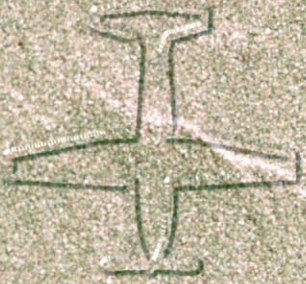
$12.00 U.S.

Pilot's Guide for the T-6A Naval Aircraft Collision Warning System

Model NACWS 991



BFGoodrich Aerospace

BFGoodrich Avionics Systems, Inc.

Errata Sheet

Information contained in this errata sheet identifies changes made to the T-6A NACWS 991 with software upgrade version 1.5. Insert this page inside the front cover of the T-6A NACWS 991 pilot's guide (P/N 009-10132-001 Rev. A).

The NACWS 991 now displays the NACWS INOP message instead of the NACWS DGRD message when your aircraft is on the ground *and* there are no locked radars. As a result of this change, please make the following changes to the pilot's guide:

1. Replace the NACWS INOP paragraph on page 2-10 with the following:

   NACWS INOP This message indicates that the NACWS 991 cannot detect any traffic due to one of the following sets of circumstances:

   a. A loss of barometric altitude.

   b. A High Voltage Power Supply (HVPS) failure concurrent with the loss of either heading, locked radar, or GPS.

   c. A loss of locked radar while your aircraft is on the ground.

   The NACWS 991 may be able to regain some or all of its ability to detect traffic once the missing input is restored.

2. Cross out the warning on page 2-11 and the corresponding listing in the Safety Summary on page ii.

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Pilot's Guide
for the
T-6A Naval Aircraft Collision Warning System
Model NACWS 991

Designed and manufactured in the United States of America by

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Safety Summary

These cautions and warnings appear later in this guide and are repeated here for emphasis:

CAUTION

pages
1-5 & 2-8

Due to a passive detection mode characteristic called the self-garble region, the NACWS 991 may track some aircraft using only the active detection mode even when you're within radar coverage. (That means that the NACWS 991 will NOT display a symbol for such aircraft on the proximity screen unless it becomes a TA, and if it does become a TA, it is displayed as a no-bearing TA.)

CAUTION

pages
1-5, 2-5, & 2-8

When only the active detection mode is available (active-only mode), the NACWS 991 only displays intruder aircraft if they become TAs. (It does NOT display proximate traffic as in the passive detection mode.) Furthermore, any TAs displayed are displayed on the active-only screen as no-bearing TAs.

page 2-8

The NACWS 991 does not detect, track, or provide warning against aircraft that do not have an operating transponder.

page 2-8

Some traffic within the chosen display range may not be tracked due to traffic prioritizing, antenna shielding, or reception of low power transponders.

page 2-9

Do not attempt evasive maneuvers based solely on traffic information shown on the NACWS traffic screens. The NACWS 991 is only an aid in detecting other aircraft. It provides a means for you to visually acquire and avoid aircraft which may pose a collision threat. It is not a replacement for ATC or see-and-avoid procedures. You must still visually scan the surrounding airspace frequently.

page 2-11

If you're on the ground and NO LOCKED RDRS is displayed, the NACWS is not tracking any aircraft even though there is no indication of INOP on the screen. NO LOCKED RDRS means the passive detection mode is not available, and being on the ground means active detection mode is not available either.

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Chapter 1
System Description

General Description

The BFGoodrich Avionics Systems T-6A Naval Aircraft Collision Warning System, model NACWS 991, provides Eyes That Never Blink™. It continuously monitors the airspace around your aircraft and advises you where to look for detected traffic that may pose a collision threat. Once you see the traffic, you can make the appropriate collision avoidance decisions. The system can track up to 35 transponder-equipped aircraft out to a maximum distance of 20 nautical miles (nmi). Figure 1-1 shows the NACWS 991 Transmitter/Receiver Computer.

Figure 1-1. T-6A NACWS 991 Transmitter/Receiver Computer (TRC)

Major Components

BFGoodrich Avionics Systems supplies the NACWS 991 TRC and its mounting tray, but does not provide the L-band antennas or the cockpit displays used with the TRC.

Transmitter/Receiver Computer (TRC)

The TRC, model TRC691, mounted in the left avionics bay with the supplied mounting tray, contains the circuitry necessary to convert inputs into aural and visual advisories of intruding aircraft. The TRC also contains built-in tests which detect faults or failures and verify that the system is operating properly.

Omnidirectional L-Band Antennas

The L-band antennas, mounted on the top and bottom of the aircraft, receive Secondary Surveillance Radar (SSR) interrogations and airborne transponder replies for the NACWS 991 passive detection mode. The top antenna also *transmits* omnidirectional transponder interrogations for the NACWS 991 active detection mode.

Engine/Systems/NACWS Display

The NACWS 991 displays its traffic screens on the engine/systems/NACWS display located on the right-hand side of the instrument panel in each cockpit. The primary screen usually seen on this display is the engine/systems screen (figure 1-2). Various NACWS status messages can be displayed along the bottom of the engine/systems screen.

Figure 1-2. Engine/Systems Screen

NACWS 991 Interaction With Other Equipment

Figure 1-3 shows how the NACWS 991 connects to other aircraft equipment and systems.

The NACWS 991 requires valid input from the following aircraft equipment:

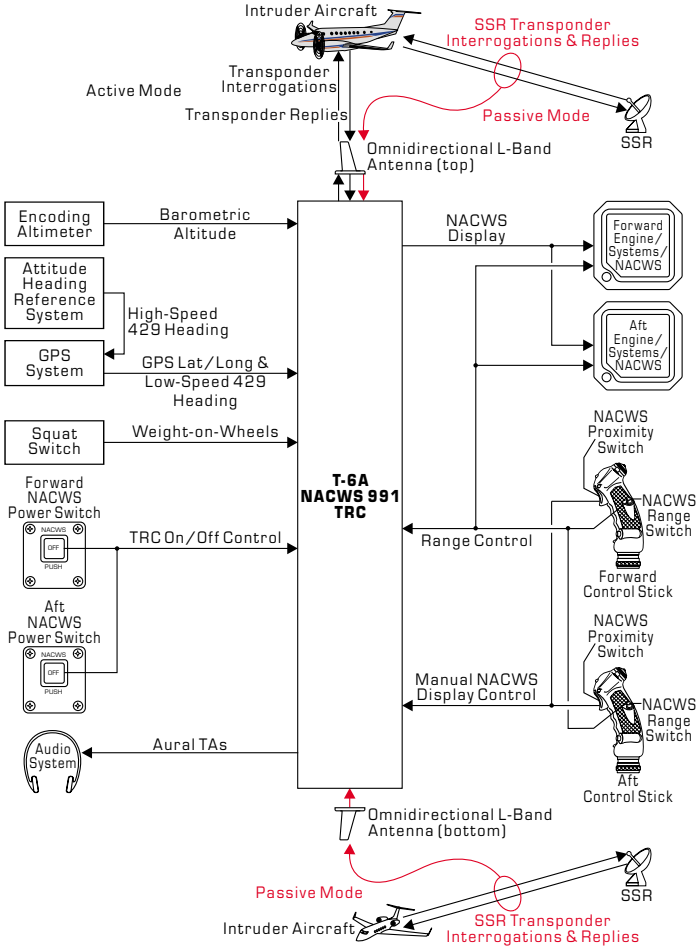


Figure 1-3. T-6A NACWS 991 Simplified Functional Diagram

Encoding Altimeter The NACWS 991 requires altitude input from your aircraft's encoding altimeter to compute differential altitudes of nearby aircraft. If the altitude input is not available to the system, the NACWS 991 will become inoperative.

