XCEL ENERGY SERVICES INC

6975 34TH AVE SOUTH

MINNEAPOLIS, MN 55450

REDUCED VERTICAL SEPARATION MINIMUM (RVSM) PROGRAM

INCLUDES THE FOLLOWING SECTIONS:

1. RVSM Operations Procedures
2. RVSM Maintenance Program
3. Aircraft Documents
4. Aircrew Documents
5. FAA Letter(s) of Authorization (LOA's)

PART 91

AIRCRAFT	SERIAL NUMBER
CESSNA 680	680-0112

Manual Prepared By:

FOXThree AVIATION CONSULTING

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RVSM MANUAL

XCEL ENERGY SERVICES INC

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MINNEAPOLIS, MN 55450

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RVSM OPERATIONS PROCEDURES

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RECORD OF REVISIONS

REVISION NUMBER	DATE OF REVISION	INITIALS
Original	07/01/2016	

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LIST OF EFFECTIVE PAGES

PAGE	REVISION NUMBER	DATE OF REVISION
COVER-1	Original	07/01/2016
COVER-2	Original	07/01/2016
GI-1	Original	07/01/2016
GI-2	Original	07/01/2016
REV-1	Original	07/01/2016
REV-2	Original	07/01/2016
LOEP-1	Original	07/01/2016
LOEP-2	Original	07/01/2016
TOC-1	Original	07/01/2016
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A-1	Original	07/01/2016
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A-23	Original	07/01/2016
A-24	Original	07/01/2016
A-25	Original	07/01/2016

FAA ACCEPTED
MSP FSDO

Daniel Thomas Lencowski
2016.07.15 08:29:26 -05'00'

FAA Accepted - Signature **Name** **Date**

LIST OF EFFECTIVE PAGES (cont'd)

PAGE	REVISION NUMBER	DATE OF REVISION
A-26	Original	07/01/2016
A-27	Original	07/01/2016
A-28	Original	07/01/2016
A-29	Original	07/01/2016
A-30	Original	07/01/2016

FAA ACCEPTED
MSP FSDO

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A. RVSM OPERATIONS PROCEDURES (cont'd)

A. RVSM OPERATIONS PROCEDURES

1. GENERAL

A. This section contains general operational information and procedures for crewmembers when conducting operations in RVSM airspace.

B. At 0901 UTC on January 20, 2005, the FAA implemented RVSM between flight level (FL) 290-410 (inclusive) in the following airspace: the airspace of the lower 48 states of the United States, Alaska, Atlantic and Gulf of Mexico High Offshore Airspace and the San Juan FIR. (A chart showing the location of offshore airspace is posted on the Domestic U.S. RVSM (DRVSM) Webpage. On the same time and date, RVSM was also introduced into the adjoining airspace of Canada and Mexico to provide a seamless environment for aircraft traversing those borders. In addition, RVSM was implemented on the same date in the Caribbean and South American regions.

C. 14 CFR Section 91.180 applies to RVSM operations within the U.S. 14 CFR Section 91.706 applies to RVSM operations outside the U.S. Both sections require that the operator obtain authorization prior to operating in RVSM airspace. 14 CFR Section 91.180 requires that, prior to conducting RVSM operations within the U.S., the operator obtain authorization from the FAA or from the responsible authority, as appropriate. In addition, it requires that the operator and the operator's aircraft comply with the standards of 14 CFR Part 91 Appendix G (Operations in RVSM Airspace).

D. Altitudes do vary worldwide and pilots will need to reference the appropriate navigational chart. Aircraft may not operate in these areas without having specific aircraft RVSM approval (Letter of Authorization authorizing RSVM). All flights conducting operations in RVSM airspace will be required to carry onboard the Letter of Authorization (LOA) or OpSpec for RVSM operations. Flight crew members must also be trained in RVSM airspace operations.

2. REQUIRED RVSM EQUIPMENT

A. In addition to the Long Range Navigation equipment required for operations in RVSM airspace, the aircraft must be equipped as follows. Refer to RVSM Critical Components of Section B, Appendix A.

1. Two independent altitude measurement systems capable of displaying aircraft altitude within 80 feet of one another.
2. One operational SSR altitude reporting Transponder.
3. One Altitude Alerting System capable of alerting flight crew members when the aircraft deviates +/- 300 feet from assigned altitude. For aircraft that are Type Certificated after January 1, 1997 the allowable deviation is +/- 200 feet.
4. One Automatic Altitude Control System capable of automatically controlling the aircraft to a reference pressure altitude within +/-65 feet under non-turbulent/ non-gust conditions.
5. If TCAS II is installed, Modification 7 is required.

3. CREW PROCEDURES

3.1 Flight Planning

A. Operators that do not file the correct aircraft equipment suffix on the FAA or ICAO Flight Plan may be denied clearance into RVSM airspace. Policies for the FAA Flight

Plan are detailed in paragraph C below. Policies for the ICAO Flight Plan are detailed in paragraph D below.

B. The operator will annotate the equipment block of the FAA or ICAO Flight Plan with an aircraft equipment suffix indicating RVSM capability only after the responsible civil aviation authority has determined that both the operator and its aircraft are RVSM-compliant and has issued RVSM authorization to the operator.

C. General Policies for FAA Flight Plan Equipment Suffix. Table 1-1: Aircraft Equipment Suffixes, on page A-3, allows operators to indicate that the aircraft has both RVSM and Advanced Area Navigation (RNAV) capabilities, or has only RVSM capability.

1. The operator will annotate the equipment block of the FAA Flight Plan with the appropriate aircraft equipment suffix from Table 1-1.
2. Operators can only file one equipment suffix in block 3 of the FAA Flight Plan. Only this equipment suffix is displayed directly to the controller.
3. Aircraft with RNAV Capability. For flight in RVSM airspace, aircraft with RNAV capability, but not Advanced RNAV capability, will file "/W". Filing "/W" will not preclude such aircraft from filing and flying direct routes in en route airspace.

D. Policy for ICAO Flight Plan Equipment Suffixes.

1. Operators/aircraft that are RVSM-compliant and that file ICAO flight plans will file "/W" in block 10 (Equipment) to indicate RVSM authorization and will also file the appropriate ICAO Flight Plan suffixes to indicate navigation and communication capabilities. The equipment suffixes in Table 1-1are for use only in an FAA Flight Plan (FAA Form 7233-1).
2. Operator/aircraft that file ICAO flight plans that include flight in Domestic U.S. RVSM airspace must file "/W" in block 10 to indicate RVSM authorization.

E. Importance of Flight Plan Equipment Suffixes. The operator must file the appropriate equipment suffix in the equipment block of the FAA Flight Plan (FAA Form 7233-1) or the ICAO Flight Plan. The equipment suffix informs ATC:

1. Whether or not the operator and aircraft are authorized to fly in RVSM airspace.
2. The navigation and/or transponder capability of the aircraft (e.g., advanced RNAV, transponder with Mode C).

F. Significant ATC uses of the flight plan equipment suffix information are:

1. To issue or deny clearance into RVSM airspace.
2. To apply a 2,000 foot vertical separation minimum in RVSM airspace to aircraft that are not authorized for RVSM, but are in one of the limited categories that the FAA has agreed to accommodate.
3. To determine if the aircraft has “Advanced RNAV” capabilities and can be cleared to fly procedures for which that capability is required.

G. During flight planning the flight crew must pay particular attention to conditions which may affect operations in RVSM airspace. Prior to receiving a flight release and conducting a flight, the pilot in command will:

1. Verify that the aircraft is approved for RVSM operations and ensure the operations manual and Letter of Authorization (LOA) is onboard.
2. Obtain reported and forecasted weather conditions, including Tropopause and Turbulence reports for the route of flight.
3. Refer to the Minimum Equipment List (MEL) to assure the required equipment is operative pertaining to height keeping systems necessary for operations in RVSM airspace.
4. Note any restriction on the aircraft flight log or applicable flight document to ensure RVSM operations are within compliance of any limitation and/or restriction.
5. If aircraft is not authorized in RVSM aircraft the flight crew must flight plan accordingly and not request a RVSM cruise flight level. Reference applicable Jeppesen High altitude chart for applicable FLOS.
6. PIC will review the Discrepancy Logs to ensure all RVSM equipment is operative.

TABLE 1-1
Aircraft Equipment Suffixes

	Navigation Capability	Transponder Capability	Suffix
RVSM	No GNSS, No RNAV	Transponder with Mode C	/W
	RNAV, No GNSS	Transponder with Mode C	/Z
	GNSS	Transponder with Mode C	/L
No RVSM	No DME	No Transponder	/X
		Transponder with no Mode C	/T
		Transponder with Mode C	/U
	DME	No Transponder	/D
		Transponder with no Mode C	/B
		Transponder with Mode C	/A
	TACAN	No Transponder	/M
		Transponder with no Mode C	/N
		Transponder with Mode C	/P
	RNAV, no GNSS	No Transponder	/Y
		Transponder with no Mode C	/C
		Transponder with Mode C	/I
	GNSS	No Transponder	/V
		Transponder with no Mode C	/S
		Transponder with Mode C	/G

3.2 Preflight Procedures

A. Review previously recorded discrepancies to determine the condition and airworthiness of the equipment required for flight into RVSM airspace. Ensure that any maintenance actions necessary have been taken to correct defects or malfunctioning equipment required for entry into RVSM airspace and that the proper documents and forms are completed.

B. Pilots will note the current aircraft Discrepancy Log and ensure that the aircraft is authorized for fight in RVSM airspace by noting that there is no check in the box in the corrective action section of the Discrepancy Log. If the box is checked, RVSM flight is not authorized.

