FTD-ID(RS)T-0607-91

FOREIGN TECHNOLOGY DIVISION

CHINA'S CJ01 SUPERSONIC ANTI-SHIP MISSILE WEAPONS SYSTEM

by

Zhou Zhicheng, Zhang Chengzeh

Approved for public release;
Distribution unlimited.

HUMAN TRANSLATION

FTD-ID(RS)T-0607-91 5 November 1991

CHINA'S C101 SUPERSONIC ANTI-SHIP MISSILE WEAPONS SYSTEM

By: Zhou Zhizhong, Zhang Changgen

English pages: 17

Source: Shijie Daodan Yu Hangtian, Nr. 11(151), November 1990, pp. 34-38

Country of origin: China
Translated by: SCITRAN
F33657-84-D-0165
Requester: FTD/SDAWS/Jerry Peters

GRAPHICS DISCLAIMER

All figures, graphics, tables, equations, etc. merged into this translation were extracted from the best quality copy available.

Zhou Zhizhong, Zhang Changgen

Translation of Shijie Daodan Yu Hangtian, Issue 11, 1990, pp 34 - 38

China's C101 Supersonic Anti-ship Missile Weapons System

Translated By

SCITRAN

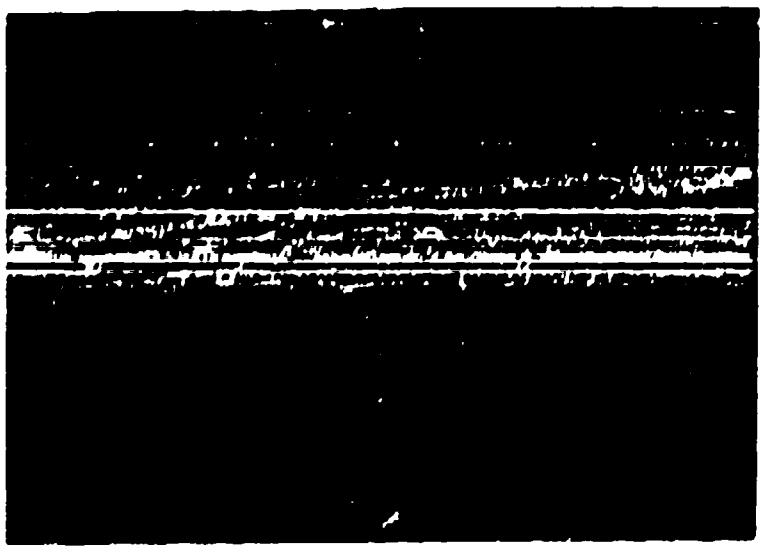
1482 East Valley Rd.

Santa Barbara CA 93108

CHINA'S C101 SUPERSONIC ANTI-SHIP MISSILE WEAPONS SYSTEM

This article describes the components and features of China's C101 supersonic anti-ship missile system, especially, the missile's aerodynamic configuration, arrangement of sections, control and guidance systems, warhead and fuse, electric and hydraulic control systems and flight trajectory. It also presents the weapon system's fire control system, launch system, ground equipment and combat procedures.

KEY WORDS: TACTICAL MISSILE, ANTI-SHIP MISSILE, C101 MISSILE, CHINA.



[illegible] STILL READY TO LAUNCH

I: INTRODUCTION

The C101 missile is a super low trajectory, super sonic tactical anti-ship missile developed independently by China. It comes in two different models - airborne and shipborne. It is used to attack large and medium class surface targets of cruisers and larger vessels.

The C101 missile weapons system is composed of the missile, the aircraft or ship fire control system, the launch apparatus and ;the surface equipment. The system's equipment is simple, it is quickly launched, the missile is small and light, but has a powerful warhead and has a strong capacity to penetrate defenses. It is an advanced missile of the 1990's.

The C101 missile uses liquid fuel ramjet engines as its main drive equipment and solid fuel rocket engines as boosters. The missile is launched from a aircraft or ship, and when it is launched, the boosters are ignited and they propel the missile to Mal.8 (sic); when the booster operations are completed, the boosters fall off from the rear of the missile and the missile stabilizes at a speed of Ma = 2.0 for cruise flight. The autometic guidance system on the missile is preprogrammed to turn the missile into level flight and to complete the self-controlled flight segment. The command mechanism aboard the missile activates the terminal guidance radar at the predetermined time. After the radar acquires the target, it executes side plane tracking of the target. The radio altimeter controls the missile in a decent to a height of five meters in its attack on the target.

