AEROSPACE INFORMATION REPORT

AIR4830™	REV. A

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Superseding AIR4830

(R) Aircraft Tire Pressure Monitoring Systems

RATIONALE

AIR4830A has been reaffirmed to comply with the SAE five-year review policy.

FOREWORD

Aircraft tire manufacturers, aircraft manufacturers, and the FAA generally recommend a daily tire inflation pressure check, preferably before any taxi operations when the tires are cool. Some airworthiness authorities throughout the world require a daily check. Traditionally, maintenance personnel use a hand-held, calibrated gage to perform the daily pressure check. Investigations of the tire failures on commercial aircraft have identified low tire pressure as a frequent cause of failure. If tire pressure can be monitored continuously, or at least more frequently, low pressure will be detected before tire failure and potentially extensive secondary damage to the aircraft is caused. Also, if the temperature of the tire is known, then its failure due to increasing temperature can be predicted and averted. The results of extensive engineering efforts to develop the means for detecting an underinflated tire and/or excessive tire temperatures are summarized in this document.

1. SCOPE

The intent of this SAE Aerospace Information Report (AIR) is to inform the aerospace industry about various systems available to monitor the inflation pressure and/or temperature of an aircraft tire. The tire pressure monitoring system (TPMS), with cockpit display, is the most widely used of all aircraft tire monitoring systems, and is detailed in this document more than other systems.

2. REFERENCES

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of the other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

ARP6137 Tire Pressure Monitoring Systems (TPMS) for Aircraft

ARP5265A Minimum Operational and Maintenance Responsibilities for Aircraft Tire Usage

ARP4102/4 Flight Deck Alerting Systems (FAS)

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AIR4830A/

2.2 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

AC 20-97B High-Speed Tire Maintenance & Operational Practices

3. TIRE PRESSURE MONITORING SYSTEMS

Three types of pressure monitoring systems are available:

a. Wheel mounted tire pressure gage/inflation valve assemblies

b. Handheld tire pressure indicating systems

c. Cockpit displayed systems

3.1 Wheel Mounted Tire Pressure Gage/Fill Valve Assembly

A direct reading pressure gage (shown below) can replace the standard tire inflation valve allowing the flight crew to check tire inflation pressure during their walk-around before each flight. The gage is a helical bourdon tube device and includes an inflation valve. It installs in the original inflation valve port in the wheel and requires no wheel modifications. Units are available with either large bore or small bore valve stems. The gage is accurate to within a 4% range of full scale; however, regular pressure checks with a calibrated, hand-held gage are recommended. A calibration check of these gages is recommended at least every tire change. Also, these devices are intended to facilitate a walk-around inspection of tire pressure and should not be used as a measure of the pressure during the inflation process.

FIGURE 1 – WHEEL MOUNTED TIRE PRESSURE GAUGE/FILL VALVE

3.2 Handheld Tire Pressure Monitoring Systems

One system (figure 2) incorporates a passive wireless sensor embedded in a tire inflation valve stem which can be read remotely by a handheld device. This system can monitor the tire pressure and temperature, and can provide a unique ID. This device has a typical accuracy of ± 1 psi from 50 and 100 psi, ± 1% of reading from 100 and 350 psi, at most temperatures.

It is currently in use on corporate aircraft but has applicability to commercial, regional, military, and general aviation aircraft.

FIGURE 2 – INFLATION VALVE PRESSURE SENSOR

Another type of handheld sensor (figure 3) utilizes the electronics in the valve cap. The manufacturer of this equipment states that "the system is not for certified aircraft and is only rated to flight level 30 and 80 psi max". This small removable electronic valve sensor transmits pressure/temperature to the LCD monitor within 25 – 50 feet of the aircraft. The sensors (valve caps) can be easily removed when adding inflation gas to the tires and will send a new pressure reading when reinstalled. These sensors are accurate to an altitude of 25 000 – 30 000 feet with a temperature range of -50 °C to 145 °C. This sensor has a maximum operating pressure of 80 PSI with a pressure accuracy of ± 1 PSI and temperature accuracy of ± 2 °C.

