ATR WEATHER RADAR

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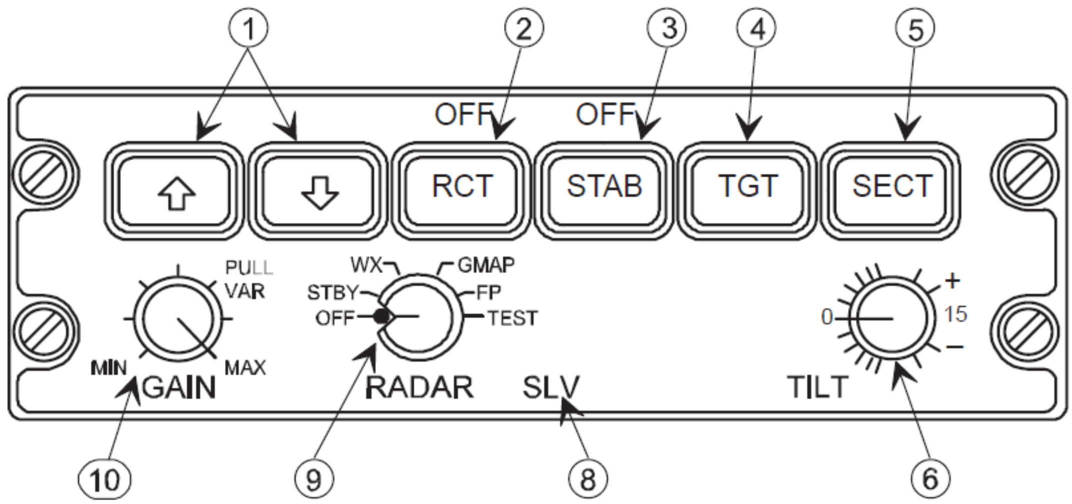
CONTROL PANEL

WC–660 WEATHER RADAR CONTROLLER OPERATION



GAIN CONTROL

VARIABLE GAIN CONTROL

The PRIMUS® 660 Digital Weather Radar variable gain control is a single turn rotary control and a push/pull switch that is used to control the radar's receiver gain. With the switch pushed in, the system is in the preset, calibrated gain mode. In calibrated gain, the rotary control does nothing.

When the GAIN switch is pulled out, the system enters the variable gain mode. Variable gain is useful for additional weather analysis. In the WX mode, variable gain can increase receiver sensitivity over the calibrated level to show very weak targets or it can be reduced below the calibrated level to eliminate weak returns.

WARNING

LOW VARIABLE GAIN SETTINGS CAN ELIMINATE HAZARDOUS TARGETS.

FORCED STANDBY MODE

FSBY (FORCED STANDBY)

FSBY is an automatic, nonselectable radar mode. As an installation option, the RTA can be wired to the weight–on–wheels (WOW) squat switch. When wired, the RTA is in the FSBY mode when the aircraft is on the ground. In FSBY mode, the transmitter and antenna scan are both inhibited, the display memory is erased, and the FSBY legend is displayed in the mode field. When in the FSBY mode, pushing the STAB button four times in three seconds restores normal operation.

RAIN ECHO ATTENUATION COMPENSATION TECHNIQUE (RCT)

RAIN ECHO ATTENUATION COMPENSATION TECHNIQUE (REACT)

Honeywell's REACT feature has three separate, but related functions.

- **Attenuation Compensation –** As the radar energy travels through rainfall, the raindrops reflect a portion of the energy back toward the airplane. This results in less energy being available to detect raindrops at greater ranges. This process continues throughout the depth of the storm, resulting in a phenomenon known as attenuation. The amount of attenuation increases with an increase in rainfall rate and with an increase in the range traveled through the rainfall (i.e., heavy rain over a large area results in high levels of attenuation, while light rain over a small area results in low levels of attenuation).

  Storms with high rainfall rates can totally attenuate the radar energy making it impossible to see a second cell hidden behind the first cell. In some cases, attenuation can be so extreme that the total depth of a single cell cannot be shown.

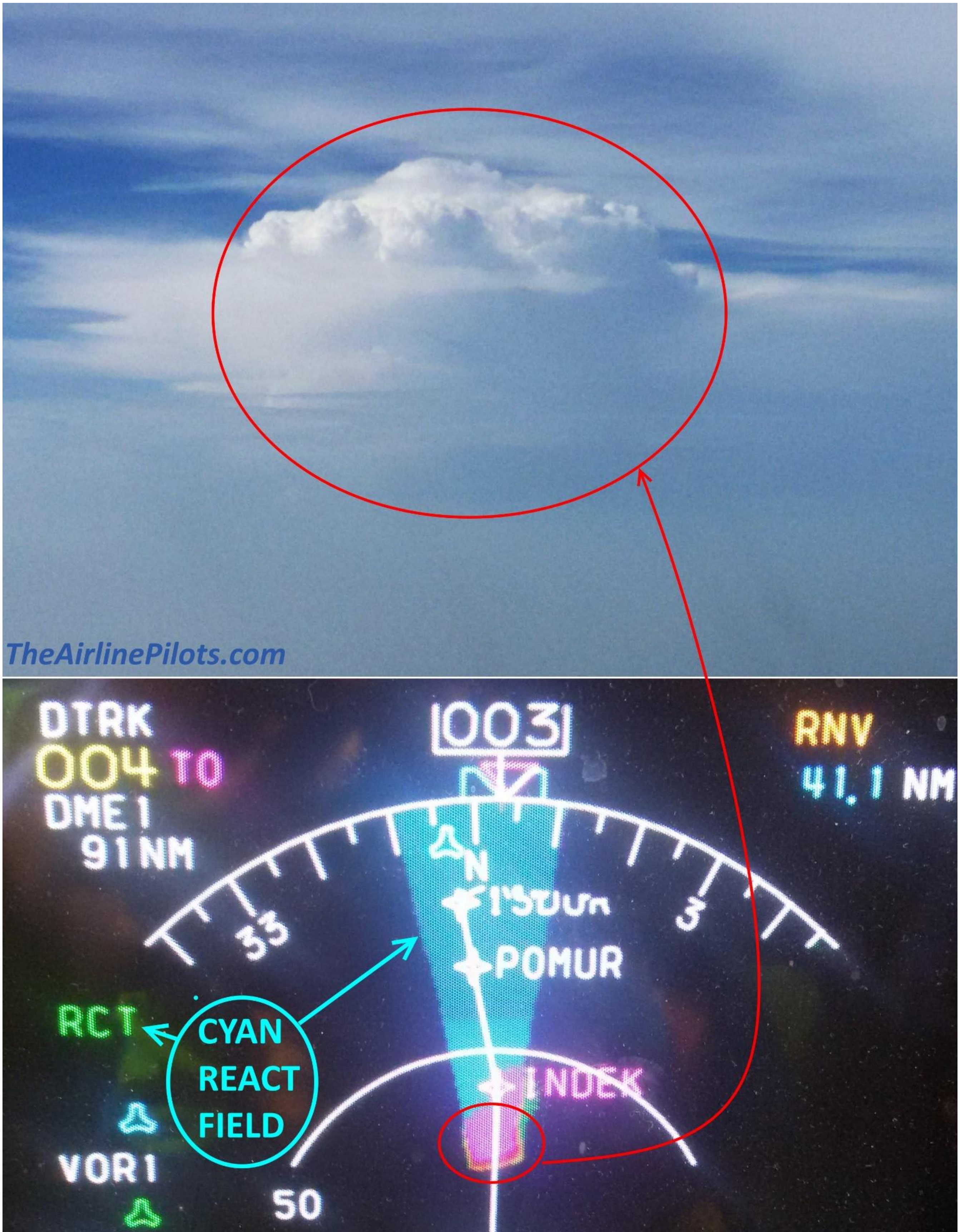
  Without some form of compensation, attenuation causes a single cell to appear to weaken as the depth of the cell increases.

