



REDUCED VERTICAL SEPARATION MINIMUM (RVSM)

SKIN WAVINESS INSPECTION PROCEDURES

FOR THE

CESSNA MODEL 560 AND S550

CITATION AIRCRAFT

FAA STC Number ST02642AT

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Record Of Revisions

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A	2/16/04	Page 4 corrected errors in list of Figures	Prepared By: E. Weaver Checked By: G. Fischer Approved By: W. Fink
B	See Front Sheet	Page 14,16,17 – corrected grid row increment reference numbers. Page 18 – corrected Figure 5.2 to show correct number of grid row reference numbers. Page 22,23 – corrected Figures A.1-A.2 to show correct grid row reference numbers.	See Front sheet

PLACEMENT OF INITIAL ISSUES AND REVISIONS

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Table Of Contents

<u>Section</u>	<u>Page</u>
Record Of Revisions.....	2
Table Of Contents	3
List Of Tables	4
List Of Figures	4
1. Introduction	5
2. Equipment Identification	6
3. Pre Test Preparation.....	8
3.1. Static Port Condition	8
3.2. Paint Removal.....	8
3.3. Paint Stripes.....	8
4. Reference Grid	10
5. Measurement Procedures	13
5.1. Depth Gauge Setup	13
5.2. Reference Bar	14
5.3. Skin Map Measurement	14
5.4. Slope Calculation	16
5.5. Skin Overlay	17
5.6. Static Port Button Step Height.....	19
6. Technical References	20
A APPENDIX A SKIN WAVINESS INSPECTION WORKSHEETS	21
B APPENDIX B STATIC PORT SKIN PREPARATION	24
B.1 Overview	25
B.2 Materials	25
B.3 Procedure	25

List Of Tables

<u>Table</u>	<u>Page</u>
2.1 Test Equipment.....	6

List Of Figures

<u>Figure</u>	<u>Page</u>
2.1 Static Port Region – L/H Side	7
3.1 Paint Stripe Limitations	9
4.1 Reference Grid - L/H Side	12
5.1 Skin Map Measurement Setup – L/H Side.....	15
5.2 Skin Overlay Inspection - L/H Side	18
A.1 Skin Waviness and Skin Overlay Inspection Worksheet	22
A.2 Skin Waviness and Skin Overlay Slope Calculation Worksheet.....	23
B.1 Static Port Skin Preparation.....	26

1. Introduction

Future proposed reductions in the vertical space separating aircraft traveling within the airspace contained between 29,000 and 41,000 ft will require increased accuracy for aircraft altitude sensing equipment. Since the performance of the altitude sensing system can be greatly influenced by variations in the skin of the aircraft and the condition of the elements of the pitot-static system, it is important to establish inspection methods that allow variations in the skin of a given aircraft to be measured accurately and in a repeatable manner.

This document serves to outline the technical procedures needed to quantify the skin contours of a given aircraft to support Reduced Vertical Separation Minimum (RVSM) operation. The procedures contained in this document are specific to the Cessna Model 560 and S550 model group. A serial number range of all aircraft applicable to this report is given in Star Aviation, Inc. Document No. R34-0221, "Master Data List for Reduced Vertical Separation Minimums Group Approval on Cessna Citation 500 Series", Original Release, dated September 15, 2003 or latest approved version.

This document gives a description of the inspection equipment, the inspection preparation and data acquisition process that has been developed by Kohlman Systems Research, Inc. for the Cessna Model 560 and S550 RVSM group. This document defines the procedures used to determine the acceptance criteria of aircraft in a group certification for RVSM qualification. These procedures must be performed only by individuals trained and approved by Star Aviation, Inc.

Tolerances used in this document for inspection of the condition of the static ports and the area around the static ports are based on the Altimetry System Error (ASE) standards set forth in FAA Document Number 91-RVSM, "Interim Guidance Material On The Approval Of Operators/Aircraft For RVSM Operations" (Reference 1).

2. Equipment Identification

The Cessna Citation Model 560 and S550 are similar airframes that are assembled in a like manner using similar parts and are intended to have identical static source systems, taking into consideration manufacturing tolerances. The static port region is illustrated in Figure 2.1. Airframe to airframe variability that occurs around the static ports from manufacturing and paint condition can influence the accuracy of altitude sensing equipment due to slight skin variations around the static ports and differences between the Pilot and Copilot side of the airframe.

In addition to the paint condition, other airframe variables that can potentially influence the accuracy of the altitude sensing equipment include skin surface variations and the static port flushness. A quantitative assessment of each of these potential influences is required to establish RVSM airworthiness.

The precision equipment, identified in Table 2.1 is required to accurately measure the skin waviness and skin lap heights for the Cessna Model 560 and S550 aircraft.

