# MEASUREMENT VERSUS PREDICTIONS OF ROTORDYNAMIC COEFFICIENTS AND LEAKAGE RATES FOR A HOLE-PATTERN GAS SEAL WITH NEGATIVE PRESWIRL

A Thesis

by

PHILIP DAVID BROWN

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2011

Major Subject: Mechanical Engineering

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Approved by:

| | |
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| Chair of Committee, | Dara W. Childs |
| Committee Members, | Gerald Morrison |
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# ABSTRACT

Measurement Versus Predictions of Rotordynamic Coefficients and Leakage Rates for a Hole-Pattern Gas Seal with Negative Preswirl.

(August 2011)

Philip David Brown, B.S., Texas A&M University

Chair of Advisory Committee: Dr. Dara W. Childs

This thesis presents the results of high supply (up to 84 bar) pressure testing of hole-pattern annular gas seals performed at the Texas A&M Turbomachinery Laboratory in College Station, TX. The test variables were chosen to determine the influence of pressure ratio, rotor speed, and negative preswirl on seal performance. Preswirl signifies the circumferential fluid flow entering a seal, and negative preswirl indicates a fluid swirl in the direction opposite of rotor rotation.

Changes in pressure ratio had only small effects on most rotordynamic coefficients. Cross-coupled stiffness showed slightly different profiles through the mid-range of excitation frequencies. Pressure ratio showed some influence on direct and cross-coupled damping at low excitation frequencies.

Rotor speed significantly affected both cross-coupled stiffness and cross-coupled damping. As rotor speed increased, the magnitude of cross-coupled rotordynamic coefficients increased due to the positive fluid swirl induced by rotor rotation. For the low rotor speed, negative inlet preswirl was able to overpower the positive rotor induced fluid rotation, producing a negative cross-coupled stiffness. This outcome showed that, for hole-pattern seals, positive fluid swirl does indeed produce positive cross-coupled stiffness coefficients and negative fluid swirl produces negative cross-coupled stiffness coefficients.

The addition of negative preswirl greatly reduced cross-coupled rotordynamic coefficients, while direct rotordynamic terms were unaffected.

Cross-over frequency signifies the excitation frequency where effective damping transitions from a negative value to a positive value with increasing excitation frequency. Peak effective damping was increased by 50% and cross-over frequency reduced by 50% for high-negative preswirl versus zero preswirl results. This led to the conclusion that a reverse swirl could greatly enhance the stability of hole-pattern balance piston seals.

A two-control-volume model that uses the ideal gas law at constant temperature (ISOT) was used to predict rotordynamic coefficients and leakage. This model predicted direct rotordynamic coefficients well, but greatly under predicted cross-coupled rotordynamic coefficients especially at high negative preswirls. The model predicted seal leakage well at low pressure ratios, but showed increasing error as the pressure ratio was increased. These results showed that the prediction model could not adequately estimate cross-coupled rotordynamic coefficients for a hole-pattern seal with negative inlet preswirl and requires modification to do so.

# ACKNOWLEDGEMENTS

I would like to thank Dr. Dara Childs for giving me the opportunity to work at the Turbomachinery Laboratory; it was a privilege to work for him. My experiences at the lab have enhanced my career as an engineer and as a person in general.

I greatly appreciate the constant technical support from Stephen Phillips and Eddie Denk. Both were bombarded with questions on a daily basis and taught me a great deal.

Many thanks go to Michael Vannarsdall, Jason Wilkes, Chris Kulhanek, and Naitik Metah, for their help and friendship. Without countless hours from Michael and Jason, the test rig never would have been brought back to life.

I would like to thank my parents, Dwight and Patricia Brown, for being an endless source of encouragement and motivation.

Finally, thank you to my girlfriend, Sarah Compton, for her love and support. You're my best friend, and I'm grateful for your patience throughout my graduate work.

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# NOMENCLATURE

| | | | |
|---|---|---|---|
| $\boldsymbol{A_{ij}}$ | - | FFT of stator acceleration | [L/T$^2$] |
| $C_r$ | - | Radial clearance | [L] |
| $C$ | - | Direct damping | [FT/L] |
| $c$ | - | Cross-coupled damping | [FT/L] |
| $C_{eff}$ | - | Effective damping | [FT/L] |
| $D_s$ | - | Seal diameter | [L] |
| $D_r$ | - | Rotor diameter | [L] |
| $\boldsymbol{D_{ij}}$ | - | FFT of relative displacement | [L] |
| $F_s$ | - | Seal reaction forces | [F] |
| $\boldsymbol{F_{ij}}$ | - | FFT of force | [F] |
| $g$ | - | Acceleration due to gravity | [L/T$^2$] |
| $\gamma$ | - | Gamma ratio | [-] |
| $\boldsymbol{H_{ij}}$ | - | FFT of dynamic-stiffness | [F/L] |
| $H_w$ | - | Inches of water | [L] |
| $j$ | - | $\sqrt{-1}$ | [-] |
| $K$ | - | Direct stiffness | [F/L] |
| $k$ | - | Cross-coupled stiffness | [F/L] |
| $K_{eff}$ | - | Effective stiffness | [F/L] |
| $L$ | - | Seal length | [L] |
| $m_s$ | - | Stator mass | [M] |
| $N$ | - | Revolutions per minute | [1/T] |
| $P$ | - | Pressure | [F/L$^2$] |
| $P_e$ | - | Exit pressure | [F/L$^2$] |
| $P_f$ | - | Flow meter pressure | [F/L$^2$] |
| $P_i$ | - | Inlet pressure | [F/L$^2$] |
| $P_s$ | - | Stator pressure | [F/L$^2$] |
| PR | - | Pressure ratio | [-] |

| | | | |
|---|---|---|---|
| $R$ | - | Gas constant | [FL/(MT)] |
| $\ddot{\boldsymbol{R}}$ | - | Stator acceleration vector | [L/T$^2$] |
| $\sigma_{total}$ | - | Total repeatability | [F/L] |
| $\sigma_{baseline}$ | - | Baseline repeatability | [F/L] |
| $\sigma_{test}$ | - | Test repeatability | [F/L] |
| $T_i$ | - | Inlet temperature | [T] |
| $T_e$ | - | Exit temperature | [T] |
| $u_0(0)$ | - | Preswirl ratio | [-] |
| $V_t$ | - | Inlet tangential (swirl) velocity | [L/T] |
| $X, Y$ | - | Displacement directions | [L] |
| $\dot{X}, \dot{Y}$ | - | Velocity components | [L/T] |
| $\Delta P$ | - | Differential pressure | [F/L$^2$] |
| $\dot{m}$ | - | Mass flow rate | [M/T] |
| $\dot{Q}$ | - | Flow rate | [L$^3$/T] |
| $\rho$ | - | Density of gas | [M/L$^3$] |
| $\rho_a$ | - | Density of air at STP | [M/L$^3$] |
| $\rho_w$ | - | Density of water | [M/L$^3$] |
| $\Omega$ | - | Excitation frequency | [1/T] |
| $\omega$ | - | Running speed | [1/T] |
| $Z_c$ | - | Gas compressibility factor | [-] |

Subscripts

| | | | |
|---|---|---|---|
| ij | - | Direction of force and response | [-] |

# INTRODUCTION

Annular gas seals are used in compressors and turbines to control the leakage of the process gas between two areas of the turbo-machine. A variety of seal designs exist, each with its own unique leakage and rotordynamic characteristics.

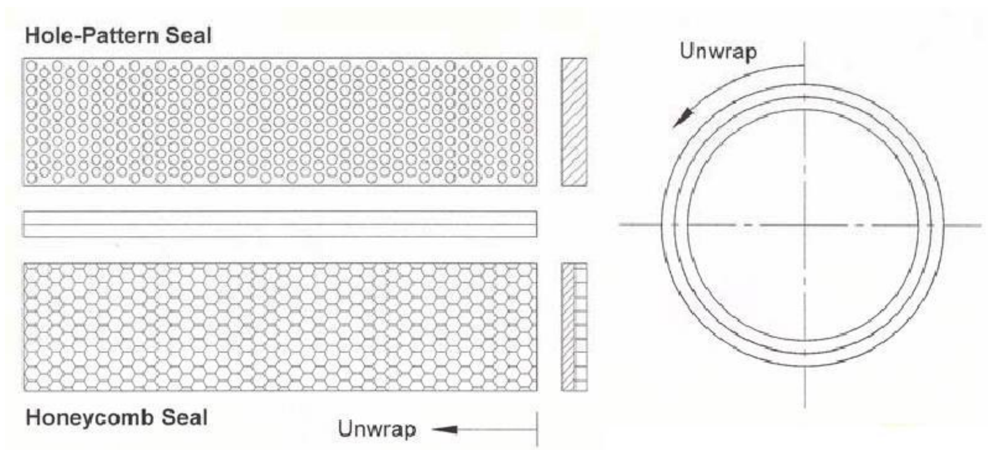


**Figure 1. Hole-pattern versus honeycomb seal configurations. [1]**

Figure 1 displays the distinct features of honeycomb and hole-pattern seals. Honeycomb and more recently hole-pattern stator seals have been used to enhance rotordynamic stability in turbo-machines. The stator of a hole-pattern seal consists of a smooth bore with multiple radial holes. Hole-pattern seals have gained attention because they show improved rotordynamic and leakage characteristics that are similar to honeycomb seals, are easier to manufacture, and can be made of softer, more rub tolerant materials.

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This thesis follows the style and format of the ASME Journal of Engineering for Gas Turbines and Power.

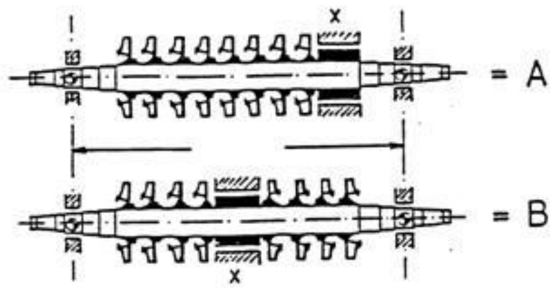


**Figure 2. "X" denotes the location of a balance piston seal in a straight-through compressor (A) and a division wall seal in a back-to-back compressor (B). [2]**

Annular gas seals, such as hole-pattern seals, are used in a variety of compressor configurations. As Figure 2 indicates, a long annular gas seal is acting as a balance piston seal in a straight-through compressor and as a division wall seal in a back-to-back compressor.

Most research in this area has been performed to predict and define the rotordynamic behavior of annular seals. Nelson [3] used a bulk flow model to predict the behavior of smooth and honeycombs seals. Nelson's one-control-volume model predicted frequency independent stiffness, damping, and mass terms. Ha and Childs [4] showed that rotordynamic coefficients of honeycomb seals were not frequency independent using a two-control-volume model.

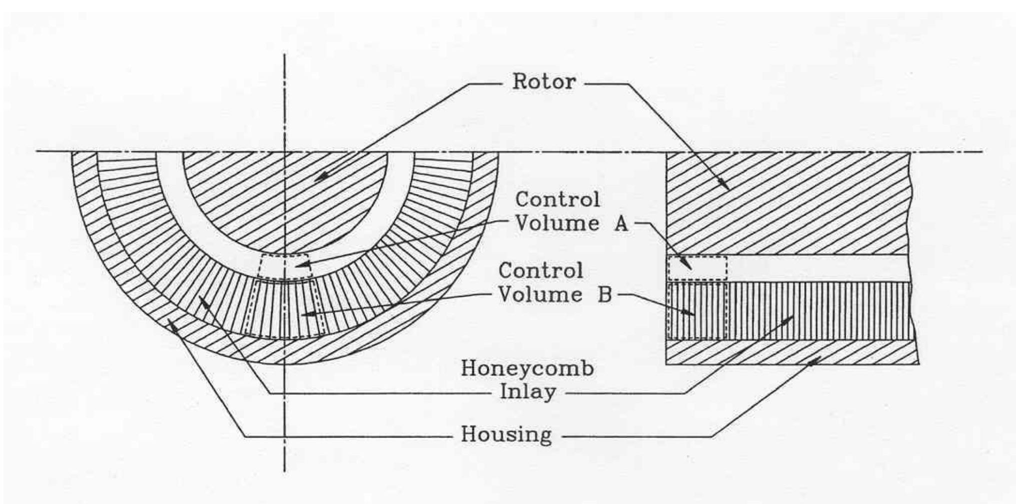


**Figure 3. Layout of two-control-volume model in honeycomb seal. [5]**

A cross section of a honeycomb seal is shown in Figure 3 with areas of the two-control-volume model labeled. “Control Volume A” designates the clearance between the smooth rotor and the inner diameter of the annular seal, while “Control Volume B” designates the cavities which make up a honeycomb or hole-pattern seals inner surface. Nelson’s model contained only control-volume A. A typical hole-pattern seal and smooth rotor configuration is shown in Figure 4. The directions of the rotor and fluid swirl rotations are indicated.

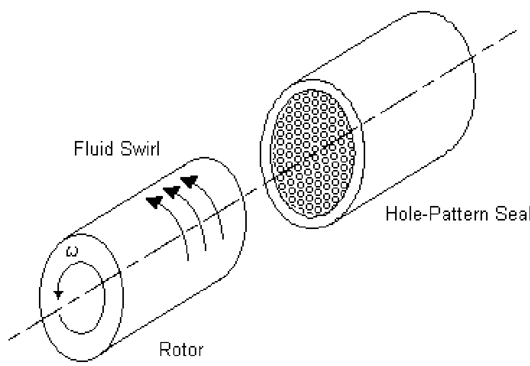


**Figure 4. Hole-pattern seal with positive fluid swirl. [6]**

Using the two-control-volume model of Figure 3, Kleynhans and Childs [5] developed the following frequency-dependent model for reaction forces produced by hole-pattern seals.

$$-\begin{Bmatrix} f_{sX} \\ f_{sY} \end{Bmatrix} = \begin{bmatrix} K(\Omega) & k(\Omega) \\ -k(\Omega) & K(\Omega) \end{bmatrix} \begin{Bmatrix} X \\ Y \end{Bmatrix} + \begin{bmatrix} C(\Omega) & c(\Omega) \\ -c(\Omega) & C(\Omega) \end{bmatrix} \begin{Bmatrix} \dot{X} \\ \dot{Y} \end{Bmatrix} \qquad (1)$$

In Eq. (1), $K$, $k$, $C$, and $c$ represent the direct stiffness, cross-coupled stiffness, direct damping, and cross-coupled damping respectively. All variables are a function of the rotor precession frequency $\Omega$.

When the inlet gas entering an annular seal has an initial circumferential rotation it is said to have preswirl. Positive preswirl designates inlet gas rotating in the same direction as the rotor. Negative preswirl designates inlet gas rotating in the opposite direction as the rotor. Benckert and Wachter [2] demonstrated that prerotation of gas into a labyrinth seal in the direction of rotor rotation created positive cross-coupled stiffness values that would destabilize a rotor. They also showed that prerotation of gas against the direction of shaft rotation created negative $k$ values that would act to stabilize the rotor.

Childs, Elrod, and Hale [7] were the first to perform dynamic tests with honeycomb seals. They were able to measure direct and cross-coupled stiffness as well as damping. Yu and Childs [1] tested multiple hole-pattern designs and found that hole-pattern seals could provide stabilizing effects comparable to honeycombs seals.

Shunt injection is the process of injecting gas near the inlet of a gas seal against the rotation of the rotor. Injection flow is supplied via multiple closely spaced circumferential pressure ports. Figure 5 shows a labyrinth balance piston seal equipped with shunt injection. Shunt injection can produce stabilizing dynamic effects similar to a negative inlet preswirl, but adversely affects seal static performance by increasing seal leakage.

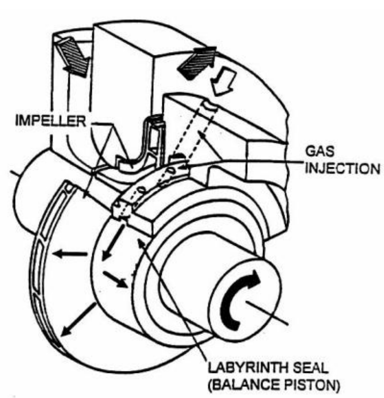


**Figure 5. Shunt injection in a labyrinth balance-piston seal. [8]**

Childs and Soto [9] compared the effective damping of labyrinths seals with shunt injection to measured values from honeycomb seals. They found that labyrinth seals with injection against rotor rotation are more stabilizing than honeycomb seals when the pressure ratio across the seal is less than 0.45, while the honeycomb seals are better when the pressure ratio is greater than 0.45.

Dawson [10] confirmed that the rotordynamic characteristics of honeycomb seals are frequency dependent. Dawson et al. [11] first described how the air seal test rig at the Texas A&M Turbomachinery Laboratory was altered to allow the testing of annular gas seals. Sprowl [12] determined that honeycomb seals are affected by fluid preswirl. Wade [6] found that hole-pattern seals are sensitive to preswirl in the direction of rotor rotation. He showed that cross-coupled stiffness coefficients increase with increasing preswirl. However, no investigation of hole-pattern seal behavior with a preswirl opposing rotor rotation was performed.

Swirl brakes, also called swirl vanes, are a series of paddles that are meant to impede or direct the flow of circumferentially rotating fluid inside an annular seal. As their name suggests, swirl brakes stop the rotation of inlet fluids and reduce destabilizing cross-coupled rotordynamic terms.

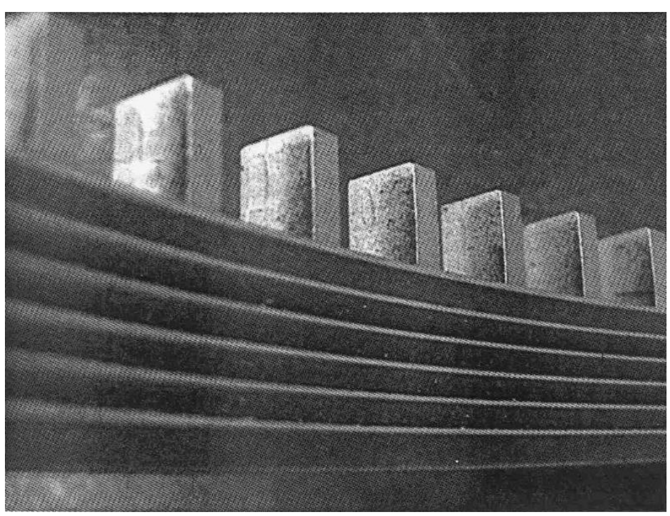

**Figure 6. Swirl brakes in a centrifugal compressor. [13]**

Benckert and Wachter [2] showed that lowering preswirl via swirl brakes could reduce cross-coupled stiffness coefficients. A conventional swirl brake on a labyrinth seal is presented in Figure 6.

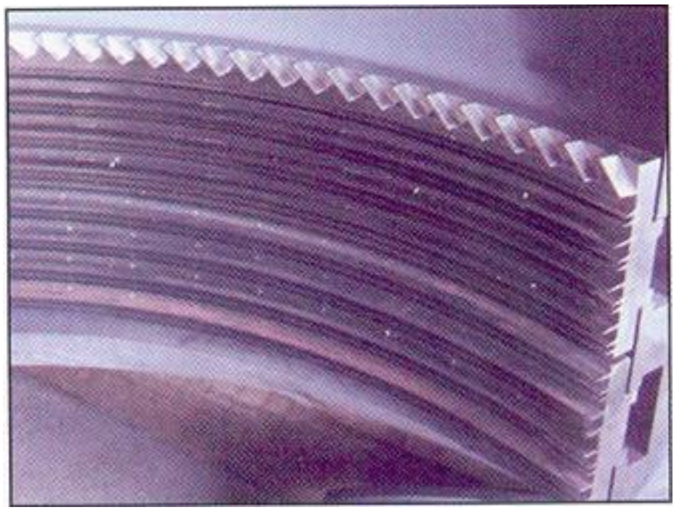

**Figure 7. Steam turbine seal with anti-swirl vanes. [14]**

Gans [14] suggested that the stability of a steam turbine could be improved by employing anti-swirl vanes. The vanes are intended to induce fluid rotation against shaft rotation and thus reduce the destabilizing effects of a combined labyrinth-brush seal. A photo of the anti-swirl vanes is seen in Figure 7.

This research investigates the effects of negative preswirl on the leakage and rotordynamic coefficients of a hole-pattern seal geometry that was tested by Wade [6]. This thesis will examine the effects of multiple pressure ratios and rotor speeds on both the rotordynamic and leakage characteristics of the indicated hole-pattern seal for zero and two negative preswirl ranges.

# THEORY AND MATHEMATICAL MODEL

Kleynhans and Childs [5] produced the reaction force model shown in Eq. (2) using the two-control-volume model developed by Ha and Childs [4]. The variable *s* is the Laplace-domain variable.

$$-\begin{Bmatrix} \boldsymbol{F}_{sx}(s) \\ \boldsymbol{F}_{sy}(s) \end{Bmatrix} = \begin{bmatrix} \boldsymbol{D} & \boldsymbol{E} \\ -\boldsymbol{E} & \boldsymbol{D} \end{bmatrix} \begin{Bmatrix} \boldsymbol{x}(s) \\ \boldsymbol{y}(s) \end{Bmatrix} \tag{2}$$

In Eq. (2), $\boldsymbol{D}$ and $\boldsymbol{E}$ are the direct and cross-coupled dynamic-stiffness coefficients, $\boldsymbol{F_s}$ is the seal reaction force, and $\boldsymbol{x}$(s) and $\boldsymbol{y}$(s) represent the Laplace-domain components of relative displacement between the rotor and stator. This model is valid for small motion about a centered position. It is applicable to seals whose rotordynamic coefficients are affected strongly by excitation frequency. Eq. (1) is the result of including frequency dependent stiffness and damping coefficients in Eq. (2). The two forms are related by,

$$\begin{aligned} \boldsymbol{D}(j\Omega) &= K(\Omega) + \boldsymbol{j}C(\Omega) \\ \boldsymbol{E}(j\Omega) &= k(\Omega) + \boldsymbol{j}c(\Omega) \end{aligned} \tag{3}$$

where $\boldsymbol{j} = \sqrt{-1}$.

Effective stiffness and effective damping are rotordynamic coefficients useful in describing the dynamic characteristics of a seal. Eq. (4) and Eq. (5) present the formulas for effective stiffness and damping.

$$K_{eff}(\Omega) = K(\Omega) + c(\Omega)\Omega \tag{4}$$

$$C_{eff} = C(\Omega) - \frac{k(\Omega)}{\Omega} \tag{5}$$

# TEST RIG DESCRIPTION

The test rig was originally designed to test high-speed hydrostatic bearings. A complete description of the original test stand configuration is included in Childs and Hale [15]. The rig was later altered to accommodate the testing of gas seals. Dawson et al. [11] describe how the test rig was altered to allow the testing of annular gas seals with an inlet pressure of up to 17.2 bar (250 psi). Later, the test rig was modified to allow testing at inlet pressures of up to 84 bar-a (1235 psi-a), Weatherwax and Childs [16]. The drive assembly rig can spin the test rotor up to 29,000 RPM. There is a throttling valve connected to exhaust hoses upstream of the exit labyrinth seals used to control the pressure drop across the test seals. Opening this valve allows more air to exit the stator, resulting in a larger pressure drop. The pressure ratio is defined as the exit pressure divided by the inlet pressure. The pressure ratios that can be achieved with the backpressure valve are from 0.1 to 0.7, depending on the leakage of the test seals.

Figure 8 shows a cross section view of the test rig. The rotor is supported on hydrostatic bearings. The hydrostatic support bearings are supplied with water at 69 bar-a (1000 psi-a). The test rotor has a diameter of 114.3 mm (4.500 in). These dimensions result in a rotor-to-seal radial clearance of 0.2 mm (8 mils) for the seals tested here.

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A majority of TEST RIG DESCRIPTION is taken from Wade [6].

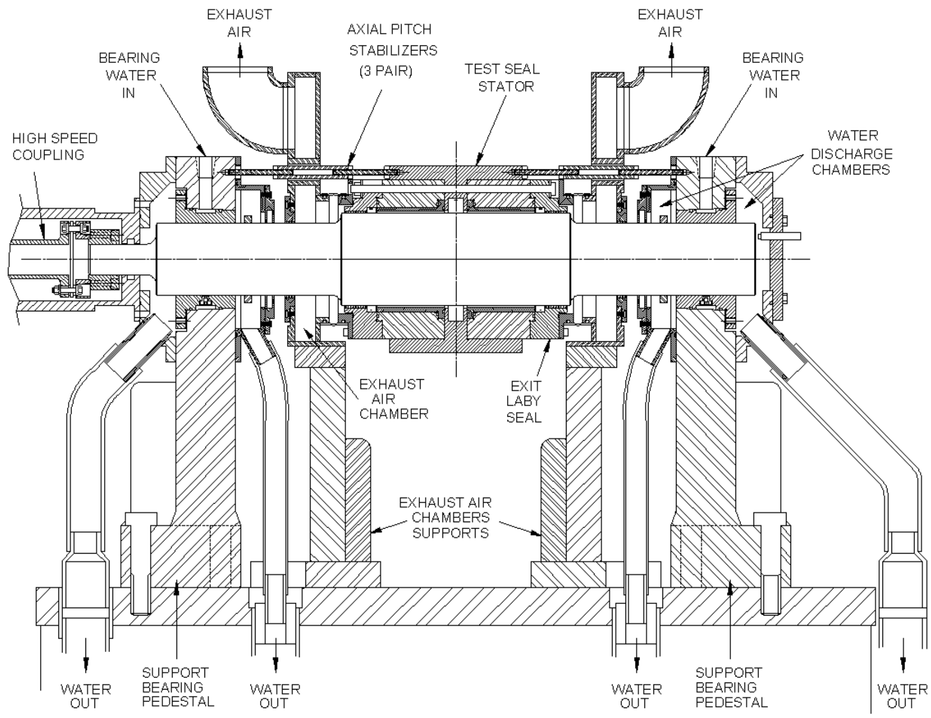



**Figure 8. Cross section of the air seal test rig.**

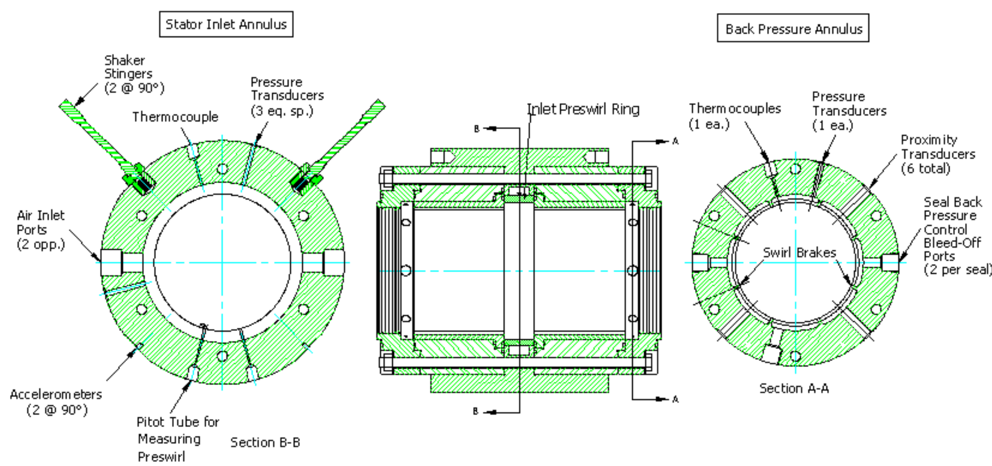



**Figure 9. Test stator assembly.**

The seals are held in the stator assembly shown in Figure 9. Two orthogonal hydraulic shakers support the stator assembly and control the seals' radial position relative to the rotor. The stingers that the hydraulic shakers act through can be seen in Figure 9, Section B-B. Force transducers that are in series with the stingers measure the force exerted on the stator by the hydraulic shakers. Opposed from the stingers $180^{\circ}$ there are accelerometers to measure the acceleration of the test stator in the two orthogonal directions corresponding to the directions that the stator is shaken.

As shown in Figure 8, there are three pitch stabilizers on each end of the stator; they are located in $120^{\circ}$ increments around the rotor. The pitch stabilizers are constructed in three pieces so they can be preloaded. The pitch stabilizers attach axially between the stator and the hydrostatic bearing pedestals and control the stator's axial position. They also align the stator with the rotor so that there is not angular misalignment between the rotor and stator. By tightening the pitch stabilizers in the appropriate manner, the stator can be aligned with the rotor.

During a test, high-pressure air enters at the middle of the stator through the inlet pre-swirl ring and then exits through the two test seals, as shown in Figure 9. The exiting air then passes through swirl brakes before the exit labyrinth seals to minimize the cross coupled forces produced by the labyrinth seals.

The stator is instrumented to obtain the inlet and exit air pressure and temperature. At the inlet to the test seals, the circumferential velocity of the air is measured and used to calculate fluid pre-swirl. The motor used to control the speed of the rotor is a 93 kW (125 hp) AC electric motor. The AC motor is coupled to a Lufkin 6.960:1 step-up gearbox, and a high-speed flexible coupling is used to link the test rotor to the gearbox, as displayed in Figure 8.

**Parameter identification**

The stator is excited in two orthogonal directions as stated before. The stator's equation of motion is,

$$\begin{Bmatrix} f_X \\ f_Y \end{Bmatrix} - \begin{Bmatrix} m_s \ddot{R}_{sX} \\ m_s \ddot{R}_{sY} \end{Bmatrix} = -\begin{Bmatrix} f_{sX} \\ f_{sY} \end{Bmatrix} \tag{6}$$

where $\boldsymbol{f}$ is the measured excitation force, $\boldsymbol{f}_s$ is the seal reaction force, $\ddot{\boldsymbol{R}}_s$ is the measured acceleration of the stator, and $m_s$ is the stator mass. The excitation force is measured via the load-cells attached to the shaker stingers, and the stator acceleration is measured via the accelerometers opposed $180^\circ$ from the stingers. The locations of these sensors are shown in Figure 9. Restating Eq. (6) in the frequency domain yields,

$$\begin{Bmatrix} \boldsymbol{F}_X - m_s \boldsymbol{A}_X \\ \boldsymbol{F}_Y - m_s \boldsymbol{A}_Y \end{Bmatrix} = -\begin{bmatrix} \boldsymbol{H}_{XX} & \boldsymbol{H}_{XY} \\ \boldsymbol{H}_{YX} & \boldsymbol{H}_{YY} \end{bmatrix} \begin{Bmatrix} \boldsymbol{D}_X \\ \boldsymbol{D}_Y \end{Bmatrix} \tag{7}$$

$\boldsymbol{F}$ and $\boldsymbol{A}$ are complex force and acceleration vectors expressed in the frequency domain, and the dynamic-stiffness coefficient matrix defines the seal reaction forces. There are four unknowns $\boldsymbol{H}_{xx}$, $\boldsymbol{H}_{xy}$, $\boldsymbol{H}_{yx}$, and $\boldsymbol{H}_{yy}$.

To solve for the four unknowns, the stator is shaken in orthogonal $X$ and $Y$ directions. By shaking in two orthogonal directions, four independent equations are obtained with four unknowns given by,

$$\begin{bmatrix} \boldsymbol{F}_{XX} - m_s \boldsymbol{A}_{XX} & \boldsymbol{F}_{XY} - m_s \boldsymbol{A}_{XY} \\ \boldsymbol{F}_{YX} - m_s \boldsymbol{A}_{YX} & \boldsymbol{F}_{YY} - m_s \boldsymbol{A}_{YY} \end{bmatrix} = -\begin{bmatrix} \boldsymbol{H}_{XX} & \boldsymbol{H}_{XY} \\ \boldsymbol{H}_{YX} & \boldsymbol{H}_{YY} \end{bmatrix} \begin{bmatrix} \boldsymbol{D}_{XX} & \boldsymbol{D}_{XY} \\ \boldsymbol{D}_{YX} & \boldsymbol{D}_{YY} \end{bmatrix} \tag{8}$$

Eq. (8) is valid for small motion about a centered position and has been verified by previous tests. The stiffness and damping terms are found directly from the dynamic-stiffnesses.

$$K(\Omega) = \mathrm{Re}(\boldsymbol{H}_{ii}(\Omega)) \tag{9}$$

$$k(\Omega) = \mathrm{Re}(\boldsymbol{H}_{ij}(\Omega)) \tag{10}$$

$$C(\Omega) = \frac{\mathrm{Im}(\boldsymbol{H}_{ii}(\Omega))}{\Omega} \tag{11}$$

$$c(\Omega) = \frac{\mathrm{Im}(\boldsymbol{H}_{ij}(\Omega))}{\Omega} \tag{12}$$

Average values for the stiffness and damping terms are of the follow form,

$$K_{avg}(\Omega) = \mathrm{Re}(\boldsymbol{H}_{XX}(\Omega) + \boldsymbol{H}_{YY}(\Omega)) / 2 \tag{13}$$

$$k_{avg}(\Omega) = \mathrm{Re}(\boldsymbol{H}_{XY}(\Omega) - \boldsymbol{H}_{YX}(\Omega)) / 2 \tag{14}$$

$$C_{avg}(\Omega) = \frac{\mathrm{Im}(\boldsymbol{H}_{XX}(\Omega) + \boldsymbol{H}_{YY}(\Omega))}{2\Omega} \tag{15}$$

$$c_{avg}(\Omega) = \frac{\mathrm{Im}(\boldsymbol{H}_{XY}(\Omega) - \boldsymbol{H}_{YX}(\Omega))}{2\Omega} \tag{16}$$

## Test seals

The hole-pattern seals described here have identical dimensions to the seals tested by Wade [6]. Replacement seals were machined out of 6061 aluminum. The test seals' inner diameter measurements are presented in Table 1. The inner bore diameter of the seals was measured using a three-point gauge that is accurate to 0.00254 mm (0.0001 in). Each seal was measured in three locations, rotating 30 degrees between each measurement, at both the inlet and outlet of the seal. As shown in Table 1, Seal 1 and Seal 2 have very similar dimensions.

**Table 1. Test seal dimensions.**

| Seal 1 | | | | |
|---|---|---|---|---|
| **Angle** | **Inlet** | | **Outlet** | |
| **0** | 114.706 mm | (4.5160 in) | 114.711 mm | (4.5162 in) |
| **30** | 114.706 mm | (4.5160 in) | 114.711 mm | (4.5162 in) |
| **90** | 114.706 mm | (4.5160 in) | 114.714 mm | (4.5163 in) |
| **Average** | 114.706 mm | (4.5160 in) | 114.712 mm | (4.5162 in) |

| Seal 2 | | | | |
|---|---|---|---|---|
| **Angle** | **Inlet** | | **Outlet** | |
| **0** | 114.701 mm | (4.5158 in) | 114.709 mm | (4.5161 in) |
| **30** | 114.701 mm | (4.5158 in) | 114.706 mm | (4.5160 in) |
| **90** | 114.704 mm | (4.5159 in) | 114.706 mm | (4.5160 in) |
| **Average** | 114.702 mm | (4.5158 in) | 114.707 mm | (4.5160 in) |

Figure 10 shows the hole-pattern of the test seals. The holes are 3.175 mm (0.125in) in diameter and 3.302 mm (0.130 in) deep. Gamma ratio ($\gamma$) is the area of the holes divided by the area of the inner surface of the seal. The test seals have a gamma ratio of 0.69, or 69% of the inner surface is taken up by holes. The seals are 85.725 mm (3.375 in) long, and the average inner diameter of the seals is 114.707 mm (4.5160 in). Therefore this seal has an L/D ratio of 0.75.

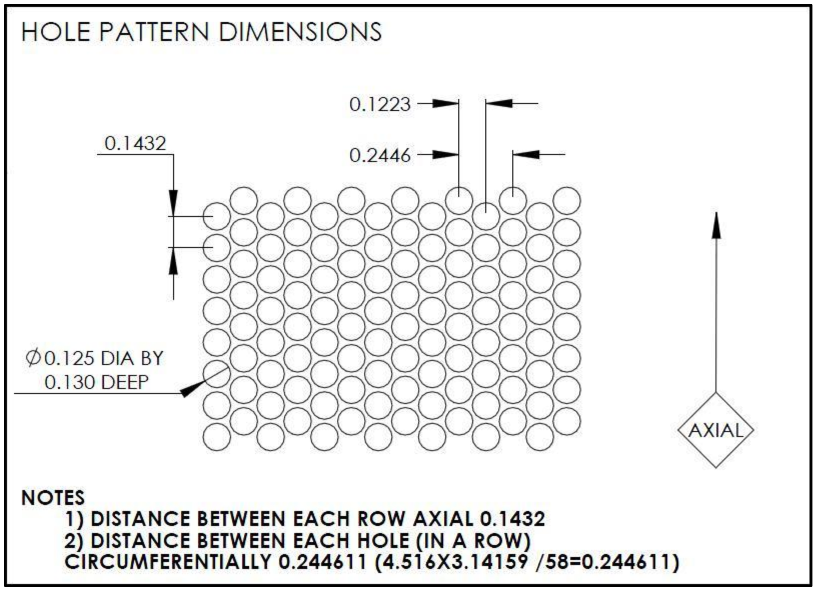



**Figure 10. Drawing of test seal hole pattern.**

## Fluid preswirl

Figure 11 shows a cross-section of the different preswirl rings and the location of the pitot tube used to measure circumferential velocity ($V_t$). Circumferential fluid flow causes cross-coupled stiffness and damping terms. Certain seals are more sensitive to fluid rotation and therefore produce larger cross-coupled terms given the same inlet fluid swirl conditions. Some of the test conditions were chosen to explore how the seals respond to various inlet swirl conditions.

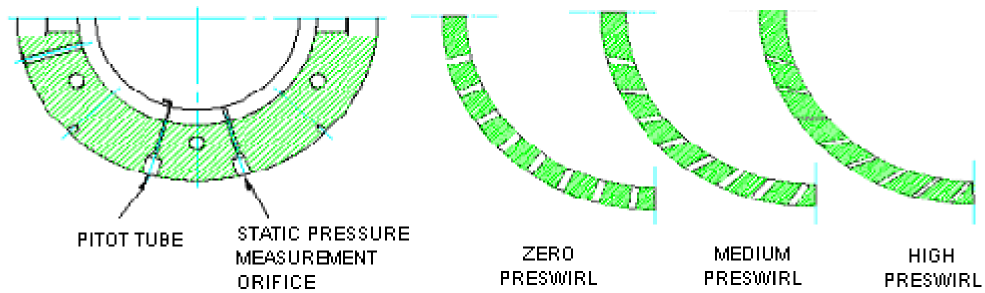



**Figure 11. Cross-section view of the preswirl rings and pitot tube location.**

Fluid preswirl ratio $u_0(0)$ is defined by Eq. (17) as the fluid's circumferential velocity ($V_t$) divided by the rotor's surface speed, where $N$ is rotor speed in RPM and $D_r$ is rotor diameter .

$$u_0(0) = \frac{V_t \cdot 60}{\pi \cdot N \cdot D_r} \tag{17}$$

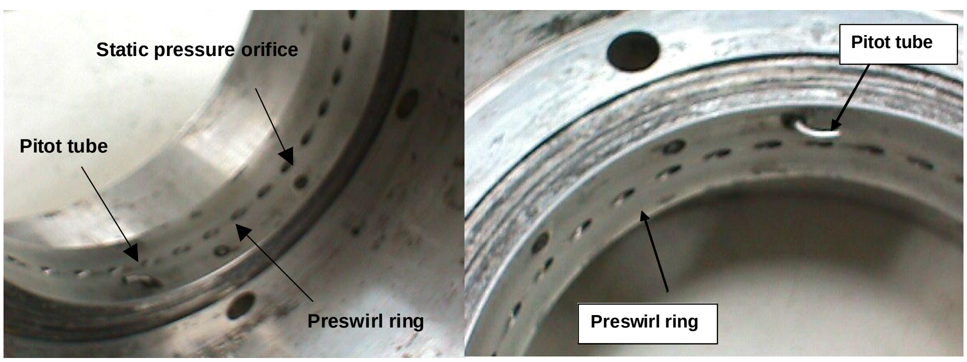



**Figure 12. Preswirl ring and preswirl measurement.**

A preswirl ratio of 1.0 means that the fluid enters the seal with a speed equal to the surface velocity of the rotor, and a value of 0.5 means that the fluid is rotating at half of the rotor's surface speed. In addition, a negative preswirl ratio would indicate that the fluid is rotating against the direction of rotor rotation.

This test rig measures the fluid circumferential velocity using a pitot tube located at the inlet annulus. The pitot tube can be seen in Figure 12, and measures the fluid swirl immediately before the fluid enters the test seals. The fluid circumferential velocity is calculated based on the pressure differential between the static and stagnation pressures measured in the inlet annulus. Some error in preswirl measurement could exist due to the angle of the pitot tube with respect to the inlet annulus as shown in Barlow, Rae, and Pope [17]. The inlet annulus is shown in the stator diagram in Figure 9 Section B-B.

The preswirl ring in the inlet annulus directs the air circumferentially as shown in Figure 11. The high-pressure air is fed into the inlet annulus and then flows through the preswirl ring before entering the test seals. Three levels of preswirl rings were tested and are designated: zero, negative-medium, and negative-high. The zero preswirl ring has holes that are radial, injecting the air radially onto the rotor. To produce the negative-medium and negative-high preswirl cases, the standard medium and high preswirl stator assemblies were simply reoriented with their front end now facing towards the rear. This change in stator orientation reverses the preswirl direction. The negative-medium preswirl ring gives the incoming air a preswirl ratio of approximately -0.5 for 70 bar inlet pressure, 10,200 RPM rotor speed, and 50% pressure ratio. The negative-high preswirl ring produces a preswirl ratio of approximately -1.0 for 70 bar inlet pressure, 10,200 RPM rotor speed, and 50% pressure ratio.

## Leakage flow rate

All annular seals leak. Leakage rates depend on many factors, but the main factors are: (1) the pressure drop across the seal, (2) the radial clearance between the rotor and the seal, (3) the length of the seal, and (4) the relative roughness of the seal and rotor surfaces.

The volumetric flow rate that flows through the seals is measured by a turbine style flow meter upstream from the test seals. The flow meter is located between the inlet control valve and the test stator and measures the total flow through both seals. Since the seals are physically as close to identical as possible, and the pressure drop across both seals is measured and found to be very nearly the same, the flow is assumed to be split evenly between each seal.

The temperature and pressure of the air passing through the flow meter are measured and used to convert from volumetric flow rate to mass flow rate. During the course of a test run, the volumetric flow rate, the temperature, and the pressure of the air are recorded four times. These four samples are recorded while the test rig is operating in a steady state condition, before and after each of the two test shakes has occurred. The four data points are then averaged, and these average values are reported.

### Test conditions

The seals were tested at three pressure ratios, three preswirls, and three rotor speeds with a total of 27 different test conditions. The test matrix is presented in Table 2. The inlet pressure was a constant 70 bar (1015 psi) for all 27 test conditions. Initially, testing was attempted at a pressure ratio of 0.40, but due to static stability problems at pressure ratios below 0.45, a lowest pressure ratio of 0.50 was chosen to avoid these issues. When experiencing this static instability, the stator drifts towards the rotor and eventually makes contact. With shaft rotation, even brief contact between the stator and rotor can cause severe damage to the aluminum test seals. Wade [6] did not experience this problem even at much lower pressure ratios. The initial geometry of his seals was selected based on proprietary test results for a seal with identical dimensions, other than a slightly more shallow hole depth of 3.180 mm. The proprietary seals experienced strong negative stiffness at low excitation frequencies. The stability issues at low pressure ratios experienced during this testing were similar and are not fully understood.

**Table 2. Test matrix.**

| 0.125 in Hole Diameter 0.130 in Hole Depth | | | Preswirl (-) | | |
|---|---|---|---|---|---|
| Radial Seal Clearance | Rotor Speed | Pressure Ratio | Zero | Negative Medium | Negative High |
| (mm) | (rpm) | (-) | Inlet Pressure (bar) | | |
| 0.2 | 10200 | 0.5 | 70 | 70 | 70 |
| | | 0.6 | 70 | 70 | 70 |
| | | 0.7 | 70 | 70 | 70 |
| | 15350 | 0.5 | 70 | 70 | 70 |
| | | 0.6 | 70 | 70 | 70 |
| | | 0.7 | 70 | 70 | 70 |
| | 20200 | 0.5 | 70 | 70 | 70 |
| | | 0.6 | 70 | 70 | 70 |
| | | 0.7 | 70 | 70 | 70 |

The test matrix for the research performed by Wade [6] is shown in Table 3. He tested seals with identical dimensions at four pressure ratios, three preswirl ratios, three rotor speeds, and two clearances.

