The Dassault Mirage III in South African Air Force service



PART 5

SAAF Mirage III radar, aircraft protection systems, communications and radio, navigation and air data systems

This E-book was compiled by Malcolm Reid and Martin Strümpfer
Malcolmreid1136@gmail.com
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Parts 1 to 8 of this E-book were originally released in May 2022. Since that initial release, comments have been received from several interested readers who have provided some corrections. In addition, more in depth research regarding various aspects of the SAAF's Mirage III camouflage schemes have been provided by Martin Strümpfer. I am indeed appreciative and thankful that Martin, a fellow SAAF Mirage fan, has invested time and effort in providing additional research and input to make this document as accurate as possible. Whilst Parts 1 to 5 have been revised (to Revision 1), Parts 6 and 7 remain unchanged as originally published in May 2022.

Revision 1 of this document (Part 5) contains the following changes / additions :

- Updated data pertaining to the threat countermeasures equipment installed on the SAAF Mirage III fleet.

In the compilation of this document, data has been obtained from various Internet sources and contributors. This data has been cross-referenced where needed to ensure, as much as possible, the consistency and correctness of that data. There have been many contributors to various Internet forums relating to the SAAF Mirage III, and in particular, the Unofficial SAAF Website (saairforce.co.za). Without the efforts by fellow enthusiasts, pilots and crews in providing this written and photographic documentation of the history of the Mirage III in SAAF service, this narrative would not have been possible. Many of the images sourced via Internet searches have been used without the specific permission from the originators as, in many cases, these are unknown. Others have been included with the originators' details retained and unedited as sourced from the Internet. The images have been included in this document on a "fair use" basis for the purposes of historical research and the recording thereof. This document is offered publicly as a free e-book and in no way does it provide a source of income for the author or any other party.

As noted in Part 1, the quality of images in many instances is low due to the electronic file size, some less than 50kB. These images have been retained as sourced from the Internet and have not been subject to any adjustments (hue, saturation etc.) and have not been sharpened.

Part 5 - SAAF Mirage III radar, aircraft protection systems, communications and radio, navigation and air data systems

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1 Radar

The Mirage IIICZ was equipped with a very simple avionics suite from the outset. A Thompson-CSF Cyrano I radar was mounted in the nose for use in the air intercept mode in conjunction with the Matra R530 Semi-Active Radar Homing (SARH) missile. Being an early generation aircraft radar, functionality and reliability of the Cyrano was not the best and often the IIICZ was restricted to clear weather day operations under control of ground radar (Dayton in South West Africa). Using cockpit photos as reference, BZ #818 does not have a radar scope on the instrument panel. The deduction is that the BZ was not equipped with the Cyrano radar.

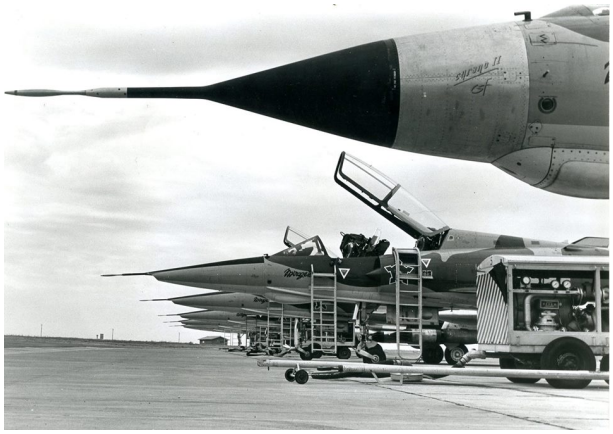
The Mirage IIIEZ was equipped with the upgraded Cyrano II radar which offered a dual air / ground mode. The ground radar mode was introduced to support the Mirage IIIE's intended ground attack role.

As noted in Part 1 of this document, the entire nose (including the radar) could be removed for maintenance. In this case, a replacement nose with adequate ballast could be installed.

The Mirage IIIDZ, D2Z, RZ and R2Z were not equipped with radars.



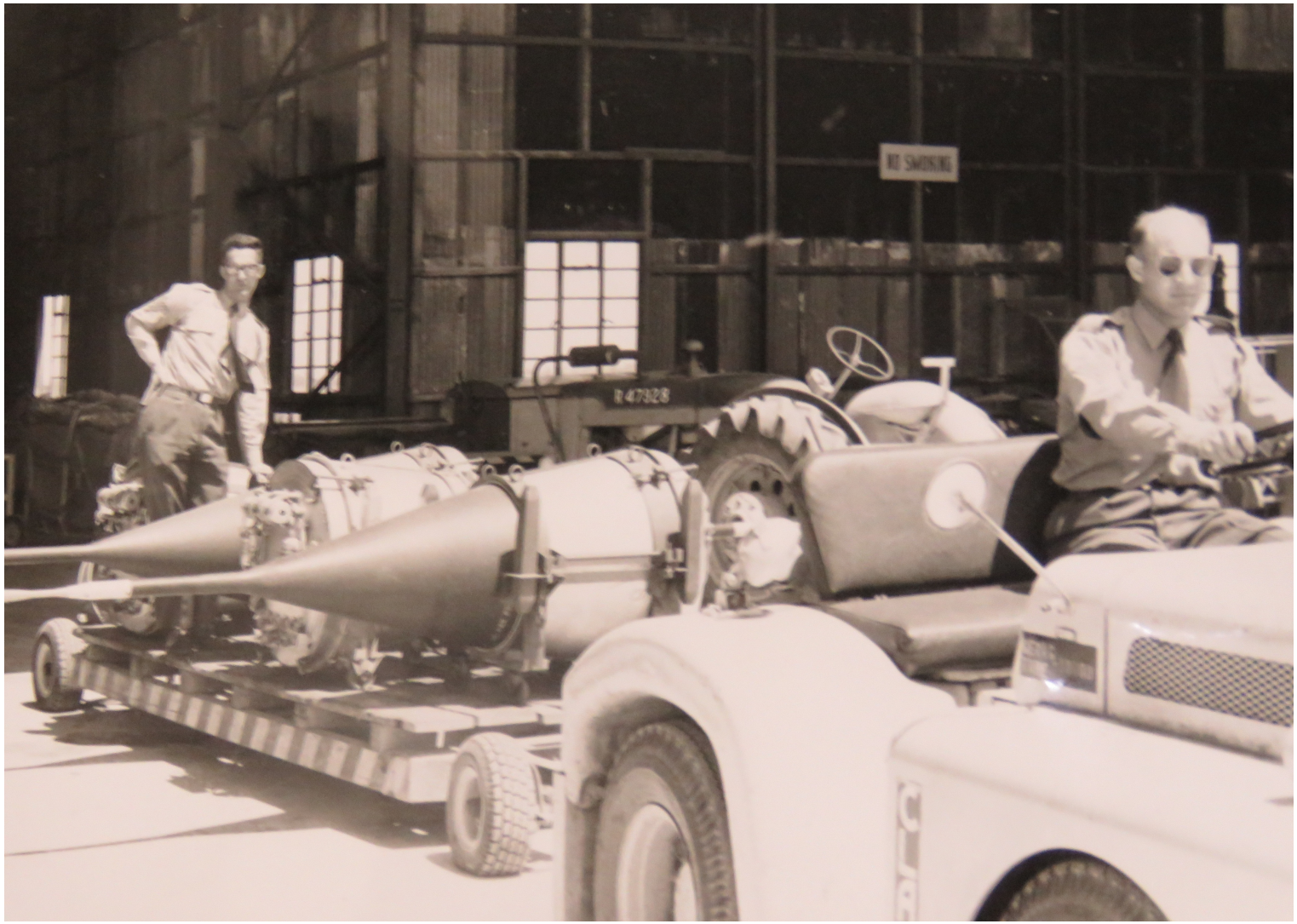
Cyrano I radar fitted to CZ #813.



