

# Electronic Coding/Packing Process of RNAV Approach Procedures for Flight Inspection

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## **ABSTRACT**

The ARINC 424 coding and packing process for uncommissioned RNAV and RNAV RNP procedures has typically been done manually by the FAA flight inspection pilot. The pilot manually codes the RNAV procedure into the Flight Management System (FMS) for flight inspection. Coding of an RNAV procedure typically takes twenty to fifty minutes, depending on the complexity of the RNAV procedure. Manual coding of ARINC 424 path/terminator data can be susceptible to data corruption as well as being time consuming. Coding of new RNAV procedures has required an aircraft to be available on the ramp and powered for the FMS to be operational.

The FAA flight inspection pilots have a new process available for coding/packing new RNAV approach procedures for flight inspection. The process provides for electronically coding/packing the new RNAV procedures straight from the FAA procedure designer's official source documents. The FAA flight inspection pilot can simply select the required RNAV procedures, through an internet server, and download to a compatible disk media. The RNAV procedures are uploaded into the flight inspection aircraft's FMS. The new RNAV procedures are then available for flight inspection evaluation of ground track, vertical track, and flyability. The time required for coding/packing is reduced from sometimes hours to only a few

minutes. After a successful flight inspection of the RNAV procedure, the exact ARINC 424 coding can then be electronically transmitted to commercial navigation data base suppliers as official source documentation.

This paper describes the process for the flight inspection pilot to electronically code and pack new RNAV approach procedures for the flight inspection mission.

## **INTRODUCTION**

Aviation System Standards (AVN) is a part of the FAA Air Traffic Organization. AVN provides flight inspection and other navigation system services including flight procedure development, charting, and navigation data base. Offices for flight inspection and procedures development are located at the Mike Monroney Aeronautical Center in Oklahoma City, Oklahoma. Offices for charting and navigation data base are located in Silver Spring, Maryland. Flight inspection and procedure development are world wide in scope. The FAA's navigation data base is called the National Flight Data Base (NFD). The NFD currently contains airways, DPs, STARs and RNAV approach procedures in the United States and Caribbean areas. The addition of RNAV coding of ILS procedures into the NFD is planned For December, 2008.

Implementing RNAV operations into the United States National Airspace System is a primary objective of the FAA. This includes development of RNAV approaches, RNAV RNP approaches, RNAV DPs, RNAV STARs and RNAV

routes. AVN had been tasked to develop and commission over 300 new RNAV approach procedures per year for the last several years. The plan now is to increase that number to developing 500 new RNAV approach procedures per year. Over a thousand of the RNAV procedures now use Space Based Augmentation System (SBAS), the FAA's Wide Area Augmentation System (WAAS), to descend to LPV minima. LPV landing minima can be as low as 200 foot ceiling and ½ mile visibility.

In addition to legacy procedures based on individual ground facilities; AVN is responsible for development and flight inspection of a navigation data base of public RNAV procedures in the national airspace system.

## **THE "GOLD STANDARD"**

AVN is initiating a process of navigation data base development called the "Gold Standard". The "Gold Standard" is a process of automation in developing a flight procedure, validating the procedure, ARINC 424 coding the procedure, and electronically packing the coded procedure into a navigation data base for use in the Flight Management System (FMS) on the flight inspection aircraft.

When a flight procedure's development is completed, the data is entered into a software program called Instrument Flight Procedures Program (IFP). IFP documents and validates the information. Validation includes adherence to ARINC 424 coding specification, TERPS criteria, and obstacle data.

The IFP ARINC coded data for a flight procedure is then used for the flight

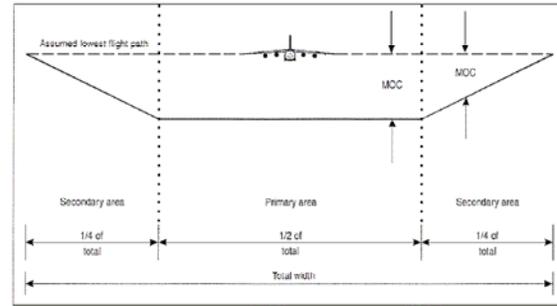
inspection. After a successful flight inspection, the navigation data base for the flight procedure is considered to meet the “Gold Standard”.

The exact ARINC 424 coding is then made available electronically for commercial navigation data base suppliers to download into their storage and packing systems. The availability of the new ARINC 424 coded procedures are coordinated with the chart publication cycle date.

## **FLIGHT INSPECTION AND VALIDATION**

Flight inspection of an RNAV procedure and its associated navigation data base are critical for obstruction clearance, aircraft performance, air traffic separation, and environmental issues. Past practice has been for the AVN flight inspection pilot to manually enter the ARINC 424 path/terminator coding of the new flight procedure into the flight inspection aircraft’s (FMS). Coding of each RNAV procedure typically takes twenty to fifty minutes, depending on the complexity of the RNAV procedure.

The path/terminator coding provides the lateral and vertical flight guidance for the flight inspection and procedure validation. Manual entry of the procedure into an FMS often requires availability of the flight inspection aircraft, is very time consuming, and can be subject to occasional undetected human error in the ARINC 424 coding or waypoint definition. Coding errors and data corruption will offset the flight guidance from the designed centerline and vertical profile of the flight procedure.