C. Visually inspect the static sources. No damage shall be allowed on the static sources (e.g., surface roughness, nicks, or scratches). Verify that there is no corrosion, elongation, or deformation of the static source areas, and ensure that no foreign matter is found within the static source orifice.

D. Before takeoff, the aircraft altimeters will be set to the local altimeter (QNH) setting and should display a known elevation (e.g., field elevation) within the limits specified in aircraft operating manuals. The difference between the known elevation and the elevation displayed on the altimeters should not exceed 50 ft. The two primary altimeters will also agree within limits specified by the aircraft operating manual.

   Note: The maximum value for these checks listed in the operating manuals shall not exceed 75 feet.

E. Pilots will read back all clearance and cross check each other's understanding of a clearance.

F. Before takeoff the equipment required for entry into RVSM airspace must be operational. Any indications of malfunctioning equipment or inaccuracies must be corrected prior to RVSM flight.

   Note: The letter "W" should be used in block 10 of the ICAO or Block 3 for FAA flight plans for DRVSM operations to indicate that the aircraft is approved for operations in RVSM airspace. The letter "X" will still need to be used in block 10 of the ICAO flight plan to indicate that operations are authorized in NAT/MNPS airspace. (Ref: Page A-17 FAA Flight Plan Aircraft Suffices)

3.3 Prior to entering RVSM Airspace

A. The following equipment must be operating normally prior to entry into RVSM airspace:

   1. Two independent primary altitude measurement systems
   2. One automatic altitude control system
   3. One altitude alert system

B. The required communication and navigation equipment for flight Operations dependent on airspace requirements and transponder. Should any of the required equipment fail prior to entry into RVSM airspace the flight crew must request a new clearance to avoid entering RVSM airspace with malfunctioning equipment.

3.4 In-flight Procedures

A. Flight crews must accurately set the sub-scale on all primary and secondary altimeters to 29.92 in. Hg. (1013.2 Mb.) when passing the transition altitude. Crews must also recheck for proper altimeter settings when the aircraft has reached initial Cleared Flight Level (CFL).

B. In level flight it is essential to maintain the CFL. The flight crew must understand and allow the clearance from ATC. Except in contingency or emergency conditions, the aircraft must not intentionally depart the CFL without obtaining clearance to deviate from the CFL.

C. During an authorized transition between flight levels, the aircraft should not be allowed to overshoot or undershoot the Cleared Flight Level by more than 150 feet. Aircraft altitude capture system characteristics should be taken into consideration.

Note: Level off will be accomplished using the altitude capture feature of the automatic altitude control system.

D. Note visual perception of other aircraft at 1,000 ft. vertical separation.

E. An automatic altitude control system (auto-pilot altitude hold) should be operative and engaged during level flight, except in circumstances such as the need to re-trim the aircraft or when encountering turbulence. In all cases adherence to assigned cruise flight levels should be accomplished referencing one or both primary altitude measurement systems.

F. The altitude alert system should be operational.

G. The flight crews will ensure an operating transponder prior to entering RVSM airspace.

H. At intervals not to exceed one hour, the flight crew must cross check altimeter readings between primary altimeters and standby altimeter. The altimeters should agree within 200 feet (60m). If not, the altimetry system must be reported as defective and ATC must be notified. The difference between the primary and standby altimeters will be noted for use in contingency situations

1. The normal flight crew scan of the cockpit instruments should suffice for crosschecking the altimeters on most flights,
2. When operating under positive radar control, the initial altimeter cross-check should be performed after level-off.
3. Where Class II navigation is authorized and is being conducted, a cross-check will be performed and recorded in the vicinity of the point where Class II is begun (e.g., on coast-out). The readings of the primary and standby altimeters will be recorded and available for use in contingency situations on Form 2a: RVSM Altimeter Log.

I. During normal and abnormal situations, the altimetry system being used to control the aircraft will also be the system providing input to the altitude reporting transponder transmitting information to ATC.

J. If there are any deviations from the assigned flight level, the flight crew must immediately take action to return the aircraft to the assigned flight level.

K. Contingency procedures after entering RVSM airspace:

1. The flight crew must immediately notify ATC of any equipment failure or meteorological conditions that may affect the ability to maintain the assigned cruise flight level.

2. Examples of equipment failures in which ATC must be notified include:

a. Failure of all automatic altitude control systems on the aircraft

b. Loss of redundancy of altimetry systems.

c. Loss of thrust on an engine necessitating the need to descend.

3. Any other equipment or system failure affecting the ability to maintain cruise flight level.

a. The flight crew must notify ATC whenever encountering greater than moderate turbulence.

b. If unable to notify ATC and obtain a revised clearance prior to deviating from an assigned altitude, the flight crew should follow the appropriate contingency procedures and notify ATC as soon as possible.

L. Pilot and ATC Standard Phraseology.

1. Table 1-2 shows standard phraseology that pilots and controllers will use to communicate in RVSM operations.

M. The flight crew will be aware of the characteristics of aircraft altitude capture systems that may lead to the occurrence of overshoots.

N. The flight crew will incorporate the use of Strategic Lateral Offset Procedures (SLOP) in oceanic airspace to mitigate the effect of wake turbulence and the effect of operational errors.

TABLE 1-2

Pilot/Controller Phraseology

MESSAGE	PHRASEOLOGY
For a controller to ascertain the RVSM approval status of an aircraft:	(call sign) confirm RVSM approved
Pilot indication that flight is RVSM approved	Affirm RVSM
Pilot will report lack of RVSM approval (Non-RVSM status): a. On the initial call on any frequency in the RVSM airspace and b. In all requests for flight level changes pertaining to flight levels within the RVSM airspace and… c. In all read-backs to flight level clearances pertaining to flight levels within the RVSM airspace and… d. In read back of flight level clearances involving climb and descent through RVSM airspace (FL290-410)	Negative RVSM, (supplementary information, e.g., “Certification flight”).
Pilot report of one of the following after entry into RVSM airspace: all primary altimeters, automatic altitude control systems or altitude alerters have failed. (This phrase is to be used to convey both the initial indication of RVSM aircraft system failure and on initial contact on all frequencies in RVSM airspace until the problem ceases to exist or the aircraft has exited RVSM airspace).	Unable RVSM Due Equipment
ATC denial of clearance into RVSM airspace	Unable issue clearance into RVSM airspace, maintain FL_____.
*Pilot reporting inability to maintain cleared flight level due to weather encounter.	*Unable RVSM due (state reason) (e.g., turbulence, mountain wave)
ATC requesting pilot to confirm that an aircraft has regained RVSM-approved status or a pilot is ready to resume RVSM	Confirm able to resume RVSM
Pilot ready to resume RVSM after aircraft system or weather contingency	Ready to resume RVSM

3.5 Post Flight

A. After completing a flight in RVSM airspace, the flight crew must report any discrepancies that affect the height keeping systems on the Height Keeping Error Report Form No. 1a. The discrepancy should be written in detail to allow maintenance personnel to effectively troubleshoot and repair the malfunctioning system or component. The following information should be annotated as a minimum and any other information deemed appropriate:

1. Primary altimeters and standby altimeter readings
2. Altitude selector settings
3. Sub-scale settings on all altimeters
4. Autopilot used to control the aircraft and any differences when the alternate system was selected
5. Differences in altimeter readings if the alternate static source was selected
6. Use of air data computer selector for fault isolation and diagnosis of malfunction
7. Transponder selected to provide altitude information to ATC and any difference when the alternate transponder was selected or altitude reporting was manually selected.

4. TCAS/RVSM ANOMALIES

4.1 General

A. With the introduction of Reduced Vertical Separation Minimums (RVSM) there is a potential for TCAS II Mod 7 to issue traffic advisories (TA) and resolution advisories(RA), during normal operations when maintaining required separation in (RVSM)airspace. Very few RAs are expected to occur, however TAs may be encountered when an aircraft passes or overtakes another aircraft at the next flight level under certain circumstances.

B. If a RA does occur the pilot flying will follow the guidance unless determined to be unsafe.

4.2 Operations

A. TCAS will be operated in the normal mode during all operations in RVSM airspace and transition areas.

B. Climb and descent rates in RVSM airspace and transition areas should be limited to1000 feet per minute when operating within 5 nautical miles and +/- 2000 vertical feet of another aircraft to minimize the generation of TA and RA messages.

4.3 Reporting Requirements

A. A written report is required for all RAs requiring a change in the existing vertical speed while operating in RVSM airspace and transition areas.

B. U.S. operators should forward these reports, in any format, to the TCAS Transition Program (TTP) ARINC, 2551 Riva Road, Annapolis Maryland, Mail Stop 6-3131,TTP. Reports may also be faxed to (410) 573-3007.

C. Reports on TAs are encouraged but not required.

Note: Flight crew members are to be aware that there may be frequent and numerous TA and RA warnings while maintaining normal expected vertical separation in RVSM airspace. Crew members should consider all factors related to what the aircraft is doing i.e. climbing, descending, etc. before responding to the TCAS advisories.

5. RVSM CONTINGENCIES

A. Contingency procedures are dependent upon the area of operation:

1. Alaska, Offshore Airspace and the San Juan FIR
2. Oceanic Airspace

B. In Oceanic Airspace resulting offsets from contingencies should be orientated from the organized track instead of the random route. To ensure flight crew situational awareness it's recommended any conflicting organized track or portion of an organized track be plotted on a plotting chart.

Note: It is important to know the position of any organized track that may cross an assigned random route.

