

**Pressure Sensitive Paint Rotor Blade Definition**  
*April 2016*

# 1 Background Information

The Pressure Sensitive Paint (PSP) rotor blades are a model scale set of rotor blades designed jointly by the U.S. Army Aviation Development Directorate (ADD) and NASA. The rotor planform was based on the High Lift Rotor (HLR) blades fabricated in 2002 for testing in the NASA Transonic Dynamics Tunnel (TDT). The rotor blades were acquired in 2007 specifically for a PSP validation test in the 14x22 Rotor Test Cell at NASA Langley. This document provides the "as designed" geometry and structural properties of the PSP blade set. The outer mold line (OML) is provided in '.iges' format. The units are inches. The XYZ coordinates are defined as: X- radius direction along the pitch axis, Y- rotor axis of rotation, Z- chord direction positive toward the trailing edge. For clarity, a PDF self viewing file is included at the end of this document.

## 2 Planform

The blade uses Government RC-series airfoils with the planform shown in Figure 1. The rotor has a linear twist of -14 degrees starting at Blade Station (BS) 16.75 and ending at the rotor tip. The blade has a chord length of 5.45 inches with a 30 degree tip sweep and a 3.27 inch tip chord length. Figure 1 shows a notch in the planform from BS 7.87 to 16.75. This notched out area contains a connector fairing to accommodate wiring from dynamic pressure sensors within two pressure instrumented blades and is present on all four blades for symmetry. The dynamic absolute pressure sensors are on the upper surface at  $r/R=93\%$  and  $r/R=99\%$ . Figure 1 also shows the flap and lead/lag hinge to be co-located 3.00 inches from the hub center.

## 3 Structural Properties

A complete set of as designed 2D sectional structural properties are provided in Table 2. The center of gravity (CG), shear center (SC) and neutral axis (NA) are given in the in the  $\eta, \zeta$  coordinate system which is defined along the pitch/twist axis (X-axis). Positive  $\eta$  is in the chord direction toward the trailing edge. Positive  $\zeta$  is the thickness direction toward the upper surface. The stiffness parameters are referenced to the local neutral axis.

Table 1. PSP Blade Planform

r/R	Twist (deg)	Chord (in)	Sweep (Deg)	Airfoil
0.12	8.2	5.45	0	-
0.17	8.2	5.45	0	RC(4)-12
0.25	7.01	5.45	0	RC(4)-12
0.65	1.4	5.45	0	RC(4)-12
0.70	0.7	5.45	0	RC(4)-10
0.80	-0.7	5.45	0	RC(4)-10
0.85	-1.4	5.45	0	RC(6)-8
0.95	-2.8	5.45	0	RC(6)-8
1.00	-3.5	3.27	30	RC(6)-8