**Figure 1. Obstruction Clearance Area**

AVN’s objective is to use only the specified ARINC 424 navigation data from the procedure source documents for flight inspection and validation. IFP has an ARINC 424 coding capability, which codes the procedure according to current ARINC 424 Specification. The coded data in IFP is considered “pending” data packages (flight procedures) until flight inspection is completed.

The flight inspection responsibility includes electronically transferring the “pending” data packages from the IFP coder, packing the procedures into a FMS compatible navigation data base, and verifying that the actual ARINC 424 coding for each procedure complies with the source procedure documents. The procedure’s “pending” data package is then actually used in the FMS navigation data base to inspect and validate the flight procedure.

## **CODING AND PACKING**

AVN Flight Inspection is developing the electronic coding and packing with two processes. The first process is to code and pack an individual flight inspection aircraft’s itinerary of procedures. The itinerary is normally one week of scheduled work. A single itinerary may

include over twenty new RNAV procedures for flight check and validation.

The second process under development is to download all new and amended procedures ready for flight inspection to the FMS manufacturer to be packed and included in the normal navigation data base cycle update for the FMS. This process will make new or amended procedures available to all AVN FMS equipped flight inspection aircraft.

**Packing Procedures Assigned to an Aircraft Itinerary (Present)**

This process provides for electronically transferring “pending” data packages from the IFP ARINC 424 coder and packing them into a format used by the FMS. Through an internet server, the flight inspection pilot accesses the specific aircraft’s itinerary. The ARINC “PACK” is then activated.

| Itinerary Search Results   |             |            |      |              |                     |                    |           |      |                      |
|----------------------------|-------------|------------|------|--------------|---------------------|--------------------|-----------|------|----------------------|
| Full Itinerary             | Coords Only | Start Date | FIFO | Service Area | PIC                 | Tech               | Tail Num. | Data | ARINC                |
| <a href="#">0506N87ANC</a> |             | 05/07/08   | ANC  |              | HAMILTON, L / VN070 | BRADLEY, E / VN011 | N87       |      | <a href="#">PACK</a> |

**Figure 2. Aircraft Itinerary**

A server screen is accessed titled “Flight Inspection Pull” and it contains the list of RNAV procedures for inspection. RNAV procedures that are scheduled to be flight inspected are grouped together for ARINC 424 packing. The inspector activates the “PACK” button at the end of the itinerary. The “pending” data packages are packed into a FMS usable format.

### Flight Inspection Pull

Check the procedures you want packed:

| Procedure   | Number | Amendment | Airport | Channel Type | Owner   | Status  |
|---|--------|-----------|---------|--------------|---------|---------|
| <input checked="" type="checkbox"/> RNAV (GPS) RWY 12 | 5370   | 1.00      | PAVL    |              | PUBLIC  | PENDING |
| <input checked="" type="checkbox"/> RNAV (GPS) RWY 30 | 5371   | 1.00      | PAVL    |              | PUBLIC  | PENDING |
| <input type="checkbox"/> RNAV (GPS) RWY 3             | 22652  | 0.00      | PADG    |              | PRIVATE | PENDING |

These procedures cannot be packed:

| Procedure     | Number | Amendment | Airport | Channel Type | Owner   | Status  |
|---------------|--------|-----------|---------|--------------|---------|---------|
| NDB/DME RWY 3 | 17291  | 1.00      | PADG    |              | PRIVATE | PENDING |
| NDB RWY 5     | 17475  | 1.00      | PPIZ    |              | PUBLIC  | PENDING |

[Pack](#) [Close](#)

**Figure 3. List of Procedures for Inspection**

The flight inspection pilot extracts the packed flight procedures to a FMS compatible disk media. The flight procedures are then uploaded into the flight inspection aircraft's FMS from the disk media.



**Figure 4. FMS Disk Load Page**

The new flight procedures then reside in the FMS data base and are available for flight inspection. The time required for coding/packing is reduced from sometimes hours to only a few minutes.

**Packing All New and Amended Procedures along with the Navigation Data Base (Future)**

This process involves the downloading of “pending” data packages to the FMS manufacturer data packer for inclusion into the FMS navigation data base cycle update. Every 28 days, the navigation data base cycle is updated. New procedures to be flight inspected are added and procedures that have been previously inspected can be deleted. The flight inspector on FMS equipped aircraft will have access to any new procedure ready for a flight inspection and validation. The packing of procedures on individual itineraries should not be required. Additionally, private procedures will be included with each download. The addition of private procedures will provide the flight inspector with continuous access to non-public procedures for periodic, after accident, or special inspections.

Every 28 days, a new updated custom navigation data base will be received by AVN for the flight inspection aircraft. The navigation data base will contain RNAV procedures for future flight inspection as well as the standard

navigation data base for the aircraft. There will be no change in the uploading of the custom data base to the FMS from the uploading of the standard navigation data base cycle updates.

### **CONCLUSION**

Air navigation is evolving from ground based facility guidance to on-board navigation computers. The flight path guidance presented to the pilot is based on software coding in the onboard navigation data base. With the implementation of RNAV, RNAV RNP, SBAS, and GBAS procedures, obstruction evaluation areas are smaller and therefore less tolerant of path definition errors.

Flight inspection practices must evolve with the technology and provide standardized procedures for inspection and validation of air navigation services which are based on software coding. Prevention of data corruption from the design phase of a flight procedure to the distribution to the public is critical. Flight inspection has an essential link in this process by taking the initiative to use only source ARINC 424 coding for the inspection and validation of RNAV procedures.

### **References**

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4. Navigation System Data Base ARINC 424 Specification
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