Attitude Heading Reference System The NACWS 991's passive detection mode requires heading input from your aircraft's Attitude Heading Reference System (AHRS) via the GPS system to determine the relative bearing of nearby aircraft. If the heading input is not available to the system, the NACWS 991 will continue to operate in active-only mode and will only provide no-bearing Traffic Advisories (TAs).

GPS System The NACWS 991's passive detection mode requires latitude and longitude input from your aircraft's GPS system to determine the position of nearby aircraft. If lat/long is not available, the NACWS 991 will continue to operate in active-only mode and will only provide no-bearing TAs.

Squat Switch The NACWS 991 requires weight-on-wheels input from your aircraft's squat switch to determine when your aircraft is on the ground. Once the NACWS 991 knows you're on the ground, it enables the operator-initiated self test and disables the active detection mode. If weight-on-wheels is not available to the system, the NACWS 991 acts as though it is always airborne.

Functional Description

Passive & Active Detection Modes

The NACWS 991 uses a dual-mode detection system (passive mode and active mode). Under normal conditions, when your aircraft is in the air, the system operates in the passive and active detection modes simultaneously. The following paragraphs describe each mode. See chapter 3 for more details.

Passive Detection Mode

In the passive detection mode, the NACWS 991 listens for ground-based SSR interrogations and the resulting airborne transponder replies in the surrounding airspace out to 20 nmi. When the NACWS 991 receives the replies, it computes the range, bearing, relative altitude (if available), closure rate, and collision threat of up to 35 aircraft, and displays up to 8 of the most threatening aircraft on the proximity screen (figure 1-4).

Figure 1-4. Proximity Screen

This passive mode of monitoring conversations between ground-based SSRs and nearby traffic is the system's primary detection mode. It is best suited for high density areas and for agile, maneuvering aircraft.

Active Detection Mode

In the active detection mode, the NACWS 991 directly interrogates other aircraft's transponders within a 6 nmi radius and determines the range and relative altitude (when available) of up to 35 intruding aircraft. Active detection mode does not determine the intruding aircraft's bearing. Active mode is best suited for areas where ground-based SSR coverage is not available.

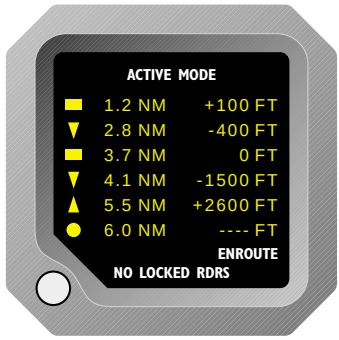


Figure 1-5. Active-Only Screen

If the passive mode is not available, the system predicts collision threats based on active mode detection and displays up to six of the most threatening no-bearing TAs on the active-only screen (figure 1-5). If the passive mode *is* available, but is not being used to track one or more aircraft, the system predicts collision threats for those aircraft based on active mode detection and displays up to three no-bearing TAs on the proximity screen, not the active-only screen.

CAUTION *Due to a passive detection mode characteristic called the self-garble region, the NACWS 991 may track some aircraft using only the active detection mode even when you're within radar coverage. (That means that the NACWS 991 will NOT display a symbol for such aircraft on the proximity screen unless it becomes a TA, and if it does become a TA, it is displayed as a no-bearing TA.)*

CAUTION *When only the active detection mode is available (active-only mode), the NACWS 991 only displays intruder aircraft if they become TAs. (It does NOT display proximate traffic as in the passive detection mode.) Furthermore, any TAs displayed are displayed on the active-only screen as no-bearing TAs.*

Calculating & Displaying Possible Collision Threats

The NACWS 991 defines two concentric cylindrical zones around your aircraft in order to classify detected aircraft as threat or non-threat aircraft. The inner zone is called the TA zone. The outer zone is called the proximity zone. Traffic in the proximity zone that is not a collision threat is called proximate traffic.

The size of the TA zone and the proximity zone depends on the sensitivity mode you select: enroute or landing. (See figure 1-6.) Both the TA zone and the proximity zone are reduced in size in landing sensitivity mode. The zones can be reduced without reducing your margin of safety due to the fact that airspeeds are usually lower around airports. (The planes can get closer to you before becoming a threat.) The smaller display range and the more relaxed TA criteria associated with the landing sensitivity mode tend to reduce the number of symbols that would otherwise clutter the display when you're near a busy airport.