**Table 3. Wade test matrix.**

| **0.125 in Hole Diameter 0.130 in Hole Depth** | | | **Preswirl (-)** | | |
|---|---|---|---|---|---|
| **Radial Seal Clearance** | **Rotor Speed** | **Pressure Ratio** | **Zero** | **Positive Medium** | **Positive High** |
| (mm) | (rpm) | (-) | Inlet Pressure (bar) | | |
| 0.1 | 10200 | 0.17 | 70 | 70 | 70 |
| | | 0.27 | 70 | 70 | 70 |
| | | 0.37 | 70 | 70 | 70 |
| | | 0.47 | 70 | 70 | 70 |
| | 15350 | 0.17 | 70 | 70 | 70 |
| | | 0.27 | 70 | 70 | 70 |
| | | 0.37 | 70 | 70 | 70 |
| | | 0.47 | 70 | 70 | 70 |
| | 20200 | 0.17 | 70 | 70 | 70 |
| | | 0.27 | 70 | 70 | 70 |
| | | 0.37 | 70 | 70 | 70 |
| | | 0.47 | 70 | 70 | 70 |
| 0.2 | 10200 | 0.17 | 70 | 70 | 70 |
| | | 0.27 | 70 | 70 | 70 |
| | | 0.37 | 70 | 70 | 70 |
| | | 0.47 | 70 | 70 | 70 |
| | 15350 | 0.17 | 70 | 70 | 70 |
| | | 0.27 | 70 | 70 | 70 |
| | | 0.37 | 70 | 70 | 70 |
| | | 0.47 | 70 | 70 | 70 |
| | 20200 | 0.17 | 70 | 70 | 70 |
| | | 0.27 | 70 | 70 | 70 |
| | | 0.37 | 70 | 70 | 70 |
| | | 0.47 | 70 | 70 | 70 |

# EXPERIMENTAL PROCEDURE

## Baseline data

To account for the stiffness and damping that are not produced by the test seals, baseline data are measured. The baseline data are comprised of the rotordynamic coefficients produced by fluid forces within the test stator and the stiffness and damping components resulting from the external assembly that supports the test stator. Baseline data are obtained by assembling the test rig without seals in the stator and performing dynamic testing. With the test seals removed, the stator is pressurized so that the pressure at the exit labyrinth seals is the same as during a fully assembled test case with seals installed. With the rotor spinning at the desired test speed, the stator is shaken and dynamic data recorded. This test gives a measurement of the forces that result from internal stator fluid forces and the stiffness and damping of the stator support assembly. The rotordynamic coefficients of the test seals are obtained by subtracting the baseline real and imaginary dynamic-stiffnesses from the real and imaginary dynamic-stiffnesses produced with the test seals installed and pressurized.

Figure 13 shows both the direct and cross-coupled components of the real dynamic stiffnesses associated with a baseline test performed at an exit pressure of 600 psi and rotor speed $\omega$ = 15,350 RPM.

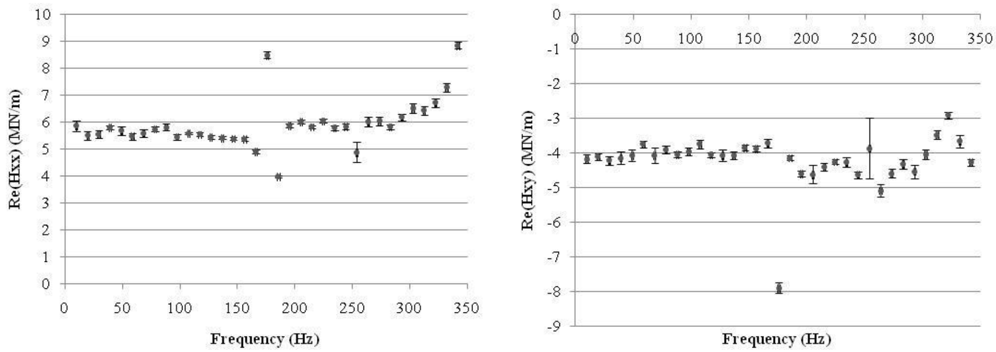



**Figure 13. Direct (left) and cross-coupled (right) components of the real portion of baseline dynamic-stiffnesses for $P_e$ = 600 psi and $\omega$ = 15,350 RPM.**

Figure 14 shows both the direct and cross-coupled components of the imaginary dynamic stiffnesses associated with a baseline test performed at an exit pressure of 600 psi and rotor speed $\omega$ = 15,350 RPM.

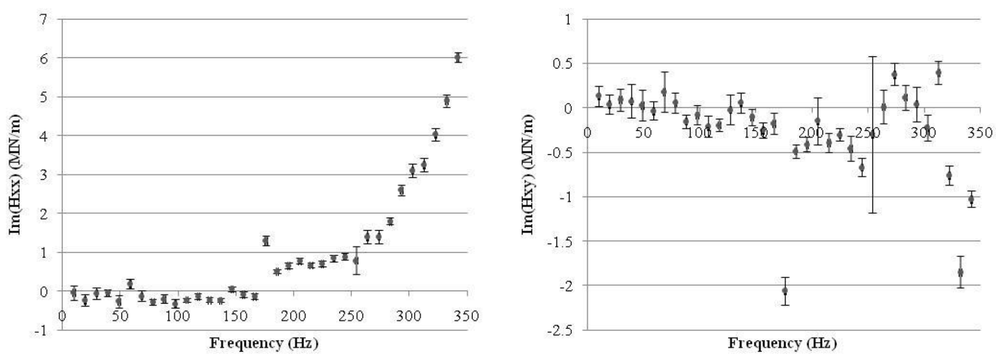



**Figure 14. Direct (left) and cross-coupled (right) components of the imaginary portion of baseline dynamic-stiffnesses for $P_e$ = 600 psi and ω = 15,350 RPM.**

Baseline data shown in Figure 13 and Figure 14 only represents data recorded in the *X* direction, but baseline data recorded in the *Y* direction are very similar. Baseline dynamic-stiffness magnitudes are approximately 15% of the dynamic-stiffness magnitudes recorded during fully assembled testing.

### Static measurement uncertainty

Measurements do not come without some level of uncertainty. With these experiments, there is uncertainty in the static measurements of stator pressure ($P_s$), pressure across the flow meter ($P_f$), stator and flow temperatures ($T$), pitot tube differential pressure ($H_w$), volumetric flow rate ($\dot{Q}$), and rotor speed ($\omega$). Uncertainty analysis for the static coefficients was performed using the method described in Coleman and Steele [18] used by Kurtin et al. [19] on the hydrostatic bearing rig. This uncertainty analysis technique employs statistical methods to combine sensor calibration error and the error associated with analog to digital data conversion within the data acquisition system. The uncertainties for the static coefficients of the test rig are presented in Table 4.

**Table 4. Static coefficient uncertainties.**

| $Ps$ | $Pf$ | $T$ | $Hw$ | $\dot{Q}$ | $\omega$ |
|---|---|---|---|---|---|
| 0.838 psi | 5.004 psi | 5.613 °F | 1.276 in-H2O | 0.547 ACFM | 2.807 RPM |

**Dynamic measurement repeatability**

To obtain a gauge for the repeatability of dynamic measurements, data collected in the $X$ and $Y$ directions are evaluated for consistency. During each dynamic test, 320 data sets are collected during the $X$ shake sequence and 320 data sets are collected during the $Y$ shake sequence. These large data sets are then condensed, resulting in five $X$ data groups and five $Y$ data groups. Every $X$ data group is compared to every $Y$ data group, corresponding to 25 individual sets of real and imaginary dynamic-stiffnesses. A standard deviation is produced from these 25 data sets at each frequency. The standard deviation of each frequency term is plotted as error bars on each corresponding data point.

Repeatability values ($\sigma$) were calculated in the same manner for the baseline data. All of the data that are reported in this thesis combine the baseline and test repeatability values. Eq. (18) shows how the repeatability values are combined.

$$\sigma_{total} = \sigma_{baseline} + \sigma_{test} \tag{18}$$

# DISCUSSION OF RESULTS

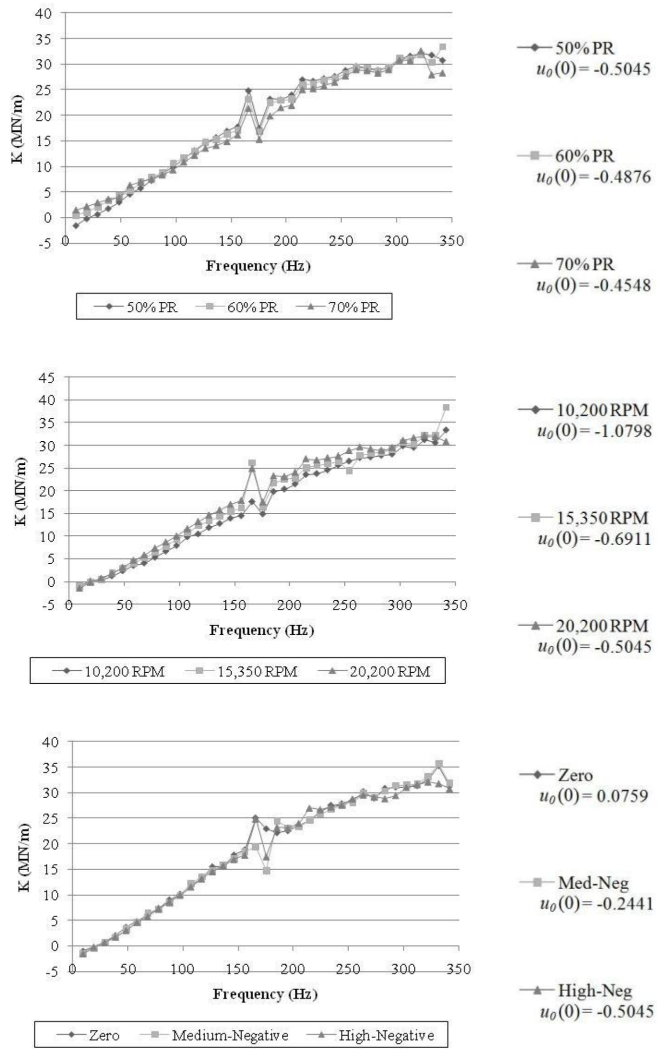
The test matrix shown in Table 2 was created to discover how the rotordynamic characteristics and leakage of the test seals react to changes in pressure ratio, rotor speed, and inlet negative preswirl.

## Direct stiffness

The direct stiffness coefficients are developed from the real part of the dynamic-stiffnesses, as shown in Eq. (9). The data to be presented represents the average direct dynamic stiffness coefficients measured in the *X* and *Y* directions. All dynamic data presented in this thesis are the average of the data measured in each direction. Dynamic data measured in the *X* and *Y* directions were very similar for all cases. The effects of varying pressure ratio, rotor speed, and preswirl on direct stiffness are shown in Figure 15. Standard conditions for these plots are 50% PR, $\omega$ = 20,200 RPM, and high-negative preswirl. Preswirl ratio ($u_0(0)$) is displayed for all test cases.

Direct stiffness is only slightly affected by pressure ratio, displaying lower stiffness values at lower pressure ratios at the initial excitation frequencies in Figure 15 (a). Testing done by Wade [6] with geometrically identical seals at a similar clearance and inlet pressure showed the same weak trend between direct stiffness and pressure ratio. In Figure 15 (b), the direct stiffness shows minor increases with increasing rotor speed. Wade [6] did not observe this relationship in his direct stiffness measurements. Figure 15 (c) shows that variation in preswirl does not affect direct stiffness. Direct stiffness data presented by Wade [6] was also independent of preswirl.

In general, direct stiffness is not strongly affected by changes in pressure ratio, rotor speed, or preswirl. Direct stiffness values were of similar magnitude to the values recorded by Wade [6] using geometrically identical seals at a similar clearance and inlet pressure.




**(a)**

**(b)**

**(c)**

**Figure 15. Direct stiffness versus excitation frequency for (a) three pressure ratios, $\omega$ = 20,200 RPM, and high-negative preswirl, (b) three rotor speeds, PR = 50%, and high-negative preswirl, and (c) three preswirls, PR = 50%, and $\omega$ = 20,200 RPM.**

### Cross-coupled stiffness

The cross-coupled stiffness coefficients are developed from the real part of the dynamic-stiffnesses, as shown in Eq. (10). The effects of varying pressure ratio, rotor speed, and preswirl on cross-coupled stiffness are shown in Figure 16. Standard conditions for these plots are 50% PR, $\omega$ = 20,200 RPM, and high-negative preswirl.

Cross-coupled stiffness has a slight response to pressure ratio, as shown in Figure 16 (a). As pressure ratio decreases so does the slope of the cross-coupled stiffness, becoming negative briefly in the 50% pressure ratio test case. Cross-coupled stiffness coefficients at all pressure ratios have roughly the same value at the initial and final excitation frequencies. Cross-coupled stiffness results presented by Wade [6] are unaffected by pressure ratio.

Figure 16 (b) displays the result of varying rotor speed on cross-coupled stiffness. Cross-coupled stiffness is drastically affected by changes in rotor speed, increasing as rotor speed is increased. For the 10,200 RPM test speed, cross-coupled stiffness becomes negative due to the effects of the high-negative preswirl condition. In this instance, the negative inlet fluid swirl that opposes the positive fluid swirl induced by rotor rotation is able to reverse the direction of the overall fluid swirl within the seal and thus eliminate destabilizing cross-coupled stiffness effects. In the remaining two test cases, rotor rotation induced swirl is able to overpower the negative inlet fluid swirl and produce positive cross-coupled stiffness values. As previously stated, Benckert and Wachter [2] found that for labyrinth seals positive preswirl produces positive cross-coupled stiffness terms while negative preswirl produces negative cross-coupled stiffness terms. Thus as rotor speed increases, more positive swirl is generated while the negative inlet preswirl remains constant. Wade [6] saw similar cross-coupled stiffness behavior, where cross-coupled stiffness values grew as $\omega$ increased. The $k$ values he reported at a similar clearance and pressure are significantly greater due to their positive preswirl test condition versus the negative preswirl test conditions presented in this thesis.

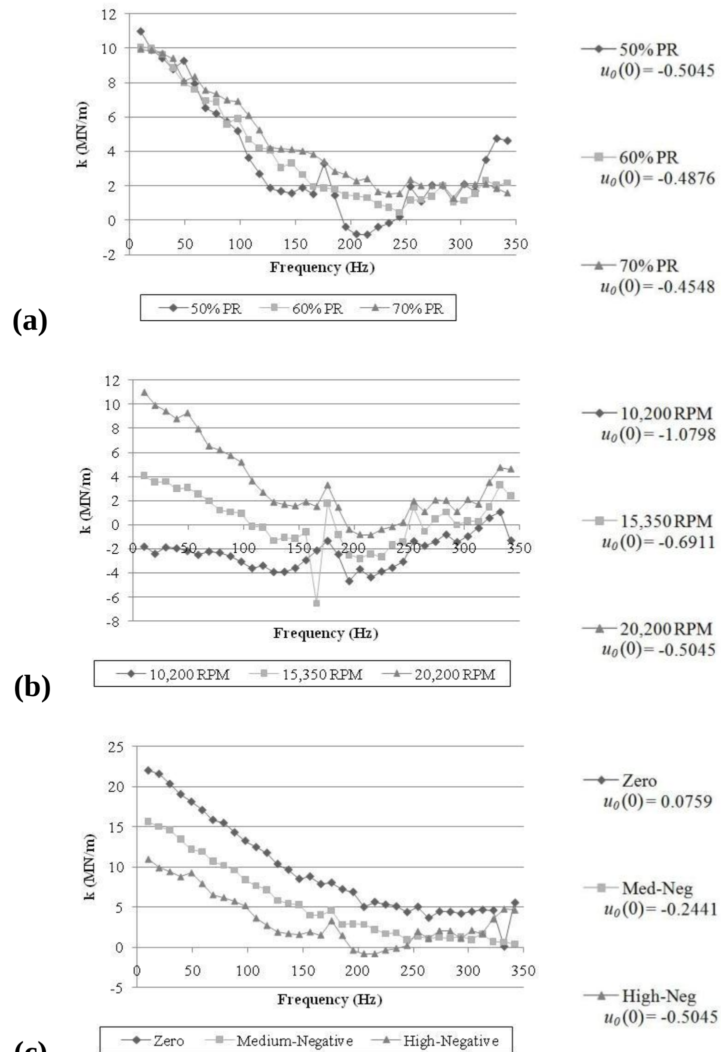



**Figure 16. Cross-coupled stiffness versus excitation frequency for (a) three pressure ratios, $\omega$ = 20,200 RPM, and high-negative preswirl, (b) three rotor speeds, PR = 50%, and high-negative preswirl, and (c) three preswirls, PR = 50%, and $\omega$ = 20,200 RPM.**

In Figure 16 (c), $k$ shows a clear relationship with preswirl, decreasing as negative preswirl is increased. Cross-coupled stiffness values for the high-negative preswirl case are reduced by 50% from the zero preswirl case. This result shows that the addition of negative preswirl can substantially reduce destabilizing cross-coupled stiffness coefficients. Wade [6] also saw a strong relationship between cross-coupled stiffness and preswirl when geometrically identical test seals were tested under positive preswirl conditions. He found that increasing positive preswirl resulted in increased cross-coupled stiffness values.

**Direct damping**

The *C* coefficients are developed from the imaginary part of the dynamic-stiffnesses, as shown in Eq. (11). The effects of varying pressure ratio, rotor speed, and preswirl on direct damping are presented in Figure 17. Standard conditions for these plots are 50% PR, $\omega$ = 20,200 RPM, and high-negative preswirl.

Figure 17 (a) shows that *C* increases with decreasing PR at the initial excitation frequencies. Pressure ratio does not affect direct damping at excitation frequencies above 100 Hz. This is the same relationship observed by Wade [6] with pressure ratios ranging from 17% to 47%. This trend could be due to the effect of pressure ratio on air density, a greater pressure drop across the test seals results in denser air within the stator.

Direct damping increases slightly with increasing rotor speed at low excitation frequencies, as displayed in Figure 17 (b). Wade [6] did not observe this mild trend, and reported that direct damping was independent of rotor speed.

Preswirl has no effect on direct damping as displayed in Figure 17 (c). Direct damping was similarly uninfluenced by preswirl in Wade's [6] results.

Overall, peak direct damping magnitudes presented in this thesis are somewhat greater than those presented by Wade [6] for similar test conditions. This is apparent when comparing the 50% pressure ratio test case peak direct damping (50,000 Ns/m) presented in this thesis versus the 47% pressure ratio test case peak direct damping (40,000 Ns/m) presented by Wade [6]. This difference is likely due to test repeatability error, and is not viewed as a significant result.

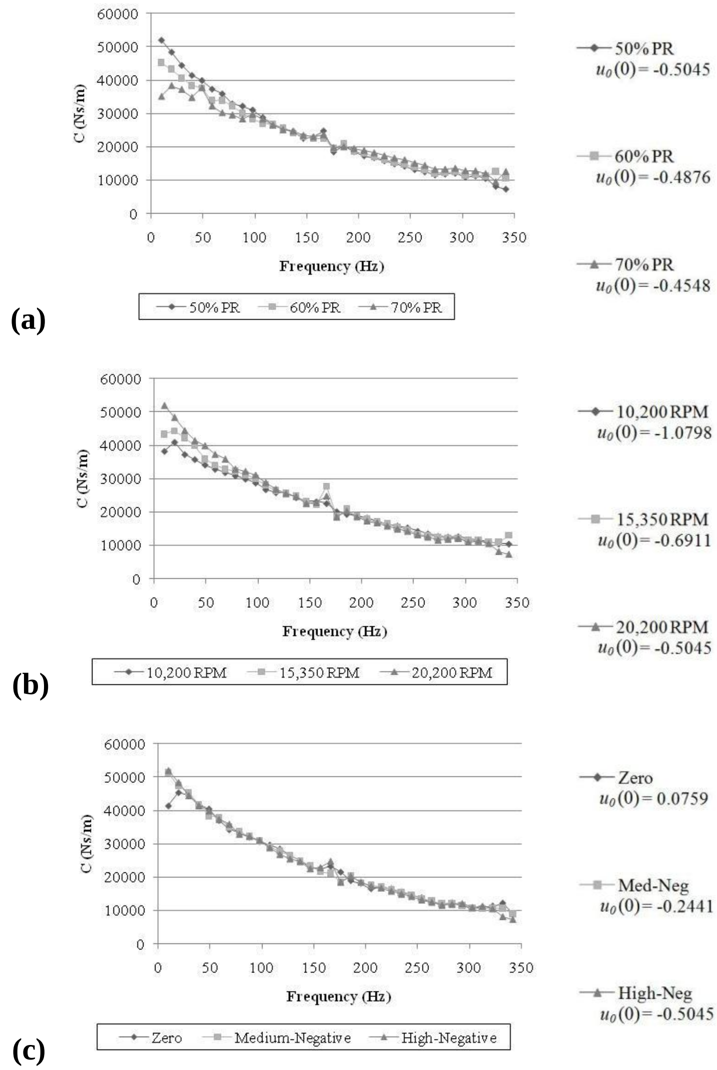



**Figure 17. Direct damping versus excitation frequency for (a) three pressure ratios, $\omega$ = 20,200 RPM, and high-negative preswirl, (b) three rotor speeds, PR = 50%, and high-negative preswirl, and (c) three preswirls, PR = 50%, and $\omega$ = 20,200 RPM.**

## Cross-coupled damping

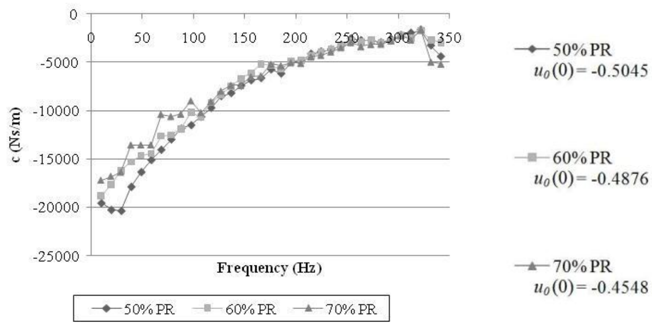
The cross-coupled damping coefficients are developed from the imaginary part of the dynamic-stiffnesses, as shown in Eq. (12). The effects of varying pressure ratio, rotor speed, and preswirl on cross-coupled damping are presented in Figure 18. Standard conditions for these plots are 50% PR, $\omega$ = 20,200 RPM, and high-negative preswirl.

Cross-coupled damping is plotted for three pressure ratios in Figure 18 (a). Changes in pressure ratio have a weak effect on cross-coupled damping coefficients, though coefficient magnitudes do increase slightly with decreasing pressure ratio at low excitation frequencies. Wade [6] reported the same cross-coupled stiffness behavior, but with more pronounced effects at the lower pressure ratios he tested.

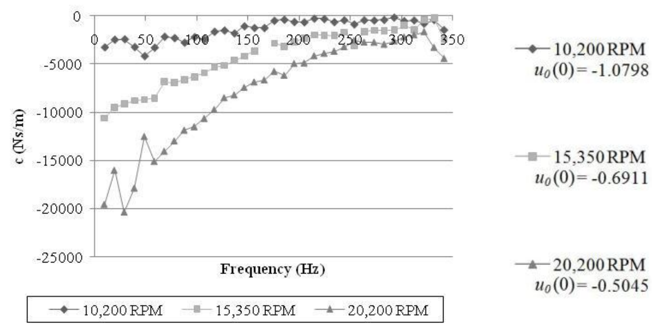
Changes in $\omega$ greatly influence cross-coupled damping. Higher rotor speeds translate to larger cross-coupled damping coefficients as shown in Figure 18 (b). Wade's [6] cross-coupled damping results had a very similar response to changes in $\omega$.

Figure 18 (c) shows cross-coupled damping decreasing as negative preswirl is increased. In the positive preswirl testing done by Wade [6], cross-coupled damping was unaffected by changes in preswirl.

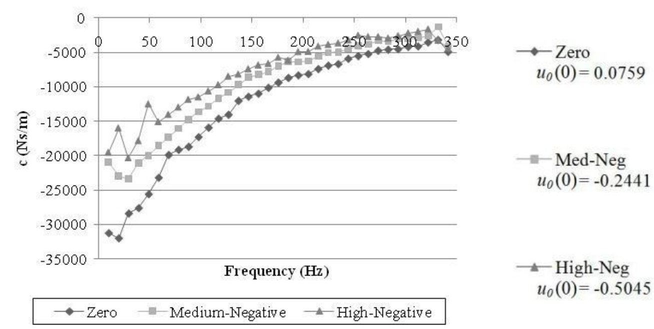
Peak Cross-coupled damping magnitudes in this thesis were very comparable to those presented by Wade [6] for 47% PR, $\omega$ = 20,200 RPM, and zero preswirl.




**(a)**




**(b)**




**(c)**

**Figure 18. Cross-coupled damping versus excitation frequency for (a) three pressure ratios, $\omega$ = 20,200 RPM, and high-negative preswirl, (b) three rotor speeds, PR = 50%, and high-negative preswirl, and (c) three preswirls, PR = 50%, and $\omega$ = 20,200 RPM.**

**Effective stiffness**

Effective stiffness is a description of the centering force of a system. The formula for effective stiffness is given in Eq. (4). The effects of varying pressure ratio, rotor speed, and preswirl on effective stiffness are shown in Figure 18. Standard conditions for these plots are 50% PR, $\omega$ = 20,200 RPM, and high-negative preswirl.

$$K_{eff}(\Omega) = K(\Omega) + c(\Omega)\Omega \tag{4}$$

Figure 19 (a) shows that $K_{eff}$ is not significantly affected by changes in pressure ratio but exhibits behavior similar to direct stiffness in Figure 15 (a) with slightly smaller values for lower pressure ratios at the initial excitation frequencies.

Effective stiffness decreases slightly as rotor speed increases as indicated by Figure 19 (b). This effect is due to the sensitivity of cross-coupled damping to rotor speed and the influence cross-coupled damping has on effective stiffness, as defined in Eq. (4).

Figure 19 (c) shows small changes in effective stiffness as preswirl is varied. Effective stiffness increases with increasing negative preswirl because destabilizing cross-coupled damping coefficients are reduced with the addition of negative preswirl.

In all test cases, effective stiffness was marginally less than direct stiffness due to the presence of low magnitude cross-coupled damping coefficients and their effect on Eq. (4).

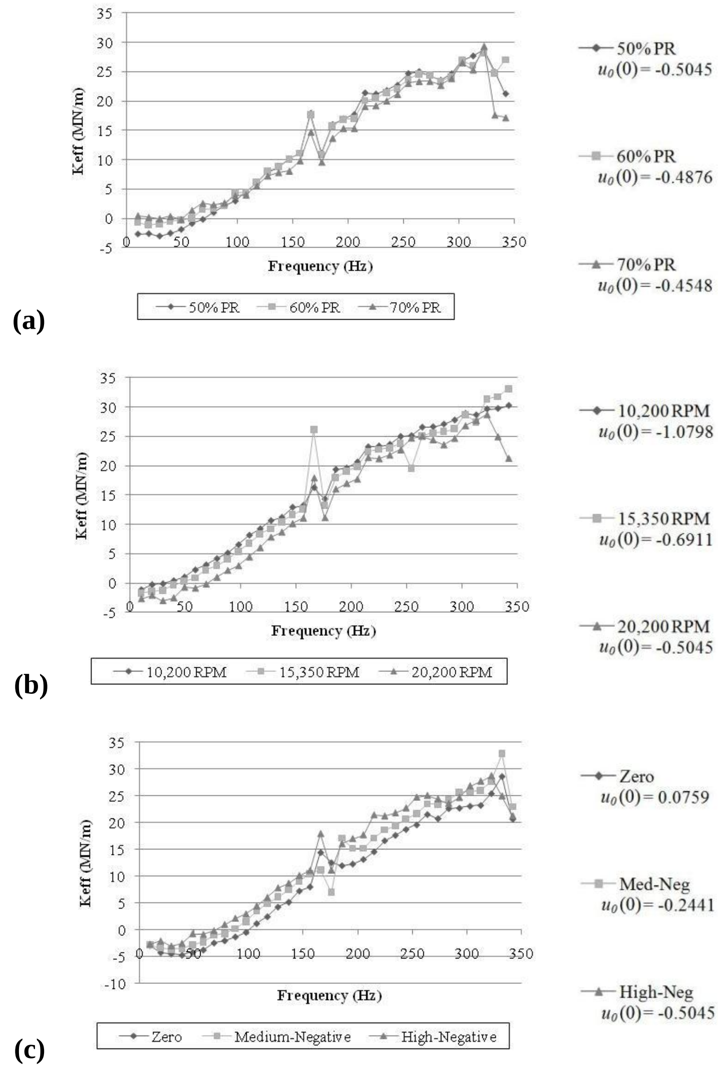
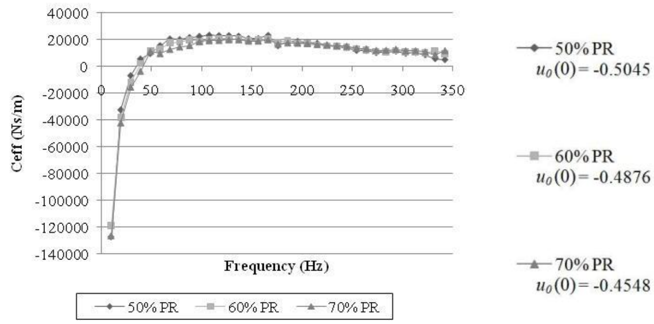



**Figure 19. Effective stiffness versus excitation frequency for (a) three pressure ratios, $\omega$ = 20,200 RPM, and high-negative preswirl, (b) three rotor speeds, PR = 50%, and high-negative preswirl, and (c) three preswirls, PR = 50%, and $\omega$ = 20,200 RPM.**

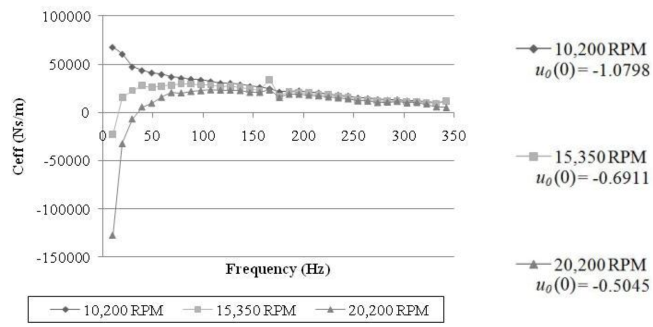
**Effective damping**

Effective damping is one of the strongest measures of stability for annular gas seals. Peak effective damping as well as the excitation frequency where effective damping values transition from negative to positive values, called the "cross-over frequency", are points of special interest. It is desirable to have a high peak effective damping and a low cross-over frequency. The lower the cross-over frequency, the more likely this transition will occur before the systems first natural frequency, thus providing positive effective damping to diminish the destabilizing effects of passing through a resonance. The formula for effective damping is given in Eq. (5). The effects of varying pressure ratio, rotor speed, and preswirl on effective damping are shown in Figure 20. Standard conditions for these plots are 50% PR, $\omega$ = 20,200 RPM, and high-negative preswirl.

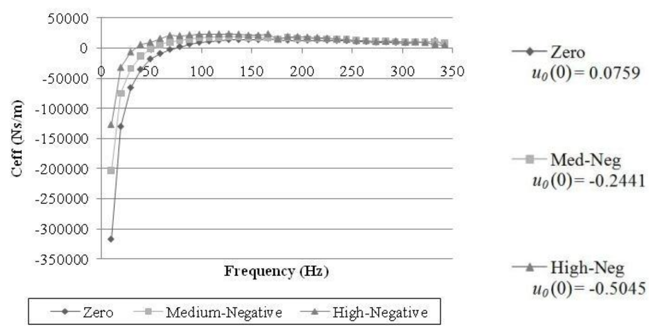
$$C_{eff} = C(\Omega) - \frac{k(\Omega)}{\Omega} \qquad (5)$$




(a)




(b)




(c)

**Figure 20. Effective damping versus excitation frequency for (a) three pressure ratios, $\omega$ = 20,200 RPM, and high-negative preswirl, (b) three rotor speeds, PR = 50%, and high-negative preswirl, and (c) three preswirls, PR = 50%, and $\omega$ = 20,200 RPM.**

Figure 20 (a) shows that $C_{eff}$ is not significantly affected by changes in pressure ratio. This outcome is explained by the minimal effects of pressure ratio on direct damping in Figure 17 (a) and on cross-coupled stiffness in Figure 16 (a).

Effective damping shows a strong relationship with rotor speed in Figure 20 (b). Peak effective damping decreases as rotor speed is increased, while cross-over frequency increases with increasing rotor speed. Changes in these parameters are both destabilizing trends, displaying the unfavorable effects of increased positive fluid swirl due to rotor rotation. The growth of cross-coupled stiffness coefficients caused by increases in rotor induced positive fluid swirl is the main contributor of destabilization via Eq. (5).

Figure 20 (c) illustrates the stabilizing effects of negative preswirl, as indicated by beneficial changes in effective damping. As negative preswirl is increased, peak effective damping increases from 15,700 Ns/m at zero preswirl to 19,200 Ns/m at medium-negative preswirl to 23,400 Ns/m at high-negative preswirl and cross-over frequency decreases from 70 Hz at zero preswirl to 55 Hz at medium-negative preswirl to 35 Hz at high-negative preswirl. This corresponds to 50% improvements in both peak effective damping and cross-over frequency with the addition of negative preswirl. This is an important finding, which validates the use of hardware such as the anti-swirl vanes employed by Gans [14] on hole-pattern seals to induce a negative inlet fluid swirl and increase their stability.

# MEASUREMENT VERSUS PREDICTIONS OF LEAKAGE RATES

This section will present a comparison between measured seal leakage mass flow rates and leakage rates predicted by the ISOT model. ISOT is based on the model by Kleynhans and Childs [5] that uses an ideal gas model with an assumed constant temperature.

The prediction model is based on a bulk flow model and uses a Blasius friction factor of the following form,

$$f_f = n\,\mathrm{Re}^m \tag{19}$$

The values for the Blasius friction factor model were $n_{rotor}$= 0.0568, $m_{rotor}$= -.217, $n_{stator}$= 0.0785, and $n_{stator}$= -0.1011. These were the default values selected by Kleynhans and Childs [5]. Entrance loss ($\xi$) and exit recovery ($\xi_e$) factors are given by,

$$p_0(0) = \frac{1+\sqrt{1-\dfrac{2(1+\xi)\phi^2}{h_0^{\,2}(0)}}}{2} \tag{20}$$

$$p_0(1) = \frac{p_e+\sqrt{p_e^{\,2}-\dfrac{2(1-\xi_e)\phi^2}{h_0^{\,2}(1)}}}{2} \tag{21}$$

$$\phi = \frac{\dot{m}\sqrt{Z_c RT}}{\pi D P C_r} \tag{22}$$

$$p_e = \frac{p_0(1)}{p_0(0)} \tag{23}$$

where $p_0$ and $h_0$ are zeroth order non-dimensionalized pressure and clearance, and $\phi$ is non-dimensionalized mass flow rate. The values for entrance loss and exit recovery factors were $\xi = 0$ and $\xi_e = 1$. These were the default values selected by Kleynhans and Childs [5].

Figure 21 presents measured and predicted seal leakage versus inlet preswirl for each pressure ratio measured at a rotor speed of 10,200 RPM.

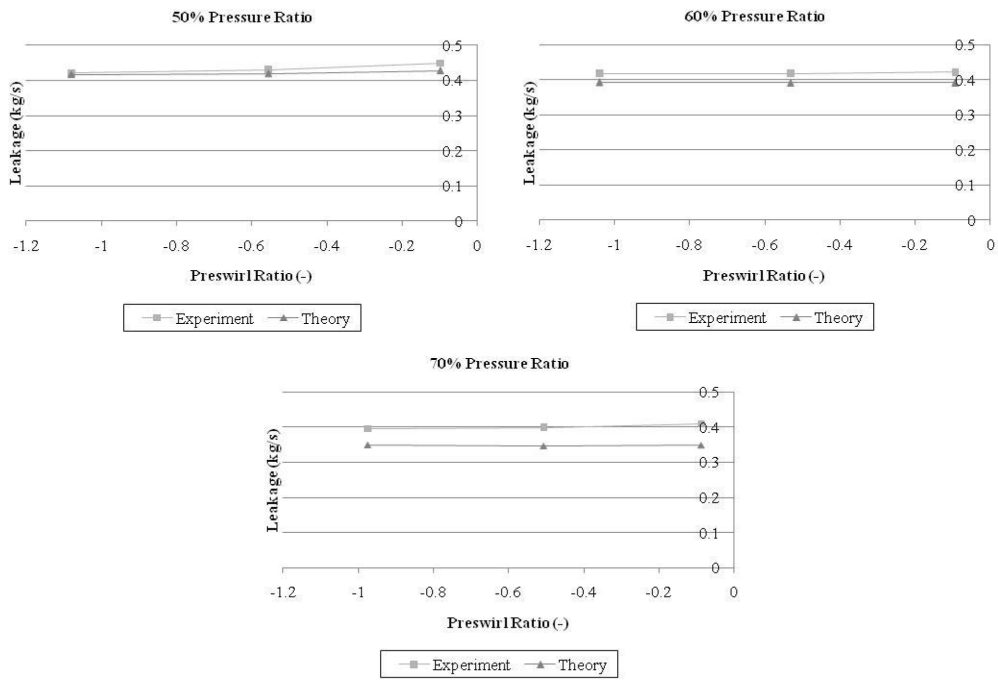



**Figure 21. Seal leakage measurements and predictions versus preswirl ratio, ω = 10,200 RPM.**

Preswirl does not significantly affect leakage, a trend also observed by Wade [6] with geometrically identical seals tested at lower pressure ratios and positive preswirls. Rotor speed does not significantly affect leakage measurements. Wade [6] similarly saw little relationship between rotor speed and leakage. Measured and predicted seal leakage values are shown versus pressure ratio at $\omega$ = 10,200 RPM in Figure 22. Measured leakage values decrease slightly as pressure ratio is increased.

Leakage results presented by Wade [6] for pressure ratios ranging from 17% to 47% showed the same decreasing leakage trend. Gas flow through the seal was both turbulent and compressible, as expressed by Reynolds numbers in excess of 100,000 and exit Mach numbers around 0.40. Leakage magnitudes presented in this thesis were extremely similar to the leakage values measured by Wade [6] for geometrically identical seals at similar seal clearance, inlet pressure, and pressure ratio.

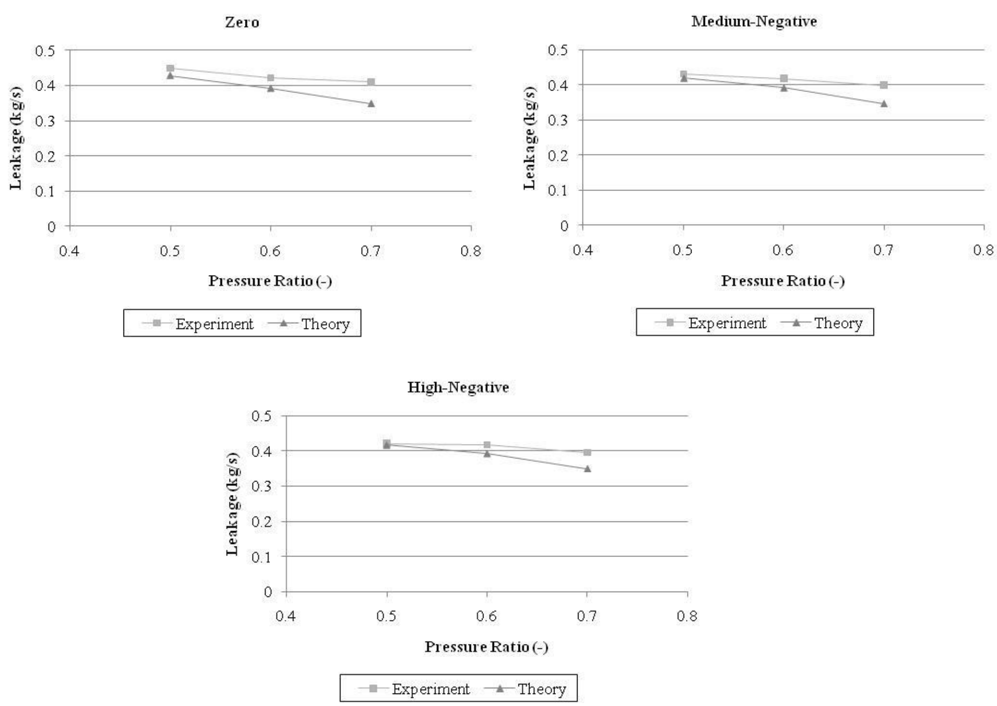



**Figure 22. Seal leakage measurements and predictions versus pressure ratio, ω = 10,200 RPM.**

The theoretical model does a good job predicting seal leakage at 50% pressure ratio but progressively does worse as pressure ratio is increased. Figure 22 shows the growing separation between measured and predicted leakage values as pressure ratio is increased. Wade's [6] leakage results show small increases in prediction error as pressure ratio increases from 17% to 47%. The leakage results presented in this thesis suggest that the model used is not well equipped for pressure ratios above 50%.

# MEASUREMENT VERSUS PREDICTIONS OF ROTORDYNAMIC COEFFICIENTS

This section will present a comparison between measured rotordynamic coefficients and rotordynamic coefficients predicted by the ISOT model. ISOT is based on the model by Kleynhans and Childs [5] that uses an ideal gas model with an assumed constant temperature. The experimental data are shown with error bars representing the repeatability ($\sigma$) at each specific dynamic measurement. The repeatability values are determined by the process indicated previously, and each error bar represents one standard deviation. Preswirl ratio ($u_0(0)$) is displayed for all test cases.

## Direct and cross-coupled stiffness

The measured direct and cross-coupled stiffness data points are shown with error bars alongside the predicted value, displayed as a solid line. Figure 23 shows direct and cross-coupled stiffness for three pressure ratios, $\omega$ = 20,200 RPM, and high-negative preswirl.

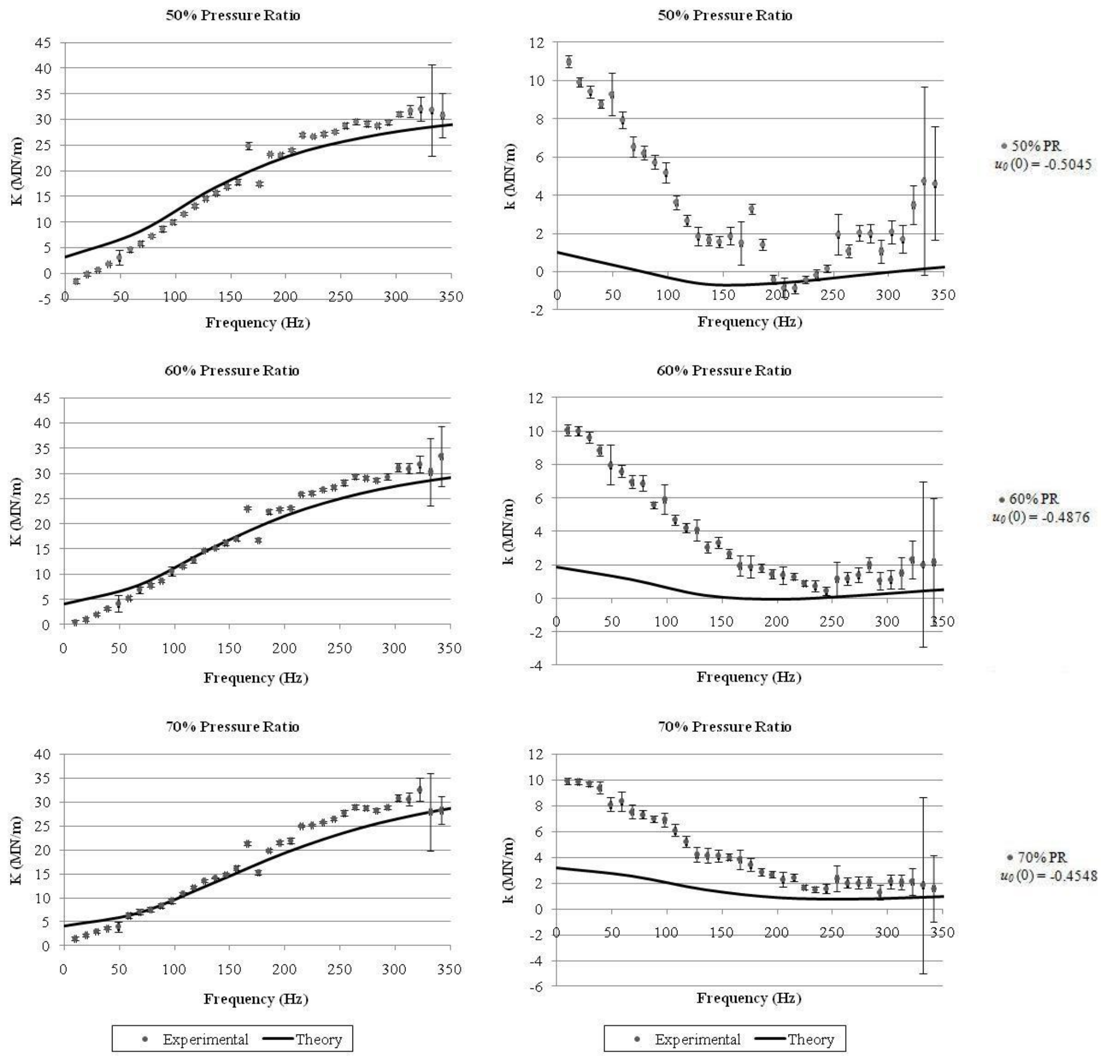



**Figure 23. Direct (left) and cross-coupled (right) stiffness versus excitation frequency for three pressure ratios, high-negative preswirl, and $\omega$ = 20,200 RPM compared with predictions.**

Direct stiffness is well predicted for all pressure ratios, though slightly over predicted at low excitation frequencies and slightly under predicted at high excitation frequencies. Direct stiffness measurements performed by Wade [6] for lower pressure ratios also showed very good agreement with predictions.

