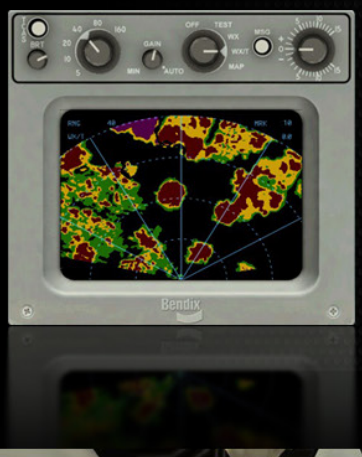


# WX Advantage Radar

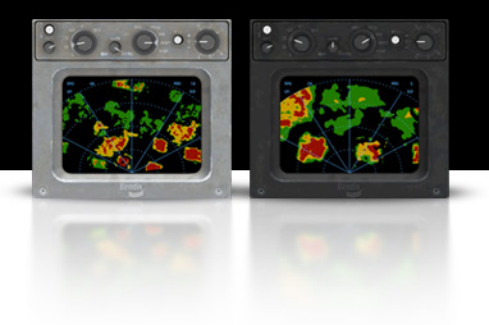
ADVANCED WEATHER RADAR SYSTEM

# USER GUIDE

LAST UPDATED NOVEMBER 4, 2019

REX SIMULATIONS

FLIGHT SIMULATION SOFTWARE





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# Introducing the WX Advantage Weather Radar System!

The **WX Advantage Radar System** is a unique, advanced weather radar system that can be used with **ANY** 3rd-party commercial weather engines, freeware weather engines as well as the built-in weather for Microsoft's Flight Simulator X, FSX:Steam Edition and Lockheed Martin Prepar3D. **Each license of the WX Advantage Radar allows activation for all three flight simulators!**

**This advanced radar system includes unique cloud scan and precipitation sync features that will dynamically sync precipitation.** Never experience precipitation falling outside indicated radar echoes.

**The radar includes a new wet runway feature. Though there may be radar echoes nearby, the runways near precipitation will appear as if rain had just fallen.** The system continuously measures four levels of precipitation: green for light precipitation, yellow for moderate, red for heavy, and magenta for severe precipitation and turbulence.

**Because the system will continuously measure and sync precipitation, you will receive realistic and accurately placed radar echoes that precisely match depicted atmospheric conditions. Turbulence "intelligence" is built-in to isolate potential radar echoes that may contain moderate to severe turbulence.**

The **WX Advantage Radar System** includes full TILT functions to analyze the complete scale of storm structures in real-time and accurately represents the effect of radar attenuation when larger more dense cells are in front of other cells – causing a rain shadow effect.

An intuitive, simple to use **Aircraft Gauge Management Tool** is also included! **This tool allows the installation, editing, and removal of the 2D weather radar gauge for any default or 3rd-party aircraft within a few simple steps.**

The Aircraft Gauge Management Tool includes **FOUR** different types of 2D gauges: **Dark and Clean, Dark with Dirt, Light and Clean, Light with Dirt**. You may select which version best represents the cockpit you are flying in as well as easily adjust the aspect ratio, size, and location of the radar gauge prior to opening the flight simulator.

The November 2016 update includes the activation of the MAP mode consisting of terrain masking and mapping, providing terrain returns and masking. Also included in this update is the improved beam geometry behavior in all modes, giving a more accurate behavior of precipitation cell detection as distance from the aircraft increases!

# Features at a Glance

- The **WX Advantage Radar System** is a unique, advanced weather radar system that can be used with **ANY** 3rd-party weather engine, freeware weather engine, as well as the built-in weather of the flight simulator.

- **Compatible with FSX, FSX:Steam and Prepar3D. Each license of the WX Advantage Radar allows activation for all three flight simulators!**

- This advanced radar system includes **unique cloudscan and precipitation sync features** that will **dynamically sync precipitation**. Never experience precipitation falling outside indicated radar echoes.

- **The radar includes a new wet runway feature. Though there may be radar echoes nearby, the runways near precipitation will appear as if rain had just fallen.**

- **High resolution 3D precipitation density map, which takes advantage of video hardware acceleration for greater performance and level of detail.**

- **High resolution precipitation cell data based on cloud density and other weather parameters at the location of each cloud.**

- **Precise control of ambient precipitation in the region of the aircraft.**

- The system continuously measures four levels of precipitation: green for light precipitation, yellow for moderate, red for heavy, and magenta for severe precipitation and turbulence.

- **Because the system will continuously measure and sync precipitation, you will receive realistic and accurately placed radar echoes that precisely match depicted atmospheric conditions.**

- **Turbulence "intelligence" is built-in to isolate potential radar echoes that may contain moderate to severe turbulence.**

- The WX Advantage Radar System includes full **TILT functions to analyze the complete scale of storm structures in real-time and accurately represents the effect of radar attenuation when larger more dense cells are in front of other cells** – causing a rain shadow effect.

- **An intuitive, simple to use Aircraft Gauge Management Tool is also included! This tool allows the installation, editing, and removal of the 2D weather radar gauge for any default or 3rd-party aircraft within a few simple steps.**

- The Aircraft Gauge Management Tool includes **FOUR different types of 2D gauges: Dark and Clean, Dark with Dirt, Light and Clean, Light with Dirt**. You may select which version best represents the cockpit you are flying in as well as easily adjust the aspect ratio, size, and location of the radar gauge prior to opening the flight simulator.

- **The WX Advantage Radar supports multiple screens and can be undocked and placed on a second window.**

- Includes a full active transmitter/receiver range up to 160NM. (FSX and Prepar3D does not support ranges greater than 160NM)

- The WX Advantage Radar includes gain features to help differentiate between weather and ground clutter.

- **The system includes test/diagnostics, WX (general weather), and WX/T (weather/ turbulence) modes.**

- **NEW - ADDED MAP mode consisting of terrain masking and mapping, providing terrain returns and masking.**

- **NEW - Improved beam geometry behavior in all modes, giving a more accurate behavior of precipitation cell detection as distance from the aircraft increases!**

# Software Installation Procedure

In this section we are going to step you through the procedure to install the **WX Advantage Radar System.**

**IMPORTANT INFORMATION**

You must install the WX Advantage Radar System on the same computer that the flight simulator is installed on. You cannot install the software on a client machine within a network setup.

## Step 1

Open the folder where the installer files are located. Double-click on the "**wxinstaller.exe**" file to start the installation process (Fig 1.1).

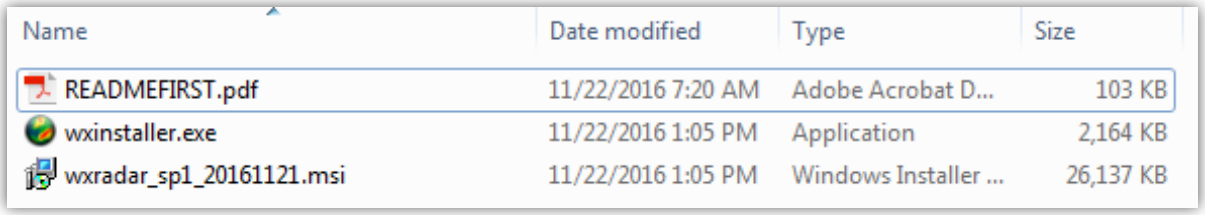



*Figure 1.1 – Installation Files*

## Step 2

Click **NEXT** to continue the setup process (Fig 1.2).

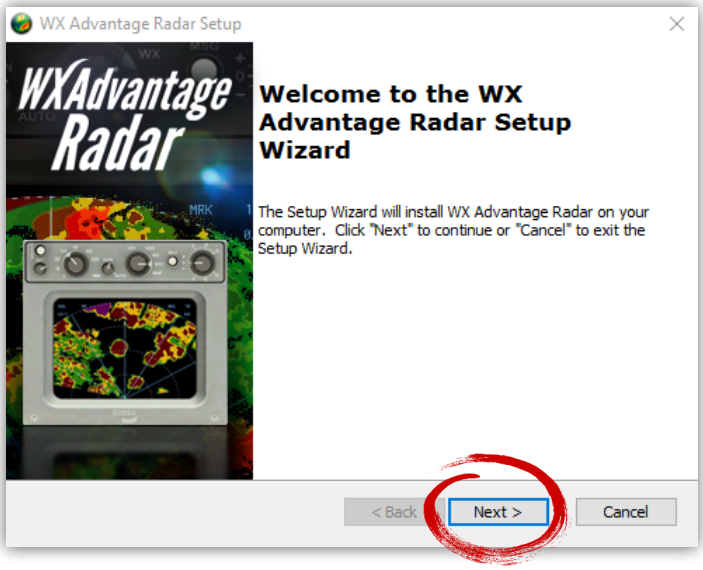



*Figure 1.2 – Initial Setup Window*

# Step 3

You are required to enter a user name, email address and the serial number provided. Click **NEXT** to validate the serial key (Fig 1.3).

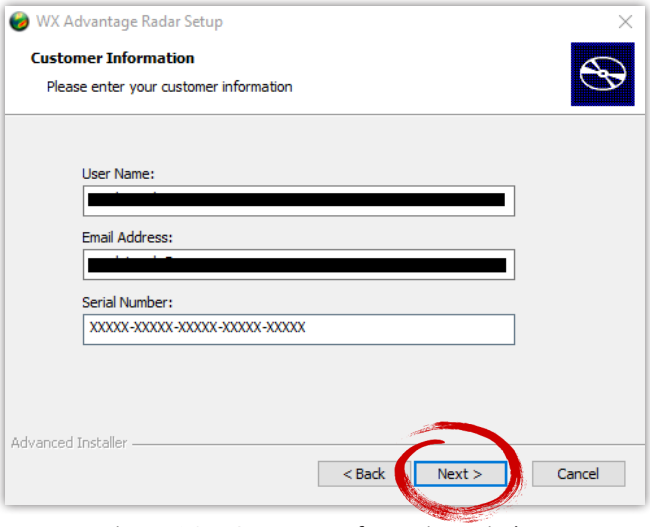



*Figure 1.3 – Customer Information Window*

## IMPORTANT INFORMATION

It is important to remember your user name and email address used with this serial key as this information is stored on secure servers for future validation purposes. This prevents unauthorized usage of the software. If you try to install your software more than a certain number of times allowed, you will be alerted with the following pop-up window (Fig 1.4). Contact our support staff to assist you in removing this error.

