NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

April 7, 2020

Attachment 8 – PSA Airlines CRJ Pilot Operating Handbook [Excerpts]

OPERATIONAL FACTORS

DCA20CA071

PSA AIRLINES

CRJ

Pilot Operating Handbook

CCN 5910021

3.2 Operational

3.2.1 Limits

Minimum flight crew	One Captain and one First Officer
Maximum 90 degree crosswind for takeoff and landing	**27 knots**
Maximum 90 degree crosswind for landing from a Category II Approach	**15 knots**
Maximum headwind for landing from a Category II Approach	**16 knots**
Maximum direct tailwind for takeoff and landing	**10 knots**
Maximum runway slope approved for takeoff and landing	+2.0% (uphill) -2.0% (downhill)
Minimum runway width approved for takeoff and landing	100 feet
Maximum operating altitude <200>	**36,000 ft.**
Maximum operating altitude <CR7> <900>	**41,000 ft.**
Maximum pressure altitude for takeoff and landing	8,000 feet
Maximum ambient temperature for takeoff and landing <200>	ISA +35°C
Maximum ambient temperature for takeoff and landing <CR7> <900>	ISA +40°C Limited to a maximum OAT of 51°C
Minimum ambient temperature approved for takeoff	-40°C
Maneuvering Limit Load Factors	
Flaps Retracted	-1.0 to +2.5 G
Flaps Extended	0.0 to +2.0 G

• Note •

Except in an emergency, takeoff or landing will not be attempted whenever peak wind value exceeds 50 knots. Crosswind components, not including gust factor, are limited to AFM maximum demonstrated as listed above. Crosswind limits may be further limited by runway conditions or Operations Specifications (See FOM 5.11.1 and POH 3.12.3).