FIGURE 3 – HANDHELD TPMS SENSOR W/VALVE CAPS

3.3 Cockpit Displayed Systems

3.3.1 Tire Pressure Monitoring Systems (TPMS)

3.3.1.1 Background

A pressure sensor is mounted on the wheel and senses tire pressure directly. Electronic circuitry located in the hubcap provides an excitation voltage to the transducer and measures the output voltage. The output is converted into a digital code that is transmitted to a computer across a rotating transformer located inside the axle. The computer decodes the digital information, compares the actual tire pressures to preset values, and decides whether or not to illuminate a “low tire” warning light in the cockpit. Tire pressure information is transmitted to the cockpit for display upon command. See Figure 4.

Several systems that fit the above description are currently in production. Various options are available, including the type of cockpit display and a TPMS combined with a brake temperature sensing capability. Most systems are designed for both production and retrofit installation, although retrofit can be much more costly.

a. Most TPMS typically have an accuracy which does not exceed +/- 2% of reading or +/- 2 psi, whichever is greater, within the normal operating range .

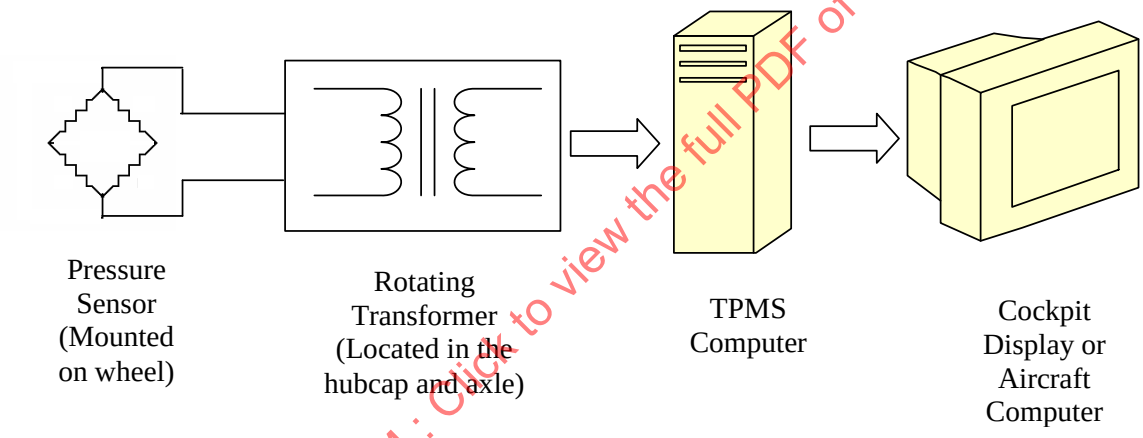

FIGURE 4 – TPMS SCHEMATIC

b. The warning is normally inhibited at certain flight phases to avoid distractions. For example, typically the system becomes inhibited part way through the takeoff roll. The alerting system level alerts are described in ARP4102/4 Flight Deck Alerting Systems (FAS).

Various other designs that are arranged in a similar manner have been proposed and prototyped. For example: replacement of the rotating transformer with slip rings to transfer tire pressure information across the rotating wheel to the stationary axle gap. Certainly, these designs and others are possible but are not currently available in production hardware.

3.3.1.2 Service History

There are several suppliers of TPMS equipment and different methods to transmit the pressure signal. The first method utilizes a wheel mounted sensor containing a pressure cell and an electronic module (integrated circuitry). The hub-mounted transformer unit contains no electronics, only windings, bearings, and seals. See Figure 5.

A second TPMS method uses a pressure sensor that provides tire pressure as a low level analog signal to the electronic module located in the transformer unit. The electronic module converts the analog signal into a frequency proportional to the pressure. See Figure 6. This type of equipment is available on the Airbus A300-600, A310, A318/A319/A320/A321, A330/A340, A340-500/-600; Boeing 747-8, 747-400, 767, 767-300ER and 777; Douglas DC10-30 and MD-11; Dassault Falcon 7X; Gulfstream 650.