Cross-coupled stiffness is grossly under predicted at all pressure ratios for $\omega$ = 20,200 RPM and high-negative preswirl. Predicted values show the most error at low pressure ratios and improve marginally as pressure ratio increases. Wade's [6] results showed strong agreement between measured and predicted cross-coupled stiffness values. Cross-coupled stiffness predictions presented by Wade [6] were consistently accurate for pressure ratios ranging from 17% to 47%. This leaves the direction of inlet fluid preswirl as the main difference between test conditions presented in this thesis and by Wade [6]. The prediction model's inability to properly account for negative inlet preswirl is the likely cause for its huge under estimation of cross-coupled stiffness.

Figure 24 shows direct and cross-coupled stiffness for three rotor speeds, 50% pressure ratio, and high-negative preswirl. Direct stiffness is well predicted for all rotor speeds, but as mentioned above, the model over predicts direct stiffness at low excitation frequencies and under predicts at high excitation frequencies. Wade [6] had good agreement between measured and predicted direct stiffness at similar rotor speeds for 47% pressure ratio and high-positive preswirl.

The magnitude of cross-coupled stiffness is once again badly under predicted at all rotor speeds. At higher excitation frequencies, predicted values correlate better with experimental data. For similar rotor speeds, Wade [6] accurately predicted cross-coupled stiffness at 47% pressure ratio and high-positive preswirl. Again, it appears that the prediction model cannot accurately account for a negative preswirl test condition when determining cross-coupled stiffness.

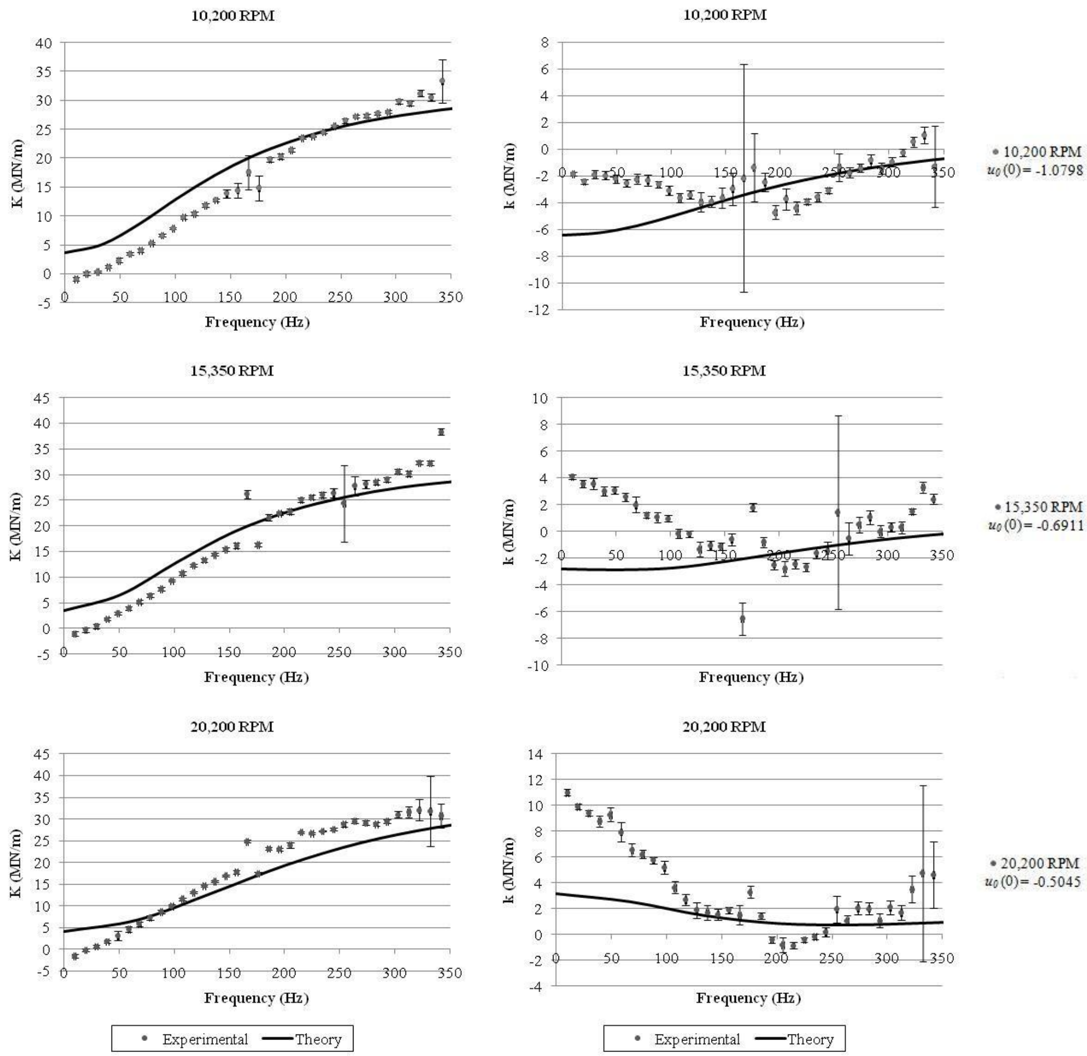



**Figure 24. Direct (left) and cross-coupled (right) stiffness versus excitation frequency for three speeds, high-negative preswirl, and PR = 50% compared with predictions.**

Figure 25 displays direct and cross-coupled stiffness for three preswirls, $\omega$ = 20,200 RPM and 50% pressure ratio. As with the previous two cases, direct stiffness predictions are too large at low excitation frequencies and too small at high excitation frequencies. Overall, direct stiffness is adequately modeled at all preswirls. Wade [6] had good prediction agreement with measured direct stiffness for 47% pressure ratio and $\omega$ = 20,200 RPM at zero and two positive preswirls.

In general, cross-coupled stiffness is strongly under predicted, though better agreement is shown for zero preswirl. For zero preswirl, the magnitude of the predicted cross-coupled stiffness at low excitation frequency is 60% of the measured value. For medium-negative preswirl, the prediction percentage of measured cross-coupled stiffness falls to 38% and to 33% for high-negative preswirl. Wade's [6] results showed very similar prediction error for zero preswirl, but prediction errors decrease as positive inlet preswirl is increased. The increases in cross-coupled stiffness prediction error associated with increasing negative preswirl along with the good prediction agreement for positive preswirl presented by Wade [6] leaves little doubt that the prediction model does not adequately account for negative preswirl.

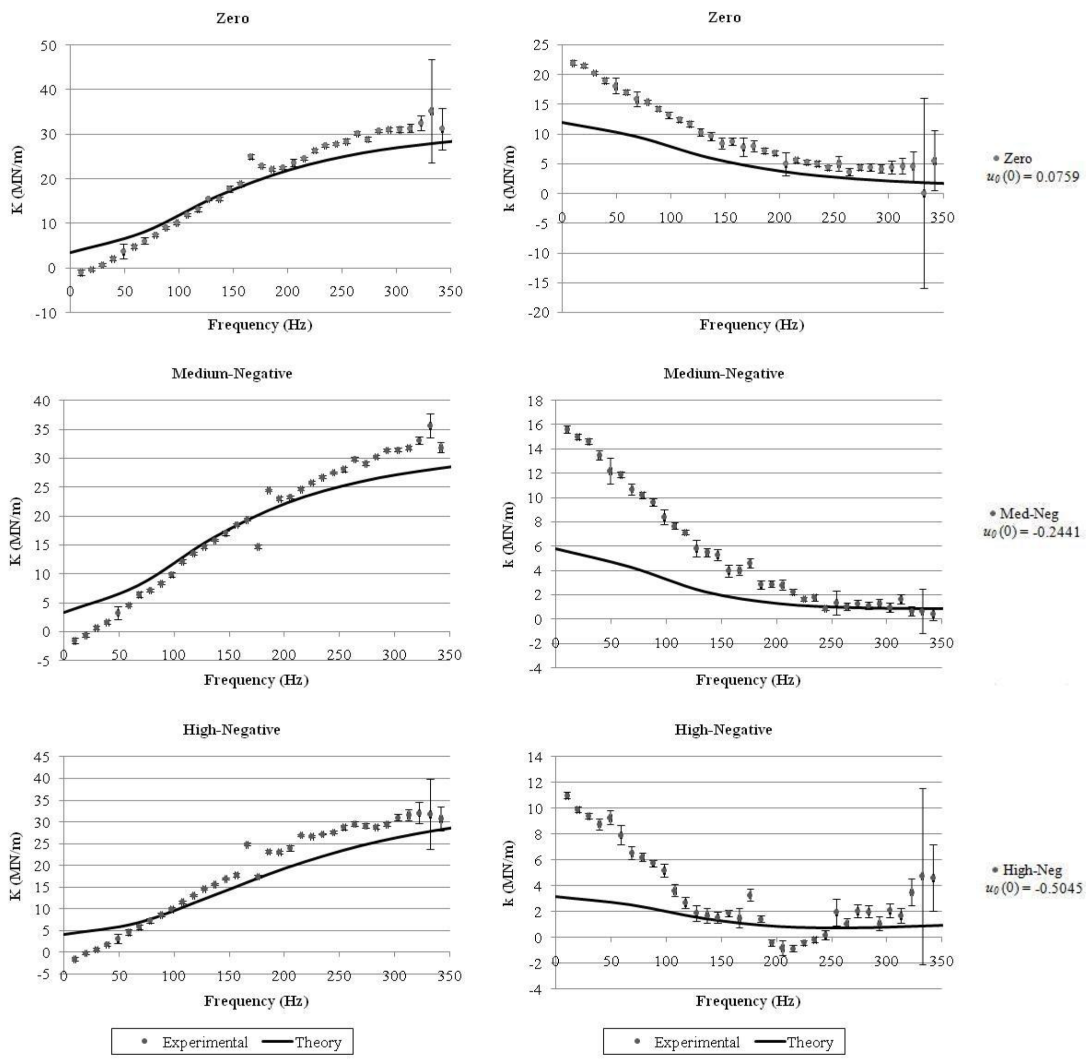



**Figure 25. Direct (left) and cross-coupled (right) stiffness versus excitation frequency for three preswirls, PR = 50%, and $\omega$ = 20,200 RPM compared with predictions.**

## Direct and cross-coupled damping

The measured direct and cross-coupled damping data points are shown with error bars alongside the predicted value, displayed as a solid line. Direct and cross-coupled damping for three pressure ratios, $\omega$ = 20,200 RPM, and high-negative preswirl are shown in Figure 26.

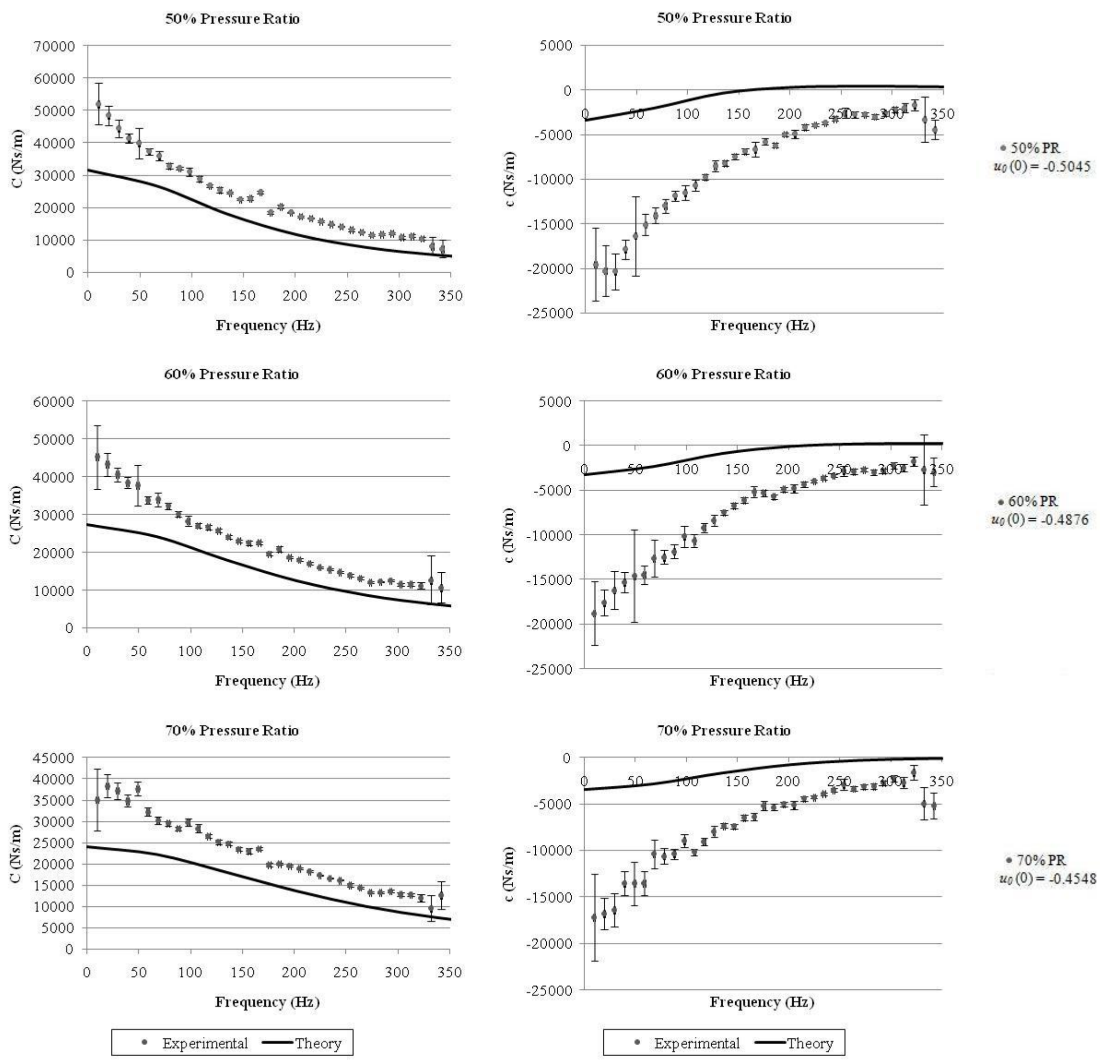



**Figure 26. Direct (left) and cross-coupled (right) damping versus excitation frequency for three pressure ratios, high-negative preswirl, and $\omega$ = 20,200 RPM compared with predictions.**

Direct damping is somewhat under predicted at all excitation frequencies, showing similar amounts of prediction error at each of the three pressure ratios. Wade [6] saw similar levels of directing damping under prediction at 47% pressure ratio, but had very good prediction agreement at 17%, 27%, and 37% pressure ratios. The prediction model may be better suited for lower pressure ratios.

Cross-coupled damping is substantially under predicted, displaying nearly a full order of magnitude difference between theory and experiment. Wade's [6] measured cross-coupled damping was accurately predicted at positive preswirl and lower pressure ratios. This result shows the same trend as the cross-coupled stiffness prediction errors discussed previously and is very likely due to the prediction models inability to correctly account for negative preswirl.

Figure 27 shows direct and cross-coupled damping for three rotor speeds, 50% pressure ratio, and high-negative preswirl. Direct damping is somewhat under predicted at all rotor speeds, but shows the worst agreement at $\omega$ = 20,200 RPM. Direct damping predictions performed by Wade [6] show strong agreement with measured values for similar rotor speeds and positive preswirl.

Cross-coupled damping predictions increase with increasing rotor speed, as is the trend in the experimental data, but hugely under predict measured coefficients. Again, this is the same prediction behavior observed with cross-coupled stiffness in Figure 24 that shows the models inability to account for negative preswirl when calculating cross-coupled coefficients. Cross-coupled damping predictions performed by Wade [6] were very accurate for zero and positive preswirl.

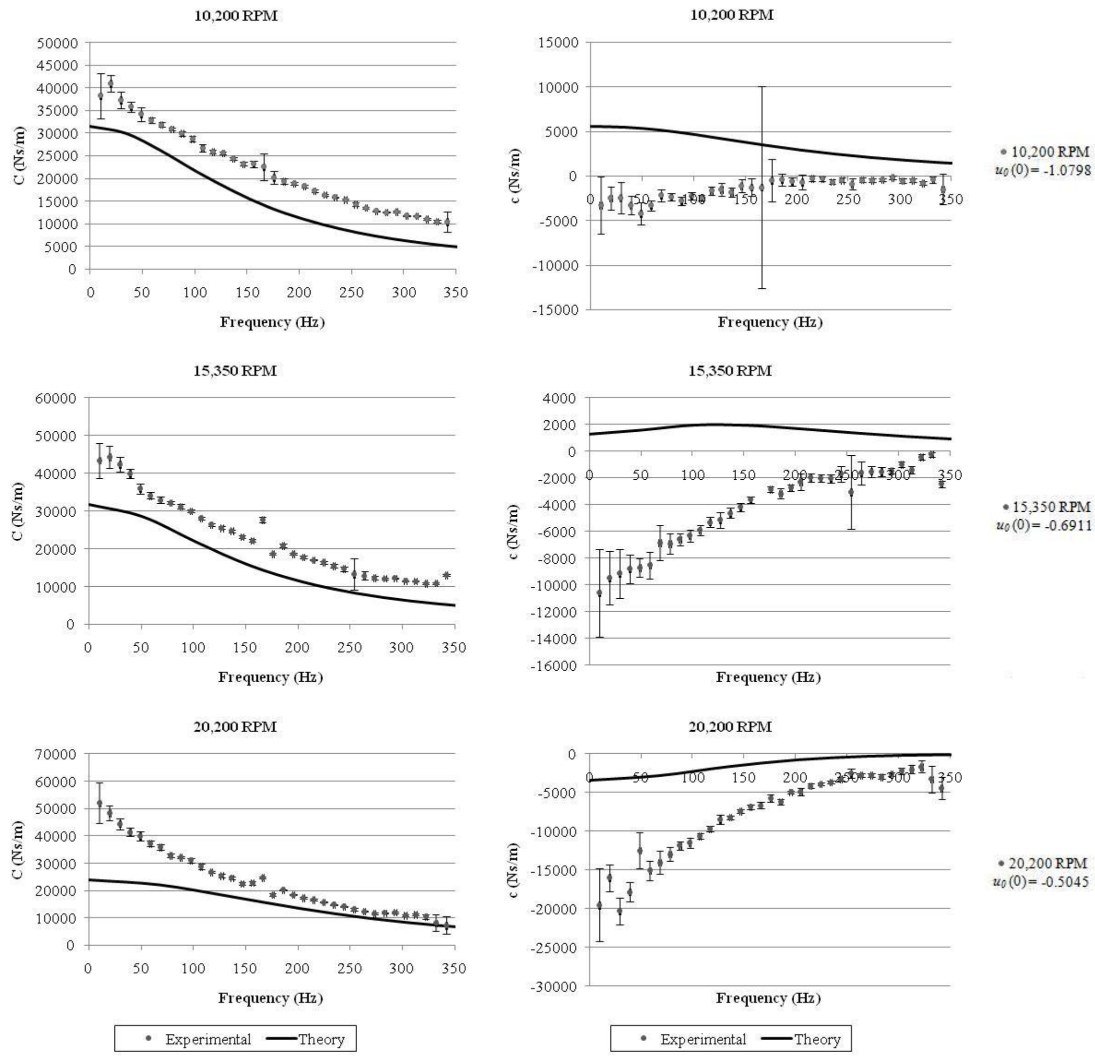



**Figure 27. Direct (left) and cross-coupled (right) damping versus excitation frequency for three speeds, high-negative preswirl, and PR = 50% compared with predictions.**

Direct and cross-coupled damping for three preswirls, $\omega$ = 20,200 RPM, and 50% pressure ratio are displayed in Figure 28.

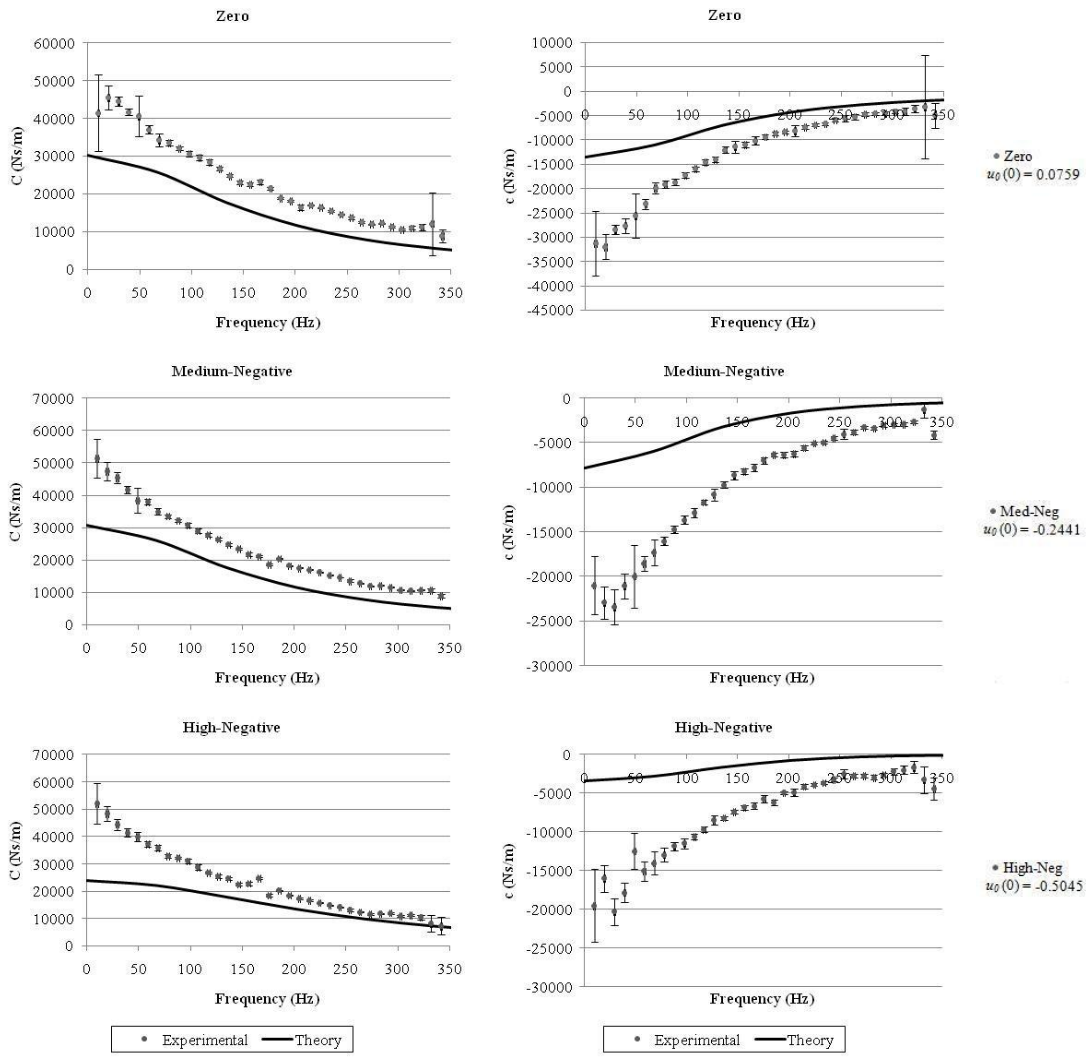



**Figure 28. Direct (left) and cross-coupled (right) damping versus excitation frequency for three preswirls, PR = 50%, and $\omega$ = 20,200 RPM compared with predictions.**

Direct damping continues to be under predicted at all preswirls, showing the worst agreement at high-negative preswirl. Wade's [6] predictions were accurate but also slightly under predicted direct damping at zero and positive preswirls.

Cross-coupled stiffness is strongly under predicted at all preswirls, though better agreement is shown for zero preswirl. For zero preswirl, the magnitude of the predicted cross-coupled damping at low excitation frequency is 45% of the measured value. For medium-negative preswirl, the prediction percentage of measured cross-coupled stiffness drops to 33%, and then to just 20% for high-negative preswirl. Wade's [6] results showed marginally less prediction error for zero preswirl, but cross-coupled damping prediction errors decrease as positive inlet preswirl is increased. The increases in cross-coupled damping prediction error associated with increasing negative preswirl, along with the good prediction agreement for positive preswirl presented by Wade [6] are identical to the cross-coupled stiffness prediction behavior reported previously. This is a further indication that the prediction model is unable to properly consider negative preswirl, leading to large errors in the estimates of cross-coupled rotordynamic coefficients.

**Effective damping**

The measured effective damping data points are shown with error bars alongside the predicted value, displayed as a solid line. Effective damping for three pressure ratios, $\omega$ = 20,200 RPM, and high-negative preswirl is shown in Figure 29.

Cross-over frequency is consistently under predicted for all pressure ratios, though error decreases as pressure ratio is increased. This trend is due to the greatly under predicted cross-coupled stiffness estimates and their effect on effective damping through Eq. (5). Cross-coupled stiffness predictions also showed slightly better agreement at greater pressure ratios.

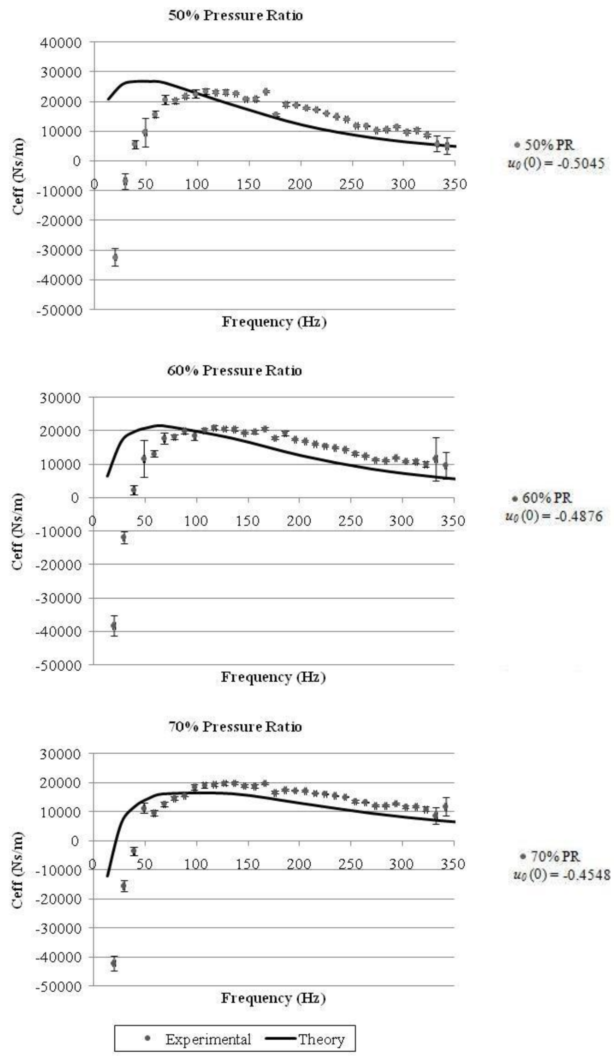



**Figure 29. Effective damping versus excitation frequency for three pressure ratios, high-negative preswirl, and $\omega$ = 20,200 RPM compared with predictions.**

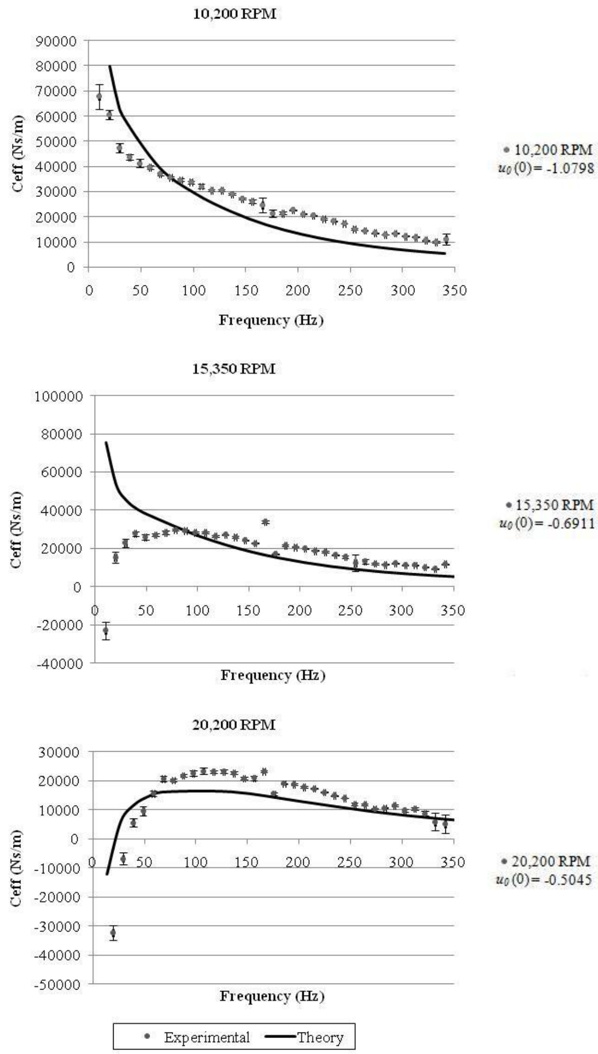



**Figure 30. Effective damping versus excitation frequency for three speeds, high-negative preswirl, and PR = 50% compared with predictions.**

Figure 30 shows effective damping for three rotor speeds, 50% pressure ratio, and high-negative preswirl. Effective damping is reasonably predicted for both $\omega$ = 10,200 RPM and $\omega$ = 20,200 RPM. In these test cases, direct damping was slightly under predicted and cross-coupled stiffness was highly under predicted. Note, despite being grossly under predicted, measured and predicted cross-coupled stiffness at low frequencies were of the same sign for $\omega$ = 10,200 RPM and $\omega$ = 20,200 RPM. This is the main reason that the $\omega$ = 10,200 RPM and $\omega$ = 20,200 RPM effective damping predictions show far better agreement with measured values than the predictions for $\omega$ = 15,350 RPM. Cross-coupled stiffness predictions at low frequencies for $\omega$ = 15,350 RPM are negative while the measured values are positive. Thus through Eq. (5), large effective damping prediction error results at low frequencies.

Effective damping for three preswirls, $\omega$ = 20,200 RPM, and 50% pressure ratio is displayed in Figure 31. Peak effective damping and cross-over frequency are both mildly under predicted for all preswirls, showing the best agreement for zero preswirl. Direct damping and cross-coupled stiffness were better predicted for zero preswirl than the two negative preswirls which yielded marginally more accurate effective damping predictions via Eq. (5). Underestimations for peak effective damping and cross-over frequency are due to low direct damping and cross-coupled stiffness predictions.

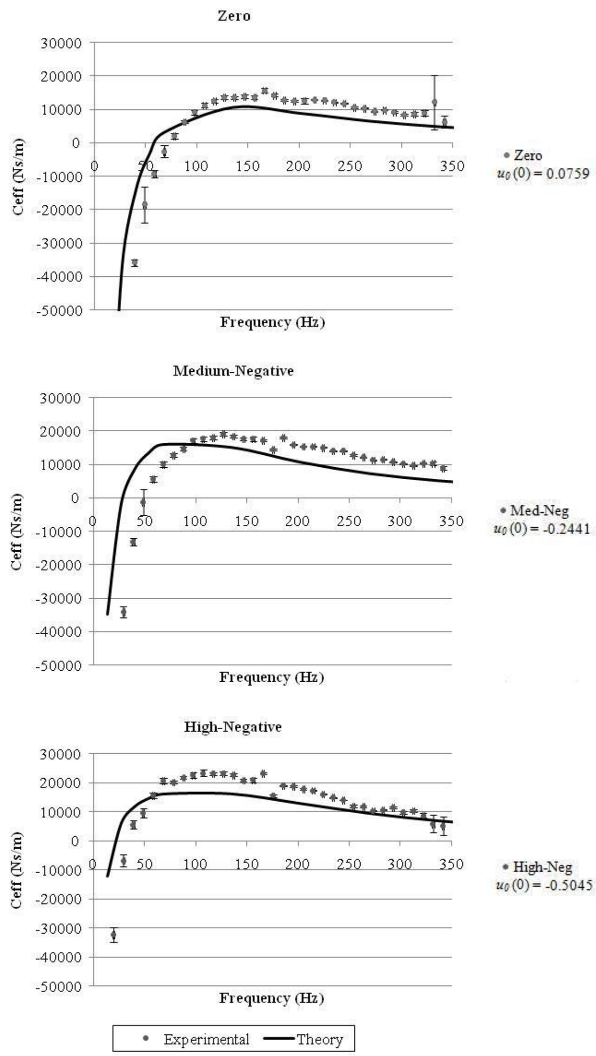



**Figure 31. Effective damping versus excitation frequency for three preswirls, PR = 50%, and $\omega$ = 20,200 RPM compared with predictions.**

# SUMMARY AND CONCLUSIONS

The test results introduced in this thesis were chosen to determine the response of rotordynamic coefficients and leakage of hole-pattern seals to changes in pressure ratio, rotor speed, and negative inlet fluid preswirl. Test results performed by Wade [6] using geometrically identical seals at lower pressure ratios and positive preswirl conditions were compared to the results presented in this thesis.

Pressure ratio variation has little effect on most rotordynamic coefficients. Direct stiffness decreases marginally with decreases in pressure ratio, a trend also observed by Wade [6]. Cross-coupled stiffness shows slightly different profiles through the mid-range of excitation frequencies but does not show strong influence to pressure ratio. Cross-coupled stiffness coefficients presented by Wade [6] were similarly unaffected by pressure ratio. Some slight influence of pressure ratio changes was observed in direct and cross-coupled damping at low excitation frequencies. Most notably, peak direct damping increases with decreasing pressure ratio. This behavior was also shown by Wade [6] for lower pressure ratios and could be due to the effect of pressure ratio on air density. Effective stiffness and effective damping are not significantly affected by variations in pressure ratio.

Direct stiffness and direct damping are not sensitive to rotor speed, while both cross-coupled stiffness and cross-coupled damping are significantly affected by it. Similarly with Wade's [6] results, the magnitudes of cross-coupled rotordynamic terms increase with increasing rotor speed. At the 10,200 RPM test speed with high-negative preswirl, cross-coupled stiffness becomes negative, presumably due to the effects of the reverse swirl condition overpowering the positive fluid swirl generated by rotor rotation. This is an exciting result considering that cross-coupled stiffness is the prime source of destabilization in a balance piston seal, and here it has been entirely eliminated. For constant flow rates, as $\omega$ is increased, positive fluid swirl increases while inlet negative preswirl remains constant. This results in positive cross-coupled stiffness coefficients at the higher test speeds.

The cross-coupled stiffness values reported by Wade [6] at a similar clearance and pressure are significantly greater due to their positive preswirl test condition versus the negative preswirl test condition presented here. These results show that the idea that positive inlet fluid swirl produces positive cross-coupled stiffness and negative inlet fluid swirl produces negative cross-coupled stiffness, based on the work by Benckert and Wachter [2] with labyrinth seals, also applies to the hole-pattern seal geometry. The confirmation of this phenomenon via variation in rotor speed begs for a more in-depth look at the effects of the addition of negative preswirl on rotordynamic coefficients.

Inlet fluid prerotation against the direction of rotor rotation displays distinct stabilizing effects on hole-pattern seal performance. Destabilizing cross-coupled stiffness coefficients decrease significantly as negative preswirl is increased. Wade [6] showed that positive preswirl increased cross-coupled stiffness. This relationship between cross-coupled stiffness coefficients and inlet swirl direction validates Benckert and Wachter [2] as discussed previously. Testing by Childs and Franchek [20] for gas bearings with tangential fluid injection against rotor rotation further supports the relationship between cross-coupled stiffness and fluid swirl direction. The best indicator of the benefits of negative inlet preswirl can be seen in the effective damping results. Peak effective damping increases by 50% from zero preswirl to negative-high preswirl, while the cross-over frequency decreases by 50%. This drastic improvement in seal stability due to the introduction of negative inlet preswirl cannot be ignored, and points to the huge performance benefits that reverse swirl hardware can have on balance piston seals.

Seal leakage performance was very similar to that reported by Wade [6]. Leakage is unaffected by preswirl ratio and decreases slightly as pressure ratio is increased. Wade [6] saw similar behavior for positive preswirl ratios and lower pressure ratios. Seal leakage values are predicted very well at 50% pressure ratio, but prediction error grows as pressure ratio is raised to 60% and 70%. Leakage predictions by Wade [6] were very accurate, though all measurements took place at pressure ratios below those presented here.

The theoretical model produces good predictions of direct rotordynamic coefficients, but greatly under predicts both cross-coupled stiffness and cross-coupled damping. Prediction error for cross-coupled rotordynamic terms increases as negative fluid preswirl is increased. Wade [6] showed very good prediction agreement with measured direct and cross-coupled rotordynamic coefficients for all test conditions. Predictions for cross-coupled coefficients presented by Wade [6] actually showed increasing accuracy as positive preswirl was increased. For the data cited here, the prediction model cannot adequately account for inlet negative preswirl.

The results illustrate the effects that the introduction of an inlet fluid swirl opposing rotor rotation can have on the performance of a hole-pattern balance piston seal. The results show that negative inlet preswirl significantly improves seal stability, as is evident by changes in effective damping, yet does not adversely affect direct rotordynamic coefficients or seal leakage rates. The addition of reverse swirl inducing hardware, such as Gans' [14] anti-swirl vanes, to existing balance piston designs could greatly increase their rotordynamic stability.

The variable hole depth hole-pattern seal design purposed by Shin [21], which displayed increases in effective damping over conventional hole-pattern seals, might be combined with a reverse swirl brake to produce even larger gains in seal stability. The question is, how much negative preswirl could anti-swirl vanes similar to Gans' [14] actually produce? The test results show that to achieve a 50% increase in peak effective damping and a 50% decrease in cross-over frequency, a preswirl ratio of about -0.5 is required. It is unknown whether a balance piston anti-swirl vane design similar to that shown in Figure 7 could induce enough reverse fluid swirl to produce negative preswirl ratios of this magnitude. A full rotordynamics analysis that includes an appraisal of the stability for backwards precessing modes is advisable for systems with negative preswirl. The results presented in this thesis support the notion that research in anti-swirl vane design could be a useful endeavor.