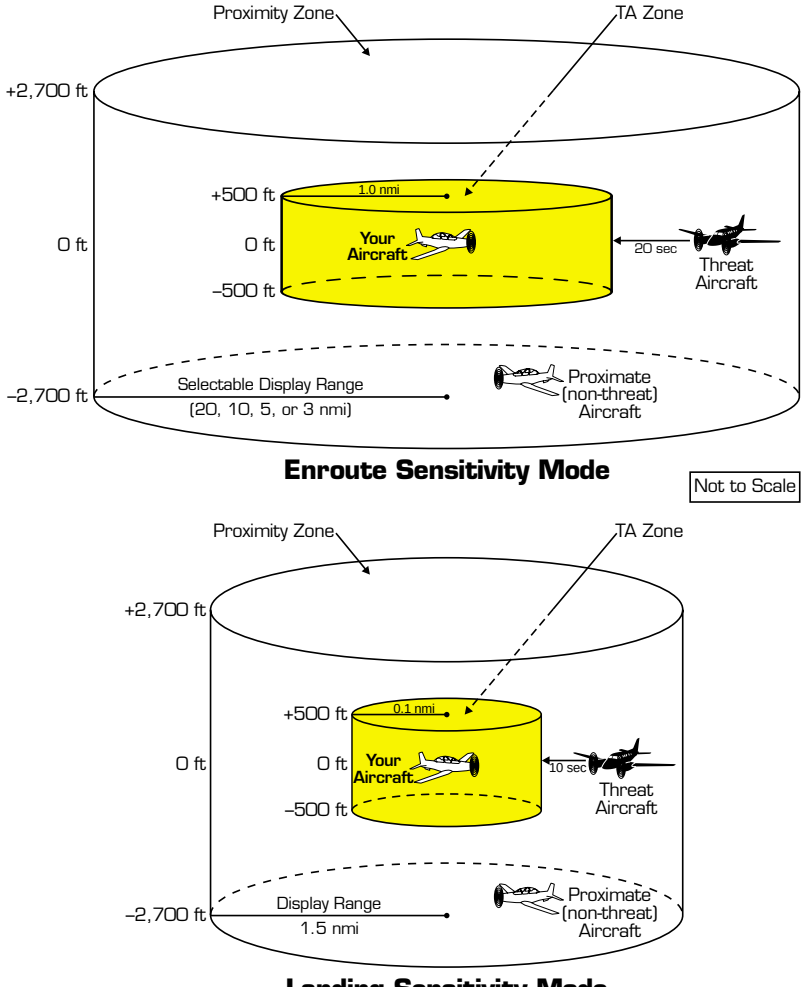


Figure 1-6. Enroute & Landing Sensitivity Modes

Enroute Sensitivity Mode

Setting the NACWS range to 20, 10, 5, or 3 nmi using the NACWS range switch on the control stick (see chapter 2) puts the NACWS 991 into enroute mode. In enroute mode, the TA zone measures ±500 ft vertically and has a radius of 1 nmi. The proximity zone in enroute mode measures ±2,700 ft vertically and has a radius equal to the current NACWS range setting of 20, 10, 5, or 3 nmi.

In enroute mode, an aircraft detected within 20 seconds of penetrating your TA zone causes the NACWS 991 to display a NACWS traffic screen with a flashing yellow TA symbol (figures 1-4 and 1-5). Six slow aural alert tones over the aircraft audio system accompany the TA symbol.

Landing Sensitivity Mode

Setting the NACWS range to 1.5 nmi using the NACWS range switch on the control stick (see chapter 2) puts the NACWS 991 into landing mode. In landing mode, the TA zone measures ±500 ft vertically and has a radius of 0.1 nmi. The proximity zone in landing mode measures ±2,700 ft vertically and has a radius equal to the current NACWS range setting of 1.5 nmi.

In landing mode, an aircraft detected within 10 seconds of your TA zone causes the NACWS 991 to display a NACWS traffic screen with a flashing yellow TA symbol (figures 1-4 and 1-5). Twelve fast aural alert tones over the aircraft audio system accompany the TA symbol.

Autoranging

When a TA first occurs, the NACWS 991 automatically sets the display range to the shortest range that will still include the new TA. Once the initial range is set, you can manually change the display range.

Example 1: If the proximity screen is set to the 5 nmi range and a TA occurs at 6 nmi, the display range automatically changes to 10 nmi.

Example 2: If the proximity screen is set to the 20 nmi range and a TA occurs at 4 nmi, the display range automatically changes to 5 nmi.

One exception to the autoranging rule is that the NACWS 991 will not automatically change the display range from 20, 10, 5, or 3 nmi to 1.5 nmi to accommodate a TA detected within 1.5 nmi; instead, the NACWS 991 changes the range to 3 nmi. This

exception is to prevent the NACWS 991 from switching into landing sensitivity mode.

Additional TA Information

1. If a TA occurs when one of the engine/systems status fields is in the caution or warning range, the TA consists of the normal alert tones and a "NACWS TA" message on the bottom of the engine screen (figure 1-2, page 1-2) instead of a NACWS traffic screen automatically appearing on the display. You may then press and hold the prox switch (see chapter 2) to display a NACWS traffic screen.

2. When your aircraft is on the ground, to eliminate distractions caused by other ground traffic, the NACWS 991 disables alert tones associated with TAs that have a relative altitude of less than +330 feet.

3. The NACWS traffic screen remains on the display for 7 seconds after the last TA aircraft being tracked ceases to be a threat, but if one of the engine/systems status fields is in the caution or warning range, the traffic screen reverts back to the engine/systems screen as soon as you release the prox switch.

4. TAs do *not* provide evasive maneuver information.

Chapter 2
Operation

Controls & Indicators

Figure 2-1 and the following paragraphs describe the controls and indicators used with the NACWS 991. The only discrete indicator associated with the NACWS 991 is the light inside the NACWS power switch. The next section (page 2-3) describes the NACWS traffic symbols and screen elements.

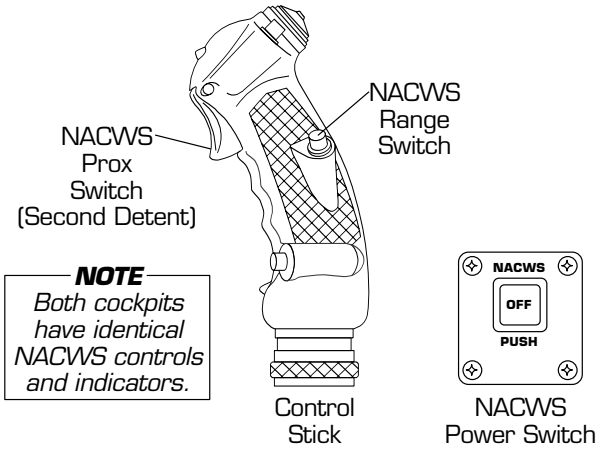


Figure 2-1. T-6A NACWS 991 Controls and Indicators

NACWS Prox Switch

Pressing the control stick trigger to the second detent turns on the NACWS prox switch and displays a NACWS traffic screen. As long as the passive detection mode is functional, the system displays the proximity screen (figure 1-4) to show nearby traffic. If radar coverage becomes inadequate for effective passive

detection, or if the passive mode becomes inoperative, the system displays the active-only screen (figure 1-5) to display traffic advisories. These NACWS traffic screens remain on the display for 7 seconds after you release the trigger or 7 seconds after the last TA being tracked ceases to be a threat. If one or more of the engine system status fields is in the warning or caution range, the display will revert back to the engine/systems screen immediately after you release the trigger instead of waiting 7 seconds.

When your aircraft has been on the ground for at least 24 seconds, pressing the prox switch while holding down the range switch starts a self test of the system.

Pressing the prox switch in one cockpit affects the display in both cockpits.

