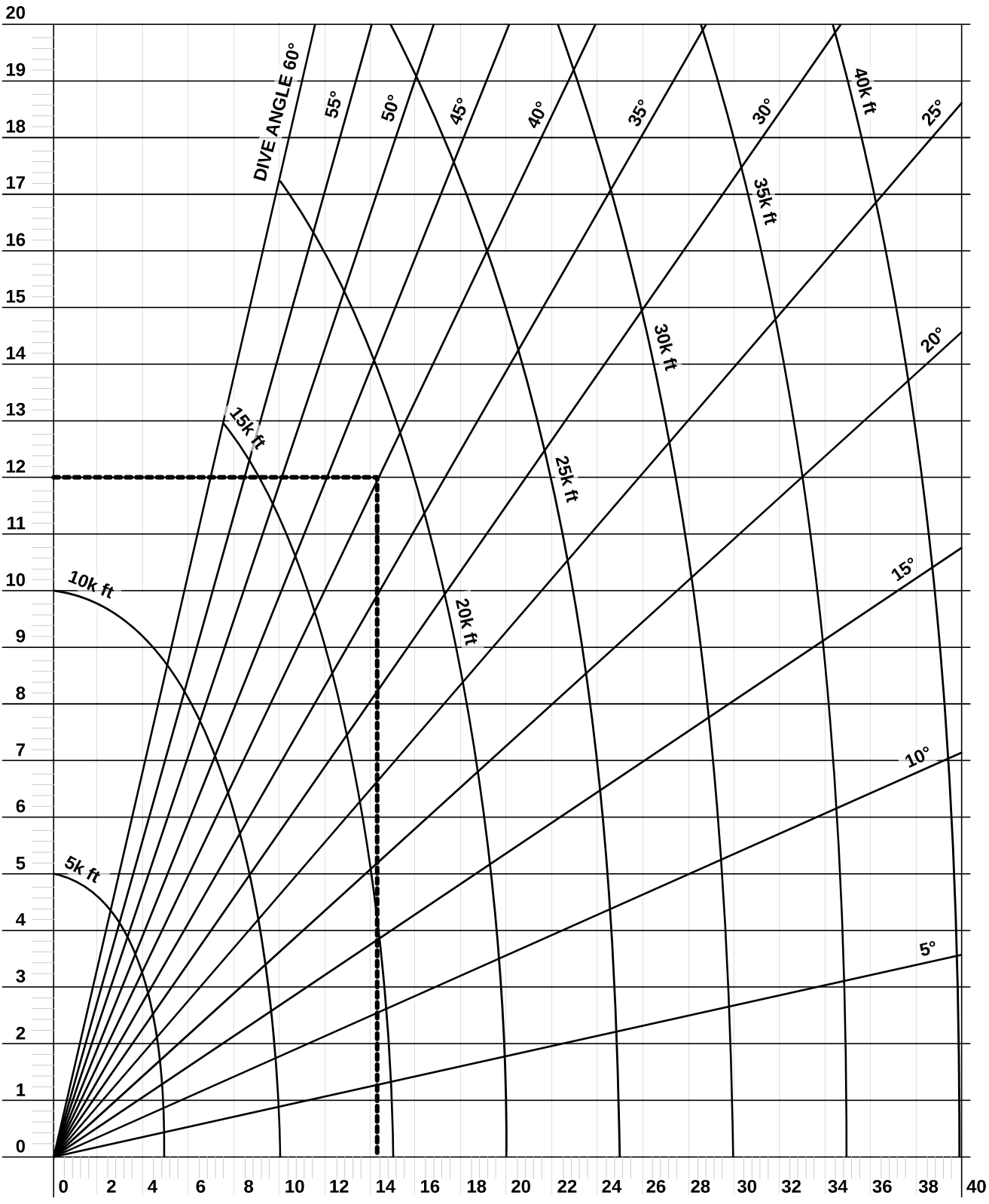
VIII. SIGHT ANGLE CHARTS: MK-82, GBU-12 | 500 KTAS



IX. SIGHT ANGLE CHARTS: MK-82, GBU-12 | 550 KTAS



X. DIVE ANGLE / HORIZONTAL DISTANCE CHART



HEIGHT: 1000ft (1 unit = 200 ft)
HORIZONTAL DISTANCE: 1000ft (1 unit = 500ft)

To find the horizontal distance from target where the roll-in is initiated, enter the chart with the desired entry height. AGL (12,000 feet) and dive angle (40°), project down and read 14,200 feet. To find the horizontal distance from the target to initiate a pop-up, multiply 2.5 times (14,200´ X 2.5 = 35,000 ft.).