5.1 General

A. The contingencies are as follows:

1. Pilot in Command Responsibility: Guidance for contingency procedures should not be interpreted in any way which prejudices the final authority and responsibility of the pilot in command for the safe operation of the aircraft.
2. If the pilot is unsure of the vertical or lateral position of the aircraft or the aircraft deviates from its assigned altitude or tack for cause without ATC clearance, the pilot must take action to mitigate the potential for collision with aircraft on adjacent routes or flight levels.
3. In this situation the pilot will alert adjacent aircraft by making maximum use of aircraft lighting and broadcasting position, flight level, and intentions on 121.5MHz or (123.45 MHz as a back-up).

B. Unless the nature of the contingency dictates otherwise, the pilot will advise ATC as soon as possible of a contingency situation and if possible, request an ATC clearance before deviating from the assigned route or flight level.

C. If a revised ATC clearance cannot be obtained in a timely manner and action is required to avoid potential conflict with other aircraft, the aircraft should be flown at an altitude and/or track where other aircraft are least likely to be encountered.

D. As more airspace falls under the rules of RVSM Contingency Procedures may not be standardized. Flight-crews will need to reference the appropriate aeronautical chart for specific procedures for that airspace.

5.2 Expanded Contingency Procedures

5.2.1 General

A. The following procedures are intended for guidance only. Although all possible contingencies cannot be covered, they provide for the more frequent cases such as:

1. Inability to maintain assigned level due to weather, aircraft performance, pressurization failure and problems associated with high level flight; or
2. Loss of, or significant reduction in, the navigation capacity when operating in parts of the airspace where high accuracy of navigation is a prerequisite to the safe conduct of flight operations; or
3. Enroute diversion across the prevailing NAT traffic flow guidance is recommended for aircraft operating within North Atlantic airspace.

Note: Concerning (1) and (3) above, the procedures are applicable primarily when rapid descent and/or turn-back or diversion is required. The pilot's judgment shall determine the sequence of actions taken and ATC shall render all possible assistance having regard to the specific circumstances.

5.2.2 Flight Crew Procedures

A. If an aircraft is unable to continue flight in accordance with its ATC clearance, are vised clearance shall, whenever possible, be obtained prior to initiating any action. This shall also apply to an aircraft that is unable to maintain accuracy of navigation on which the safety of the airspace system relies based on the separation minima applied by ATC between it and adjacent aircraft. This shall be accomplished using the radiotelephony distress or urgency signal as appropriate. Subsequent ATC action with respect to that aircraft shall be based on the intentions of the pilot and the overall air traffic situation. If prior clearance cannot be obtained, an ATC clearance shall be obtained at the earliest possible time and, in the meantime, the pilot shall:

1. Broadcast position (including the air traffic route (ATS) route designator or the track code as appropriate) and intentions on frequency 121.5 at suitable intervals until ATC clearance is received use 123.45 as a backup;
2. Make maximum use of aircraft lights to make the aircraft visible;
3. Maintain a watch for conflicting traffic; and
4. Initiate such action as necessary to ensure safety of the aircraft.

5.2.3 Weather Contingencies

A. For weather contingencies the following actions should be taken:

1. Initial Pilot Actions when unable to maintain flight level (FL) or unsure of aircraft altitude-keeping capability:
    a. Notify ATC and request assistance as detailed below
    b. Maintain cleared flight level, to the extent possible, while evaluating the situation
    c. Watch for conflicting traffic both visually and by reference to TCAS, if equipped
    d. Alert nearby aircraft by illuminating exterior lights (commensurate with aircraft limitations)

5.2.4 Contingency Procedures

5.2.4.1 For Subsonic Aircraft

A. If unable to comply with the above provision prior ATC clearance, the aircraft should leave its assigned route or track by turning 90° to the right or left whenever possible. The direction of the turn should, where possible, be determined by the position of the aircraft relative to any organized route or track system (e.g. whether the aircraft is outside, at the edge of, or within the system). Other factors that may affect the direction of the turn are the direction of an alternate airport, terrain clearance and the levels allocated to adjacent routes or tracks.

1. An aircraft able to maintain its assigned flight level should:
    a. Turn to acquire and maintain in either direction a track laterally separated by 15 NM from its assigned route or track; and
    b. If above FL 410, climb or descend 1,000 feet; or
    c. If below FL 410, climb or descend 500 feet; or
    d. If at FL 410 climb 1000 feet or descend 500 feet.
2. An aircraft not able to maintain its assigned flight level should
    a. Initially minimize its descent rate to the extent that is operationally feasible;
    b. Turn while descending to acquire and maintain in either direction a track laterally separated by 15 NM from its assigned route or track; and
    c. For the subsequent level flight, a level should be selected which differs from those normally used by 1000 feet if above FL 410 or by 500 feet if below FL 410.

5.2.5 Enroute Diversion Across the Prevailing NAT Air Traffic Flow

A. The guidance in the following paragraph applies to aircraft that:
    1. Are operating within the Organized Track System (OTS) or on random routes that are proximate to the OTS; and
    2. Can climb or descend to an altitude above or below those where the majority of NAT aircraft operate.

B. The basic concept of this guidance is that, when operationally feasible, before diverting across tracks or routes with heavy traffic, the aircraft should offset from the assigned track or route by 15 NM and expedite a descent to an altitude be lower a climb to an altitude above those where the vast majority of NAT aircraft operate before proceeding toward the alternate aerodrome. Flight below FL 285or above FL 410 should meet this objective. In the event of a contingency that necessitates an enroute diversion to an alternate aerodrome, across the direction of the prevailing NAT traffic flow and prior ATC clearance cannot be obtained:
    1. An aircraft able to maintain its assigned flight level should:
        a. Turn toward the alternate aerodrome to acquire a track which is separated laterally by 15 NM from the assigned route or track; and
        b. If above FL 410, climb or descend 1,000 feet; or
        c. If below FL 410, climb or descend 500 feet; or
        d. If at FL 410, climb 1,000 feet or descend 500 feet; and
        e. Fly the offset track while expediting its descent to an altitude below FL 285or a climb to an altitude above FL 410; and
        f. When below FL 285 or above FL 410, proceed toward the alternate aerodrome while maintaining a level which differs from those normally used by 500 feet if below FL 410 or 1,000 feet if above FL 410; or
        g. If unable or unwilling to make a major climb or descent, fly an altitude

offset for the diversion until obtaining an ATC clearance.

2. An aircraft not able to maintain its assigned flight level should:
   a. Initially minimize its descent rate to the extent it is feasible;
   b. Start its descent while turning to acquire a track separated laterally by 15 NM from its assigned route or track;
   c. Unless the nature of the contingency dictates otherwise, maintain the offset track while expediting its descent to an altitude below FL 285;
   d. Unless the nature of the contingency dictates otherwise, when below FL285, it should proceed towards the alternate aerodrome; and
   e. Continue descent to a level which can be maintained and which differs from those normally used.

      Note: If these contingency procedures are employed by a multi-engine aircraft as a result of a shutdown of a power unit or a primary airplane system failure, the pilot should so advise ATC when practicable, reminding ATC of the type of aircraft involved and requesting expeditious handling.

3. Aircraft required to divert across the prevailing NAT air traffic flow and are:
   a. Unable or unwilling to descend to an altitude below those where the majority of NAT aircraft operate due to operational constraints;
   b. Unsure of their proximity to other routes or tracks;
   c. Assigned to a route that crosses the OTS at a significant angle; Should execute the following actions below:

4. Should execute the following actions below:
   a. An aircraft that is able to maintain its assigned flight level should:
      i. If above FL 410, climb or descend 1,000 feet;
      ii. If below FL 410, climb or descend 500 feet; or
      iii. If at FL 410, climb 1,000 feet or descend 500 feet while turning to proceed toward the alternate aerodrome.
   b. An aircraft that is unable to maintain its assigned flight level should:
      i. Expedite a descent to an altitude below those where the majority of NAT aircraft operate while turning toward the alternate aerodrome; and
      ii. Diligently follow the guidance with regards to radio calls, aircraft lights and watching for conflicting traffic.

5.3 RVSM Contingency Procedures

5.3.1 General

A. Report to Air Traffic Control, as soon as practical, any contingency that may affectability to comply with the RVSM clearance. Example: severe turbulence, loss of thrust, loss of pressurization, need to divert, uncertainty of present position, etc. If at any time it is not possible to notify Air Traffic Control that a problem has occurred, comply as accurately as possible with the specified contingency procedures.

1. Notify ATC and request assistance as detailed below.
2. Maintain cleared flight level, to the extent possible, while evaluating the situation.
3. Watch for conflicting traffic both visually and by reference to TCAS, if equipped.
4. Alert nearby aircraft by illuminating exterior lights (commensurate with aircraft limitations).

B. Equipment Failures

1. The following equipment failures must be reported to Air Traffic Control as soon as practical:
   a. Loss of thrust on one or more engines necessitating descent
   b. Loss of one or more Altimeter Systems
   c. Failure of all Automatic Altitude Control Systems
   d. Failure of any other equipment that could affect the ability of the aircraft to maintain the RVSM clearance.
2. The following tables provide pilot guidance on actions to take under certain conditions of aircraft system failure. They also describe the expected ATC controller actions in these situations. It is recognized that the pilot and controller will use judgment to determine the action most appropriate to any given situation.