The nose in the foreground is that of an EZ with hard edge gloss camouflage and *Cyrano II CSF* on the nose. Note the characteristic doppler antenna located beneath the nose. The second aircraft is a DZ (note the doppler antennas) and the remainder appear to be D2Zs (no doppler antenna).



Picture taken from 2 Squadron Diary dated 1967 showing the removal of a radar nose cone. Note *Cyrano II CSF* script on the natural metal portion of the nose cone, indicating that the aircraft tis a Mirage IIIEZ. Note the doppler antenna on third EZ.



Mirage III radar nose cones – 2 Squadron Diary dated 1967.

2 Doppler

The Mirage IIIDZ, EZ and RZ were equipped with a Marconi continuous-wave Doppler navigation antenna located in a distinct round fairing beneath the cockpit and forward of the nose gear. This uses the Doppler effect to accurately measure the aircraft's groundspeed and drift which is displayed on the cockpit Doppler radar control panel and used by the Position Homing Indicator (PHI) navigation computer to provide an accurate navigation plot. Doppler can function from 40ft to 50,000ft altitude and 80 knots to 800 knots air speed.



Doppler fairing on EZ #822. The dielectric antenna panel is cream coloured.



Doppler fairing on RZ #838. The teeth cover the dielectric panel.

3 Mirage III RWS, RIMS and ECM aircraft protection system upgrades

3.1 Radar Warning System (RWS)

SAAF Mirage III RWR (Radar Warning Receiver) fits as delivered from the factory varied across the various Mirage types:

- The CZ fleet, being the oldest Mirage type, stemmed from a time before the importance of warning against threat radars was fully realized and thus had no RWR equipment.
- The EZ and RZ aircraft were fitted with French Thompson BZ RWR equipment which only allowed for the basic detection of threat radar signals with audio and visual warning. The pancake shaped antenna was located in a housing above the rudder on the vertical stabilizer.
- The R2Z fleet shared the French Thompson-CSF BF RWR equipment as fitted to the Mirage F1s. This system's antennas are located in prominent bullet shaped fairings on the leading and trailing edge of the vertical stabilizer. The BF system provided the pilot with an audio warning and a general direction of the threat using a set of dashboard display lamps. It had a limited ability to indicate general classes of radars.
- None of the SAAF's dual seat trainer Mirage IIIs (BZ, DZ and D2Z) were fitted with RWR equipment.

During the 1980s, the SAAF was conducting a significant number of offensive operations over Southern Angolan. This exposed the SAAF aircraft to the dense ground-based air defense threat care of Cuban and Russian supplied anti-aircraft systems including a large number of Surface to Air Missile (SAM) systems and types. The airspace over Southern Angola at that time was considered some of the most contested on the planet. Because of this, there was a need to equip the SAAF aircraft with a more technically advanced RWR package to offer better protection to aircraft which were considered irreplaceable under the International Arms Embargo imposed on South Africa at the time. As such, several Mirage III types which were used in combat operations (CZ, RZ and R2Z) were upgraded with locally developed digital radar warning systems (RWS) and self-protection systems. The new RWS was developed in conjunction with Israel which approached the SAAF due to their ongoing experience facing the latest Soviet SAM systems. The eventual South African RWS was however unique and adapted specifically to the SAAF's requirements.

The RWS consisted of four spiral antennas covering the four quadrants of the aircraft. They were placed such that at least two, sometimes three antennas, depending on a threat radar's position relative to the aircraft, could detect an emitting radar. By continually comparing the detected signal strength between each antenna the system could determine the position of the emitting radar relative to the aircraft. The four spiral antennas covered the 2 to 18 GHz frequency range where search and track radars typically operate.

Two additional antennas formed part of the RWS suite covering the frequency range 0,5 to 2 GHz. They are omnidirectional antennas consisting of a button and blade antenna. The button antenna purely scanned for the continuous wave illumination signal of the long-range SAM-6 when guiding towards the aircraft and thus served as launch warning detection. The blade antenna covered the rest of the frequency spectrum and was optimized for the guidance signals of the SAM-2 and SAM-3 missiles – again functioning as launch warning detection.

A display unit on the instrument panel provided the pilot with an indication of the threat type, the direction relative to their aircraft, and whether they were within or outside the detected SAM's engagement range. The RWS was equipped with a threat library so that detected signals could be matched to the exact type of threat, informing the pilot accordingly so that appropriate defensive actions could be taken. The library could be updated as new threat signatures were identified and was typically programmed before a deployment, based on intelligence regarding the anticipated threats. A recording function was also included for post-flight analysis of any new radar signals detected during a mission.

By the early 1980s, most SAAF Mirage III types (EZ, DZ and D2Z) were earmarked for Cheetah conversion which would have included an advanced RWS. These types were mainly used in the advanced training role and there was thus no urgent demand to have them upgraded before undergoing the Cheetah conversion.

The "Recce flight" consisting of the RZ and R2Z aircraft were however regularly being deployed to the border playing a central role in the gathering of photographic intelligence about potential targets. Their speed made them ideal for gathering information about targets located in high threat environments where the much slower Canberras proved to be too vulnerable for this type of operation.

While the RZ and R2Z fleets were also earmarked for conversion to the reconnaissance Cheetah R/R2 standard, their regular operational use meant there was an immediate demand to have them fitted with the upgraded RWS before undergoing the Cheetah conversion. These aircraft would thus have their original French RWR equipment replaced with the new digital RWS.

On the RZ fleet, the two rear quarter spiral antennas were built into the existing housing for the BF RWR antenna. On the R2Z, the rear facing BF RWR antenna was removed from the top of the vertical stabilizer and replaced with the two rear quarter spiral antennas. The forward-facing BF RWR antenna housing and equipment was also removed. On both types, the two forward spiral antennas were mounted on the lower nose of the aircraft, just ahead of the windshield with the two omnidirectional antennas being mounted on the nose gear door.