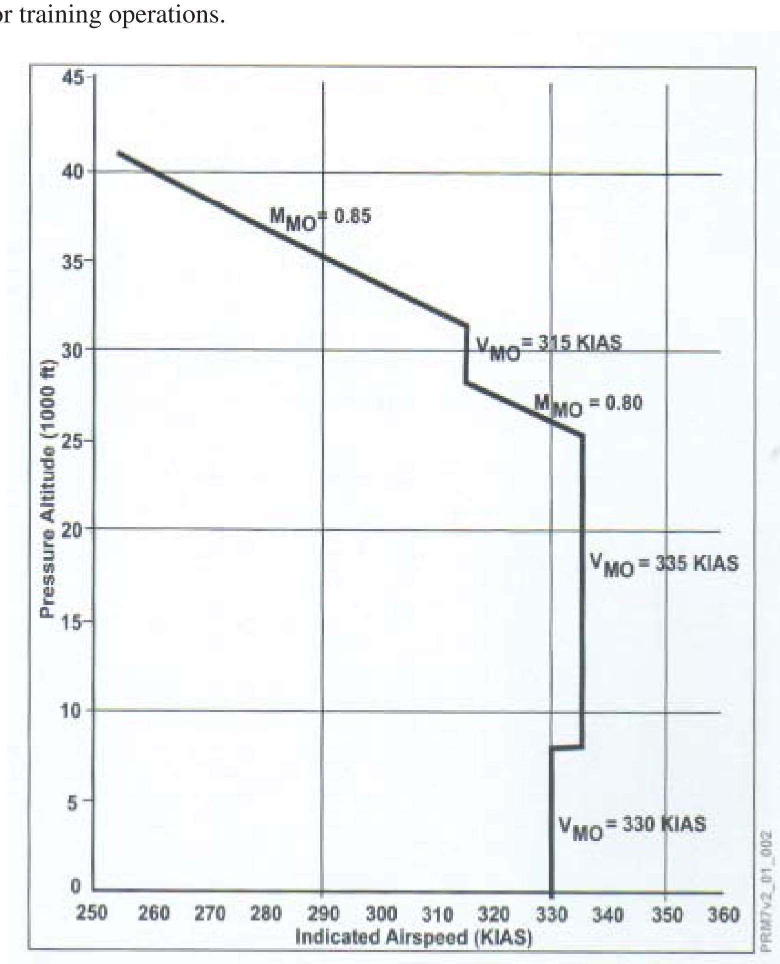
3.4 Airspeeds

3.4.1 Limits

Turbulence Penetration Speed	**280 KIAS/.75M, whichever is lower**
Maximum gear extension speed	**220 KIAS**
Maximum gear extended speed	**220 KIAS**
Maximum gear retraction speed	**200 KIAS**
Maximum airspeed for windshield wiper operation	**220 KIAS**
Maximum airspeed for windshield wiper operation failed in the non-parked position	220 KIAS <200> 250 KIAS <CR7> <900>
Maximum Cruise Mach in RVSM Airspace	0.82M
Tire limit ground speed, <200>, <CR7>	182 knots
Tire limit ground speed, <900>	195 knots

3.4.2 Maximum Operating Speed and Mach Number

Maximum operating limit speeds must not be deliberately exceeded in any regime of flight unless a higher speed is specifically authorized for flight test or training operations.



8.4 Weather Radar

The primary function of the WXR-840 weather radar system is to aid pilots in the detection and avoidance of areas of precipitation in and around thunderstorms.

The WXR-840 cannot detect clear air turbulence, windshear, clouds or lightning. However, rain, wet hail, moderate to heavy wet snow — and in some cases, possible icing conditions — can be detected by the system.

The WXT-840 can also be used to map-read the terrain.

The basic characteristics of the X-band radar system are:

- Low-power transmitter (25 watts)
- Flat-plate antenna (14 inches)
- Digital processing
- Relatively narrow beam width, and
- Color screen imagery

This new-technology solid-state radar requires different operating techniques when compared to older parabolic-antenna radar.

8.4.1 Power Output.

The WXR-840 weather radar system uses digital-signal processing which has allowed transmitter power requirements to be reduced to 25 watts.

The use of digital-signal processing and low power optimizes the performance of the radar system.

8.4.2 Display Calibration.

The colors on this radar represent variations in rainfall rate and create a display which is easier to interpret than the older monochrome sets. Detectable weather appears as one of the following colors — least reflective to most reflective: Black, Green, Yellow, Red, and Magenta.

Another significant difference is the way the picture is painted on the screen. In previous analog weather radar, new returns were added by each sweep of the antenna while old returns gradually bled away.

The new radar display is generated in the same way as a TV screen; each new sweep is a totally new picture — the old picture is completely erased. Thus, color changes can occur quickly if a return is close to the threshold between rainfall-rate categories.

Digital weather radar incorporates hypersensitive receivers and sensitivity time control (STC) circuitry to present a true calibrated image within a range of approximately 60 miles. Therefore, a yellow storm return at 60 miles will still be yellow at 10 miles.

WARNING

Sunglasses with polarized lenses that are designed to filter specific colors/frequencies of light may adversely affect a pilot's ability to see some colors shown on radar and EFIS displays. Some elements on the display could be completely invisible while wearing these types of sunglasses.

Also, the color of some elements may be changed. For example, some blue light filtering lenses can change magenta to red. For a radar target, this represents a reduction in the actual level of intensity of the target.

Storm Category	VIP* Level	Precipitation Rate		Color
		in/hr	mm/hr	
-		Less than 0.03	Less than 0.8	BLACK
Weak[1]	1	0.03 to 0.07	0.8 to 1.8	GREEN
Moderate[2]	2	0.07 to 0.2	1.8 to 5.1	YELLOW
Strong[3]	3	0.2 to .52	5.1 to 13.2	RED
Very Strong[4]	4			
Intense[5]	5	0.52 and greater	13.2 and greater	MAGENTA
Extreme[6]	6			

* Video Integrated Processor

[1] Weak Storm - Light to moderate turbulence, possible lightning

[2] Moderate Storm - Light to moderate turbulence, possible lightning

[3] Strong Storm - Severe turbulence, possible lightning

[4] Very Strong Storm - Severe turbulence, likely lightning

[5] Intense Storm - Severe turbulence, lightning, wing gusts, hail

[6] Extreme Storm - Severe turbulence, large hail, lightning, extensive wind gusts.