C. Pilot controller phraseology for failure of automatic altitude control system

1. One Primary Altimeter Remains Operational

TABLE 1-3
One Primary Altimeter Remains Operational

PILOT WILL:	CONTROLLER WILL:
• Cross check stand-by altimeter • Notify ATC of operation with single primary altimeter • If unable to confirm primary altimeter accuracy, follow actions for failure of all primary altimeters	• Acknowledge operation with single primary altimeter

D. Failure of Automatic Altitude Control System, Altitude Alerter or All Primary Altimeters

TABLE 1-4

"Unable RVSM Due Equipment"
Failure of Automatic Altitude Control System, Altitude Alerter or All Primary Altimeters

PILOT WILL:	CONTROLLER WILL:
• Contact ATC and state "Unable RVSM Due to Equipment" • Request clearance out of RVSM airspace unless operational situation dictates otherwise	• Provide 2,000 foot vertical separation or appropriate horizontal separation • Clear aircraft out of RVSM airspace unless operational situation dictates otherwise

5.4 Policies for Application of the Strategic Lateral Offset Procedure & In Gulf Of Mexico Oceanic Airspace

A. The policies below will apply for use of the Strategic Lateral Offset Procedure and in Gulf of Mexico oceanic airspace. The offset procedure can be used as standard operating practice in the course of normal operations. It is intended to mitigate both wake vortex encounters and to mitigate the heightened risk of collision when non-normal events occur (e.g., operational altitude deviation errors and turbulence-induced altitude deviations).

B. The Strategic Lateral Offset Procedure will be applied using the following guidelines:

1. Pilots should apply an offset outbound once ATC terminates radar service or reports that radar contact is lost. Pilots must return to centerline or request ATC clearance to remain offset once radar contact is re-established.
2. Strategic lateral offsets and those executed to mitigate the effects of wake turbulence are to be made to the right of a route or track;
3. In relation to a route or track, there are three positions that an aircraft may fly: centerline, one or 2 NM right; and,
4. Offsets are not to exceed 2 NM right of centerline.

C. The intent of this procedure is to reduce risk (increase the safety margin) by distributing aircraft laterally and equally across the three available positions. In this connection, pilots must take account of the following:

1. Aircraft without automatic offset programming capability must fly the centerline;
2. Aircraft capable of being programmed with automatic offsets may fly the center line or offset one or 2 NM right of centerline to obtain lateral spacing from nearby aircraft;
3. Pilots should use whatever means are available (e.g. TCAS, communications, visual acquisition, GPWS) to determine the best flight path to fly;
4. Any aircraft overtaking another aircraft is to offset within the confines of this procedure, if capable, so as to create the least amount of wake turbulence for the aircraft being overtaken;
5. For wake turbulence purposes, pilots are also to fly one of the three positions in 5.4 above and never offset to the left of centerline nor offset more than 2 NM right of centerline.

Note: It is recognized that the pilot will use his/her judgment to determine the action most appropriate to any given situation and has the final authority and responsibility for the safe operation of the airplane. The use of air-to-air channel,123.45, may be used to co-ordinate the best wake turbulence offset option.

5.4.1 Transponder Failure and RVSM Transition Areas

A. The specific actions that ATC will take in the event of transponder failure in RVSM transition areas will be determined by the provider States. (Transition areas are planned to be established between airspaces where different vertical separation standards are applied).

1. Pilot controller phraseology for failure of Transponder.

TABLE 1-5
Transponder Failure

PILOT WILL:	CONTROLLER WILL:
• Contact ATC and request authority to continue to operate at cleared flight level • Comply with revised ATC clearance, if issued ***NOTE:****14 CFR Section 91.215 (ATC transponder and altitude reporting equipment and use) regulates operation with the transponder inoperative.*	• Consider request to continue to operate at cleared flight level • Issue revised clearance, if necessary

5.4.2 Procedures to be Followed When Notified of TVE or ASE Errors Exceeding Established Limits

A. It is anticipated that a height-monitoring system will be an element of the RVSM implementation program for the NAT or DRVSM airspace. When the height-monitoring system is deployed, it is expected that regional procedures will be developed for their use. If the monitoring system allows for real-time notification, to the pilots of TVE (Total Vertical Error) or ASE (Avionics Error) errors, then pilots will complete a height monitoring error report and notify the Director of Maintenance.

5.5 Loss of All Automatic Altitude Control Systems

A. Initial actions. The pilot should:

1. Maintain CFL
2. Evaluate the aircraft's capability to maintain altitude through manual control.

B. Subsequent actions. The pilot should:

1. Watch for conflicting traffic.
2. If considered necessary, alert nearby aircraft by;
   a. Making maximum use of exterior lights; and
   b. Broadcasting position, flight level and immediate intentions on 121.5 (123.45may be used as a backup).

3. Notify ATC of the failure and the intended course of action. Possible courses of action include:
   a. Continuing in MNPS airspace provided that the aircraft can maintain the CFL.
   b. Requesting ATC clearance to climb above or descend below MNPS airspace if the aircraft cannot maintain CFL and ATC cannot establish increased vertical, longitudinal, or lateral separation.
   c. Executing the published contingency maneuver to leave the assigned route or track according to the procedures if prior ATC clearance cannot be obtained and the aircraft cannot maintain CFL.

5.6 Loss of Redundancy in Primary Altimetry Systems.

A. Course of action. The pilot should take the following action:

1. If the remaining altimetry system is functioning normally, couple that system to the automatic altitude control system, notify ATC of the loss of redundancy and maintain vigilance of altitude keeping.
2. ATC can be expected to acknowledge the situation and continue to monitor progress.

5.7 All Primary Altimetry Systems Fail or are Considered Unreliable

5.7.1 Initial Actions

A. The pilot should:

1. Maintain altitude by reference to the standby altimeter, if the aircraft is so equipped.

   Note: Due to the limitations in terms of accuracy of standby altimeter contingencies, where applicable, pilots should review the application of the SSEC (Static Source Error Correction) / PEC (Position Error Correction)through the use of correction cards.

2. Alert nearby aircraft by:
   a. Making maximum use of exterior lights; and
   b. Broadcasting position, flight level and intentions on 121.5 (123.45 can be used as a backup); and
   c. Notify ATC of the inability to meet MNPS/RVSM performance requirements, consider declaring an emergency, and request clearance to exit MNPS/RVSM airspace.

5.7.2 Subsequent Actions

A. The pilot should:

1. If unable to obtain ATC clearance, in a timely manner, execute the contingency procedures to leave the assigned route and descend below RVSM airspace, if operationally feasible.
2. If it is not operationally feasible to execute the published contingency procedures, continue to alert nearby aircraft and coordinate with ATC. Use the RVSM Altimeter Log Form 2a to record any altimeter errors.

5.8 Primary Altimeters Diverge by More Than ± 200 Feet

A. The pilot should:

1. Attempt to determine the defective system through established trouble shooting procedures and/or comparing the primary altimeter displays to the standby altimeter.
2. If the defective system can be determined, couple the functioning altimetry system to the altitude-keeping device.
3. If the altimeter displays differ by more than ±200 feet and it cannot be determined which system is defective, follow the published guidance for failure or unreliable altimeter indications of all primary altimeters. (Use the RVSM Altimeter Log to record any Altimeter errors).
4. If the crews are notified by ATC of a deviation that exceeds 300 feet, flight crew should consider exiting RVSM airspace and reporting altimetry errors on the Height Keeping Error Report Form 1a.

6. GUIDANCE ON SEVERE TURBULENCE AND MOUNTAIN WAVE ACTIVITY (MWA)

6.1 Introduction/Explanation

A. The information and practices in this section are provided to emphasize to pilots and controllers the importance of taking appropriate action in RVSM airspace when aircraft experience severe turbulence and/or MWA that is of sufficient magnitude to significantly affect altitude-keeping.

6.1.1 Severe Turbulence

A. Severe turbulence causes large, abrupt changes in altitude and/or attitude usually accompanied by large variations in indicated airspeed. Aircraft may be momentarily out of control. Encounters with severe turbulence must be remedied immediately in any phase of flight. Severe turbulence may be associated with MWA.

6.1.2 Mountain Wave Activity (MWA)

A. Significant MWA occurs both below and above the floor of RVSM airspace, FL 290. MWA often occurs in western states in the vicinity of mountain ranges. It may occur when strong winds blow perpendicular to mountain ranges resulting in up and down or wave motions in the atmosphere. Wave action can produce altitude excursions and airspeed fluctuations accompanied by only light turbulence. With sufficient amplitude, however, wave action can induce altitude and airspeed fluctuations accompanied by severe turbulence. MWA is difficult to forecast and can be highly localized and short lived.

B. Wave activity is not necessarily limited to the vicinity of mountain ranges. Pilots experiencing wave activity anywhere that significantly affects altitude-keeping can follow the guidance provided below.

C. Inflight MWA Indicators (Including Turbulence). Indicators that the aircraft is being subjected to MWA are:

1. Altitude excursions and/or airspeed fluctuations with or without associated turbulence.
2. Pitch and trim changes required to maintain altitude with accompanying airspeed fluctuations.
3. Light to severe turbulence depending on the magnitude of the MWA.

6.1.3 Priority for Controller Application of Merging Target Procedures

A. Explanation of Merging Target Procedures.

1. ATC will use “merging target procedures” to mitigate the effects of both severe turbulence and MWA. These procedures have been adapted from existing procedures published in FAA Order JO 7110.65, Air Traffic Control, Paragraph 5-1-8, Merging Target Procedures. Paragraph 5-1-8 calls for en route controllers to advise pilots of potential traffic that they perceive may fly directly above or below his/her aircraft at minimum vertical separation. In response, pilots are given the option of requesting a radar vector to ensure their radar target will not merge or overlap with the traffic's radar target.

B. The provision of “merging target procedures” to mitigate the effects of severe turbulence and/or MWA is not optional for the controller, but rather is a priority responsibility. Pilot requests for vectors for traffic avoidance when encountering MWA or pilot reports of “Unable RVSM due turbulence or MWA” are considered first priority aircraft separation and sequencing responsibilities. (FAA Order JO 7110.65, paragraph 2-1-2, Duty Priority, states that the controller's first priority is to separate aircraft and issue safety alerts).