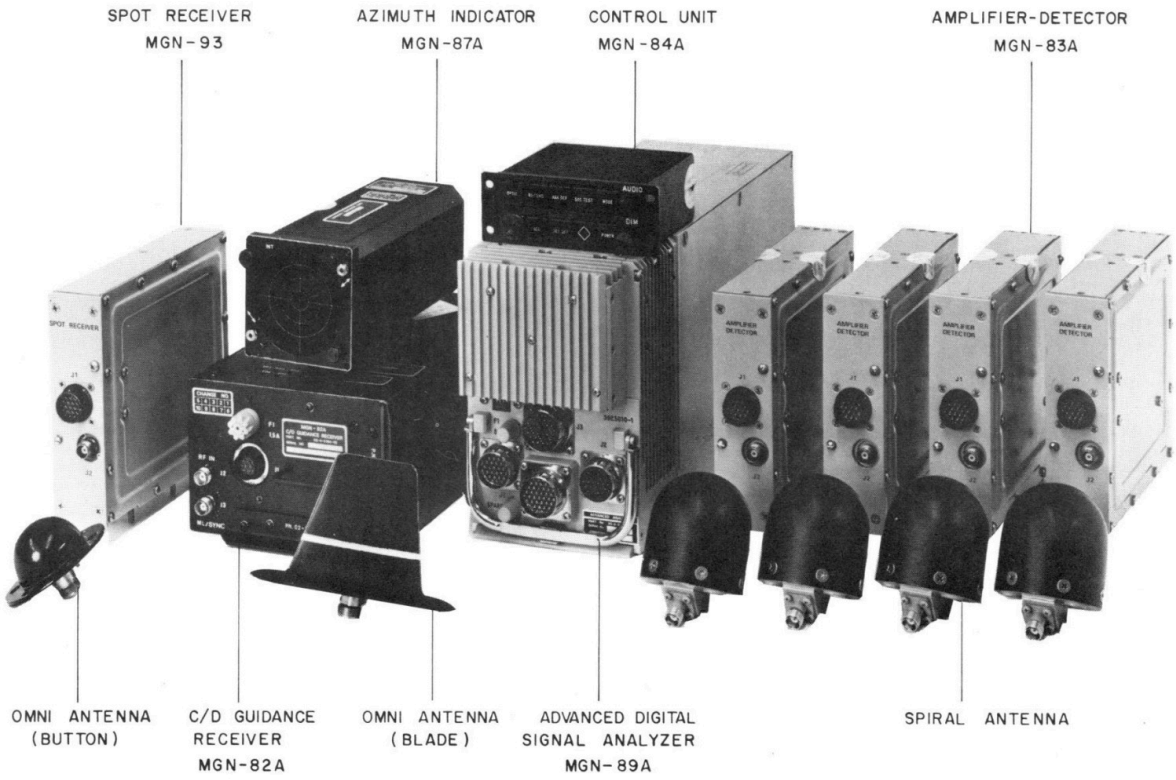
Both types started receiving the upgraded RWS by the early 1980s. The earliest photographic proof noted by the author being an RZ in 1981. By the time of the Recce Mirage III retirement in 1990, all remaining aircraft (RZ #835, #837, #838 and R2Z #857) had been equipped with the upgraded RWS. As the type was heavily involved in photo intelligence gathering, RWS equipped aircraft saw regular use during operations over southern Angola.

The CZ fleet in contrast held a mainly second line role in air defense within SA for most of the 1980s after the introduction of the Mirage F1 to the SAAF in the late 1970s. The CZ was not earmarked for later upgrade to Cheetah standard.

As the war in Southern Angola progressed, the CZs were mostly relegated to base defense usually operating from AFB Ondangwa. Towards the end of the 1980s there was a desire to extend the useful service life of the CZ, most likely while the Cheetah E fleet (converted from the Mirage IIIEZ fleet) was building towards its full operational capability. During this period, some CZs (#801, #805, #807 and #809 being noted) were upgraded with the Compact Radar Warning System (CRWS) which was based on the CRWS installed on the SAAF F1 fleet. Visually the CRWS and RWS are identical in terms of antennas but have differences in avionic function. In terms of aircraft protection and pilot warning they

provided the same functionality. The CRWS four spiral antennas took up the same positions as on the Recce Mirages. The button antenna was placed on the nose gear door as before, but the blade antenna was located further back on the aircraft's belly, just ahead of the gun pack.

CZ #805 served as the prototype for the upgrade starting conversion at Atlas in October 1988. Flight tests started in September 1989 continuing until #805 was returned to the Squadron by late February 1990. By the time the CZs were retired in October 1990, only four aircraft had been upgraded with the CRWS.



Some details of the various RWS avionic boxes and the antennas as fitted to the Mirage III's.



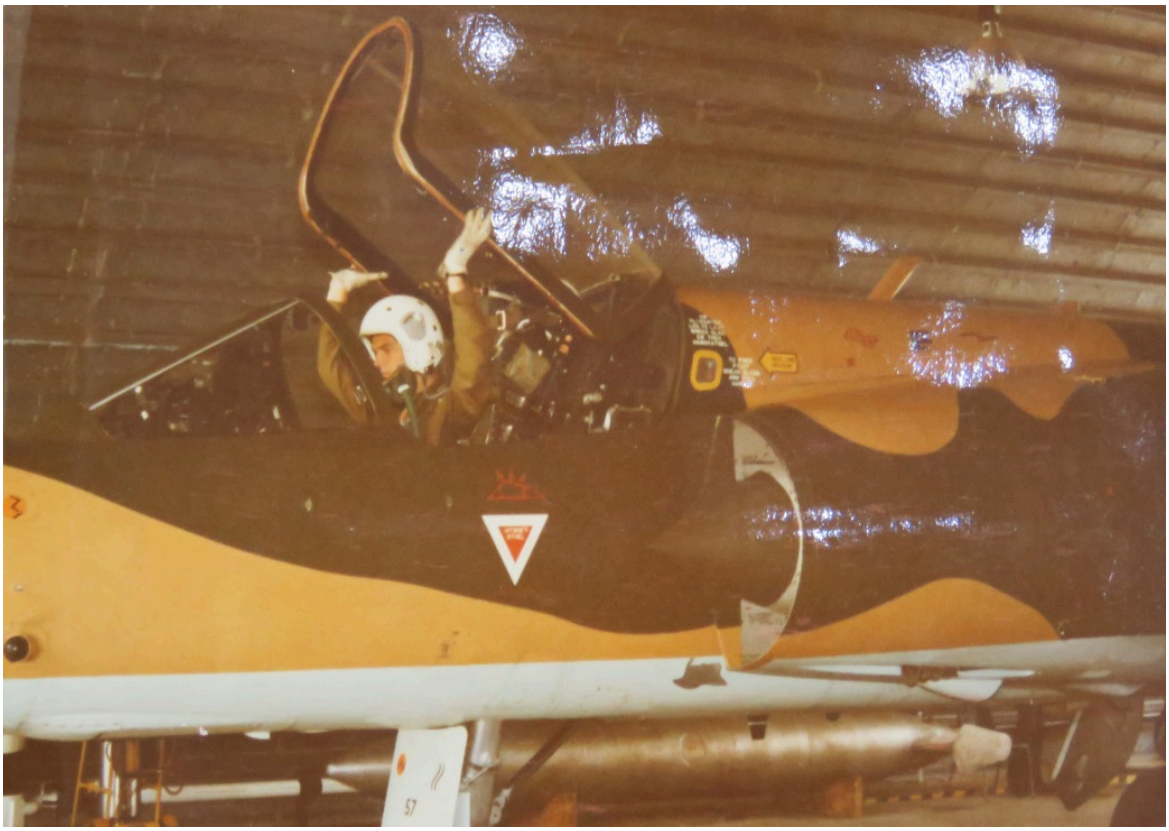
The RWS display unit as seen in R2Z 857. All Mirage IIIs that received the RWS/CRWS had this display added in a similar position within the cockpit.