The hydraulic control system on the missile operates the highspeed controls, and together with the high precision control system, carries out the attack on the ideal location of the target. The missile fire control system can attack the target through instantaneous position of the target or by leading the target.

II: WEIGHT AND DIMENSIONS OF THE C101 MISSILE

MISSILE LAUNCH WEIGHT	
SHIPBORNE MODEL	1850 KILOGRAMS
AIRBORNE MODEL	1500 KILOGRAMS
TOTAL MISSILE LENGTH	
SHIPBORNE MODEL	6.5 METERS
AIRBORNE MODEL	7.5 METERS
DIAMETER	0.54 METERS
WINGSPAN	1.62 METERS

III: FEATURES OF THE C101 MISSILE

Since the eighties, in order to further ensure the attack superiority of anti-ship missiles, western nations began developing new fourth generation anti-ship missiles with strong defense penetration capabilities - the surface skimming supersonic cruise missile. An example of such a missile is the French supersonic anti-ship missile built in cooperation with the Germans - the ANS. Other examples are the British supersonic Sea Eagle and the Italian Aotuomahe (translator's note: phonetic) - 2. Since 1990, sales of subsonic anti-ship missiles have dropped sharply. They have been replaced with the continuously expanding supersonic anti-ship missiles.

Compared to similar supersonic anti-ship missiles of other countries, the C101 missile possesses the following characteristic features:

1. It has relative strong defense penetrating capabilities.

(1). It flies at a low trajectory skimming over the water, giving the missile excellent concealment.

A cruise flight altitude of 50 meters was chosen, but when the missile is around 3,000 meters from target, it dives to a height of five

meters to fly just above the water in its attack on the target. It has both the features of having the concealment of current surface skimming anti-ship missiles and ensuring hitting at approximately the water line of the target.

(2). Ma = 2.0 supersonic flight speed.

The C101 missile maintains a supersonic speed of Ma = 2.0 from the time it begins cruising until it hits the target, displaying the superiority of high speed attack.

The concealment and high speeds ensure the defense penetrating capabilities of the C101 missile. The diving attack when the missile approaches 3,000 meters from the target, occurs just at the firing point of the target's terminal intercept weapons, and the sudden movement of the missile cannot but result in a greatly reduced shootdown percentage.

For example, using a French Sea Rattlesnake or a British Sea Wolf terminal intercept missile to intercept the C101 missile, even if the infrared tracker detects and tracks the C101 missile under ideal conditions, and intercepts at emergency speeds, it has only one chance to intercept the missile, and the point of intersection is just where the C101 missile is making its dive maneuver. If ship artillery systems are used to intercept the missile, then there is only a very short intercept time, of only one or two minutes. Clearly, hard-type weapons are almost useless against the C101 missile.

(3). Strong counter ECM capabilities

The C101 missile uses two centimeter single pulse radar with multiple counter ECM capabilities. It also has supersonic surface skimming flight technology, so even if the enemy uses electronic countermeasures, because there are only ten seconds or so for the countermeasures, it is difficult for these countermeasures to be effective.

2. The C101 missile has a relatively high target hit rate.

The use of high precision control and guidance systems, powerful high speed response hydraulic servo machinery, single plane control system and excellent control characteristics ensure the missiles high target hit rate. Multiple flight testing of the C101 shows that the missile usually hits near the target waterline.

3. The missile has relatively high probability of destruction.

Using a high energy semi-armor piercing demolition type warhead and a time delay detonation fuse, a warhead weighing 300 kilograms, larger than the warheads of similar foreign anti-ship missiles, so once this missile strikes the target it can sink or seriously damage enemy destroyer class surface vessels.

4. Fire and forget.

After the missile is launched, its entire flight is completely automatic. During the self control leg it relies on the missile control system for automatic piloting, and during the self-guided stage it relies on the terminal guidance radar to automatically track the target. After this type of missile is launched from its carrier platform, the carrier ship or aircraft can perform evasion maneuvers immediately and can shut off the airborne or shipborne radar to maintain radio silence.