  Honeywell has incorporated attenuation compensation that adjusts the receiver gain by an amount equal to the amount of attenuation. That is, the greater the amount of attenuation, the higher the receiver gain and thus, the more sensitive the receiver. Attenuation compensation continuously calibrates the display of weather targets, regardless of the amount of attenuation.

  With attenuation compensation, weather target calibration is maintained throughout the entire range of a single cell. The cell behind a cell remains properly calibrated, making proper calibration of weather targets at long ranges possible.

- **Cyan REACT Field –** From the description of attenuation, it can be seen that high levels of attenuation (caused by cells with heavy rainfall) causes the attenuation compensation circuitry to increase the receiver gain at a fast rate.

  Low levels of attenuation (caused by cells with low rainfall rates) cause the receiver gain to increase at a slower rate.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DTRK
004 TO
DME1
91NM
003
RNV
41.1 NM
33
3
N
POMUR
INDEK
RCT
CYAN
REACT
FIELD
VOR1
VOR2
50
HDG
003
00.0L
GSPD
237 KTS

The receiver gain is adjusted to maintain target calibration. Since there is a maximum limit to receiver gain, strong targets (high attenuation levels) cause the receiver to reach its maximum gain value in a short time/short range. Weak or no targets (low attenuation levels) cause the receiver to reach its maximum gain value in a longer time/longer range. Once the receiver reaches its maximum gain value, weather targets can no longer be calibrated. The point where red level weather target calibration is no longer possible is highlighted by changing the background field from black to cyan.

Any area of cyan background is an area where attenuation has caused the receiver gain to reach its maximum value, so further calibration of returns is not possible. Extreme caution is recommended in any attempt to analyze weather in these cyan areas. The radar cannot display an accurate picture of what is in these cyan areas. Cyan areas should be avoided.

NOTE: If the radar is operated such that ground targets are affecting REACT, they could cause REACT to give invalid indications.

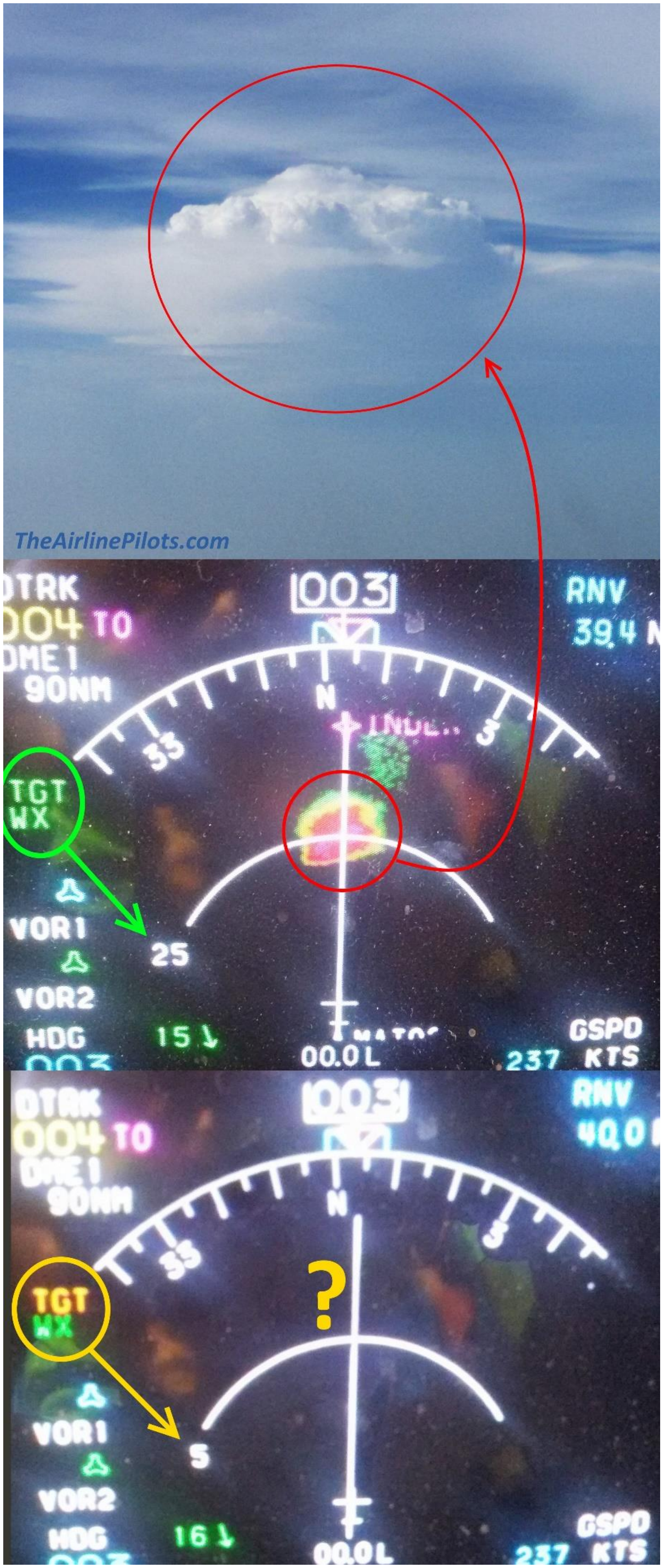
Any target detected inside a cyan area is automatically forced to a magenta color indicating maximum severity. Figure 5–31 shows the same storm with REACT OFF and with REACT ON.