A factory fresh R2Z #855. Note the prominent BF bullet shaped antennas of the French RWR system on the upper vertical stabilizer leading and trailing edges.



R2Z #857 seen in 1990. Notice the deletion of the bullet shaped BF RWR antennas which indicates the aircraft has been fitted with the upgraded RWS.



R2Z #857 in July 1985. Note the black spiral antenna on the nose and the two black omnidirectional antennas on the nose gear door (just visible with the fuel tank in the background as a backdrop).



An RZ is seen at AFB Ondangwa during 1981. Note the starboard spiral antenna on the aircraft nose along with the two omnidirectional antennas on the nose gear door.



A close-up photo of a RZ, possibly #838, tail. The housing for the old BZ antenna is still visible, but now with the RWS spiral antenna located just above it. (*Photo: Paul Dubois*)



RZ #835 seen at AFB Ondangwa in August 1986. The aircraft is equipped with RWS. (*Photo: Daan Conradie*)



CZ #807 at a Durban ACM camp in July 1990. Note the Spiral antennas of the CRWS fit located on the nose and on the vertical stabiliser. (*Photo: Daan Conradie*)



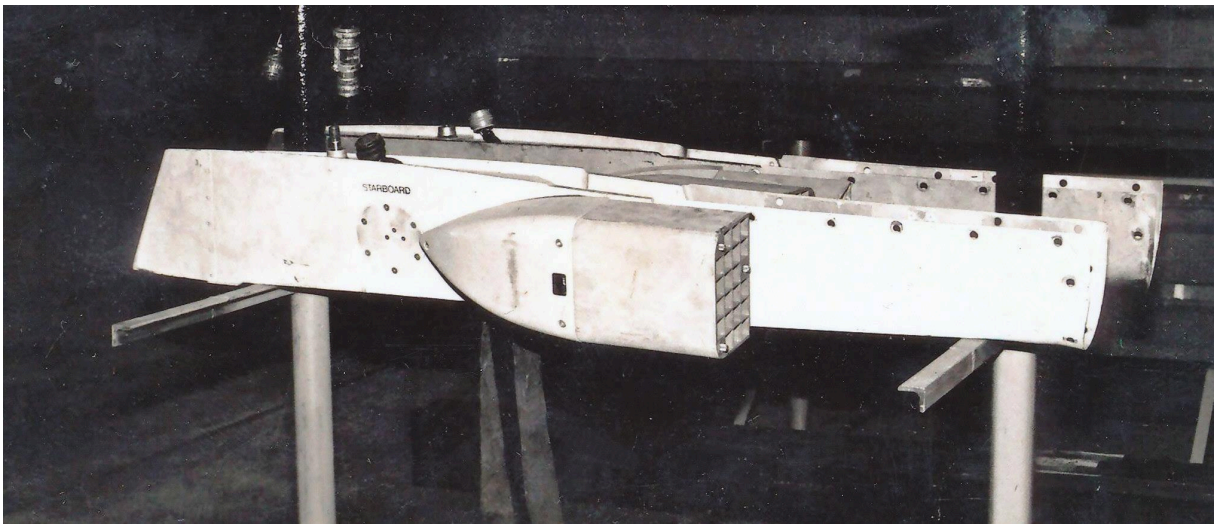
Three CZs at a Durban ACM camp in July 1990. Note the Spiral antennas of the CRWS fit located on the nose and on the vertical stabiliser. (*Photo: Daan Conradie*)

3.2 Radar and Infrared Misleading System (RIMS)

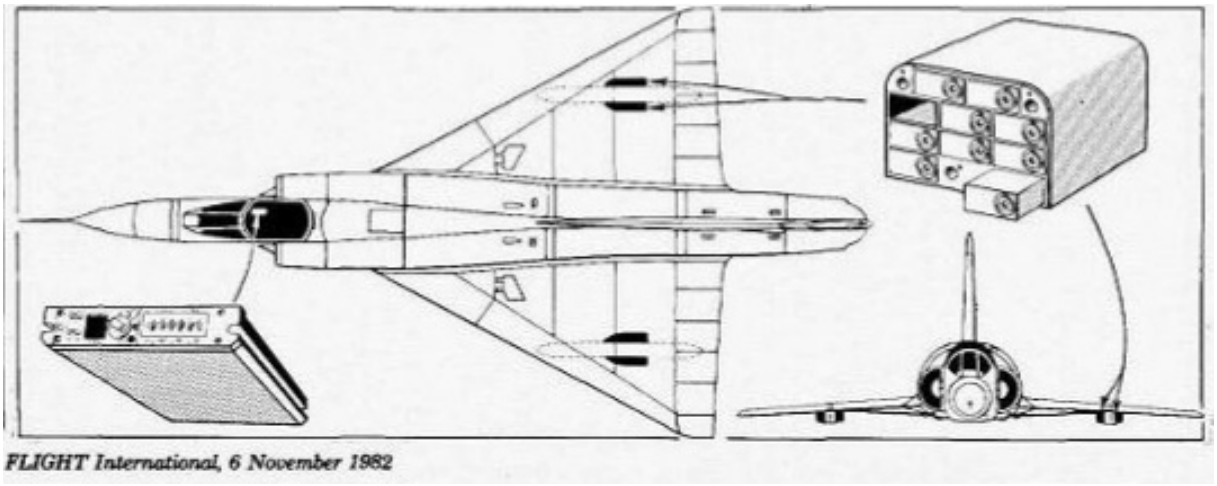
RIMS was intended to reduce the effectiveness of enemy infra-red and radar guided anti-aircraft systems by introducing decoy chaff and flares onto SAAF aircraft, thereby providing a higher probability of survival.