25. CONTENTS INDEX

At the moment of writing Draft 64, there are 291 images (besides the ones in Chapter 23.1 (Friends and Foes) and Chapter 23.2 (***Air-to-Air and Surface-to-Air Missiles in DCS): 283 Figures and 8 Plates.

The images labelled “Figures” are made by myself (or taken and edited, in case of screenshots). The “Plates” are images that are taken from the sources mentioned in the labelled of the image itself.

25.1 ***ACRONYMS AND ABBREVIATIONS

A summary of the most recurring acronyms, alphabetically ordered.
A few peculiar abbreviations or keywords are included in the list (such as HDG or BRG).

CTX stands for “Context”, and marks in which context the definition is commonly used (there can be more than one).

- **AA** – Air-to-Air procedures (e.g. Geometry, Intercepts);
- **AG** – Air-to-Ground procedures (e.g. CAS);
- **AVIO** – Aircraft and Avionics;
- **DCS** – DCS-related definition (or plug-ins / mods);
- **FLY** – Aviation procedures and non-avionics related terminology;
- **gen** – Generic definition (multiple contexts);
- **NAVY** – US Navy or Nautical definitions;
- **SA/S** – Surface-to-Air or Surface-to-Surface
- **TECH** – Technical details and theory (e.g. radar theory);
- **WPN** – Weapons and Engagements.

A

ACR	MEANING	CTX	REFERENCE
AAA	Anti-Aircraft Artillery	SA/S	

ACR	MEANING	CTX	REFERENCE
AA	Aspect Angle	*AA*	**5.2**
ACM	Airspace Coordinating Measures	*ACM*	
ADF	Automatic Direction Finder	*AVIO*	
ADL	Armament Datum Line	*AG*	
AIC	Air Intercept Controller	*AA*	
AFT	Aft – in this document used to refer to the RIO's radio.	*AVIO*	
AHRS	Attitude and Heading Reference Set	*AVIO*	
AO	Angle Off (synonym of ATA, RBRG)	*AA*	**5.2**
AoA	Angle of Attack	*AVIO*	
AoB	Angle of Bank	AVIO	
AREO	Azimuth, Range, Elevation, Overtake (VC)	AA	**9.4.3**
ARH	Active Radar Homing		
ATA	Antenna Train Angle (synonym of AO, RBRG)	*AA*	**5.2**
ATC	Air-Traffic Control	FLY	
AWACS	Airborne Warning and Control System	AA	

B

ACR	MEANING	CTX	REFERENCE
BB	Bandit Bearing.	*AA*	**5.2**
BDHI	Bearing, Distance, Heading Indicator	*AVIO*	**10.2.4**
BFP	Bandit Flight Path.	*AA*	**5.2**
BH	Bandit Heading.	*AA*	**5.2**
BR	Bandit Reciprocal.	*AA*	**5.2**
BRA/A	Bearing, Range, Altitude (Aspect)	*AA*	
BRG	Bearing.	*gen*	
BVR	Beyond Visual Range	AA	

C

ACR	MEANING	TPC	REFERENCE
CAP	Computer Address Panel.	*AA*	
CAS	Close Air Support.	*AG*	
CB	Collision Bearing.	*AA*	
CC	Collision Course Correction.	*AA*	
CM	Conventional Counter Measures (Chaff, Flares, ..)	*AVIO*	

ACR	MEANING	TPC	REFERENCE
CSDC	Computer Signal Data Converter	*AVIO*	
CVW	Carrier Air Wing	*NAVY*	

D

ACR	MEANING	TPC	REFERENCE
DA	Dead-Ahead.	*AA*	
DCS	Digital Combat Simulator.	*DCS*	
DDD	Detail Data Display	*AVIO*	
DEAD	Destruction of Enemy Air Defenses	AG	
D/ECM	(Defensive) Electronic Counter Measures	*AVIO*	
DME	Distance Measuring Equipment	FLY	
DoP	Direction of Passage.	*AA*	
DOR	Desired Out Range (synonym of MOR).	*AA*	
DR	Decision Range.	*AA*	
DT	Displacement Turn.	*AA*	
DTG	Degrees-To-Go (synonym of HCA).	*AA*	

E

ACR	MEANING	TPC	REFERENCE
ELF	Extremely Low Frequency (30 Hz – 300 Hz)		