TARGET MODE (TGT)

4 TGT (TARGET)

The TGT switch is an alternate–action, button that enables and disables the radar target alert feature. Target alert is selectable in all but the 300–mile range. When selected, target alert monitors beyond the selected range and 7.5° on each side of the aircraft heading. If a return with certain characteristics is detected in the monitored area, the target alert changes from the green armed condition to the yellow TGT warning condition. This annunciation advises the pilot that a potentially hazardous target lies directly in front and outside of the selected range. When this warning is received, the pilot should select longer ranges to view the questionable target. Note that target alert is inactive within the selected range.

Selecting target alert forces the system to preset gain. Target alert can only be selected in the WX and FP modes.



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DTRK
004 TO
DME1
90NM
003
RNV
39.4
N
33
3
TGT
WX
VOR1
25
VOR2
HDG
15
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237
GSPD
KTS
DTRK
004 TO
DME1
90NM
003
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40.0
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TGT
WX
VOR1
5
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HDG
16
00.0 L
237
GSPD
KTS

SECTOR SCAN

(5) SECT (SCAN SECTOR)

The SECT switch is an alternate–action button that is used to select either the normal 12 looks/minute 120° scan or the faster update 24 looks/minute 60° sector scan.

TILT CONTROL

(6) TILT

The TILT knob is a rotary control that is used to select the tilt angle of antenna beam with relation to the horizon. CW rotation tilts beam upward 0° to 15°; ccw rotation tilts beam downward 0° to –15°. The range between +5° and –5° is expanded for ease of setting. A digital readout of the antenna tilt angle is displayed on the EFIS.

To find the ideal tilt angle after the aircraft is airborne, adjust the TILT control so that groundclutter does not interfere with viewing of weather targets. Usually, this can be done by tilting the antenna downward in 1° increments until ground targets begin to appear at the display periphery. Ground returns can be distinguished from strong storm cells by watching for closer ground targets with each small downward increment of tilt. The more the downward tilt, the closer the ground targets that are displayed.

When ground targets are displayed, move the tilt angle upward in 1° increments until the ground targets begin to disappear. Proper tilt adjustment is a pilot judgment, but typically the best tilt angle lies where ground targets are barely visible or just off the radar image.

After heading changes in a foul weather situation, the pilot should adjust the tilt to see what was brought into the aircraft's flightpath by the heading changes, as shown in figure 5–13.

PRELIMINARY CONTROL SETTINGS

Step	Procedure
1	Verify that the system controls are in the positions described below before powering up the radar system. Mode control: Off GAIN control: Preset Position TILT control: +15

TEST AND FAULT MESSAGES

TEST MODE WITH TEXT FAULTS ENABLED

When airborne, if the radar is switched to TEST mode, any current faults are displayed.

When on the ground (weight on wheels active) and the radar is switched to TEST mode, any current faults are displayed, followed by up to 32 faults from the last 10 power on cycles. The historic faults are displayed going from the most recent to the oldest and are cycled every two antenna sweeps (approximately 8 seconds). The POC number indicates how many power on counts back into the history the fault occurred. After the last fault, an END OF LIST message is displayed. To recycle through the list again, exit and re–enter the TEST mode.

Pilot MSG	Description
RADAR FAIL	The radar is currently inoperable and should not be relied upon. It needs to be replaced or repaired at the next opportunity.
RADAR CAUTION	A failure has been detected that can compromise the calibration accuracy of the radar. Information from the radar should be used only for advisory purposes such as ground mapping for navigation.
PICTURE UNCAL	The radar functions are ok, but receiver calibration is degraded. Color level calibration should be assumed to be incorrect. Have the RTA checked at the next opportunity.
TILT UNCAL	An error in the antenna position system has been detected. The displayed tilt angle setting could be incorrect. This can also cause ground spoking. Have the RTA checked at the next opportunity.
SPOKING LIKELY	A problem has been detected that can cause spoking to occur. Have the system checked at the next opportunity.
STAB UNCAL	An error in the antenna positioning system has been detected. Groundspoking, or excessive ground returns during roll maneuvers can occur. This can be due either to the RTA or the source of pitch and roll information to the RTA.
SCAN SWITCH	The SCAN SWITCH located on the RTA is off, disabling the antenna scan. Check at the next opportunity.
XMIT SWITCH	The XMIT switch located on the RTA is off, disabling the transmitter. Check at the next opportunity.

LEVEL FLIGHT STABILIZATION CHECK

LEVEL FLIGHT STABILIZATION CHECK

Check stabilization in level flight using the procedure in table 5–3.