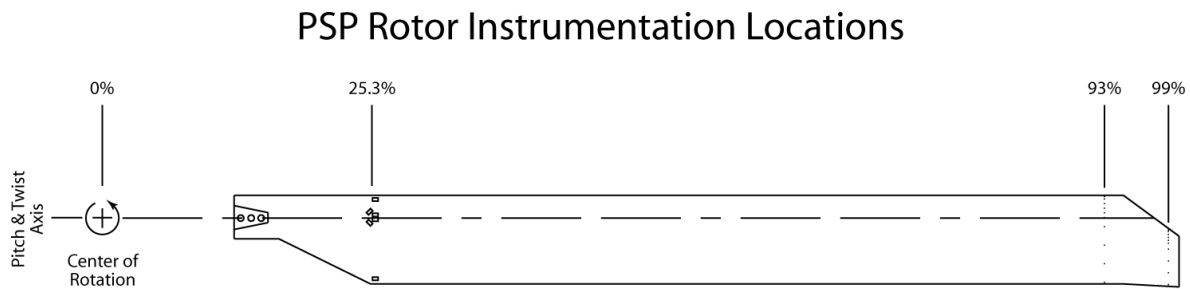
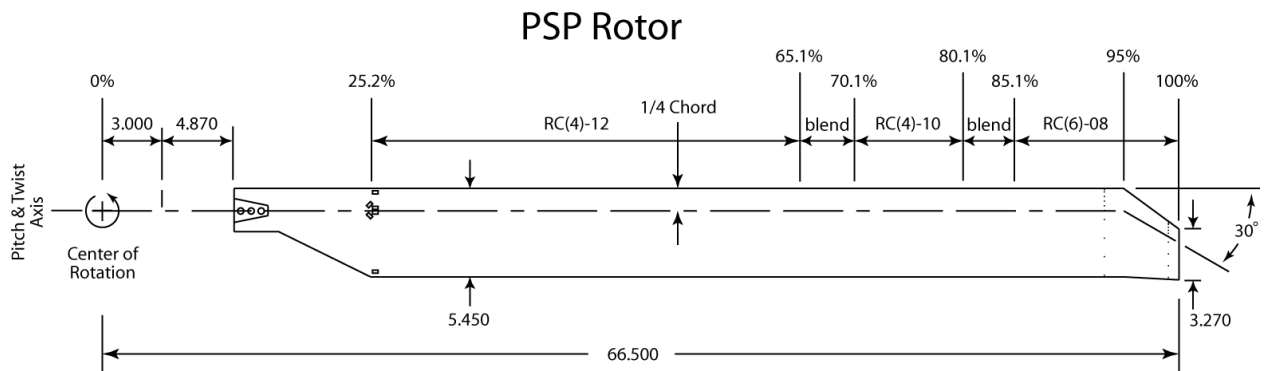
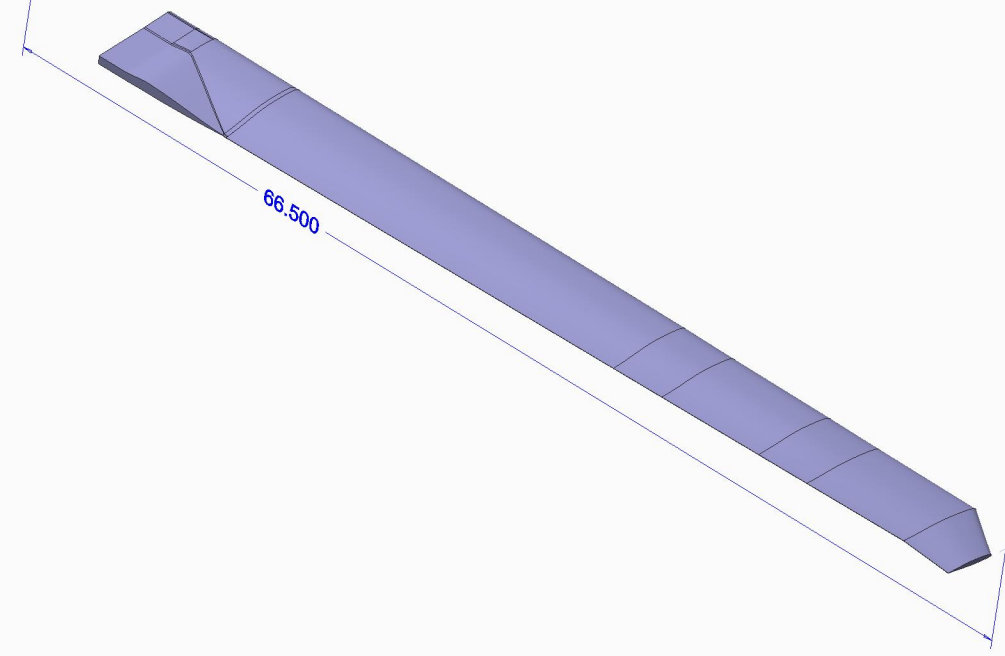


Figure 1. PSP Blade Planform and Instrumentation Locations.