It consists of a 16 inch steel reference bar with a base that is used in conjunction with a dial-indicator depth gauge to measure the skin contour. The reference bar consists of a rectangular bar attached to a three-point base. The equipment is meant to provide the necessary level of accuracy while being portable and easy to use.

Table 2.1 Test Equipment

Component	Part Number
Skin Map Reference Bar – With Base	KSR TOL 723
Dial Indicator Depth Gauge	Mitutoyo 547-217
24 in. Flexible Steel Ruler	Various
Grease Pencil or Dry Erase Marker	Various

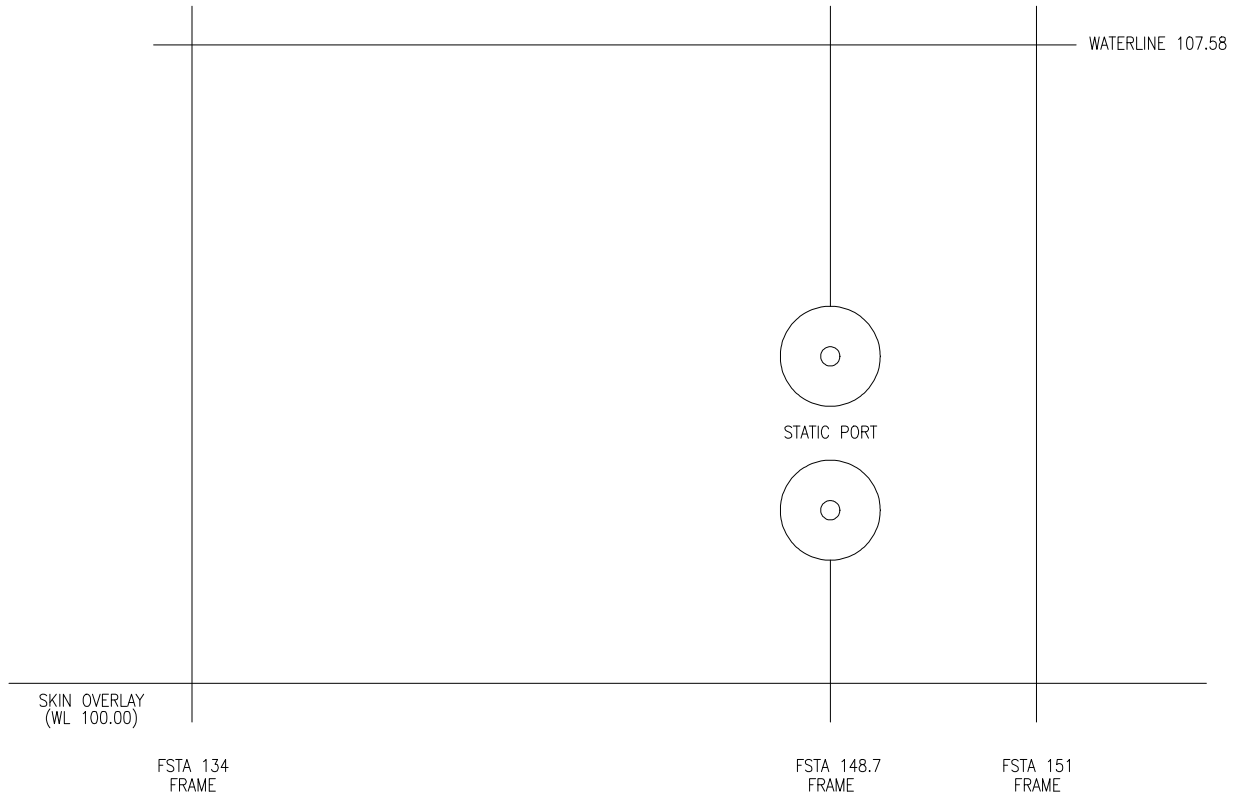


Figure 2.1 Static Port Region – L/H Side

3. Pre Test Preparation

In order to ensure repeatable and accurate results the condition of all items in the area surrounding the static ports shall be checked. This includes the condition of the static ports, the fasteners used to mount the static ports, the paint condition and the skin waviness.

3.1. Static Port Condition

Check each of the static ports for damage in accordance with appropriate Cessna Maintenance Manual. Make sure the area around the static ports, 6 inches aft, 24 inches forward, 12 inches above and below is clean and has no visible damage.

Any static ports and static port areas that do not meet the requirements noted above must be replaced or repaired to bring them into compliance.

3.2. Paint Removal

To reduce the influence of the paint thickness and condition on the measured pressures, the static port buttons on the Cessna Model 560 and S550 airframes are to be stripped of paint. Appendix B describes in detail how the static port area must be prepared before the skin waviness inspection measurements can be taken. Paint is to be removed only from the static port buttons.