Step	Procedure
1	Trim the aircraft for straight and level flight in smooth, clear air over level terrain.
2	Select the 50–mile range.
3	Rotate the tilt control until a band of ground returns starts at the 40 NM range arc.
4	After several antenna sweeps, verify that ground returns are equally displayed (figure 5–18). If returns are only on one side of the radar screen or uneven across the radar screen, a misalignment of the radar antenna mounting is indicated.

ROLL STABILIZATION CHECK

ROLL STABILIZATION (WHILE TURNING) CHECK

Once proper operation is established in level flight, verify stabilization in a turn using this procedure.

Step	Procedure
1	Place the aircraft in 20° roll to the right.
2	Note the radar display. It should contain appreciably no more returns than found during level flight. See figure 5–24.
3	If returns display on the right side of radar indicator; the radar system is understabilizing.
4	Targets on the left side of the radar display indicate the system is overstabilizing. See figure 5–23.
NOTE:	Proper radar operation in turns depends on the accuracy and stability of the installed attitude source.

PITCH STABILIZATION CHECK

PITCH STABILIZATION CHECK

Once proper operation of the roll stabilization is established, verify pitch stabilization using the procedure in table 5–5 and figures 5–25, 5–26, and 5–27.

Step	Procedure
1	Complete the steps listed in table 5–3.
2	Place the aircraft between 5 and 10° pitch up.
3	Note the radar display. If it is correctly stabilized, there is very little change in the ground returns.
4	If the display of ground returns resembles figure 5–26, the radar is understabilized.
5	If the display of ground returns resembles figure 5–27, the radar is overstabilized.

INFLIGHT TRIM ADJUSTMENTS

Trim Adjustment	Flight Condition	Effect On Ground Return Display (Over Level Terrain)
Roll offset	Straight and level	Nonsymmetrical display
Pitch offset	Straight and level	Ground displays do not follow contour of range arcs.
Roll gain	Constant roll angle >20°	Nonsymmetrical display
Pitch gain	Constant pitch angle >5°	Ground displays do not follow contour of range arcs.
NOTE: Generally, it is recommended to perform trim adjustments only if noticeable effects are being observed.		

In–Flight Roll Offset Adjustment Procedure

Step	Procedure
1	If two controllers are installed, one must be turned off. If an indicator is used as the controller, the procedure is the same as given below.
2	Fly to an altitude of 10,000 feet above ground level (AGL), or greater.
3	Set range to 50 NM.
4	Adjust the tilt down until a solid band of ground returns are shown on the screen. Then adjust the tilt until the green region of the ground returns start at about 40 NM.
5	Select STAB (STB) 4 times within 3 seconds. A display with text instructions is displayed. See figure 7–4. The radar unit is in the roll offset adjustment mode.
6	Pull out the GAIN knob to make a roll offset adjustment. See figure 7–5 for a typical display. The offset range is from –2.0° to +2.0° and is adjustable by the GAIN knob. The polarity of the GAIN knob is such that clockwise rotation of the knob causes the antenna to move down when scanning on the right side.
7	While flying straight and level, adjust the GAIN knob until ground clutter display is symmetrical.
8	Push in the GAIN knob. When the GAIN knob is pushed in, the display returns to the previous message.
9	Push the STAB (STB) button to exit, or to go to the next menu (pitch offset), if the full stab trim mode is enabled in your installation.
NOTE:	Once set, the roll compensation is stored in nonvolatile memory in the RTA. It is remembered when the system is powered down.

Pitch Offset Adjustment Procedure

This in–flight adjustment is made in straight and level flight when the ground returns do not follow the contours of the radar display range arcs.

Step	Procedure
1	If two controllers are installed, one <u>must</u> be turned off. If an indicator is used, the procedure is the same as given below.
2	Fly to an altitude of 10,000 feet AGL or greater.
3	Set range to 50 NM.
4	Adjust the tilt down until a solid band of ground returns are shown on the screen. Then adjust the tilt until the green region of the ground returns start at about 40 NM.
5	Select STAB (STB) 4 times within 3 seconds. The roll offset display is shown.
6	From the roll offset entry menu, push the STAB (STB) button once more to bring up the pitch offset entry menu.
7	To change the pitch offset value, pull out the GAIN knob and rotate it. The offset range is from -2.0° to $+2.0^\circ$.
8	When flying straight and level, adjust so the contour of the ground returns follow the contour of the range arcs as closely as possible.
9	When change is completed, push in the GAIN knob. The display returns to the previous message.
10	Push the STAB (STB) button to go to the next menu (roll gain).

Roll Gain Adjustment Procedure

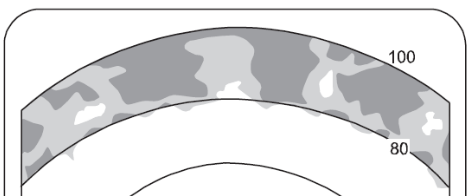
This in–flight adjustment is made in a bank when the ground returns do not remain symmetrical during turns.

Step	Procedure
1	If two controllers are installed, one <u>must</u> be turned off. If an indicator is used as the controller, the procedure is the same as given below.
2	Fly to an altitude of 10,000 feet AGL or greater.
3	Set range to 50 NM.
4	Adjust the tilt down until a solid band of ground returns are shown on the screen. Then adjust the tilt until the green region of the ground returns start at about 40 NM.
5	Select STAB (STB) 4 times within 3 seconds. A display with text instructions for roll offset is shown.
6	From the roll offset entry menu, push the STAB (STB) button twice more to bring up the roll gain entry menu.
7	To change the roll gain value, pull out the GAIN knob and rotate it. The roll gain adjustment range is from 90 to 110%.
8	While flying with a steady roll angle of at least 20°, adjust for symmetrical display of ground returns at the 40–NM range arc..
9	When change is completed, push in the GAIN knob. The display returns to the previous message.
10	Push the STAB (STB) button to go to the next menu (pitch gain).