NACWS Range Switch

Repeatedly pressing this switch on the control stick toggles the radius of the proximity zone (and the display range) through the following values: 20, 10, 5, 3, and 1.5 nmi. Setting the radius to 1.5 nmi puts the NACWS 991 into landing mode as indicated by the LANDING label at the bottom right corner of the screen. Setting the radius to 20, 10, 5, or 3 nmi puts the NACWS 991 into enroute mode as indicated by the ENROUTE label at the bottom right corner of the screen.

With the proximity screen displayed, a label at the bottom of the outer range ring indicates the proximity zone/display range radius. With the active-only screen displayed, pressing the range switch still toggles the radius of the proximity zone, but since no proximate traffic is listed on the active-only screen, and since the interrogation range is fixed at 6 nmi, pressing the switch only affects the screen when you switch into and out of the 1.5 nmi range to change sensitivity modes as indicated by the LANDING or ENROUTE label at the bottom right corner of the screen.

When your aircraft has been on the ground for at least 24 seconds, pressing and holding the range switch then pressing the prox switch starts a self test of the system.

Pressing the range switch in one cockpit affects the display in both cockpits.

NACWS Power Switch

Pressing this switch on the right side of the instrument panel toggles power off and on to the NACWS 991 TRC. The light inside the switch lights up when the NACWS 991 is off. Pressing the switch when the light is not lit turns off the NACWS 991 and turns on the light. Pressing the switch when the light is lit turns on the NACWS 991 and turns off the light.

Pressing the power switch in one cockpit affects the display and the light inside the power switch in both cockpits.

Display Symbols & Screen Elements

Figure 2-2 and the following paragraphs describe the NACWS traffic symbols and screen elements on the proximity screen.

White outlined traffic symbols represent proximate traffic (no collision threat). Yellow outlined traffic symbols with flashing yellow fills are TAs that represent threatening traffic.

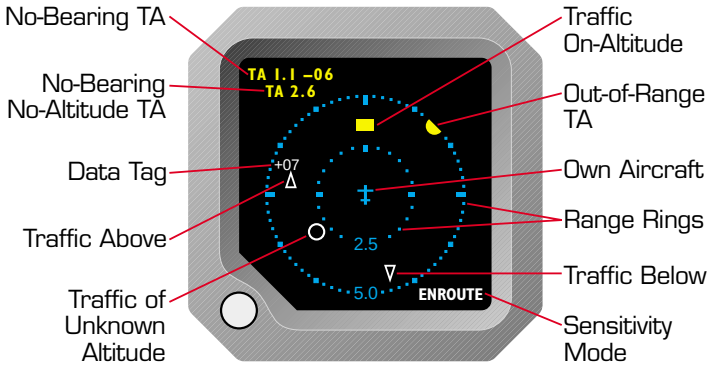
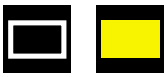


Figure 2-2. Display Symbols & Screen Elements – Proximity Screen



Traffic On-Altitude A rectangle represents an intruder aircraft within ±300 ft of your current altitude.

Out-of-Range TA This half circle or any other half symbol represents a threatening intruder aircraft beyond the current display range. The symbol is located at a position along the outer range ring that indicates the relative bearing of the intruder aircraft.

Own Aircraft This symbol represents your aircraft.

Range Rings The range rings indicate distance from your aircraft in nautical miles. The equal spacing of azimuth markers around the range rings can help you quantify the angular location of traffic within the rings. The outer range ring represents the current range setting (20, 10, 5, 3, or 1.5 nmi). The inner range ring is always half the distance of the outer range ring. A label at the bottom of each ring indicates the distance of the ring from your aircraft.

Traffic Below A downward pointing triangle represents an intruder aircraft 400 to 2,700 ft below your present altitude. If the aircraft is 400 to 900 ft below you, the symbol includes a data tag that indicates the intruder aircraft's relative altitude. An aircraft more than 2,700 ft below you is not displayed unless it generates a traffic advisory.

Sensitivity Mode This field indicates which sensitivity mode you're in. (See page 1-7 for a description of the enroute and landing sensitivity modes.)

Traffic of Unknown Altitude A circle represents an intruder aircraft that is not reporting its altitude. This aircraft could be at *any* altitude, but for the purpose of calculating whether or not the aircraft should generate a TA, the NACWS 991 assumes the aircraft is at your present altitude.

Traffic Above An upward pointing triangle represents an intruder aircraft 400 to 2,700 ft above you. If the aircraft is 400 to 900 ft above you, the symbol includes a data tag that indicates the intruder aircraft's relative altitude. An aircraft more than 2,700 ft above you is not displayed unless it generates a TA.

Data Tag These two digits indicate, in hundreds of feet, the relative altitude of the intruder aircraft. For example, +07 means the intruder aircraft is 700 ft above you. A positive data tag is displayed above the traffic symbol to emphasize that the intruder aircraft is above you. Similarly, a negative data tag is displayed below the traffic symbol. Data tags are only displayed for altitude-reporting aircraft 400 to 900 feet above you and 400 to 900 feet below you.

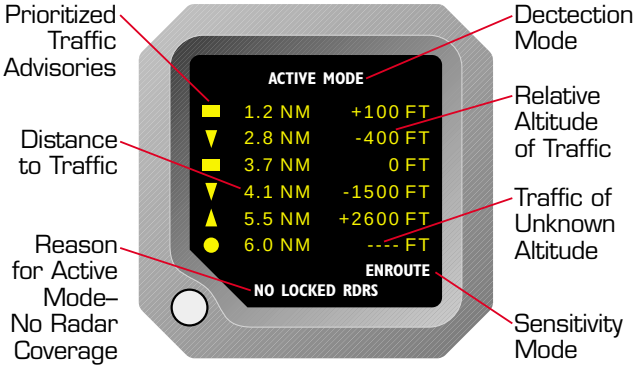
No-Bearing No-Altitude TA If bearing and altitude are not available for an intruder aircraft that meets the requirements for generating a TA, the TA takes the form of this yellow line of text consisting of the letters TA and the intruder aircraft's range. The NACWS 991 can display as many as three no-bearing/no-bearing no-altitude TAs with the highest priority TA listed first.

No-Bearing TA If bearing is not available for an intruder aircraft that meets the requirements for generating a TA, the TA takes the form of this yellow line of text beginning with the letters TA and including the intruder aircraft's range and a data tag (relative altitude). The NACWS 991 can display as many as three no-bearing/no-bearing no-altitude TAs with the highest priority TA listed first.

Figure 2-3 identifies the screen elements found on the active-only screen. This screen is displayed when the passive detection mode is not available.

CAUTION

When only the active detection mode is available (active-only mode), the NACWS 991 only displays intruder aircraft if they become TAs. (It does NOT display proximate traffic as in the passive detection mode.) Furthermore, any TAs displayed are displayed on the active-only screen as no-bearing TAs.



(The active mode interrogates aircraft within a 6 nmi radius.)