3.3. Paint Stripes

Excessive ridges in the paint caused by stripes or similar color scheme changes need to be eliminated.

In an area 3 feet forward of the static ports and 1 foot above and below the static ports, any transitions in the paint scheme must be smooth. Reference Figure 3.1 for acceptable paint stripe configurations.

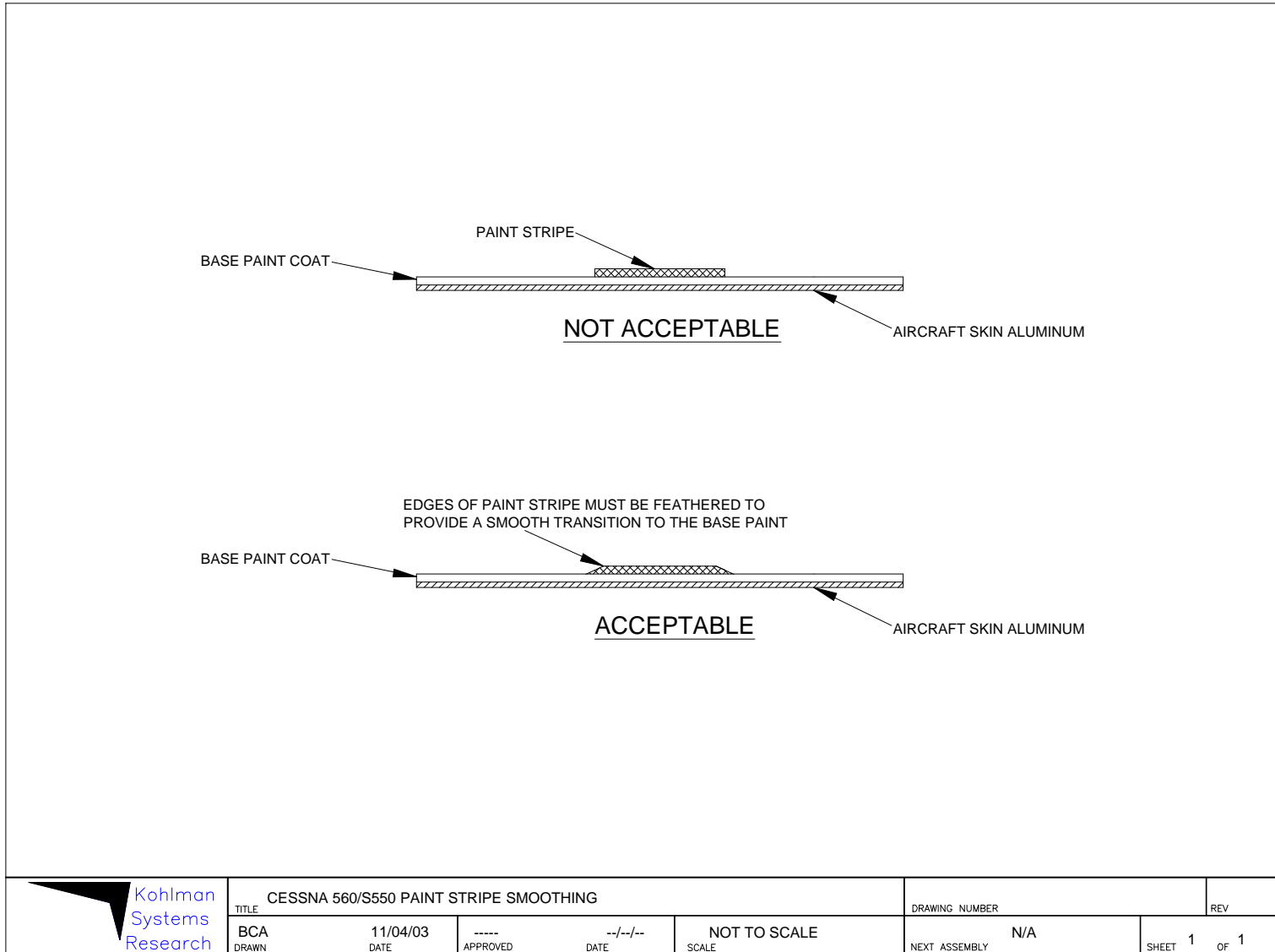


Figure 3.1 Paint Stripe Limitations

4. Reference Grid

In order to create a repeatable and accurate means to quantify the skin waviness, a reference grid must be established. This grid will be used to determine the location of each point at which the skin waviness measurements will be taken.