During 1978 there were trials of a French RIMS design manufactured by Alkan on a D2Z. This system fitted large 40mm chaff/flare cartridge dispensers to either side of the Mirage's centerline pylon The performance of this system did not meet SAAF requirements and wasn't taken into service. After these early trials, focus shifted to developing a local RIMS solution for the Mirage III.

Inspiration for the design came from Israel where they fitted chaff/flare dispensers on either side of their F-4 Phantom's wing pylons. The Kfir also used a similar design, but the dispensers were fitted to its centerline pylon. The SAAF Mirage III solution would take the form of modified outboard wing pylons with a chaff/flare dispenser fitted to either side of the pylon. Development was completed, with the system marketed to the world by 1982.



The RIMS equipped outboard pylon as developed for the Mirage III fleet. (*Photo: Kobus de Villiers*)



It would appear that only a limited number of the modified pylons were manufactured, but, according to an ex-2 Squadron armourer they were extensively used by the Recce Mirages (RZ and R2Z) deployed to the operational area during the latter years of the war and during exercises thereafter. No other Mirage III type has been observed by the author as using these RIMS pylons.

Further RIMS related work, other than chaff/flare improvements shared with other aircraft types, would appear to have not been a high priority as most Mirage III types were earmarked for Cheetah conversion by the mid-1980s.

The interest in extending the service life of the CZ fleet by the late 1980s however meant a Mirage III RIMS solution was again investigated, although this time work would be CZ specific. Why the RIMS installation shown above was not adopted is uncertain. The CZ fleet would at this time begin receiving surplus EZ wings as they were being replaced on the EZs by Kfir wings during conversion to Cheetah Es. Installation of the RIMS pylons as used on the RZ/R2Z would thus not have been an issue. The likely motivation would possibly be a desire for a lower drag RIMS installation.

The CZ RIMS solution thus took the form of a specially designed installation extending aft from the aircraft's ventral fin. The design is unique to the CZ and differs significantly from that seen on the Cheetah, although the installation location is roughly the same.

At least four aircraft are noted as being equipped with this installation, namely #801, #805, #807, and #809. #805 would serve as the prototype for the upgrade which included both the integral RIMS package along with EZ wings, with work commencing at Atlas in late October 1988. Flight tests began in September 1989.



RZ #835 operating from AFB Ondangwa in August 1986. Note the use of RIMS equipped outboard pylons. (*Photo: Daan Conradie*)



R2Z #857 rolling down the runway at AFB Rundu during late 1988 for a photographic sortie. Note the RIMS equipped outer pylons of the aircraft. The aircraft is not fitted with self-defense missiles for minimum drag and maximum speed. (*Photo: John Sinclair*)



The CZ specific RIMS installation on #805. A blanking plate is currently fitted where the dispensers would have been located.



Underside view of CZ #805 (looking to the rear) clearly showing the simple blade ventral strake with the box like fairing to the rear which would house the RIMS chaff and flare dispenser.



Starboard view of CZ #809 clearly showing the box like fairing (beneath the aircraft number "809") which would house the RIMS chaff and flare dispenser. Note the forward CRWS antennas just aft of the nose cone break.

3.3 Active Countermeasures System (Bikini) Pod

The story of electronic countermeasures (ECM) in the SAAF began with Israel, as did most projects of the era. In the early 1980s, the SAAF was approached by Israel, who offered to co-develop and equip SAAF aircraft with electronic jammers. However, the proposed jamming system did not meet local requirements.

Project Bikini was thus initiated to acquire jamming pods for SAAF aircraft. The desired pods needed to be external to the aircraft to allow for quick replacement if any faults were detected before a mission. Additionally, the pods were required to have their own power generation capability to avoid placing strain on the host aircraft's onboard power systems. While the performance impact of an external store was acknowledged, it was considered an acceptable trade-off for the operational benefits provided.

The Italian company Elettronica SpA provided the solution with its ELT-555 series of self-contained jamming pods. These pods were largely self-contained, featuring a ram-air turbine at the front to generate the power required for the onboard electronics. They were designated the Active Countermeasures System (ACS) pod but were often referred to as the "Bikini pod" after the name of the acquisition project.

However, the delivered pods had a limited effective jamming range. Furthermore, they were unable to differentiate between various tracking radars, instead employing the same ECM technique regardless of the type of tracking used. This limitation was far from ideal and often rendered the pods ineffective. As the threat over Angola evolved and its capabilities improved, it became increasingly clear that the pods, as procured, could no longer provide the necessary protection.

The pods were subsequently reworked locally to enhance their threat response- and range capabilities. These upgrades enabled the pods to identify radars and deploy threat-specific jamming techniques tailored to each radar type. Like the RWS, the upgraded ACS pods were now programmable with threat libraries, enabling them to recognise specific radar threats and tailor the jamming response accordingly. This adaptability significantly improved their effectiveness in complex threat environments.

There were two variants of the ACS pod in SAAF service: a noise jammer and a deception jammer.

The noise variant consisted of a family of four pods, each covering a specific frequency range. The overall frequency range of 2 to 18 GHz was divided into four bands: 2 to 4 GHz, 4 to 8 GHz, 8 to 12 GHz, and 12 to 18 GHz. These pods utilised an ECM technique known as noise gate pull-off. This technique involves generating a strong noise signal that initially mimics the characteristics of the true return echo. Over time, the jammer gradually increases the noise level while simultaneously reducing the strength of the legitimate return echo, causing it to become obscured by the artificial noise. As the radar becomes overwhelmed by the high noise level, it eventually fails to differentiate between the true target and the noise, resulting in a loss of lock on of the target.

The noise pod was typically employed in a stand-off escort jamming role or in lower-threat environments. Visually, this variant can be identified by the two T-shaped antennas on its underside.

The deception variant operated within the 7 to 17 GHz frequency range. It employed an ECM technique known as range gate pull-off. This technique begins by transmitting a jamming signal that mimics the