F

ACR	MEANING	TPC	REFERENCE
FAC /A	Forward Air Controller (Airborne)	*AG*	
FFP	Fighter Flight Path.	*AA*	
FH	Fighter Heading.	*AA*	
FLO	First Launch Opportunity.	AA	
FO	Forward Observer.	AG	
FR	Factor Range.	*AA*	
FSCL	Fire Support Coordination Line	*AG*	
FWD	Forward – in this document used to refer to the Pilot's radio.	*AVIO*	

G

ACR	MEANING	TPC	REFERENCE
GCI	Ground-Controlled Intercept	*AA*	

ACR	MEANING	TPC	REFERENCE
GS	Ground Speed	*AVIO*	

H

ACR	MEANING	TPC	REFERENCE
HCA	Heading Cross Angle (synonym of DGT).	*AA*	
HCU	Hand Control Unit.	*AVIO*	
HD	High-Drag.	*AG*	
HDG	Heading.	*gen*	
HF	High Frequency (3 MHz – 30 MHz)		
HPRF	High Pulse Repetition Frequency.	*TECH*	

I

ACR	MEANING	TPC	REFERENCE
IAS	Indicated Air Speed.	*AVIO*	
ICS	Intercommunication System	*AVIO*	
IFF	Instrumental Friend-or-Foe	*AVIO*	
IMU	Inertial Measurement Unit	*AVIO*	
INS	Inertial Navigation System.	*AVIO*	

J

ACR	MEANING	TPC	REFERENCE
JTAC	Joint Terminal Attack Controller	*AG*	

K

ACR	MEANING	TPC	REFERENCE
KBC	Kill Box Coordinator	*AG*	

L

ACR	MEANING	TPC	REFERENCE
LAR	Launch Acceptability Region.	*AA*	
L_D	Lateral Displacement (synonym of LS).	*AA*	
LD	Low-Drag (ordnance)	AG	
LPRF	Low Pulse Repetition Frequency.	*TECH*	
LS	Lateral Separation (synonym of L_D).	*AA*	

M

ACR	MEANING	TPC	REFERENCE
MANPAD	Man Portable Air Defence Systems	SA/S	
MAR	Minimum Abort Range.	*AA*	
MER	Multiple Ejector Rack		
MF	Medium Frequency (300 kHz – 3 MHz)		
MOR	Minimum Out Range (synonym of DOR).	*AA*	

N

ACR	MEANING	TPC	REFERENCE
NDB	Non-Directional Beacon	*FLY*	
nm	Nautical Miles.	*gen*	
NFO	Naval Flight Officer	*NAVY*	

P

ACR	MEANING	TPC	REFERENCE
P	Pulse (radar mode).	*TECH*	
PD	Pulse Doppler (radar mode).	*TECH*	
P_K	Probability of Kill.	*WPN*	
PRF	Pulse Repetition Frequency.	*TECH*	
PTT	Push-To-Talk	*gen*	

R

ACR	MEANING	TPC	REFERENCE
RBRG	Relative Bearing (synonym of ATA, RBRG).	*AA*	
RCS	Radar Cross-Section	*TECH*	
ROC	Rate of Closure (synonym of V_C).	*AA*	
RROC	Range Rage of Closure.	*AA*	
RWR	Radar Warning Receiver	*AVIO*	

S

ACR	MEANING	TPC	REFERENCE
SA	Situational Awareness	*gen*	
SAM	Surface-to-Air Missile.	*SA/S*	
SARH	Semi-Active Radar Homing		

ACR	MEANING	TPC	REFERENCE
SCAR	Strike Coordination And Reconnaissance	*AG*	
SEAD	Suppression of Enemy Air Defences	*AG*	
SR	Slant Range.	*gen*	
SRS	SimpleRadio Standalone.	*DCS*	

T

ACR	MEANING	TPC	REFERENCE
TA / TAA	Target Aspect (Angle).	*AA*	
TA	Transition Altitude.	*FLY*	
TACAN	Tactical Air Navigation System.	AVIO	
TAS	True AirSpeed.	*FLY*	
TCS	Television Camera Set	*AVIO*	
TER	Triple Ejector Rack		
TGT	Target	*gen*	
TID (AS / GS)	Tactical Information Display. • AS: Aircraft Stabilized mode; • GS: Ground Stabilized mode.	*AVIO*	
TL	Transition Level.	*AVIO*	
TOT	Time-On-Target.	*AG*	
TTT	Time-To-Target.	*AG*	

U

ACR	MEANING	TPC	REFERENCE
UHF	Ultra High Frequency.	*gen*	
ULF	Ultra Low Frequency (300 Hz – 3 kHz). See also VF.		