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# APPENDIX A

# MEASURED TEST CONDITIONS

## Table A1. 50% PR, $\omega$ = 10,200 RPM, and zero preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *f* | *Re Hxx* | *Re Hxy* | *Re Hyx* | *Re Hyy* | *Im Hxx* | *Im Hxy* | *Im Hyx* | *Im Hyy* | *Re eHxx* | *Re eHxy* | *Re eHyx* | *Re eHyy* | *Im eHxx* | *Im eHxy* | *Im eHyx* | *Im eHyy* |
| **9.77** | 1.02E+05 | 1.00E+07 | -1.13E+07 | -3.20E+05 | 2.16E+06 | -1.11E+06 | 9.58E+05 | 2.77E+06 | -3.23E+05 | -2.91E+05 | -3.45E+05 | -3.09E+05 | -4.45E+05 | -1.96E+05 | -3.63E+05 | -1.75E+05 |
| **19.53** | 5.85E+05 | 9.77E+06 | -1.12E+07 | 2.43E+05 | 4.77E+06 | -1.97E+06 | 1.75E+06 | 4.76E+06 | -2.11E+05 | -2.42E+05 | -3.06E+05 | -2.28E+05 | -1.94E+05 | -1.40E+05 | -3.01E+05 | -2.06E+05 |
| **29.30** | 1.48E+06 | 9.08E+06 | -1.09E+07 | 1.22E+06 | 6.93E+06 | -2.33E+06 | 2.41E+06 | 7.58E+06 | -3.14E+05 | -2.72E+05 | -2.51E+05 | -3.15E+05 | -2.58E+05 | -2.44E+05 | -1.79E+05 | -3.01E+05 |
| **39.06** | 2.97E+06 | 8.35E+06 | -1.05E+07 | 1.91E+06 | 8.60E+06 | -3.28E+06 | 2.67E+06 | 9.59E+06 | -3.73E+05 | -4.58E+05 | -3.23E+05 | -4.34E+05 | -4.38E+05 | -6.01E+05 | -2.73E+05 | -3.62E+05 |
| **48.83** | 2.72E+06 | 8.84E+06 | -9.53E+06 | 2.56E+06 | 1.07E+07 | -3.68E+06 | 3.14E+06 | 1.14E+07 | -5.49E+05 | -3.31E+05 | -2.37E+05 | -3.93E+05 | -3.77E+05 | -2.33E+05 | -7.21E+05 | -2.81E+05 |
| **58.59** | 5.06E+06 | 7.83E+06 | -9.36E+06 | 4.08E+06 | 1.19E+07 | -4.60E+06 | 4.33E+06 | 1.30E+07 | -3.28E+05 | -4.96E+05 | -4.18E+05 | -6.02E+05 | -3.58E+05 | -2.57E+05 | -4.70E+05 | -4.29E+05 |
| **68.36** | 4.47E+06 | 7.81E+06 | -8.81E+06 | 5.99E+06 | 1.31E+07 | -4.28E+06 | 4.20E+06 | 1.40E+07 | -4.58E+05 | -5.35E+05 | -4.24E+05 | -8.33E+05 | -4.89E+05 | -5.62E+05 | -4.97E+05 | -5.89E+05 |
| **78.13** | 6.62E+06 | 7.34E+06 | -8.68E+06 | 6.41E+06 | 1.52E+07 | -5.19E+06 | 4.06E+06 | 1.69E+07 | -3.30E+05 | -3.01E+05 | -2.88E+05 | -3.01E+05 | -3.12E+05 | -2.40E+05 | -2.96E+05 | -4.36E+05 |
| **87.89** | 7.57E+06 | 6.88E+06 | -7.96E+06 | 7.93E+06 | 1.63E+07 | -5.24E+06 | 4.55E+06 | 1.80E+07 | -4.77E+05 | -4.08E+05 | -4.51E+05 | -2.33E+05 | -2.00E+05 | -2.14E+05 | -2.55E+05 | -2.87E+05 |
| **97.66** | 8.89E+06 | 5.81E+06 | -7.80E+06 | 9.10E+06 | 1.69E+07 | -6.23E+06 | 4.06E+06 | 1.93E+07 | -3.09E+05 | -3.44E+05 | -2.98E+05 | -5.50E+05 | -3.44E+05 | -1.93E+05 | -3.34E+05 | -3.43E+05 |
| **107.42** | 9.91E+06 | 5.52E+06 | -8.33E+06 | 1.07E+07 | 1.81E+07 | -5.37E+06 | 4.91E+06 | 2.03E+07 | -3.50E+05 | -3.18E+05 | -6.62E+05 | -4.60E+05 | -6.53E+05 | -3.89E+05 | -6.32E+05 | -3.55E+05 |
| **117.19** | 1.17E+07 | 4.51E+06 | -7.19E+06 | 1.25E+07 | 1.99E+07 | -6.01E+06 | 4.87E+06 | 2.03E+07 | -4.17E+05 | -3.20E+05 | -5.94E+05 | -3.34E+05 | -5.03E+05 | -4.42E+05 | -6.26E+05 | -3.74E+05 |
| **126.95** | 1.22E+07 | 4.50E+06 | -6.69E+06 | 1.30E+07 | 1.91E+07 | -5.39E+06 | 5.25E+06 | 2.11E+07 | -5.53E+05 | -6.72E+05 | -6.15E+05 | -9.09E+05 | -6.03E+05 | -9.14E+05 | -6.33E+05 | -1.00E+06 |
| **136.72** | 1.40E+07 | 3.26E+06 | -6.96E+06 | 1.51E+07 | 2.00E+07 | -4.98E+06 | 5.16E+06 | 2.11E+07 | -8.43E+05 | -1.04E+06 | -5.42E+05 | -6.88E+05 | -5.29E+05 | -3.28E+05 | -5.77E+05 | -8.26E+05 |
| **146.48** | 1.59E+07 | 2.92E+06 | -6.81E+06 | 1.66E+07 | 2.01E+07 | -5.41E+06 | 5.05E+06 | 2.36E+07 | -1.21E+06 | -2.41E+06 | -1.15E+06 | -1.81E+06 | -1.06E+06 | -5.82E+05 | -7.65E+05 | -2.00E+06 |
| **156.25** | 1.62E+07 | 3.71E+06 | -6.87E+06 | 1.72E+07 | 1.97E+07 | -5.12E+06 | 6.32E+06 | 2.27E+07 | -1.98E+06 | -3.03E+06 | -2.05E+06 | -1.78E+06 | -1.95E+06 | -1.48E+06 | -1.25E+06 | -2.14E+06 |
| **166.02** | 1.55E+07 | 3.19E+07 | 2.73E+06 | -7.19E+06 | 3.38E+07 | -2.26E+07 | -1.63E+06 | 6.74E+06 | -2.70E+06 | -5.36E+06 | -5.17E+06 | -8.68E+06 | -4.63E+06 | -7.02E+06 | -3.30E+06 | -5.30E+06 |
| **175.78** | 1.21E+07 | -4.44E+06 | -1.08E+07 | 2.41E+07 | 1.56E+07 | 1.67E+06 | 1.02E+07 | 2.76E+07 | -3.67E+06 | -7.51E+06 | -3.48E+06 | -5.80E+06 | -4.85E+06 | -6.88E+06 | -2.93E+06 | -5.14E+06 |
| **185.55** | 1.93E+07 | 2.73E+06 | -5.83E+06 | 2.02E+07 | 2.22E+07 | -5.66E+06 | 5.60E+06 | 2.33E+07 | -1.08E+06 | -9.40E+05 | -1.15E+06 | -1.36E+06 | -1.61E+06 | -1.83E+06 | -1.13E+06 | -5.14E+05 |
| **195.31** | 2.11E+07 | 1.86E+06 | -5.38E+06 | 2.16E+07 | 2.23E+07 | -5.96E+06 | 5.85E+06 | 2.42E+07 | -8.49E+05 | -4.68E+05 | -5.26E+05 | -8.83E+05 | -5.44E+05 | -1.38E+06 | -8.59E+05 | -5.71E+05 |
| **205.08** | 2.10E+07 | 2.25E+06 | -5.00E+06 | 2.45E+07 | 2.34E+07 | -4.09E+06 | 7.20E+06 | 2.34E+07 | -2.34E+06 | -1.71E+06 | -1.01E+06 | -2.91E+06 | -1.01E+06 | -5.93E+06 | -1.16E+06 | -2.25E+06 |
| **214.84** | 2.17E+07 | 1.72E+06 | -4.13E+06 | 2.31E+07 | 2.31E+07 | -5.12E+06 | 6.16E+06 | 2.39E+07 | -5.64E+05 | -5.96E+05 | -2.35E+05 | -2.65E+05 | -5.28E+05 | -5.87E+05 | -4.43E+05 | -3.64E+05 |
| **224.61** | 2.38E+07 | 1.16E+06 | -4.68E+06 | 2.46E+07 | 2.41E+07 | -5.98E+06 | 5.47E+06 | 2.49E+07 | -3.03E+05 | -2.91E+05 | -3.59E+05 | -5.01E+05 | -4.89E+05 | -6.44E+05 | -3.85E+05 | -3.46E+05 |
| **234.38** | 2.47E+07 | 7.80E+05 | -4.85E+06 | 2.62E+07 | 2.36E+07 | -4.84E+06 | 6.16E+06 | 2.45E+07 | -3.13E+05 | -4.90E+05 | -2.56E+05 | -4.44E+05 | -5.40E+05 | -5.12E+05 | -1.89E+05 | -5.04E+05 |
| **244.14** | 2.60E+07 | 5.57E+05 | -4.42E+06 | 2.66E+07 | 2.33E+07 | -4.62E+06 | 5.83E+06 | 2.46E+07 | -2.99E+05 | -3.67E+05 | -3.52E+05 | -4.48E+05 | -4.00E+05 | -7.22E+05 | -2.03E+05 | -2.77E+05 |
| **253.91** | 2.63E+07 | 1.51E+06 | -4.07E+06 | 2.79E+07 | 2.25E+07 | -3.80E+06 | 6.35E+06 | 2.43E+07 | -7.13E+05 | -1.32E+06 | -2.53E+05 | -4.66E+05 | -6.34E+05 | -9.46E+05 | -2.50E+05 | -5.33E+05 |
| **263.67** | 2.80E+07 | -2.11E+05 | -3.57E+06 | 2.94E+07 | 2.22E+07 | -3.27E+06 | 5.92E+06 | 2.33E+07 | -4.36E+05 | -6.20E+05 | -4.19E+05 | -6.66E+05 | -4.63E+05 | -8.32E+05 | -3.41E+05 | -3.16E+05 |
| **273.44** | 2.68E+07 | 1.53E+06 | -3.81E+06 | 2.88E+07 | 2.19E+07 | -2.27E+06 | 5.62E+06 | 2.31E+07 | -4.01E+05 | -5.41E+05 | -2.71E+05 | -4.21E+05 | -2.57E+05 | -8.24E+05 | -3.70E+05 | -5.35E+05 |
| **283.20** | 2.84E+07 | 1.53E+06 | -4.10E+06 | 2.97E+07 | 2.37E+07 | -4.00E+06 | 6.09E+06 | 2.35E+07 | -2.73E+05 | -5.33E+05 | -1.90E+05 | -4.02E+05 | -3.74E+05 | -3.19E+05 | -3.31E+05 | -2.97E+05 |
| **292.97** | 2.95E+07 | 1.56E+04 | -4.49E+06 | 3.09E+07 | 2.29E+07 | -3.98E+06 | 6.08E+06 | 2.25E+07 | -3.12E+05 | -4.22E+05 | -2.86E+05 | -3.10E+05 | -2.59E+05 | -2.52E+05 | -3.04E+05 | -3.09E+05 |
| **302.73** | 3.01E+07 | 1.80E+05 | -4.42E+06 | 3.06E+07 | 2.23E+07 | -2.76E+06 | 6.65E+06 | 2.17E+07 | -4.94E+05 | -7.07E+05 | -2.38E+05 | -2.78E+05 | -4.05E+05 | -5.36E+05 | -3.21E+05 | -4.54E+05 |
| **312.50** | 3.14E+07 | 2.94E+06 | -2.49E+06 | 3.09E+07 | 2.43E+07 | -1.01E+06 | 9.01E+06 | 2.41E+07 | -3.87E+05 | -5.06E+05 | -3.42E+05 | -3.50E+05 | -3.24E+05 | -6.39E+05 | -3.19E+05 | -4.15E+05 |
| **322.27** | 3.23E+07 | 3.09E+06 | -3.67E+06 | 3.01E+07 | 2.29E+07 | -3.23E+06 | 6.79E+06 | 2.46E+07 | -5.76E+05 | -6.88E+05 | -2.88E+05 | -5.09E+05 | -3.39E+05 | -4.31E+05 | -2.93E+05 | -2.70E+05 |
| **332.03** | 3.46E+07 | 1.11E+06 | -6.57E+06 | 3.44E+07 | 2.39E+07 | -1.37E+06 | 6.01E+06 | 2.21E+07 | -3.45E+05 | -3.52E+05 | -3.47E+05 | -4.21E+05 | -3.40E+05 | -4.65E+05 | -3.24E+05 | -4.46E+05 |
| **341.80** | 3.15E+07 | 1.92E+06 | -2.40E+06 | 3.44E+07 | 2.46E+07 | -3.82E+06 | 5.92E+06 | 2.35E+07 | -6.67E+05 | -9.91E+05 | -7.35E+05 | -1.11E+06 | -1.20E+06 | -1.24E+06 | -1.18E+06 | -9.94E+05 |

## Table A2. 50% PR, $\omega$ = 15,350 RPM, and zero preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *f* | *Re Hxx* | *Re Hxy* | *Re Hyx* | *Re Hyy* | *Im Hxx* | *Im Hxy* | *Im Hyx* | *Im Hyy* | *Re eHxx* | *Re eHxy* | *Re eHyx* | *Re eHyy* | *Im eHxx* | *Im eHxy* | *Im eHyx* | *Im eHyy* |
| **9.77** | -5.56E+04 | 1.52E+07 | -1.68E+07 | -1.10E+06 | 2.49E+06 | -1.65E+06 | 8.18E+05 | 3.16E+06 | -3.62E+05 | -3.11E+05 | -3.76E+05 | -3.42E+05 | -5.45E+05 | -2.83E+05 | -4.50E+05 | -2.47E+05 |
| **19.53** | 3.26E+05 | 1.47E+07 | -1.67E+07 | -1.36E+05 | 4.96E+06 | -2.75E+06 | 2.45E+06 | 5.61E+06 | -3.44E+05 | -2.50E+05 | -4.14E+05 | -3.31E+05 | -1.81E+05 | -1.77E+05 | -2.92E+05 | -2.61E+05 |
| **29.30** | 1.38E+06 | 1.45E+07 | -1.59E+07 | 1.06E+06 | 7.72E+06 | -4.02E+06 | 3.92E+06 | 8.15E+06 | -3.85E+05 | -4.02E+05 | -3.49E+05 | -4.78E+05 | -2.48E+05 | -2.87E+05 | -2.28E+05 | -2.76E+05 |
| **39.06** | 2.61E+06 | 1.33E+07 | -1.48E+07 | 1.53E+06 | 9.43E+06 | -4.83E+06 | 4.47E+06 | 9.80E+06 | -2.29E+05 | -3.40E+05 | -4.50E+05 | -5.47E+05 | -3.02E+05 | -2.78E+05 | -3.24E+05 | -4.73E+05 |
| **48.83** | 3.29E+06 | 1.28E+07 | -1.44E+07 | 3.61E+06 | 1.09E+07 | -5.55E+06 | 5.33E+06 | 1.23E+07 | -3.41E+05 | -4.09E+05 | -2.83E+05 | -4.21E+05 | -4.60E+05 | -3.26E+05 | -4.69E+05 | -3.36E+05 |
| **58.59** | 4.34E+06 | 1.29E+07 | -1.32E+07 | 3.88E+06 | 1.24E+07 | -6.17E+06 | 5.95E+06 | 1.34E+07 | -2.77E+05 | -3.60E+05 | -3.98E+05 | -7.21E+05 | -3.69E+05 | -3.25E+05 | -5.89E+05 | -5.36E+05 |
| **68.36** | 4.92E+06 | 1.15E+07 | -1.37E+07 | 5.36E+06 | 1.38E+07 | -6.28E+06 | 5.42E+06 | 1.74E+07 | -6.33E+05 | -8.93E+05 | -8.85E+05 | -1.07E+06 | -8.32E+05 | -1.04E+06 | -7.83E+05 | -1.10E+06 |
| **78.13** | 6.79E+06 | 9.86E+06 | -1.26E+07 | 6.74E+06 | 1.49E+07 | -6.85E+06 | 6.68E+06 | 1.72E+07 | -3.20E+05 | -3.29E+05 | -2.85E+05 | -3.80E+05 | -4.89E+05 | -4.50E+05 | -3.07E+05 | -3.70E+05 |
| **87.89** | 8.01E+06 | 9.55E+06 | -1.15E+07 | 8.47E+06 | 1.68E+07 | -7.69E+06 | 7.15E+06 | 1.84E+07 | -3.63E+05 | -2.49E+05 | -2.45E+05 | -4.89E+05 | -3.25E+05 | -3.34E+05 | -3.67E+05 | -3.50E+05 |
| **97.66** | 9.08E+06 | 8.72E+06 | -1.15E+07 | 1.08E+07 | 1.76E+07 | -7.68E+06 | 7.46E+06 | 1.94E+07 | -3.38E+05 | -3.49E+05 | -3.58E+05 | -3.43E+05 | -4.13E+05 | -2.88E+05 | -4.23E+05 | -5.48E+05 |
| **107.42** | 1.12E+07 | 8.25E+06 | -1.08E+07 | 1.17E+07 | 1.89E+07 | -8.30E+06 | 7.80E+06 | 1.99E+07 | -2.85E+05 | -5.01E+05 | -5.25E+05 | -4.66E+05 | -3.98E+05 | -3.74E+05 | -3.80E+05 | -5.06E+05 |
| **117.19** | 1.26E+07 | 7.24E+06 | -1.04E+07 | 1.38E+07 | 1.96E+07 | -8.20E+06 | 7.49E+06 | 2.06E+07 | -4.79E+05 | -2.09E+05 | -3.28E+05 | -2.76E+05 | -2.21E+05 | -2.68E+05 | -2.78E+05 | -2.30E+05 |
| **126.95** | 1.32E+07 | 7.45E+06 | -9.08E+06 | 1.41E+07 | 2.03E+07 | -7.49E+06 | 7.24E+06 | 1.96E+07 | -3.73E+05 | -5.29E+05 | -3.38E+05 | -6.29E+05 | -5.04E+05 | -6.31E+05 | -3.94E+05 | -5.35E+05 |
| **136.72** | 1.51E+07 | 6.03E+06 | -9.39E+06 | 1.65E+07 | 2.07E+07 | -8.67E+06 | 8.17E+06 | 2.20E+07 | -4.18E+05 | -8.04E+05 | -4.21E+05 | -6.37E+05 | -3.79E+05 | -4.29E+05 | -4.22E+05 | -4.39E+05 |
| **146.48** | 1.56E+07 | 5.79E+06 | -9.33E+06 | 1.84E+07 | 2.04E+07 | -8.01E+06 | 8.31E+06 | 2.34E+07 | -3.98E+05 | -7.23E+05 | -4.34E+05 | -9.99E+05 | -4.91E+05 | -3.94E+05 | -4.22E+05 | -5.89E+05 |
| **156.25** | 1.75E+07 | 4.35E+06 | -7.96E+06 | 1.80E+07 | 2.07E+07 | -8.27E+06 | 7.84E+06 | 2.21E+07 | -4.69E+05 | -8.93E+05 | -3.27E+05 | -5.60E+05 | -5.10E+05 | -4.08E+05 | -3.49E+05 | -5.25E+05 |
| **166.02** | 1.98E+07 | -2.03E+06 | -1.42E+07 | 2.81E+07 | 2.23E+07 | -8.46E+06 | 4.97E+06 | 3.03E+07 | -1.10E+06 | -5.83E+05 | -9.89E+05 | -1.36E+06 | -3.89E+05 | -2.75E+06 | -9.00E+05 | -2.54E+06 |
| **175.78** | 1.79E+07 | 6.04E+06 | -1.03E+07 | 2.06E+07 | 2.45E+07 | -4.40E+06 | 1.04E+07 | 2.88E+07 | -4.93E+05 | -1.17E+06 | -6.67E+05 | -1.07E+06 | -6.03E+05 | -7.92E+05 | -6.27E+05 | -6.65E+05 |
| **185.55** | 2.07E+07 | 4.38E+06 | -7.43E+06 | 2.12E+07 | 2.25E+07 | -7.43E+06 | 7.38E+06 | 2.33E+07 | -4.00E+05 | -6.90E+05 | -2.95E+05 | -7.06E+05 | -3.63E+05 | -4.13E+05 | -5.32E+05 | -4.48E+05 |
| **195.31** | 2.13E+07 | 4.53E+06 | -7.49E+06 | 2.26E+07 | 2.26E+07 | -7.74E+06 | 8.72E+06 | 2.35E+07 | -4.71E+05 | -7.23E+05 | -5.98E+05 | -3.85E+05 | -3.76E+05 | -6.52E+05 | -5.49E+05 | -4.85E+05 |
| **205.08** | 2.04E+07 | -2.72E+05 | -5.60E+06 | 2.42E+07 | 2.16E+07 | -5.39E+06 | 8.73E+06 | 2.18E+07 | -1.84E+06 | -2.61E+06 | -8.98E+05 | -1.89E+06 | -9.92E+05 | -3.53E+06 | -7.81E+05 | -1.72E+06 |
| **214.84** | 2.28E+07 | 3.22E+06 | -6.24E+06 | 2.39E+07 | 2.33E+07 | -8.10E+06 | 7.28E+06 | 2.37E+07 | -4.65E+05 | -3.20E+05 | -6.22E+05 | -4.56E+05 | -3.93E+05 | -8.48E+05 | -3.39E+05 | -6.23E+05 |
| **224.61** | 2.45E+07 | 2.12E+06 | -6.65E+06 | 2.58E+07 | 2.34E+07 | -7.79E+06 | 7.90E+06 | 2.39E+07 | -7.04E+05 | -7.20E+05 | -6.37E+05 | -5.64E+05 | -7.15E+05 | -6.54E+05 | -3.42E+05 | -3.13E+05 |
| **234.38** | 2.64E+07 | 1.50E+06 | -6.15E+06 | 2.62E+07 | 2.34E+07 | -6.95E+06 | 7.94E+06 | 2.30E+07 | -9.47E+05 | -9.34E+05 | -5.78E+05 | -9.69E+05 | -7.83E+05 | -1.36E+06 | -7.48E+05 | -4.42E+05 |
| **244.14** | 2.77E+07 | 1.67E+06 | -5.88E+06 | 2.68E+07 | 2.29E+07 | -6.64E+06 | 7.72E+06 | 2.36E+07 | -1.62E+06 | -1.78E+06 | -8.47E+05 | -2.15E+06 | -1.02E+06 | -2.77E+06 | -1.26E+06 | -7.37E+05 |
| **253.91** | 3.07E+07 | 8.93E+06 | -8.44E+06 | 7.91E+06 | 1.86E+07 | -3.31E+07 | 6.11E+06 | 2.52E+07 | -6.40E+06 | -7.89E+06 | -5.25E+06 | -4.63E+06 | -7.39E+06 | -7.75E+06 | -4.65E+06 | -6.05E+06 |
| **263.67** | 3.01E+07 | 2.97E+05 | -7.24E+06 | 3.01E+07 | 1.93E+07 | -2.29E+06 | 7.48E+06 | 2.12E+07 | -3.41E+06 | -1.82E+06 | -2.07E+06 | -4.35E+06 | -2.37E+06 | -6.28E+06 | -2.04E+06 | -1.44E+06 |
| **273.44** | 2.74E+07 | 3.26E+06 | -5.29E+06 | 2.87E+07 | 2.11E+07 | -3.62E+06 | 8.05E+06 | 2.15E+07 | -9.36E+05 | -1.12E+06 | -7.83E+05 | -2.05E+06 | -1.22E+06 | -2.40E+06 | -6.45E+05 | -6.58E+05 |
| **283.20** | 2.89E+07 | 1.53E+06 | -4.97E+06 | 3.00E+07 | 2.32E+07 | -5.91E+06 | 7.83E+06 | 2.27E+07 | -5.14E+05 | -1.30E+06 | -6.10E+05 | -5.84E+05 | -9.47E+05 | -9.19E+05 | -4.03E+05 | -1.04E+06 |
| **292.97** | 3.02E+07 | 2.20E+06 | -4.85E+06 | 3.12E+07 | 2.28E+07 | -4.35E+06 | 7.74E+06 | 2.10E+07 | -4.73E+05 | -8.50E+05 | -5.04E+05 | -4.77E+05 | -7.55E+05 | -8.35E+05 | -3.04E+05 | -6.39E+05 |
| **302.73** | 3.01E+07 | 2.11E+06 | -5.21E+06 | 3.03E+07 | 2.19E+07 | -3.96E+06 | 8.75E+06 | 1.98E+07 | -6.25E+05 | -8.33E+05 | -3.26E+05 | -4.09E+05 | -7.40E+05 | -4.64E+05 | -4.59E+05 | -7.24E+05 |
| **312.50** | 3.21E+07 | 4.92E+06 | -2.85E+06 | 3.06E+07 | 2.32E+07 | -3.70E+06 | 9.03E+06 | 2.16E+07 | -7.82E+05 | -9.59E+05 | -4.99E+05 | -3.96E+05 | -6.06E+05 | -7.81E+05 | -5.24E+05 | -1.05E+06 |
| **322.27** | 3.30E+07 | 4.72E+06 | -4.13E+06 | 3.03E+07 | 2.30E+07 | -4.36E+06 | 8.53E+06 | 2.39E+07 | -6.91E+05 | -9.86E+05 | -2.99E+05 | -4.05E+05 | -6.68E+05 | -3.58E+05 | -4.31E+05 | -7.01E+05 |
| **332.03** | 3.60E+07 | 3.10E+06 | -7.58E+06 | 3.40E+07 | 2.26E+07 | -3.97E+06 | 7.46E+06 | 1.92E+07 | -5.90E+05 | -8.33E+05 | -3.65E+05 | -5.41E+05 | -4.66E+05 | -6.49E+05 | -4.61E+05 | -7.45E+05 |
| **341.80** | 3.40E+07 | 4.25E+06 | -4.76E+06 | 3.16E+07 | 2.15E+07 | -6.29E+06 | 1.01E+07 | 2.14E+07 | -3.43E+05 | -4.15E+05 | -3.52E+05 | -5.48E+05 | -6.92E+05 | -7.74E+05 | -3.58E+05 | -5.20E+05 |

## Table A3. 50% PR, $\omega$ = 20,200 RPM, and zero preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***f*** | ***Re Hxx*** | ***Re Hxy*** | ***Re Hyx*** | ***Re Hyy*** | ***Im Hxx*** | ***Im Hxy*** | ***Im Hyx*** | ***Im Hyy*** | ***Re eHxx*** | ***Re eHxy*** | ***Re eHyx*** | ***Re eHyy*** | ***Im eHxx*** | ***Im eHxy*** | ***Im eHyx*** | ***Im eHyy*** |
| **9.77** | -3.33E+05 | 2.09E+07 | -2.31E+07 | -1.62E+06 | 1.94E+06 | -1.70E+06 | 2.13E+06 | 3.15E+06 | -5.78E+05 | -3.94E+05 | -4.32E+05 | -3.94E+05 | -6.25E+05 | -4.11E+05 | -5.09E+05 | -2.13E+05 |
| **19.53** | 3.27E+05 | 2.07E+07 | -2.24E+07 | -8.61E+05 | 5.26E+06 | -3.82E+06 | 4.03E+06 | 5.90E+06 | -3.73E+05 | -3.07E+05 | -3.87E+05 | -3.03E+05 | -3.98E+05 | -3.11E+05 | -2.57E+05 | -2.09E+05 |
| **29.30** | 1.38E+06 | 1.94E+07 | -2.12E+07 | 1.69E+05 | 7.66E+06 | -5.16E+06 | 5.29E+06 | 8.73E+06 | -2.55E+05 | -2.86E+05 | -2.48E+05 | -3.30E+05 | -2.29E+05 | -1.80E+05 | -2.36E+05 | -2.38E+05 |
| **39.06** | 2.77E+06 | 1.81E+07 | -1.99E+07 | 1.44E+06 | 9.90E+06 | -6.97E+06 | 6.58E+06 | 1.06E+07 | -4.72E+05 | -4.62E+05 | -3.28E+05 | -4.56E+05 | -2.36E+05 | -3.73E+05 | -4.73E+05 | -4.39E+05 |
| **48.83** | 4.32E+06 | 1.72E+07 | -1.90E+07 | 3.11E+06 | 1.25E+07 | -8.13E+06 | 7.57E+06 | 1.24E+07 | -1.66E+06 | -1.32E+06 | -5.48E+05 | -4.04E+05 | -1.65E+06 | -1.39E+06 | -4.08E+05 | -4.28E+05 |
| **58.59** | 5.53E+06 | 1.60E+07 | -1.81E+07 | 4.11E+06 | 1.26E+07 | -8.84E+06 | 8.23E+06 | 1.47E+07 | -3.65E+05 | -4.22E+05 | -4.87E+05 | -4.33E+05 | -3.84E+05 | -3.73E+05 | -3.93E+05 | -4.04E+05 |
| **68.36** | 5.66E+06 | 1.50E+07 | -1.66E+07 | 6.62E+06 | 1.45E+07 | -7.92E+06 | 9.15E+06 | 1.49E+07 | -7.54E+05 | -1.24E+06 | -8.21E+05 | -1.17E+06 | -7.61E+05 | -5.01E+05 | -8.62E+05 | -6.73E+05 |
| **78.13** | 7.83E+06 | 1.43E+07 | -1.66E+07 | 6.98E+06 | 1.53E+07 | -9.74E+06 | 9.05E+06 | 1.76E+07 | -3.04E+05 | -3.82E+05 | -3.48E+05 | -4.43E+05 | -3.81E+05 | -3.55E+05 | -4.30E+05 | -3.84E+05 |
| **87.89** | 9.16E+06 | 1.31E+07 | -1.55E+07 | 8.95E+06 | 1.68E+07 | -1.08E+07 | 9.85E+06 | 1.87E+07 | -3.34E+05 | -3.22E+05 | -4.40E+05 | -3.51E+05 | -2.50E+05 | -3.73E+05 | -3.58E+05 | -4.05E+05 |
| **97.66** | 9.79E+06 | 1.21E+07 | -1.44E+07 | 1.06E+07 | 1.79E+07 | -1.08E+07 | 1.04E+07 | 1.97E+07 | -3.07E+05 | -5.46E+05 | -3.35E+05 | -4.84E+05 | -4.40E+05 | -3.29E+05 | -4.80E+05 | -4.45E+05 |
| **107.42** | 1.20E+07 | 1.07E+07 | -1.42E+07 | 1.19E+07 | 1.89E+07 | -1.14E+07 | 1.01E+07 | 2.11E+07 | -2.59E+05 | -4.26E+05 | -5.21E+05 | -4.79E+05 | -4.54E+05 | -3.29E+05 | -6.62E+05 | -4.64E+05 |
| **117.19** | 1.28E+07 | 1.07E+07 | -1.28E+07 | 1.37E+07 | 2.04E+07 | -1.09E+07 | 1.06E+07 | 2.15E+07 | -4.67E+05 | -4.84E+05 | -3.72E+05 | -3.34E+05 | -4.82E+05 | -4.34E+05 | -3.49E+05 | -6.04E+05 |
| **126.95** | 1.51E+07 | 8.45E+06 | -1.23E+07 | 1.59E+07 | 2.03E+07 | -1.21E+07 | 1.03E+07 | 2.22E+07 | -3.71E+05 | -6.38E+05 | -2.25E+05 | -6.60E+05 | -4.16E+05 | -4.60E+05 | -3.96E+05 | -3.55E+05 |
| **136.72** | 1.54E+07 | 8.23E+06 | -1.11E+07 | 1.56E+07 | 2.06E+07 | -1.04E+07 | 1.02E+07 | 2.20E+07 | -3.85E+05 | -6.32E+05 | -3.24E+05 | -4.63E+05 | -3.48E+05 | -5.52E+05 | -2.99E+05 | -4.20E+05 |
| **146.48** | 1.72E+07 | 6.13E+06 | -1.09E+07 | 1.84E+07 | 2.00E+07 | -1.05E+07 | 1.05E+07 | 2.25E+07 | -7.50E+05 | -9.37E+05 | -3.81E+05 | -6.38E+05 | -5.11E+05 | -1.19E+06 | -4.05E+05 | -4.38E+05 |
| **156.25** | 1.83E+07 | 7.42E+06 | -1.02E+07 | 1.94E+07 | 2.17E+07 | -1.12E+07 | 1.03E+07 | 2.26E+07 | -5.12E+05 | -6.67E+05 | -4.74E+05 | -9.57E+05 | -5.46E+05 | -5.60E+05 | -5.84E+05 | -7.00E+05 |
| **166.02** | 2.14E+07 | 1.25E+06 | -1.45E+07 | 2.86E+07 | 2.21E+07 | -1.19E+07 | 9.18E+06 | 2.63E+07 | -5.17E+05 | -1.54E+06 | -6.93E+05 | -9.94E+05 | -6.21E+05 | -9.13E+05 | -5.55E+05 | -1.59E+06 |
| **175.78** | 2.20E+07 | 7.92E+06 | -8.16E+06 | 2.39E+07 | 2.44E+07 | -1.08E+07 | 9.92E+06 | 2.31E+07 | -3.14E+05 | -9.12E+05 | -4.55E+05 | -8.72E+05 | -4.73E+05 | -4.92E+05 | -5.33E+05 | -4.96E+05 |
| **185.55** | 2.17E+07 | 5.51E+06 | -8.94E+06 | 2.25E+07 | 2.21E+07 | -1.01E+07 | 1.01E+07 | 2.19E+07 | -2.89E+05 | -5.15E+05 | -4.72E+05 | -4.69E+05 | -2.61E+05 | -3.45E+05 | -3.10E+05 | -4.34E+05 |
| **195.31** | 2.22E+07 | 5.17E+06 | -8.59E+06 | 2.28E+07 | 2.16E+07 | -1.04E+07 | 1.00E+07 | 2.28E+07 | -3.10E+05 | -3.82E+05 | -3.67E+05 | -5.10E+05 | -2.56E+05 | -3.43E+05 | -3.76E+05 | -5.91E+05 |
| **205.08** | 2.25E+07 | 3.25E+06 | -6.78E+06 | 2.48E+07 | 2.17E+07 | -9.91E+06 | 1.10E+07 | 2.08E+07 | -9.09E+05 | -1.94E+06 | -8.65E+05 | -1.71E+06 | -1.02E+06 | -1.47E+06 | -8.68E+05 | -1.61E+06 |
| **214.84** | 2.46E+07 | 4.19E+06 | -7.09E+06 | 2.45E+07 | 2.25E+07 | -1.02E+07 | 9.75E+06 | 2.36E+07 | -3.15E+05 | -3.90E+05 | -2.12E+05 | -3.46E+05 | -2.58E+05 | -4.78E+05 | -2.38E+05 | -3.01E+05 |
| **224.61** | 2.55E+07 | 3.41E+06 | -7.22E+06 | 2.72E+07 | 2.34E+07 | -9.49E+06 | 9.95E+06 | 2.30E+07 | -4.19E+05 | -4.33E+05 | -5.02E+05 | -3.19E+05 | -1.85E+05 | -5.07E+05 | -2.03E+05 | -3.65E+05 |
| **234.38** | 2.70E+07 | 2.91E+06 | -7.27E+06 | 2.80E+07 | 2.30E+07 | -8.90E+06 | 1.08E+07 | 2.28E+07 | -3.40E+05 | -4.48E+05 | -2.11E+05 | -4.43E+05 | -2.81E+05 | -5.04E+05 | -2.55E+05 | -3.18E+05 |
| **244.14** | 2.72E+07 | 2.35E+06 | -6.40E+06 | 2.84E+07 | 2.25E+07 | -8.06E+06 | 1.01E+07 | 2.24E+07 | -3.04E+05 | -4.36E+05 | -2.25E+05 | -3.14E+05 | -2.37E+05 | -5.92E+05 | -2.58E+05 | -3.61E+05 |
| **253.91** | 2.75E+07 | 3.51E+06 | -6.57E+06 | 2.93E+07 | 2.17E+07 | -7.22E+06 | 1.04E+07 | 2.21E+07 | -5.42E+05 | -1.22E+06 | -3.00E+05 | -5.62E+05 | -6.44E+05 | -1.00E+06 | -2.22E+05 | -5.87E+05 |
| **263.67** | 2.95E+07 | 1.71E+06 | -5.63E+06 | 3.09E+07 | 2.03E+07 | -6.84E+06 | 1.04E+07 | 2.14E+07 | -4.15E+05 | -6.42E+05 | -3.82E+05 | -6.18E+05 | -3.22E+05 | -8.97E+05 | -2.81E+05 | -4.86E+05 |
| **273.44** | 2.78E+07 | 3.25E+06 | -5.65E+06 | 3.00E+07 | 2.08E+07 | -5.71E+06 | 1.05E+07 | 2.06E+07 | -4.26E+05 | -4.28E+05 | -2.43E+05 | -6.13E+05 | -2.17E+05 | -6.73E+05 | -2.65E+05 | -3.99E+05 |
| **283.20** | 3.00E+07 | 3.26E+06 | -5.56E+06 | 3.16E+07 | 2.25E+07 | -6.75E+06 | 9.54E+06 | 2.12E+07 | -2.33E+05 | -5.81E+05 | -2.92E+05 | -4.61E+05 | -2.76E+05 | -4.18E+05 | -3.01E+05 | -6.36E+05 |
| **292.97** | 3.09E+07 | 2.88E+06 | -5.48E+06 | 3.12E+07 | 2.18E+07 | -6.61E+06 | 1.00E+07 | 2.00E+07 | -4.45E+05 | -7.08E+05 | -3.92E+05 | -3.81E+05 | -5.06E+05 | -6.19E+05 | -2.93E+05 | -5.33E+05 |
| **302.73** | 3.14E+07 | 3.82E+06 | -5.06E+06 | 3.07E+07 | 2.15E+07 | -5.88E+06 | 1.00E+07 | 1.90E+07 | -5.61E+05 | -1.08E+06 | -3.73E+05 | -5.88E+05 | -5.13E+05 | -7.25E+05 | -4.18E+05 | -7.54E+05 |
| **312.50** | 3.17E+07 | 5.11E+06 | -4.20E+06 | 3.10E+07 | 2.14E+07 | -6.52E+06 | 9.61E+06 | 2.17E+07 | -9.48E+05 | -1.35E+06 | -5.06E+05 | -8.38E+05 | -9.53E+05 | -1.36E+06 | -5.35E+05 | -8.55E+05 |
| **322.27** | 3.36E+07 | 4.61E+06 | -4.58E+06 | 3.15E+07 | 2.31E+07 | -4.95E+06 | 9.34E+06 | 2.24E+07 | -1.64E+06 | -2.45E+06 | -9.32E+05 | -1.30E+06 | -1.57E+06 | -1.59E+06 | -1.09E+06 | -1.51E+06 |
| **332.03** | 3.23E+07 | -3.88E+06 | -4.06E+06 | 3.81E+07 | 2.71E+07 | -2.03E+06 | 1.12E+07 | 2.35E+07 | -1.15E+07 | -1.60E+07 | -1.45E+07 | -1.88E+07 | -1.73E+07 | -2.20E+07 | -4.91E+06 | -7.51E+06 |
| **341.80** | 2.97E+07 | 6.13E+06 | -4.97E+06 | 3.27E+07 | 1.85E+07 | -6.87E+06 | 1.42E+07 | 1.95E+07 | -4.71E+06 | -5.05E+06 | -2.40E+06 | -3.25E+06 | -3.74E+06 | -5.49E+06 | -2.89E+06 | -3.13E+06 |

## Table A4. 60% PR, $\omega$ = 10,200 RPM, and zero preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***f*** | ***Re Hxx*** | ***Re Hxy*** | ***Re Hyx*** | ***Re Hyy*** | ***Im Hxx*** | ***Im Hxy*** | ***Im Hyx*** | ***Im Hyy*** | ***Re eHxx*** | ***Re eHxy*** | ***Re eHyx*** | ***Re eHyy*** | ***Im eHxx*** | ***Im eHxy*** | ***Im eHyx*** | ***Im eHyy*** |
| **9.77** | 1.46E+06 | 9.11E+06 | -1.02E+07 | 1.04E+06 | 1.91E+06 | -9.62E+05 | 6.78E+05 | 2.60E+06 | -2.27E+05 | -1.77E+05 | -2.78E+05 | -1.97E+05 | -4.20E+05 | -1.48E+05 | -4.44E+05 | -2.00E+05 |
| **19.53** | 2.08E+06 | 8.95E+06 | -1.03E+07 | 1.28E+06 | 4.00E+06 | -1.36E+06 | 1.19E+06 | 4.73E+06 | -3.01E+05 | -2.29E+05 | -3.22E+05 | -2.11E+05 | -2.90E+05 | -1.45E+05 | -2.69E+05 | -2.49E+05 |
| **29.30** | 2.69E+06 | 8.70E+06 | -9.84E+06 | 2.29E+06 | 6.31E+06 | -1.79E+06 | 2.18E+06 | 6.57E+06 | -3.21E+05 | -3.82E+05 | -2.54E+05 | -3.55E+05 | -1.56E+05 | -2.80E+05 | -2.78E+05 | -3.01E+05 |
| **39.06** | 3.43E+06 | 8.63E+06 | -9.61E+06 | 3.23E+06 | 8.52E+06 | -2.71E+06 | 2.72E+06 | 8.56E+06 | -1.90E+05 | -3.56E+05 | -2.42E+05 | -2.42E+05 | -2.41E+05 | -2.33E+05 | -2.36E+05 | -4.57E+05 |
| **48.83** | 4.34E+06 | 8.27E+06 | -8.82E+06 | 3.99E+06 | 9.76E+06 | -3.04E+06 | 2.41E+06 | 1.02E+07 | -3.83E+05 | -2.39E+05 | -2.91E+05 | -3.14E+05 | -3.14E+05 | -2.65E+05 | -2.45E+05 | -3.28E+05 |
| **58.59** | 5.60E+06 | 7.54E+06 | -8.98E+06 | 4.78E+06 | 1.13E+07 | -4.47E+06 | 3.20E+06 | 1.23E+07 | -3.53E+05 | -3.70E+05 | -4.21E+05 | -4.02E+05 | -2.57E+05 | -3.62E+05 | -3.37E+05 | -3.82E+05 |
| **68.36** | 5.76E+06 | 6.65E+06 | -8.64E+06 | 5.34E+06 | 1.25E+07 | -4.22E+06 | 2.86E+06 | 1.38E+07 | -4.67E+05 | -6.78E+05 | -6.32E+05 | -3.98E+05 | -6.76E+05 | -5.59E+05 | -4.48E+05 | -9.00E+05 |
| **78.13** | 7.14E+06 | 7.06E+06 | -8.26E+06 | 6.36E+06 | 1.41E+07 | -4.24E+06 | 3.65E+06 | 1.50E+07 | -2.17E+05 | -3.71E+05 | -2.24E+05 | -3.05E+05 | -3.67E+05 | -2.14E+05 | -3.29E+05 | -2.92E+05 |
| **87.89** | 7.95E+06 | 6.46E+06 | -7.99E+06 | 7.55E+06 | 1.50E+07 | -4.94E+06 | 3.73E+06 | 1.68E+07 | -2.35E+05 | -2.75E+05 | -1.75E+05 | -2.90E+05 | -2.54E+05 | -2.26E+05 | -2.61E+05 | -2.34E+05 |
| **97.66** | 8.85E+06 | 6.32E+06 | -7.54E+06 | 9.20E+06 | 1.67E+07 | -5.32E+06 | 4.12E+06 | 1.77E+07 | -2.60E+05 | -3.80E+05 | -3.14E+05 | -2.71E+05 | -3.88E+05 | -3.40E+05 | -3.64E+05 | -2.14E+05 |
| **107.42** | 1.08E+07 | 5.54E+06 | -7.94E+06 | 1.07E+07 | 1.73E+07 | -5.27E+06 | 5.06E+06 | 1.89E+07 | -3.44E+05 | -3.60E+05 | -4.06E+05 | -4.61E+05 | -3.37E+05 | -2.35E+05 | -4.57E+05 | -3.58E+05 |
| **117.19** | 1.14E+07 | 4.73E+06 | -7.51E+06 | 1.19E+07 | 1.96E+07 | -5.55E+06 | 4.70E+06 | 2.02E+07 | -3.45E+05 | -2.76E+05 | -3.26E+05 | -2.94E+05 | -5.14E+05 | -2.31E+05 | -5.87E+05 | -3.86E+05 |
| **126.95** | 1.26E+07 | 3.52E+06 | -7.11E+06 | 1.39E+07 | 1.90E+07 | -5.10E+06 | 4.85E+06 | 2.08E+07 | -3.96E+05 | -9.60E+05 | -3.47E+05 | -7.84E+05 | -4.67E+05 | -5.36E+05 | -3.46E+05 | -7.20E+05 |
| **136.72** | 1.35E+07 | 4.07E+06 | -6.82E+06 | 1.45E+07 | 2.02E+07 | -5.37E+06 | 4.84E+06 | 2.13E+07 | -3.56E+05 | -4.28E+05 | -3.26E+05 | -3.12E+05 | -5.07E+05 | -4.11E+05 | -1.96E+05 | -4.45E+05 |
| **146.48** | 1.51E+07 | 3.63E+06 | -5.89E+06 | 1.59E+07 | 2.07E+07 | -5.50E+06 | 5.06E+06 | 2.17E+07 | -4.80E+05 | -5.60E+05 | -4.23E+05 | -6.11E+05 | -2.83E+05 | -5.27E+05 | -3.85E+05 | -6.46E+05 |
| **156.25** | 1.61E+07 | 3.93E+06 | -5.41E+06 | 1.63E+07 | 2.25E+07 | -5.98E+06 | 4.02E+06 | 2.26E+07 | -5.69E+05 | -7.07E+05 | -3.83E+05 | -1.02E+06 | -7.52E+05 | -9.36E+05 | -3.93E+05 | -7.08E+05 |
| **166.02** | 2.00E+07 | -1.19E+06 | -7.69E+06 | 2.34E+07 | 2.58E+07 | -9.63E+06 | 2.09E+06 | 2.62E+07 | -3.19E+06 | -8.96E+06 | -2.81E+06 | -7.74E+06 | -3.09E+06 | -7.40E+06 | -3.06E+06 | -7.63E+06 |
| **175.78** | 1.81E+07 | 3.48E+06 | -4.66E+06 | 2.01E+07 | 2.42E+07 | -3.18E+06 | 4.77E+06 | 2.89E+07 | -1.37E+06 | -2.27E+06 | -1.38E+06 | -2.39E+06 | -1.45E+06 | -2.37E+06 | -1.18E+06 | -2.23E+06 |
| **185.55** | 2.00E+07 | 2.85E+06 | -6.52E+06 | 2.00E+07 | 2.31E+07 | -4.90E+06 | 5.33E+06 | 2.31E+07 | -3.99E+05 | -7.29E+05 | -5.29E+05 | -4.47E+05 | -4.53E+05 | -6.68E+05 | -4.86E+05 | -5.55E+05 |
| **195.31** | 2.03E+07 | 2.24E+06 | -5.87E+06 | 2.17E+07 | 2.30E+07 | -5.38E+06 | 5.61E+06 | 2.39E+07 | -3.12E+05 | -5.20E+05 | -3.28E+05 | -2.88E+05 | -3.13E+05 | -2.55E+05 | -3.06E+05 | -5.36E+05 |
| **205.08** | 2.00E+07 | 3.19E+05 | -5.58E+06 | 2.32E+07 | 2.33E+07 | -4.83E+06 | 6.69E+06 | 2.42E+07 | -4.74E+05 | -8.20E+05 | -3.06E+05 | -8.16E+05 | -3.90E+05 | -8.06E+05 | -4.32E+05 | -7.08E+05 |
| **214.84** | 2.17E+07 | 1.62E+06 | -4.50E+06 | 2.30E+07 | 2.37E+07 | -4.36E+06 | 6.37E+06 | 2.37E+07 | -3.33E+05 | -4.15E+05 | -2.02E+05 | -4.81E+05 | -2.28E+05 | -3.35E+05 | -3.08E+05 | -3.38E+05 |
| **224.61** | 2.29E+07 | 1.96E+06 | -3.85E+06 | 2.36E+07 | 2.46E+07 | -4.72E+06 | 5.49E+06 | 2.41E+07 | -2.18E+05 | -2.70E+05 | -1.96E+05 | -2.16E+05 | -2.74E+05 | -3.39E+05 | -2.86E+05 | -2.84E+05 |
| **234.38** | 2.48E+07 | 1.02E+06 | -4.43E+06 | 2.55E+07 | 2.45E+07 | -4.19E+06 | 5.15E+06 | 2.48E+07 | -1.64E+05 | -4.82E+05 | -2.05E+05 | -3.68E+05 | -2.50E+05 | -2.75E+05 | -2.56E+05 | -3.51E+05 |
| **244.14** | 2.56E+07 | 1.12E+06 | -4.26E+06 | 2.58E+07 | 2.43E+07 | -4.20E+06 | 5.40E+06 | 2.46E+07 | -2.06E+05 | -2.94E+05 | -1.72E+05 | -3.25E+05 | -2.39E+05 | -3.74E+05 | -2.05E+05 | -2.05E+05 |
| **253.91** | 2.57E+07 | 2.16E+06 | -4.45E+06 | 2.72E+07 | 2.34E+07 | -2.87E+06 | 6.14E+06 | 2.46E+07 | -4.77E+05 | -1.09E+06 | -3.87E+05 | -3.88E+05 | -5.45E+05 | -9.30E+05 | -2.10E+05 | -3.20E+05 |
| **263.67** | 2.72E+07 | 6.38E+05 | -3.98E+06 | 2.84E+07 | 2.36E+07 | -3.04E+06 | 6.06E+06 | 2.39E+07 | -3.31E+05 | -4.30E+05 | -1.79E+05 | -2.38E+05 | -2.42E+05 | -3.92E+05 | -3.60E+05 | -2.68E+05 |
| **273.44** | 2.68E+07 | 1.66E+06 | -3.28E+06 | 2.87E+07 | 2.31E+07 | -1.68E+06 | 6.31E+06 | 2.26E+07 | -3.35E+05 | -5.74E+05 | -2.53E+05 | -4.63E+05 | -2.21E+05 | -2.62E+05 | -2.64E+05 | -5.30E+05 |
| **283.20** | 2.79E+07 | 2.60E+06 | -3.70E+06 | 2.83E+07 | 2.48E+07 | -3.67E+06 | 5.50E+06 | 2.42E+07 | -2.29E+05 | -3.96E+05 | -2.12E+05 | -3.28E+05 | -2.12E+05 | -4.26E+05 | -2.34E+05 | -4.01E+05 |
| **292.97** | 2.95E+07 | 1.26E+06 | -4.00E+06 | 3.06E+07 | 2.43E+07 | -3.35E+06 | 6.02E+06 | 2.36E+07 | -2.73E+05 | -3.84E+05 | -2.96E+05 | -2.61E+05 | -3.10E+05 | -2.99E+05 | -2.13E+05 | -2.93E+05 |
| **302.73** | 3.05E+07 | 2.18E+06 | -4.50E+06 | 3.02E+07 | 2.40E+07 | -2.70E+06 | 6.18E+06 | 2.24E+07 | -3.07E+05 | -2.72E+05 | -1.99E+05 | -3.47E+05 | -3.07E+05 | -3.27E+05 | -3.53E+05 | -2.97E+05 |
| **312.50** | 3.11E+07 | 2.57E+06 | -1.84E+06 | 3.12E+07 | 2.50E+07 | -2.08E+06 | 6.42E+06 | 2.33E+07 | -3.17E+05 | -3.76E+05 | -2.71E+05 | -4.02E+05 | -4.23E+05 | -4.92E+05 | -3.51E+05 | -2.72E+05 |
| **322.27** | 3.29E+07 | 3.76E+06 | -3.60E+06 | 3.03E+07 | 2.44E+07 | -2.26E+06 | 6.19E+06 | 2.43E+07 | -5.14E+05 | -3.50E+05 | -3.05E+05 | -3.97E+05 | -4.47E+05 | -5.16E+05 | -4.84E+05 | -5.69E+05 |
| **332.03** | 3.63E+07 | 4.34E+05 | -8.60E+06 | 3.63E+07 | 2.43E+07 | -2.53E+06 | 5.92E+06 | 2.28E+07 | -9.02E+05 | -1.16E+06 | -7.74E+05 | -8.74E+05 | -8.46E+05 | -9.35E+05 | -9.50E+05 | -1.01E+06 |
| **341.80** | 3.39E+07 | 3.60E+06 | -3.16E+06 | 3.40E+07 | 2.48E+07 | -3.97E+06 | 6.62E+06 | 2.41E+07 | -2.59E+06 | -2.96E+06 | -2.65E+06 | -3.28E+06 | -2.76E+06 | -2.25E+06 | -2.80E+06 | -1.88E+06 |