For the Cessna aircraft, a grid spacing of one inch is used. The waterline reference for this grid is a line that runs through a point midway between the static ports, parallel to the skin overlay, which is approximately 3.25 inches below the center of the static ports. This grid will cover an approximate area 10 inches forward and 3 inches aft of the centerline of the static ports and 6 inches above and 6 inches below the centerline of the static ports.

Figure 4.1 shows the grid as it should be marked on the aircraft.

The following steps are used to establish the grid. This should be done on both sides of the aircraft.

1. Draw a vertical line through the upper and lower static ports, extend the line at least 6 inches above and below the static port doublers. Then locate and mark a point midway between the upper and lower static ports.
2. Determine the distance from of the center point between the upper and lower static ports to the skin overlay below the static ports.
3. At a point about 12 inches forward of the static ports, measure up from the skin overlay this same offset.
4. Using the 24 inch straight edge and the dry erase marker, draw a horizontal line through the midpoint of the static ports and the mark from Step 3. Extend this line at least 14 inches forward of the static port centerline and at least 4 inches aft.
5. Along the horizontal line drawn in Step 4, mark a point 3 inches aft of the static port centerline. Measure 3 inches aft from the top and bottom of the vertical line drawn in Step 1 (the static port centerline). Using the 24 inch straight edge and the dry erase marker, draw a vertical line through these points. This is the Aft Vertical Reference Line as shown in Figure 4.1.
6. At a point 15 inches forward of the Aft Vertical Reference Line, use the straight edge and the dry erase marker to draw a vertical reference line. This vertical reference line should extend eight inches above and below the horizontal reference line. This is the Fwd Vertical Reference Line as shown in Figure 4.1.

7. Verify the vertical reference lines are parallel by measuring the distance between the lines at the positive and negative five (± 5) inch mark. See Figure 4.1 for reference. The distance from the aft reference line to the forward vertical reference line should be 15 inches.
8. For both vertical lines, at each one (1) inch increment (up to five inches above and below the horizontal reference line) on the forward vertical reference line, make a mark and indicate the distance from the horizontal reference (positive numbers above the horizontal reference line and negative numbers below the horizontal reference line).
9. After all skin waviness measurements are completed, remove all markings from the aircraft.