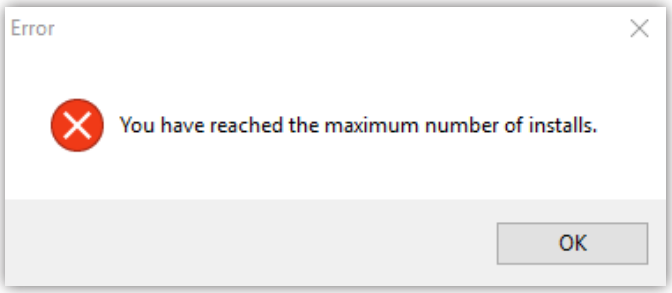



*Figure 1.4 – Maximum Installation Alert*

# Step 4

The WX Advantage Radar requires .net Framework 4.5 to be installed. If it is not found or has not been installed, the installation wizard will automatically download the file and install it. Otherwise, you can skip this action and click **NEXT** to continue (Fig 1.5).

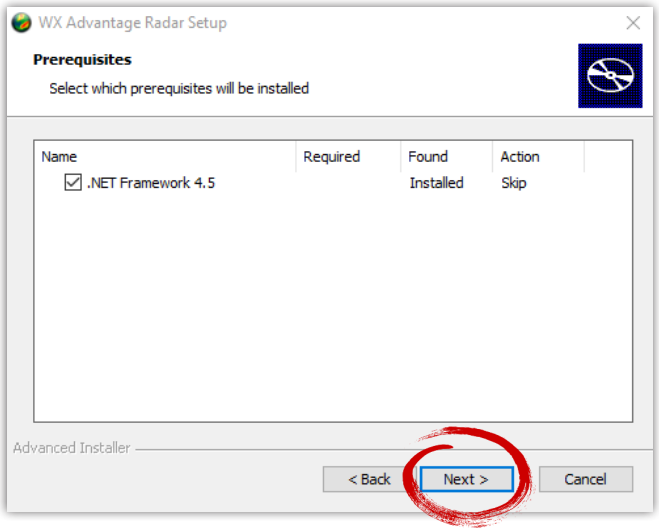



*Figure 1.5 – Prerequisites Window*

# Step 5

To complete the installation process you must agree to the *End-User License Agreement*. We encourage you to read it thoroughly before you proceed. Click "I accept the terms in the License Agreement" option and then **NEXT** to continue the installation process (Fig 1.6).

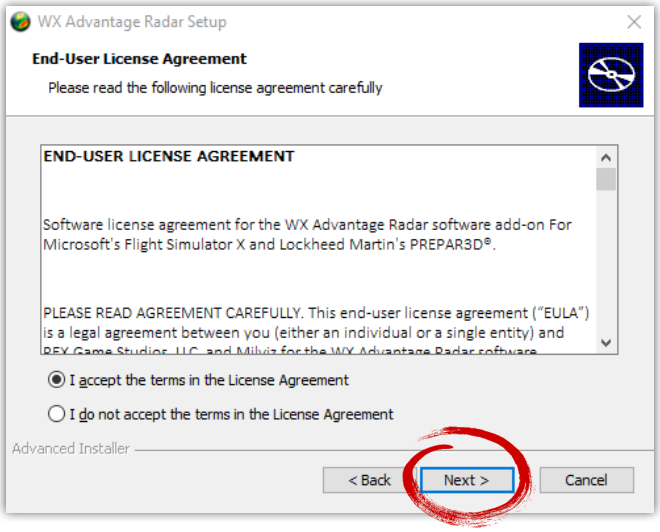



*Figure 1.6 – EULA Agreement Window*

# Step 6

You are prompted with the ideal location to install the software. You may modify this location by clicking **BROWSE**. Click **NEXT** to confirm your installation (Fig 1.7).

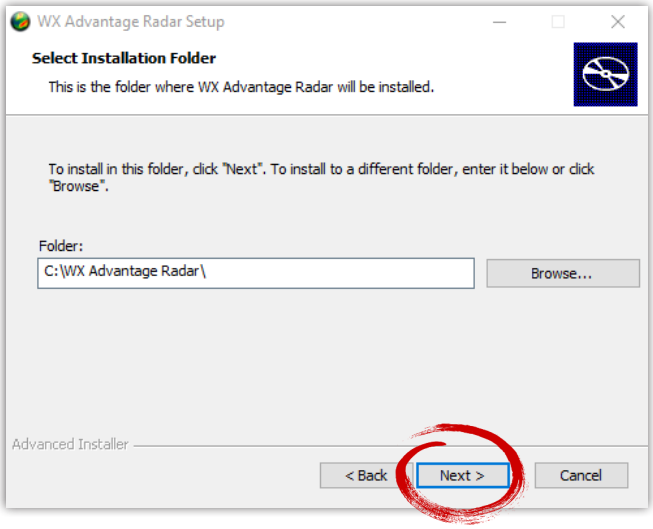



*Figure 1.7 – Folder Selection Window*

**IMPORTANT INFORMATION**

We STRONGLY recommend you do NOT install the software into the Program Files or Program Files (x86) folder as this may cause issues with the operation of the radar.

# Step 7

Click **INSTALL** to confirm and initiate the installation process (Fig 1.8).

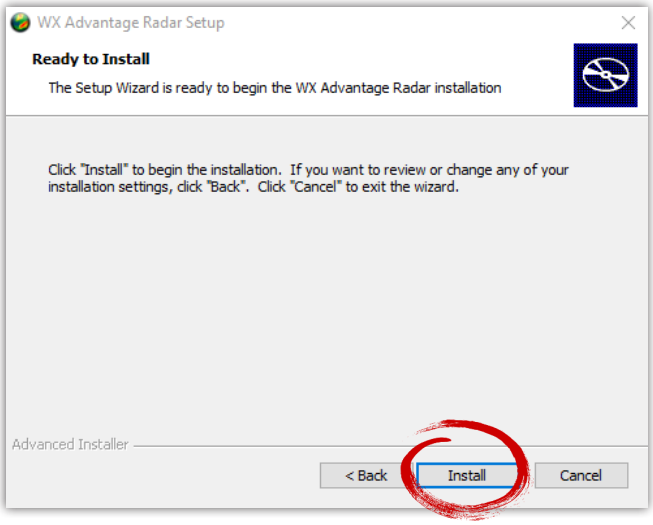



*Figure 1.8 – Confirm Installation Window*

During the installation process you will be provided a window that gives the progress of the installation (Fig 1.9).

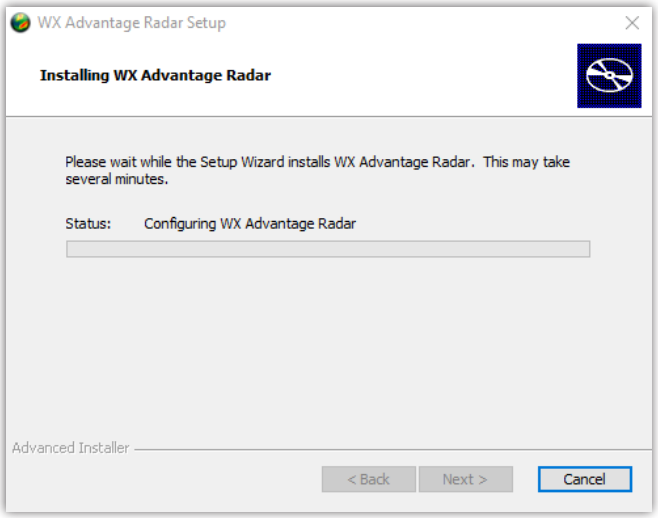



*Figure 1.9 – Installation Process Window*

**IMPORTANT INFORMATION**

During the installation process you will be presented with the **Gauge Management Tool**. You will use this tool to install and modify the placement of the radar gauge within each aircraft you wish to install it. See Chapter 2 for this process.

# Step 8

Once the installation process has completed you will be presented with the final installation window (Fig 1.10). Click the **FINISH** button to finalize the installation process.

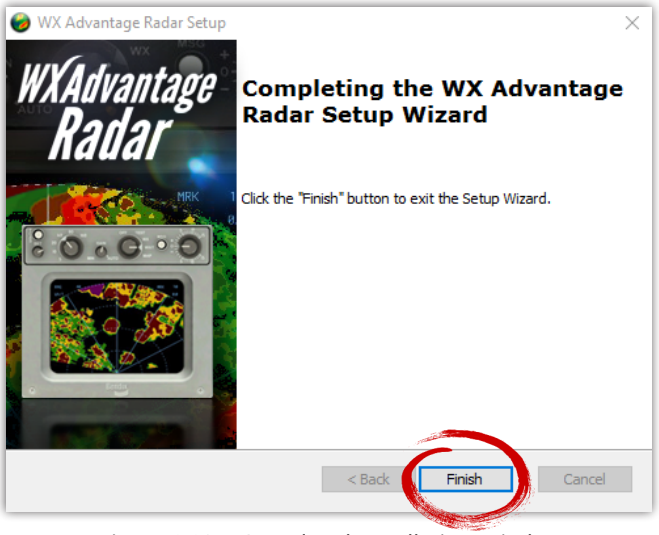



*Figure 1.10 – Completed Installation Window*

# How to Install the Weather Radar Into an Aircraft

In this section we are going show you how to operate the **Radar Gauge Management Tool**. This tool allows you to install, edit, and remove the radar gauge within any default or 3rd-party aircraft.