Figure 2-3. Display Symbols & Screen Elements – Active-Only Screen

Turn On the NACWS 991

1. Once you've powered-up the aircraft, make sure the light inside the NACWS power switch is *not* lit; if it *is* lit, press the switch to turn on the NACWS 991 and to turn off the light inside the switch.

   During power up, the NACWS FAIL message is temporarily displayed at the bottom of the engine/systems screen while the NACWS 991 performs a power up self test, sounds six slow aural alert tones over the aircraft audio system, and goes into landing mode.

   If the system detects a problem during the power up self test, it displays a message at the bottom of the screen below the engine/systems information. If the message is NACWS DGRD, press the prox switch to display more information about the NACWS problem (at the bottom of the NACWS traffic screen). Refer to the System Messages section on page 2-9 for a description of NACWS system messages.

Run the Operator-Initiated Self Test

You should run the following operator-initiated self test before the first flight of the day or as specified in your aircraft operating manual. The operator-initiated self test can only be run when the aircraft is on the ground and has been on the ground for at least 24 seconds to ensure that a test is not activated during a go-around or during a touch-and-go maneuver.

1. Press and hold the range switch, then press the prox switch.

   The NACWS 991 begins its self test, displays the test screen (figure 2-4), and sounds 12 fast aural alert tones over the aircraft audio system. Upon successful completion of the self test, you will hear a "CWS Test Passed" message and the display will revert to the engine/systems screen.

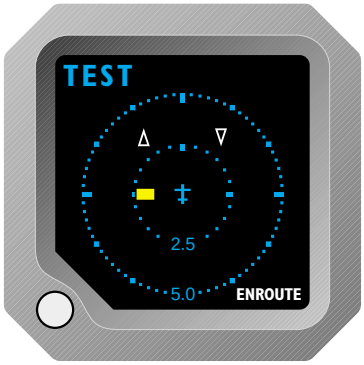


Figure 2-4. Operator-Initiated Self Test Screen

2. If the 12 fast aural alert tones do not sound during the test, contact your aircraft maintenance personnel for trouble-shooting help.

3. If you hear a "CWS Test Failed" message or see a NACWS FAIL message, run the test again. If it continues to fail, try turning the NACWS 991 off then back on, then run the test again. If it continues to fail, contact your aircraft maintenance personnel for troubleshooting help.

Display Traffic

1. Press and hold the NACWS prox switch to display the NACWS proximity screen or the NACWS active-only screen.

Change the Range & Sensitivity Mode

1. Press the NACWS range switch repeatedly to toggle the display range of the proximity screen between 20, 10, 5, 3, and 1.5 nmi.

2. Set the range to 20, 10, 5, or 3 nmi to put the NACWS 991 into enroute mode.

3. Set the range to 1.5 nmi to switch the NACWS 991 into landing mode.

Observe the Display

The NACWS 991 does not detect, track, or provide warning against aircraft that do not have an operating transponder.

Some traffic within the chosen display range may not be tracked due to traffic prioritizing, antenna shielding, or reception of low power transponders.

CAUTION

Due to a passive detection mode characteristic called the self-garble region, the NACWS 991 may track some aircraft using only the active detection mode even when you're within radar coverage. (That means that the NACWS 991 will NOT display a symbol for such aircraft on the proximity screen unless it becomes a TA, and if it does become a TA, it is displayed as a no-bearing TA.)

CAUTION

When only the active detection mode is available (active-only mode), the NACWS 991 only displays intruder aircraft if they become TAs. (It does NOT display proximate traffic as in the passive detection mode.) Furthermore, any TAs displayed are displayed on the active-only screen as no-bearing TAs.

Monitor the activity of any traffic displayed. Keep in mind the following points when watching traffic on the display. See page 3-3 for more information on detection characteristics that may limit the effectiveness of the NACWS 991.

- Traffic Prioritizing – The NACWS 991 can track up to 35 intruder aircraft simultaneously, but to reduce clutter, it displays only up to a fixed number of the most threatening aircraft of those tracked: 8 on the proximity screen, and 6 on the active-only screen.

- Ground Target Filtering – When your aircraft is on the ground, to eliminate distractions caused by other ground traffic, the NACWS 991 disables alert tones associated with TAs that have a relative altitude of less than +330 feet.

Respond to Traffic Advisories

Do not attempt evasive maneuvers based solely on traffic information shown on the NACWS traffic screens. The NACWS 991 is only an aid in detecting other aircraft. It provides a means for you to visually acquire and avoid aircraft which may pose a collision threat. It is not a replacement for ATC or see-and-avoid procedures. You must still visually scan the surrounding airspace frequently.

When the NACWS 991 issues a TA, look outside for the intruder aircraft. When you spot an intruder aircraft, use normal right-of-way procedures to maintain separation.

Turn Off the NACWS 991

1. Press the NACWS power switch.

   The light inside the switch lights up when the NACWS 991 is off, and a "NACWS OFF" message appears on the bottom of the engine/systems screen.

System Messages

The NACWS 991 displays two types of system messages, level 1 and level 2, as described in the following sections.

Level 1 Messages

Level 1 messages (listed below) appear at the bottom of the engine/systems screen (figure 2-5a).

NACWS FAIL	NACWS INOP	NACWS DGRD
NACWS TA	NACWS OFF	

With the exception of the NACWS DGRD and NACWS TA messages, the level 1 messages also appear in a box in the middle of a blank screen (figure 2-5b) when the flight crew presses the prox switch while the level 1 message is displayed on the engine/systems screen.

If you get a NACWS FAIL, INOP, or DGRD message, and you can not resolve the problem using the information in this section, contact your aircraft maintenance personnel for trouble-shooting help.

The following paragraphs describe the level 1 messages.

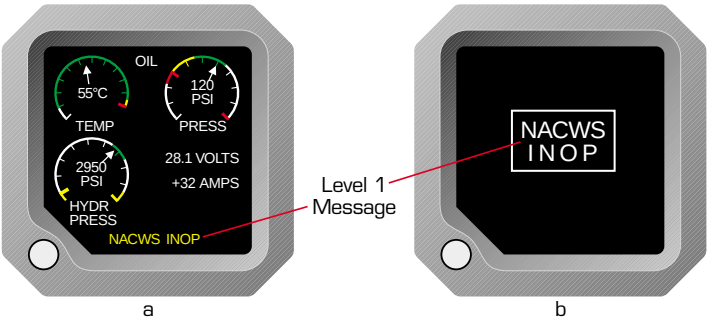


Figure 2-5. Examples of a Level 1 Message

NACWS INOP
This message indicates that the NACWS 991 cannot detect any traffic due to one of the following sets of circumstances:

a. A loss of barometric altitude.

b. A High Voltage Power Supply (HVPS) failure concurrent with the loss of either heading, locked radar, or GPS.

c. A loss of locked radar while your aircraft is on the ground.