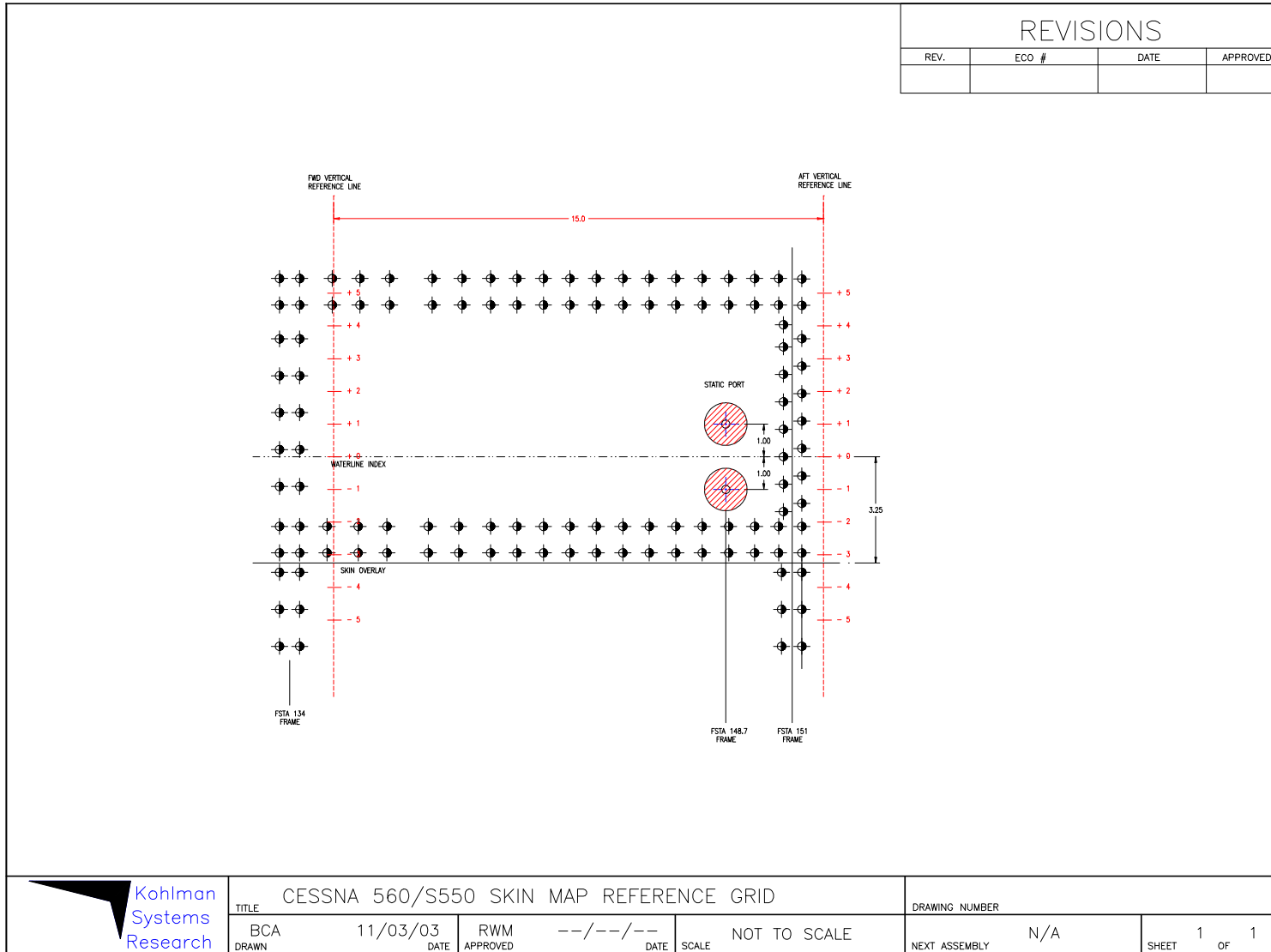


Figure 4.1 Reference Grid - L/H Side
Note: Figure 4.1 depicts the paint-free area (shaded zone).

5. Measurement Procedures

Skin waviness is measured as the dimensional variation between the airframe skin and an offset from the foot of a reference bar (KSR TOL 723). To alleviate airframe induced measurement error, the waviness reference plane is offset from the skin surface. The reference bar (KSR TOL 723), is held against the aircraft skin at the points on the reference grid. A dial depth gauge is then used to measure the distance from the reference bar to the aircraft skin. Figure 5.1 shows how the different pieces of equipment are used in the measurement.

5.1. Depth Gauge Setup

The dial depth gauge is used to determine the distance from the reference point to the aircraft skin. In order to ensure repeatable measurements the following steps should be taken:

1. Check the function of the dial depth gauge. Ensure the plunger movement is free and smooth. Clean the gauge as necessary with a clean, dry, cloth. Do not use any oil based cleaning products on the depth gauge.
2. Remove the plunger end and replace it with the 2½ inch extension and plunger end. Ensure that the tip of the plunger is securely in place.
3. Place the reference bar on a flat smooth surface. Place the depth gauge in the reference bar track near one end of the reference bar. Zero the dial indication to read 0.000. Confirm this zero (± 0.002) at the opposite end of the reference bar.
4. Check the function of the dial depth gauge. Ensure the gauge reads a negative number when the plunger is extended and a positive number when the plunger is retracted. If not, push the +/- button on the upper right of the gauge and confirm the proper sign. Reconfirm the proper sign convention periodically throughout the measurement process.

5.2. Reference Bar

The rigid reference bar is used as a baseline to determine the waviness of the aircraft skin around the static ports. The feet at the end of the reference bar allow the bar to stand off from the aircraft and avoid the influence of any of the local skin waviness. The procedure for placing the reference bar on the aircraft skin is:

1. Check the reference bar for any damage or missing components. Clean the bar as necessary with a clean, dry, cloth. Do not use any oil based cleaning products.
2. Align the top of the feet of the reference bar with the tick marks on the vertical reference lines. This is shown in Figure 5.1.
3. The reference bar should be held firmly against the aircraft skin with the handles on each end. Do not push in the middle of the reference bar.

5.3. Skin Map Measurement

Using the procedures detailed in the previous sections, the entire skin map can be performed.

1. Align the reference bar, as detailed in section 5.2, with the +5 inch mark on the vertical reference lines.
2. With the reference bar in place against the aircraft, stick the plunger of the dial depth gauge through the space in the reference bar. Aligned the dial depth gauge at the number 1, one inch increment.
3. Bring the base of the dial depth gauge up against the reference bar. Gently but firmly hold the dial depth gauge against the reference bar. Figure 5.1 shows the placement of the dial depth gauge.
4. Read the indications on the dial depth gauge.
5. Record the resulting measurements in Figure A.1.
6. Move the dial depth gauge to each remaining one inch increment (2 thru 13) on the reference bar and repeat steps 3 thru 5.
7. Move the reference bar to the remaining points on the vertical reference lines. Repeat steps 1 thru 6 at each of the remaining points on the vertical reference lines.