**IMPORTANT INFORMATION**

**DO NOT INSTALL THE GAUGE INTO AN AIRCRAFT WHILE THE SIMULATOR IS RUNNING!**

## Step 1

To install the radar within an aircraft, locate and double-click on the **Gauge Management Tool** icon on your desktop (Fig 2.1).

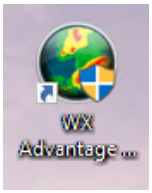



*Figure 2.1 -WX Radar Gauge Management Desktop Icon*

## Step 2

On the startup window click **BEGIN** to continue the installation process (Fig 2.2).

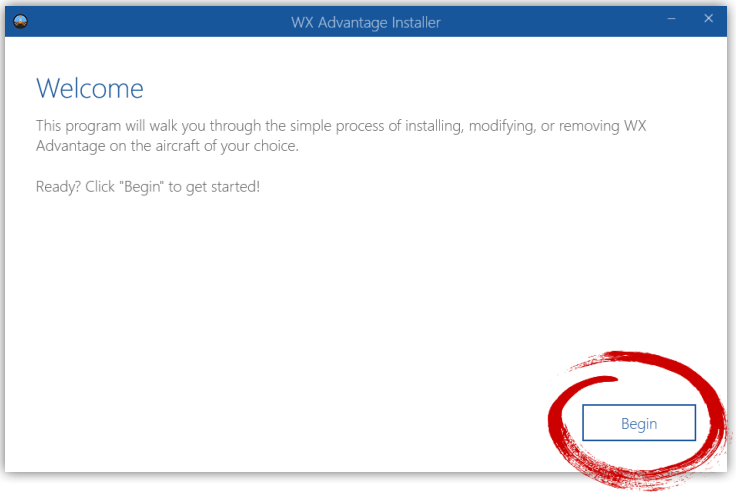



*Figure 2.2 – Gauge Management Tool – Startup Window*

# Step 3

Click on **INSTALL** and then **NEXT** (Fig 2.3).

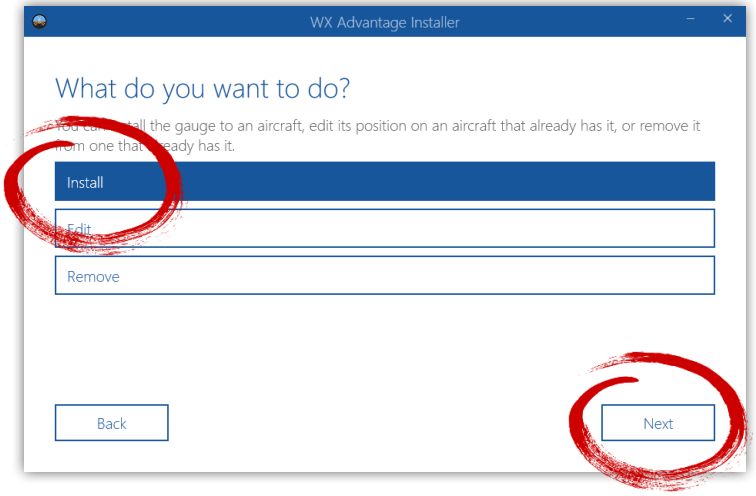



*Figure 2.3 – Gauge Management Tool – Work Window*

# Step 4

Select the flight simulator that you want to install the gauge into. Click **NEXT** to continue (Fig 2.4). *(These buttons will change based upon which flight simulator(s) you have installed).*

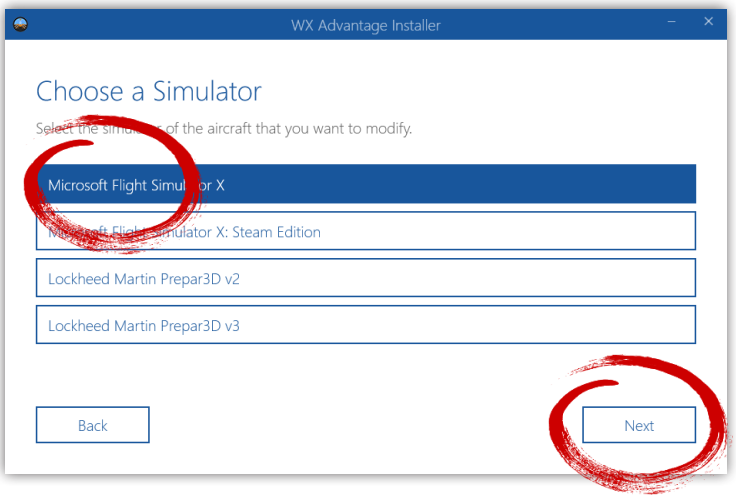



*Figure 2.4 – Gauge Management Tool – Flight Simulator Window*

# Step 5

Select which aircraft you want the gauge to be installed into, then click **NEXT** (Fig 2.5). **You only need to select ONE aircraft livery as the gauge will automatically install into all other aircraft within that specific aircraft type!**

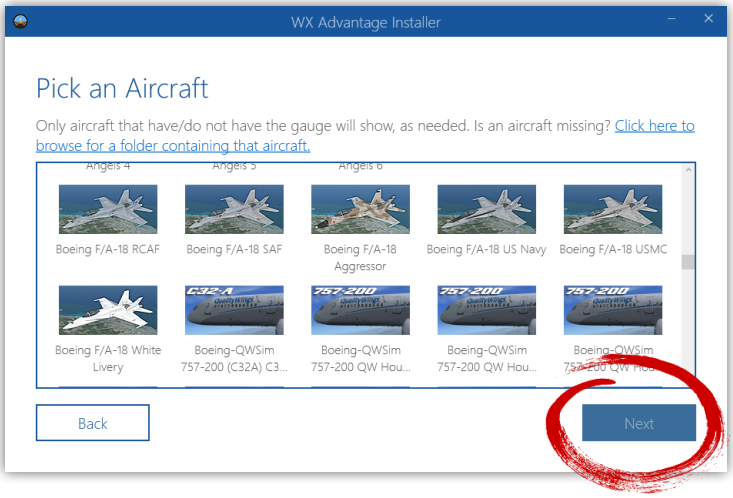



*Figure 2.5 – Gauge Management Tool – Aircraft Selection Window*

## IMPORTANT INFORMATION

If for some reason an aircraft is not displayed, select "**Click here to browse for a folder containing that aircraft**" to select the aircraft to modify.

# Step 6

Next, you can make adjustments to the radar based upon screen resolutions and gauge type (Fig 2.6). Click **NEXT** to save your changes and complete the installation.

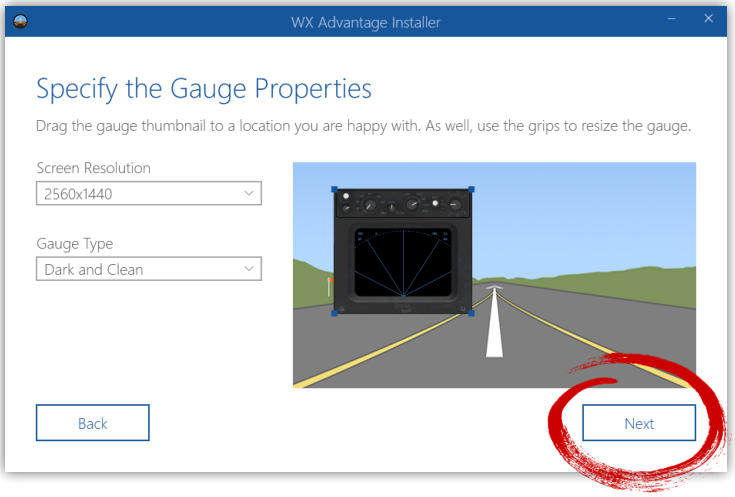



*Figure 2.6 – Gauge Management Tool – Gauge Properties Window*

| FEATURES AND FUNCTIONS | |
|---|---|
| Screen Resolution | Reads the different screen resolutions of your monitor and allows you to adjust the aspect ratio dynamically by what is set within your flight simulator. |
| Gauge Type | Allows you to select from four different types of 2D radar models.<br>• Dark and Clean<br>• Dark with Dirt<br>• Light and Clean<br>• Light with Dirt |

# Step 7 *(Optional)*

You can move and adjust the size of the 2D model. Click on the radar model image to move it around and/or adjust the size. This is a pre-image of how the radar will appear within the simulator when activated (Fig 2.7). After you make your adjustments click **NEXT** to continue.

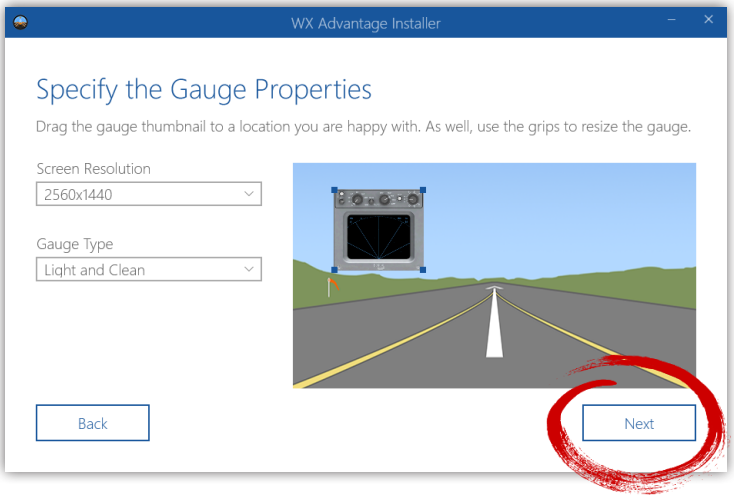



*Figure 2.7 – Gauge Management Tool – Gauge Properties Window*

**IMPORTANT INFORMATION**

The gauge size and aspect ratio can be adjusted within the flight simulator at run time.