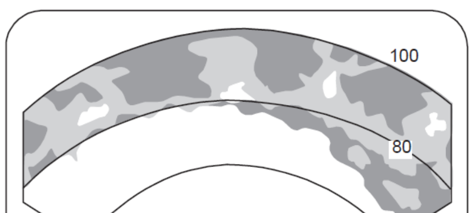
Pitch Gain Adjustment Procedure

This in–flight adjustment is made in a bank when the ground returns do not follow the contours of the range arcs during turns.

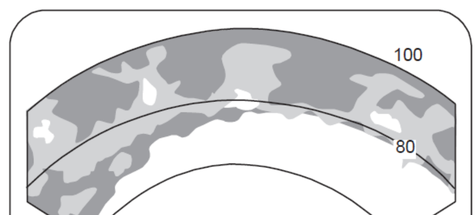
Step	Procedure
1	If two controllers are installed, one <u>must</u> be turned off. If an indicator is used as the controller, the procedure is the same as given below.
2	Fly to an altitude of 10,000 feet AGL or greater.
3	Set range to 50 NM.
4	Adjust the tilt down until a solid band of ground returns are shown on the screen. Then adjust the tilt until the green region of the ground returns start at about 40 NM.
5	Push STAB (STB) 4 times within 3 seconds. A display with text instruction is shown.
6	From the roll offset entry menu, push the STAB (STB) button 3 more times to bring up the pitch gain entry menu.
7	To change the pitch gain value, pull out the GAIN knob and rotate it. The pitch gain adjustment range is from 90 to 110%.
8	While flying with a steady pitch angle of >5°, adjust so the contour of the ground returns follow the contour of the range arcs as closely as possible.
9	When change is completed, push in the GAIN knob. The display returns to the previous message.
10	Push the STAB button to exit the mode and save the value in nonvolatile memory.



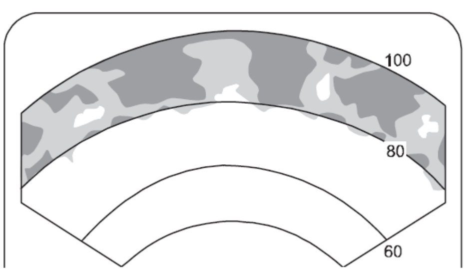
Symmetrical Ground Returns, Level Flight and Good Roll Stabilization



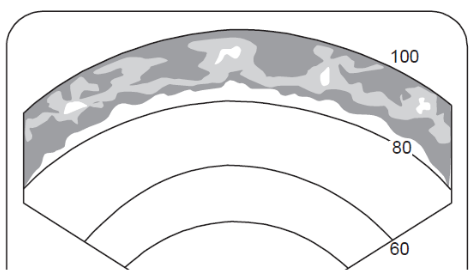
Understabilization in a Right Roll



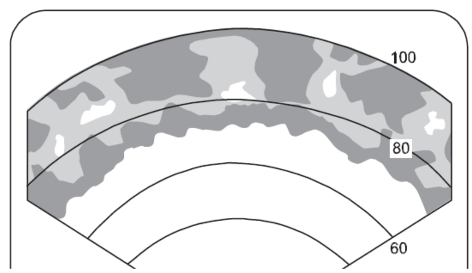
Overstabilization in a Right Roll



Level Flight and Good Pitch Stabilization



Understabilized in Pitch Up



Overstabilized in Pitch Up

PILOT EVENT MARKER

PILOT EVENT MARKER

At any time a full set of BITE parameters can be recorded by going in and out of variable gain four times (pull GAIN knob for VAR, push for preset, pull for VAR, and push for preset) within three seconds. There is no annunciation on the display after this operation.

This feature can be useful if the radar appears to be malfunctioning and a fail annunciation is not shown on the display. If the pilot event marker is used, it is best to record several sets of data during the period of misoperation. Refer to the PRIMUS® 660 System Description and Installation Manual for information on constructing an interconnect cable for accessing this information.

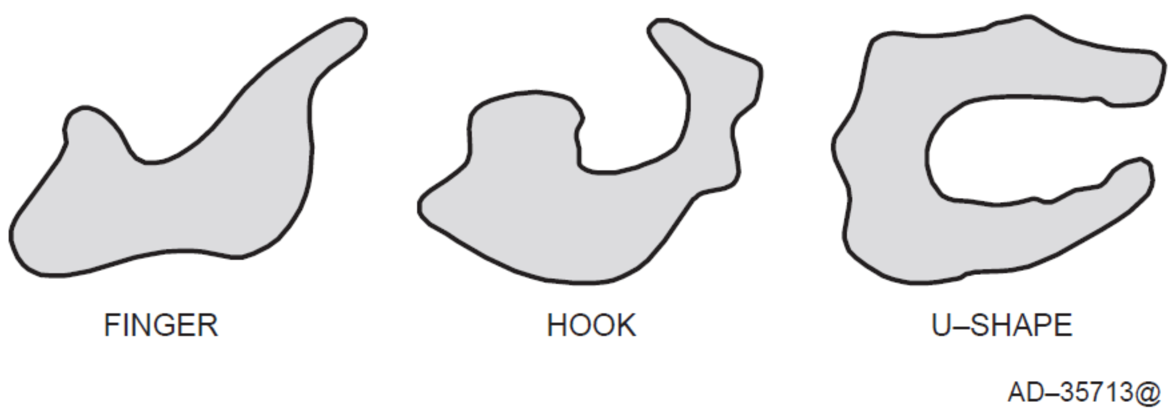
WEATHER PATTERNS AND AVOIDANCE

Step	Procedure
1	Keep TGT alert enabled when using short ranges to be alerted if a new storm cell develops in the aircraft's flightpath.
2	Keep the gain in preset. The gain control should be in preset except for brief periods when variable gain is used for detailed analysis. Immediately after the analysis, switch back to preset gain. **WARNING** **DO NOT LEAVE THE RADAR IN VARIABLE GAIN. SIGNIFICANT WEATHER CAN NOT BE DISPLAYED.**