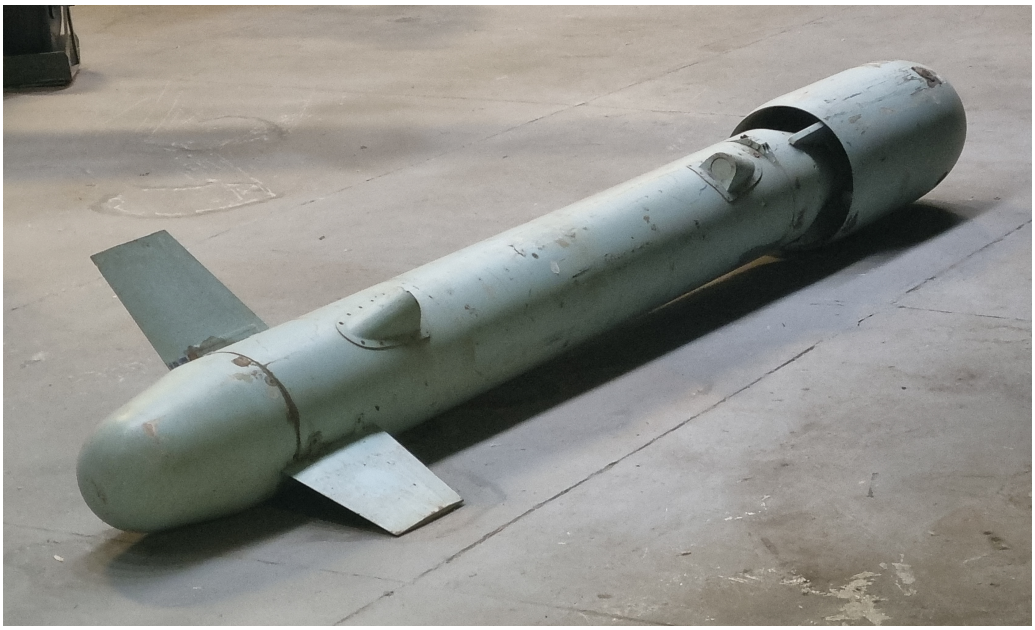
radar's return echo, aligning with the target's actual position. Gradually, the jammer introduces a delay to this false signal, creating the illusion that the target is moving away from the radar. As a result, the radar adjusts its tracking window away from the true position of the target. Once the tracking window has shifted sufficiently far from the actual target, the radar loses track of the aircraft.

These pods were however available only in limited numbers and were thus reserved for use by aircraft types commonly used in high threat environments over southern Angola. Most Mirage III types were used for advanced training or in a second line of defense role by the early 1980s role, thus the integration of the ACS jamming pod was of low priority.

The Recce Mirages were however regularly being deployed to the border to gather intelligence about potential targets or locations of interest. Their high speed meant they could be used in high threat environments, with speed and the element of surprise as their means of protection. Subsequently, the decision was made that they too could benefit from the protection offered by the ACS pod, with integration work starting in mid-1986.



Bikini pod (ELT-555) as used by the SAAF.





RZ #835, seen in the final days of Mirage operations in 1990, carries an ACS pod on the centreline station (the cylindrical object to the right of the image aft of the nose gear leg). The standard PM3 pylon was used as the interface for the pod, although the rear bomb release unit and associated sway braces were removed. This was not a common layout for the type.

Although successfully integrated, the pod was however not used operationally by the Recce Mirages. The reasons for this are threefold:

Firstly, the Mirage's lack of internal fuel is well publicised. Given the long ranges involved in the operational area over southern Angola, the Recce Mirages would often require a centerline RP825 external fuel tank in addition to the two large RP62s. For missions that didn't need an external centreline fuel tank, the additional drag caused by the ACS pod, courtesy of the ram-air turbine, would have increased fuel burn and, thus, decrease the aircraft's range.

Secondly, the increase in drag would also negatively impact the aircraft's speed – an unwelcome fact for tasks where speed was vital to survival. One could argue the trade off in reduced top speed for electronic protection was worthwhile, but the impact of the pod's carriage on the aircraft's already limited range was the decisive factor.

Thirdly, and perhaps the lesser understood but critical role the Recce Mirages fulfilled, was the type's use in a passive electronic warfare role[1]. Thanks to the RWS's ability to record newly detected radar signals, it offered the ability to gather information about unknown threat radars operating in the target area. Pilots could also note the relative directions and distances of detected radars during flight, and, during post-mission analysis, the noted relative positions and the aircraft's flight path could be used to estimate the approximate positions of the radars and their associated missile batteries. This was

[1] By the end of 1986, this was largely the domain of the Electronic Intelligence (ELINT) Boeing 707 fleet, although the Recce Mirages could still provide valuable information for use in mission planning.

valuable information in addition to the photographic intelligence being gathered. By jamming threat radars, this information would not have been captured for use in mission planning.

The author was able to confirm the use of the pod during some exercises within South Africa. It was used by two Recce Mirages during 1989, over Wallmannsthal for trials against a captured SAM-8 and again during some exercises in the last days of service in October 1990. Being integrated on the aircraft some years earlier it is likely that it was used during other exercises. For the most part however, use of the pod remained very limited, and it was a mostly unused capability.

4 Comms / radios / navigation

The radio communications and navigation suite installed on the SAAF Mirage III fleet varied. Associated with these systems were various antennas. The most obvious antennas were the white conformal dielectric antennas associated with radio communications located on the tip and leading edge of the vertical stabilizer. Later upgrades saw the installation of various prominent trapezoidal and triangular shaped blade antennas at various locations along the fuselage spine as well as beneath the nose and on the fuselage underside. It is therefore important to check photographic references of the various SAAF Mirage IIIs.

This section addresses the antennas configurations for each of the SAAF Mirage III variants. This would be of particular interest for the detailed modeler or Mirage III enthusiast.

Whilst the exact details / purpose of the various antennas are not known due to a lack of SAAF specific reference material (i.e. flight manuals) available to the author, it can be generally accepted that :

- The two conformal antenna located on the vertical stabilizer were for UHF radio communications. The fin tip antenna was for the primary UHF (Ultra High Frequency) radio and the antenna below this on the leading edge was for the secondary UHF radio. This was common for all Mirage variants when delivered to the SAAF.
- An additional conformal antenna was located on the vertical stabilizer leading edge fillet (specific to the BZ and CZ only as all other SAAF Mirage IIIs dispensed with this leading edge fillet). This was possibly for HF (High Frequency) communications.
- A conformal dielectric panel was located on the avionic bay hatch aft of the cockpit. This was initially of large rectangular configuration on the earlier versions of the SAAF Mirage III, but was later replaced with a much smaller square shaped panel. These were later replaced with blade antennas in a similar location. The purpose of this panel is unknown.
- A circular conformal antenna on the nose gear door was likely the IFF (Identification, Friend or Foe) antenna.
- A trapezoidal shaped blade antenna (usually yellow) installed on the fuselage spine ahead of the vertical stabilizer was likely for the TACAN (Tactical Air Navigation) system. A second similar antennas was located on the starboard fuselage underside adjacent to the ventral fairing. This was particular to the EZ, DZ, D2Z, RZ and R2Z.
- Various other smaller blade antennas were added through the life of the various Mirage III variants in SAAF service. Details are provided elsewhere in this document.

The Mirage III was equipped with a radar altimeter. Two small conformal antennas were located on the fuselage underside just aft of the nose wheel bay. One antenna was used to transmit radar pulses whilst the second one received reflected energy. It is likely that all SAAF Mirage III variants were so equipped.

An “impact temperature probe” was located on all Mirage IIIs on the fuselage underside aft of the nose wheel bay. This provided ambient temperature measurement for use by the aircraft’s air data computer.