# Step 8

After the installation process is completed you will be presented with the following screen indicating that the gauge code successfully installed (Fig 2.8).

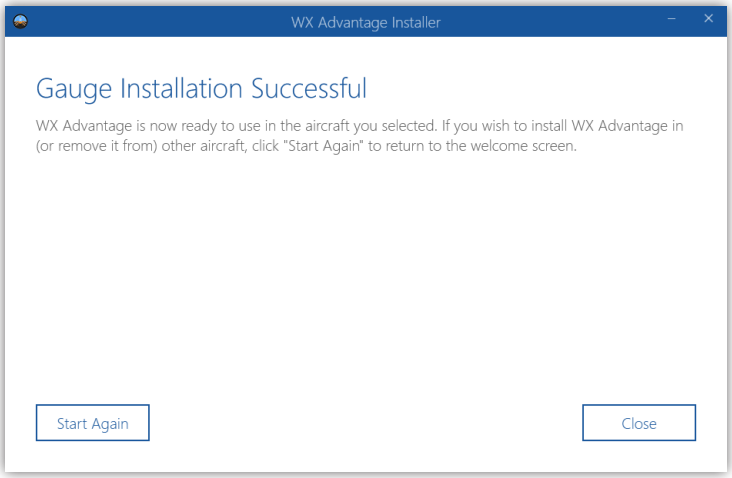



*Figure 2.8 – Gauge Management Tool – Successful Installation Window*

# How to Edit Gauge Properties

In this procedure you will use the **Gauge Management Tool** to modify/edit the radar properties.

**IMPORTANT INFORMATION**

**DO NOT EDIT THE GAUGE WHILE THE SIMULATOR IS RUNNING!**

## Step 1

To modify/edit the gauge properties, locate and double-click on the **Gauge Management Tool** icon on your desktop (Fig 3.1).


*Figure 3.1 -WX Radar Gauge Management Desktop Icon*

## Step 2

On the startup window click **BEGIN** to continue (Fig 3.2).

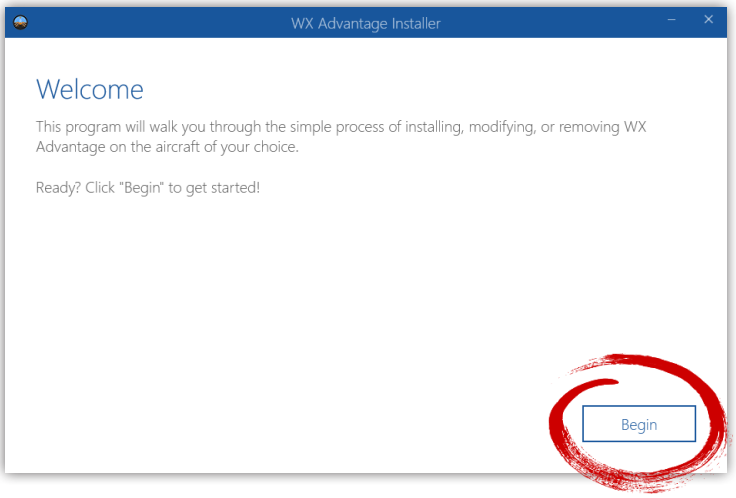



*Figure 3.2 – Gauge Management Tool – Startup Window*

# Step 3

Click on **EDIT** and then **NEXT** (Fig 3.3).

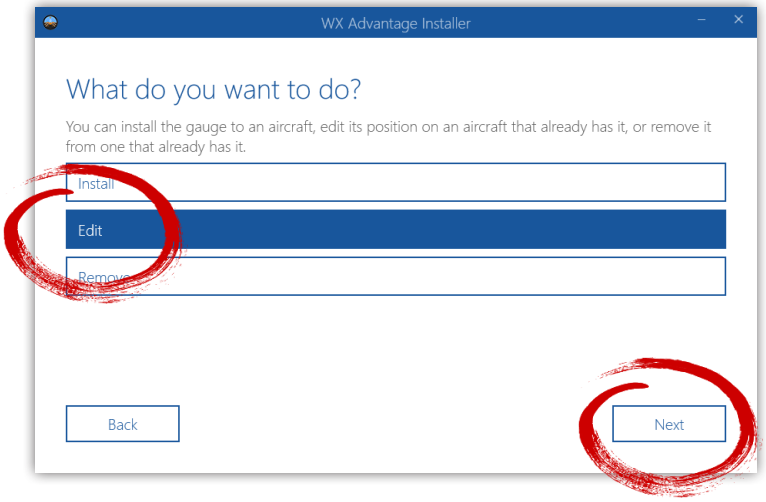



*Figure 3.3 – Gauge Management Tool – Work Window*

# Step 4

Select the flight simulator that you want to edit the gauge then click **NEXT** to continue (Fig 3.4). *(These buttons will change based upon which flight simulator(s) you have installed).*

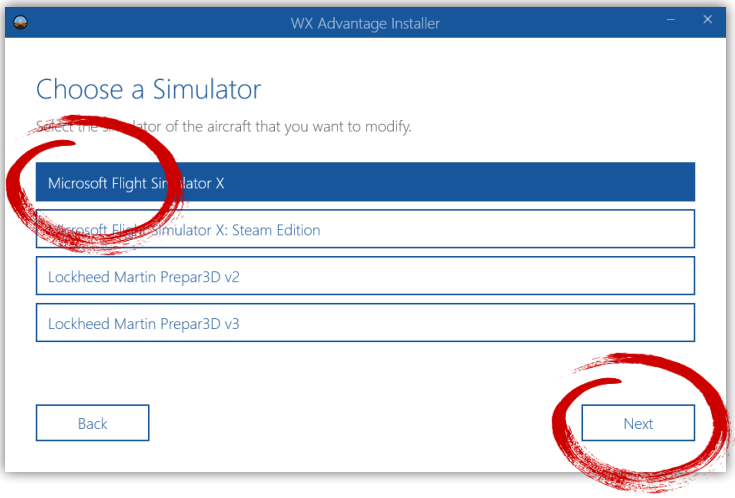



*Figure 3.4 – Gauge Management Tool – Flight Simulator Window*

# Step 5

Select the aircraft that you want to make the modification to, then click **NEXT** (Fig 3.5).

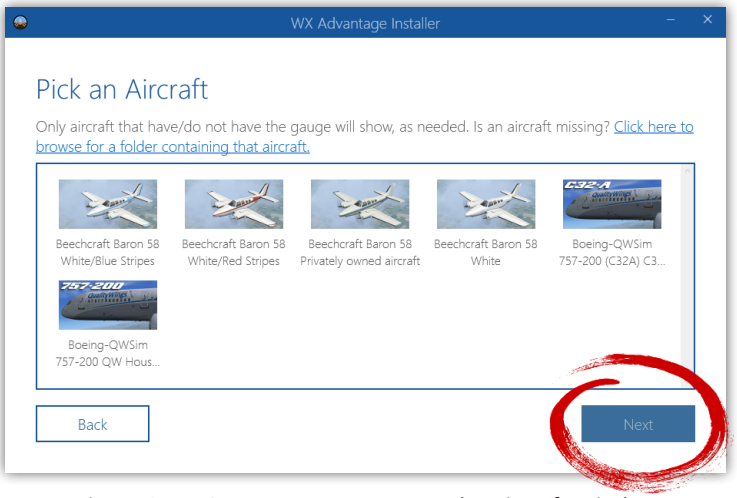



*Figure 3.5 – Gauge Management Tool – Aircraft Window*

**IMPORTANT INFORMATION**

Only the aircraft that currently have the gauge installed will appear in this window (Fig 3.5).

# Step 6

You can make adjustments to the radar based upon screen resolutions and gauge type (Fig 3.6). Click **NEXT** to save your changes and complete the modifications.

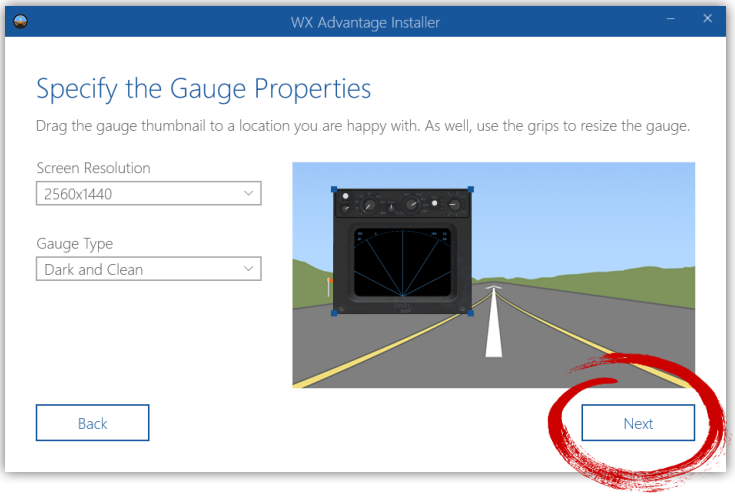



*Figure 3.6 – Gauge Management Tool – Gauge Properties Window*

# Step 7

After the modification process is completed you will be presented with the following screen indicating that the gauge code was successfully modified (Fig 3.7).