C. Explanation of the term “traffic permitting.” The contingency actions for MWA and severe turbulence detailed in Table 1-8 state that the controller will “vector aircraft to avoid merging targets with traffic at adjacent flight levels, traffic permitting.” The term “traffic permitting” is not intended to imply that merging target procedures are not a priority duty. The term is intended to recognize that, as stated in FAA Order JO 7110.65, Paragraph 2-1-2, Duty Priority, there are circumstances when the controller is required to perform more than one action and must “exercise their best judgment based on the facts and circumstances known to them” to prioritize their actions. Further direction given is: “That action which is most critical from a safety standpoint is performed first."

6.1.4 TCAS Sensitivity

A. For both MWA and severe turbulence encounters in RVSM airspace, an additional concern is the sensitivity of collision avoidance systems when one or both aircraft operating in close proximity receive TCAS advisories in response to disruptions in altitude hold capability.

6.1.5 Pre-Flight Tools

A. Sources of observed and forecast information that can help the pilot ascertain the possibility of MWA or severe turbulence are: Forecast Winds and Temperatures Aloft (FD), Area Forecast (FA), Graphical Turbulence Guidance (GTG), SIGMETs and PIREPs.

6.2 Aircraft Encounters Turbulence (greater than moderate) That the Pilot Believes Will Impact the Aircraft's Capability to Maintain Flight Level

A. The pilot should:

1. Watch for conflicting traffic and make maximum use of exterior lights.
2. Broadcast call sign, position, flight level, nature and severity of turbulence, and intentions on 121.5 (123.45 may be used as a back-up).
3. Notify ATC as soon as possible and request flight level change if necessary.
4. If the aircraft cannot maintain CFL, leave the assigned route or track according to the procedures as outlined in paragraph 5.2 Expanded Contingency Procedures of this document.

6.3 Pilot Actions When Encountering Weather (e.g., Severe Turbulence or MWA)

A. Weather Encounters Inducing Altitude Deviations of Approximately 200 feet.

1. When the pilot experiences weather induced altitude deviations of approximately 200 feet, the pilot will contact ATC and state "Unable RVSM Due (state reason)" (e.g., turbulence, mountain wave).

B. Severe Turbulence (including that associated with MWA).

1. When pilots encounter severe turbulence, they should contact ATC and report the situation. Until the pilot reports clear of severe turbulence, the controller will apply merging target vectors to one or both passing aircraft to prevent their targets from merging:

EXAMPLE-

"Yankee 123, FL 310, unable RVSM due severe turbulence."

"Yankee 123, fly heading 290; traffic twelve o'clock, 10 miles, opposite direction; eastbound MD-80 at FL 320" (or the controller may issue a vector to the MD-80 traffic to avoid Yankee 123).

C. Severe Mountain Wave Activity (MWA)

1. When pilots encounter MWA, they should contact ATC and report the magnitude and location of the wave activity. When a controller makes a merging targets traffic call, the pilot may request a vector to avoid flying directly over or under the traffic. In situations where the pilot is experiencing altitude deviations of 200 feet or greater, the pilot will request a vector to avoid traffic. Until the pilot reports clear of MWA, the controller will apply merging target vectors to one or both passing aircraft to prevent their targets from merging:

EXAMPLE-

"Yankee 123, FL 310, unable RVSM due mountain wave."

"Yankee 123, fly heading 290; traffic twelve o'clock, 10 miles, opposite direction; eastbound MD-80 at FL 320" (or the controller may issue a vector to the MD-80 traffic to avoid Yankee 123).

D. FL Change or Re-route

1. To leave airspace where MWA or severe turbulence is being encountered, the pilot may request a FL change and/or re-route, if necessary.

6.4 Guidance on Wake Turbulence

A. Pilots should be aware of the potential for wake turbulence encounters in RVSM airspace. Experience gained since 1997 has shown that such encounters in RVSM airspace are generally moderate or less in magnitude.

B. Prior to DRVSM implementation, the FAA established provisions for pilots to report wake turbulence events in RVSM airspace using the NASA Aviation Safety Reporting System (ASRS). A “Safety Reporting” section established on the FAA RVSM Documentation webpage provides contacts, forms, and reporting procedures.

C. To date, wake turbulence has not been reported as a significant factor in DRVSM operations. European authorities also found that reports of wake turbulence encounters did not increase significantly after RVSM implementation (eight versus seven reports in a ten-month period). In addition, they found that reported wake turbulence was generally similar to moderate clear air turbulence.

D. Pilot Action to Mitigate Wake Turbulence Encounters

1. Pilots should be alert for wake turbulence when operating:
   a. In the vicinity of aircraft climbing or descending through their altitude.
   b. Approximately 10-30 miles after passing 1,000 feet below opposite-direction traffic.
   c. Approximately 10-30 miles behind and 1,000 feet below same-direction traffic.
2. Pilots encountering or anticipating wake turbulence in DRVSM airspace have the option of requesting a vector, FL change, or if capable, a lateral offset.

NOTE-

1. *Offsets of approximately a wing span upwind generally can move the aircraft out of the immediate vicinity of another aircraft's wake vortex.*

2. *In domestic U.S. airspace, pilots must request clearance to fly a lateral offset. Strategic lateral offsets flown in oceanic airspace do not apply.*

E. The FAA will track wake turbulence events as an element of its post implementation program. The FAA will advertise wake turbulence reporting procedures to the operator community and publish reporting procedures on the RVSM Documentation Webpage (Google search "FAA RVSM Website Homepage").

6.5 Contingency Actions: Weather Encounters that Occur After Entry into RVSM Airspace

A. The following tables provide pilot guidance on actions to take under certain weather conditions after entry into RVSM airspace. They also describe the expected ATC controller actions in these situations. It is recognized that the pilot and controller will use judgment to determine the action most appropriate to any given situation.

TABLE 1-6
Mountain Wave Activity (MWA) Encounters - General

PILOT ACTIONS:	CONTROLLER ACTIONS:
• Contact ATC and report experiencing MWA • If so desired, pilot may request a FL change or re-route • Report location and magnitude of MWA to ATC	• Advise pilot of conflicting traffic at adjacent FL • If pilot requests, vector aircraft to avoid merging target with traffic at adjacent RVSM flight levels, traffic permitting • Issue FL change or re-route, traffic permitting • Issue PIREP to other aircraft

TABLE 1-7
Wake Turbulence Encounters

PILOT SHOULD:	CONTROLLER SHOULD:
• Contact ATC and request vector, FL change or, if capable, a lateral offset	• Issue vector, FL change or lateral offset clearance, traffic permitting
• Be alert for wake turbulence when operating in the vicinity of aircraft climbing or descending through their altitude.	• Monitor flight path
• Be alert for wake turbulence when operating approximately 10-30 miles after passing 1,000 feet below same-direction traffic	• Monitor flight path
• Be alert for wake turbulence when operating approximately 10-30 miles behind and 1,000 feet below same-direction traffic.	• Monitor flight path

TABLE 1-8

Severe Turbulence and/or Mountain Wave Activity (MWA) Induced Altitude Deviations of Approximately 200 feet

PILOT WILL:	CONTROLLER WILL:
• When experiencing severe turbulence and/or MWA induced altitude deviations of approximately 200 feet or greater, pilot will contact ATC and state "Unable RVSM Due (state reason)" (e.g., turbulence, mountain wave) • If not issued by the controller, request vector clear of traffic at adjacent FLs • If desired, request FL change or re-route • Report location and magnitude of turbulence or MWA to ATC See Section 6, Guidance on Severe Turbulence and Mountain Wave Activity (MWA) for detailed guidance.	• Vector aircraft to avoid merging target with traffic at adjacent flight levels, traffic permitting. • Advise pilot of conflicting traffic • Issue FL change or re-route, traffic permitting • Issue PIREP to other aircraft Section 6.1.3 explains "traffic permitting."

7. RVSM TRAINING

A. Items listed in the crew training syllabus are found in the Operator's Training Program. This section is intended as a reference to ensure compliance with required training items.

7.1 Crew Training And Qualifications

A. All RVSM and International aircrews must be knowledgeable in additional procedures when flying in RVSM and International airspace. Therefore, all pilots must successfully complete an RVSM Procedures Course provided by a Part 142 approved training center.
B. The Operator's aircrew receives RVSM training from Air Training International (ATI).