5. Safe and reliable, easy to use and maintain.

It uses ordinary aircraft kerosine for fuel, which is safe and non-toxic, is not subject to spontaneous combustion. It is easy to operate and simple to maintain.

IV: GUIDANCE

The C101 missile is composed of the missile body, the control and

guidance systems, the hydraulic system, the warhead and fuse, the electrical system, and the hydraulic control system.

1. The missile external appearance and aerodynamic configuration.

The missile is composed of a first stage and a second stage. The second stage missile aerodynamic configuration is ducklike. Two liquid fuel ramjet engines are arranged on either side of the missile body, connected at the front and back. The forward and rear couplings are also the forward and rear fins. The second stage missile tail portion has a pair of vertical tail fins, and on the rear edge of these tail fins there are a pair of differential rudder surfaces which are used to control the direction and rolling of the missile. There are a pair of symmetrically opposed duck wings on either side of the forward portion of the missile which control the pitch of the missile. The first stage configuration is different for the airborne and the shipborne models. The shipborne model uses two solid fuel boosters connected to either side of the second stage. On the top of this stage and below the boosters there is an "X" shaped stabilizing surface and a pair of rear edge ailerons (to the right above and to the left below) in order to control the rolling of the first stage. The airborne model uses a single solid fuel booster connected to the rear of the second stage. An "X" shaped stabilizing surface is formed on the booster and there is a pair of rear edge ailerons (to the right above and the left below).

2. The missile compartments and placement.

From front to rear, the missile is divided into seven compartments.

(1). The radar compartment. This contains the terminal guidance radar, and there is a non-metallic shield at the front.

(2). The warhead compartment. This contains the semi-armor piercing warhead and the fuse system.

(3). The fuel tanks. These contain 200 kilograms of aviation kerosine.

(4). Load bearing compartment. This the primary load bearing portion of the missile. On the top of this section there is a hanger, and on either side there are also the engine and booster connections.

(5). The guidance instruments compartment. This contains the primary equipment of the control, propulsion and electronic systems. At the very bottom of this compartment there is a turbine pump intake.

(6). The equipment compartment. This contains the hydraulic and control systems and the steering engine. On either side of this compartment are the two rear engine connections.

(7). Connection. This is the power transmission section from the first to second stage. Below this section there are also the rear connections for the boosters.

(8). Ventral fin. This contains electrical cable and conduit.

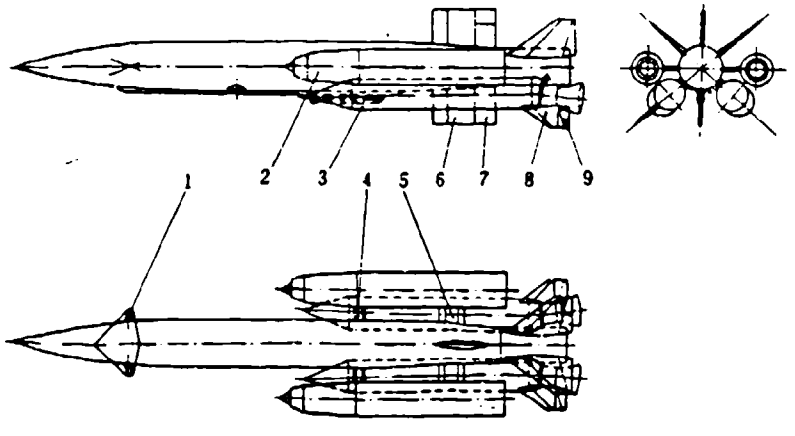


ILLUSTRATION TWO: THREE VIEWS OF THE SHIPBORNE C101 MISSILE
(Please see key on following page)

1. Duck wings
2. Ramjet engines
3. Boosters
4. Forward missile wings
5. Rear missile wings
6. Vertical stabilizers
7. Differential rudder surfaces
8. First stage stabilizing fins
9. First stage rear edge ailerons