## Table A5. 60% PR, $\omega$ = 15,350 RPM, and zero preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***f*** | ***Re Hxx*** | ***Re Hxy*** | ***Re Hyx*** | ***Re Hyy*** | ***Im Hxx*** | ***Im Hxy*** | ***Im Hyx*** | ***Im Hyy*** | ***Re eHxx*** | ***Re eHxy*** | ***Re eHyx*** | ***Re eHyy*** | ***Im eHxx*** | ***Im eHxy*** | ***Im eHyx*** | ***Im eHyy*** |
| **9.77** | 2.01E+06 | 1.44E+07 | -1.56E+07 | 8.77E+05 | 2.16E+06 | -1.49E+06 | 6.49E+05 | 2.31E+06 | -3.51E+05 | -2.60E+05 | -3.12E+05 | -2.89E+05 | -4.98E+05 | -2.58E+05 | -6.18E+05 | -3.27E+05 |
| **19.53** | 1.84E+06 | 1.42E+07 | -1.52E+07 | 1.22E+06 | 4.69E+06 | -2.26E+06 | 2.13E+06 | 4.84E+06 | -3.24E+05 | -2.38E+05 | -2.96E+05 | -2.48E+05 | -3.48E+05 | -2.41E+05 | -3.56E+05 | -2.64E+05 |
| **29.30** | 2.80E+06 | 1.32E+07 | -1.48E+07 | 2.54E+06 | 6.72E+06 | -3.24E+06 | 3.47E+06 | 7.06E+06 | -2.33E+05 | -2.81E+05 | -2.51E+05 | -3.16E+05 | -2.31E+05 | -2.42E+05 | -2.27E+05 | -3.35E+05 |
| **39.06** | 3.33E+06 | 1.29E+07 | -1.44E+07 | 2.73E+06 | 8.55E+06 | -4.14E+06 | 3.55E+06 | 9.61E+06 | -2.40E+05 | -4.21E+05 | -3.34E+05 | -3.98E+05 | -2.90E+05 | -2.74E+05 | -3.49E+05 | -4.97E+05 |
| **48.83** | 4.36E+06 | 1.24E+07 | -1.37E+07 | 4.19E+06 | 1.04E+07 | -4.79E+06 | 3.96E+06 | 1.12E+07 | -3.38E+05 | -2.95E+05 | -2.75E+05 | -3.25E+05 | -2.94E+05 | -2.90E+05 | -3.15E+05 | -1.81E+05 |
| **58.59** | 5.64E+06 | 1.16E+07 | -1.34E+07 | 5.00E+06 | 1.16E+07 | -5.53E+06 | 5.01E+06 | 1.30E+07 | -3.71E+05 | -3.55E+05 | -3.60E+05 | -4.06E+05 | -3.82E+05 | -3.06E+05 | -4.79E+05 | -3.44E+05 |
| **68.36** | 6.23E+06 | 1.08E+07 | -1.34E+07 | 5.94E+06 | 1.30E+07 | -6.36E+06 | 4.64E+06 | 1.51E+07 | -5.49E+05 | -5.01E+05 | -6.41E+05 | -6.19E+05 | -6.09E+05 | -7.73E+05 | -4.55E+05 | -4.83E+05 |
| **78.13** | 7.28E+06 | 1.07E+07 | -1.23E+07 | 6.93E+06 | 1.48E+07 | -6.36E+06 | 5.57E+06 | 1.60E+07 | -2.46E+05 | -3.37E+05 | -2.38E+05 | -3.63E+05 | -3.38E+05 | -2.72E+05 | -3.13E+05 | -3.83E+05 |
| **87.89** | 8.83E+06 | 1.00E+07 | -1.15E+07 | 8.45E+06 | 1.61E+07 | -7.04E+06 | 6.29E+06 | 1.74E+07 | -2.19E+05 | -2.20E+05 | -3.03E+05 | -2.80E+05 | -2.92E+05 | -2.23E+05 | -2.00E+05 | -2.56E+05 |
| **97.66** | 9.75E+06 | 9.29E+06 | -1.14E+07 | 9.67E+06 | 1.74E+07 | -7.61E+06 | 6.06E+06 | 1.86E+07 | -3.22E+05 | -3.64E+05 | -2.66E+05 | -4.68E+05 | -3.50E+05 | -2.74E+05 | -2.85E+05 | -3.42E+05 |
| **107.42** | 1.15E+07 | 8.80E+06 | -1.05E+07 | 1.17E+07 | 1.87E+07 | -7.91E+06 | 6.72E+06 | 2.00E+07 | -3.09E+05 | -3.77E+05 | -4.58E+05 | -5.13E+05 | -3.08E+05 | -2.37E+05 | -4.95E+05 | -3.86E+05 |
| **117.19** | 1.22E+07 | 7.79E+06 | -1.00E+07 | 1.31E+07 | 1.93E+07 | -7.55E+06 | 6.72E+06 | 2.05E+07 | -3.57E+05 | -2.28E+05 | -4.97E+05 | -2.33E+05 | -4.50E+05 | -2.63E+05 | -2.78E+05 | -2.85E+05 |
| **126.95** | 1.41E+07 | 6.63E+06 | -9.86E+06 | 1.30E+07 | 1.97E+07 | -7.93E+06 | 6.12E+06 | 2.07E+07 | -3.82E+05 | -4.70E+05 | -4.00E+05 | -6.17E+05 | -3.37E+05 | -3.86E+05 | -3.23E+05 | -5.26E+05 |
| **136.72** | 1.43E+07 | 6.73E+06 | -9.57E+06 | 1.52E+07 | 2.04E+07 | -7.55E+06 | 6.70E+06 | 2.18E+07 | -3.26E+05 | -6.21E+05 | -2.85E+05 | -5.47E+05 | -4.21E+05 | -4.40E+05 | -3.40E+05 | -3.68E+05 |
| **146.48** | 1.62E+07 | 5.63E+06 | -9.02E+06 | 1.73E+07 | 2.04E+07 | -7.07E+06 | 7.43E+06 | 2.20E+07 | -3.12E+05 | -5.76E+05 | -4.13E+05 | -6.26E+05 | -3.23E+05 | -5.32E+05 | -3.03E+05 | -5.00E+05 |
| **156.25** | 1.77E+07 | 5.59E+06 | -8.37E+06 | 1.75E+07 | 2.19E+07 | -7.69E+06 | 7.00E+06 | 2.22E+07 | -4.06E+05 | -5.42E+05 | -5.77E+05 | -4.21E+05 | -5.89E+05 | -3.62E+05 | -4.20E+05 | -5.22E+05 |
| **166.02** | 2.07E+07 | 2.24E+06 | -1.33E+07 | 2.58E+07 | 2.48E+07 | -1.27E+07 | 2.34E+06 | 3.35E+07 | -6.43E+05 | -1.08E+06 | -4.42E+05 | -5.31E+05 | -3.33E+05 | -1.40E+06 | -3.64E+05 | -1.17E+06 |
| **175.78** | 1.94E+07 | 4.48E+06 | -8.85E+06 | 1.91E+07 | 2.24E+07 | -8.03E+06 | 7.28E+06 | 2.31E+07 | -2.36E+05 | -6.24E+05 | -5.56E+05 | -5.64E+05 | -3.86E+05 | -4.21E+05 | -3.03E+05 | -4.05E+05 |
| **185.55** | 2.08E+07 | 4.48E+06 | -7.63E+06 | 2.17E+07 | 2.28E+07 | -7.43E+06 | 7.35E+06 | 2.31E+07 | -2.74E+05 | -5.49E+05 | -3.82E+05 | -4.19E+05 | -4.54E+05 | -3.58E+05 | -4.23E+05 | -3.69E+05 |
| **195.31** | 2.14E+07 | 4.01E+06 | -8.00E+06 | 2.29E+07 | 2.26E+07 | -7.72E+06 | 8.09E+06 | 2.37E+07 | -5.83E+05 | -4.49E+05 | -1.70E+05 | -2.68E+05 | -3.34E+05 | -2.96E+05 | -4.86E+05 | -3.89E+05 |
| **205.08** | 2.19E+07 | 2.82E+06 | -8.06E+06 | 2.29E+07 | 2.36E+07 | -7.53E+06 | 7.95E+06 | 2.44E+07 | -6.22E+05 | -1.18E+06 | -5.46E+05 | -1.35E+06 | -5.48E+05 | -1.08E+06 | -6.12E+05 | -9.97E+05 |
| **214.84** | 2.24E+07 | 3.51E+06 | -6.38E+06 | 2.48E+07 | 2.35E+07 | -6.65E+06 | 8.48E+06 | 2.35E+07 | -5.31E+05 | -4.49E+05 | -3.45E+05 | -3.45E+05 | -3.60E+05 | -4.83E+05 | -3.41E+05 | -5.32E+05 |
| **224.61** | 2.44E+07 | 3.39E+06 | -5.76E+06 | 2.55E+07 | 2.44E+07 | -6.96E+06 | 7.60E+06 | 2.40E+07 | -3.19E+05 | -4.62E+05 | -5.40E+05 | -5.68E+05 | -5.88E+05 | -5.07E+05 | -2.45E+05 | -3.20E+05 |
| **234.38** | 2.58E+07 | 2.17E+06 | -6.50E+06 | 2.68E+07 | 2.36E+07 | -6.36E+06 | 7.82E+06 | 2.40E+07 | -4.16E+05 | -5.98E+05 | -6.62E+05 | -6.95E+05 | -9.06E+05 | -6.69E+05 | -4.69E+05 | -6.80E+05 |
| **244.14** | 2.65E+07 | 2.31E+06 | -6.12E+06 | 2.71E+07 | 2.31E+07 | -5.82E+06 | 7.88E+06 | 2.40E+07 | -8.65E+05 | -1.22E+06 | -6.15E+05 | -1.05E+06 | -1.32E+06 | -1.54E+06 | -8.07E+05 | -8.93E+05 |
| **253.91** | 2.83E+07 | 9.66E+06 | -8.27E+06 | 1.87E+07 | 1.93E+07 | -1.71E+07 | 7.38E+06 | 2.21E+07 | -1.28E+07 | -9.99E+06 | -5.68E+06 | -5.68E+06 | -6.95E+06 | -6.54E+06 | -8.79E+06 | -6.12E+06 |
| **263.67** | 2.81E+07 | 1.60E+06 | -5.74E+06 | 2.84E+07 | 2.28E+07 | -4.43E+06 | 8.20E+06 | 2.26E+07 | -2.74E+06 | -1.67E+06 | -6.96E+05 | -1.99E+06 | -9.45E+05 | -2.89E+06 | -1.98E+06 | -1.20E+06 |
| **273.44** | 2.73E+07 | 4.02E+06 | -4.68E+06 | 2.95E+07 | 2.26E+07 | -3.20E+06 | 9.02E+06 | 2.20E+07 | -1.10E+06 | -1.16E+06 | -5.80E+05 | -1.45E+06 | -5.91E+05 | -1.58E+06 | -8.04E+05 | -7.78E+05 |
| **283.20** | 2.90E+07 | 3.41E+06 | -4.98E+06 | 2.98E+07 | 2.40E+07 | -5.46E+06 | 7.35E+06 | 2.35E+07 | -5.08E+05 | -1.02E+06 | -4.40E+05 | -5.42E+05 | -6.85E+05 | -7.23E+05 | -3.85E+05 | -7.33E+05 |
| **292.97** | 3.05E+07 | 2.49E+06 | -5.50E+06 | 3.13E+07 | 2.41E+07 | -4.89E+06 | 7.83E+06 | 2.25E+07 | -4.27E+05 | -6.53E+05 | -4.86E+05 | -4.43E+05 | -5.14E+05 | -3.81E+05 | -2.84E+05 | -4.82E+05 |
| **302.73** | 3.13E+07 | 3.33E+06 | -4.89E+06 | 3.10E+07 | 2.36E+07 | -3.91E+06 | 8.63E+06 | 2.19E+07 | -4.31E+05 | -6.44E+05 | -4.03E+05 | -3.01E+05 | -6.57E+05 | -5.06E+05 | -2.92E+05 | -4.75E+05 |
| **312.50** | 3.19E+07 | 4.87E+06 | -3.22E+06 | 3.21E+07 | 2.53E+07 | -3.13E+06 | 9.37E+06 | 2.40E+07 | -5.24E+05 | -6.01E+05 | -3.47E+05 | -3.21E+05 | -4.17E+05 | -6.58E+05 | -3.79E+05 | -5.24E+05 |
| **322.27** | 3.41E+07 | 5.34E+06 | -4.43E+06 | 3.18E+07 | 2.39E+07 | -4.59E+06 | 7.84E+06 | 2.41E+07 | -5.53E+05 | -3.81E+05 | -3.39E+05 | -4.62E+05 | -3.12E+05 | -4.03E+05 | -4.05E+05 | -3.41E+05 |
| **332.03** | 3.73E+07 | 3.67E+06 | -8.94E+06 | 3.59E+07 | 2.43E+07 | -4.77E+06 | 6.01E+06 | 2.17E+07 | -6.28E+05 | -7.14E+05 | -3.54E+05 | -4.42E+05 | -4.22E+05 | -4.33E+05 | -5.62E+05 | -6.50E+05 |
| **341.80** | 3.58E+07 | 5.17E+06 | -5.99E+06 | 3.31E+07 | 2.25E+07 | -5.83E+06 | 9.91E+06 | 2.29E+07 | -5.03E+05 | -2.90E+05 | -2.75E+05 | -3.30E+05 | -3.19E+05 | -3.56E+05 | -3.67E+05 | -3.28E+05 |

## Table A6. 60% PR, $\omega$ = 20,200 RPM, and zero preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***f*** | ***Re Hxx*** | ***Re Hxy*** | ***Re Hyx*** | ***Re Hyy*** | ***Im Hxx*** | ***Im Hxy*** | ***Im Hyx*** | ***Im Hyy*** | ***Re eHxx*** | ***Re eHxy*** | ***Re eHyx*** | ***Re eHyy*** | ***Im eHxx*** | ***Im eHxy*** | ***Im eHyx*** | ***Im eHyy*** |
| **9.77** | 9.78E+05 | 1.98E+07 | -2.10E+07 | 3.93E+05 | 2.09E+06 | -1.90E+06 | 1.59E+06 | 2.95E+06 | -4.13E+05 | -4.17E+05 | -4.05E+05 | -3.82E+05 | -5.28E+05 | -2.01E+05 | -5.07E+05 | -2.79E+05 |
| **19.53** | 1.62E+06 | 1.93E+07 | -2.06E+07 | 5.22E+05 | 5.04E+06 | -3.18E+06 | 2.85E+06 | 5.48E+06 | -4.84E+05 | -3.34E+05 | -3.85E+05 | -3.10E+05 | -2.23E+05 | -2.58E+05 | -3.13E+05 | -2.43E+05 |
| **29.30** | 2.31E+06 | 1.84E+07 | -1.98E+07 | 1.99E+06 | 7.61E+06 | -4.52E+06 | 4.56E+06 | 7.72E+06 | -2.77E+05 | -2.60E+05 | -2.09E+05 | -3.04E+05 | -2.55E+05 | -2.86E+05 | -2.79E+05 | -2.69E+05 |
| **39.06** | 3.49E+06 | 1.73E+07 | -1.92E+07 | 2.72E+06 | 9.47E+06 | -6.04E+06 | 5.36E+06 | 9.80E+06 | -2.62E+05 | -4.01E+05 | -2.88E+05 | -3.11E+05 | -3.76E+05 | -3.04E+05 | -2.77E+05 | -3.23E+05 |
| **48.83** | 5.15E+06 | 1.56E+07 | -1.78E+07 | 4.43E+06 | 9.89E+06 | -6.93E+06 | 6.40E+06 | 1.13E+07 | -1.10E+06 | -9.04E+05 | -2.86E+05 | -3.13E+05 | -1.06E+06 | -9.33E+05 | -3.73E+05 | -2.81E+05 |
| **58.59** | 6.34E+06 | 1.61E+07 | -1.74E+07 | 5.39E+06 | 1.26E+07 | -7.85E+06 | 7.12E+06 | 1.32E+07 | -3.51E+05 | -4.13E+05 | -3.60E+05 | -4.90E+05 | -3.03E+05 | -2.68E+05 | -4.93E+05 | -4.58E+05 |
| **68.36** | 5.71E+06 | 1.43E+07 | -1.56E+07 | 6.79E+06 | 1.28E+07 | -6.23E+06 | 8.18E+06 | 1.34E+07 | -7.18E+05 | -5.84E+05 | -8.37E+05 | -6.33E+05 | -4.21E+05 | -7.25E+05 | -3.99E+05 | -8.66E+05 |
| **78.13** | 8.47E+06 | 1.38E+07 | -1.68E+07 | 8.16E+06 | 1.46E+07 | -8.81E+06 | 8.24E+06 | 1.70E+07 | -2.97E+05 | -2.87E+05 | -3.06E+05 | -4.07E+05 | -2.71E+05 | -2.52E+05 | -4.12E+05 | -2.92E+05 |
| **87.89** | 9.19E+06 | 1.29E+07 | -1.59E+07 | 8.88E+06 | 1.53E+07 | -9.22E+06 | 8.53E+06 | 1.80E+07 | -3.20E+05 | -2.66E+05 | -3.02E+05 | -3.78E+05 | -2.72E+05 | -2.10E+05 | -2.23E+05 | -2.22E+05 |
| **97.66** | 1.02E+07 | 1.25E+07 | -1.54E+07 | 1.05E+07 | 1.69E+07 | -1.00E+07 | 9.02E+06 | 1.90E+07 | -4.54E+05 | -4.90E+05 | -4.45E+05 | -3.97E+05 | -4.21E+05 | -3.26E+05 | -2.96E+05 | -2.99E+05 |
| **107.42** | 1.15E+07 | 1.20E+07 | -1.37E+07 | 1.22E+07 | 1.89E+07 | -1.02E+07 | 9.97E+06 | 1.98E+07 | -3.67E+05 | -3.97E+05 | -3.47E+05 | -3.72E+05 | -5.18E+05 | -2.88E+05 | -5.35E+05 | -4.73E+05 |
| **117.19** | 1.27E+07 | 1.03E+07 | -1.29E+07 | 1.36E+07 | 1.98E+07 | -1.03E+07 | 9.67E+06 | 2.07E+07 | -2.96E+05 | -2.87E+05 | -3.93E+05 | -3.17E+05 | -4.12E+05 | -2.20E+05 | -4.37E+05 | -3.78E+05 |
| **126.95** | 1.47E+07 | 9.74E+06 | -1.20E+07 | 1.53E+07 | 2.03E+07 | -1.04E+07 | 9.77E+06 | 2.11E+07 | -3.44E+05 | -6.85E+05 | -4.26E+05 | -6.73E+05 | -4.60E+05 | -5.55E+05 | -5.60E+05 | -5.88E+05 |
| **136.72** | 1.54E+07 | 9.16E+06 | -1.19E+07 | 1.67E+07 | 2.08E+07 | -1.01E+07 | 9.97E+06 | 2.19E+07 | -3.53E+05 | -5.08E+05 | -2.42E+05 | -2.28E+05 | -3.19E+05 | -3.48E+05 | -2.20E+05 | -3.23E+05 |
| **146.48** | 1.75E+07 | 7.38E+06 | -1.13E+07 | 1.80E+07 | 2.04E+07 | -1.03E+07 | 9.55E+06 | 2.25E+07 | -3.41E+05 | -4.05E+05 | -3.66E+05 | -5.79E+05 | -2.85E+05 | -4.80E+05 | -3.17E+05 | -3.30E+05 |
| **156.25** | 1.80E+07 | 7.66E+06 | -1.06E+07 | 1.86E+07 | 2.10E+07 | -9.57E+06 | 9.51E+06 | 2.19E+07 | -3.25E+05 | -4.31E+05 | -2.73E+05 | -2.87E+05 | -3.62E+05 | -3.41E+05 | -2.95E+05 | -3.89E+05 |
| **166.02** | 2.02E+07 | 3.69E+06 | -1.35E+07 | 2.50E+07 | 2.34E+07 | -1.31E+07 | 6.15E+06 | 3.04E+07 | -4.71E+05 | -8.98E+05 | -3.77E+05 | -6.62E+05 | -3.62E+05 | -7.07E+05 | -3.63E+05 | -8.13E+05 |
| **175.78** | 2.02E+07 | 6.65E+06 | -1.11E+07 | 2.03E+07 | 2.26E+07 | -1.00E+07 | 9.51E+06 | 2.32E+07 | -1.84E+05 | -5.47E+05 | -2.36E+05 | -4.43E+05 | -2.98E+05 | -2.84E+05 | -2.84E+05 | -4.26E+05 |
| **185.55** | 2.15E+07 | 5.87E+06 | -9.78E+06 | 2.25E+07 | 2.26E+07 | -9.63E+06 | 1.04E+07 | 2.30E+07 | -1.90E+05 | -4.56E+05 | -2.08E+05 | -4.76E+05 | -2.23E+05 | -3.21E+05 | -2.45E+05 | -2.67E+05 |
| **195.31** | 2.23E+07 | 5.15E+06 | -9.11E+06 | 2.43E+07 | 2.20E+07 | -9.68E+06 | 1.06E+07 | 2.32E+07 | -1.64E+05 | -3.45E+05 | -2.77E+05 | -2.78E+05 | -1.81E+05 | -2.40E+05 | -2.90E+05 | -2.92E+05 |
| **205.08** | 2.39E+07 | 4.40E+06 | -8.41E+06 | 2.43E+07 | 2.26E+07 | -1.11E+07 | 1.07E+07 | 2.28E+07 | -6.36E+05 | -8.47E+05 | -6.69E+05 | -1.07E+06 | -4.38E+05 | -1.05E+06 | -5.64E+05 | -1.28E+06 |
| **214.84** | 2.39E+07 | 4.08E+06 | -7.72E+06 | 2.53E+07 | 2.24E+07 | -8.72E+06 | 1.07E+07 | 2.32E+07 | -3.12E+05 | -3.51E+05 | -2.28E+05 | -4.35E+05 | -2.21E+05 | -3.18E+05 | -3.15E+05 | -3.46E+05 |
| **224.61** | 2.48E+07 | 3.90E+06 | -6.74E+06 | 2.65E+07 | 2.34E+07 | -9.04E+06 | 9.91E+06 | 2.35E+07 | -3.53E+05 | -2.52E+05 | -2.22E+05 | -3.35E+05 | -1.37E+05 | -2.41E+05 | -1.98E+05 | -1.62E+05 |
| **234.38** | 2.65E+07 | 3.48E+06 | -7.14E+06 | 2.73E+07 | 2.35E+07 | -8.25E+06 | 1.03E+07 | 2.30E+07 | -2.55E+05 | -2.83E+05 | -2.65E+05 | -3.41E+05 | -3.03E+05 | -4.03E+05 | -2.04E+05 | -3.52E+05 |
| **244.14** | 2.70E+07 | 3.07E+06 | -6.85E+06 | 2.81E+07 | 2.29E+07 | -7.71E+06 | 1.00E+07 | 2.29E+07 | -2.04E+05 | -3.43E+05 | -2.54E+05 | -3.99E+05 | -2.08E+05 | -2.94E+05 | -1.96E+05 | -3.94E+05 |
| **253.91** | 2.72E+07 | 4.15E+06 | -6.40E+06 | 2.94E+07 | 2.22E+07 | -6.59E+06 | 1.02E+07 | 2.30E+07 | -5.29E+05 | -1.03E+06 | -3.20E+05 | -3.93E+05 | -7.01E+05 | -8.76E+05 | -2.17E+05 | -5.13E+05 |
| **263.67** | 2.92E+07 | 2.39E+06 | -6.05E+06 | 3.11E+07 | 2.20E+07 | -6.53E+06 | 1.02E+07 | 2.22E+07 | -4.02E+05 | -5.20E+05 | -3.43E+05 | -3.30E+05 | -5.00E+05 | -5.22E+05 | -3.64E+05 | -5.36E+05 |
| **273.44** | 2.83E+07 | 4.37E+06 | -5.02E+06 | 3.10E+07 | 2.16E+07 | -5.41E+06 | 1.07E+07 | 2.15E+07 | -3.59E+05 | -4.18E+05 | -2.28E+05 | -2.91E+05 | -2.49E+05 | -3.07E+05 | -2.75E+05 | -6.41E+05 |
| **283.20** | 2.98E+07 | 3.76E+06 | -5.61E+06 | 3.12E+07 | 2.35E+07 | -6.92E+06 | 9.16E+06 | 2.17E+07 | -3.19E+05 | -3.36E+05 | -2.35E+05 | -3.14E+05 | -2.08E+05 | -4.57E+05 | -2.72E+05 | -3.58E+05 |
| **292.97** | 3.14E+07 | 3.83E+06 | -5.66E+06 | 3.24E+07 | 2.31E+07 | -5.98E+06 | 9.68E+06 | 2.07E+07 | -3.96E+05 | -4.89E+05 | -2.88E+05 | -3.86E+05 | -3.37E+05 | -4.45E+05 | -3.39E+05 | -3.83E+05 |
| **302.73** | 3.19E+07 | 4.23E+06 | -5.78E+06 | 3.19E+07 | 2.18E+07 | -5.31E+06 | 9.81E+06 | 1.96E+07 | -4.55E+05 | -5.56E+05 | -3.46E+05 | -4.51E+05 | -3.50E+05 | -6.45E+05 | -3.21E+05 | -4.93E+05 |
| **312.50** | 3.33E+07 | 7.54E+06 | -3.37E+06 | 3.27E+07 | 2.38E+07 | -4.75E+06 | 1.05E+07 | 2.26E+07 | -6.83E+05 | -9.47E+05 | -3.51E+05 | -6.28E+05 | -6.99E+05 | -1.04E+06 | -6.16E+05 | -3.32E+05 |
| **322.27** | 3.43E+07 | 5.37E+06 | -5.54E+06 | 3.14E+07 | 2.28E+07 | -6.41E+06 | 9.47E+06 | 2.26E+07 | -1.14E+06 | -1.17E+06 | -7.22E+05 | -8.51E+05 | -1.33E+06 | -1.07E+06 | -7.43E+05 | -7.67E+05 |
| **332.03** | 4.08E+07 | 7.74E+06 | -7.87E+06 | 3.89E+07 | 2.56E+07 | -3.75E+06 | 5.50E+06 | 1.88E+07 | -5.55E+06 | -5.48E+06 | -3.59E+06 | -6.07E+06 | -4.28E+06 | -7.30E+06 | -4.68E+06 | -4.72E+06 |
| **341.80** | 3.26E+07 | 2.04E+06 | -5.39E+06 | 3.36E+07 | 1.96E+07 | -8.05E+06 | 1.26E+07 | 2.30E+07 | -3.21E+06 | -2.93E+06 | -2.46E+06 | -1.91E+06 | -3.87E+06 | -3.11E+06 | -1.79E+06 | -1.87E+06 |

## Table A7. 70% PR, $\omega$ = 10,200 RPM, and zero preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***f*** | ***Re Hxx*** | ***Re Hxy*** | ***Re Hyx*** | ***Re Hyy*** | ***Im Hxx*** | ***Im Hxy*** | ***Im Hyx*** | ***Im Hyy*** | ***Re eHxx*** | ***Re eHxy*** | ***Re eHyx*** | ***Re eHyy*** | ***Im eHxx*** | ***Im eHxy*** | ***Im eHyx*** | ***Im eHyy*** |
| **9.77** | 1.46E+06 | 9.11E+06 | -1.02E+07 | 1.04E+06 | 1.91E+06 | -9.62E+05 | 6.78E+05 | 2.60E+06 | -2.27E+05 | -1.77E+05 | -2.78E+05 | -1.97E+05 | -4.20E+05 | -1.48E+05 | -4.44E+05 | -2.00E+05 |
| **19.53** | 2.08E+06 | 8.95E+06 | -1.03E+07 | 1.28E+06 | 4.00E+06 | -1.36E+06 | 1.19E+06 | 4.73E+06 | -3.01E+05 | -2.29E+05 | -3.22E+05 | -2.11E+05 | -2.90E+05 | -1.45E+05 | -2.69E+05 | -2.49E+05 |
| **29.30** | 2.69E+06 | 8.70E+06 | -9.84E+06 | 2.29E+06 | 6.31E+06 | -1.79E+06 | 2.18E+06 | 6.57E+06 | -3.21E+05 | -3.82E+05 | -2.54E+05 | -3.55E+05 | -1.56E+05 | -2.80E+05 | -2.78E+05 | -3.01E+05 |
| **39.06** | 3.43E+06 | 8.63E+06 | -9.61E+06 | 3.23E+06 | 8.52E+06 | -2.71E+06 | 2.72E+06 | 8.56E+06 | -1.90E+05 | -3.56E+05 | -2.42E+05 | -2.42E+05 | -2.41E+05 | -2.33E+05 | -2.36E+05 | -4.57E+05 |
| **48.83** | 4.34E+06 | 8.27E+06 | -8.82E+06 | 3.99E+06 | 9.76E+06 | -3.04E+06 | 2.41E+06 | 1.02E+07 | -3.83E+05 | -2.39E+05 | -2.91E+05 | -3.14E+05 | -3.14E+05 | -2.65E+05 | -2.45E+05 | -3.28E+05 |
| **58.59** | 5.60E+06 | 7.54E+06 | -8.98E+06 | 4.78E+06 | 1.13E+07 | -4.47E+06 | 3.20E+06 | 1.23E+07 | -3.53E+05 | -3.70E+05 | -4.21E+05 | -4.02E+05 | -2.57E+05 | -3.62E+05 | -3.37E+05 | -3.82E+05 |
| **68.36** | 5.76E+06 | 6.65E+06 | -8.64E+06 | 5.34E+06 | 1.25E+07 | -4.22E+06 | 2.86E+06 | 1.38E+07 | -4.67E+05 | -6.78E+05 | -6.32E+05 | -3.98E+05 | -6.76E+05 | -5.59E+05 | -4.48E+05 | -9.00E+05 |
| **78.13** | 7.14E+06 | 7.06E+06 | -8.26E+06 | 6.36E+06 | 1.41E+07 | -4.24E+06 | 3.65E+06 | 1.50E+07 | -2.17E+05 | -3.71E+05 | -2.24E+05 | -3.05E+05 | -3.67E+05 | -2.14E+05 | -3.29E+05 | -2.92E+05 |
| **87.89** | 7.95E+06 | 6.46E+06 | -7.99E+06 | 7.55E+06 | 1.50E+07 | -4.94E+06 | 3.73E+06 | 1.68E+07 | -2.35E+05 | -2.75E+05 | -1.75E+05 | -2.90E+05 | -2.54E+05 | -2.26E+05 | -2.61E+05 | -2.34E+05 |
| **97.66** | 8.85E+06 | 6.32E+06 | -7.54E+06 | 9.20E+06 | 1.67E+07 | -5.32E+06 | 4.12E+06 | 1.77E+07 | -2.60E+05 | -3.80E+05 | -3.14E+05 | -2.71E+05 | -3.88E+05 | -3.40E+05 | -3.64E+05 | -2.14E+05 |
| **107.42** | 1.08E+07 | 5.54E+06 | -7.94E+06 | 1.07E+07 | 1.73E+07 | -5.27E+06 | 5.06E+06 | 1.89E+07 | -3.44E+05 | -3.60E+05 | -4.06E+05 | -4.61E+05 | -3.37E+05 | -2.35E+05 | -4.57E+05 | -3.58E+05 |
| **117.19** | 1.14E+07 | 4.73E+06 | -7.51E+06 | 1.19E+07 | 1.96E+07 | -5.55E+06 | 4.70E+06 | 2.02E+07 | -3.45E+05 | -2.76E+05 | -3.26E+05 | -2.94E+05 | -5.14E+05 | -2.31E+05 | -5.87E+05 | -3.86E+05 |
| **126.95** | 1.26E+07 | 3.52E+06 | -7.11E+06 | 1.39E+07 | 1.90E+07 | -5.10E+06 | 4.85E+06 | 2.08E+07 | -3.96E+05 | -9.60E+05 | -3.47E+05 | -7.84E+05 | -4.67E+05 | -5.36E+05 | -3.46E+05 | -7.20E+05 |
| **136.72** | 1.35E+07 | 4.07E+06 | -6.82E+06 | 1.45E+07 | 2.02E+07 | -5.37E+06 | 4.84E+06 | 2.13E+07 | -3.56E+05 | -4.28E+05 | -3.26E+05 | -3.12E+05 | -5.07E+05 | -4.11E+05 | -1.96E+05 | -4.45E+05 |
| **146.48** | 1.51E+07 | 3.63E+06 | -5.89E+06 | 1.59E+07 | 2.07E+07 | -5.50E+06 | 5.06E+06 | 2.17E+07 | -4.80E+05 | -5.60E+05 | -4.23E+05 | -6.11E+05 | -2.83E+05 | -5.27E+05 | -3.85E+05 | -6.46E+05 |
| **156.25** | 1.61E+07 | 3.93E+06 | -5.41E+06 | 1.63E+07 | 2.25E+07 | -5.98E+06 | 4.02E+06 | 2.26E+07 | -5.69E+05 | -7.07E+05 | -3.83E+05 | -1.02E+06 | -7.52E+05 | -9.36E+05 | -3.93E+05 | -7.08E+05 |
| **166.02** | 2.00E+07 | -1.19E+06 | -7.69E+06 | 2.34E+07 | 2.58E+07 | -9.63E+06 | 2.09E+06 | 2.62E+07 | -3.19E+06 | -8.96E+06 | -2.81E+06 | -7.74E+06 | -3.09E+06 | -7.40E+06 | -3.06E+06 | -7.63E+06 |
| **175.78** | 1.81E+07 | 3.48E+06 | -4.66E+06 | 2.01E+07 | 2.42E+07 | -3.18E+06 | 4.77E+06 | 2.89E+07 | -1.37E+06 | -2.27E+06 | -1.38E+06 | -2.39E+06 | -1.45E+06 | -2.37E+06 | -1.18E+06 | -2.23E+06 |
| **185.55** | 2.00E+07 | 2.85E+06 | -6.52E+06 | 2.00E+07 | 2.31E+07 | -4.90E+06 | 5.33E+06 | 2.31E+07 | -3.99E+05 | -7.29E+05 | -5.29E+05 | -4.47E+05 | -4.53E+05 | -6.68E+05 | -4.86E+05 | -5.55E+05 |
| **195.31** | 2.03E+07 | 2.24E+06 | -5.87E+06 | 2.17E+07 | 2.30E+07 | -5.38E+06 | 5.61E+06 | 2.39E+07 | -3.12E+05 | -5.20E+05 | -3.28E+05 | -2.88E+05 | -3.13E+05 | -2.55E+05 | -3.06E+05 | -5.36E+05 |
| **205.08** | 2.00E+07 | 3.19E+05 | -5.58E+06 | 2.32E+07 | 2.33E+07 | -4.83E+06 | 6.69E+06 | 2.42E+07 | -4.74E+05 | -8.20E+05 | -3.06E+05 | -8.16E+05 | -3.90E+05 | -8.06E+05 | -4.32E+05 | -7.08E+05 |
| **214.84** | 2.17E+07 | 1.62E+06 | -4.50E+06 | 2.30E+07 | 2.37E+07 | -4.36E+06 | 6.37E+06 | 2.37E+07 | -3.33E+05 | -4.15E+05 | -2.02E+05 | -4.81E+05 | -2.28E+05 | -3.35E+05 | -3.08E+05 | -3.38E+05 |
| **224.61** | 2.29E+07 | 1.96E+06 | -3.85E+06 | 2.36E+07 | 2.46E+07 | -4.72E+06 | 5.49E+06 | 2.41E+07 | -2.18E+05 | -2.70E+05 | -1.96E+05 | -2.16E+05 | -2.74E+05 | -3.39E+05 | -2.86E+05 | -2.84E+05 |
| **234.38** | 2.48E+07 | 1.02E+06 | -4.43E+06 | 2.55E+07 | 2.45E+07 | -4.19E+06 | 5.15E+06 | 2.48E+07 | -1.64E+05 | -4.82E+05 | -2.05E+05 | -3.68E+05 | -2.50E+05 | -2.75E+05 | -2.56E+05 | -3.51E+05 |
| **244.14** | 2.56E+07 | 1.12E+06 | -4.26E+06 | 2.58E+07 | 2.43E+07 | -4.20E+06 | 5.40E+06 | 2.46E+07 | -2.06E+05 | -2.94E+05 | -1.72E+05 | -3.25E+05 | -2.39E+05 | -3.74E+05 | -2.05E+05 | -2.05E+05 |
| **253.91** | 2.57E+07 | 2.16E+06 | -4.45E+06 | 2.72E+07 | 2.34E+07 | -2.87E+06 | 6.14E+06 | 2.46E+07 | -4.77E+05 | -1.09E+06 | -3.87E+05 | -3.88E+05 | -5.45E+05 | -9.30E+05 | -2.10E+05 | -3.20E+05 |
| **263.67** | 2.72E+07 | 6.38E+05 | -3.98E+06 | 2.84E+07 | 2.36E+07 | -3.04E+06 | 6.06E+06 | 2.39E+07 | -3.31E+05 | -4.30E+05 | -1.79E+05 | -2.38E+05 | -2.42E+05 | -3.92E+05 | -3.60E+05 | -2.68E+05 |
| **273.44** | 2.68E+07 | 1.66E+06 | -3.28E+06 | 2.87E+07 | 2.31E+07 | -1.68E+06 | 6.31E+06 | 2.26E+07 | -3.35E+05 | -5.74E+05 | -2.53E+05 | -4.63E+05 | -2.21E+05 | -2.62E+05 | -2.64E+05 | -5.30E+05 |
| **283.20** | 2.79E+07 | 2.60E+06 | -3.70E+06 | 2.83E+07 | 2.48E+07 | -3.67E+06 | 5.50E+06 | 2.42E+07 | -2.29E+05 | -3.96E+05 | -2.12E+05 | -3.28E+05 | -2.12E+05 | -4.26E+05 | -2.34E+05 | -4.01E+05 |
| **292.97** | 2.95E+07 | 1.26E+06 | -4.00E+06 | 3.06E+07 | 2.43E+07 | -3.35E+06 | 6.02E+06 | 2.36E+07 | -2.73E+05 | -3.84E+05 | -2.96E+05 | -2.61E+05 | -3.10E+05 | -2.99E+05 | -2.13E+05 | -2.93E+05 |
| **302.73** | 3.05E+07 | 2.18E+06 | -4.50E+06 | 3.02E+07 | 2.40E+07 | -2.70E+06 | 6.18E+06 | 2.24E+07 | -3.07E+05 | -2.72E+05 | -1.99E+05 | -3.47E+05 | -3.07E+05 | -3.27E+05 | -3.53E+05 | -2.97E+05 |
| **312.50** | 3.11E+07 | 2.57E+06 | -1.84E+06 | 3.12E+07 | 2.50E+07 | -2.08E+06 | 6.42E+06 | 2.33E+07 | -3.17E+05 | -3.76E+05 | -2.71E+05 | -4.02E+05 | -4.23E+05 | -4.92E+05 | -3.51E+05 | -2.72E+05 |
| **322.27** | 3.29E+07 | 3.76E+06 | -3.60E+06 | 3.03E+07 | 2.44E+07 | -2.26E+06 | 6.19E+06 | 2.43E+07 | -5.14E+05 | -3.50E+05 | -3.05E+05 | -3.97E+05 | -4.47E+05 | -5.16E+05 | -4.84E+05 | -5.69E+05 |
| **332.03** | 3.63E+07 | 4.34E+05 | -8.60E+06 | 3.63E+07 | 2.43E+07 | -2.53E+06 | 5.92E+06 | 2.28E+07 | -9.02E+05 | -1.16E+06 | -7.74E+05 | -8.74E+05 | -8.46E+05 | -9.35E+05 | -9.50E+05 | -1.01E+06 |
| **341.80** | 3.39E+07 | 3.60E+06 | -3.16E+06 | 3.40E+07 | 2.48E+07 | -3.97E+06 | 6.62E+06 | 2.41E+07 | -2.59E+06 | -2.96E+06 | -2.65E+06 | -3.28E+06 | -2.76E+06 | -2.25E+06 | -2.80E+06 | -1.88E+06 |