Table 2. PSP Blade Structural Properties

$r/R$	$WT/IN$	$CG, \eta$	$CG, \zeta$	$SC, \eta$	$SC, \zeta$	$NA, \eta$	$NA, \zeta$	$EI_F$	$EI_C$	GJ	$I_F$	$I_C$	EA
-	$lb/in$	$in$	$in$	$in$	$in$	$in$	$in$	$Mbf \cdot in^2$	$Mbf \cdot in^2$	$Mbf \cdot in^2$	$mbf \cdot in$	$mbf \cdot in$	$Mbf$
0.118	0.065	-0.209	0.021	-0.209	0.020	-0.206	0.020	0.245	3.460	1.202	1.419	24.204	8.431
0.149	0.065	-0.209	0.021	-0.209	0.020	-0.206	0.020	0.245	3.460	1.202	1.419	24.204	8.431
0.167	0.040	-0.207	0.040	-0.209	0.041	-0.209	0.042	0.359	3.165	1.786	1.932	16.913	7.428
0.253	0.027	0.524	0.065	-0.007	0.044	-0.127	0.074	0.231	2.633	0.147	1.454	48.726	3.539
0.263	0.042	-0.064	0.048	-0.007	0.044	-0.128	0.073	0.231	2.637	0.147	1.551	76.380	3.543
0.303	0.042	-0.064	0.048	-0.007	0.044	-0.128	0.073	0.231	2.637	0.147	1.551	76.380	3.543
0.352	0.042	-0.064	0.048	-0.007	0.044	-0.128	0.073	0.231	2.637	0.147	1.551	76.380	3.543
0.402	0.042	-0.064	0.048	-0.007	0.044	-0.128	0.073	0.231	2.637	0.147	1.551	76.380	3.543
0.452	0.042	-0.064	0.048	-0.007	0.044	-0.128	0.073	0.231	2.637	0.147	1.551	76.380	3.543
0.502	0.042	-0.064	0.048	-0.007	0.044	-0.128	0.073	0.231	2.637	0.147	1.551	76.380	3.543
0.552	0.042	-0.086	0.049	-0.008	0.048	-0.139	0.074	0.231	2.483	0.147	1.550	72.716	3.534
0.602	0.036	0.020	0.049	0.001	0.046	-0.118	0.073	0.194	2.203	0.145	1.437	67.897	2.917
0.651	0.036	0.020	0.049	0.001	0.046	-0.118	0.073	0.194	2.203	0.145	1.437	67.897	2.917
0.701	0.036	0.027	0.047	-0.003	0.050	-0.113	0.072	0.130	2.116	0.100	0.998	65.473	2.877
0.751	0.034	0.040	0.046	0.019	0.050	-0.078	0.073	0.101	1.828	0.097	0.920	64.882	2.251
0.801	0.034	0.040	0.046	0.019	0.050	-0.078	0.073	0.101	1.828	0.097	0.920	64.882	2.251
0.851	0.040	-0.188	0.046	0.083	0.039	-0.071	0.052	0.056	1.780	0.053	0.512	64.478	2.225
0.900	0.040	-0.188	0.046	0.083	0.039	-0.071	0.052	0.056	1.780	0.053	0.512	64.478	2.225
0.940	0.040	-0.188	0.046	0.083	0.039	-0.071	0.052	0.056	1.780	0.053	0.512	64.478	2.225
0.940	0.060	0.031	0.045	0.110	0.039	0.032	0.052	0.044	1.627	0.058	0.727	81.099	1.725
0.950	0.047	0.027	0.044	0.110	0.039	0.032	0.052	0.042	1.594	0.058	0.495	76.086	1.685
0.950	0.029	0.730	0.045	0.110	0.039	0.035	0.052	0.042	1.588	0.058	0.449	38.586	1.680
1.000	0.016	2.168	-0.068	1.854	-0.105	1.750	-0.101	0.004	0.285	0.005	0.109	9.753	0.624

PSP\_BLADE\_OML\_AS\_DEIGNED



X.X+0.1  
X.XX+0.03  
X.XXX+0.010  
ANG.+0.5