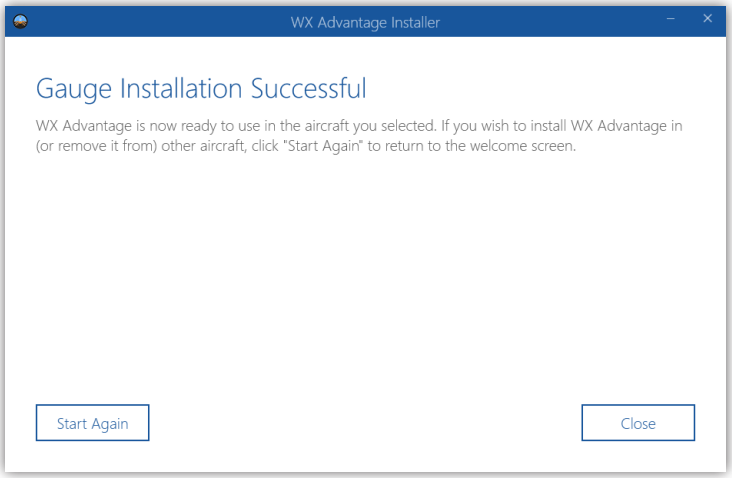



*Figure 3.7 – Gauge Management Tool – Successful Modification Window*

# How to Remove the Weather Radar from an Aircraft

In this procedure you will use the **Gauge Management Tool** to remove the radar from an aircraft.

**IMPORTANT INFORMATION**

**DO NOT REMOVE THE GAUGE WHILE THE SIMULATOR IS RUNNING!**

## Step 1

To remove the gauge from an aircraft, locate and double-click on the **Gauge Management Tool** icon on your desktop (Fig 4.1).


*Figure 4.1 -WX Radar Gauge Management Desktop Icon*

## Step 2

On the startup window click **BEGIN** to continue (Fig 4.2).

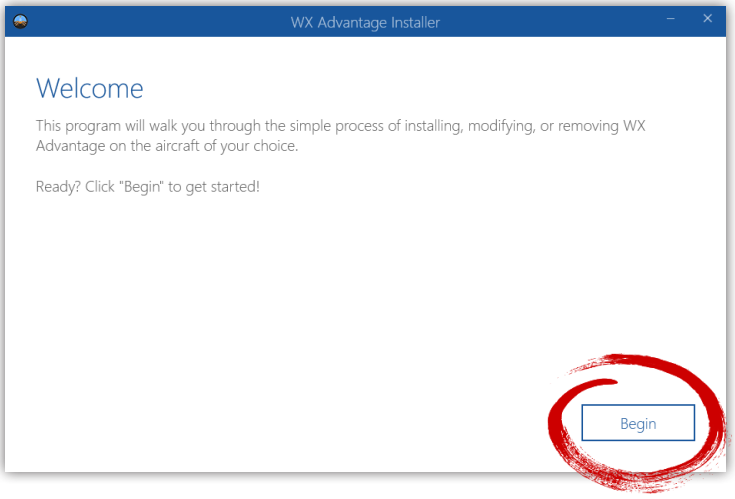



*Figure 4.2 – Gauge Management Tool – Startup Window*

# Step 3

Click **REMOVE** and then **NEXT** (Fig 4.3).

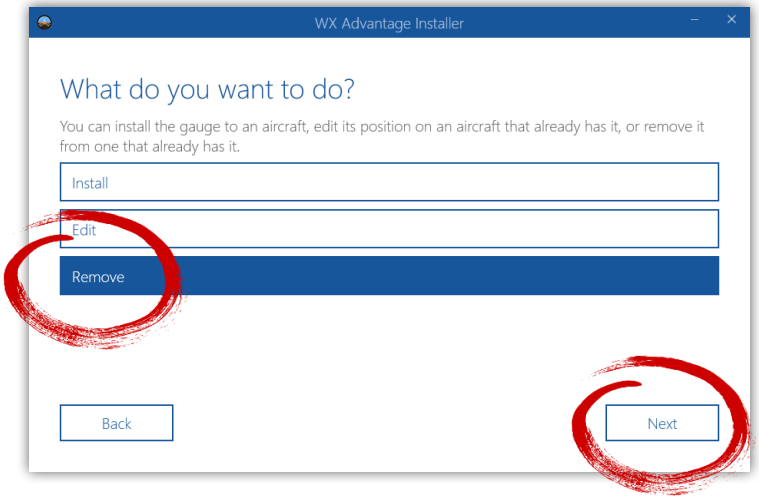



*Figure 4.3 – Gauge Management Tool – Work Window*

# Step 4

Select the flight simulator that you want to remove the gauge from, then click **NEXT** to continue (Fig 4.4). *(These buttons will change based upon which flight simulator(s) you have installed).*

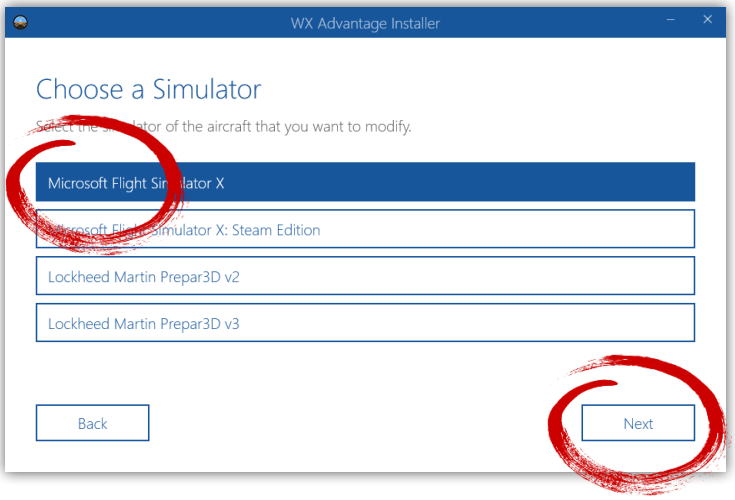



*Figure 4.4 – Gauge Management Tool – Flight Simulator Window*

# Step 5

Select the aircraft that you want to remove the gauge from, then click **NEXT** (Fig 4.5).

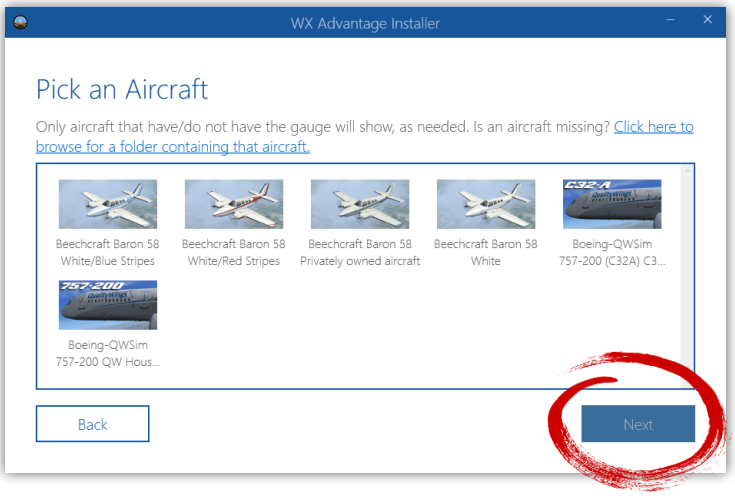



*Figure 4.5 – Gauge Management Tool – Aircraft Window*

**IMPORTANT INFORMATION**

Only the aircraft that currently have the gauge installed will appear in this window (Fig 4.5).

# Step 6

After the removal process is completed you will be presented with the following screen indicating that the gauge code was successfully removed (Fig 4.6).

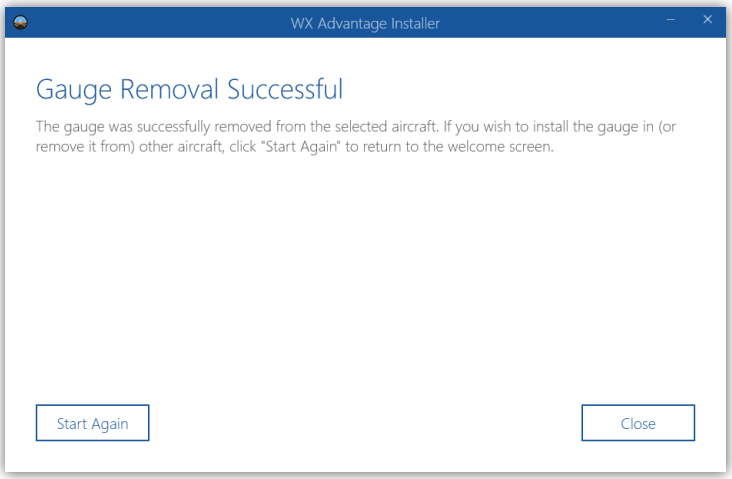



*Figure 4.6 – Gauge Management Tool – Gauge Removal Success Window*

# WX Advantage Radar Functions

The following diagram illustrates the different gauge knobs and functions (Fig. 5.1).