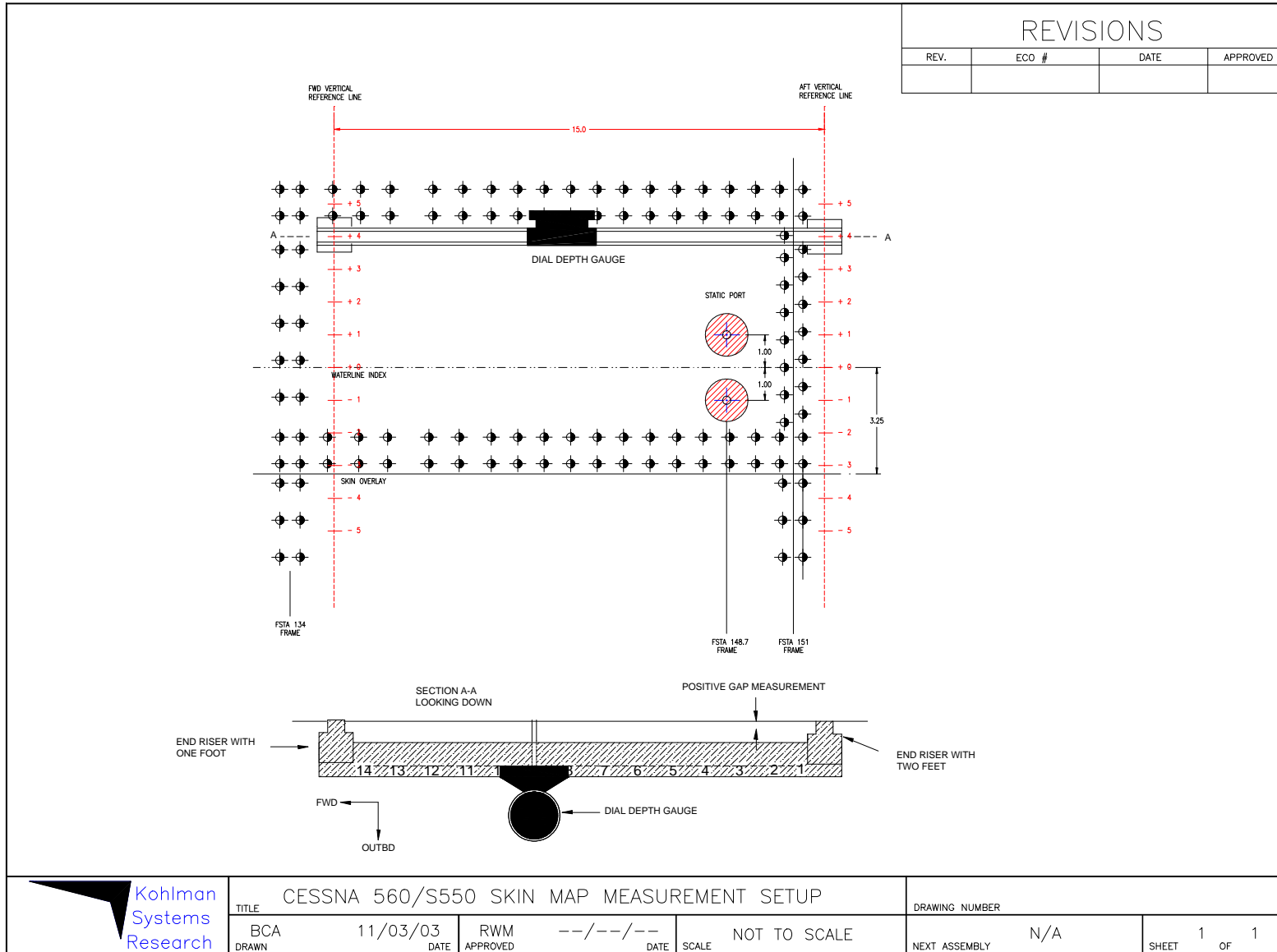


Figure 5.1 Skin Map Measurement Setup – L/H Side

5.4. Slope Calculation

Using the measurements recorded in the previous section, the slope can be calculated as follows.

1. Starting at Horizontal Grid Reference 5.0 and Reference Bar Graduation 12.0, note the recorded measurement.
2. Subtract this recorded measurement from the recorded measurement to the immediate left, in this case, Horizontal Grid Reference 5.0 and Reference Bar Graduation 13.0.
3. Enter the result in corresponding location in Figure A.2, in this case, Horizontal Grid Reference 5.0 and Reference Bar Graduation 12.0.
4. Repeat Steps 2-3 for the remaining Reference Bar Graduations aft.
5. Repeat Steps 1-4 for the remaining Horizontal Grid Reference rows down.

5.5. Skin Overlay

Refer to Section 4 (Reference Grid) and to Figure 5.2. For data acquisition, complete the following steps:

1. Complete the skin waviness procedures. Before erasing the aft vertical line, use the 24 inch flexible ruler to mark 13 – one inch marks (1-13) forward of the aft vertical reference line on the skin overlay seam.