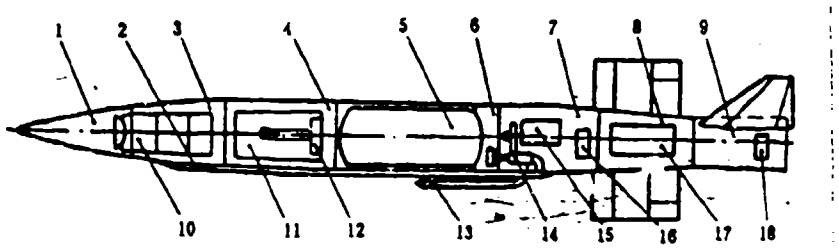


ILLUSTRATION THREE: POSITIONAL ARRANGEMENT OF THE C101 MISSILE

1. Cone
2. Ventral Fin
3. Radar compartment
4. Warhead compartment
5. Fuel tanks
6. Load bearing compartment
7. Guidance instruments compartment
8. Equipment compartment
9. Connection
10. Terminal guidance radar

11. Semi-armor piercing radar
12. Fuse system
13. Turbine pump intake
14. Fuel regulating system
15. Control equipment
16. Electric equipment
17. Hydraulic control system
18. First stage control system

3. Control and Guidance Systems

The missile control uses an automatic pilot system. It is an automatic control and regulating system. The three control circuits are independent of each other. These are made up of a combination control instrument and a damper steering gyroscope. It is used to stabilize the missile's attitude in flight. During the automatic control leg, it ensures the missile enters the prescribed flight altitude; in the self-guidance leg, it receives control signals sent out by the radar to control the automatic tracking of the target.

The terminal guidance radar is composed of an antenna, a transmitter, a receiver, and a power source panel. It is used to search, capture and lock onto targets on the surface of the water. It also transmits relevant control signals to the guidance instruments to accomplish automatic guidance.

4. Propulsion Systems

(1). The Primary Engine

The C101 missile uses two parallel liquid fuel ramjet engines for its primary engines. These are simple in structure, easy to operate, and are stable and reliable. The engines take over when the Ma number is 1.8. After the boosters drop off, the engines continue to accelerate to cruise at Ma 2.0. The missile fuel regulation system controls the amount of fuel

supplied to the engines. During the cruise segment, each engine has a thrust of about 180,000 newtons, enough to overcome the resistance of the missile, so the missile always maintains a flight speed of 2.0 until it reaches the target.

(2). The Boosters

The boosters use a six pointed star shape internal hole combustion solid fuel rocket engines. They use polysulfide mixture for a propellant. The boosters are equipped with a safety ignition mechanism.

The airborne C101 missile uses a single series booster, and the shipborne missile uses two parallel boosters. After the missile is launched, they produce around 180,000 and 360,000 newtons rated thrust respectively to accelerate the missile. After the missile reaches Mach 1.8, the booster and the connection drop off together, having completed their function.

5. Warhead and Fuse

The missile uses a supersonic high energy semi-armor piercing demolition type of warhead. It relies on the tremendous kinetic energy generated by the high speed of the missile to penetrate the armor into the hold of the ship where it explodes, generating tremendous destructive effects.

It uses a time delay fuse which can effectively control the explosion of the warhead inside the hold of the enemy ship. The fuse has a long range release safety mechanism and several safety stages which use different operating principles.

6. The Electrical System and the Hydraulic System

The electrical system is composed of the electrical equipment and the missile cable network. The electrical equipment includes the battery

group, various types of switches, relays and drop off plugs. The cable network connects the electrical equipment together. The electrical system ensures the supply of electricity to the electrical equipment on the missile, the transmission of electrical signals and checks and measurements.

The function of the hydraulic control system is to supply high pressure oil to the hydraulic steering engines so the steering engines can control the steering surfaces under the control of the automatic guidance instruments, ensuring the flight position of the missile.