## Table A8. 70% PR, ω = 15,350 RPM, and zero preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***f*** | ***Re Hxx*** | ***Re Hxy*** | ***Re Hyx*** | ***Re Hyy*** | ***Im Hxx*** | ***Im Hxy*** | ***Im Hyx*** | ***Im Hyy*** | ***Re eHxx*** | ***Re eHxy*** | ***Re eHyx*** | ***Re eHyy*** | ***Im eHxx*** | ***Im eHxy*** | ***Im eHyx*** | ***Im eHyy*** |
| **9.77** | 2.39E+06 | 1.35E+07 | -1.45E+07 | 1.47E+06 | 2.32E+06 | -1.11E+06 | 9.11E+05 | 2.55E+06 | -5.84E+05 | -3.32E+05 | -3.43E+05 | -3.56E+05 | -4.42E+05 | -2.33E+05 | -4.58E+05 | -2.30E+05 |
| **19.53** | 2.66E+06 | 1.30E+07 | -1.43E+07 | 2.05E+06 | 4.28E+06 | -2.10E+06 | 1.95E+06 | 4.52E+06 | -3.05E+05 | -2.46E+05 | -3.97E+05 | -3.39E+05 | -2.73E+05 | -2.13E+05 | -3.91E+05 | -2.60E+05 |
| **29.30** | 3.12E+06 | 1.25E+07 | -1.37E+07 | 2.69E+06 | 6.61E+06 | -2.71E+06 | 2.65E+06 | 6.66E+06 | -2.64E+05 | -2.62E+05 | -2.89E+05 | -3.54E+05 | -2.82E+05 | -3.28E+05 | -2.08E+05 | -2.59E+05 |
| **39.06** | 3.70E+06 | 1.22E+07 | -1.38E+07 | 3.80E+06 | 8.11E+06 | -3.40E+06 | 3.53E+06 | 8.70E+06 | -2.36E+05 | -3.44E+05 | -4.03E+05 | -3.21E+05 | -2.79E+05 | -2.25E+05 | -2.25E+05 | -3.27E+05 |
| **48.83** | 4.91E+06 | 1.15E+07 | -1.34E+07 | 4.26E+06 | 9.84E+06 | -4.36E+06 | 3.36E+06 | 1.05E+07 | -3.23E+05 | -3.75E+05 | -3.51E+05 | -3.72E+05 | -3.81E+05 | -2.09E+05 | -4.43E+05 | -2.53E+05 |
| **58.59** | 5.66E+06 | 1.19E+07 | -1.26E+07 | 5.15E+06 | 1.15E+07 | -4.82E+06 | 4.29E+06 | 1.23E+07 | -3.36E+05 | -4.39E+05 | -5.04E+05 | -4.66E+05 | -3.75E+05 | -2.98E+05 | -3.66E+05 | -5.55E+05 |
| **68.36** | 5.92E+06 | 9.59E+06 | -1.27E+07 | 5.90E+06 | 1.21E+07 | -3.65E+06 | 5.14E+06 | 1.35E+07 | -5.94E+05 | -4.98E+05 | -7.57E+05 | -7.27E+05 | -6.39E+05 | -7.04E+05 | -7.46E+05 | -1.20E+06 |
| **78.13** | 7.43E+06 | 1.03E+07 | -1.19E+07 | 7.14E+06 | 1.44E+07 | -5.48E+06 | 4.96E+06 | 1.56E+07 | -2.54E+05 | -3.97E+05 | -3.24E+05 | -2.16E+05 | -3.28E+05 | -2.54E+05 | -3.33E+05 | -2.69E+05 |
| **87.89** | 8.44E+06 | 9.97E+06 | -1.19E+07 | 8.39E+06 | 1.58E+07 | -6.13E+06 | 5.70E+06 | 1.68E+07 | -3.55E+05 | -2.61E+05 | -2.00E+05 | -3.14E+05 | -1.78E+05 | -2.45E+05 | -2.31E+05 | -2.53E+05 |
| **97.66** | 9.63E+06 | 9.37E+06 | -1.11E+07 | 1.01E+07 | 1.70E+07 | -6.44E+06 | 5.73E+06 | 1.81E+07 | -2.94E+05 | -3.45E+05 | -3.63E+05 | -2.61E+05 | -3.24E+05 | -4.31E+05 | -2.84E+05 | -4.28E+05 |
| **107.42** | 1.05E+07 | 8.90E+06 | -1.09E+07 | 1.06E+07 | 1.78E+07 | -6.81E+06 | 5.35E+06 | 1.95E+07 | -5.27E+05 | -2.69E+05 | -3.75E+05 | -3.52E+05 | -3.70E+05 | -2.59E+05 | -4.59E+05 | -2.69E+05 |
| **117.19** | 1.23E+07 | 7.54E+06 | -1.04E+07 | 1.20E+07 | 1.96E+07 | -7.20E+06 | 5.63E+06 | 2.08E+07 | -3.22E+05 | -2.40E+05 | -3.54E+05 | -2.87E+05 | -3.02E+05 | -2.64E+05 | -2.77E+05 | -3.64E+05 |
| **126.95** | 1.35E+07 | 6.63E+06 | -9.82E+06 | 1.45E+07 | 1.96E+07 | -7.34E+06 | 6.33E+06 | 2.03E+07 | -3.91E+05 | -7.91E+05 | -2.99E+05 | -4.16E+05 | -4.94E+05 | -4.09E+05 | -2.77E+05 | -3.67E+05 |
| **136.72** | 1.45E+07 | 6.52E+06 | -9.68E+06 | 1.48E+07 | 2.03E+07 | -7.39E+06 | 6.48E+06 | 2.18E+07 | -1.65E+05 | -4.29E+05 | -2.76E+05 | -3.67E+05 | -4.01E+05 | -3.31E+05 | -2.97E+05 | -4.57E+05 |
| **146.48** | 1.54E+07 | 7.05E+06 | -9.45E+06 | 1.59E+07 | 2.13E+07 | -7.02E+06 | 6.55E+06 | 2.30E+07 | -3.41E+05 | -2.72E+05 | -2.19E+05 | -5.28E+05 | -2.50E+05 | -3.82E+05 | -3.70E+05 | -4.41E+05 |
| **156.25** | 1.67E+07 | 5.17E+06 | -9.55E+06 | 1.81E+07 | 2.16E+07 | -7.66E+06 | 7.36E+06 | 2.29E+07 | -4.07E+05 | -3.10E+05 | -2.55E+05 | -5.75E+05 | -5.56E+05 | -3.45E+05 | -4.09E+05 | -4.37E+05 |
| **166.02** | 1.97E+07 | -3.47E+05 | -1.40E+07 | 2.82E+07 | 2.34E+07 | -9.41E+06 | 4.73E+06 | 2.92E+07 | -3.06E+05 | -7.49E+05 | -7.08E+05 | -1.15E+06 | -3.57E+05 | -4.59E+05 | -4.37E+05 | -9.04E+05 |
| **175.78** | 1.85E+07 | 4.75E+06 | -9.30E+06 | 1.89E+07 | 2.33E+07 | -6.72E+06 | 7.11E+06 | 2.40E+07 | -3.76E+05 | -3.52E+05 | -2.52E+05 | -6.09E+05 | -2.61E+05 | -4.59E+05 | -3.13E+05 | -3.73E+05 |
| **185.55** | 2.01E+07 | 4.93E+06 | -8.25E+06 | 2.13E+07 | 2.37E+07 | -7.27E+06 | 7.81E+06 | 2.42E+07 | -3.31E+05 | -2.33E+05 | -3.39E+05 | -3.98E+05 | -2.28E+05 | -1.87E+05 | -3.18E+05 | -4.76E+05 |
| **195.31** | 2.19E+07 | 3.04E+06 | -8.40E+06 | 2.71E+07 | 2.44E+07 | -8.61E+06 | 5.04E+06 | 2.78E+07 | -3.68E+05 | -4.00E+05 | -5.81E+05 | -4.60E+05 | -3.10E+05 | -3.28E+05 | -2.79E+05 | -3.57E+05 |
| **205.08** | 2.19E+07 | 3.48E+06 | -8.06E+06 | 2.21E+07 | 2.47E+07 | -8.57E+06 | 7.33E+06 | 2.57E+07 | -6.41E+05 | -9.28E+05 | -4.73E+05 | -1.13E+06 | -4.83E+05 | -1.34E+06 | -5.03E+05 | -9.83E+05 |
| **214.84** | 2.26E+07 | 3.93E+06 | -6.94E+06 | 2.42E+07 | 2.47E+07 | -6.77E+06 | 7.74E+06 | 2.52E+07 | -3.07E+05 | -2.66E+05 | -2.23E+05 | -2.84E+05 | -3.07E+05 | -3.77E+05 | -2.51E+05 | -3.24E+05 |
| **224.61** | 2.38E+07 | 3.62E+06 | -6.26E+06 | 2.55E+07 | 2.53E+07 | -6.67E+06 | 8.05E+06 | 2.51E+07 | -2.86E+05 | -2.59E+05 | -2.41E+05 | -2.88E+05 | -1.67E+05 | -2.81E+05 | -2.23E+05 | -2.74E+05 |
| **234.38** | 2.60E+07 | 3.49E+06 | -6.12E+06 | 2.69E+07 | 2.56E+07 | -6.68E+06 | 7.25E+06 | 2.51E+07 | -1.50E+05 | -2.68E+05 | -1.64E+05 | -3.43E+05 | -2.39E+05 | -3.36E+05 | -2.62E+05 | -2.63E+05 |
| **244.14** | 2.73E+07 | 3.71E+06 | -6.29E+06 | 2.75E+07 | 2.52E+07 | -6.20E+06 | 7.19E+06 | 2.47E+07 | -3.43E+05 | -4.08E+05 | -2.37E+05 | -3.24E+05 | -3.52E+05 | -4.93E+05 | -3.16E+05 | -3.41E+05 |
| **253.91** | 2.86E+07 | 3.24E+06 | -6.69E+06 | 2.55E+07 | 2.35E+07 | -1.13E+07 | 6.78E+06 | 2.64E+07 | -1.62E+06 | -2.04E+06 | -4.68E+05 | -7.06E+05 | -7.02E+05 | -1.30E+06 | -1.04E+06 | -1.16E+06 |
| **263.67** | 2.85E+07 | 1.45E+06 | -6.94E+06 | 2.76E+07 | 2.31E+07 | -5.43E+06 | 7.64E+06 | 2.41E+07 | -4.63E+05 | -5.76E+05 | -3.39E+05 | -4.28E+05 | -3.92E+05 | -6.22E+05 | -3.42E+05 | -4.10E+05 |
| **273.44** | 2.78E+07 | 3.41E+06 | -5.58E+06 | 2.93E+07 | 2.41E+07 | -4.38E+06 | 7.90E+06 | 2.37E+07 | -3.25E+05 | -4.49E+05 | -2.45E+05 | -3.89E+05 | -3.00E+05 | -3.65E+05 | -2.34E+05 | -4.52E+05 |
| **283.20** | 2.90E+07 | 2.24E+06 | -5.99E+06 | 3.05E+07 | 2.56E+07 | -5.39E+06 | 7.53E+06 | 2.51E+07 | -1.72E+05 | -3.74E+05 | -1.57E+05 | -3.81E+05 | -2.06E+05 | -2.44E+05 | -2.66E+05 | -3.64E+05 |
| **292.97** | 3.02E+07 | 1.70E+06 | -6.23E+06 | 3.13E+07 | 2.47E+07 | -4.32E+06 | 7.75E+06 | 2.37E+07 | -2.14E+05 | -3.50E+05 | -2.07E+05 | -3.02E+05 | -2.74E+05 | -2.16E+05 | -1.51E+05 | -3.05E+05 |
| **302.73** | 3.08E+07 | 2.34E+06 | -6.01E+06 | 3.04E+07 | 2.48E+07 | -3.44E+06 | 9.13E+06 | 2.27E+07 | -3.74E+05 | -4.43E+05 | -1.97E+05 | -2.36E+05 | -4.19E+05 | -3.63E+05 | -2.61E+05 | -3.18E+05 |
| **312.50** | 3.13E+07 | 4.55E+06 | -4.06E+06 | 3.19E+07 | 2.67E+07 | -3.81E+06 | 9.66E+06 | 2.53E+07 | -3.14E+05 | -3.97E+05 | -3.20E+05 | -5.04E+05 | -2.32E+05 | -2.90E+05 | -3.93E+05 | -3.47E+05 |
| **322.27** | 3.32E+07 | 4.55E+06 | -4.89E+06 | 3.14E+07 | 2.62E+07 | -4.02E+06 | 8.44E+06 | 2.65E+07 | -3.49E+05 | -2.56E+05 | -2.33E+05 | -3.94E+05 | -3.31E+05 | -3.07E+05 | -2.39E+05 | -2.56E+05 |
| **332.03** | 3.64E+07 | 3.16E+06 | -8.45E+06 | 3.59E+07 | 2.60E+07 | -3.92E+06 | 7.86E+06 | 2.39E+07 | -3.93E+05 | -5.01E+05 | -4.14E+05 | -3.29E+05 | -2.57E+05 | -4.28E+05 | -3.52E+05 | -4.81E+05 |
| **341.80** | 3.39E+07 | 4.35E+06 | -4.86E+06 | 3.36E+07 | 2.49E+07 | -5.30E+06 | 1.07E+07 | 2.51E+07 | -3.91E+05 | -2.61E+05 | -3.98E+05 | -2.46E+05 | -2.65E+05 | -3.76E+05 | -4.92E+05 | -2.80E+05 |

## Table A9. 70% PR, $\omega$ = 20,200 RPM, and zero preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***f*** | ***Re Hxx*** | ***Re Hxy*** | ***Re Hyx*** | ***Re Hyy*** | ***Im Hxx*** | ***Im Hxy*** | ***Im Hyx*** | ***Im Hyy*** | ***Re eHxx*** | ***Re eHxy*** | ***Re eHyx*** | ***Re eHyy*** | ***Im eHxx*** | ***Im eHxy*** | ***Im eHyx*** | ***Im eHyy*** |
| **9.77** | 2.34E+06 | 1.88E+07 | -2.04E+07 | 9.77E+05 | 2.25E+06 | -2.09E+06 | 1.84E+06 | 3.05E+06 | -4.15E+05 | -3.35E+05 | -6.47E+05 | -4.75E+05 | -4.75E+05 | -2.05E+05 | -4.37E+05 | -2.76E+05 |
| **19.53** | 2.58E+06 | 1.83E+07 | -1.96E+07 | 1.43E+06 | 4.94E+06 | -2.71E+06 | 2.97E+06 | 5.19E+06 | -3.12E+05 | -2.51E+05 | -2.80E+05 | -2.55E+05 | -3.19E+05 | -2.26E+05 | -4.19E+05 | -3.45E+05 |
| **29.30** | 3.30E+06 | 1.74E+07 | -1.89E+07 | 2.56E+06 | 7.43E+06 | -4.27E+06 | 3.94E+06 | 7.78E+06 | -4.47E+05 | -4.47E+05 | -3.43E+05 | -3.86E+05 | -2.27E+05 | -3.23E+05 | -2.25E+05 | -3.31E+05 |
| **39.06** | 4.38E+06 | 1.72E+07 | -1.82E+07 | 3.72E+06 | 9.30E+06 | -5.64E+06 | 4.98E+06 | 9.57E+06 | -2.97E+05 | -3.40E+05 | -2.60E+05 | -2.62E+05 | -3.04E+05 | -3.38E+05 | -2.05E+05 | -2.98E+05 |
| **48.83** | 5.04E+06 | 1.62E+07 | -1.73E+07 | 4.32E+06 | 1.04E+07 | -6.24E+06 | 5.16E+06 | 1.14E+07 | -1.44E+06 | -1.18E+06 | -4.02E+05 | -4.76E+05 | -1.28E+06 | -1.07E+06 | -5.74E+05 | -3.87E+05 |
| **58.59** | 6.27E+06 | 1.56E+07 | -1.64E+07 | 5.42E+06 | 1.17E+07 | -6.82E+06 | 6.28E+06 | 1.26E+07 | -3.97E+05 | -2.71E+05 | -3.49E+05 | -4.36E+05 | -3.13E+05 | -3.93E+05 | -3.23E+05 | -2.97E+05 |
| **68.36** | 6.65E+06 | 1.42E+07 | -1.66E+07 | 7.36E+06 | 1.32E+07 | -6.79E+06 | 6.49E+06 | 1.49E+07 | -5.92E+05 | -6.40E+05 | -7.18E+05 | -6.61E+05 | -5.62E+05 | -6.34E+05 | -5.43E+05 | -7.42E+05 |
| **78.13** | 8.79E+06 | 1.42E+07 | -1.64E+07 | 7.82E+06 | 1.50E+07 | -8.20E+06 | 6.98E+06 | 1.63E+07 | -2.35E+05 | -3.23E+05 | -3.17E+05 | -3.09E+05 | -3.89E+05 | -2.27E+05 | -3.35E+05 | -3.13E+05 |
| **87.89** | 9.77E+06 | 1.30E+07 | -1.47E+07 | 8.88E+06 | 1.59E+07 | -8.91E+06 | 7.57E+06 | 1.74E+07 | -4.40E+05 | -2.23E+05 | -2.46E+05 | -2.19E+05 | -2.56E+05 | -2.88E+05 | -2.21E+05 | -2.67E+05 |
| **97.66** | 1.12E+07 | 1.20E+07 | -1.46E+07 | 1.01E+07 | 1.66E+07 | -9.65E+06 | 7.46E+06 | 1.87E+07 | -8.06E+05 | -7.41E+05 | -4.90E+05 | -3.75E+05 | -7.38E+05 | -6.51E+05 | -5.00E+05 | -5.02E+05 |
| **107.42** | 1.18E+07 | 1.12E+07 | -1.44E+07 | 1.20E+07 | 1.77E+07 | -9.43E+06 | 8.98E+06 | 2.02E+07 | -4.44E+05 | -3.97E+05 | -5.16E+05 | -3.37E+05 | -4.68E+05 | -4.53E+05 | -4.78E+05 | -3.44E+05 |
| **117.19** | 1.28E+07 | 1.05E+07 | -1.30E+07 | 1.28E+07 | 1.92E+07 | -9.55E+06 | 8.32E+06 | 2.09E+07 | -2.35E+05 | -2.06E+05 | -1.85E+05 | -4.80E+05 | -1.84E+05 | -2.37E+05 | -3.40E+05 | -2.52E+05 |
| **126.95** | 1.42E+07 | 9.47E+06 | -1.25E+07 | 1.54E+07 | 2.00E+07 | -9.90E+06 | 9.02E+06 | 2.08E+07 | -3.35E+05 | -4.57E+05 | -4.07E+05 | -6.33E+05 | -3.42E+05 | -4.02E+05 | -4.27E+05 | -6.85E+05 |
| **136.72** | 1.55E+07 | 8.86E+06 | -1.17E+07 | 1.61E+07 | 2.06E+07 | -9.60E+06 | 9.04E+06 | 2.18E+07 | -3.39E+05 | -4.58E+05 | -2.68E+05 | -3.37E+05 | -3.15E+05 | -4.68E+05 | -3.13E+05 | -2.82E+05 |
| **146.48** | 1.70E+07 | 8.71E+06 | -1.15E+07 | 1.71E+07 | 2.10E+07 | -9.99E+06 | 8.86E+06 | 2.24E+07 | -1.94E+05 | -5.14E+05 | -2.90E+05 | -4.30E+05 | -3.22E+05 | -2.89E+05 | -2.83E+05 | -5.27E+05 |
| **156.25** | 1.84E+07 | 6.99E+06 | -1.11E+07 | 1.91E+07 | 2.17E+07 | -1.04E+07 | 1.03E+07 | 2.29E+07 | -3.58E+05 | -5.42E+05 | -3.92E+05 | -5.40E+05 | -4.43E+05 | -3.25E+05 | -4.70E+05 | -6.47E+05 |
| **166.02** | 1.97E+07 | 4.62E+06 | -1.45E+07 | 2.58E+07 | 2.39E+07 | -1.09E+07 | 6.56E+06 | 2.85E+07 | -2.55E+05 | -4.24E+05 | -5.55E+05 | -1.11E+06 | -2.24E+05 | -6.02E+05 | -5.46E+05 | -1.00E+06 |
| **175.78** | 1.97E+07 | 6.35E+06 | -1.09E+07 | 1.98E+07 | 2.27E+07 | -9.65E+06 | 9.14E+06 | 2.32E+07 | -3.21E+05 | -4.65E+05 | -4.04E+05 | -5.33E+05 | -4.44E+05 | -3.62E+05 | -4.56E+05 | -1.97E+05 |
| **185.55** | 2.14E+07 | 6.33E+06 | -1.04E+07 | 2.21E+07 | 2.36E+07 | -9.48E+06 | 9.44E+06 | 2.42E+07 | -2.20E+05 | -3.65E+05 | -3.22E+05 | -3.34E+05 | -1.91E+05 | -2.49E+05 | -2.39E+05 | -2.23E+05 |
| **195.31** | 2.27E+07 | 5.01E+06 | -1.00E+07 | 2.59E+07 | 2.30E+07 | -1.01E+07 | 9.00E+06 | 2.49E+07 | -2.45E+05 | -3.03E+05 | -3.17E+05 | -4.54E+05 | -3.03E+05 | -3.07E+05 | -4.49E+05 | -3.89E+05 |
| **205.08** | 2.33E+07 | 4.21E+06 | -7.88E+06 | 2.58E+07 | 2.35E+07 | -1.09E+07 | 1.12E+07 | 2.27E+07 | -5.30E+05 | -1.04E+06 | -3.92E+05 | -9.69E+05 | -5.63E+05 | -6.65E+05 | -5.65E+05 | -6.64E+05 |
| **214.84** | 2.39E+07 | 4.29E+06 | -7.76E+06 | 2.51E+07 | 2.34E+07 | -8.85E+06 | 1.01E+07 | 2.40E+07 | -2.01E+05 | -2.86E+05 | -2.66E+05 | -3.53E+05 | -2.52E+05 | -3.71E+05 | -2.42E+05 | -2.61E+05 |
| **224.61** | 2.48E+07 | 4.53E+06 | -7.22E+06 | 2.59E+07 | 2.46E+07 | -8.87E+06 | 9.33E+06 | 2.47E+07 | -3.72E+05 | -2.79E+05 | -2.46E+05 | -3.52E+05 | -2.10E+05 | -3.05E+05 | -2.46E+05 | -2.56E+05 |
| **234.38** | 2.63E+07 | 3.75E+06 | -7.79E+06 | 2.71E+07 | 2.41E+07 | -8.86E+06 | 9.22E+06 | 2.49E+07 | -2.50E+05 | -2.88E+05 | -2.77E+05 | -4.17E+05 | -2.73E+05 | -3.24E+05 | -2.07E+05 | -3.35E+05 |
| **244.14** | 2.76E+07 | 3.22E+06 | -7.61E+06 | 2.79E+07 | 2.43E+07 | -8.44E+06 | 9.30E+06 | 2.43E+07 | -3.21E+05 | -2.97E+05 | -1.73E+05 | -3.44E+05 | -2.94E+05 | -3.49E+05 | -3.36E+05 | -3.49E+05 |
| **253.91** | 2.73E+07 | 3.82E+06 | -7.22E+06 | 2.93E+07 | 2.34E+07 | -7.04E+06 | 9.70E+06 | 2.45E+07 | -5.30E+05 | -1.10E+06 | -2.55E+05 | -4.20E+05 | -6.84E+05 | -9.13E+05 | -2.45E+05 | -4.20E+05 |
| **263.67** | 2.95E+07 | 2.00E+06 | -6.66E+06 | 3.10E+07 | 2.31E+07 | -7.45E+06 | 1.01E+07 | 2.41E+07 | -4.29E+05 | -3.91E+05 | -4.45E+05 | -4.56E+05 | -4.83E+05 | -7.10E+05 | -3.58E+05 | -5.09E+05 |
| **273.44** | 2.81E+07 | 3.28E+06 | -6.82E+06 | 3.04E+07 | 2.27E+07 | -5.67E+06 | 1.02E+07 | 2.29E+07 | -4.04E+05 | -3.66E+05 | -3.05E+05 | -4.43E+05 | -3.29E+05 | -4.05E+05 | -3.10E+05 | -5.76E+05 |
| **283.20** | 2.93E+07 | 2.94E+06 | -6.72E+06 | 3.19E+07 | 2.45E+07 | -6.23E+06 | 9.43E+06 | 2.32E+07 | -3.14E+05 | -5.89E+05 | -3.58E+05 | -3.31E+05 | -3.77E+05 | -3.52E+05 | -3.73E+05 | -5.22E+05 |
| **292.97** | 3.08E+07 | 3.17E+06 | -6.51E+06 | 3.21E+07 | 2.40E+07 | -5.87E+06 | 9.86E+06 | 2.26E+07 | -3.26E+05 | -8.23E+05 | -4.12E+05 | -3.95E+05 | -5.00E+05 | -2.35E+05 | -2.81E+05 | -4.01E+05 |
| **302.73** | 3.13E+07 | 3.31E+06 | -6.54E+06 | 3.17E+07 | 2.36E+07 | -5.12E+06 | 1.02E+07 | 2.17E+07 | -6.75E+05 | -9.53E+05 | -4.42E+05 | -4.91E+05 | -7.87E+05 | -4.10E+05 | -4.02E+05 | -5.61E+05 |
| **312.50** | 3.19E+07 | 5.31E+06 | -4.42E+06 | 3.28E+07 | 2.49E+07 | -4.97E+06 | 1.01E+07 | 2.41E+07 | -1.07E+06 | -8.36E+05 | -3.82E+05 | -8.09E+05 | -7.65E+05 | -1.23E+06 | -6.52E+05 | -4.17E+05 |
| **322.27** | 3.49E+07 | 5.78E+06 | -5.98E+06 | 3.16E+07 | 2.48E+07 | -5.29E+06 | 9.06E+06 | 2.40E+07 | -1.92E+06 | -1.65E+06 | -6.88E+05 | -8.66E+05 | -1.26E+06 | -1.15E+06 | -1.19E+06 | -1.03E+06 |
| **332.03** | 2.37E+07 | -1.77E+07 | -2.85E+06 | 4.64E+07 | 2.94E+07 | -3.84E+06 | 1.70E+07 | 3.89E+07 | -1.41E+07 | -2.64E+07 | -1.69E+07 | -1.32E+07 | -1.66E+07 | -8.83E+06 | -6.72E+06 | -1.90E+07 |
| **341.80** | 3.09E+07 | 5.04E+06 | -5.41E+06 | 3.27E+07 | 2.29E+07 | -8.92E+06 | 1.47E+07 | 2.38E+07 | -3.82E+06 | -2.56E+06 | -3.08E+06 | -2.37E+06 | -5.13E+06 | -4.05E+06 | -1.77E+06 | -1.42E+06 |

## Table A10. 50% PR, $\omega$ = 10,200 RPM, and medium-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***f*** | ***Re Hxx*** | ***Re Hxy*** | ***Re Hyx*** | ***Re Hyy*** | ***Im Hxx*** | ***Im Hxy*** | ***Im Hyx*** | ***Im Hyy*** | ***Re eHxx*** | ***Re eHxy*** | ***Re eHyx*** | ***Re eHyy*** | ***Im eHxx*** | ***Im eHxy*** | ***Im eHyx*** | ***Im eHyy*** |
| **9.77** | -1.48E+06 | 2.18E+06 | -2.32E+06 | 1.08E+05 | 2.09E+06 | -3.86E+05 | 3.88E+05 | 2.52E+06 | -2.22E+05 | -1.34E+05 | -2.59E+05 | -2.05E+05 | -2.77E+05 | -2.00E+05 | -3.37E+05 | -1.74E+05 |
| **19.53** | -4.45E+05 | 1.85E+06 | -2.84E+06 | 6.43E+05 | 5.27E+06 | -9.06E+05 | 2.76E+05 | 4.91E+06 | -2.39E+05 | -2.24E+05 | -1.88E+05 | -1.39E+05 | -2.55E+05 | -2.11E+05 | -2.68E+05 | -1.46E+05 |
| **29.30** | -1.12E+05 | 1.90E+06 | -2.31E+06 | 9.75E+05 | 7.09E+06 | -9.14E+05 | 1.44E+06 | 7.07E+06 | -2.66E+05 | -3.30E+05 | -2.50E+05 | -4.48E+05 | -2.98E+05 | -3.75E+05 | -2.74E+05 | -4.52E+05 |
| **39.06** | 4.85E+05 | 1.74E+06 | -2.17E+06 | 2.14E+06 | 9.23E+06 | -1.97E+06 | 1.42E+06 | 8.73E+06 | -2.16E+05 | -2.49E+05 | -2.00E+05 | -2.07E+05 | -1.79E+05 | -2.37E+05 | -2.13E+05 | -4.89E+05 |
| **48.83** | 1.85E+06 | 1.47E+06 | -1.82E+06 | 2.87E+06 | 1.06E+07 | -1.87E+06 | 1.52E+06 | 1.07E+07 | -4.43E+05 | -2.76E+05 | -3.01E+05 | -2.98E+05 | -3.39E+05 | -2.86E+05 | -2.84E+05 | -2.19E+05 |
| **58.59** | 3.28E+06 | 1.31E+06 | -2.37E+06 | 3.96E+06 | 1.23E+07 | -2.26E+06 | 1.84E+06 | 1.31E+07 | -2.62E+05 | -2.29E+05 | -3.96E+05 | -4.30E+05 | -2.56E+05 | -3.17E+05 | -3.63E+05 | -2.21E+05 |
| **68.36** | 4.02E+06 | 1.50E+06 | -6.87E+05 | 4.96E+06 | 1.40E+07 | -2.78E+06 | 1.21E+06 | 1.47E+07 | -3.07E+05 | -4.45E+05 | -4.28E+05 | -6.27E+05 | -3.72E+05 | -4.60E+05 | -4.17E+05 | -7.69E+05 |
| **78.13** | 4.66E+06 | 7.45E+05 | -1.26E+06 | 6.93E+06 | 1.54E+07 | -2.84E+06 | 1.96E+06 | 1.60E+07 | -1.94E+05 | -2.36E+05 | -2.37E+05 | -2.80E+05 | -1.82E+05 | -2.32E+05 | -3.04E+05 | -2.81E+05 |
| **87.89** | 6.26E+06 | 4.08E+05 | -1.17E+06 | 8.12E+06 | 1.69E+07 | -3.06E+06 | 1.97E+06 | 1.76E+07 | -3.23E+05 | -1.58E+05 | -2.50E+05 | -3.57E+05 | -2.29E+05 | -2.58E+05 | -1.52E+05 | -3.17E+05 |
| **97.66** | 7.74E+06 | 1.14E+04 | -5.95E+05 | 9.62E+06 | 1.81E+07 | -3.17E+06 | 2.14E+06 | 1.85E+07 | -2.71E+05 | -2.53E+05 | -3.15E+05 | -4.08E+05 | -1.91E+05 | -2.24E+05 | -3.11E+05 | -2.29E+05 |
| **107.42** | 9.31E+06 | -2.27E+05 | -9.16E+05 | 1.11E+07 | 1.90E+07 | -2.79E+06 | 1.43E+06 | 2.01E+07 | -1.83E+05 | -1.86E+05 | -4.23E+05 | -3.63E+05 | -2.88E+05 | -1.98E+05 | -5.24E+05 | -3.03E+05 |
| **117.19** | 1.05E+07 | -8.03E+05 | -4.07E+05 | 1.25E+07 | 1.96E+07 | -3.46E+06 | 2.60E+06 | 2.01E+07 | -2.32E+05 | -1.87E+05 | -2.94E+05 | -2.55E+05 | -3.15E+05 | -2.14E+05 | -4.40E+05 | -2.42E+05 |
| **126.95** | 1.18E+07 | -8.66E+05 | -4.90E+04 | 1.38E+07 | 2.00E+07 | -2.91E+06 | 1.96E+06 | 2.02E+07 | -1.56E+05 | -5.45E+05 | -2.74E+05 | -6.14E+05 | -2.81E+05 | -5.01E+05 | -1.92E+05 | -5.63E+05 |
| **136.72** | 1.29E+07 | -1.59E+06 | -6.22E+05 | 1.52E+07 | 2.13E+07 | -2.60E+06 | 2.44E+06 | 2.12E+07 | -3.31E+05 | -5.44E+05 | -4.49E+05 | -2.88E+05 | -2.39E+05 | -3.31E+05 | -4.06E+05 | -4.41E+05 |
| **146.48** | 1.43E+07 | -9.83E+05 | 3.56E+05 | 1.62E+07 | 2.17E+07 | -2.86E+06 | 8.83E+05 | 2.16E+07 | -2.38E+05 | -4.26E+05 | -4.63E+05 | -4.78E+05 | -2.36E+05 | -2.95E+05 | -4.18E+05 | -3.13E+05 |
| **156.25** | 1.60E+07 | -1.87E+06 | 3.94E+05 | 1.72E+07 | 2.34E+07 | -2.21E+06 | 1.10E+06 | 2.16E+07 | -4.20E+05 | -4.02E+05 | -3.36E+05 | -4.49E+05 | -4.24E+05 | -5.08E+05 | -2.79E+05 | -2.49E+05 |
| **166.02** | 1.78E+07 | -3.70E+06 | 2.12E+06 | 1.36E+07 | 2.51E+07 | -9.32E+06 | 4.79E+05 | 2.49E+07 | -9.78E+05 | -3.23E+06 | -4.28E+05 | -1.94E+06 | -4.74E+05 | -1.65E+06 | -7.47E+05 | -2.26E+06 |
| **175.78** | 1.36E+07 | 3.45E+06 | 8.49E+06 | 8.16E+06 | 3.07E+07 | -1.05E+07 | -9.46E+06 | 3.55E+07 | -6.63E+05 | -1.17E+06 | -1.24E+06 | -1.68E+06 | -9.49E+05 | -1.22E+06 | -6.16E+05 | -1.17E+06 |
| **185.55** | 1.99E+07 | -2.36E+06 | 6.72E+05 | 2.40E+07 | 2.25E+07 | -3.34E+06 | 2.69E+05 | 2.76E+07 | -1.88E+05 | -3.14E+05 | -2.23E+05 | -5.50E+05 | -8.36E+04 | -4.06E+05 | -3.44E+05 | -8.06E+05 |
| **195.31** | 2.03E+07 | -2.83E+06 | 3.08E+05 | 2.17E+07 | 2.37E+07 | -2.70E+06 | 1.36E+06 | 2.34E+07 | -2.59E+05 | -1.62E+05 | -1.93E+05 | -2.58E+05 | -1.96E+05 | -2.94E+05 | -2.05E+05 | -2.34E+05 |
| **205.08** | 2.17E+07 | -3.74E+06 | 3.84E+05 | 2.23E+07 | 2.37E+07 | -2.24E+06 | 1.68E+06 | 2.42E+07 | -2.18E+05 | -4.65E+05 | -2.41E+05 | -4.48E+05 | -3.20E+05 | -5.25E+05 | -4.11E+05 | -4.62E+05 |
| **214.84** | 2.18E+07 | -2.92E+06 | 5.13E+05 | 2.34E+07 | 2.39E+07 | -2.20E+06 | 2.90E+06 | 2.42E+07 | -3.21E+05 | -2.34E+05 | -2.07E+05 | -2.11E+05 | -1.86E+05 | -2.39E+05 | -2.33E+05 | -2.75E+05 |
| **224.61** | 2.24E+07 | -3.12E+06 | 7.64E+05 | 2.50E+07 | 2.44E+07 | -1.67E+06 | 2.65E+06 | 2.36E+07 | -2.73E+05 | -1.83E+05 | -2.08E+05 | -1.69E+05 | -2.67E+05 | -2.39E+05 | -2.98E+05 | -3.24E+05 |
| **234.38** | 2.38E+07 | -3.31E+06 | 5.72E+05 | 2.59E+07 | 2.50E+07 | -1.57E+06 | 2.37E+06 | 2.45E+07 | -1.78E+05 | -2.81E+05 | -2.07E+05 | -3.11E+05 | -1.60E+05 | -2.73E+05 | -1.60E+05 | -2.15E+05 |
| **244.14** | 2.56E+07 | -3.54E+06 | 1.57E+06 | 2.72E+07 | 2.45E+07 | -2.01E+06 | 1.65E+06 | 2.40E+07 | -2.17E+05 | -2.00E+05 | -1.92E+05 | -2.55E+05 | -2.56E+05 | -2.96E+05 | -2.41E+05 | -2.74E+05 |
| **253.91** | 2.56E+07 | -2.66E+06 | 6.65E+05 | 2.86E+07 | 2.35E+07 | -9.03E+05 | 1.92E+06 | 2.32E+07 | -4.74E+05 | -9.48E+05 | -1.95E+05 | -3.51E+05 | -5.75E+05 | -9.04E+05 | -2.21E+05 | -3.06E+05 |
| **263.67** | 2.81E+07 | -4.33E+06 | 2.55E+05 | 2.93E+07 | 2.38E+07 | -5.17E+05 | 2.42E+06 | 2.29E+07 | -3.07E+05 | -3.01E+05 | -2.09E+05 | -2.60E+05 | -2.24E+05 | -3.97E+05 | -2.38E+05 | -2.68E+05 |
| **273.44** | 2.79E+07 | -3.57E+06 | 7.96E+05 | 2.97E+07 | 2.34E+07 | 2.70E+05 | 1.97E+06 | 2.19E+07 | -2.93E+05 | -3.17E+05 | -2.62E+05 | -2.03E+05 | -2.00E+05 | -2.67E+05 | -1.58E+05 | -4.05E+05 |
| **283.20** | 2.85E+07 | -3.07E+06 | 7.50E+05 | 3.00E+07 | 2.45E+07 | -1.05E+06 | 2.27E+06 | 2.27E+07 | -1.65E+05 | -3.53E+05 | -1.74E+05 | -2.61E+05 | -2.93E+05 | -2.64E+05 | -2.78E+05 | -2.37E+05 |
| **292.97** | 3.07E+07 | -4.45E+06 | -3.01E+05 | 3.14E+07 | 2.45E+07 | -7.49E+05 | 2.20E+06 | 2.23E+07 | -2.66E+05 | -3.35E+05 | -1.74E+05 | -2.34E+05 | -1.73E+05 | -2.21E+05 | -1.63E+05 | -2.21E+05 |
| **302.73** | 3.13E+07 | -4.08E+06 | 3.62E+04 | 3.19E+07 | 2.37E+07 | 1.25E+05 | 3.10E+06 | 2.10E+07 | -4.16E+05 | -2.69E+05 | -1.68E+05 | -1.97E+05 | -2.40E+05 | -3.42E+05 | -2.84E+05 | -2.36E+05 |
| **312.50** | 3.19E+07 | -3.02E+06 | 1.32E+06 | 3.07E+07 | 2.38E+07 | 8.29E+05 | 2.78E+06 | 2.12E+07 | -3.51E+05 | -2.79E+05 | -2.53E+05 | -3.08E+05 | -2.81E+05 | -3.41E+05 | -2.99E+05 | -3.04E+05 |
| **322.27** | 3.33E+07 | -2.82E+06 | 1.56E+05 | 3.23E+07 | 2.33E+07 | 6.82E+05 | 1.08E+06 | 2.18E+07 | -3.78E+05 | -2.04E+05 | -2.77E+05 | -3.24E+05 | -2.48E+05 | -3.47E+05 | -3.05E+05 | -2.90E+05 |
| **332.03** | 3.46E+07 | -2.91E+06 | -5.64E+05 | 3.29E+07 | 2.26E+07 | -3.73E+05 | 1.84E+06 | 2.11E+07 | -6.97E+05 | -6.44E+05 | -4.95E+05 | -5.01E+05 | -5.66E+05 | -6.37E+05 | -4.24E+05 | -5.93E+05 |
| **341.80** | 3.36E+07 | -3.16E+06 | 5.79E+05 | 3.21E+07 | 1.92E+07 | -4.02E+05 | 5.64E+06 | 2.13E+07 | -1.86E+06 | -1.44E+06 | -1.64E+06 | -1.19E+06 | -1.20E+06 | -1.66E+06 | -1.06E+06 | -1.34E+06 |