Note: Do not remove these temporary index marks.

2. Position the dial depth gauge near the skin overlay mark such that the plunger is depressed by the upper fuselage skin. Zero the dial depth gauge so it reads 0.000 while the contact is resting on the upper fuselage skin.
3. Move the dial depth gauge until the plunger is resting on the lower fuselage skin. See Figure 5.2. Record the measurement on Figure A.1. Use unshaded and shaded boxes for the L/H and R/H sides, respectively.
4. Repeat Steps 2-3 for the remaining skin overlay index marks (equivalent to 12 in. steel rule indexes 12.0 through 1.0). Record measurements on Figure A.1.

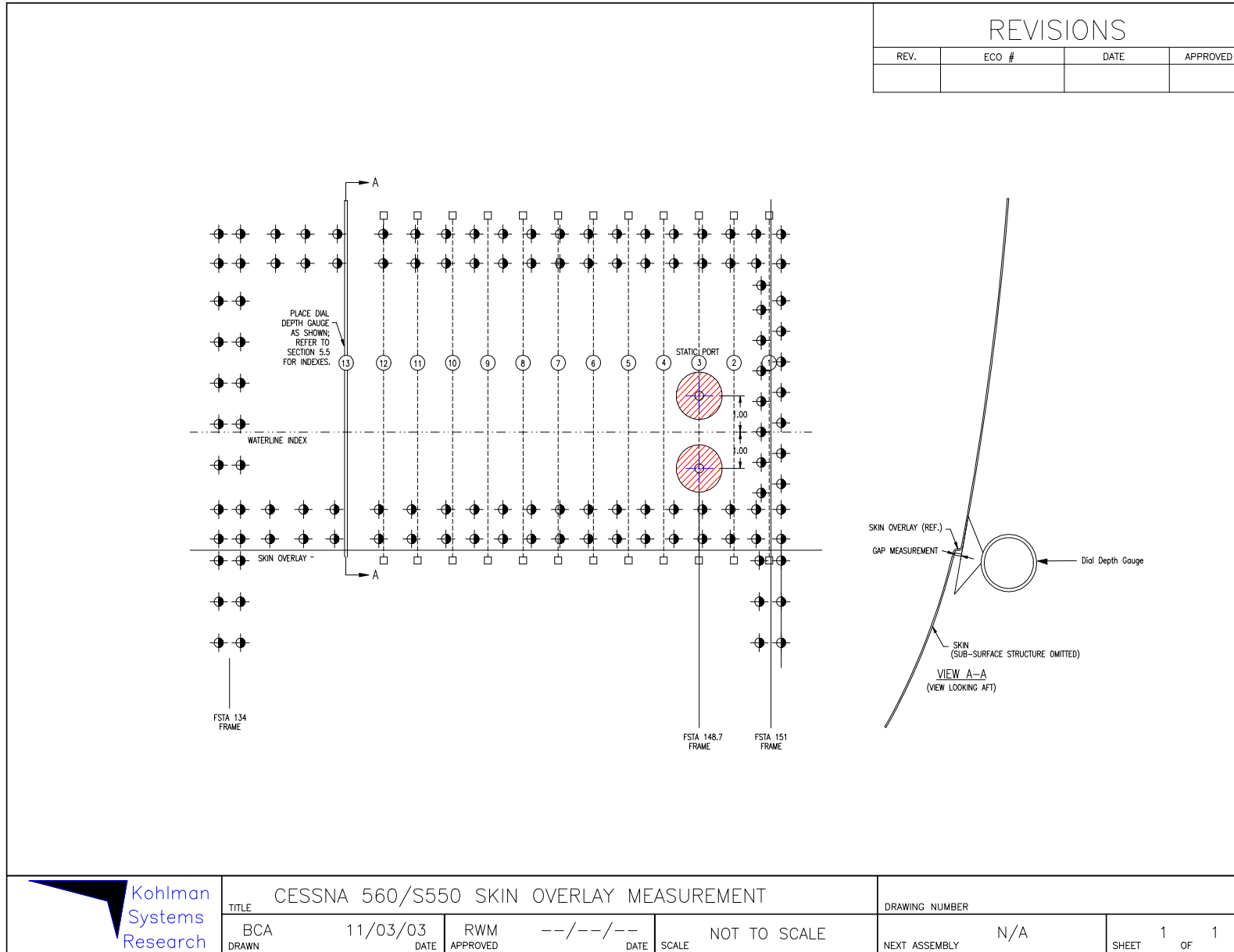


Figure 5.2 Skin Overlay Inspection - L/H Side

5.6. Static Port Button Step Height

For data acquisition, complete the following steps:

1. Position the dial depth gauge on the upper left static port button with the plunger located within the inner flat surface, not over the hole, and the base of the gauge flush with the inner flat surface. Zero the dial depth gauge so it reads 0.000 while the contact is resting on the button.
2. Slide the dial depth gauge forward, centered between the top and bottom of the button, keeping the base flush with the inner flat surface, until the plunger is clear of the button and measure the step height. Record measurement in Figure A.1.
3. Slide the dial depth gauge aft, centered between the top and bottom of the button, keeping the base flush with the inner flat surface, until the plunger is clear of the button and measure the step height. Record measurement in Figure A.1.
4. Slide the dial depth gauge up, centered between the forward and aft of the button, keeping the base flush with the inner flat surface, until the plunger is clear of the button and measure the step height. Record measurement in Figure A.1.
5. Slide the dial depth gauge down, centered between the forward and aft of the button, keeping the base flush with the inner flat surface, until the plunger is clear of the button and measure the step height. Record measurement in Figure A.1.
6. Repeat Steps 1-5 for the remaining static port buttons on the left and right sides.

6. Technical References

1. Federal Aviation Administration, "Interim Guidance Material On The Approval Of Operators/Aircraft For RVSM Operations", FAA Document Number 91-RVSM, Change 1, 30 June 1999.

APPENDIX A

SKIN WAVINESS INSPECTION WORKSHEETS

Cessna Model 560/S550 RVSM													A/C SERIAL #:		
Skin Waviness Inspection Worksheet													A/C REG. #:		
DATE: _____													COMPLETED BY: _____		
AIRPORT: _____															
Horizontal Grid Reference	A/C	Reference Bar Graduation											Aft	Horizontal Grid Reference	
	Side	13	12	11	10	9	8	7	6	5	4	3	2		1
5 (Top)	Left														5 (Top)
	Right														
4	Left														4
	Right														
3	Left														3
	Right														
2	Left														2
	Right														
1	Left														1
	Right														
0	Left														0
	Right														
-1	Left														-1
	Right														
-2	Left														-2
	Right														
-3	Left														-3
	Right														
Skin Overlay	Left														Skin Overlay
	Right														
-4	Left														-4
	Right														
5 (Bottom)	Left														5 (Bottom)
	Right														

Button Step Height:	Upper:	Fore	Aft	Top	Bottom	Lower:	Fore	Aft	Top	Bottom
	Left					Left				
	Right					Right				

Figure A.1 Skin Waviness and Skin Overlay Inspection Worksheet

Cessna Model 560/S550 RVSM													A/C SERIAL #:		
Skin Waviness Inspection Worksheet													A/C REG. #:		
DATE: _____													COMPLETED BY: _____		
AIRPORT: _____															
Horizontal Grid Reference	A/C	Forward	Reference Bar Graduation										Aft	Horizontal Grid Reference	
	Side	13	12	11	10	9	8	7	6	5	4	3	2		1
5 (Top)	Left														5 (Top)
	Right														
4	Left														4
	Right														
3	Left														3
	Right														
2	Left														2
	Right														
1	Left														1
	Right														
0	Left														0
	Right														
-1	Left														-1
	Right														
-2	Left														-2
	Right														
-3	Left														-3
	Right														
Skin Overlay	Left														Skin Overlay
	Right														
-4	Left														-4
	Right														
5 (Bottom)	Left														5 (Bottom)
	Right														

Figure A.2 Skin Waviness and Skin Overlay Slope Calculation Worksheet

APPENDIX B

STATIC PORT SKIN PREPARATION

B.1 Overview

This procedure establishes the static port refinishing process for the Cessna Model 560 and S550 RVSM Group

B.2 Materials

Use standard aircraft procedure and practices for paint stripping and polishing the static port buttons. The static port buttons are illustrated by the shaded areas in Figure B.1.

B.3 Procedure

Caution: Observe Safety Precautions Listed in Cessna 500 Series Maintenance Manual, Section 20-31-00

1. Protect static ports from any residue generated by the paint removal and aluminum polishing process.
2. Thoroughly clean airplane surface to remove all grease and other dirt, which might keep the stripping agent from attacking paint.
3. Mask the static port buttons. These buttons, as illustrated by the shaded areas in Figure B.1, are the only areas to be stripped of paint and polished.
4. Strip paint from aircraft static port buttons (Ref. Figure B.1). Paint and existing primer should be removed down to bare aluminum. Clean area and allow drying.

NOTE: Ensure mechanical methods used do not scratch or in any other way damage the surface area being stripped

5. Remove masking material.
6. Polish the bare aluminum area around the static ports using an appropriate Polishing Compound.