The NACWS 991 may be able to regain some or all of its ability to detect traffic once the missing input is restored.

NACWS FAIL This message indicates that the NACWS 991 cannot detect any traffic due to one or more failures within the NACWS 991, or because the NACWS 991 has not yet finished its power-up sequence. If you get a NACWS FAIL message, wait a few minutes then turn the NACWS 991 off then back on to see if that resolves the problem.

NACWS INOP ~~This message indicates that the NACWS 991 cannot detect any traffic due to a loss of barometric altitude, or due to a High Voltage Power Supply (HVPS) failure concurrent with the loss of either heading, locked radar, or GPS. The NACWS 991 may be able to regain some or all of its ability to detect traffic once the missing input is restored.~~

NACWS DGRD This message indicates that the NACWS 991's ability to detect traffic is degraded due to an HVPS failure, an internal radar database failure, or the loss of an external input. Pressing the prox switch when the NACWS DGRD message is displayed brings up a NACWS traffic screen with a level 2 message displayed at the bottom. (Level 2 messages provide information on the cause of NACWS 991's degraded operation.) In degraded operation, the NACWS 991 can only use one detection mode (passive or active), but it may be able to regain the other detection mode if a missing input is restored.

NACWS TA This message indicates that the NACWS 991 has generated a TA, but the NACWS traffic screen is not being displayed because one or more of the engine system status fields is in the warning or caution range. If this message is displayed, you can still press and hold the prox switch to display the NACWS traffic screen.

NACWS OFF This message means that the NACWS 991 is off.

Level 2 Messages

Level 2 messages (listed below) appear at the bottom of the NACWS traffic screens (figure 2-6) when the NACWS 991's operation is degraded. These messages provide information on the cause of NACWS 991's degraded operation.

GPS LOST	NO LOCKED RDRS	HVPS FAIL
RDB FAIL	HEADING LOST	

The following paragraphs describe the level 2 messages.

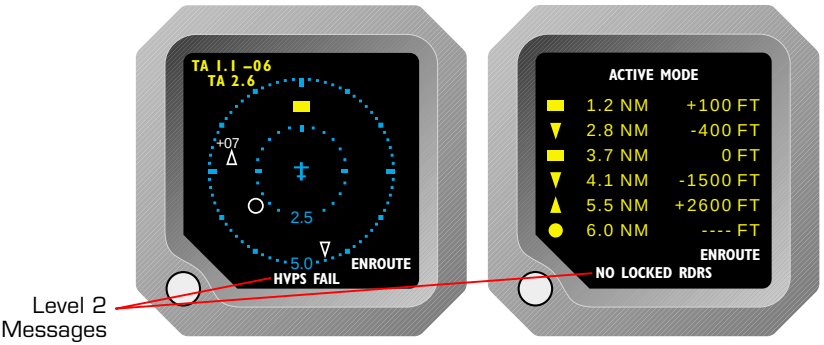


Figure 2-6. Examples of Level 2 Messages

GPS LOST This message indicates that the NACWS 991 is not receiving a valid GPS input and that only the active detection mode is available. Once a valid GPS input is restored, the passive detection mode will be restored.

NO LOCKED RDRS This message indicates that the NACWS 991 cannot detect, decode, or verify radar sites, and that only the active detection mode is available. Once radar coverage is restored, the passive detection mode will be restored.

WARNING

If you're on the ground and NO LOCKED RDRS is displayed, the NACWS is not tracking any aircraft even though there is no indication of INOP on the screen. NO LOCKED RDRS means the passive detection mode is not available, and being on the ground means active detection mode is not available either.

HVPS FAIL This message indicates that the high voltage power supply has failed and only passive detection mode is available.

RDB FAIL This message indicates that the NACWS 991 internal radar database is corrupt or missing and that only the active

detection mode is available. Once a valid radar database is restored, the passive detection mode will be restored.

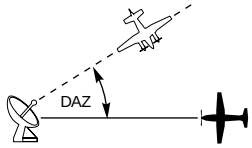
HEADING LOST This message indicates that the NACWS 991 is not receiving a valid heading input and that only the active detection mode is available. Once a valid heading input is restored, the passive detection mode will be restored. Note that the GPS system will not pass along the AHRS heading until the GPS system itself resolves heading, which it may not be able to do until the aircraft begins to move.

Chapter 3
Theory of Operation

Passive Detection Mode

The NACWS 991 radar database stores information about Secondary Surveillance Radars (SSRs) located throughout the United States and its territories. When the system is turned on, it begins to sample interrogation signals from surrounding ground-based radars. By comparing the interrogations with radar signatures stored in the database, the system identifies each radar site, confirms its lat/long position and its elevation, then locks onto the radar. The NACWS 991 also monitors the rate of interrogations to synchronize its internal clock with the radar's rotation. This synchronization allows the NACWS 991 to know precisely the direction the radar antenna is facing at any time.

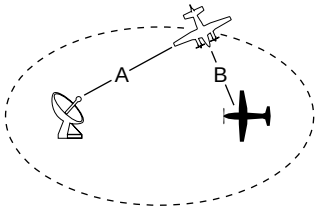
The NACWS 991 marks the point in time when it hears an intruder aircraft reply to an interrogation signal. Since the system knows where the antenna was pointing when the reply was made, it also knows the direction of the intruder from the radar site. Using this information, the radar's lat/long position, and your current GPS lat/long position, the system is able to determine the Differential Azimuth (DAZ) of the intruder (figure 3-1).



The intruder is somewhere along the dotted line.

Figure 3-1. Differential Azimuth (DAZ)

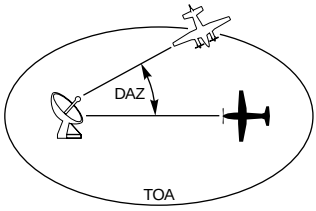
To further define the intruder's position, the NACWS 991 measures the elapsed time between the interrogation and the reply. Because the system knows the radar's signature and is synchronized with its rotation, it also knows when the radar will transmit. The system's internal clock starts when the interrogation signal is transmitted (A, figure 3-2). The clock stops when the system hears the intruder's reply (B, figure 3-2). Based on the total elapsed time, the system identifies all possible intruder locations that could provide the time of arrival information (A+B). The resulting Time of Arrival (TOA) ellipse surrounds you and the radar site.



The intruder is somewhere along the dotted ellipse.