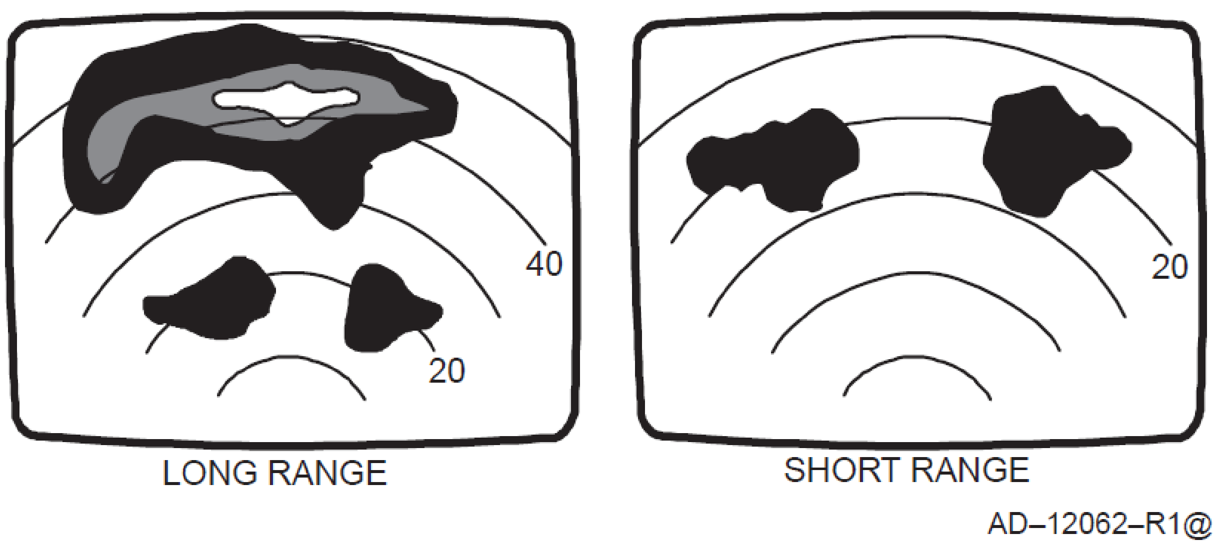
Step	Procedure
11	**Never continue flight towards or into a radar shadow or the blue REACT field.** **WARNING** **STORMS SITUATED BEHIND INTERVENING RAINFALL CAN BE MORE SEVERE THAN DEPICTED ON THE DISPLAY.** If the radar signal can penetrate a storm, the target displayed seems to cast a shadow with no visible returns. This indicates that the storm contains a great amount of rain, that attenuates the signal and prevents the radar from seeing beyond the cell under observation. The REACT blue field shows areas where attenuation could be hiding severe weather. Both the shadow and the blue field are to be avoided by 20 miles. Keep the REACT blue field turned on. The blue field forms fingers that point toward the stronger cells.

Shadowing

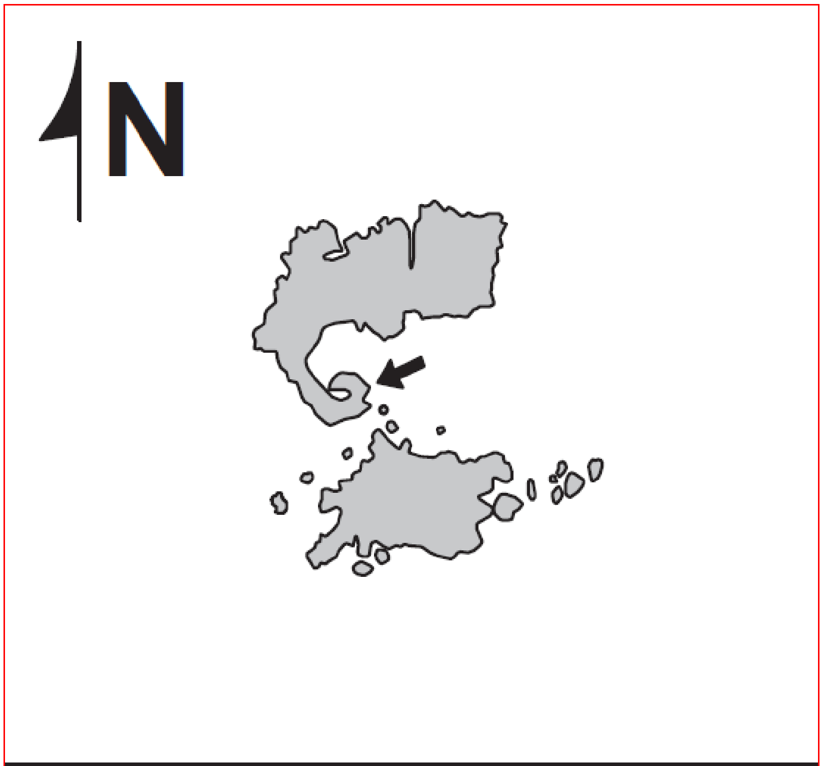
An operating technique similar to the REACT blue field is shadowing. To use the shadowing technique, tilt the antenna down until ground is being painted just in front of the storm cell(s). An area of no ground returns behind the storm cell has the appearance of a shadow behind the cell. This shadow area indicates that the storm cell has totally attenuated the radar energy and the radar cannot show any additional targets (WX or ground) behind the cell. The cell that produces a radar shadow is a very strong and dangerous cell. It should be avoided by 20 miles.