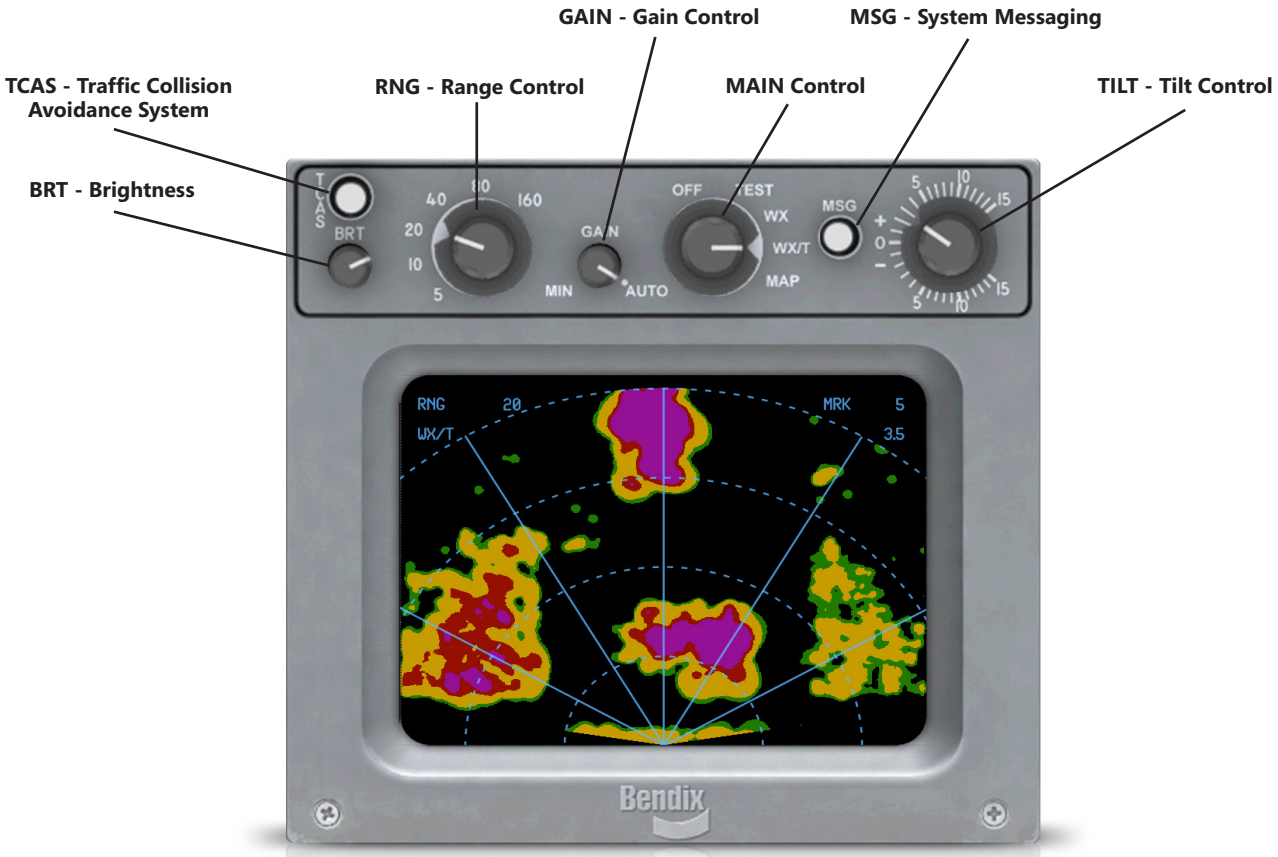
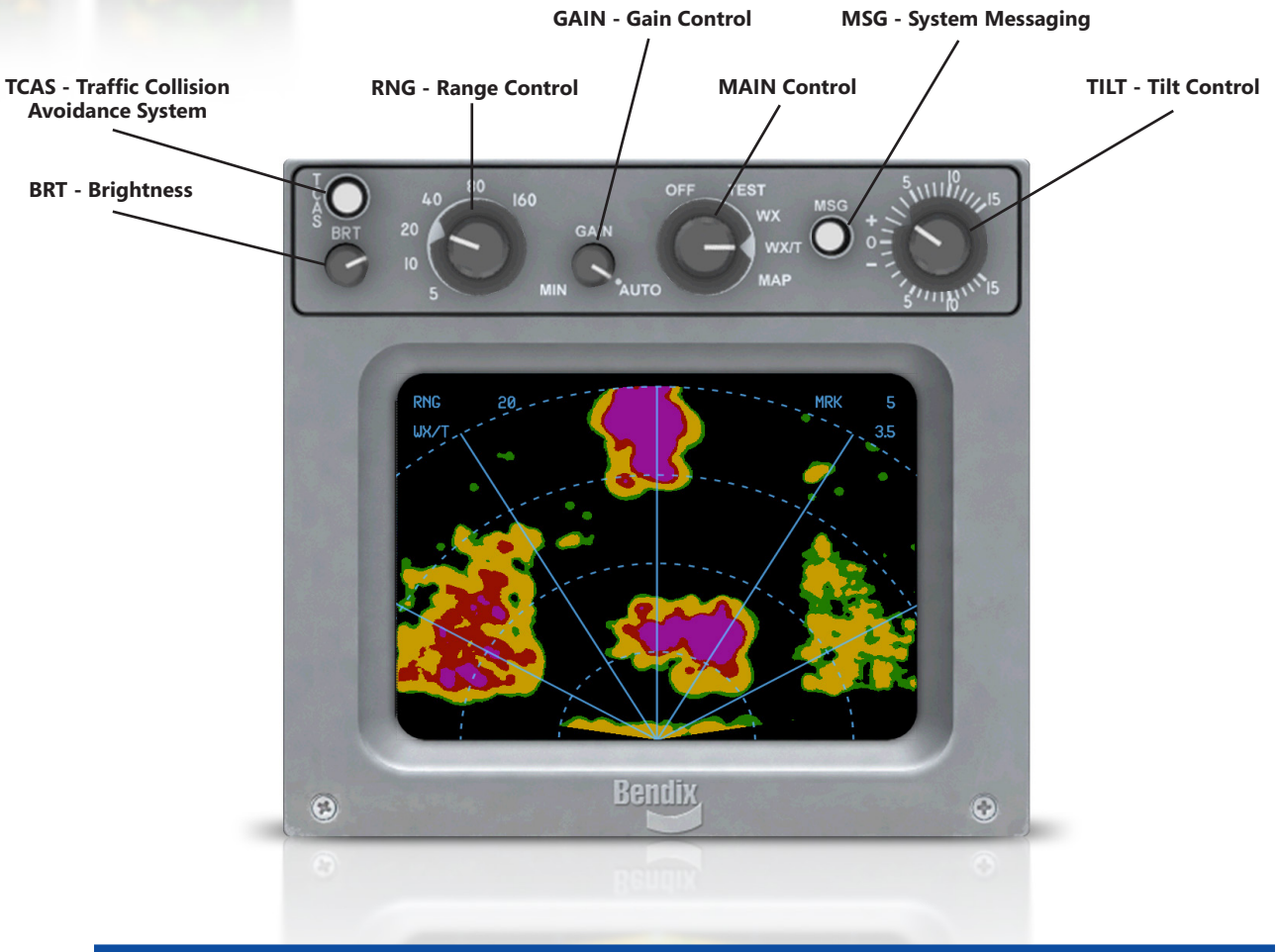



*Figure 5.1 – WX Advantage Radar*

**Precipitation Levels**

- Green - Light Precipitation
- Yellow - Moderate Precipitation
- RED - Heavy Precipitation
- Magenta - Turbulence




| KNOB | FUNCTION DESCRIPTION |
|---|---|
| TCAS | [NOT OPERATIONAL] - Traffic collision avoidance system. |
| BRT | Controls brightness of the indicator display (Clock-wise rotation for max brightness). |
| RNG | Adjusts displayed distance of the radar map. Increasing the range causes the radar to show radar echoes further from the aircraft. Decreasing the range causes the radar to show radar echoes near the aircraft. |
| GAIN | Adjusts the sensitivity of the receiver for the purpose of locating the most dense storm cells. This is used to regulate the intensity level of the radar echoes on the screen. |
| MAIN | **Controls several aspects of the radar:**<br>• OFF – turns off the radar screen and receiver.<br>• TEST – runs a series of test functions to determine if the radar receiver is working correctly.<br>• WX – turns on the radar receiver to receive precipitation echoes.<br>• WX/T – turns on the radar receiver to receive precipitation echoes and potential areas of turbulence.<br>• MAP – turns on ground terrain detection as terrain masking and mapping now active |
| MSG | [NOT OPERATIONAL] – Activates any status or system messages received from the radar receiver. |
| TILT | Adjusts the angle of the radar beam relative to the horizon. Positive tilt forces the radar antenna upward, while negative tilt forces the radar antenna downward. Tilt allows examination of the heights and depths of radar echoes. |

# How to Display the Radar - FSX/FSX:Steam

To open the radar while the simulator is running, choose:
**VIEWS -> INSTRUMENT PANEL -> WX ADVANTAGE** (Fig 6.1).

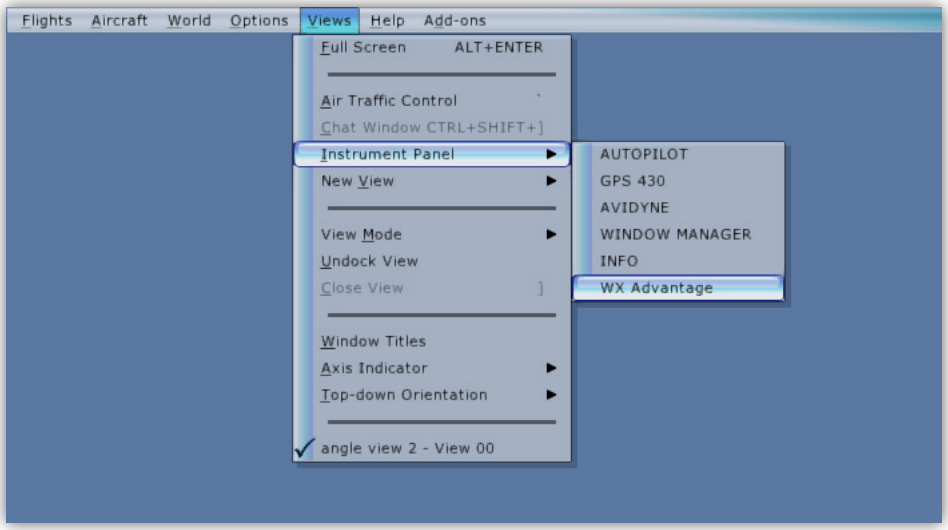



*Figure 6.1 – Activation of Radar menu system in FSX and FSX:Steam*

# How to Display the Radar - PREPAR3D

To open the radar while the simulator is running, choose:
**VEHICLE -> INSTRUMENT PANEL -> WX ADVANTAGE** (Fig 6.2).