V

ACR	MEANING	TPC	REFERENCE
V_C	Closure Rate (synonym of ROC).	*AA*	
V_D	Vertical Displacement.	*AA*	
VF	Voice Frequency (300 Hz – 3 kHz). See also ULF.		
VHF	Very High Frequency	*gen*	
VID	Visual Identification	*gen*	
VLF	Very Low Frequency		

ACR	MEANING	TPC	REFERENCE
VOR	VHF Omnidirectional Range		
VUL	Vulnerability Time / Window	*FLY*	

W

ACR	MEANING	TPC	REFERENCE
WCA	Wind Correction Angle	*FLY*	
WEZ	Weapon Engagement Zone.	*AA*	
WD	Wind Direction	*FLY*	
WS	Wind Speed	*FLY*	
W/V	Wind Velocity	*FLY*	
WVR	Within Visual Range	*AA*	

25.2 LIST OF FIGURES

25.3 LIST OF PLATES

25.4 BIBLIOGRAPHY

The list of books, articles, videos, podcasts I used to learn what I poured into this book is incredibly long.
The following is a short list of the books and publications I read or re-read recently. Other minor sources are listed directly in this book, along with the author.

Books

I recommended the books here listed. They are also available in eBook / Kindle format and definitely worth buying.

Dave "Bio" Baranek (YouTube channel)	• Tomcat RIO: A Topgun Instructor on the F-14 Tomcat and the Heroic Naval Aviators Who Flew It; • Top Gun Days: Dogfighting, Cheating Death, and Hollywood Glory as One of America's Best Fighter Jocks;
David Gledhill	• The Phantom in Focus; • Per Ardua – Training an RAF Phantom Crew. With Philip Keeble.

Robert L. Shaw	• Fighter Combat – Tactics and Maneuvering.
Wg Cdr C. G. Jefford	• Observers and Navigators: And Other Non-Pilot Aircrew in the RFC, RNAS and RAF.
C. R. Anderegg[147]	• Sierra Hotel: Flying Air Force Fighters In The Decade After Vietnam.
John Trotti	• Phantom Over Vietnam.
Dave Parsons, George Hall, Bob Lawson	• Grumman F-14 Tomcat: Bye - Bye Baby...!
Peter Hunt	• Angles of Attack, An A-6 Intruder Pilot's War.
Steve Davies	• Red Eagles: America's Secret MiGs.
Bruce Gordon	• The Spirit of Attack: Fighter Pilot Stories

Series

Babak Taghvaee	• Iranian Tigers at War.
Farzad Bishop and Tom Cooper	• Iranian F-4 Phantom II Units in Combat. • Iranian F-14 Tomcat Units in Combat.
Shlomo Aloni	• Israeli F-4 Phantom II Aces.

Documentation

Chief of Naval Air Training (CNATRA)	• Several publications. Notable mentions:
	  • P-825, 2017 edition;
	  • P-825, 2008 edition;
	  • P-825, 2002 edition;
	  • P-1209, 2009 edition;
	  • P-1208, 2019 edition.

Joint Publications	• 3-9.3 – Joint Fire Support; • 3-5.2 – Joint Airspace Control.

147 Author sometimes is listed "U.S. Air Force".

26. ~~ANTE~~ POST SCRIPT

> This used to be the very first chapter of the book. Since Draft 65, it is now at the very bottom. I figures that very few care about the personal notes: how often do you skip them in book. Heck, there's even a popular meme about recipes and cooking websites!

I played DCS since day-one on the Ka-50, back in 2008. Before, LOMAC and Falcon 4.0 quite randomly, and mostly Il2 FB. The F-14 therefore, has been my first modern Fixed Wing aircraft, and I zero meaningful knowledge of anything related to air-to-air. I was frustrated by my lack of understanding of what was going on.
The only solution was diving into the problem itself and slowly put bits and pieces together.

I launched FlyAndWire in 2019 for a completely different reason (it was meant to host Arduino discussions and firmware), then the F-14 was released by Heatblur, and everything changed.

This book is a tentative to convey the sense of organization and progression that my website cannot convey, given its blog-style format.

CORE POINTS OF THE BOOK

The level of the discussion, both in terms of contents, maths and procedures, is intentionally kept somewhere between simulative and "inspired to the reality". In a few occasions, I diverted from the doctrinal sources to propose solutions I deemed more appropriate to DCS. When it happened, I usually added a note. There's a lot of room to go deeper!

This book often links the F-14 Manual written by Heatblur. That excellent book is the primary source of technical information about the F-14, more than enough to cover all the basic operations. Do not expect to understand much of this book without reading the manual first (or having some relative background). Learning takes a bit of effort, this book is not for people with no patience and that want everything right-away.