## Table A11. 50% PR, $\omega$ = 15,350 RPM, and medium-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***f*** | ***Re Hxx*** | ***Re Hxy*** | ***Re Hyx*** | ***Re Hyy*** | ***Im Hxx*** | ***Im Hxy*** | ***Im Hyx*** | ***Im Hyy*** | ***Re eHxx*** | ***Re eHxy*** | ***Re eHyx*** | ***Re eHyy*** | ***Im eHxx*** | ***Im eHxy*** | ***Im eHyx*** | ***Im eHyy*** |
| **9.77** | -1.83E+06 | 8.08E+06 | -8.71E+06 | -8.96E+05 | 2.51E+06 | -8.55E+05 | 9.65E+05 | 2.73E+06 | -3.24E+05 | -1.45E+05 | -3.10E+05 | -1.87E+05 | -2.76E+05 | -1.54E+05 | -3.57E+05 | -1.64E+05 |
| **19.53** | -4.79E+05 | 7.65E+06 | -9.10E+06 | -8.62E+04 | 5.50E+06 | -1.76E+06 | 1.35E+06 | 5.80E+06 | -2.73E+05 | -1.51E+05 | -3.55E+05 | -2.08E+05 | -3.19E+05 | -1.74E+05 | -2.91E+05 | -2.20E+05 |
| **29.30** | 3.17E+05 | 7.31E+06 | -8.47E+06 | 4.56E+05 | 7.41E+06 | -2.42E+06 | 2.72E+06 | 7.97E+06 | -3.00E+05 | -2.95E+05 | -2.96E+05 | -3.79E+05 | -3.07E+05 | -3.11E+05 | -2.98E+05 | -3.68E+05 |
| **39.06** | 1.61E+06 | 7.14E+06 | -7.80E+06 | 1.85E+06 | 9.80E+06 | -3.18E+06 | 3.11E+06 | 9.66E+06 | -2.63E+05 | -3.20E+05 | -3.17E+05 | -2.96E+05 | -2.10E+05 | -3.89E+05 | -2.86E+05 | -3.60E+05 |
| **48.83** | 2.66E+06 | 6.89E+06 | -7.37E+06 | 3.07E+06 | 1.17E+07 | -3.85E+06 | 3.76E+06 | 1.19E+07 | -2.60E+05 | -2.87E+05 | -3.72E+05 | -2.72E+05 | -4.34E+05 | -2.56E+05 | -2.77E+05 | -2.98E+05 |
| **58.59** | 3.93E+06 | 6.32E+06 | -6.65E+06 | 4.10E+06 | 1.31E+07 | -4.58E+06 | 4.07E+06 | 1.37E+07 | -3.68E+05 | -2.11E+05 | -4.57E+05 | -3.54E+05 | -2.91E+05 | -3.26E+05 | -3.74E+05 | -3.59E+05 |
| **68.36** | 4.44E+06 | 5.89E+06 | -6.59E+06 | 5.48E+06 | 1.46E+07 | -4.54E+06 | 3.83E+06 | 1.54E+07 | -3.09E+05 | -4.21E+05 | -5.55E+05 | -4.83E+05 | -3.06E+05 | -4.66E+05 | -3.58E+05 | -6.83E+05 |
| **78.13** | 5.95E+06 | 4.92E+06 | -5.71E+06 | 6.71E+06 | 1.59E+07 | -5.43E+06 | 3.86E+06 | 1.70E+07 | -2.00E+05 | -2.59E+05 | -3.11E+05 | -2.51E+05 | -1.80E+05 | -2.63E+05 | -2.07E+05 | -2.80E+05 |
| **87.89** | 7.56E+06 | 4.30E+06 | -5.11E+06 | 8.12E+06 | 1.73E+07 | -5.45E+06 | 4.66E+06 | 1.84E+07 | -2.64E+05 | -2.12E+05 | -3.10E+05 | -2.81E+05 | -2.39E+05 | -2.85E+05 | -3.13E+05 | -1.44E+05 |
| **97.66** | 8.92E+06 | 3.61E+06 | -4.57E+06 | 1.02E+07 | 1.85E+07 | -6.37E+06 | 4.58E+06 | 1.93E+07 | -2.64E+05 | -2.33E+05 | -4.19E+05 | -3.86E+05 | -3.01E+05 | -4.52E+05 | -3.74E+05 | -4.09E+05 |
| **107.42** | 9.87E+06 | 3.05E+06 | -4.47E+06 | 1.15E+07 | 1.91E+07 | -6.18E+06 | 5.21E+06 | 1.96E+07 | -3.24E+05 | -2.93E+05 | -4.05E+05 | -3.66E+05 | -5.00E+05 | -2.69E+05 | -6.16E+05 | -3.98E+05 |
| **117.19** | 1.13E+07 | 2.10E+06 | -4.26E+06 | 1.32E+07 | 1.97E+07 | -5.61E+06 | 4.71E+06 | 2.07E+07 | -3.18E+05 | -1.33E+05 | -2.62E+05 | -3.02E+05 | -3.10E+05 | -2.11E+05 | -2.73E+05 | -2.66E+05 |
| **126.95** | 1.30E+07 | 1.44E+06 | -3.31E+06 | 1.44E+07 | 2.05E+07 | -5.01E+06 | 4.96E+06 | 2.09E+07 | -2.33E+05 | -6.53E+05 | -3.74E+05 | -5.37E+05 | -3.07E+05 | -4.40E+05 | -2.16E+05 | -8.60E+05 |
| **136.72** | 1.36E+07 | 1.76E+06 | -4.05E+06 | 1.63E+07 | 2.07E+07 | -5.54E+06 | 5.00E+06 | 2.16E+07 | -1.43E+05 | -2.62E+05 | -2.55E+05 | -2.35E+05 | -1.94E+05 | -2.94E+05 | -2.55E+05 | -3.41E+05 |
| **146.48** | 1.53E+07 | 1.04E+06 | -3.11E+06 | 1.71E+07 | 2.15E+07 | -5.40E+06 | 4.88E+06 | 2.16E+07 | -3.57E+05 | -5.69E+05 | -3.19E+05 | -3.56E+05 | -3.58E+05 | -3.02E+05 | -3.93E+05 | -3.46E+05 |
| **156.25** | 1.68E+07 | 8.04E+05 | -3.12E+06 | 1.78E+07 | 2.19E+07 | -5.67E+06 | 4.77E+06 | 2.20E+07 | -3.18E+05 | -2.57E+05 | -2.46E+05 | -3.22E+05 | -3.11E+05 | -4.16E+05 | -3.25E+05 | -2.03E+05 |
| **166.02** | 1.77E+07 | 1.38E+06 | -3.41E+06 | 2.04E+07 | 2.26E+07 | -5.31E+06 | 4.81E+06 | 2.35E+07 | -2.24E+05 | -6.63E+05 | -2.40E+05 | -5.28E+05 | -2.27E+05 | -3.47E+05 | -2.70E+05 | -7.13E+05 |
| **175.78** | 1.27E+07 | 7.66E+06 | 5.09E+06 | 1.12E+07 | 2.15E+07 | -3.14E+06 | 5.83E+06 | 2.05E+07 | -2.85E+05 | -4.01E+05 | -3.50E+05 | -3.68E+05 | -4.15E+05 | -4.03E+05 | -3.19E+05 | -2.53E+05 |
| **185.55** | 2.05E+07 | 7.26E+05 | -3.09E+06 | 1.81E+07 | 2.28E+07 | -6.25E+06 | 5.42E+06 | 3.23E+07 | -2.62E+05 | -2.99E+05 | -4.26E+05 | -5.85E+05 | -2.02E+05 | -2.39E+05 | -2.34E+05 | -2.51E+05 |
| **195.31** | 2.10E+07 | -6.33E+05 | -2.57E+06 | 2.26E+07 | 2.28E+07 | -5.17E+06 | 5.01E+06 | 2.29E+07 | -2.87E+05 | -2.95E+05 | -1.36E+05 | -3.09E+05 | -2.83E+05 | -2.22E+05 | -2.36E+05 | -1.79E+05 |
| **205.08** | 2.19E+07 | -1.46E+06 | -2.44E+06 | 2.32E+07 | 2.29E+07 | -5.37E+06 | 4.73E+06 | 2.35E+07 | -2.19E+05 | -5.43E+05 | -1.71E+05 | -7.41E+05 | -2.05E+05 | -5.00E+05 | -4.32E+05 | -4.54E+05 |
| **214.84** | 2.31E+07 | -7.81E+05 | -1.69E+06 | 2.46E+07 | 2.38E+07 | -4.66E+06 | 4.63E+06 | 2.32E+07 | -1.53E+05 | -3.32E+05 | -2.93E+05 | -3.17E+05 | -2.91E+05 | -4.18E+05 | -2.43E+05 | -3.26E+05 |
| **224.61** | 2.45E+07 | -1.89E+06 | -2.52E+06 | 2.70E+07 | 2.34E+07 | -4.39E+06 | 4.51E+06 | 2.30E+07 | -2.22E+05 | -2.98E+05 | -2.30E+05 | -3.37E+05 | -1.95E+05 | -4.12E+05 | -2.77E+05 | -3.17E+05 |
| **234.38** | 2.52E+07 | -1.94E+06 | -1.91E+06 | 2.71E+07 | 2.47E+07 | -3.64E+06 | 5.57E+06 | 2.33E+07 | -4.73E+05 | -4.88E+05 | -3.33E+05 | -6.85E+05 | -2.45E+05 | -5.47E+05 | -2.36E+05 | -5.85E+05 |
| **244.14** | 2.70E+07 | -1.55E+06 | -1.13E+05 | 2.83E+07 | 2.41E+07 | -3.77E+06 | 4.02E+06 | 2.23E+07 | -6.04E+05 | -8.56E+05 | -3.84E+05 | -8.12E+05 | -3.40E+05 | -9.81E+05 | -4.34E+05 | -7.89E+05 |
| **253.91** | 2.86E+07 | -1.24E+06 | 1.62E+05 | 2.72E+07 | 2.57E+07 | -5.85E+06 | 1.98E+06 | 2.31E+07 | -3.24E+06 | -7.22E+06 | -2.34E+06 | -3.91E+06 | -2.41E+06 | -5.09E+06 | -1.98E+06 | -5.23E+06 |
| **263.67** | 3.02E+07 | -2.37E+06 | -1.58E+06 | 2.99E+07 | 2.38E+07 | -2.17E+06 | 3.77E+06 | 2.09E+07 | -6.59E+05 | -1.66E+06 | -9.81E+05 | -1.21E+06 | -1.21E+06 | -1.73E+06 | -4.34E+05 | -1.42E+06 |
| **273.44** | 2.87E+07 | -1.31E+06 | -1.16E+06 | 2.99E+07 | 2.24E+07 | -1.43E+06 | 4.17E+06 | 2.09E+07 | -3.71E+05 | -8.70E+05 | -4.31E+05 | -6.70E+05 | -5.65E+05 | -8.76E+05 | -3.35E+05 | -9.50E+05 |
| **283.20** | 2.87E+07 | -1.20E+06 | -7.71E+05 | 3.02E+07 | 2.39E+07 | -3.21E+06 | 4.66E+06 | 2.16E+07 | -3.15E+05 | -5.94E+05 | -1.73E+05 | -4.47E+05 | -3.08E+05 | -4.91E+05 | -4.34E+05 | -4.19E+05 |
| **292.97** | 3.04E+07 | -2.64E+06 | -1.32E+06 | 3.08E+07 | 2.40E+07 | -2.72E+06 | 4.34E+06 | 2.14E+07 | -3.76E+05 | -5.09E+05 | -2.34E+05 | -3.76E+05 | -3.46E+05 | -5.24E+05 | -2.80E+05 | -4.13E+05 |
| **302.73** | 3.16E+07 | -1.66E+06 | -1.52E+06 | 3.13E+07 | 2.23E+07 | -1.81E+06 | 5.17E+06 | 1.99E+07 | -3.41E+05 | -4.75E+05 | -1.70E+05 | -3.16E+05 | -2.69E+05 | -4.88E+05 | -2.43E+05 | -3.46E+05 |
| **312.50** | 3.21E+07 | -1.31E+06 | -1.84E+05 | 3.07E+07 | 2.29E+07 | -2.11E+06 | 4.64E+06 | 2.07E+07 | -3.60E+05 | -3.32E+05 | -3.15E+05 | -2.98E+05 | -3.00E+05 | -5.13E+05 | -2.45E+05 | -3.68E+05 |
| **322.27** | 3.36E+07 | -1.46E+06 | -1.56E+06 | 3.19E+07 | 2.25E+07 | -1.65E+06 | 4.18E+06 | 2.13E+07 | -3.80E+05 | -3.42E+05 | -3.34E+05 | -3.63E+05 | -4.61E+05 | -3.62E+05 | -2.74E+05 | -2.52E+05 |
| **332.03** | 3.46E+07 | -1.24E+06 | -2.23E+06 | 3.24E+07 | 2.14E+07 | -2.43E+06 | 5.05E+06 | 2.10E+07 | -3.70E+05 | -2.59E+05 | -3.70E+05 | -4.05E+05 | -4.50E+05 | -4.22E+05 | -3.28E+05 | -3.98E+05 |
| **341.80** | 3.39E+07 | -1.90E+06 | -1.24E+06 | 3.24E+07 | 2.13E+07 | -2.47E+06 | 6.61E+06 | 2.08E+07 | -2.99E+05 | -2.58E+05 | -2.96E+05 | -1.90E+05 | -3.56E+05 | -4.85E+05 | -3.23E+05 | -3.38E+05 |

## Table A12. 50% PR, $\omega$ = 20,200 RPM, and medium-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***f*** | ***Re Hxx*** | ***Re Hxy*** | ***Re Hyx*** | ***Re Hyy*** | ***Im Hxx*** | ***Im Hxy*** | ***Im Hyx*** | ***Im Hyy*** | ***Re eHxx*** | ***Re eHxy*** | ***Re eHyx*** | ***Re eHyy*** | ***Im eHxx*** | ***Im eHxy*** | ***Im eHyx*** | ***Im eHyy*** |
| **9.77** | -1.68E+06 | 1.54E+07 | -1.59E+07 | -1.37E+06 | 2.80E+06 | -1.77E+06 | 1.79E+06 | 3.51E+06 | -4.35E+05 | -2.93E+05 | -3.30E+05 | -2.18E+05 | -3.70E+05 | -1.98E+05 | -3.74E+05 | -1.54E+05 |
| **19.53** | -5.09E+05 | 1.42E+07 | -1.58E+07 | -6.02E+05 | 5.76E+06 | -2.97E+06 | 2.66E+06 | 5.88E+06 | -3.01E+05 | -2.27E+05 | -2.38E+05 | -1.82E+05 | -3.53E+05 | -2.18E+05 | -2.77E+05 | -1.80E+05 |
| **29.30** | 6.45E+05 | 1.36E+07 | -1.56E+07 | 6.94E+05 | 7.58E+06 | -4.52E+06 | 4.09E+06 | 9.12E+06 | -3.40E+05 | -2.39E+05 | -3.27E+05 | -2.84E+05 | -3.02E+05 | -3.66E+05 | -3.75E+05 | -4.12E+05 |
| **39.06** | 1.51E+06 | 1.30E+07 | -1.40E+07 | 1.85E+06 | 9.99E+06 | -5.12E+06 | 5.22E+06 | 1.05E+07 | -2.62E+05 | -3.62E+05 | -3.36E+05 | -2.91E+05 | -3.00E+05 | -3.48E+05 | -2.93E+05 | -4.58E+05 |
| **48.83** | 3.57E+06 | 1.18E+07 | -1.26E+07 | 3.08E+06 | 1.13E+07 | -6.28E+06 | 5.98E+06 | 1.22E+07 | -1.12E+06 | -1.06E+06 | -5.05E+05 | -2.83E+05 | -1.18E+06 | -1.08E+06 | -3.34E+05 | -3.59E+05 |
| **58.59** | 4.53E+06 | 1.12E+07 | -1.26E+07 | 4.67E+06 | 1.32E+07 | -7.11E+06 | 6.57E+06 | 1.47E+07 | -2.06E+05 | -2.23E+05 | -3.92E+05 | -4.88E+05 | -3.02E+05 | -3.09E+05 | -3.83E+05 | -3.63E+05 |
| **68.36** | 5.66E+06 | 9.96E+06 | -1.15E+07 | 7.24E+06 | 1.45E+07 | -7.67E+06 | 7.22E+06 | 1.56E+07 | -5.54E+05 | -4.70E+05 | -9.03E+05 | -9.94E+05 | -3.92E+05 | -6.20E+05 | -7.54E+05 | -4.57E+05 |
| **78.13** | 6.77E+06 | 9.64E+06 | -1.08E+07 | 7.60E+06 | 1.57E+07 | -8.16E+06 | 7.59E+06 | 1.73E+07 | -2.31E+05 | -2.78E+05 | -2.86E+05 | -2.47E+05 | -2.69E+05 | -2.39E+05 | -3.51E+05 | -2.36E+05 |
| **87.89** | 8.45E+06 | 8.70E+06 | -1.05E+07 | 8.35E+06 | 1.69E+07 | -8.88E+06 | 7.45E+06 | 1.87E+07 | -2.75E+05 | -2.87E+05 | -2.40E+05 | -3.23E+05 | -2.68E+05 | -2.28E+05 | -3.29E+05 | -4.73E+05 |
| **97.66** | 9.43E+06 | 7.86E+06 | -8.93E+06 | 1.04E+07 | 1.84E+07 | -9.08E+06 | 7.69E+06 | 1.94E+07 | -4.00E+05 | -5.97E+05 | -3.51E+05 | -3.87E+05 | -4.29E+05 | -3.03E+05 | -3.11E+05 | -3.43E+05 |
| **107.42** | 1.12E+07 | 6.31E+06 | -9.04E+06 | 1.32E+07 | 1.86E+07 | -8.74E+06 | 8.61E+06 | 2.05E+07 | -2.68E+05 | -2.52E+05 | -4.53E+05 | -3.68E+05 | -4.11E+05 | -3.31E+05 | -2.80E+05 | -2.55E+05 |
| **117.19** | 1.30E+07 | 5.84E+06 | -8.47E+06 | 1.41E+07 | 1.97E+07 | -9.17E+06 | 8.05E+06 | 2.12E+07 | -3.03E+05 | -1.71E+05 | -1.93E+05 | -2.58E+05 | -3.32E+05 | -1.92E+05 | -3.91E+05 | -2.48E+05 |
| **126.95** | 1.41E+07 | 4.46E+06 | -7.20E+06 | 1.55E+07 | 2.00E+07 | -9.38E+06 | 7.91E+06 | 2.22E+07 | -3.75E+05 | -7.06E+05 | -3.58E+05 | -3.77E+05 | -4.08E+05 | -5.36E+05 | -1.83E+05 | -5.69E+05 |
| **136.72** | 1.49E+07 | 4.14E+06 | -6.83E+06 | 1.68E+07 | 2.08E+07 | -8.87E+06 | 7.83E+06 | 2.18E+07 | -1.97E+05 | -3.65E+05 | -3.98E+05 | -3.38E+05 | -3.64E+05 | -3.05E+05 | -3.33E+05 | -4.85E+05 |
| **146.48** | 1.63E+07 | 4.18E+06 | -6.41E+06 | 1.79E+07 | 2.13E+07 | -8.84E+06 | 7.11E+06 | 2.19E+07 | -4.23E+05 | -4.39E+05 | -2.71E+05 | -2.87E+05 | -3.27E+05 | -4.30E+05 | -2.85E+05 | -2.99E+05 |
| **156.25** | 1.77E+07 | 2.81E+06 | -5.19E+06 | 1.93E+07 | 2.15E+07 | -8.28E+06 | 7.87E+06 | 2.12E+07 | -1.89E+05 | -4.92E+05 | -3.65E+05 | -2.42E+05 | -6.13E+05 | -3.07E+05 | -3.82E+05 | -2.59E+05 |
| **166.02** | 1.87E+07 | 3.05E+06 | -5.03E+06 | 2.01E+07 | 2.14E+07 | -8.64E+06 | 7.70E+06 | 2.27E+07 | -2.21E+05 | -4.36E+05 | -3.24E+05 | -7.50E+05 | -3.07E+05 | -4.45E+05 | -3.06E+05 | -6.87E+05 |
| **175.78** | 1.55E+07 | 8.50E+06 | 6.94E+05 | 1.40E+07 | 2.12E+07 | -6.57E+06 | 8.87E+06 | 1.99E+07 | -3.46E+05 | -3.83E+05 | -3.67E+05 | -2.64E+05 | -2.87E+05 | -3.93E+05 | -3.05E+05 | -4.26E+05 |
| **185.55** | 2.16E+07 | 4.64E+05 | -5.21E+06 | 2.73E+07 | 2.18E+07 | -8.32E+06 | 6.46E+06 | 2.59E+07 | -1.82E+05 | -3.12E+05 | -2.62E+05 | -3.16E+05 | -2.44E+05 | -2.59E+05 | -2.71E+05 | -2.95E+05 |
| **195.31** | 2.18E+07 | 9.70E+05 | -4.82E+06 | 2.43E+07 | 2.18E+07 | -7.79E+06 | 7.88E+06 | 2.30E+07 | -2.69E+05 | -2.78E+05 | -2.68E+05 | -2.45E+05 | -1.63E+05 | -3.67E+05 | -2.15E+05 | -2.34E+05 |
| **205.08** | 2.26E+07 | 3.64E+05 | -5.27E+06 | 2.40E+07 | 2.26E+07 | -8.31E+06 | 7.81E+06 | 2.27E+07 | -2.54E+05 | -4.37E+05 | -3.68E+05 | -5.39E+05 | -2.44E+05 | -4.14E+05 | -2.95E+05 | -6.22E+05 |
| **214.84** | 2.35E+07 | 7.56E+05 | -3.73E+06 | 2.58E+07 | 2.32E+07 | -7.51E+06 | 7.59E+06 | 2.29E+07 | -2.23E+05 | -2.37E+05 | -1.49E+05 | -3.02E+05 | -1.95E+05 | -3.75E+05 | -2.12E+05 | -2.79E+05 |
| **224.61** | 2.47E+07 | -3.03E+04 | -3.40E+06 | 2.70E+07 | 2.30E+07 | -7.20E+06 | 7.10E+06 | 2.29E+07 | -1.85E+05 | -1.58E+05 | -1.68E+05 | -2.13E+05 | -1.86E+05 | -2.36E+05 | -2.57E+05 | -2.08E+05 |
| **234.38** | 2.56E+07 | -3.38E+05 | -3.92E+06 | 2.79E+07 | 2.28E+07 | -6.61E+06 | 7.99E+06 | 2.24E+07 | -2.19E+05 | -2.56E+05 | -3.16E+05 | -2.50E+05 | -2.30E+05 | -2.80E+05 | -2.58E+05 | -3.47E+05 |
| **244.14** | 2.67E+07 | -4.56E+05 | -2.28E+06 | 2.84E+07 | 2.26E+07 | -6.48E+06 | 7.25E+06 | 2.24E+07 | -1.80E+05 | -1.76E+05 | -9.71E+04 | -2.24E+05 | -1.44E+05 | -2.73E+05 | -2.69E+05 | -1.70E+05 |
| **253.91** | 2.65E+07 | -5.28E+04 | -2.75E+06 | 2.97E+07 | 2.19E+07 | -5.33E+06 | 7.53E+06 | 2.15E+07 | -4.28E+05 | -9.79E+05 | -2.48E+05 | -3.70E+05 | -5.72E+05 | -8.89E+05 | -2.23E+05 | -3.63E+05 |
| **263.67** | 2.93E+07 | -1.32E+06 | -3.45E+06 | 3.04E+07 | 2.16E+07 | -5.40E+06 | 7.33E+06 | 2.10E+07 | -2.92E+05 | -3.12E+05 | -1.75E+05 | -2.41E+05 | -2.65E+05 | -3.79E+05 | -2.14E+05 | -2.63E+05 |
| **273.44** | 2.84E+07 | -1.39E+05 | -2.65E+06 | 2.97E+07 | 2.13E+07 | -4.05E+06 | 7.22E+06 | 2.00E+07 | -3.28E+05 | -3.44E+05 | -2.79E+05 | -3.23E+05 | -2.74E+05 | -2.81E+05 | -2.22E+05 | -3.56E+05 |
| **283.20** | 2.98E+07 | -1.66E+05 | -2.42E+06 | 3.07E+07 | 2.27E+07 | -5.28E+06 | 6.80E+06 | 2.06E+07 | -1.85E+05 | -2.77E+05 | -1.66E+05 | -2.20E+05 | -1.71E+05 | -2.48E+05 | -2.18E+05 | -3.02E+05 |
| **292.97** | 3.13E+07 | -4.34E+05 | -3.00E+06 | 3.15E+07 | 2.23E+07 | -4.47E+06 | 6.84E+06 | 2.03E+07 | -2.59E+05 | -3.74E+05 | -2.25E+05 | -2.29E+05 | -2.53E+05 | -3.62E+05 | -2.03E+05 | -2.26E+05 |
| **302.73** | 3.13E+07 | -5.20E+05 | -2.47E+06 | 3.16E+07 | 2.19E+07 | -3.85E+06 | 7.52E+06 | 1.91E+07 | -3.08E+05 | -3.50E+05 | -2.74E+05 | -2.34E+05 | -3.33E+05 | -3.26E+05 | -1.94E+05 | -3.41E+05 |
| **312.50** | 3.26E+07 | 1.06E+06 | -2.23E+06 | 3.10E+07 | 2.15E+07 | -4.70E+06 | 6.82E+06 | 1.99E+07 | -3.03E+05 | -3.83E+05 | -2.45E+05 | -2.52E+05 | -2.91E+05 | -3.75E+05 | -2.96E+05 | -2.34E+05 |
| **322.27** | 3.39E+07 | -1.03E+06 | -2.37E+06 | 3.23E+07 | 2.23E+07 | -4.89E+06 | 5.91E+06 | 2.10E+07 | -6.19E+05 | -3.98E+05 | -2.82E+05 | -4.64E+05 | -3.15E+05 | -3.27E+05 | -3.61E+05 | -2.77E+05 |
| **332.03** | 3.59E+07 | 6.62E+05 | -6.46E+05 | 3.54E+07 | 2.69E+07 | 1.00E+06 | 4.49E+06 | 1.76E+07 | -2.12E+06 | -1.81E+06 | -1.25E+06 | -1.64E+06 | -1.03E+06 | -1.80E+06 | -1.19E+06 | -9.96E+05 |
| **341.80** | 3.13E+07 | -2.82E+06 | -3.70E+06 | 3.24E+07 | 1.70E+07 | -6.34E+06 | 1.14E+07 | 2.18E+07 | -8.73E+05 | -5.03E+05 | -7.15E+05 | -4.83E+05 | -1.18E+06 | -9.70E+05 | -3.37E+05 | -3.81E+05 |

## Table A13. 60% PR, $\omega$ = 10,200 RPM, and medium-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *f* | *Re Hxx* | *Re Hxy* | *Re Hyx* | *Re Hyy* | *Im Hxx* | *Im Hxy* | *Im Hyx* | *Im Hyy* | *Re eHxx* | *Re eHxy* | *Re eHyx* | *Re eHyy* | *Im eHxx* | *Im eHxy* | *Im eHyx* | *Im eHyy* |
| **9.77** | 6.43E+05 | 2.31E+06 | -2.17E+06 | 1.86E+06 | 2.20E+06 | -5.36E+05 | 1.52E+05 | 2.40E+06 | -4.17E+05 | -1.36E+05 | -3.21E+05 | -1.85E+05 | -3.10E+05 | -2.24E+05 | -3.14E+05 | -2.40E+05 |
| **19.53** | 1.34E+06 | 2.39E+06 | -2.72E+06 | 2.55E+06 | 4.62E+06 | -7.90E+05 | 5.24E+05 | 4.28E+06 | -3.24E+05 | -1.58E+05 | -3.33E+05 | -1.69E+05 | -3.01E+05 | -1.96E+05 | -3.29E+05 | -2.11E+05 |
| **29.30** | 1.69E+06 | 1.92E+06 | -2.31E+06 | 2.66E+06 | 6.53E+06 | -1.69E+06 | 7.26E+05 | 6.88E+06 | -2.56E+05 | -2.33E+05 | -3.28E+05 | -4.29E+05 | -3.43E+05 | -3.52E+05 | -2.47E+05 | -1.57E+05 |
| **39.06** | 2.31E+06 | 1.96E+06 | -2.29E+06 | 3.55E+06 | 8.08E+06 | -1.70E+06 | 1.08E+06 | 8.37E+06 | -3.04E+05 | -3.46E+05 | -2.15E+05 | -3.99E+05 | -2.94E+05 | -3.42E+05 | -3.74E+05 | -3.58E+05 |
| **48.83** | 3.34E+06 | 1.72E+06 | -1.89E+06 | 4.23E+06 | 9.97E+06 | -1.90E+06 | 1.17E+06 | 9.56E+06 | -2.14E+05 | -2.76E+05 | -3.97E+05 | -2.27E+05 | -3.28E+05 | -2.59E+05 | -4.17E+05 | -2.88E+05 |
| **58.59** | 4.31E+06 | 1.21E+06 | -1.75E+06 | 4.77E+06 | 1.12E+07 | -2.23E+06 | 1.69E+06 | 1.19E+07 | -2.03E+05 | -1.27E+05 | -3.57E+05 | -3.79E+05 | -3.44E+05 | -2.17E+05 | -3.31E+05 | -2.32E+05 |
| **68.36** | 4.97E+06 | 1.62E+06 | -1.75E+06 | 7.25E+06 | 1.32E+07 | -2.61E+06 | 1.05E+06 | 1.44E+07 | -3.60E+05 | -4.15E+05 | -4.73E+05 | -7.16E+05 | -3.23E+05 | -4.60E+05 | -7.80E+05 | -7.86E+05 |
| **78.13** | 6.07E+06 | 1.27E+06 | -9.58E+05 | 7.25E+06 | 1.46E+07 | -2.55E+06 | 1.12E+06 | 1.57E+07 | -3.58E+05 | -3.33E+05 | -3.20E+05 | -2.45E+05 | -4.29E+05 | -2.80E+05 | -3.22E+05 | -3.01E+05 |
| **87.89** | 6.87E+06 | 6.42E+05 | -1.28E+06 | 8.12E+06 | 1.57E+07 | -2.78E+06 | 1.92E+06 | 1.66E+07 | -2.21E+05 | -1.85E+05 | -1.50E+05 | -2.61E+05 | -1.88E+05 | -2.82E+05 | -2.25E+05 | -2.98E+05 |
| **97.66** | 8.00E+06 | 2.95E+05 | -1.32E+06 | 9.29E+06 | 1.73E+07 | -3.17E+06 | 1.63E+06 | 1.78E+07 | -2.01E+05 | -3.49E+05 | -3.93E+05 | -1.98E+05 | -3.68E+05 | -3.85E+05 | -5.27E+05 | -3.02E+05 |
| **107.42** | 8.91E+06 | 4.69E+05 | -1.36E+06 | 1.13E+07 | 1.86E+07 | -3.26E+06 | 1.69E+06 | 1.96E+07 | -4.00E+05 | -2.80E+05 | -2.87E+05 | -3.79E+05 | -4.13E+05 | -4.48E+05 | -7.47E+05 | -2.33E+05 |
| **117.19** | 1.05E+07 | -4.96E+05 | -5.96E+05 | 1.22E+07 | 1.92E+07 | -3.14E+06 | 1.86E+06 | 1.99E+07 | -3.55E+05 | -1.95E+05 | -3.48E+05 | -2.51E+05 | -3.62E+05 | -2.44E+05 | -4.78E+05 | -2.91E+05 |
| **126.95** | 1.20E+07 | -8.07E+05 | -5.42E+05 | 1.31E+07 | 1.99E+07 | -3.35E+06 | 1.55E+06 | 2.12E+07 | -3.37E+05 | -6.82E+05 | -2.87E+05 | -5.46E+05 | -2.94E+05 | -7.15E+05 | -3.62E+05 | -8.07E+05 |
| **136.72** | 1.21E+07 | -4.14E+05 | -3.61E+05 | 1.45E+07 | 2.11E+07 | -3.43E+06 | 2.00E+06 | 2.14E+07 | -3.17E+05 | -6.36E+05 | -5.39E+05 | -6.33E+05 | -6.15E+05 | -3.30E+05 | -3.50E+05 | -4.03E+05 |
| **146.48** | 1.39E+07 | -1.50E+06 | -1.37E+05 | 1.55E+07 | 2.20E+07 | -3.37E+06 | 1.50E+06 | 2.17E+07 | -1.82E+05 | -8.29E+05 | -6.65E+05 | -9.72E+05 | -8.19E+05 | -8.10E+05 | -4.37E+05 | -3.34E+05 |
| **156.25** | 1.44E+07 | -1.13E+06 | 5.55E+05 | 1.67E+07 | 2.37E+07 | -3.12E+06 | 2.02E+06 | 2.23E+07 | -5.55E+05 | -1.41E+06 | -1.66E+06 | -1.47E+06 | -2.02E+06 | -1.22E+06 | -7.29E+05 | -9.30E+05 |
| **166.02** | 1.34E+07 | -1.36E+07 | -7.86E+06 | 1.12E+07 | 1.30E+07 | -1.45E+07 | 6.92E+06 | 3.71E+07 | -3.69E+06 | -1.42E+07 | -6.75E+06 | -1.23E+07 | -7.25E+06 | -1.25E+07 | -2.32E+06 | -1.09E+07 |
| **175.78** | 1.54E+07 | 2.46E+06 | 8.68E+06 | 1.75E+07 | 2.75E+07 | 4.63E+06 | 9.68E+05 | 2.09E+07 | -2.65E+06 | -2.70E+06 | -2.92E+06 | -4.54E+06 | -4.15E+06 | -4.96E+06 | -3.27E+06 | -1.18E+06 |
| **185.55** | 2.04E+07 | -2.88E+06 | -3.45E+05 | 2.47E+07 | 2.39E+07 | -3.89E+06 | -3.27E+05 | 3.03E+07 | -1.37E+06 | -7.70E+05 | -6.93E+05 | -1.68E+06 | -2.59E+05 | -1.89E+06 | -1.33E+06 | -1.29E+06 |
| **195.31** | 2.00E+07 | -2.68E+06 | -4.18E+05 | 2.16E+07 | 2.43E+07 | -3.17E+06 | 2.46E+06 | 2.48E+07 | -8.07E+05 | -5.58E+05 | -6.86E+05 | -3.68E+05 | -6.61E+05 | -6.94E+05 | -2.87E+05 | -7.35E+05 |
| **205.08** | 2.03E+07 | -2.61E+06 | -3.32E+05 | 2.19E+07 | 2.50E+07 | -1.93E+06 | 2.02E+06 | 2.40E+07 | -7.20E+05 | -6.76E+05 | -7.39E+05 | -1.01E+06 | -9.20E+05 | -1.52E+06 | -2.75E+05 | -7.55E+05 |
| **214.84** | 2.16E+07 | -2.67E+06 | -1.86E+05 | 2.37E+07 | 2.49E+07 | -2.24E+06 | 2.53E+06 | 2.54E+07 | -4.82E+05 | -6.13E+05 | -4.52E+05 | -3.78E+05 | -4.99E+05 | -3.51E+05 | -2.11E+05 | -5.47E+05 |
| **224.61** | 2.25E+07 | -2.84E+06 | 3.70E+05 | 2.48E+07 | 2.51E+07 | -2.18E+06 | 2.81E+06 | 2.54E+07 | -4.81E+05 | -2.21E+05 | -1.68E+05 | -2.73E+05 | -3.57E+05 | -3.91E+05 | -3.99E+05 | -2.93E+05 |
| **234.38** | 2.33E+07 | -3.21E+06 | 6.75E+05 | 2.53E+07 | 2.62E+07 | -2.27E+06 | 2.83E+06 | 2.63E+07 | -3.91E+05 | -4.51E+05 | -2.14E+05 | -3.51E+05 | -2.70E+05 | -3.72E+05 | -3.86E+05 | -3.14E+05 |
| **244.14** | 2.52E+07 | -3.22E+06 | 1.08E+06 | 2.71E+07 | 2.62E+07 | -2.40E+06 | 1.77E+06 | 2.65E+07 | -4.37E+05 | -1.78E+05 | -1.44E+05 | -2.64E+05 | -2.11E+05 | -3.74E+05 | -3.15E+05 | -2.76E+05 |
| **253.91** | 2.56E+07 | -2.83E+06 | 3.37E+05 | 2.87E+07 | 2.57E+07 | -1.19E+06 | 2.16E+06 | 2.55E+07 | -6.05E+05 | -1.07E+06 | -2.67E+05 | -4.30E+05 | -6.10E+05 | -9.78E+05 | -2.14E+05 | -3.35E+05 |
| **263.67** | 2.82E+07 | -4.15E+06 | 2.12E+05 | 2.94E+07 | 2.56E+07 | -1.23E+06 | 2.30E+06 | 2.53E+07 | -4.87E+05 | -5.18E+05 | -4.15E+05 | -2.73E+05 | -4.85E+05 | -5.81E+05 | -1.96E+05 | -2.92E+05 |
| **273.44** | 2.73E+07 | -3.30E+06 | 5.16E+05 | 3.00E+07 | 2.47E+07 | -3.44E+04 | 2.36E+06 | 2.39E+07 | -3.03E+05 | -3.45E+05 | -3.03E+05 | -2.46E+05 | -3.48E+05 | -3.70E+05 | -2.60E+05 | -4.13E+05 |
| **283.20** | 2.84E+07 | -2.97E+06 | -6.14E+04 | 3.03E+07 | 2.62E+07 | -1.18E+06 | 2.25E+06 | 2.45E+07 | -3.07E+05 | -3.54E+05 | -1.83E+05 | -3.49E+05 | -3.22E+05 | -3.44E+05 | -2.68E+05 | -2.45E+05 |
| **292.97** | 3.01E+07 | -4.09E+06 | -4.68E+05 | 3.12E+07 | 2.61E+07 | -1.04E+06 | 2.22E+06 | 2.45E+07 | -2.96E+05 | -4.09E+05 | -1.87E+05 | -2.18E+05 | -3.42E+05 | -3.01E+05 | -2.13E+05 | -1.73E+05 |
| **302.73** | 3.13E+07 | -3.79E+06 | -4.38E+05 | 3.24E+07 | 2.56E+07 | 2.45E+05 | 2.55E+06 | 2.38E+07 | -3.71E+05 | -4.31E+05 | -1.35E+05 | -1.99E+05 | -2.07E+05 | -3.24E+05 | -2.20E+05 | -1.85E+05 |
| **312.50** | 3.20E+07 | -2.70E+06 | 6.08E+05 | 3.11E+07 | 2.58E+07 | 2.09E+05 | 3.65E+06 | 2.31E+07 | -4.55E+05 | -2.94E+05 | -2.15E+05 | -2.39E+05 | -2.65E+05 | -4.91E+05 | -3.00E+05 | -2.14E+05 |
| **322.27** | 3.35E+07 | -2.63E+06 | 6.17E+04 | 3.22E+07 | 2.55E+07 | 1.60E+05 | 1.41E+06 | 2.44E+07 | -4.03E+05 | -3.15E+05 | -2.82E+05 | -3.01E+05 | -4.15E+05 | -4.23E+05 | -2.41E+05 | -2.87E+05 |
| **332.03** | 3.42E+07 | -3.59E+06 | -1.26E+06 | 3.28E+07 | 2.52E+07 | -5.22E+05 | 2.51E+06 | 2.37E+07 | -3.74E+05 | -3.32E+05 | -3.01E+05 | -2.44E+05 | -4.24E+05 | -4.73E+05 | -2.57E+05 | -2.87E+05 |
| **341.80** | 3.48E+07 | -3.17E+06 | -5.22E+05 | 3.27E+07 | 2.41E+07 | -1.75E+05 | 4.27E+06 | 2.34E+07 | -3.14E+05 | -2.14E+05 | -2.13E+05 | -2.00E+05 | -4.57E+05 | -5.47E+05 | -2.95E+05 | -2.38E+05 |

## Table A14. 60% PR, $\omega$ = 15,350 RPM, and medium-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *f* | *Re Hxx* | *Re Hxy* | *Re Hyx* | *Re Hyy* | *Im Hxx* | *Im Hxy* | *Im Hyx* | *Im Hyy* | *Re eHxx* | *Re eHxy* | *Re eHyx* | *Re eHyy* | *Im eHxx* | *Im eHxy* | *Im eHyx* | *Im eHyy* |
| **9.77** | 5.90E+05 | 7.89E+06 | -8.02E+06 | 1.28E+06 | 2.35E+06 | -8.35E+05 | 5.88E+05 | 2.52E+06 | -3.62E+05 | -3.31E+05 | -3.65E+05 | -2.21E+05 | -3.49E+05 | -2.48E+05 | -4.01E+05 | -1.89E+05 |
| **19.53** | 1.52E+06 | 7.34E+06 | -8.33E+06 | 1.76E+06 | 4.79E+06 | -1.59E+06 | 8.50E+05 | 4.74E+06 | -3.17E+05 | -2.63E+05 | -4.73E+05 | -2.57E+05 | -2.53E+05 | -1.76E+05 | -3.79E+05 | -2.37E+05 |
| **29.30** | 1.89E+06 | 7.40E+06 | -7.81E+06 | 2.42E+06 | 6.65E+06 | -2.00E+06 | 2.08E+06 | 7.25E+06 | -3.36E+05 | -3.89E+05 | -3.89E+05 | -2.94E+05 | -3.22E+05 | -2.17E+05 | -2.64E+05 | -2.81E+05 |
| **39.06** | 3.08E+06 | 6.98E+06 | -7.72E+06 | 3.39E+06 | 9.07E+06 | -3.08E+06 | 3.10E+06 | 9.23E+06 | -3.69E+05 | -3.99E+05 | -3.52E+05 | -3.67E+05 | -3.13E+05 | -2.88E+05 | -2.62E+05 | -4.79E+05 |
| **48.83** | 3.59E+06 | 6.53E+06 | -6.88E+06 | 4.18E+06 | 9.87E+06 | -3.23E+06 | 3.15E+06 | 1.06E+07 | -3.72E+05 | -2.65E+05 | -4.61E+05 | -2.99E+05 | -4.30E+05 | -2.20E+05 | -2.81E+05 | -1.80E+05 |
| **58.59** | 4.76E+06 | 6.09E+06 | -6.96E+06 | 5.03E+06 | 1.14E+07 | -3.62E+06 | 3.24E+06 | 1.26E+07 | -3.80E+05 | -3.05E+05 | -3.11E+05 | -4.06E+05 | -3.08E+05 | -2.13E+05 | -4.66E+05 | -2.76E+05 |
| **68.36** | 5.89E+06 | 5.72E+06 | -6.28E+06 | 5.16E+06 | 1.33E+07 | -5.08E+06 | 2.47E+06 | 1.55E+07 | -5.11E+05 | -5.26E+05 | -7.52E+05 | -6.16E+05 | -4.46E+05 | -6.19E+05 | -4.53E+05 | -8.29E+05 |
| **78.13** | 6.47E+06 | 5.21E+06 | -5.44E+06 | 7.47E+06 | 1.46E+07 | -4.67E+06 | 3.68E+06 | 1.52E+07 | -2.48E+05 | -2.80E+05 | -2.77E+05 | -3.40E+05 | -3.59E+05 | -3.23E+05 | -3.43E+05 | -2.48E+05 |
| **87.89** | 7.77E+06 | 4.98E+06 | -5.37E+06 | 8.70E+06 | 1.61E+07 | -5.06E+06 | 4.10E+06 | 1.69E+07 | -2.81E+05 | -1.06E+05 | -2.87E+05 | -2.32E+05 | -2.95E+05 | -3.07E+05 | -2.32E+05 | -1.76E+05 |
| **97.66** | 8.92E+06 | 4.44E+06 | -5.11E+06 | 9.91E+06 | 1.72E+07 | -5.34E+06 | 3.20E+06 | 1.84E+07 | -4.24E+05 | -2.87E+05 | -3.52E+05 | -4.15E+05 | -2.88E+05 | -2.36E+05 | -3.40E+05 | -2.99E+05 |
| **107.42** | 9.90E+06 | 3.86E+06 | -4.78E+06 | 1.09E+07 | 1.81E+07 | -5.94E+06 | 4.17E+06 | 1.94E+07 | -3.82E+05 | -2.21E+05 | -4.54E+05 | -2.26E+05 | -2.94E+05 | -1.88E+05 | -2.28E+05 | -3.56E+05 |
| **117.19** | 1.18E+07 | 2.83E+06 | -4.74E+06 | 1.28E+07 | 1.93E+07 | -5.27E+06 | 4.17E+06 | 2.06E+07 | -2.62E+05 | -1.74E+05 | -3.42E+05 | -3.17E+05 | -2.93E+05 | -2.81E+05 | -3.54E+05 | -2.45E+05 |
| **126.95** | 1.25E+07 | 1.53E+06 | -4.18E+06 | 1.46E+07 | 1.93E+07 | -5.11E+06 | 4.44E+06 | 2.12E+07 | -3.85E+05 | -7.67E+05 | -3.14E+05 | -6.46E+05 | -3.70E+05 | -3.91E+05 | -4.04E+05 | -5.22E+05 |
| **136.72** | 1.38E+07 | 2.13E+06 | -4.22E+06 | 1.58E+07 | 2.06E+07 | -5.89E+06 | 4.20E+06 | 2.18E+07 | -2.72E+05 | -3.38E+05 | -2.59E+05 | -2.34E+05 | -2.35E+05 | -4.73E+05 | -1.77E+05 | -3.63E+05 |
| **146.48** | 1.46E+07 | 2.03E+06 | -3.62E+06 | 1.70E+07 | 2.19E+07 | -5.56E+06 | 4.38E+06 | 2.15E+07 | -1.81E+05 | -4.70E+05 | -3.15E+05 | -2.92E+05 | -3.77E+05 | -4.69E+05 | -3.15E+05 | -3.63E+05 |
| **156.25** | 1.61E+07 | 1.48E+06 | -3.35E+06 | 1.75E+07 | 2.15E+07 | -5.40E+06 | 4.49E+06 | 2.23E+07 | -3.49E+05 | -2.54E+05 | -3.48E+05 | -3.06E+05 | -5.56E+05 | -2.23E+05 | -1.98E+05 | -4.25E+05 |
| **166.02** | 1.69E+07 | 5.17E+05 | -3.15E+06 | 1.96E+07 | 2.21E+07 | -4.56E+06 | 4.73E+06 | 2.19E+07 | -2.10E+05 | -2.10E+05 | -2.56E+05 | -5.54E+05 | -8.90E+04 | -5.78E+05 | -2.94E+05 | -6.66E+05 |
| **175.78** | 1.36E+07 | 6.67E+06 | 2.16E+06 | 1.36E+07 | 2.20E+07 | -3.59E+06 | 5.62E+06 | 2.09E+07 | -4.05E+05 | -2.76E+05 | -3.46E+05 | -4.04E+05 | -2.48E+05 | -2.83E+05 | -3.09E+05 | -2.74E+05 |
| **185.55** | 2.06E+07 | 1.52E+06 | -4.19E+06 | 1.63E+07 | 2.34E+07 | -6.76E+06 | 4.72E+06 | 3.14E+07 | -2.09E+05 | -4.84E+05 | -3.17E+05 | -5.07E+05 | -2.82E+05 | -3.28E+05 | -2.62E+05 | -7.85E+05 |
| **195.31** | 2.13E+07 | 1.74E+05 | -3.47E+06 | 2.24E+07 | 2.36E+07 | -5.23E+06 | 4.84E+06 | 2.40E+07 | -2.32E+05 | -3.23E+05 | -2.08E+05 | -4.04E+05 | -2.73E+05 | -2.68E+05 | -3.25E+05 | -4.30E+05 |
| **205.08** | 2.09E+07 | -5.04E+05 | -3.23E+06 | 2.24E+07 | 2.37E+07 | -5.75E+06 | 4.75E+06 | 2.41E+07 | -2.60E+05 | -5.98E+05 | -3.92E+05 | -9.69E+05 | -3.45E+05 | -5.40E+05 | -4.16E+05 | -5.99E+05 |
| **214.84** | 2.24E+07 | -4.11E+05 | -2.29E+06 | 2.43E+07 | 2.44E+07 | -4.95E+06 | 5.22E+06 | 2.46E+07 | -2.80E+05 | -3.40E+05 | -1.49E+05 | -3.50E+05 | -2.00E+05 | -4.39E+05 | -1.66E+05 | -3.93E+05 |
| **224.61** | 2.39E+07 | -1.51E+06 | -2.52E+06 | 2.63E+07 | 2.44E+07 | -4.62E+06 | 4.45E+06 | 2.44E+07 | -2.19E+05 | -3.46E+05 | -2.38E+05 | -2.72E+05 | -3.79E+05 | -3.67E+05 | -2.94E+05 | -2.85E+05 |
| **234.38** | 2.46E+07 | -1.48E+06 | -2.47E+06 | 2.69E+07 | 2.57E+07 | -3.74E+06 | 5.84E+06 | 2.46E+07 | -2.71E+05 | -5.92E+05 | -2.33E+05 | -5.34E+05 | -2.13E+05 | -6.87E+05 | -1.60E+05 | -4.38E+05 |
| **244.14** | 2.63E+07 | -1.16E+06 | -7.86E+05 | 2.77E+07 | 2.48E+07 | -4.09E+06 | 4.20E+06 | 2.45E+07 | -2.79E+05 | -8.41E+05 | -4.13E+05 | -6.50E+05 | -3.26E+05 | -8.51E+05 | -3.11E+05 | -8.74E+05 |
| **253.91** | 2.62E+07 | -8.01E+05 | 1.62E+06 | 2.76E+07 | 2.89E+07 | -5.45E+06 | 2.46E+06 | 2.45E+07 | -1.96E+06 | -6.60E+06 | -2.52E+06 | -4.94E+06 | -3.21E+06 | -7.02E+06 | -1.38E+06 | -5.69E+06 |
| **263.67** | 2.95E+07 | -2.46E+06 | -2.36E+06 | 2.96E+07 | 2.48E+07 | -2.93E+06 | 4.00E+06 | 2.34E+07 | -5.11E+05 | -1.55E+06 | -2.42E+05 | -1.20E+06 | -4.59E+05 | -1.55E+06 | -5.46E+05 | -1.23E+06 |
| **273.44** | 2.81E+07 | -1.31E+06 | -1.95E+06 | 2.97E+07 | 2.35E+07 | -1.68E+06 | 4.53E+06 | 2.28E+07 | -4.13E+05 | -7.94E+05 | -1.91E+05 | -6.41E+05 | -2.58E+05 | -8.95E+05 | -2.93E+05 | -6.47E+05 |
| **283.20** | 2.84E+07 | -1.43E+06 | -1.40E+06 | 3.00E+07 | 2.49E+07 | -3.09E+06 | 4.91E+06 | 2.30E+07 | -2.66E+05 | -5.86E+05 | -2.07E+05 | -4.43E+05 | -2.07E+05 | -5.63E+05 | -2.49E+05 | -4.37E+05 |
| **292.97** | 3.00E+07 | -1.53E+06 | -1.86E+06 | 3.08E+07 | 2.56E+07 | -3.33E+06 | 4.14E+06 | 2.34E+07 | -2.29E+05 | -5.60E+05 | -2.85E+05 | -3.80E+05 | -2.79E+05 | -3.77E+05 | -2.20E+05 | -3.12E+05 |
| **302.73** | 3.11E+07 | -1.35E+06 | -2.44E+06 | 3.12E+07 | 2.43E+07 | -2.55E+06 | 5.42E+06 | 2.23E+07 | -2.95E+05 | -3.45E+05 | -2.02E+05 | -2.67E+05 | -3.22E+05 | -4.10E+05 | -1.57E+05 | -3.46E+05 |
| **312.50** | 3.20E+07 | -7.93E+05 | -1.21E+06 | 3.11E+07 | 2.51E+07 | -2.65E+06 | 4.79E+06 | 2.30E+07 | -3.07E+05 | -2.86E+05 | -2.42E+05 | -2.57E+05 | -2.85E+05 | -3.39E+05 | -2.72E+05 | -3.57E+05 |
| **322.27** | 3.30E+07 | -1.22E+06 | -1.82E+06 | 3.20E+07 | 2.42E+07 | -2.27E+06 | 3.93E+06 | 2.34E+07 | -3.63E+05 | -2.44E+05 | -3.46E+05 | -3.13E+05 | -3.08E+05 | -4.04E+05 | -2.98E+05 | -2.85E+05 |
| **332.03** | 3.42E+07 | -1.49E+06 | -3.17E+06 | 3.21E+07 | 2.39E+07 | -2.77E+06 | 5.22E+06 | 2.32E+07 | -4.15E+05 | -3.69E+05 | -2.42E+05 | -2.80E+05 | -2.73E+05 | -4.27E+05 | -3.55E+05 | -4.08E+05 |
| **341.80** | 3.49E+07 | -1.02E+06 | -2.38E+06 | 3.31E+07 | 2.41E+07 | -2.25E+06 | 6.85E+06 | 2.30E+07 | -2.36E+05 | -2.73E+05 | -2.15E+05 | -2.03E+05 | -2.90E+05 | -4.10E+05 | -3.81E+05 | -3.29E+05 |