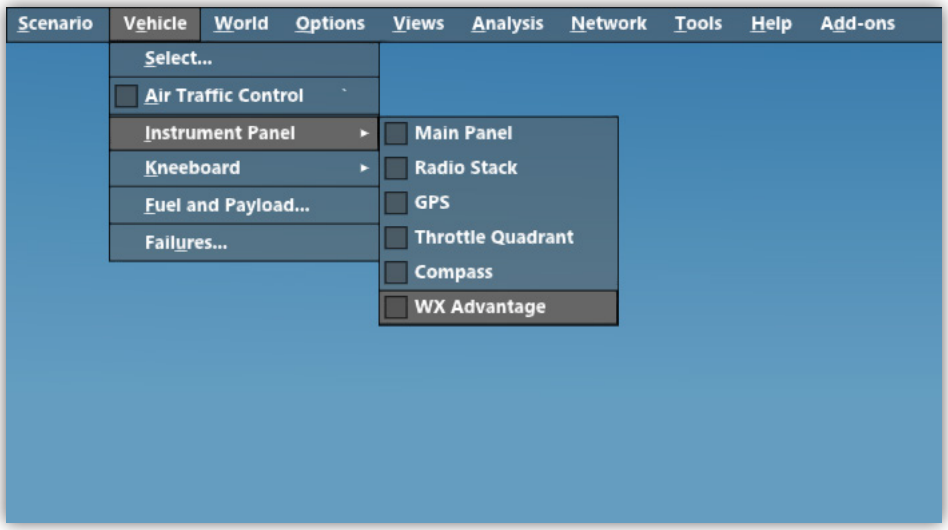



*Figure 6.2 – Activation of Radar menu system in Prepar3D*

# Weather Radar Flight Operations

## TEST MODE OPERATIONS

Prior to departing, perform a system TEST. This will provide a comprehensive check of the system performance. To turn on and test the unit, please use the following procedure:

Set the radar system controls as follows (Figure 7.1):

a. Mode select to **TEST**
b. GAIN to **AUTO**
c. Range selector to any range
d. BRT set to desired viewing level

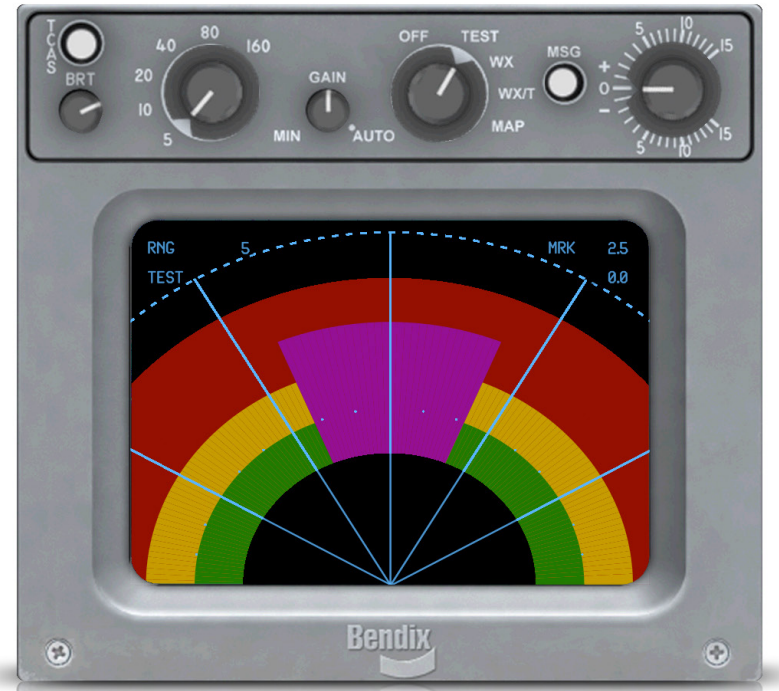



*Figure 7.1 – Test Pattern*

## WEATHER AVOIDANCE

Weather targets (radar echoes) are color-coded by the intensity of the return. The display correlation to approximate rainfall is as follows:

| ECHO COLOR | RETURN | RAINFALL RATE |
|---|---|---|
| **Black** | Very Light - No Returns | Less than .7 mm/hr |
| **Green** | Light Returns | .7 – 4 mm/hr |
| **Yellow** | Medium Returns | 4 – 12 mm/hr |
| **Red** | Strong Returns | Greater than 12 mm/hr |
| **Magenta** | Turbulence | N/A |

**Use the following procedure for effective weather avoidance:**

1. When weather appears within 40NM on the display, use both **WX** mode and **WX/T** mode to obtain the best analysis of the weather situation (Figure 7.2).

2. Effective tilt management is the single most important key to more informative weather radar displays.

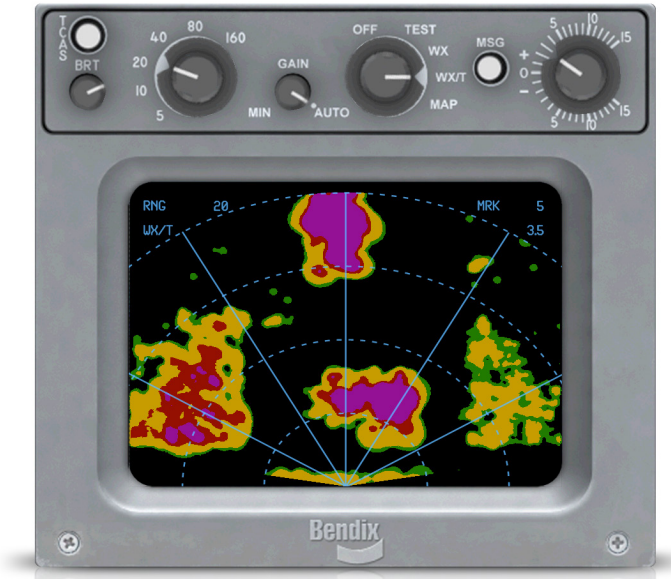



*Figure 7.2 – Intense Storms*

## TILT MANAGEMENT DURING FLIGHT OPERATIONS

**Before takeoff:**

1. Perform **TEST** mode procedure.
2. Set mode selector to **WX/T**.
3. Set range selector to range sufficient to display the area included in the planned flight path.
4. Adjust antenna **TILT** control down to -5 then slowly adjust the antenna TILT control in 1 or 2 degree increments until + 4 (Figure 7.3).


*Figure 7.3 – TILT Selector*

**Climb-out:**

1. Shortly after takeoff, slowly rotate antenna **TILT** selector to +15, then down to where returns appear, then back to +4 while searching for weather targets.
2. Maintain tilt settings of +4 as long as aircraft's pitch attitude is approximately +15 degrees nose up or greater.
3. Repeat step 1 if course changes of 45 degrees or more are made during climb-out.

**Cruise:**

1. As soon as practical, after reaching cruise altitude, select the 40NM range and set the antenna **TILT** control to -10 then back +4.
2. While scanning and observing display for weather targets, adjust antenna **TILT** selector clockwise.
3. Repeat step 2 for each intermediate range through the longest range intended for use.

**Approach:**

1. Just before descent from cruise altitude, note **TILT** selector setting.
2. As descent begins, increase **TILT** selector setting in +1 degree increments for each 10,000 feet of planned descent.

**! IMPORTANT INFORMATION**

After descending to approximately 15,000 feet and when flying over exceptional terrain such as mountains or cities, it may be necessary to adjust the TILT selector setting in +1 degree increments of tilt for 5,000 feet of planned descent.

## TURBULENCE DETECTION

Turbulence detection is a weather radar system option. Turbulence detection requires the presence of precipitation. Therefore, turbulence detection does not display clear air turbulence. Turbulence detection should be used only to isolate turbulence. Therefore, all areas display as red or magenta, whether turbulence or weather, should be avoided.

1. Select **WX/T** mode.
2. Select desired range.
3. Adjust antenna **TILT** selector to eliminate ground returns within 40NM if possible.

**! IMPORTANT INFORMATION**

Turbulence information is limited to the first 40 NM. Turbulence within this range will be displayed in magenta along with weather displayed in red, yellow, and green.

## GAIN CONTROL

The **GAIN** control should always be returned to the **AUTO** position before evaluating weather in other areas or searching for distant targets.

## WEATHER RADAR: RESCAN

The **rescan** function immediately forces the WX Advantage Radar to re-populate its knowledge of the current weather situation. This can be useful if you have recently changed your weather and the changes are not being reflected within the radar display.

To use the rescan option while the simulator is running, choose:
**ADD-ONS -> WEATHER RADAR -> RESCAN** (Fig 7.4).

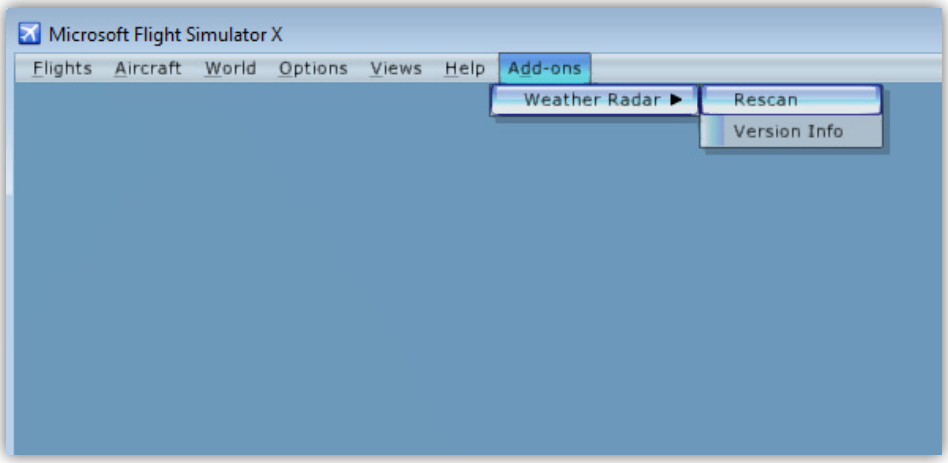



*Figure 7.4 – Weather Radar Rescan Function*

## WEATHER RADAR: VERSION INFO

To view the currently installed version of the WX Advantage Radar, choose:
**ADD-ONS -> WEATHER RADAR -> VERSION INFO** (Fig 7.5).