4.1 Mirage IIICZ

The IIICZ, in both the delivery unpainted natural metal scheme and early gloss hard edge buff/green camouflage, appear to have had the following antennas configuration :

- Conformal antenna at the top of the vertical stabilizer (UHF).
- Conformal antenna on leading edge of vertical stabilizer (UHF).
- Conformal antenna on vertical stabilizer fillet (HF).
- Large rectangular shaped conformal dielectric panel on spine aft of cockpit.
- Circular conformal antenna on nose gear sideways opening door (IFF).

These are clearly demonstrated in the following photos.



Mirage IIICZs in delivery scheme clearly showing the various conformal antennas as noted in the text above.



IIICZ - note the circular conformal antenna on the sideways opening nose gear door as well as the large rectangular conformal dielectric panel located towards the rear of the avionics hatch aft of the canopy.

The white conformal antennas were painted over when the CZ received the later matt soft edge buff/green camouflage. This seems to have coincided with the installation of several blade antennas as follows :

- Large blade antenna aft of canopy – possibly to have replaced the original conformal dielectric panel.
- Two smaller trapezoidal blade antennas on the fuselage spine aft of the large blade antenna.
- One large and one smaller blade antenna located on the nose gear door, the larger one being in the same position as the original circular (IFF) antenna.

This was the same antenna configuration present on those CZs which were painted in the low visibility blue / grey scheme. At this stage, some aircraft had the CRWS “cat balls” antennas installed.



IIICZ in the later matt soft-edge buff/green camouflage - note that the conformal antennas have been painted over. The single large and two small blade antennas have now been installed on the fuselage spine.



IIICZ in final blue/grey low visibility camouflage - one large and two small blade antennas have been installed on the fuselage spine. This aircraft has now also been equipped with the CRWS “cat balls” antennas, located on the vertical stabilizer above the rudder and on the forward fuselage aft of the radome.



CZ #813 - the large blade antennas can be seen on the spine and on the nose gear door.



A small trapezoidal shaped antenna can be seen just aft of the nose gear bay – its purpose is unknown. Just aft of this is the impact temperature probe. The large blade antenna on the nose gear door has replaced the original circular conformal IFF antenna.



CZ #813 - this antenna is the underside TACAN antenna and is offset to starboard.

4.2 Mirage IIIBZ

The Mirage IIIBZ had a conformal antenna arrangement similar to that on the CZ in its delivery configuration. This did not appear to have been upgraded over the life of the BZ, with the exception being that the antennas were painted over in the later buff/green camouflage scheme.

CRWS was not fitted to the three BZs operated by the SAAF.



BZ #816 - note that the large white conformal dielectric panel does not appear aft of the canopy.



BZ #818 in fresh coat of hard edge gloss camouflage. The conformal dielectric panels have not been painted over. Note the large white panel aft of the canopy.



(Photo: 1 Military Printing Unit)

Mirage III CZ fitted with long-range fuel tanks. Four of these aircraft flew from Waterkloof to Ondangwa to take part in Operation REINDEER.

BZ #817 in hard edge camouflage. All conformal antennas have now been painted over.



Another view of BZ #817 in later nonstandard soft edge camouflage which covers all conformal antennas.

4.3 Mirage IIIEZ

For the EZ natural metal scheme delivery scheme, the conformal antennas arrangement on the vertical stabilizer was similar to that of the CZ delivery scheme as detailed above. An additional yellow blade antenna was installed ahead of the vertical stabilizer on the fuselage spine. This appears to have been for the TACAN (Tactical Air Navigation) system.

Early gloss hard edge buff/green camouflage : the conformal antennas had not been painted over at this stage. A further smaller blade antenna appears to have been added to the fuselage spine aft of the canopy.

Later matt soft edge buff/green camouflage : the original white conformal antennas were painted over. A large blade antenna was added to the nose gear door – this was likely to have replaced the original circular IFF antenna.

The EZs were not equipped with the CRWS “cat balls” antennas.



Two natural metal EZs in formation with a camouflaged CZ. The conformal antennas on the vertical stabilizer of EZ #820 are readily apparent. The doppler antenna beneath the nose of the two EZs are also apparent. The yellow TACAN blade antenna on the fuselage spine is visible on the closest aircraft. This is not present on the CZ.



Possibly EZ #825. An additional small blade antenna has now been added to the aft end of the avionics bay on the spine. The original yellow TACAN antenna is clearly visible ahead of the vertical stabilizer. The UHF conformal antennas on the vertical stabilizer are still clearly present.



Final EZ antenna configuration on EZ #819 which appears to have coincided with application of the late matt soft edge buff/green camouflage. The conformal antennas on the vertical stabilizer have been painted over. A large blade antenna has been added to the nose gear door. The two blade antennas are visible on the fuselage spine, the rearmost one being for TACAN.

4.4 Mirage IIIDZ

The DZ had the doppler antenna located beneath the forward fuselage.

The DZ conformal antennas configuration was similar to that seen on the early gloss hard edge buff/green camouflage EZ. The yellow TACAN antenna forward of the vertical stabilizer was also present.

The Mirage IIIDZ fleet was not equipped with the CRWS “cat balls” antennas.



DZ #840 - note the distinctive doppler antenna just ahead of the nose gear. The yellow TACAN antenna on the fuselage spine can just be made out in this photo just forward of the engine cooling intake scoops.

4.5 Mirage IIID2Z

Unlike the DZ, the D2Z did not have the doppler antenna located beneath the forward fuselage.

The D2Z antennas configuration was similar to that seen on the early gloss hard edge buff/green camouflage EZ, including the yellow TACAN antenna on the fuselage spine.

The D2Z also had two horizontal blade antennas installed either side of the vertical stabilizer just beneath the fin tip conformal antenna. It is believed that these are VOR / ILS antennas, similar to those fitted to the SAAF's Mirage F1AZ/CZ aircraft. This was fitted only to the D2Z and R2Z versions of the SAAF Mirage III.

The IIID2Zs were not equipped with the CRWS "cat balls" antennas.



Differing from the DZ, this D2Z (#853) has no doppler antenna beneath the nose making it look much sleeker. It does have the yellow TACAN antenna installed on the fuselage spine as well as the white UHF conformal antennas on the vertical stabilizer. The starboard side horizontal VOR/ILS blade antenna is also visible near the top of the vertical stabilizer. This was particular to the D2Z and R2Z.



D2Z #846. The white antennas panel on the leading edge of the vertical stabilizer has been painted over. The black stripe beneath the white fin tip is the horizontal VOR/ILS blade antenna. Note the yellow TACAN antenna on the fuselage spine.



D2Z #848 with all UHF antennas painted over. The TACAN antenna is visible on the fuselage spine.

4.6 Mirage IIIRZ

The RZ had the doppler antenna located beneath the forward fuselage.