On the other hand, almost everything you find here, besides the minor details and especially procedures, can be applied to other aircraft.

CONTENTS

Initially, due to time constraints, the book will vastly take content from my website, in a 30/70 ratio between new content and older. Later, every paragraph and sentence will be review and normalized.

The result is a hands-on approach to the backseat, however, a good chunk of theory and background needs to be discussed before getting to the actual employment.

NOTES ON LANGUAGE AND LEXICON

I am not a native English speaker, so you *will* find mistakes (typos, grammar, lexicon, et cetera) and sentences structured in some funny way. If you ran into those, please point them out, and I will fix them in the next review.

The contents and lexicon, especially when it comes to Maths, are the same I learnt in 2nd and 3rd year of high school (uh, I feel old now). Friends pointed out that some terms and rarely used in other countries or outside specific contexts, so do not take them as a tentative to sound fancy or original. If I were writing in my native language, those terms would probably sound less alien, but English is de facto the nouveau lingua franca, ergo…

MAIN SOURCES

I used a considerable number of sources, all original, no work done by peers or other content creators (unless they collaborated to this project).

The main sources are:

1. F-14 manual by Heatblur;
2. P-825, rev 2017, 2008 and 2002;
3. Other documentation.

It is important to understand that sources such as the P-825 are very basic: their goal is introducing the bedrock concepts, and the described procedures are often too monolithic to be applied as they are. Nevertheless, they provide an incredibly interesting point of view for both neophytes and seasoned pilots looking to providing a more solid structure to their missions.

THANKS TO…

- Dave “Bio” Baranek, for the clarifications and the permission to include quotes of his book in this document;
- Scott “Weird” Altorfer, former F-14A RIO. Thanks for the great discussions!
- 132nd Virtual Wing Sabre squadron, for listening to my nonsense (and being my Guinea pigs)!

- Digital Coalition Air Force (DCAF), especially Peter, Rob and Brody. Peter has recently posted a couple of articles on FlyAndWire. Thanks mate!
- witcohe, former A-6 B/N. One day I'll understand why AN/ASN-92 ≠ AN/ASN-92! :)
- Kip, Ce_Zeta, Don H., Snappy and BlackDragon for feedback, corrections and the suggestions;
- AssafB, Professor, and others for their input in the CAS discussion;
- Rifle (Canadian JTAC), check his Discord and YouTube channel;
- SkillyJ (US JFO) for his input in the CAS discussion;
- LynxOfTheSky for prompting the INS/MagVar in-depth discussion and his great observations.

FEEDBACK / QUESTIONS / COMMENTS

My Discord ID and other forum profiles are listed here. You are welcome to get in touch!

26.1 RELEASES AND CHANGELOG

The first releases will be incomplete. Non-completed Chapters (checks for typos and grammars excluded) are stripped from the public version and re-integrated only when complete.

Examples of such Chapters are:

1. Operations: Air to Ground – an overview of the Air to Ground procedure that can be used by the F-14 Tomcat. For example, a discussion about the 9-line CAS brief and others;
2. Appendix: Friends and Foes – most of the aircraft operative in the years around the arrival of the F-14 are mentioned in this Chapter. Each aircraft has a picture, description, a few notes both for DCS and historical. Later, each will have a typical MAR and other useful parameters.
3. Appendix: Comms & Pictures – a series of sketches and examples to explain how the Picture is passed to the committed fighters.
4. Intercept Geometry Study: Other Sources – a brief mention of intercepts from different sources. From the F-4, to the intercepts described by R. Shaw in his book. The goal is providing more ideas and apply what studies to those intercepts.
5. Cockpit Introduction and Startup – a more detailed version of the startup checklist, plus the startup and the INS alignment from a Carrier.

RELEASE HISTORY AND LOG

1. 10/09/2022 Draft 113: Public Draft V;
2. 05/05/2022 Draft 108S: Public Draft IV update;
3. 24/03/2022 Draft 103S: Public Draft IV;
4. 08/12/2021 Draft 71b: Public Draft III;
5. 08/12/2021 Draft 71: Public Draft III, RC1;
6. 24/10/2021 Draft 61: Draft II released;
7. 21/10/2021 Draft 60: Public Draft II, RC1;
8. 09/10/2021 Draft 54: Draft I released;
9. 09/10/2021 Draft 53: Public Draft I, RC2;
10. 06/10/2021 Draft 51: Public Draft I, RC1;
11. 05/10/2021 Draft 47: first private release for feedback;
12. 02/09/2021 Draft 1: opera start.

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