Figure 3-2. Time of Arrival (TOA)

The NACWS 991 now has a fix on the intruder – precisely where the differential azimuth crosses the time of arrival ellipse (figure 3-3). Combining this information with the intruder's Mode C data and your current position, heading, and altitude, the NACWS 991 is able to display the bearing and relative altitude of the intruder. The system also tracks the intruder's flight path so that traffic advisories will be issued when the traffic poses a collision threat.

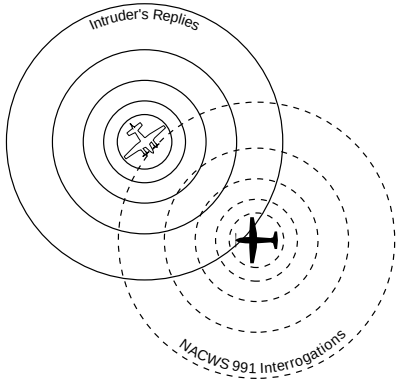


The intersection defines the intruder's position.

Figure 3-3. Intersection of DAZ and TOA

Active Detection Mode

Unlike passive mode, which relies on ground-based radars to interrogate traffic, active mode operates whenever you're in the air without regard to the extent of radar coverage. The NACWS 991 transmits omnidirectional interrogations to other aircraft transponders and listens for their replies (figure 3-4). The time between transmission and receipt of the signals tells the system how far it is to the intruder aircraft. If the intruder is transmitting Mode C information, the system can also determine the intruder's relative altitude. When traffic poses a collision threat, the NACWS 991 issues *no-bearing* traffic advisories.



Active mode determines the intruder's range and possibly relative altitude.

Figure 3-4. Active Detection Mode

Detection Characteristics

Some detection characteristics may limit the effectiveness of the NACWS 991. Most of these characteristics affect the passive detection mode. Fortunately, the dual-detection capability of the NACWS 991 allows the active mode to continue its surveillance and advise you of potential collision threats.

There are four main characteristics that affect intruder detection: radar environment, antenna shadowing, invalid data, and misleading data.

Radar Environment

Passive detection is dependent on adequate radar coverage. The NACWS 991 passive detection mode must be able to receive SSR interrogations *and* intruder replies; therefore, at least one SSR must be within line-of-sight of your aircraft and the NACWS 991

must be able to identify its radar signature. The system must also be able to confirm the radar site within its radar database. If these criteria cannot be met, the NACWS 991 displays the NO LOCKED RDRS message. Typically this message occurs in areas with few or no radar sites.

Even in areas with adequate radars, poor radar coverage may be induced by flying beneath the coverage, flying behind mountains, or encountering intruders that are not in radar coverage. In these cases, intruders may temporarily disappear from the display, then reappear as the geometry changes.

Antenna Shadowing

In simplest terms, the NACWS 991 must be able to hear an intruder's reply to an SSR or to the NACWS 991's active interrogations in order to detect the intruder. Transponder antennas are typically mounted on the underside of the aircraft. If an intruder is positioned in a way that hides its antenna, the NACWS 991 will probably not be able to track the intruder until the intruder's antenna is no longer in the aircraft's "shadow."

Invalid Data

The NACWS 991 requires valid input from other aircraft equipment as discussed in the *NACWS 991 Interaction With Other Equipment* section starting on page 1-2. If the NACWS 991 does not receive these valid inputs, the detection capability of the NACWS 991 will be diminished as detailed starting on page 1-2.

Misleading Data

To display the relative altitude of nearby traffic, the NACWS 991 depends on intruders transmitting valid Mode C information. If the intruder transmits inaccurate altitude data, the system will display it as received. Erroneous information could result in misleading data tags.

Also misleading are aircraft transponder replies that do not contain any Mode C information. The system cannot determine the relative altitude of aircraft not reporting altitude. The aircraft may be well above or below you, but for safety's sake, the NACWS 991 treats the intruder as though it's at your altitude. This assumption could result in misleading data on the display.

Chapter 4
Display Interpretation

Introduction

This chapter explains the meaning of several sample screens.