8. FLIGHT PLAN SUFFICES

A. The following are the ICAO Flight Plan Aircraft Suffices from ICAO Doc 4444:

TABLE 1-9

A	GBAS Landing System	K	MLS
B	LPB (APV with SBAS)	L	ILS
D	DME	M1	ATC RTF SATCOM (INMARSAT)
E1	FMC WPR ACARS	M2	ATC RTF (MTSAT)
E2	D-FIS ACARS	M3	ATC RTF (Iridium)
E3	PDC ACARS	O	VOR
F	ADF	P1-P9	Reserved for RCP
G	GNSS	Q	(Not Allocated)
H	HF RTF	R	PBN Approved
I	Inertial Navigation	T	TACAN
J1	CPDLC ATN VDL Mode 2	U	UHF RTF
J2	CPDLC FANS 1/A HFDL	V	VHF RTF
J3	CPDLC FANS 1/A VDL Mode 4	W	RVSM Approved
J4	CPDLC FANS 1/A VDL Mode 2	X	MNPS Approved
J5	CPDLC FANS 1/A SATCOM (INMARSAT)	Y	VHF with 8.33 kHz channel spacing capability
J6	CPDLC FANS 1/A SATCOM (MTSAT)	Z	Other equipment carried or other capabilities
J7	CPDLC FANS 1/A SATCOM (Iridium)		

B. The following are the Aircraft Surveillance Equipment Suffices:

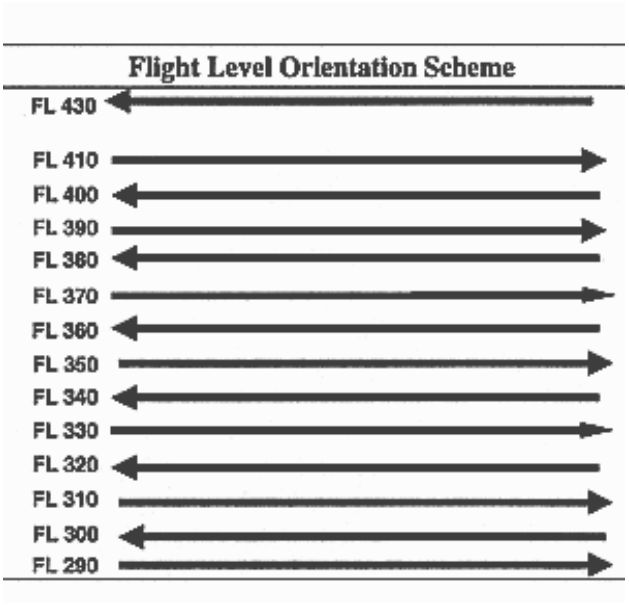
TABLE 1-10

	INSERT one or two of the following letters to describe the serviceable surveillance equipment carried:
N	No Surveillance Equipment
	SSR Modes A and C
A	Transponder - Mode A (4 digits - 4096 codes)
C	Transponder - Mode A (4 digits - 4096 codes) and Mode C
	SSR Modes S
E	Transponder - Mode S, including aircraft identification, pressure-altitude and extended squitter (ADS-B) capability
H	Transponder - Mode S, including aircraft identification, pressure-altitude and enhanced surveillance capability
I	Transponder - Mode S, including aircraft identification, but no pressure-altitude capability
L	Transponder - Mode S, including aircraft identification, pressure-altitude, extended squitter (ADS-B) and enhanced surveillance capability
P	Transponder - Mode S, including pressure-altitude, but no aircraft identification capability
S	Transponder - Mode S, including both pressure-altitude and aircraft identification transmission
X	Transponder - Mode S without both aircraft identification and pressure-altitude transmission
	ADS-B
B1	ADS-B with dedicated 1090 MHz ADS-B “out” capability
B2	ADS-B with dedicated 1090 MHz ADS-B “out” and “in” capability
U1	ADS-B “out” capability using UAT
U2	ADS-B “out” and “in” capability using UAT
V1	ADS-B “out” capability using VDL Mode 4
V2	ADS-B “out” and “in” capability using VDL Mode 4
	ADS-C
D1	ADS-C with FANS 1/A capabilities
G1	ADS-C with ATN capabilities

9. RVSM FLIGHT LEVEL SCHEME

A. Altitude assignments for direction of flight follow a scheme of odd altitude assignment for magnetic courses 000-179 degrees and even altitudes for magnetic courses 180-359 degrees for flights up to and including FL 410, as indicated in the Figure 1 below.

FIGURE 1



NOTE:
Odd Flight Levels: Magnetic Course 000-179 Degrees
Even Flight Levels: Magnetic Course 180-359 Degrees

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10. Form 1a: HEIGHT KEEPING ERROR REPORT

Date	Time	Location
Aircraft Make	**Aircraft Model**	**Aircraft Serial Number**

Pilot In Command	Second In Command

Description of Defect/Pertinent Information

	ADC 1	ADC 2	Alternate	Setting
6. Pilot				
Co-Pilot				
Standby				

Altimeter	Altitude Selector Setting	Autopilot Used

Altitude Difference with Autopilot Selected

Transponder	ADC	Reported Altitude
Transponder	**ADC**	**Reported Altitude**

Additional Remarks

PIC Signature	Date

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11. Form 2a: RVSM ALTIMETER LOG

As required by the Operations Manual, at intervals of approximately one hour, cross-checks between the primary altimeters and the stand-by altimeter should be made. A minimum of two primary altimeters should agree within 200 ft (60 m). Failure to meet this condition will require that the altimetry system be reported as defective and notified to ATC. The difference between the primary and standby altimeters will be noted for use in contingency situations..

REGISTRATION	DATE	LOCATION	PIC	SIC
N____________				

	TIME	FIELD ELEV / FLT LEVEL	#1 ALTIMETER	#2 ALTIMETER	STBY ALTIMETER	QNH/STBY SETTING
DEPARTURE:						
INITIAL LEG:						
OPTIONAL LEG:						

REGISTRATION	DATE	LOCATION	PIC	SIC
N____________				

	TIME	FIELD ELEV / FLT LEVEL	#1 ALTIMETER	#2 ALTIMETER	STBY ALTIMETER	QNH/STBY SETTING
DEPARTURE:						
INITIAL LEG:						
OPTIONAL LEG:						

REGISTRATION	DATE	LOCATION	PIC	SIC
N____________				

	TIME	FIELD ELEV / FLT LEVEL	#1 ALTIMETER	#2 ALTIMETER	STBY ALTIMETER	QNH/STBY SETTING
DEPARTURE:						
INITIAL LEG:						
OPTIONAL LEG:						

REGISTRATION	DATE	LOCATION	PIC	SIC
N____________				

	TIME	FIELD ELEV / FLT LEVEL	#1 ALTIMETER	#2 ALTIMETER	STBY ALTIMETER	QNH/STBY SETTING
DEPARTURE:						
INITIAL LEG:						
OPTIONAL LEG:						

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XCEL ENERGY SERVICES INC

6975 34TH AVE SOUTH
MINNEAPOLIS, MN 55450

REDUCED VERTICAL SEPARATION MINIMUM (RVSM) PROGRAM

RVSM MAINTENANCE PROGRAM

PART 91

AIRCRAFT	SERIAL NUMBER
CESSNA 680	680-0112

Manual Prepared By:

FOXThree AVIATION CONSULTING

WWW.FOXTHREEAVIATION.COM

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RECORD OF REVISIONS

REVISION NUMBER	DATE OF REVISION	INITIALS
Original	07/01/2016	

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LIST OF EFFECTIVE PAGES

PAGE	REVISION NUMBER	DATE OF REVISION
COVER-1	Original	07/01/2016
COVER-2	Original	07/01/2016
REV-1	Original	07/01/2016
REV-2	Original	07/01/2016
LOEP-1	Original	07/01/2016
LOEP-2	Original	07/01/2016
TOC-1	Original	07/01/2016
TOC-2	Original	07/01/2016
B-1	Original	07/01/2016
B-2	Original	07/01/2016
B-3	Original	07/01/2016
B-4	Original	07/01/2016
B-5	Original	07/01/2016
B-6	Original	07/01/2016
B-7	Original	07/01/2016
B-8	Original	07/01/2016
B-9	Original	07/01/2016
B-10	Original	07/01/2016
B-11	Original	07/01/2016
B-12	Original	07/01/2016

FAA APPROVED
MSP FSDO

Digitally signed by CURTIS D LUNDEEN
Date: 2016.07.19 06:59:21 -05'00'

FAA Approved - Signature **Name** **Date**

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TABLE OF CONTENTS

B. RVSM MAINTENANCE PROGRAM

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B. RVSM MAINTENANCE PROGRAM

1. MAINTENANCE PROGRAMS

A. This manual will be used by XCEL ENERGY SERVICES INC (hereinafter referred to as "the Owner") and other approved Operators, to ensure that the aircraft approved for Reduced Vertical Separation Minimums (RVSM) operations will be maintained in accordance with current FAA regulations and to required specifications.

B. The approved Operators conduct RVSM operations with a Cessna Citation Sovereign, Model 680, S/N: 680-0112, in accordance with 14 CFR Part 91. The Owner maintains its aircraft under a manufacturer's inspection program in accordance with 14 CFR Part 43 and 91.409(f)(3). Accordingly, the Owner's current inspection program is in compliance to maintain the aircraft systems and equipment in accordance with RVSM requirements. A computerized maintenance-tracking program tracks these requirements.

C. The Owner will maintain operating history of incidents related to poor height keeping performance, which indicates weaknesses in training, procedures, maintenance, or the aircraft group.

D. Responsibility for compliance with the requirements of this manufacturer's inspection program lies with the Owner through the RVSM Responsible Person. Additionally, the Owner's RVSM Responsible Person is responsible for distribution, control, and revision of this manual, and may be contacted via the information in Table 2-1 below. The RVSM Responsible Person also serves as the RVSM Point of Contact. In the event the RVSM Responsible Person is unable to personally ensure that the compliance with the requirements of this RVSM Maintenance Program is being accomplished, a qualified aircrew member and/or aircraft mechanic employed or appointed by the Owner may act as a delegate.

TABLE 2-1

RVSM RESPONSIBLE PERSON & RVSM POINT OF CONTACT	PHONE NUMBER	E-MAIL ADDRESS
Michael Pawloski	763-258-7558	michael.r.pawloski@xcelenergy.com

E. Approval of this manual is indicated on the List of Effective Pages together with the date of approval, inspector's signature, office name, and location. Each succeeding page may be marked with the district office stamp, date, and initialed by the approving inspector, however, that is up to the individual inspector's preferred approval method. At such time a revision to this program is required, the RVSM Responsible Person will submit their revision(s) in duplicate to the applicable Flight Standards District Office for review and approval. Upon approval, the RVSM Responsible Person will ensure that each authorized holder of this manual receives and inserts the revision within 10 business days from the date of approval. A copy of this manual is required to be carried onboard the aircraft and available to the flight crew along with the Letter of Authorization when RVSM operations are in effect.