7. The Flight Trajectory

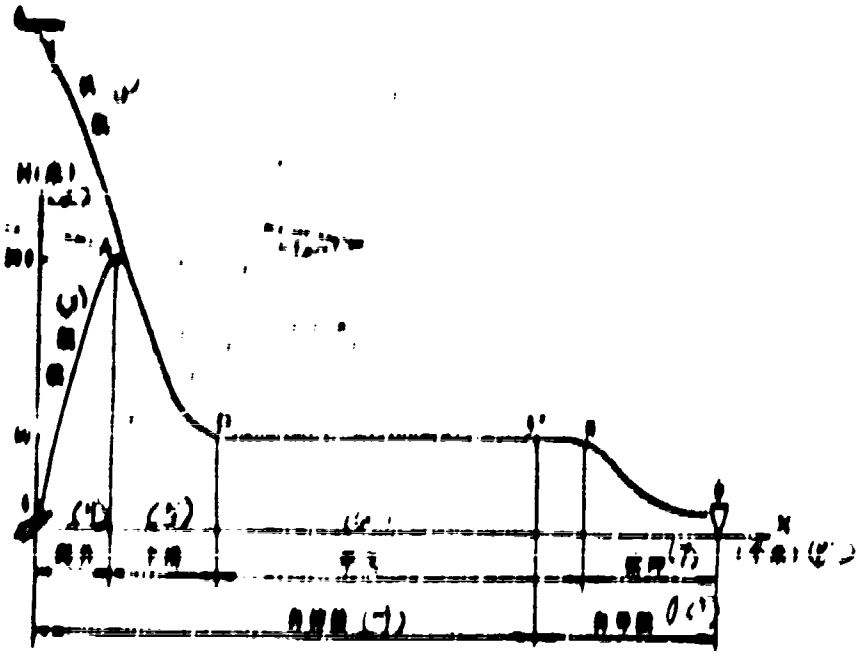


ILLUSTRATION FOUR: FLIGHT TRAJECTORY SCHEMATIC OF THE CJ01 MISSILE

1. Airborne
2. Height (in meters)
3. Midplane
4. Climb

5. Descent
6. Level flight
7. Dive
8. (Thousands of meters)
9. Automatic control segment
10. Self guided segment

The flight trajectory of the C101 missile is different for the shipborne and the airborne versions of the missiles. The trajectory of the shipborne missile can be divided into two stages by the type of control used, automatic control segment and the self-guided segment.

(1). The Automatic Control Segment

This can be divided into the climbing, descent, and level flight segments.

Climbing Segment: When the missile is launched at a certain angle from the launch equipment on the ship, the forward and rear slide plates leave the rails at the same time, and after leaving the rail, the missile quickly climbs and accelerates because of the effects of the boosters. When the missile reaches Ma = 1.8, the boosters separate from the second stage.

Descent Segment. The missile starts to descend from point A, and when the missile command mechanism sends out the signal to descend, the missile descends to point D at a height of 50 meters according to instructions.

Level Flight Segment: When the command mechanism sends out the signal for level flight, the missile immediately stabilizes in level flight at a height of 50 meters.

(2). The Self Guided Segment

During the time of automatic control determined by the command instrument on board the ship, the missile command mechanism sends out signal number three, and the terminal guidance radar is turned on and searches for the target. sends out lock on signals and lock on command. Then it sends out directional operational commands to the guidance instruments, controlling the direction of the missile. Along the altitude path, it is still controlled in level flight by the signal from the altimeter. When it comes to point B within 3,000 meters of the target, the radar sends out an order to dive, and the missile drops down to a height of five meters and stays at this height until it strikes the target.

The airborne model of this missile has a trajectory that differs from that of a shiplaunched missile only in the climb segment. The missile follows the mother craft to a certain altitude and then is dropped and launched. After it has fallen for sixty meters, the boosters ignite causing the missile to accelerate. After about three of four minutes, the booster accelerates the missile to mach 1.8 and separates from the second stage. The missile continues to dive to point A, and then enters into the same trajectory as that of the ship launched missile.

V: LAUNCH VEHICLE FIRE CONTROL SYSTEMS

The launch vehicle (airplane or ship) fire control system is the missile fire control system located on the aircraft or the ship. It is composed of a missile attack radar, a missile command instrument, a spiral platform and a power source. It is mainly used to search for and track enemy surface targets, and for real time measurement of position and movement parameters of the carrier vehicle, to calculate the target movement parameters and missile launch data and to load these onto the missile, and for conducting inspection of the missile prior to launch and for launch control.

The missile attack radar is the main observation equipment on the carrier vessel. It is used to search the surface of the water, and to

select targets of attack and to track them. It is used to precisely calculate the movement parameters of the target, and to continue to transmit data to the missile command instrument.

The missile command instrument is central control equipment of the missile fire control system. It is primarily used to calculate the automatic control flight time of the missile and the angle of deviation from the carrier vehicle operational direction. Necessary parameters and orders are loaded onto the missile. It conducts a prefire inspection of the missile, controls the launch of the missile, and has a missile simulator for training.