Familiar Hailstorm Patterns

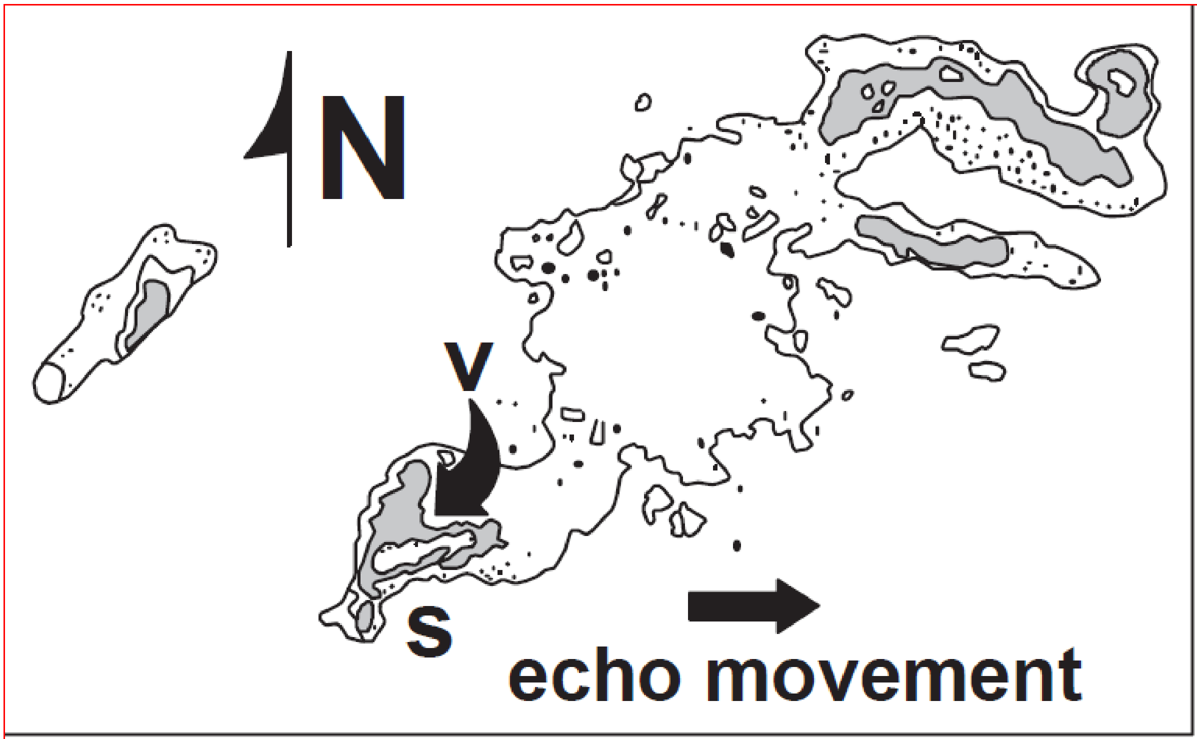


Short– and Long–Blind Alley



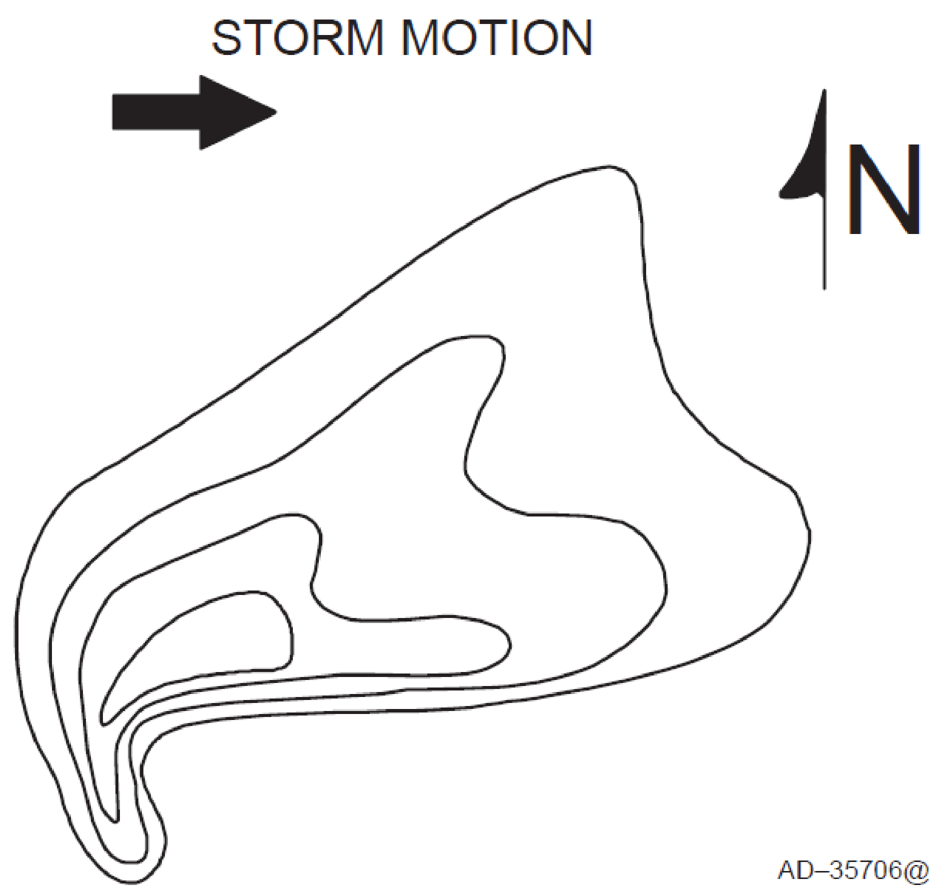
AD–15560–R1@

Typical Hook Pattern
Figure 5–40

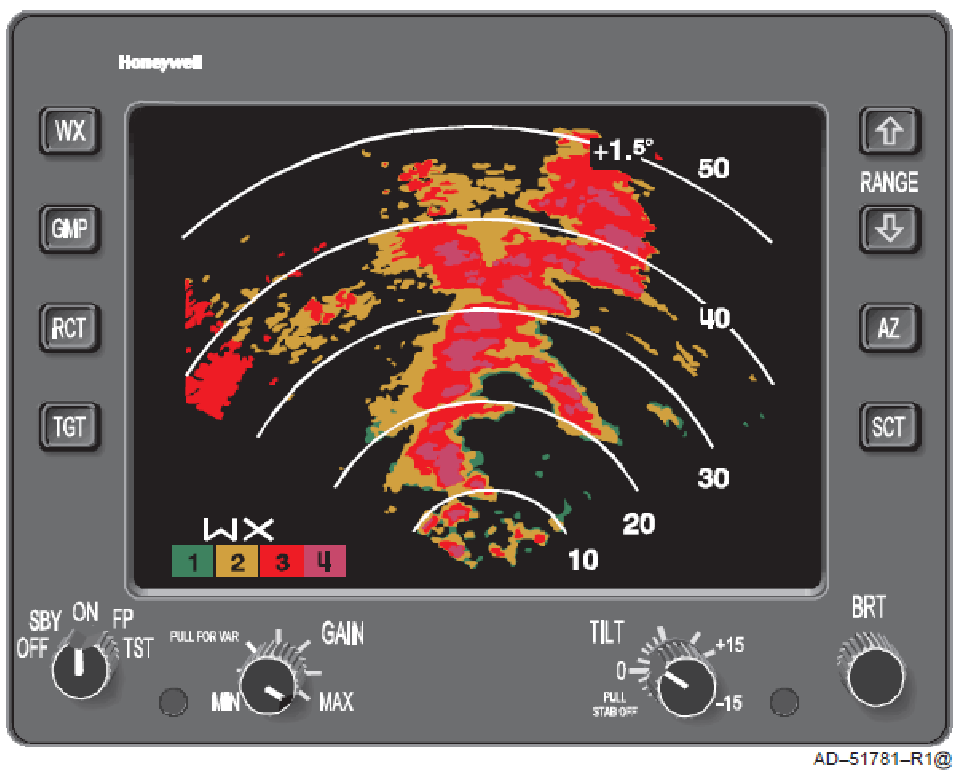


AD–15561–R1@