8.4.3 Flat-Plate Antenna.

Some energy from the older parabolic antenna was lost in the side lobes. This resulted in more ground clutter at low altitudes and more close-range weather returns around the periphery of the main beam. The flat-plate antenna transmits a narrow-focus, long-range beam which greatly reduces the side lobes and focuses much more energy into the main lobe.

With the loss of the side lobes, TILT control becomes more critical. As you approach storms and reduce the range, the tilt must be adjusted downward to avoid overscanning significant returns.

When using a flat-plate antenna for the first time, some pilots have expressed doubts about the lack of weather targets displayed, pointing out that they could see clouds that were not shown on the radar. Since radar display of clouds is dependent upon moisture content, clouds with low moisture may not have enough reflectivity to be displayed. This misunderstanding has been aggravated by use of the flat-plate antenna.

The flat-plate antenna exhibits characteristics different from the parabolic antenna. A great reduction in side-lobe energy results in the tilt setting being very sensitive, and its adjustment is critical to effective weather detection. It is recommended that the PM coordinate tilt and range selections with the PF to detect and avoid weather.

8.4.4 TILT Control.

The TILT control allows the radar beam to be moved up +15°or down -15° to aid the pilot in interpreting storm activity. Proper use of the TILT control allows the pilot to achieve the best picture of storm-cell size, height, and relative direction of movement. Procedures for adjusting the TILT control vary depending on user requirements. Proper use requires experience and practice.

8.4.5 Operating Tips.

Maximum rainfall rates in a thunderstorm usually occur about mid level in the storm. This is normally the area that will paint the strongest returns. If the airplane is below that altitude, some antenna uptilt will be needed. Conversely, if the airplane is above that altitude, some degree of down-tilt will be needed.

The amount of tilt needed varies with the estimated distance of the storm, the closer the storm, the more tilt required. In either instance, it is good practice to periodically move the TILT control throughout its range to reduce the possibility of missing close-in targets.

When operating over land, the best general guideline is to select a range that is within the line-of-sight distance to the horizon and adjust the antenna tilt until a small amount of ground clutter appears at about the outer third of the display.

An aircraft at 10,000 ft. AGL, with the 300 nm range selected, will not be able to paint ground clutter much beyond 123 nm. A better range selection at this altitude may be the 100 nm setting.

Once weather activity is identified, it is important to keep the radar beam pointed to the liquid portion of the cell. As discussed earlier, ice crystals reflect less energy than liquid precipitation. Tilting the beam above the freezing level may result in an underestimation of the cell's intensity. Move the TILT control up and down to determine the most reflective portion of the cell.

8.4.6 Autotilt (AUTO) Switch.

Autotilt is designed to reduce pilot workload by automatically adjusting the antenna tilt angle to maintain to ratio tilt/angle following altitude or range changes.

Autotilt is selected with the PUSH AUTO switch (push ON/push OFF). On the weather radar mode line, active autotilt is indicated by a suffix "A" at the angle readout.

When autotilt is selected ON, manual tilt commands from the TILT control remain operational.

8.4.7 GAIN Control.

The GAIN control is a seven-position switch that allows manual GAIN control of the radar system when operating in the MAP and WX modes. When placed in the NORM position, the gain is preset to a value that allows the radar receiver to calibrate its operation to the actual reflectivity level.

To aid pilots in making correct weather judgements, the GAIN control may be adjusted to higher or lower gain settings. The high settings (+1, +2, +3) may be chosen to identify the highest levels of precipitation, while the lower settings (-1, -2, -3) may be temporarily chosen to allow a more in-depth study of the most intense weather targets.

Each of the minus settings (-1, -2, -3) reduces the sensitivity of the radar system below that of the NORM setting by approximately one color level.