VI: LAUNCH EQUIPMENT

The ship launched model of the C101 missile uses a tubular launch. The launch equipment is composed of the launch tube and the launcher.

The launcher is set on the deck of the vessel at a certain azimuth and at a certain angle to the horizon. The missile is placed inside the launch tube, and then they are both hung on the launcher. Therefore, the launch tube serves for both transport and launch.

The launch equipment of the aircraft launched model of the C101 is composed of a transition beam and a special use rack.

The transition beam is affixed under the wing of the mother craft, it is the universal hanger of the aircraft, and is used to hang bombs, beacons, and missiles. The special purpose hanger is connected at the bottom of the transition beam, and at the bottom of the special use hanger there are two hooks. The C101 missile is hung on the special use hanger by loops at the front and back on the transition beam. When launch conditions are met, the hooks automatically open and the missile falls free, thereby launching the missile.

VII: SURFACE EQUIPMENT

The C101 missile surface equipment is composed of technical position tow vehicles, missile loading vehicles, fueling trucks, hydraulic pressure trucks, and booster connecting trucks. The surface equipment is used to arm, load, fill, connect, and inspect the missile to provide overall technical preparations and maintenance so the missile is always in good technical condition so it can be transported toward the launch position at any time.

VIII: OPERATIONAL SEQUENCE OF THE WEAPONS SYSTEM

After the missile attack radar aboard the carrier vehicle detects the target, it recognizes and evaluates the target, and selects those targets which are to be attacked. The radar then switches over to a tracking mode. At this time, preliminary preparations are made to the missile, including preheating of the magnetic control tube of the missile's radar.

After the missile attack radar tracks the target, it automatically calculates the targets movement parameters and supplies these in live time to the missile command instrument. The command instrument calculates the launch data and loads operational parameters and instructions on the missile, performs pre-launch checks of the missile and controls the launch of the missile. The missiles can be launched individually or a number of missiles maybe launched at the same time.

Before the missile is launched, electrical power is supplied to the missile by a power source ont he carrier vehicle. When launch conditions are met, the batteries are activated, the missile gyroscope is unlocked, the boosters are ignited (air-launched models must fall for 60 seconds before the boosters are ignited, and the missile switches over to its own electrical supply. After the missile has left the launch equipment, it climbs, drops and levels off according to a preset sequence. When the automatic control flight time preloaded onto the missile is reached, the missile radar is turned on and searches for and tracks the target. After

the missile is launched, according to a certain sequence, the fuse and other levels of safety locks are released, and when the missile contacts the target, the fuse detonates the warhead, and the target is struck near the waterline.

IX: CONCLUDING REMARKS

A great deal of surface testing and multiple launch flight testing and study over a long time has shown that the C101 missile has overcome the whole series of technical problems of super low altitudes supersonic speeds. It has solved the key technical problems of matching thrust and impedance in the pulse jet engine, reliable separation of the two boosters, normal operation of equipment in the vibrating environment inside the missile, electrical - magnetic compatibility, and precision control, achieving successful test flights and striking ideal target locations.

The results of the flight testing demonstrate that the C101 missile meets design standards, has advanced capabilities, and is of the level of the fourth generation anti-ship missiles of the 1990's.

DISTRIBUTION LIST

DISTRIBUTION DIRECT TO RECIPIENT

ORGANIZATION		MICROFICHE
B085	DIA/RTS-2FI	1
C509	BALL0C509 BALLISTIC RES LAB	1
C510	R&T LABS/AVEADCOM	1
C513	ARRADCOM	1
C535	AVRADCOM/TSARCOM	1
C539	TRASANA	1
Q592	FSTC	4
Q619	MSIC REDSTONE	1
Q008	NTIC	1
Q043	AFMIC-IS	1
E051	HQ USAF/INET	1
E404	AEDC/DOF	1
E408	AFWL	1
E410	ASDTC/IN	1
E411	ASD/FTD/TTIA	1
E429	SD/IND	1
P005	DOE/ISA/DDI	1
P050	CIA/OCR/ADD/SD	2
1051	AFIT/LDE	1
CCV		1
P090	NSA/CDB	1
2206	FSL	1

Microfiche Nbr: FTD91C000681
FTD-ID(RS)T-0607-91