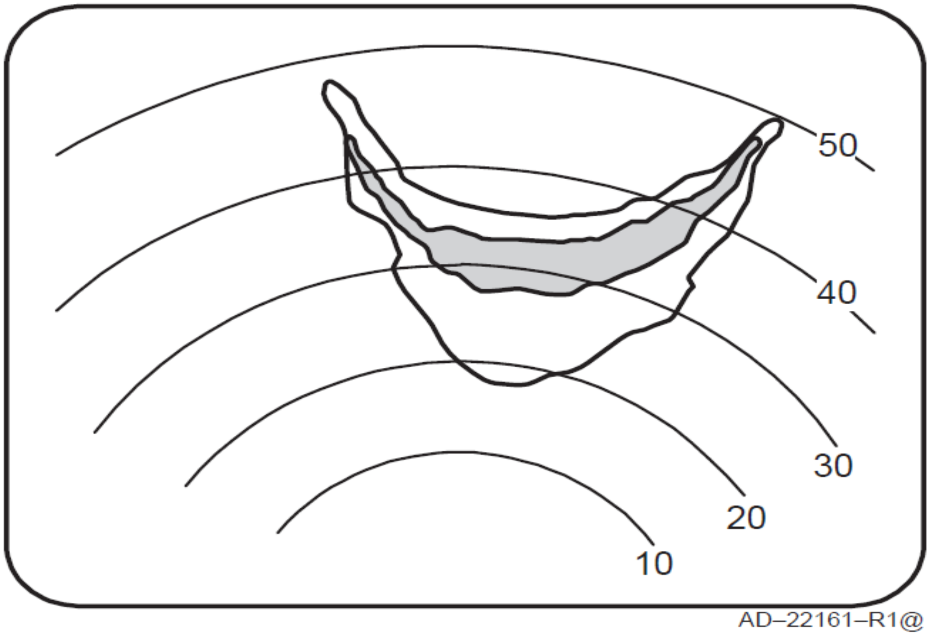
V–Notch Echo, Pendant Shape



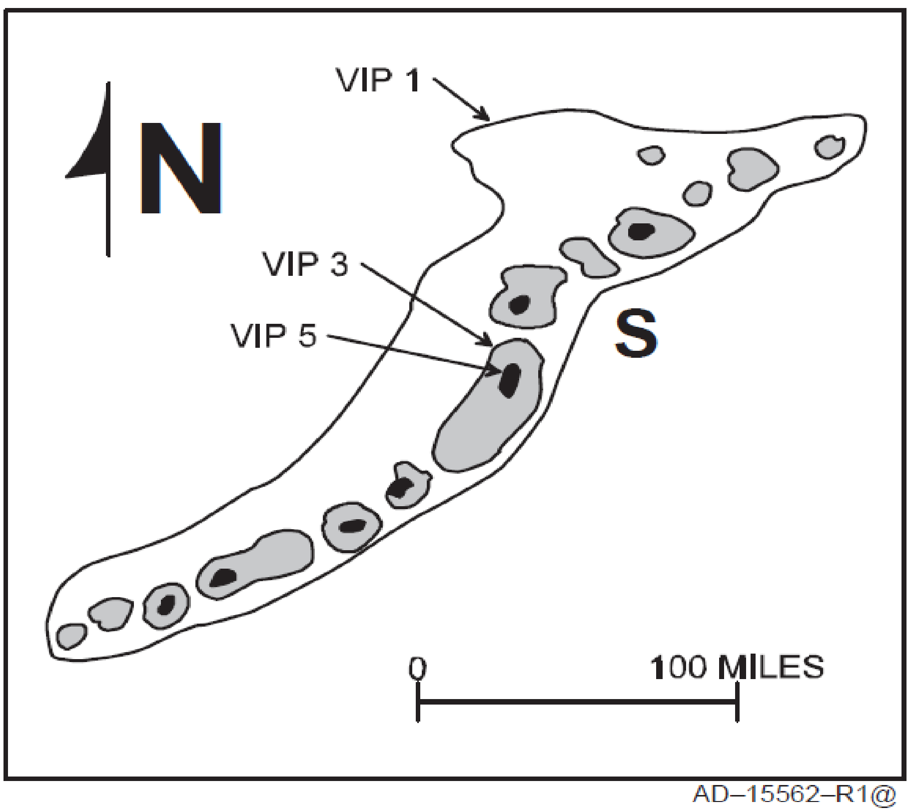
The Classic Pendant Shape



Rain Gradients



Crescent Shape



Line Echo Wave Pattern (LEWP)

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