NATO grey/green delivery scheme :

- Conformal antennas were located on the vertical stabilizer (tip and leading edge).
- Yellow TACAN antenna on fuselage spine forward of vertical stabilizer.
- Small white rectangular conformal antenna aft of canopy.
- A large blade antenna on the nose gear door – possibly for upgraded IFF.



RZ with white conformal antennas on the vertical stabilizer, small white rectangular panel aft of cockpit and yellow TACAN antenna on the fuselage spine. The Doppler antenna is also visible beneath the nose. There is a round pancake shaped antenna barely visible immediately above the rudder. It is likely this was a factory installed French RWR antenna. This appears to have been only installed on the Mirage III EZ and RZ and were later replaced by the South African developed CRWS antennas.



RZ #835 in soft edge buff/green camouflage. The pancaked shaped antenna above the rudder has been removed and the locally produced CRWS “cat balls” antennas have been installed in its place. The missile on the wing is most probably a V3B.

The application of the soft edge buff/green camouflage to the Mirage IIIRZ possibly coincided with the addition of a smaller blade antenna aft of the canopy. This also seems to have coincided with the installation of the CRWS. The same configuration would have been present when the RZs were repainted in the final low visibility blue/grey camouflage schemes.



RZ #838 repainted in soft edge buff/green camouflage. All conformal antennas on the vertical stabilizer have been painted over. The yellow TACAN blade antenna is visible forward of the vertical stabilizer. There is also an additional white blade antenna ahead of this. The CRWS antennas are visible on the vertical stabilizer above the rudder and on the nose above the doppler fairing. Note the two small black antenna also associated with CRWS on the nose gear door. Ahead of these appears to be a large yellow blade antenna which may be an improved IFF antenna, replacing the earlier circular IFF antenna. The white missile is a Matra R530 which was not compatible with the RZ.



IIIRZ, likely #835 – note the small blade antenna added just aft of the avionics hatch on the fuselage spine. The TACAN antenna has been painted grey. A large blade antenna has also been added on the nose gear door to replace the original circular conformal antenna. CRWS antennas are also visible above the rudder and above the doppler fairing.



Round black CRWS antenna above the rudder on RZ #838. The original pancake shaped antenna has been retained.



Round black RWS antenna above rudder on RZ #835. The pancake shaped antennas has been removed.



RZ #835 – three antennas on the nose gear door : large (possibly IFF) and small (RWS) blade antennas and small round RWS antenna to the rear. The RWS and smaller blade antennas were originally black and may have erroneously been painted over when #835 was repainted.



Another close-up of RZ #83. A dual blade antennas can be seen just aft of the wing leading edge scoop. It is assumed that this was associated with navigation avionics specific to the RZ as it does not appear to have been fitted to the R2Z.
Aft of the nose gear door on the fuselage underside, a small blade antenna and the impact temperature probe can be seen.

4.7 Mirage IIIR2Z

Original delivery configuration :

- Conformal UHF fin tip and leading edge antennas in white with black leading edges.
- Two horizontally mounted VOR/ILS blade antennas located on each side of the vertical stabilizer just beneath the fin tip UHF antenna.
- Yellow TACAN antenna on fuselage spine forward of vertical stabilizer.
- Small white rectangular conformal dielectric panel aft of canopy.

Later updated configuration – a large blade antenna was installed aft of cockpit.

The R2Zs were delivered with a French design RWR system consisting of forward and aft facing bullet shaped antennas on the upper vertical stabilizer. These were replaced with the locally developed CRWS, which provided semispherical antennas in 5 locations (two above the rudder, two on the forward fuselage and on the nose gear door).



R2Z #855 with white conformal antennas on vertical stabilizer, VOR/ILS horizontal blade antenna located near the top of the vertical stabilizer, yellow TACAN antenna on spine and large blade antenna aft of canopy. #855 has the original French forward and rearward facing RWR bullet antenna installed near the top of the vertical stabilizer. The South African RWS had not been installed at this stage.



RZ #857 with the factory installed bullet shaped RWR antenna removed from the vertical stabilizer. In its place, the RWS has been installed as witnessed by the round black antenna visible directly above the rudder. The forward RWS antenna appears as a light buff round object on the nose.



R2Z #857 nose gear door antenna configuration was slightly different to that on the RZ in that the circular conformal IFF antenna has been retained. A black blade antenna and a semispherical antenna have now been added, both as part of the CRWS.

5 External sensor probes

5.1 Air data probes

The Mirage IIIs were fitted with a dynamic and static air measurement system to feed primary instruments and the air data computing system.

All SAAF Mirage III variants were equipped with a nose mounted pitot probe. At the center of the probe is the total pressure inlet. This is surrounded by a number of circumferential static ports. Together, these provide data to the airspeed indicator (ASI) / mach meter, vertical speed indicator (VSI) and the air data computer. On the BZ, CZ and EZ, this was attached to the center of the nose. On the DZ and D2Z the pitot probe was mounted above the small nose intake. On the RZ and R2Z the pitot probe was mounted above the forward looking camera window.

For the BZ and CZ, the nose mounted pitot probe was supplemented with a single total pressure probe located on the lower left of the forward fuselage which provided data to the ASI / mach meter.

For the DZ, D2Z, EZ, RZ and R2Z, the single total pressure probe was replaced with two total pressure probes located ahead of the windshield. Those installed on the RZ and R2Z were much larger than those installed on the EZ, DZ and D2Z.

A single static port was located at the rear fuselage.

A small straight incidence probe was located on the forward fuselage below the windshield.



CZ #813 showing the pitot probe and its total pressure orifice. The supplementary total pressure probe can be seen on the lower fuselage offset to port. This was typical for the BZ and CZ.



The single total pressure probe located on the lower left forward fuselage of CZ #813. The round hole above this is the crash tow tube.



The dual total pressure probes located ahead of the windshield on RZ #838.



The dual total pressure probes located ahead of the windshield on RZ #838 with red FOD covers on. Just beneath the eye can be seen the thin straight incidence probe. Below that is one of the “cat balls” RWS antennas.



EZ – the smaller total pressure probe is located ahead of the windshield. There are two of these, one each side of the windshield. These are visibly smaller than those fitted to the RZ and R2Z.



D2Z #848. The starboard total pressure probe is visible ahead of the windshield. These are similar in size to those on the DZ and EZ.

5.2 Rear fuselage probes

The BZ and CZ had two small probes located on both lower sides of the rear fuselage. It is assumed this either had something to do with the aircraft's air data system or the Atar 09B afterburner. The DZ, D2Z, EZ, RZ and R2Z did not have these probes.



BZ #818 showing two probes on lower rear fuselage.



RZ #838 showing no probes – similar for DZ, D2Z, EZ and R2Z.





Probe on BZ #818.



Probe on starboard rear fuselage CZ #813.



6 References

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