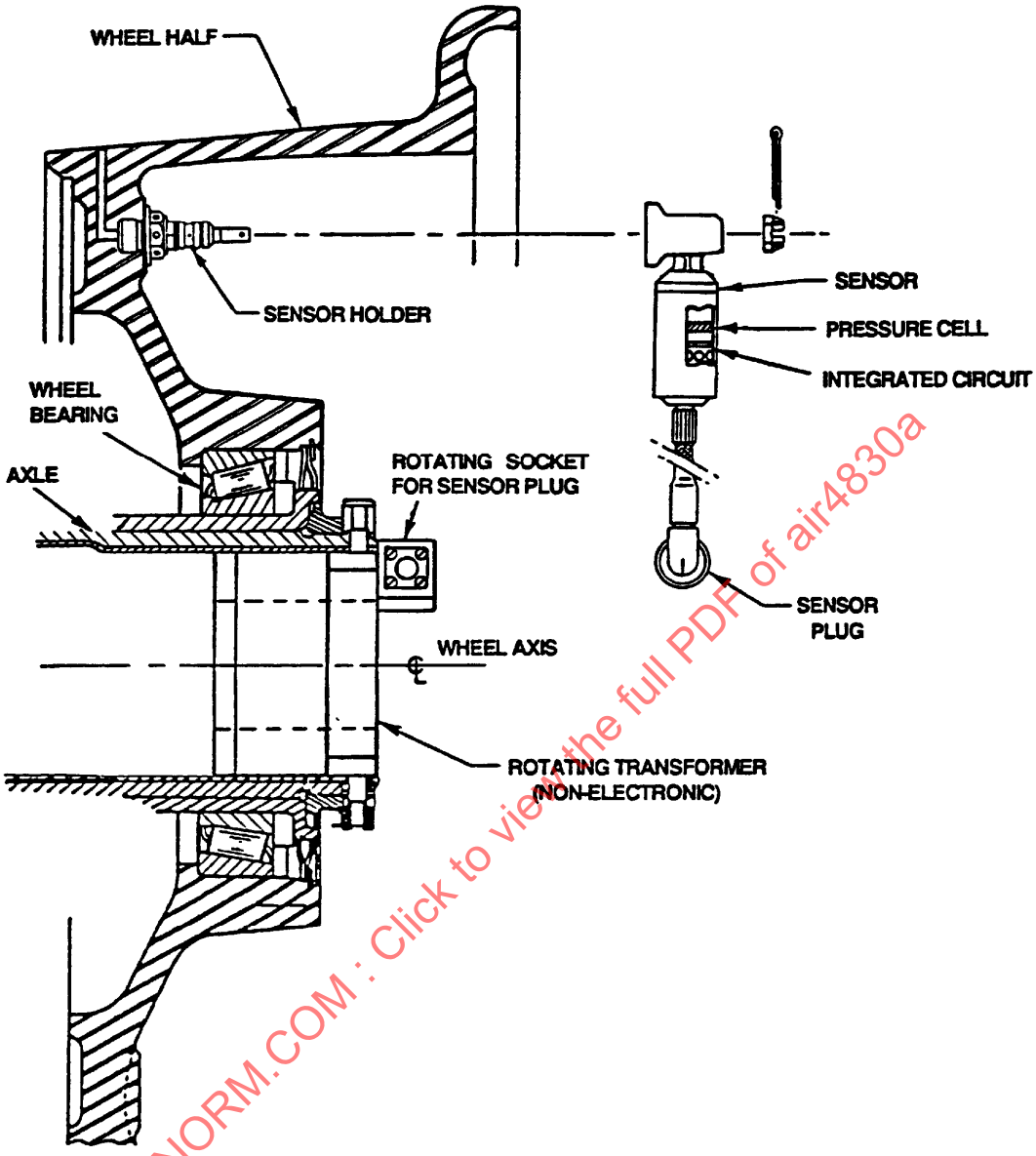

FIGURE 5 - TPMS WITH NON-ELECTRONIC ROTATING TRANSFORMER