F. Information related to the Owner's maintenance and inspection procedures for RVSM specific equipment and systems are also contained in this manual. The Owner's primary base is located in Minneapolis, MN (KMSP). However, the Owner will use appropriately approved maintenance facilities for its aircraft to ensure continued

compliance with RVSM requirements on an “as needed” basis.

Additional maintenance support will be provided at the following maintenance facilities:

Xcel Energy Flight Department
6975 34th Ave South
Minneapolis, MN 55450

Duncan Aviation - KSTP
525 Eaton St.
St. Paul, MN 55107

Other FAA-approved Repair Stations may be used based on aircraft location.

2. INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

A. This approved inspection program identifies all aircraft equipment required for RVSM, together with scheduled maintenance requirements for that equipment. The aircraft manufacturer has issued RVSM approval via TCDS T00012WI, Note 9. APPENDIX A of this section “RVSM Aircraft Specific Information & Critical Components” lists the critical RVSM components.

B. To retain RVSM approval for this aircraft, it is necessary to accomplish the Instructions for Continued Airworthiness listed below in Section 2.1: Required RVSM Inspections.

TABLE 2-2

AIRCRAFT	SERIAL NUMBER	RVSM MM REFERENCE	TCDS
Cessna 680	680-0112	ATA Chapters 5, 34	T00012WI

NOTE: Always verify currency of Aircraft Maintenance Manual references.

2.1 REQUIRED RVSM INSPECTIONS

A. **EVERY 24 MONTHS:** Cessna 680 MM, 5-12-20, Inspection Document 20.

Perform the following Inspection Document 20 Item Codes:

1) B341001: Pitot-Static System Functional Check, Task 34-11-00-700
   a. Includes RVSM Skin Waviness Inspection
2) B345301: Transponder Functional Check, Task 34-53-00-700

3. MAINTENANCE PROCEDURES

To ensure the continued altitude keeping ability of RVSM approved aircraft the RVSM Responsible Person is responsible for ensuring the following practices are accomplished:

A. Avionics components of identical part number may be interchanged freely during the service lifetime of this airframe. If alternate equipment part numbers are to be installed, the units must be analyzed on a system level to determine if the new components are acceptable for RVSM.

Note: Current Equipment List and Illustrated Parts Catalog must be researched and matched up to completed Service Bulletins to verify proper RVSM equipment part numbers prior to replacing components.

B. Checklist calls out for the pilot to inspect the Pitot/Static areas during the Preflight Inspection. It is imperative that prior to all flights in RVSM airspace, the pilot visually

inspects the RVSM Critical Region for obvious damage or deformation to the skin surface.

C. Airframe and static systems shall be maintained in accordance with the airframe manufacturer's inspection standards and procedures, instructions for continued airworthiness and skin waviness checks.

D. Any modification, repair, or design change, which in any way alters the initial RVSM approval, will require a design review by Manufacturer and FAA engineering or existing Structural Repair Manuals.

E. RVSM specific maintenance procedures are in accordance to the FAA Approved RVSM Maintenance Program and Aircraft Maintenance Manual as referenced.

4. REMOVAL FROM RVSM SERVICE/RETURN TO RVSM SERVICE PROCEDURES

A. When RVSM-critical equipment malfunctions occur, the Minimum Equipment List will be referred to for specific, allowable flight operations. Refer to the FAA Approved Flight Manual, and for a listing of RVSM-critical equipment see APPENDIX A – RVSM Aircraft Specific Information & Critical Components. At such time an RVSM related malfunction occurs, the aircraft will become non-compliant regarding RVSM operations and the following procedures will be adhered to by the RVSM Responsible Person:

1. All flight plans in RVSM applicable airspace will make reference to RVSM noncompliance and indicate that until corrective action is accomplished, the aircraft is not to be operated in RVSM airspace.

2. A detailed entry will be made on Form 4a: Operator's Aircraft Discrepancy Log to indicate a discrepancy.

3. If the discrepancy affects RVSM compliance, the words "RVSM Non-Compliant" will be written in the Discrepancy area.

4. A placard shall be placed on the aircraft instrument panel and/or pilots control yoke stating "AIRCRAFT IS RVSM NON-COMPLIANT."

5. In order to return to service in RVSM airspace, the RVSM Responsible Person or his designee will review the RVSM maintenance instructions of the affected component prior to any corrective action procedure. Once the maintenance instructions have been reviewed, the component will be corrected and returned to service per the outlined instructions.

6. Upon completion of corrective maintenance and testing the placard may be removed and an entry made in the Aircraft Discrepancy Log, which will return the aircraft to RVSM authorized status in accordance with 14 CFR Part 43.9.Mark the "Compliant" block to indicate the RVSM critical equipment is RVSM compliant.

5. MAINTENANCE TRAINING

A. The Owner does not provide in-house training for maintenance personnel. As such, all initial and recurrent training is accomplished through model-specific schools provided by the aircraft or component manufacturer at designated facilities. Specific to RVSM, the Owner will utilize personnel that received initial training regarding RVSM requirements through a Part 145 Repair Station or equivalent and accomplish recurrent training per Part 145 Repair Station approved requirements or approved by

the model specific school. Part 145 Repair Stations must be on an anti-drug program prior to commencing work on company aircraft. Required training will include:

1. A general overview of RVSM as a concept in theory and practice.
2. Special Emphasis will be placed on the additional inspection criteria for RVSM aircraft, which includes but is not limited to the following:

    a. Aircraft Flight Manual Revisions.

    b. Aircraft Maintenance Manual Revisions.

    c. Aircraft Illustrated Parts Catalog Revisions.

    d. Revisions to approved maintenance program and/or existing manual procedures.

    e. Minimum Equipment List Items, RVSM components.

    f. Aircraft Specific systems and equipment

Note: When using a certificated Repair Station, the RVSM Responsible Person will speak with the Accountable Manager or a designee to ensure the mechanics are properly trained on the Owner's RVSM equipment.

B. It is the responsibility of the RVSM Responsible Person or designee for the Owner to inquire with the management of the FAA Part 145 maintenance facility to ensure that all personnel performing maintenance on the RVSM systems are properly trained, qualified, and knowledgeable to perform maintenance on RVSM systems.

C. The RVSM Responsible Person or designee will review records of all RVSM related maintenance performed to ensure compliance with the requirements of this program and to ensure continued height-keeping ability of covered aircraft. The RVSM Responsible Person will record the information and complete the certification on Form 3a - Repair Station Audit Form. Any discovered discrepancies shall be resolved prior to using the maintenance facility.

6. RVSM COMPLIANT TEST EQUIPMENT

A. The Owner does not presently own or control test equipment specific to the maintenance or calibration of RVSM equipment. As such, this company will use only approved RVSM maintenance facilities operating as FAA certified repair stations under FAR Part 145 who, by virtue of their approval from the aircraft manufacturer or the FAA, are qualified and responsible for the utilization, calibration, and operation of approved test equipment.

B. The Owner's RVSM Responsible Person is responsible for approving and authorizing maintenance facilities. Form 3a - Repair Station Audit Form will be completed and kept by the RVSM Responsible Person for each approved facility.

C. The Owner will utilize these facilities on an "as needed basis" for maintenance and/or calibrations of RVSM equipment. The RVSM Responsible Person or designee is responsible for ensuring that the following requirements are met, by communicating these requirements to an approved facility, or authorized facilities, operating as FAA certified repair stations under FAR Part 145 who, by virtue of their approval from the aircraft manufacturer are qualified and responsible for:

1. Calibration of RVSM test equipment does not exceed 12 calendar months or component manufacturer's requirement.
2. Traceability of calibrated test equipment to standards of the NIST.
3. Appropriate list of repair station personnel trained in the use of specialized RVSM test equipment.
4. Adherence to traceability of RVSM components used during line maintenance and/or inspections of RVSM systems.
5. Specific test equipment, as identified in the airframe or component maintenance manuals, or equivalent, is utilized during RVSM maintenance/inspection procedures.

D. The results of the review will be recorded by the RVSM Responsible Person on Form 3a - Repair Station Audit Form.

Note: Built-In Test Equipment (BITE) Testing is not an acceptable basis for use in calibrations unless it is shown to be acceptable by the component manufacturer with approval from the pertinent authorities.

7. RVSM PARTS AND COMPONENTS CONTROL

A. The RVSM Responsible Person or designee will ensure that all persons responsible for obtaining or replacement of RVSM system components are knowledgeable of the aircraft's RVSM status and requirements. The following procedures shall be utilized:

1. The RVSM Responsible Person or designee and Maintenance personnel will ensure that all RVSM related parts and components to be used on the aircraft are the part numbers that are described in the appropriate Aircraft Service Change and/or the Aircraft Parts Manual which also identifies RVSM critical equipment.
2. Any deviations to part or model numbers of RVSM related equipment requires TC, STC, or SB, manufacturing and FAA engineering approval.

   Note: Current Equipment List and Illustrated Parts Catalog must be researched and matched up to completed Service Bulletins to verify proper RVSM equipment part numbers prior to replacing components.
3. Computer generated maintenance entry will be used to track RVSM related components and maintenance.

8. FUNCTIONAL FLIGHT TESTING

A. At the time of RVSM approval a verification/monitoring flight evaluation was accomplished and deemed satisfactory as part of the RVSM compliance. Height monitoring will be accomplished every 24 months or 1,000 hours, whichever period is longer, or if the integrity of the aircraft's RVSM-required systems, as defined in this program, are compromised and require functional flight test.