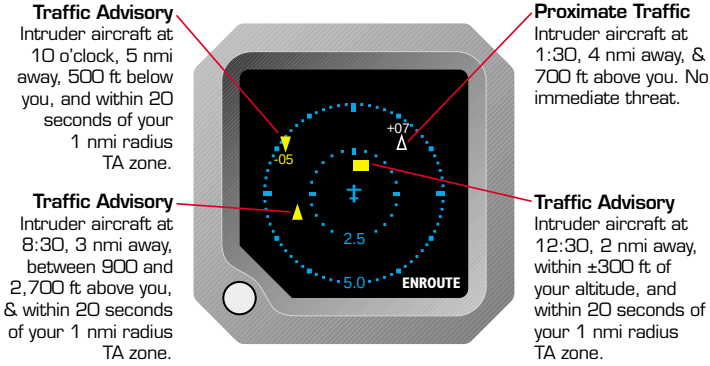


Figure 4-1. Traffic in Enroute Mode

Figure 4-2. Traffic in Landing Mode

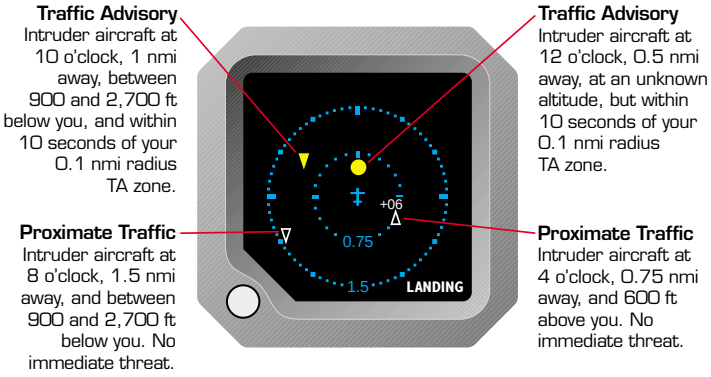


Figure 4-3. More Traffic in Landing Mode

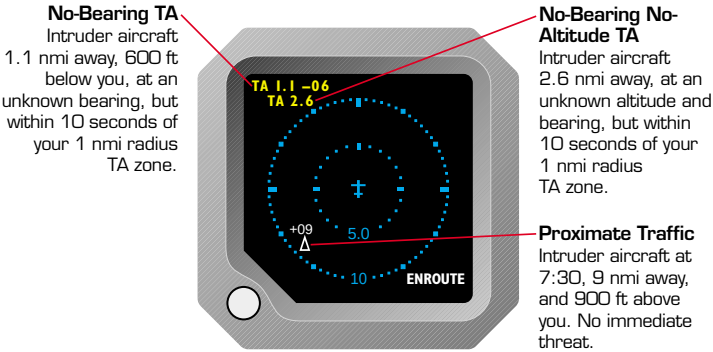


Figure 4-4. No-Bearing TAs

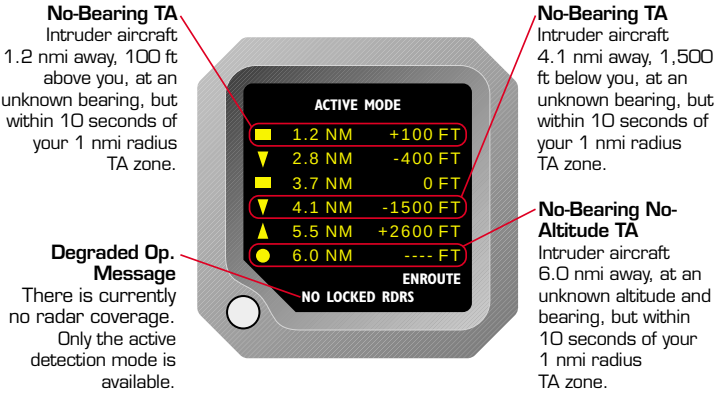


Figure 4-5. More No-Bearing TAs and a System Message

Chapter 5
Specifications

Table 5-1. T-6A NACWS 991 Specifications

Part Number Definition:
805-10012-013 – TRC691 w/o GPS
805-10024-002 – TRC Mounting Tray With Self-Locking Holddown (no safety wire required)

TRC Enclosure Size:
7.64 in (19.35 cm) high
6.19 in (15.72 cm) wide
13.58 in (34.49 cm) deep

Weight:
17 lb 14 oz (8.11 kg) without mounting tray
19 lb 4 oz (8.73 kg) with mounting tray

Power Input Requirements:
18 to 32.2 V dc, 45 W (typical)

Operating Temperature:
-55 to +70 °C (-67 to +158 °F)

Storage Temperature:
-55 to +85 °C (-67 to +185 °F)

Operating Altitude:
55,000 ft maximum

Cooling:
Conduction and forced air (internal fan) convection

Tracking Capability
Tracks up to 35 intruder aircraft (displays up to 8 aircraft on the proximity screen, and up to 6 aircraft on the active-only screen)

Surveillance Range
20 nmi maximum

(Continues on next page.)

Table 5-1. T-6A NACWS 991 Specifications – Continued

Display Ranges
1.5, 3, 5, 10, and 20 nmi

Range Accuracy
±0.1 nmi (typical)

Bearing Accuracy
5° RMS (typical)

Altitude Accuracy
±200 ft

Traffic Advisory Criteria
Enroute Mode: Intruder aircraft 20 seconds from a 1.0 nmi radius cylinder of space that extends 2,700 ft above and 2,700 ft below your own aircraft
Landing Mode: Intruder aircraft 10 seconds from a 0.1 nmi radius cylinder of space that extends 2,700 ft above and 2,700 ft below your own aircraft

RTCA Compliance:
Environmental:
DO-160C Category:
F2-XB(NBM)XWXXXX*BBBAUAXXX

Chapter 6
Warranty Information

Introduction

The NACWS 991 is warranted for 2 years from the date of installation (not to exceed 30 months from the date of shipment from BFGoodrich Avionics Systems, Inc.) subject to the following limitations.

Warranty Statement

BFGoodrich Avionics Systems, Inc. (hereinafter called BFGAS) warrants each item of new equipment manufactured or sold by BFGAS to be free from defects in material and workmanship, under normal use as intended, for a period of 30 months from date of shipment by BFGAS to an authorized facility, or 24 months from date of installation by an authorized facility, whichever occurs first. No claim for breach of warranties will be allowed unless BFGAS is notified thereof, in writing, within thirty (30) days after the material or workmanship defect is found.

The obligation of BFGAS shall be limited to replacing or repairing at its factory the equipment found defective under terms of this warranty certificate; providing that such equipment is returned in an approved shipping container, transportation charges prepaid, to BFGAS, Grand Rapids, Michigan, or such other location as BFGAS may authorize. BFGAS reserves the right to have necessary repairs performed by an authorized agency.

This warranty shall not apply to any unit or part thereof which has not been installed or maintained in accordance with BFGAS instructions, or has been repaired or altered in any way so as to

adversely affect its performance or reliability, or which has been subjected to misuse, negligence or accident.

This warranty is exclusive and is accepted by buyer in lieu of all other guaranties or warranties express or implied, including without limitation the implied warranties of merchantability and fitness for a particular purpose. Buyer agrees that in no event will BFGAS liability for all losses from any cause, whether based in contract, negligence, strict liability, other tort or otherwise, exceed buyer's net purchase price, nor will BFGAS be liable for any special, incidental, consequential, or exemplary damages.

BFGAS reserves the right to make changes in design or additions to or improvements in its equipment without the obligation to install such additions or improvement in equipment theretofore manufactured.

A Subsidiary of The BFGoodrich Company

Related Policies and Procedures

a. If the original registered owner of a NACWS 991 sells the aircraft in which the NACWS 991 is installed during the warranty period, the remaining warranty may be transferred. Written notification of the transaction must be submitted by the initial recipient of the warranty to:

ATTENTION: WARRANTY ADMINISTRATOR
BFGoodrich Avionics Systems, Inc.
5353 52nd Street, S.E.
Grand Rapids, MI 49588-0873 U.S.A.

Telephone: (800)253-9525

b. Equipment must be installed by a BFG Avionics Systems, Inc. authorized dealer or installer. Installation of equipment by facilities not specifically authorized will void the equipment warranty.

c. Notice of a claimed product defect must be given to BFG Avionics Systems, Inc. or a designated BFG Avionics Systems, Inc. service agency within the specified warranty period.

d. A product which is defective in workmanship and/or material shall be returned to BFG Avionics Systems, Inc. via any

authorized dealer with transportation charges prepaid. After correction of such defects, the equipment will be returned to the dealer, transportation prepaid by BFG Avionics Systems, Inc. via surface transportation. Any other means of transportation must be paid by the customer.

The risk of loss or damage to all products in transit shall be assumed by the party initiating the transportation of such products. All items repaired or replaced hereunder shall be warranted for the unexpired portion of the original warranty.

e. BFG Avionics Systems, Inc. is in no way obligated or responsible for supporting or participating in the costs of the installation warranty. The entire responsibility lies with the BFG Avionics Systems, Inc. authorized dealer making the installation. BFG Avionics Systems, Inc. is only responsible for the product warranties outlined in the warranty statement.

f. BFG Avionics Systems, Inc. cannot authorize warranty credit for troubleshooting of other systems in the aircraft in order to reduce noise interference with the NACWS 991.

BFGoodrich
Aerospace

009-10132-001 (Rev. A, 1/28/00)

T-6A NACWS 991

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