

# Modifying an APA Jr. to Perform both Highway and Airfield PURWheel Test Protocols

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This document includes the original PURWheel description letter which covers the PURWheel protocols for highway loadings. It also contains a section discussing the requirements to meeting airfield loadings for two typical aircraft.

## 1. Original Concept Letter

The goal of this letter is to start a dialogue about the potential of adding PURWheel test capabilities to existing commercially available equipment that can test asphalt slabs as per the Hamburg Loaded Wheel Test (HLWT). Key parameters of the PURWheel Test that need to be adapted are summarized as follows. Some of these parameters may be adjusted on a case by case basis as dialogue progresses. Mississippi State University (MSU) has a PURWheel tracker, but the equipment is dated, and we are interested in trying to configure commercially available wheel trackers to run the experiment. We are interested in pricing estimates to purchase an existing wheel tracker that runs HLWT testing with an upgrade so PURWheel testing can also be performed.

**Tire:** Pneumatic 4-ply tire inflated to 125 psi (862 kPa), tracked at a nominal speed of 33 cm/sec, having a gross contact area of 2,800 mm<sup>2</sup> and a gross contact pressure of 91 psi (0.63 MPa). The current equipment applies a vertical load of 395 lb (179 kg [1.75 kN]) to achieve the gross contact pressure. The key parameter is not vertical load, but a contact pressure as close to 91 psi as possible (e.g. 90 to 95 psi). Figure 1 has a few photographs of the tire, which can be provided by MSU. The equipment vendor would provide a rim onto which the Figure 1 tire can be applied. The outside diameter of the tire is approximately 8.75 in (22.2 cm), and the diameter of the inner hole of the tire is around 3.75 in (9.5 cm). The tire is around 2.6 in (6.6 cm) wide at the widest point and narrows to around 2.1 in (5.3 cm) at the tread.



Figure 1. Example Photographs of PURWheel Tire

**Testing Environment:** Maintain temperature of an asphalt slab from room temperature to 64 °C, which is likely to require circulation of temperature controlled air and/or water. Ideally air temperature differentials around the specimen would be 3 °C or less. Testing needs conducted with specimens surrounded with air, and also surrounded by water where all other test parameters are identical. In other words, there is a wet protocol test and a dry protocol test. Specimens need to be conditioned for 6 hours prior to testing commencing.

**Test Specimen:** Asphalt slab with approximate dimensions of 12 in by 12 in by 3 in thick. Current slabs are 11.4 in (29 cm) by 12.2 in (31 cm) and are 2.75 to 3.25 in (7 to 8.3 cm) thick. Slab preparation is to be performed with existing equipment, and exact length and width dimensions are not critical.

**Testing Parameters:** Specimens are tested for up to 20,000 passes, where a pass is defined as the wheel traversing over the specimen one time (a cycle is one extend pass and one retract pass). Failure criteria would be rutting of 0.75 to 1 in, which can be discussed and adjusted slightly if necessary. Rut depth is measured from the original horizontal surface. Rutting is measured in the middle 8 in (20 cm) of the specimen, and approximately 20 readings are collected over the 8 in measurement area during a pass where data is collected.

## 2. Airfield PURWheel Requirements

ERDC would want to perform the PURWheel test identically to the one MSU needs; the only difference being the contact pressure on the specimen (may or may not require a different tire). The highway PURWheel uses a 91 psi gross contact pressure, or a 123 psi net contact pressure when the tire tread is accounted for.

The two aircraft that are the most common reference points for military airfield work are the C-17 cargo aircraft and F-15 fighter aircraft. A single C-17 wheel produces a contact pressure of 142 psi (gross and net are, for all practical purposes, the same because the C-17 tires are mostly solid-tread). If we were to scale up the 395 lb load used to produce the 91/123 psi gross/net contact pressure in the highway PURWheel, the airfield PURWheel version would require a 456 lb load to produce 142 psi contact pressure. This is about 60 lb higher than would already be required for the highway PURWheel modification.

The F-15 load may not be possible due to load limits, and it may require looking at a smaller tire with a small contact area in order to achieve the necessary 325 psi contact pressure with less load. This is open for discussion, but the key thing with both C-17 and F-15 configurations is that the tire(s) selected should provide the same elliptical footprint of a typical pneumatic tire like in Figure 1.

**Table 1. Summary of PURWheel Test Specifications**

Specification		Highway	Airfield (C-17)	Airfield (F-15)
Load	Vertical Load (lb)	395	456	??
	Notes	Load should be sized to produce required contact pressures.		
Tire	Type	Pneumatic 4-ply rubber tire	Pneumatic or solid rubber tire	Pneumatic or solid rubber tire
	Outside Dia. (in.)	8.75	---	---
	Inside Dia. (in.)	3.75	---	---
	Overall Width (in.)	2.60	---	---
	Width at Tread (in.)	2.10	---	---
	Pressure (psi)	125	---	---
	Contact Area (Gross) (mm <sup>2</sup> )	2800	---	---
	Contact Area (Net) (mm <sup>2</sup> )	2070	---	---
	Contact Pressure (Gross) (psi)	91	142	325
	Contact Pressure (Net) (psi)	123	142	325
Notes	The specific tire is negotiable. A tire selected for the airfield test protocol must provide approximately similar contact area.			