Each of the plus settings (+1, +2, +3) increases the sensitivity of the radar system through a combination of lengthening the transmitted pulse-width and increasing the receiver gain. The effective gain increase with each setting can be as much as one color level when the target is in close (out to approximately 65 nm) and less than one color level at longer ranges.

The greatest utility offered by the plus gain setting is the ability to display light precipitation that otherwise would be just under the green level threshold on the NORM setting. In many cases, these light levels still cause turbulence and can be avoided by use of the plus gain feature.

Proper use of of the GAIN control allows a pilot, with weather radar operating experience, to estimate rainfall rates greater than a VIP level 3 (red) or 5 (magenta) return. Targets that show in a reduced gain condition indicate that severe turbulence, hail, and heavy rainfall is likely.

Caution

Although proper use of the GAIN control can provide added knowledge of the targets being displayed, the pilot should always return the GAIN control to the NORM position when finished analyzing the display. Failure to do so may result in missing significant targets at any range when operating in one of the minus settings (-1, -2, -3).

8.4.8 Ground Clutter Suppression.

Ground clutter suppression (GCS) is operable only in the WX mode. When selected, GCS reduces the intensity of ground returns and makes the precipitation returns easier to interpret. When selected, “GCS” is annunciated in cyan in the upper left corner of the MFD.

GCS should only be used to identify ground clutter. Continuous operations with the GCS feature turned on is not recommended because some precipitation returns may also be reduced in intensity or eliminated from the display.

If the antenna is excessively tilted down and GCS is turned on, a phenomenon knows as a “GCS wedge” may occur. This wedge is represented as a black area (an area showing no return) located approximately +/- 10 degrees from the aircraft’s nose, and of the same depth of the ground return that was being painted prior to turning on GCS. To eliminate the wedge, turn GCS off or raise the tilt angle until the wedge disappears.

8.4.9 RANGE Control.

The RANGE control is a rotary knob that is used to select the maximum display range. For all of the selectable ranges, one cyan or white (white for MAP mode only) half-range arc is shown in the center of the MFD.

Extending outward from the aircraft symbol is a blanked ranged area. The size of this blanked range area equals one eighth of the selected range. The pilot should remember that the area between the airplane symbol and the perimeter of the blanked range does not show any targets. The selectable ranges, range-arc annunciations and blanked range are shown on the MFD.

Selected Range (NM)	Half-Range ARC Annunciation	* Blanked Range (nm)
5	2.5	0.6
10	5	1.2
20	10	2.5
40	20	5
80	40	10
160	80	20
320	160	40
640	320	80
* The blanked range is equal to one-eigth of the selected range		

• Note •

The pilot must always keep in mind the blanked area of the radar display during and after airplane maneuvers in the presence of potential weather. If one of the longer ranges is selected during and after airplane maneuvers, it is possible for weather targets to slip within the blanked range area and therefore not shown on the display. The shortest practical range should be momentarily selected both during and following airplane maneuvers to ensure close-in weather shows on the display.

8.4.10 Transfer Mode.

In dual-radar control installations, the radar works in the split-scan mode. In the split-scan mode, the radar display on one side can be completely different from the one on the other side except for the scan width (SEC). Selecting the XFR switch will cause the system to operate as if it was a single-radar installation.

In single-radar installations, the XFR push button determines which display control panel (DCP) has control of the radar range. If both sides have selected the radar format on the multifunction display and the ranges are the same, the display mileage on the side controlling the radar range will be white; it will be yellow on the side not in control. A push on the XFR switch will cause the other DCP to assume control of the radar range.

When the radar range is different than the one on the MFD, the annunciation “RADAR NOT AT THIS RANGE” will be displayed.

8.4.11 Operation.

Ground Operation.

The description of operation that follows has been derived from the vendor’s Pilot’s Guide. For a complete description of operation, refer to the Collins WXR-840 Weather Radar System, Pilot’s Guide-Operation.

Switch the system to STBY mode when on the ground, unless you are using WX mode to check the terminal area prior to departure.

WARNING

The safe distance for human exposure to radar radiation of the WXR-840 weather radar system is 2 feet. Users should take necessary and reasonable precautions to ensure that personnel and equipment sensitive to microwave radiation are kept safely beyond this distance.