9. HEIGHT PERFORMANCE ERROR REPORTING

A. The Owner will advise their applicable Flight Standards District Office of any height keeping performance error within 72 business hours, using the Height Keeping Error Report Form 1a found in the back of the RVSM Operations Procedures section of this manual. This notification must list the contributing factors and measures to prevent further event from occurring.

1. Total Vertical Error (TVE) equal to or greater than +/- 300 feet.

    a. Total Vertical Error is the vertical geometric difference between the actual pressure flown by the aircraft and its assigned pressure altitude (Flight Level)

2. Altimetry System Error (ASE) equal to or greater than +/- 245 feet.

    a. Altimetry System Error is the difference between the pressure altitude displayed to the flight crew when referenced to ISA standard ground pressure setting (29.92 in. Hg / 1013.25 hPa) and free stream pressure altitude.

3. Assigned Altitude Deviation (AAD) equal to or greater than +/- 300 feet.

    a. Assigned Altitude Deviation is the difference between the transponder Mode C altitude and the assigned altitude/flight level.

4. Dispensation of Height Keeping Error Report.

    a. The RVSM Responsible Person will retain a copy of all Height Keeping Error Reports.
    b. The Height Keeping reports will be reviewed and the reason for the error may become part of pilot initial and recurrent training.

B. The Owner will maintain operating history of incidents related to poor height keeping performance, which indicates weaknesses in training procedures, maintenance, or the aircraft group. This record will be available for renewal applications.

The Owner's history currently does not include any events or incidents to poor height keeping performance or height keeping errors.

10. APPENDIX A- RVSM Aircraft Specific Information & Critical Components

TABLE 2-3

Owner Information			
Name	XCEL Energy Services Inc	**Type of Operation**	Part 91
RVSM Responsible Person	Michael Pawloski	**Issuing FSDO**	Minneapolis FSDO
Address	6975 34th Ave South	**Date Issued**	N/A
City	Minneapolis	**Phone**	763-258-7558
State	Minnesota	**E-mail**	michael.r.pawloski@xcelenergy.com
Zip	55450	**Today's Date**	07/01/2016
Aircraft Specifications			
Make	Cessna	**Serial No.**	680-0112
Model	680 Sovereign	**RVSM Qualified**	TCDS T00012WI
Type	Fixed Wing Multi-Engine	**Colors**	White/Blue/Grey

Long Range Navigation MNPS Equipment			
Quantity	**Type**	**Manufacturer**	**Model**
2	VHF NAV Module	Honeywell	NV-875A
2	FMS/GPS Module	Honeywell/CMC	CMA-4024

Communication MNPS Equipment			
Quantity	**Type**	**Manufacturer**	**Model**
2	VHF COM Module	Honeywell	TR-865A
2	HF COM w/ SELCAL	Honeywell	HF 1050
1	VHF AFIS	Honeywell	TR-865A

RVSM CRITICAL COMPONENTS			
Quantity	**Type**	**Manufacturer**	**Model**
2	Air Data Module	Honeywell	AZ-200
2	ATC Transponder Module	Honeywell	XS-858B w/ ADS-B Out
2	Autopilot with Altitude Alerting	Honeywell	(1) GP-400 Guidance Panel, (4) Modular Avionics Units (MAU) and (3) SM-1000 Servos

TABLE 2-3 (cont'd)

RVSM Critical Region Description				
The RVSM Critical Static Port Region (aka Static Port Inspection Area) is shown in Figure 601 below.				
TCAS and Pitot/Static Probe Equipment				
Type	**TSO C-119B or Later (Ver. 7.0)**	**Date Installed**	**Original Equipment**	**Rosemount Probe**
ACSS TCAS 2000	YES **x** | NO □	Original	YES **x** | NO □	YES □ | NO **x**

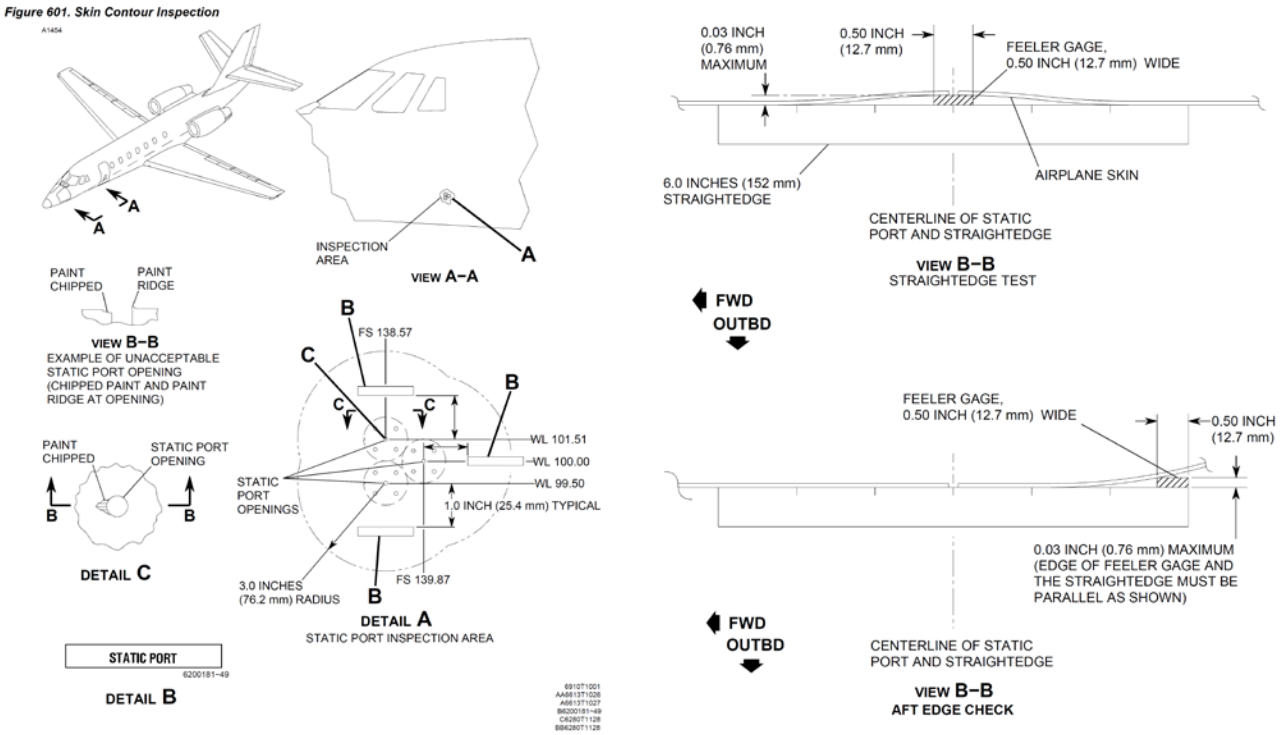

Figure 601

11. Form 3a: REPAIR STATION AUDIT FORM

This Form Must Be Completed On Initial Inspection and Every 24 Calendar Months

Date: _____

Facility Performing RVSM Maintenance and/or Inspections		
Name of Facility		
Address of Facility		
City, State, Zip		
Phone Number		
Fax Number		
Email Address		
FAA Certified Repair Station?	Yes____ No____	
If Yes, CRS Number		
Is This Facility Authorized by Any Other Regulatory Agencies?	Yes____ No____	
If Yes, List Agencies and Authorization Numbers Here		

Facility Personnel Responsible for RVSM		
Name	Title	Phone Number

All RVSM Repairs completed at this station have been made by RVSM trained and certified technicians and training certificates are available for inspection.

All tools and equipment used to make RVSM repairs meet appropriate standards and are in good working order. All tools and equipment have been calibrated to required standard and copies of those calibration reports are available for inspection.

All required documents that relate to the airworthiness of RVSM repairs and/or modifications will be inspected to insure they conform to the manufacturer's Service Bulletin and/or Maintenance Manual. This facility's parts control program meets the requirements for RVSM.

By signing below, I certify that all the above statements are true and accurate.

Printed Name of Representative From this Facility	Signature	Date

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12. Form 4a: OPERATOR'S AIRCRAFT DISCREPANCY LOG

Location:	**Date Discovered:**	**Discovered By:**
Discrepancy:		
Aircraft RVSM Status Before Repair:	**Compliant** ☐	**Non-Compliant** ☐
Corrective Action:		
Aircraft RVSM Status After Repair:	**Compliant** ☐	**Non-Compliant** ☐
The above described repair/maintenance was performed in accordance with manufacturer's service instructions and current FARs and is approved for return to service.		
Corrected By:	**Certificate #:**	**Date:**

Location:	**Date Discovered:**	**Discovered By:**
Discrepancy:		
Aircraft RVSM Status Before Repair:	**Compliant** ☐	**Non-Compliant** ☐
Corrective Action:		
Aircraft RVSM Status After Repair:	**Compliant** ☐	**Non-Compliant** ☐
The above described repair/maintenance was performed in accordance with manufacturer's service instructions and current FARs and is approved for return to service.		
Corrected By:	**Certificate #:**	**Date:**

Location:	**Date Discovered:**	**Discovered By:**
Discrepancy:		
Aircraft RVSM Status Before Repair:	**Compliant** ☐	**Non-Compliant** ☐
Corrective Action:		
Aircraft RVSM Status After Repair:	**Compliant** ☐	**Non-Compliant** ☐
The above described repair/maintenance was performed in accordance with manufacturer's service instructions and current FARs and is approved for return to service.		
Corrected By:	**Certificate #:**	**Date:**

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