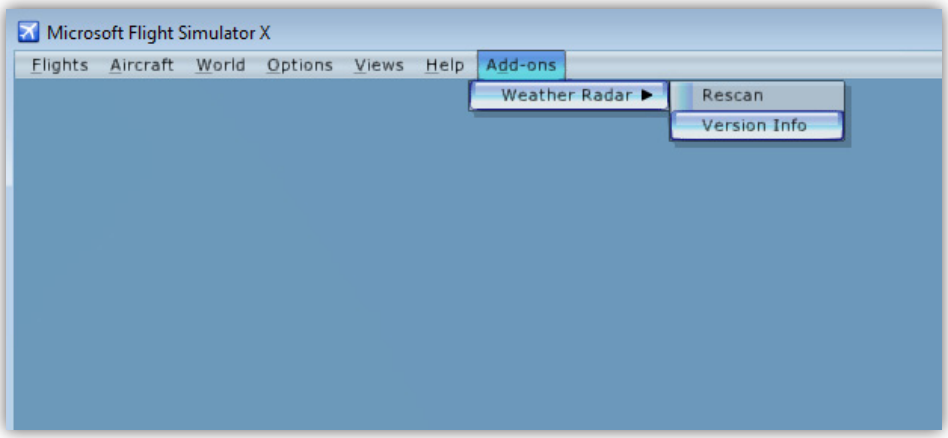



*Figure 7.5 – Weather Radar Version Info*

## IDENTIFYING DANGEROUS WEATHER

The best way to identify storms that pose the best threat for dangerous weather is often indicated by the shapes of the radar echoes (Figure 7.6).

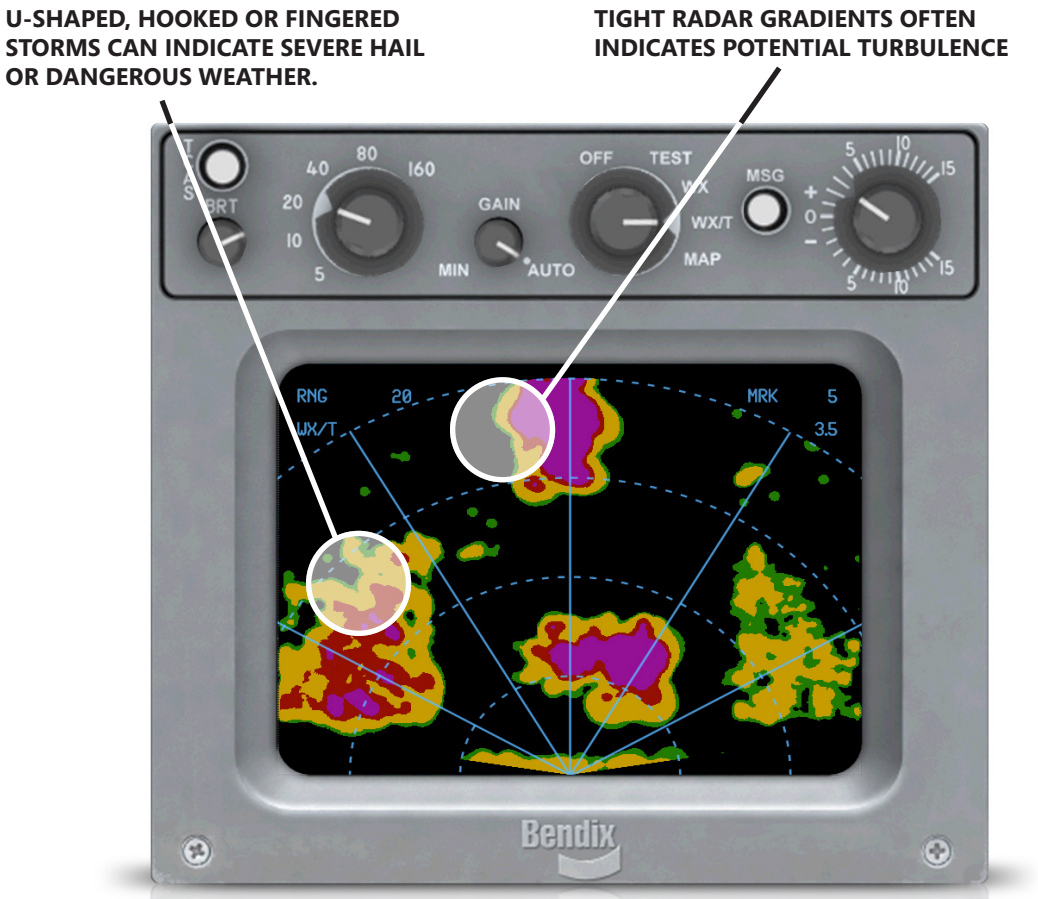



*Figure 7.6 – Radar Echo Types*

## TIGHT GRADIENT RADAR ECHOES

Tight radar echo gradients often indicate areas of severe turbulence. These areas should be avoided at all times.

## U-SHAPED, HOOKED, OR FINGERED RADAR ECHOES

These types of radar echoes can indicate various types of severe weather such as severe turbulence, hail, and possible tornadoes. These types of storms should be avoided at all times.

## USING WEATHER RADAR TO AVOID BAD WEATHER

Radar is fundamentally a distance measuring system using the principle of radio echoing. The term RADAR is an acronym from **Radio Detection And Ranging**. It is a method for locating targets by using radio waves.

The receiver transmitter unit generates microwave energy in the form of pulses. These pulses are then transferred to the antenna where they are focused into a beam by the antenna. The radar beam is much like a beam of a flashlight. The energy is focused and radiated by the antenna in such a way that it is most intense in the center of the beam with decreasing intensity near the edge.

The same antenna is used for both transmitting and receiving. When a pulse intercepts a target, the energy is reflected as an echo, or return signal, back to the antenna. From the antenna, the returned signal is transferred to the receiver and processing circuits located in the receiver transmitter unit. The echoes or returned signals are displayed on a scope called the **Plan Position Indicator** (PPI).

Radio waves travel at the speed of 300 million meters per second and thus yield nearly instantaneous information when echoing back. Radar ranging is a two-way process that requires 12.36 microseconds for the radio wave to travel out and back for each nautical mile of target range (Figure 8.1).


*Figure 8.1 – Aviation Radar – Beam Relationship*

Airborne weather avoidance radar, as it names implies, is for avoiding severe weather-not for penetrating it. Whether to fly into an area of radar echoes depends on echo intensity, spacing between the echoes, and the capabilities of both pilot and aircraft. **Remember that weather radar detects only precipitation; it does not detect minute cloud droplets.**

Therefore, the radar display provides no assurance of avoiding instrument weather in clouds and fog. Your display may be clear between intense echoes; this clear area does not necessarily mean you can fly between the storms and maintain visual separation from them.

**USING WEATHER RADAR TO AVOID BAD WEATHER** *(continued)*

The geometry of the weather radar radiated beam precludes its use for reliable proximity warning or anti-collision protection. The beam is characterized as a cone shaped pencil beam. It is much like that of a flashlight or spotlight beam. It would be an event of chance, not of certainty, that such a beam would come upon another aircraft in flight.

Weather radar detects droplets of precipitation size. The strength of the radar returns (echo) depends on drop size, composition, and amount. Water particles return almost five times as much signal as ice particles of the same size. This means that rain is more easily detected than snow, although at times large, wet snowflakes may give a strong return.

Meteorologists have shown that drop size is almost directly proportional to rainfall rate. The greatest rainfall rate is in thunderstorms and therefore, the strongest echoes are from thunderstorms. Since the strongest echoes identify thunderstorms, they also mark the areas of the greatest hazards. Radar information can be valuable both from ground based radar for preflight planning and airborne radar for severe weather avoidance.

## THUNDERSTORM FLYING

Thunderstorms build and dissipate rapidly. Therefore, you SHOULD NOT attempt to pre-plan a flight plan course between closely spaced echoes. The best use of ground radar information is to isolate general areas and coverages of echoes. You should avoid individual storms from in-flight observation's either by visual sighting or by airborne radar.

Updrafts in thunderstorms support abundant water; and when carried above the freezing level, the water becomes super cooled. When temperature in the upward current cools to about -15C, much of the remaining water vapor sublimates as ice crystals; and above this level, the amount of super cooled water decreases.

Super cooled water freezes on impact with an aircraft. Clear icing can occur at any altitude above the freezing level; but at high levels, icing bay be rime or mixed rime and clear. The abundance of super cooled water makes clear icing very rapidly between 0C and -15C, and encounters can be frequent in a cluster of cells.

## SHADOWED AREAS

Extremely heavy rainfall can reduce the ability of the radar waves to penetrate and present a full picture of the weather area. This condition is referred to as "**radar attenuation**". It is a case where ground returns can be helpful in analyzing the weather situation. Tilt the antenna down and observe the ground returns around the radar echo. With very heavy intervening rain, the ground returns behind the echo will not be present but rather will appear as a shadow. This may indicate a larger area of precipitation than appears on the indicator.

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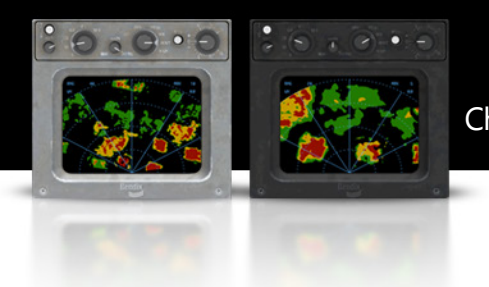



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