Takeoff and Climb.

Prior to takeoff, a short range selection such as 20 nm scale should be used. Tilt the antenna up to approximately +5 degrees to scan for weather along the departure path. Select autotilt to compensate for the initial altitude and range changes during climbout. As the airplane climbs, the tilt should be gradually decreased to aim at the regions of maximum precipitation while avoiding ground clutter, and the range should be increased. To reduce pilot workload, the use of autotilt during ascents and descents is encouraged.

Cruise.

For cruise, the tilt should be adjusted so that the ground returns are barely visible at the outer edge of the screen. Ground returns are displayed in arcs, paralleled to range marks. They merge together as the tilt is brought down and cause shadowing behind prominent features. They are generally smaller, sharper, and more angular than weather returns. To avoid overscanning, the tilt will have to be adjusted more frequently as storms are approached or range is changed.

Having once adjusted the tilt setting, pilots should not be content with just an occasional glance at the screen. Failure to periodically down-tilt leads to disappearing targets.

Middle Altitudes.

Antenna tilt for airplane flying at 20,000 ft. should be set near 0 degrees or slightly down.

Higher Altitudes.

This radar detects only liquid moisture in the form of raindrops, wet hail or wet snowflakes. Unless the beam is aimed at or below the freezing level of weather cells, there may not be sufficient moisture to paint a return on the display.

TILT Control at High Altitudes (Above FL350).

The tilt used for the middle altitudes is not effective for flight above 35,000 feet. Typically, at high altitudes, a longer range is selected and the tilt is adjusted slightly down. When selecting the operating range, keep in mind the line-of-sight distance to the horizon. When operating at the higher altitudes, it is particularly easy to scan over the top of significant storm cells.

Do not attempt to overfly targets. It is possible that dry hail (which generally cannot be detected) and severe turbulence may be present far above (radar) top of any areas of detected precipitation. The pilot should always remember that the weather radar system is an avoidance tool. It is strongly recommended that pilots never attempt to overfly, underfly, or penetrate storm cells or squall lines. For the safest operation, it is suggested that the pilot plan ahead to establish a flight path that avoids all returns by the distance established in the FOM.

Descent.

Antenna tilt has to be raised approximately one degree per 10,000 ft. of descent down to 15,000 ft., then one degree per 5,000 ft. below 15,000 ft. Range should be adjusted as necessary to scan the arrival route adequately. In heavy weather, the longest appropriate range should be used to plan a safe avoidance route; the selection of shorter ranges will show greater details as you enter the affected area. Remember that more tilt adjustment will be required each time the range is switched. Only very small corrections will be required when using autotilt.

8.4.12 Summary.

Experience enables the pilot to properly analyze various types of storm displays. The key to avoiding detected weather is to first determine the heading change needed to bypass a storm safely. Once established on the appropriate heading, recheck the weather radar display to determine if further heading changes are required. The pilot should remember that the weather radar system was designed as a weather avoidance tool.

The pilot has the sole responsibility to decide how close to approach the various types of storms shown on the displays. Most convective weather systems in North America travel from south/southwest to north/northeast. The areas ahead of these storms (north/northeast) can then be expected to contain gust fronts, turbulence, heavy rain, and possibly hail. It is suggested that these areas be avoided by no less than the minimum distance established in the FOM.

Chapter 10: Weight and Balance

10.1 Weight and Balance System

PSA Airlines' FAA-approved Weight and Balance (W&B) system provides W&B and Takeoff Weight (TOW) calculations for all flights and must be complied with prior to all 14 CFR Part 121 flights.

A. Scheduled flights shall complete the Cabin Loading Form and Cargo Load Report to provide the required information to the flight crewmembers to complete the W&B calculation.

B. The Company's approved W&B system is based on average weights derived from Advisory Circular AC 120-27 for a large cabin aircraft (Type Certificate 71 seats and greater).
   - Passenger and Crew average weights.
   - Checked baggage and Carry-on Baggage average weights.
   - Pilot Flight Bag average weight of 20 lbs is revised in the Weight and Balance Manual to 5 lbs for flight operations utilizing the Electronic Flight Bag.

C. The Company's approved W&B system is in compliance with the Operations Specifications A099 and E096.

Maintenance provides operations with the Basic Operating Weight (BOW) and index for calculating the TOW and Center of Gravity (CG) to comply with manufacturer and FAA operational performance requirements.

There are two W&B systems utilized by PSA: One is primary. The second one is backup (POH 10.2, "Backup Weight and Balance").

The primary system for W&B calculation is the ACARS W&B method, which consists of:
- Dispatch Release
- AeroData ACARS W&B/Performance Module
- Takeoff and Landing Report (TLR)

10.1.1 Takeoff Weight.

No PSA Airlines flight will takeoff unless the Captain has determined that the actual takeoff weight is at or lower than the most limiting of the following weights:

A. The maximum certificated gross weight.

B. The maximum weight allowed for runway length, brake energy and obstacle clearance.

C. The maximum weight that will allow the aircraft to not exceed the maximum landing weight at the destination after the enroute fuel burnoff.

10.1.2 Average Crewmember/Observer Weights.

Crewmember	Average Weight
Flight Crewmember + Flight Bag	195 lbs
Flight Attendant + Kit	180 lbs
ACM	190 lbs
Crewmember Rollaboard	30 lbs

10.1.3 Average Passenger Weights.

Average Passenger Weight	Weight Per Passenger		
	<200>	<CR7>	<900>
Summer Weights (May – October)			
Average Passenger Weight	184 lbs.	184 lbs.	190 lbs.
Child Weight (2 years to less than 13 years of age)	76 lbs.	76 lbs.	82 lbs.
Winter Weights (November – April)			
Average Passenger Weight	189 lbs.	189 lbs.	195 lbs.
Child Weight (2 years to less than 13 years of age)	81 lbs.	81 lbs.	87 lbs.

The average passenger weights listed above account for small personal items (e.g. purses, briefcases, computers and cases, cosmetic cases, book bags, diaper bags and similar size items.)

Personal items must fit easily in the overheads or under the seat. Other items, such as coats, umbrellas, reading material, food for consumption, infant restraining device, and passenger assist/comfort animals and devices, are allowed to be carried on the aircraft and are not counted against the personal item allowance.

10.1.4 Average Baggage Weight.

Average Bag Weight	Weight Per Bag		
	<200>	<CR7>	<900>
Standard Checked Bag (50 lbs. or less)	30 lbs.	30 lbs.	30 lbs.
Plane Side Bag	20 lbs.	20 lbs.	30 lbs.
Heavy Check Bag (>50 lbs. or < 100 lbs.)	60 lbs.	60 lbs.	60 lbs.
Bags 100 lbs. or greater	Actual Weight	Actual Weight	Actual Weight

10.1.5 Crew Bag Storage.

Bags belonging to the working crew are calculated as part of the aircraft weight and therefore must be stowed in the cabin in their designated locations. Bags that cannot be accommodated in the approved location must be properly identified with a personal ID tag and a valet tag and placed in the cargo compartment.

Aircraft	Crew Bag Storage Location
<200>	• First OHB, A/C Left: FA Tote/Manual • FA Station – lower compartment: 1 rollaboard • OHB above Row 11 A/C Left: 1 rollaboard • OHB above Row 12 A/C Right: 1 rollaboard
<CR7>	• Wardrobe: 3 rollaboards, FWD FA Tote/Manual • Second to last OHB, A/C Right: 1 rollaboard, AFT FA Tote/Manual
<900>	• Wardrobe: FWD FA Tote/Manual • OHB above Row 12 A/C Left: 1 rollaboard • OHB above Row 12 A/C Right: 1 rollaboard • Second to last OHB A/C Left: 1 rollaboard • Second to last OHB A/C Right: 1 rollaboard, AFT FA Tote/Manual

OHB = Overhead Bin