### Table A15. 60% PR, $\omega$ = 20,200 RPM, and medium-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *f* | *Re Hxx* | *Re Hxy* | *Re Hyx* | *Re Hyy* | *Im Hxx* | *Im Hxy* | *Im Hyx* | *Im Hyy* | *Re eHxx* | *Re eHxy* | *Re eHyx* | *Re eHyy* | *Im eHxx* | *Im eHxy* | *Im eHyx* | *Im eHyy* |
| **9.77** | 6.48E+05 | 1.43E+07 | -1.50E+07 | 4.68E+05 | 2.81E+06 | -1.23E+06 | 1.11E+06 | 3.03E+06 | -5.49E+05 | -2.88E+05 | -6.77E+05 | -3.43E+05 | -4.70E+05 | -2.54E+05 | -4.92E+05 | -2.93E+05 |
| **19.53** | 1.63E+06 | 1.35E+07 | -1.46E+07 | 1.68E+06 | 4.85E+06 | -2.52E+06 | 2.16E+06 | 5.21E+06 | -3.65E+05 | -3.21E+05 | -3.57E+05 | -2.32E+05 | -4.86E+05 | -3.04E+05 | -3.17E+05 | -1.83E+05 |
| **29.30** | 2.52E+06 | 1.35E+07 | -1.44E+07 | 2.22E+06 | 7.09E+06 | -3.39E+06 | 3.55E+06 | 7.54E+06 | -4.08E+05 | -2.96E+05 | -4.31E+05 | -4.27E+05 | -3.61E+05 | -3.22E+05 | -3.71E+05 | -3.36E+05 |
| **39.06** | 3.52E+06 | 1.27E+07 | -1.37E+07 | 2.93E+06 | 9.26E+06 | -4.66E+06 | 3.69E+06 | 1.00E+07 | -2.93E+05 | -4.09E+05 | -3.64E+05 | -3.66E+05 | -4.70E+05 | -4.27E+05 | -3.82E+05 | -3.47E+05 |
| **48.83** | 4.65E+06 | 1.15E+07 | -1.30E+07 | 4.76E+06 | 1.03E+07 | -5.45E+06 | 5.04E+06 | 1.12E+07 | -1.44E+06 | -1.11E+06 | -4.98E+05 | -4.49E+05 | -1.63E+06 | -1.14E+06 | -4.19E+05 | -3.98E+05 |
| **58.59** | 5.37E+06 | 1.15E+07 | -1.21E+07 | 5.46E+06 | 1.23E+07 | -5.90E+06 | 5.47E+06 | 1.33E+07 | -2.82E+05 | -2.64E+05 | -4.36E+05 | -2.95E+05 | -3.40E+05 | -4.61E+05 | -4.80E+05 | -3.29E+05 |
| **68.36** | 6.35E+06 | 1.15E+07 | -1.12E+07 | 6.22E+06 | 1.42E+07 | -5.70E+06 | 4.82E+06 | 1.47E+07 | -4.75E+05 | -5.29E+05 | -5.03E+05 | -4.56E+05 | -4.37E+05 | -5.78E+05 | -3.41E+05 | -6.35E+05 |
| **78.13** | 7.31E+06 | 1.00E+07 | -1.06E+07 | 8.02E+06 | 1.46E+07 | -6.78E+06 | 6.31E+06 | 1.57E+07 | -2.14E+05 | -2.56E+05 | -2.25E+05 | -3.16E+05 | -3.15E+05 | -2.43E+05 | -3.68E+05 | -3.31E+05 |
| **87.89** | 8.94E+06 | 9.01E+06 | -1.07E+07 | 9.33E+06 | 1.61E+07 | -7.64E+06 | 6.76E+06 | 1.78E+07 | -2.54E+05 | -1.08E+05 | -2.89E+05 | -2.61E+05 | -2.00E+05 | -2.95E+05 | -2.97E+05 | -2.48E+05 |
| **97.66** | 1.01E+07 | 8.60E+06 | -1.03E+07 | 1.03E+07 | 1.76E+07 | -8.05E+06 | 5.77E+06 | 1.90E+07 | -4.23E+05 | -3.15E+05 | -4.77E+05 | -3.00E+05 | -4.23E+05 | -3.08E+05 | -4.21E+05 | -5.65E+05 |
| **107.42** | 1.13E+07 | 7.71E+06 | -1.01E+07 | 1.25E+07 | 1.83E+07 | -8.68E+06 | 8.31E+06 | 2.02E+07 | -3.28E+05 | -3.71E+05 | -4.91E+05 | -3.34E+05 | -4.43E+05 | -2.38E+05 | -6.41E+05 | -5.29E+05 |
| **117.19** | 1.30E+07 | 6.62E+06 | -8.89E+06 | 1.38E+07 | 1.92E+07 | -8.54E+06 | 7.84E+06 | 2.07E+07 | -3.54E+05 | -2.50E+05 | -3.17E+05 | -3.38E+05 | -1.77E+05 | -2.18E+05 | -3.26E+05 | -1.96E+05 |
| **126.95** | 1.39E+07 | 6.35E+06 | -7.82E+06 | 1.57E+07 | 1.98E+07 | -8.41E+06 | 7.79E+06 | 2.10E+07 | -2.50E+05 | -8.14E+05 | -3.49E+05 | -7.12E+05 | -4.01E+05 | -3.68E+05 | -4.20E+05 | -5.55E+05 |
| **136.72** | 1.42E+07 | 5.75E+06 | -7.34E+06 | 1.65E+07 | 2.02E+07 | -8.04E+06 | 7.71E+06 | 2.19E+07 | -2.20E+05 | -4.81E+05 | -3.29E+05 | -2.82E+05 | -2.97E+05 | -2.30E+05 | -2.42E+05 | -2.41E+05 |
| **146.48** | 1.61E+07 | 4.74E+06 | -6.91E+06 | 1.78E+07 | 2.09E+07 | -7.87E+06 | 7.08E+06 | 2.21E+07 | -3.58E+05 | -5.09E+05 | -3.74E+05 | -3.78E+05 | -3.29E+05 | -4.17E+05 | -2.41E+05 | -5.08E+05 |
| **156.25** | 1.66E+07 | 4.63E+06 | -6.44E+06 | 1.86E+07 | 2.19E+07 | -8.44E+06 | 7.70E+06 | 2.25E+07 | -3.28E+05 | -3.41E+05 | -5.00E+05 | -2.89E+05 | -5.50E+05 | -2.92E+05 | -3.86E+05 | -3.49E+05 |
| **166.02** | 1.77E+07 | 4.25E+06 | -6.27E+06 | 2.05E+07 | 2.19E+07 | -7.43E+06 | 7.59E+06 | 2.28E+07 | -2.45E+05 | -3.67E+05 | -3.00E+05 | -4.82E+05 | -3.28E+05 | -4.84E+05 | -2.56E+05 | -4.98E+05 |
| **175.78** | 1.49E+07 | 9.40E+06 | -5.73E+05 | 1.38E+07 | 2.13E+07 | -6.21E+06 | 8.59E+06 | 2.06E+07 | -2.95E+05 | -4.18E+05 | -3.93E+05 | -3.81E+05 | -3.06E+05 | -3.50E+05 | -3.41E+05 | -2.55E+05 |
| **185.55** | 2.13E+07 | 2.53E+06 | -5.49E+06 | 2.51E+07 | 2.27E+07 | -8.27E+06 | 6.33E+06 | 2.47E+07 | -1.85E+05 | -2.16E+05 | -4.19E+05 | -4.65E+05 | -2.29E+05 | -2.30E+05 | -2.81E+05 | -3.65E+05 |
| **195.31** | 2.20E+07 | 2.13E+06 | -5.96E+06 | 2.36E+07 | 2.29E+07 | -8.18E+06 | 7.73E+06 | 2.36E+07 | -2.03E+05 | -2.12E+05 | -4.20E+05 | -2.70E+05 | -1.52E+05 | -1.91E+05 | -1.90E+05 | -2.44E+05 |
| **205.08** | 2.28E+07 | 9.03E+05 | -5.75E+06 | 2.41E+07 | 2.30E+07 | -7.93E+06 | 7.48E+06 | 2.36E+07 | -3.33E+05 | -5.90E+05 | -5.00E+05 | -4.53E+05 | -2.54E+05 | -5.28E+05 | -3.04E+05 | -6.85E+05 |
| **214.84** | 2.35E+07 | 1.72E+06 | -4.31E+06 | 2.52E+07 | 2.39E+07 | -7.95E+06 | 7.53E+06 | 2.38E+07 | -2.38E+05 | -2.31E+05 | -1.86E+05 | -1.91E+05 | -1.44E+05 | -3.23E+05 | -2.22E+05 | -2.71E+05 |
| **224.61** | 2.44E+07 | 1.15E+06 | -3.82E+06 | 2.65E+07 | 2.39E+07 | -7.59E+06 | 7.35E+06 | 2.40E+07 | -1.52E+05 | -1.26E+05 | -2.69E+05 | -2.07E+05 | -2.83E+05 | -2.83E+05 | -3.26E+05 | -2.24E+05 |
| **234.38** | 2.56E+07 | 3.66E+05 | -4.43E+06 | 2.73E+07 | 2.39E+07 | -7.05E+06 | 7.65E+06 | 2.40E+07 | -2.72E+05 | -2.34E+05 | -1.81E+05 | -3.00E+05 | -2.22E+05 | -3.28E+05 | -2.07E+05 | -3.23E+05 |
| **244.14** | 2.64E+07 | 2.99E+05 | -3.58E+06 | 2.80E+07 | 2.35E+07 | -7.00E+06 | 7.40E+06 | 2.38E+07 | -1.78E+05 | -1.72E+05 | -1.69E+05 | -3.21E+05 | -2.44E+05 | -3.69E+05 | -2.06E+05 | -2.55E+05 |
| **253.91** | 2.64E+07 | 5.59E+05 | -3.47E+06 | 2.96E+07 | 2.34E+07 | -5.89E+06 | 7.15E+06 | 2.34E+07 | -4.79E+05 | -1.10E+06 | -2.35E+05 | -3.84E+05 | -6.73E+05 | -8.95E+05 | -3.40E+05 | -3.57E+05 |
| **263.67** | 2.95E+07 | -7.35E+05 | -4.26E+06 | 3.03E+07 | 2.35E+07 | -5.24E+06 | 7.35E+06 | 2.30E+07 | -5.67E+05 | -4.84E+05 | -4.40E+05 | -4.36E+05 | -2.35E+05 | -6.14E+05 | -4.19E+05 | -3.68E+05 |
| **273.44** | 2.85E+07 | -2.91E+05 | -3.61E+06 | 3.08E+07 | 2.28E+07 | -4.34E+06 | 7.28E+06 | 2.21E+07 | -3.46E+05 | -3.66E+05 | -5.50E+05 | -3.95E+05 | -2.40E+05 | -3.44E+05 | -2.50E+05 | -5.94E+05 |
| **283.20** | 2.93E+07 | -8.61E+04 | -2.91E+06 | 3.13E+07 | 2.43E+07 | -5.17E+06 | 7.00E+06 | 2.15E+07 | -3.41E+05 | -4.48E+05 | -3.92E+05 | -3.44E+05 | -3.40E+05 | -5.25E+05 | -2.67E+05 | -4.40E+05 |
| **292.97** | 3.06E+07 | -3.37E+05 | -3.53E+06 | 3.12E+07 | 2.41E+07 | -5.35E+06 | 6.97E+06 | 2.25E+07 | -2.95E+05 | -5.10E+05 | -3.22E+05 | -2.45E+05 | -5.57E+05 | -5.07E+05 | -3.27E+05 | -2.86E+05 |
| **302.73** | 3.20E+07 | -3.55E+05 | -3.49E+06 | 3.17E+07 | 2.31E+07 | -4.33E+06 | 7.44E+06 | 2.12E+07 | -5.30E+05 | -6.74E+05 | -3.14E+05 | -5.97E+05 | -5.90E+05 | -7.32E+05 | -6.61E+05 | -3.83E+05 |
| **312.50** | 3.29E+07 | 4.77E+05 | -3.14E+06 | 3.16E+07 | 2.35E+07 | -4.66E+06 | 6.60E+06 | 2.21E+07 | -1.10E+06 | -7.27E+05 | -3.34E+05 | -6.43E+05 | -5.14E+05 | -1.05E+06 | -7.89E+05 | -5.39E+05 |
| **322.27** | 3.36E+07 | 3.46E+05 | -3.92E+06 | 3.22E+07 | 2.35E+07 | -4.36E+06 | 6.61E+06 | 2.21E+07 | -1.89E+06 | -1.18E+06 | -9.62E+05 | -9.78E+05 | -6.96E+05 | -1.28E+06 | -1.21E+06 | -1.01E+06 |
| **332.03** | 3.05E+07 | -1.86E+06 | -6.58E+06 | 3.22E+07 | 1.70E+07 | -6.34E+06 | 1.13E+07 | 2.29E+07 | -5.22E+06 | -4.85E+06 | -4.01E+06 | -3.33E+06 | -3.98E+06 | -5.04E+06 | -2.20E+06 | -3.40E+06 |
| **341.80** | 3.11E+07 | 5.19E+05 | -5.17E+06 | 3.14E+07 | 1.71E+07 | -7.04E+06 | 1.22E+07 | 2.22E+07 | -3.35E+06 | -2.96E+06 | -3.59E+06 | -1.75E+06 | -5.00E+06 | -2.81E+06 | -7.91E+05 | -1.78E+06 |

### Table A16. 70% PR, $\omega$ = 10,200 RPM, and medium-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *f* | *Re Hxx* | *Re Hxy* | *Re Hyx* | *Re Hyy* | *Im Hxx* | *Im Hxy* | *Im Hyx* | *Im Hyy* | *Re eHxx* | *Re eHxy* | *Re eHyx* | *Re eHyy* | *Im eHxx* | *Im eHxy* | *Im eHyx* | *Im eHyy* |
| **9.77** | 7.89E+05 | 2.63E+06 | -2.13E+06 | 1.69E+06 | 1.45E+06 | -1.10E+05 | 7.46E+05 | 1.83E+06 | -3.02E+05 | -1.63E+05 | -3.51E+05 | -1.29E+05 | -4.27E+05 | -1.61E+05 | -2.99E+05 | -2.00E+05 |
| **19.53** | 1.85E+06 | 2.38E+06 | -2.67E+06 | 1.85E+06 | 4.36E+06 | -7.73E+05 | 2.76E+04 | 4.23E+06 | -2.85E+05 | -1.30E+05 | -3.35E+05 | -1.71E+05 | -3.08E+05 | -1.91E+05 | -2.98E+05 | -1.87E+05 |
| **29.30** | 1.86E+06 | 2.40E+06 | -2.13E+06 | 2.63E+06 | 6.08E+06 | -1.32E+06 | 5.52E+05 | 6.02E+06 | -3.37E+05 | -1.68E+05 | -3.00E+05 | -2.68E+05 | -3.66E+05 | -3.35E+05 | -2.27E+05 | -2.75E+05 |
| **39.06** | 3.02E+06 | 2.40E+06 | -2.10E+06 | 3.01E+06 | 7.84E+06 | -1.40E+06 | 9.53E+05 | 7.86E+06 | -2.79E+05 | -3.16E+05 | -2.53E+05 | -2.13E+05 | -3.68E+05 | -2.55E+05 | -2.75E+05 | -3.10E+05 |
| **48.83** | 3.79E+06 | 1.83E+06 | -2.50E+06 | 3.75E+06 | 8.41E+06 | -1.43E+06 | 5.85E+05 | 9.74E+06 | -3.88E+05 | -3.58E+05 | -3.94E+05 | -2.58E+05 | -3.66E+05 | -4.07E+05 | -2.55E+05 | -2.22E+05 |
| **58.59** | 4.53E+06 | 1.58E+06 | -2.15E+06 | 4.02E+06 | 1.07E+07 | -1.89E+06 | 9.41E+05 | 1.15E+07 | -3.63E+05 | -3.54E+05 | -3.21E+05 | -3.58E+05 | -3.18E+05 | -3.29E+05 | -3.30E+05 | -2.24E+05 |
| **68.36** | 4.82E+06 | 1.49E+06 | -2.06E+06 | 5.69E+06 | 1.19E+07 | -2.49E+06 | 9.33E+05 | 1.28E+07 | -2.64E+05 | -2.79E+05 | -5.31E+05 | -4.06E+05 | -3.81E+05 | -3.06E+05 | -4.57E+05 | -5.48E+05 |
| **78.13** | 5.44E+06 | 1.58E+06 | -1.70E+06 | 6.06E+06 | 1.35E+07 | -2.26E+06 | 1.33E+06 | 1.46E+07 | -2.93E+05 | -2.13E+05 | -1.80E+05 | -2.83E+05 | -1.95E+05 | -2.36E+05 | -2.22E+05 | -2.00E+05 |
| **87.89** | 6.76E+06 | 1.22E+06 | -1.72E+06 | 7.06E+06 | 1.49E+07 | -2.73E+06 | 1.32E+06 | 1.62E+07 | -2.38E+05 | -1.78E+05 | -1.79E+05 | -2.43E+05 | -2.12E+05 | -2.61E+05 | -1.69E+05 | -2.29E+05 |
| **97.66** | 7.42E+06 | 9.82E+05 | -1.91E+06 | 8.28E+06 | 1.59E+07 | -2.60E+06 | 1.98E+06 | 1.69E+07 | -3.04E+05 | -2.08E+05 | -2.38E+05 | -2.76E+05 | -2.71E+05 | -1.89E+05 | -2.43E+05 | -2.90E+05 |
| **107.42** | 8.51E+06 | 7.48E+05 | -1.82E+06 | 9.47E+06 | 1.70E+07 | -3.40E+06 | 2.05E+06 | 1.86E+07 | -3.98E+05 | -3.27E+05 | -3.65E+05 | -2.30E+05 | -2.91E+05 | -3.45E+05 | -3.87E+05 | -2.59E+05 |
| **117.19** | 9.49E+06 | 3.20E+05 | -8.59E+05 | 1.06E+07 | 1.86E+07 | -3.03E+06 | 1.65E+06 | 1.96E+07 | -3.36E+05 | -1.30E+05 | -3.40E+05 | -1.63E+05 | -2.72E+05 | -2.59E+05 | -2.24E+05 | -1.93E+05 |
| **126.95** | 1.05E+07 | -3.35E+05 | -1.33E+06 | 1.20E+07 | 1.95E+07 | -3.14E+06 | 1.97E+06 | 1.99E+07 | -2.00E+05 | -5.84E+05 | -2.58E+05 | -4.32E+05 | -3.34E+05 | -4.58E+05 | -2.77E+05 | -3.32E+05 |
| **136.72** | 1.14E+07 | -4.23E+05 | -1.35E+06 | 1.29E+07 | 2.00E+07 | -3.17E+06 | 1.92E+06 | 2.09E+07 | -3.45E+05 | -2.89E+05 | -3.25E+05 | -3.41E+05 | -2.92E+05 | -3.39E+05 | -2.52E+05 | -2.53E+05 |
| **146.48** | 1.23E+07 | -2.70E+05 | -5.63E+05 | 1.34E+07 | 2.13E+07 | -3.30E+06 | 2.09E+06 | 2.17E+07 | -6.21E+05 | -5.06E+05 | -4.05E+05 | -3.74E+05 | -5.07E+05 | -5.74E+05 | -5.81E+05 | -3.66E+05 |
| **156.25** | 1.32E+07 | -6.05E+05 | -2.38E+05 | 1.45E+07 | 2.24E+07 | -3.44E+06 | 2.39E+06 | 2.23E+07 | -1.14E+06 | -5.96E+05 | -5.79E+05 | -6.31E+05 | -1.02E+06 | -7.41E+05 | -8.31E+05 | -6.02E+05 |
| **166.02** | 1.37E+07 | -3.24E+06 | -9.61E+05 | 1.97E+07 | 2.17E+07 | 6.14E+05 | 3.17E+06 | 2.47E+07 | -2.30E+06 | -4.65E+06 | -1.74E+06 | -4.69E+06 | -2.07E+06 | -5.46E+06 | -1.89E+06 | -3.67E+06 |
| **175.78** | 1.37E+07 | 6.30E+05 | 1.40E+06 | 1.62E+07 | 2.37E+07 | -1.91E+06 | 2.09E+06 | 2.25E+07 | -2.13E+06 | -2.07E+06 | -1.87E+06 | -1.60E+06 | -2.12E+06 | -2.11E+06 | -1.75E+06 | -1.64E+06 |
| **185.55** | 1.78E+07 | -2.12E+06 | -6.40E+05 | 2.10E+07 | 2.36E+07 | -3.27E+06 | 1.30E+06 | 2.56E+07 | -4.71E+05 | -6.21E+05 | -4.56E+05 | -5.91E+05 | -5.07E+05 | -6.71E+05 | -5.99E+05 | -5.08E+05 |
| **195.31** | 1.84E+07 | -1.73E+06 | -9.05E+05 | 1.96E+07 | 2.38E+07 | -2.94E+06 | 2.25E+06 | 2.49E+07 | -3.93E+05 | -3.83E+05 | -3.19E+05 | -3.50E+05 | -4.37E+05 | -4.37E+05 | -4.14E+05 | -4.16E+05 |
| **205.08** | 1.91E+07 | -1.80E+06 | -1.17E+06 | 2.03E+07 | 2.44E+07 | -3.02E+06 | 1.94E+06 | 2.46E+07 | -3.60E+05 | -6.91E+05 | -3.18E+05 | -7.00E+05 | -4.85E+05 | -6.03E+05 | -2.81E+05 | -5.32E+05 |
| **214.84** | 2.03E+07 | -2.19E+06 | -5.60E+05 | 2.20E+07 | 2.52E+07 | -2.46E+06 | 2.21E+06 | 2.55E+07 | -2.40E+05 | -4.67E+05 | -2.06E+05 | -2.95E+05 | -2.69E+05 | -3.60E+05 | -2.57E+05 | -3.01E+05 |
| **224.61** | 2.13E+07 | -2.22E+06 | -4.46E+05 | 2.31E+07 | 2.55E+07 | -2.59E+06 | 2.30E+06 | 2.56E+07 | -2.03E+05 | -1.90E+05 | -3.13E+05 | -2.12E+05 | -2.79E+05 | -2.36E+05 | -1.26E+05 | -2.22E+05 |
| **234.38** | 2.24E+07 | -2.44E+06 | -5.09E+04 | 2.38E+07 | 2.61E+07 | -2.52E+06 | 2.81E+06 | 2.63E+07 | -3.00E+05 | -3.77E+05 | -1.17E+05 | -3.05E+05 | -1.72E+05 | -3.40E+05 | -2.42E+05 | -2.62E+05 |
| **244.14** | 2.34E+07 | -2.46E+06 | 1.24E+05 | 2.50E+07 | 2.63E+07 | -2.76E+06 | 2.11E+06 | 2.61E+07 | -2.07E+05 | -2.36E+05 | -1.80E+05 | -2.70E+05 | -2.26E+05 | -3.51E+05 | -2.54E+05 | -2.15E+05 |
| **253.91** | 2.37E+07 | -2.11E+06 | -1.89E+05 | 2.65E+07 | 2.63E+07 | -1.66E+06 | 2.42E+06 | 2.59E+07 | -4.70E+05 | -9.71E+05 | -3.24E+05 | -3.56E+05 | -6.62E+05 | -8.94E+05 | -2.26E+05 | -3.02E+05 |
| **263.67** | 2.68E+07 | -3.49E+06 | -9.31E+05 | 2.78E+07 | 2.66E+07 | -1.63E+06 | 2.70E+06 | 2.58E+07 | -2.70E+05 | -3.01E+05 | -3.48E+05 | -2.20E+05 | -2.95E+05 | -4.96E+05 | -2.58E+05 | -2.97E+05 |
| **273.44** | 2.66E+07 | -2.44E+06 | -5.29E+05 | 2.79E+07 | 2.57E+07 | -8.70E+05 | 2.70E+06 | 2.47E+07 | -2.81E+05 | -2.81E+05 | -1.66E+05 | -2.02E+05 | -2.78E+05 | -3.26E+05 | -2.79E+05 | -3.31E+05 |
| **283.20** | 2.78E+07 | -2.88E+06 | -8.96E+04 | 2.87E+07 | 2.65E+07 | -1.82E+06 | 2.57E+06 | 2.53E+07 | -2.18E+05 | -2.11E+05 | -1.77E+05 | -2.58E+05 | -1.94E+05 | -2.66E+05 | -2.79E+05 | -2.52E+05 |
| **292.97** | 2.92E+07 | -3.73E+06 | -9.01E+05 | 2.96E+07 | 2.66E+07 | -1.09E+06 | 2.40E+06 | 2.52E+07 | -3.17E+05 | -3.31E+05 | -2.87E+05 | -2.24E+05 | -2.73E+05 | -2.69E+05 | -2.31E+05 | -2.24E+05 |
| **302.73** | 3.04E+07 | -3.45E+06 | -1.04E+06 | 3.02E+07 | 2.63E+07 | -5.27E+05 | 3.09E+06 | 2.43E+07 | -2.97E+05 | -3.57E+05 | -3.00E+05 | -2.02E+05 | -2.90E+05 | -3.35E+05 | -1.89E+05 | -2.81E+05 |
| **312.50** | 3.09E+07 | -2.43E+06 | -1.92E+05 | 2.97E+07 | 2.62E+07 | -8.42E+04 | 3.54E+06 | 2.51E+07 | -3.22E+05 | -4.14E+05 | -2.50E+05 | -3.00E+05 | -4.41E+05 | -3.46E+05 | -3.04E+05 | -2.18E+05 |
| **322.27** | 3.21E+07 | -2.55E+06 | -3.10E+05 | 3.16E+07 | 2.61E+07 | -5.61E+05 | 2.83E+06 | 2.58E+07 | -4.12E+05 | -4.15E+05 | -4.04E+05 | -4.24E+05 | -4.17E+05 | -3.35E+05 | -2.77E+05 | -3.19E+05 |
| **332.03** | 3.34E+07 | -2.81E+06 | -8.66E+05 | 3.17E+07 | 2.54E+07 | -1.36E+06 | 3.35E+06 | 2.53E+07 | -1.02E+06 | -9.00E+05 | -9.53E+05 | -7.76E+05 | -4.82E+05 | -5.85E+05 | -4.79E+05 | -4.69E+05 |
| **341.80** | 3.75E+07 | -2.05E+06 | -3.40E+06 | 3.15E+07 | 2.34E+07 | 1.37E+06 | 5.95E+06 | 2.34E+07 | -5.22E+06 | -2.05E+06 | -4.27E+06 | -1.78E+06 | -1.21E+06 | -2.94E+06 | -1.02E+06 | -2.51E+06 |

## Table A17. 70% PR, $\omega$ = 15,350 RPM, and medium-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *f* | *Re Hxx* | *Re Hxy* | *Re Hyx* | *Re Hyy* | *Im Hxx* | *Im Hxy* | *Im Hyx* | *Im Hyy* | *Re eHxx* | *Re eHxy* | *Re eHyx* | *Re eHyy* | *Im eHxx* | *Im eHxy* | *Im eHyx* | *Im eHyy* |
| **9.77** | 1.08E+06 | 8.00E+06 | -7.42E+06 | 1.45E+06 | 1.79E+06 | -9.05E+05 | 6.88E+05 | 2.24E+06 | -3.90E+05 | -1.79E+05 | -4.84E+05 | -2.49E+05 | -3.79E+05 | -2.03E+05 | -4.09E+05 | -1.52E+05 |
| **19.53** | 1.64E+06 | 7.69E+06 | -7.84E+06 | 2.10E+06 | 4.03E+06 | -1.49E+06 | 7.15E+05 | 4.44E+06 | -2.97E+05 | -2.05E+05 | -3.34E+05 | -1.66E+05 | -3.50E+05 | -1.94E+05 | -2.66E+05 | -2.04E+05 |
| **29.30** | 2.57E+06 | 7.82E+06 | -7.59E+06 | 2.14E+06 | 6.40E+06 | -1.64E+06 | 1.45E+06 | 6.58E+06 | -3.21E+05 | -2.16E+05 | -3.20E+05 | -2.36E+05 | -3.83E+05 | -4.59E+05 | -3.01E+05 | -2.38E+05 |
| **39.06** | 2.86E+06 | 7.81E+06 | -7.55E+06 | 2.85E+06 | 8.47E+06 | -2.58E+06 | 1.86E+06 | 8.35E+06 | -2.81E+05 | -3.33E+05 | -3.22E+05 | -3.66E+05 | -2.39E+05 | -2.78E+05 | -2.54E+05 | -2.34E+05 |
| **48.83** | 4.13E+06 | 6.92E+06 | -7.23E+06 | 3.78E+06 | 9.46E+06 | -3.16E+06 | 2.34E+06 | 1.02E+07 | -2.68E+05 | -2.87E+05 | -2.94E+05 | -1.60E+05 | -4.97E+05 | -2.26E+05 | -3.10E+05 | -1.86E+05 |
| **58.59** | 5.43E+06 | 7.05E+06 | -6.83E+06 | 4.63E+06 | 1.12E+07 | -3.80E+06 | 2.55E+06 | 1.19E+07 | -3.84E+05 | -1.38E+05 | -3.75E+05 | -2.99E+05 | -3.50E+05 | -2.73E+05 | -5.12E+05 | -2.40E+05 |
| **68.36** | 5.88E+06 | 5.96E+06 | -6.67E+06 | 6.21E+06 | 1.30E+07 | -4.02E+06 | 2.29E+06 | 1.31E+07 | -5.23E+05 | -7.12E+05 | -4.91E+05 | -6.23E+05 | -4.68E+05 | -5.16E+05 | -6.57E+05 | -6.10E+05 |
| **78.13** | 6.15E+06 | 5.82E+06 | -5.98E+06 | 6.91E+06 | 1.38E+07 | -4.27E+06 | 3.21E+06 | 1.50E+07 | -2.34E+05 | -3.14E+05 | -1.96E+05 | -2.34E+05 | -2.27E+05 | -3.93E+05 | -3.30E+05 | -2.41E+05 |
| **87.89** | 7.19E+06 | 5.20E+06 | -5.78E+06 | 8.00E+06 | 1.52E+07 | -4.86E+06 | 3.58E+06 | 1.64E+07 | -2.36E+05 | -1.88E+05 | -1.31E+05 | -1.96E+05 | -1.60E+05 | -3.19E+05 | -1.85E+05 | -1.81E+05 |
| **97.66** | 8.49E+06 | 4.98E+06 | -5.18E+06 | 8.95E+06 | 1.68E+07 | -4.78E+06 | 3.73E+06 | 1.72E+07 | -2.53E+05 | -2.81E+05 | -3.55E+05 | -2.06E+05 | -3.29E+05 | -2.60E+05 | -3.27E+05 | -3.40E+05 |
| **107.42** | 9.40E+06 | 4.51E+06 | -5.41E+06 | 1.03E+07 | 1.74E+07 | -4.97E+06 | 3.83E+06 | 1.89E+07 | -2.47E+05 | -2.93E+05 | -6.79E+05 | -3.73E+05 | -2.57E+05 | -2.91E+05 | -5.05E+05 | -3.82E+05 |
| **117.19** | 1.08E+07 | 3.53E+06 | -5.16E+06 | 1.22E+07 | 1.88E+07 | -5.47E+06 | 3.94E+06 | 1.99E+07 | -2.20E+05 | -2.80E+05 | -3.21E+05 | -2.58E+05 | -3.50E+05 | -2.13E+05 | -3.25E+05 | -2.51E+05 |
| **126.95** | 1.20E+07 | 2.41E+06 | -4.54E+06 | 1.34E+07 | 1.93E+07 | -5.77E+06 | 3.89E+06 | 2.08E+07 | -1.87E+05 | -3.87E+05 | -2.56E+05 | -2.18E+05 | -1.50E+05 | -4.20E+05 | -2.26E+05 | -4.14E+05 |
| **136.72** | 1.27E+07 | 3.28E+06 | -3.88E+06 | 1.44E+07 | 2.05E+07 | -5.70E+06 | 3.93E+06 | 2.10E+07 | -1.77E+05 | -3.38E+05 | -2.58E+05 | -1.27E+05 | -1.76E+05 | -2.22E+05 | -2.07E+05 | -1.95E+05 |
| **146.48** | 1.35E+07 | 2.60E+06 | -4.04E+06 | 1.54E+07 | 2.07E+07 | -4.95E+06 | 4.37E+06 | 2.14E+07 | -2.65E+05 | -2.94E+05 | -3.20E+05 | -2.69E+05 | -1.85E+05 | -3.22E+05 | -2.40E+05 | -2.52E+05 |
| **156.25** | 1.47E+07 | 2.53E+06 | -3.85E+06 | 1.66E+07 | 2.14E+07 | -4.84E+06 | 4.53E+06 | 2.26E+07 | -3.08E+05 | -2.31E+05 | -2.35E+05 | -3.21E+05 | -3.57E+05 | -2.02E+05 | -3.01E+05 | -3.15E+05 |
| **166.02** | 1.55E+07 | 3.13E+06 | -3.80E+06 | 1.71E+07 | 2.25E+07 | -4.33E+06 | 4.35E+06 | 2.29E+07 | -2.00E+05 | -5.02E+05 | -2.14E+05 | -7.50E+05 | -1.80E+05 | -5.82E+05 | -2.63E+05 | -5.99E+05 |
| **175.78** | 1.67E+07 | 2.77E+06 | -2.94E+06 | 1.76E+07 | 2.27E+07 | -4.85E+06 | 3.82E+06 | 2.27E+07 | -2.09E+05 | -3.33E+05 | -4.21E+05 | -3.52E+05 | -3.77E+05 | -3.05E+05 | -3.01E+05 | -2.84E+05 |
| **185.55** | 1.87E+07 | 1.33E+06 | -3.55E+06 | 2.16E+07 | 2.31E+07 | -5.06E+06 | 4.23E+06 | 2.43E+07 | -1.51E+05 | -2.63E+05 | -1.28E+05 | -3.17E+05 | -9.42E+04 | -1.97E+05 | -1.40E+05 | -2.62E+05 |
| **195.31** | 1.98E+07 | 7.75E+05 | -3.48E+06 | 2.10E+07 | 2.37E+07 | -5.17E+06 | 3.85E+06 | 2.38E+07 | -2.28E+05 | -1.77E+05 | -1.57E+05 | -2.32E+05 | -1.14E+05 | -2.42E+05 | -2.14E+05 | -2.43E+05 |
| **205.08** | 2.07E+07 | 5.52E+05 | -4.49E+06 | 2.15E+07 | 2.35E+07 | -5.59E+06 | 3.99E+06 | 2.50E+07 | -2.51E+05 | -4.71E+05 | -3.51E+05 | -5.34E+05 | -3.02E+05 | -4.88E+05 | -3.19E+05 | -4.74E+05 |
| **214.84** | 2.10E+07 | 3.86E+05 | -2.38E+06 | 2.31E+07 | 2.46E+07 | -5.05E+06 | 4.91E+06 | 2.45E+07 | -1.06E+05 | -2.26E+05 | -2.76E+05 | -2.18E+05 | -2.33E+05 | -2.50E+05 | -2.26E+05 | -2.68E+05 |
| **224.61** | 2.27E+07 | -8.09E+05 | -2.92E+06 | 2.55E+07 | 2.54E+07 | -4.84E+06 | 4.07E+06 | 2.51E+07 | -2.34E+05 | -1.96E+05 | -2.76E+05 | -2.53E+05 | -2.40E+05 | -2.92E+05 | -2.43E+05 | -1.74E+05 |
| **234.38** | 2.39E+07 | -7.43E+05 | -3.74E+06 | 2.59E+07 | 2.50E+07 | -3.86E+06 | 5.33E+06 | 2.47E+07 | -2.73E+05 | -2.16E+05 | -2.54E+05 | -2.66E+05 | -1.97E+05 | -2.08E+05 | -1.20E+05 | -3.24E+05 |
| **244.14** | 2.47E+07 | -5.80E+05 | -2.33E+06 | 2.69E+07 | 2.43E+07 | -3.62E+06 | 5.08E+06 | 2.44E+07 | -3.09E+05 | -2.92E+05 | -2.36E+05 | -3.46E+05 | -2.23E+05 | -3.65E+05 | -4.03E+05 | -2.24E+05 |
| **253.91** | 2.17E+07 | 4.28E+06 | -4.09E+06 | 2.58E+07 | 2.11E+07 | -4.24E+06 | 8.50E+06 | 2.16E+07 | -1.40E+06 | -1.73E+06 | -1.14E+06 | -9.85E+05 | -1.41E+06 | -1.65E+06 | -7.30E+05 | -7.34E+05 |
| **263.67** | 2.61E+07 | -9.19E+05 | -2.76E+06 | 2.90E+07 | 2.44E+07 | -2.82E+06 | 6.48E+06 | 2.33E+07 | -3.48E+05 | -3.92E+05 | -5.07E+05 | -3.24E+05 | -5.64E+05 | -4.88E+05 | -2.27E+05 | -3.09E+05 |
| **273.44** | 2.67E+07 | -6.61E+05 | -2.13E+06 | 2.92E+07 | 2.42E+07 | -2.17E+06 | 5.84E+06 | 2.29E+07 | -3.52E+05 | -2.77E+05 | -3.19E+05 | -2.73E+05 | -3.14E+05 | -2.86E+05 | -2.59E+05 | -3.21E+05 |
| **283.20** | 2.85E+07 | -5.96E+05 | -2.07E+06 | 2.95E+07 | 2.49E+07 | -3.46E+06 | 4.75E+06 | 2.33E+07 | -2.32E+05 | -2.62E+05 | -1.77E+05 | -1.97E+05 | -2.55E+05 | -3.39E+05 | -2.26E+05 | -3.02E+05 |
| **292.97** | 2.95E+07 | -1.18E+06 | -2.36E+06 | 3.01E+07 | 2.49E+07 | -3.09E+06 | 4.66E+06 | 2.35E+07 | -1.82E+05 | -3.57E+05 | -1.77E+05 | -2.23E+05 | -2.70E+05 | -2.11E+05 | -2.18E+05 | -2.14E+05 |
| **302.73** | 3.07E+07 | -1.82E+06 | -2.22E+06 | 3.06E+07 | 2.53E+07 | -2.70E+06 | 5.32E+06 | 2.28E+07 | -2.86E+05 | -2.57E+05 | -1.48E+05 | -2.72E+05 | -2.47E+05 | -2.52E+05 | -2.33E+05 | -2.09E+05 |
| **312.50** | 3.07E+07 | -8.74E+05 | -1.44E+06 | 3.00E+07 | 2.48E+07 | -2.71E+06 | 5.55E+06 | 2.38E+07 | -2.02E+05 | -2.97E+05 | -1.69E+05 | -1.92E+05 | -2.74E+05 | -2.56E+05 | -2.23E+05 | -1.79E+05 |
| **322.27** | 3.27E+07 | -7.00E+05 | -2.40E+06 | 3.17E+07 | 2.56E+07 | -2.22E+06 | 4.49E+06 | 2.42E+07 | -2.23E+05 | -1.62E+05 | -2.32E+05 | -2.39E+05 | -2.68E+05 | -2.80E+05 | -2.43E+05 | -2.64E+05 |
| **332.03** | 3.43E+07 | -7.24E+05 | -2.90E+06 | 3.25E+07 | 2.48E+07 | -2.77E+06 | 5.30E+06 | 2.38E+07 | -2.03E+05 | -2.72E+05 | -1.99E+05 | -2.62E+05 | -2.30E+05 | -3.54E+05 | -3.02E+05 | -2.43E+05 |
| **341.80** | 3.38E+07 | -1.08E+06 | -1.94E+06 | 3.24E+07 | 2.42E+07 | -2.60E+06 | 6.29E+06 | 2.38E+07 | -2.94E+05 | -2.22E+05 | -1.92E+05 | -2.04E+05 | -2.87E+05 | -3.65E+05 | -3.31E+05 | -2.23E+05 |

## Table A18. 70% PR, $\omega$ = 20,200 RPM, and medium-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *f* | *Re Hxx* | *Re Hxy* | *Re Hyx* | *Re Hyy* | *Im Hxx* | *Im Hxy* | *Im Hyx* | *Im Hyy* | *Re eHxx* | *Re eHxy* | *Re eHyx* | *Re eHyy* | *Im eHxx* | *Im eHxy* | *Im eHyx* | *Im eHyy* |
| **9.77** | 1.70E+06 | 1.43E+07 | -1.38E+07 | 1.16E+06 | 3.20E+06 | -1.28E+06 | 4.47E+05 | 2.68E+06 | -4.86E+05 | -2.78E+05 | -4.33E+05 | -2.34E+05 | -4.77E+05 | -2.91E+05 | -3.19E+05 | -2.10E+05 |
| **19.53** | 2.16E+06 | 1.38E+07 | -1.41E+07 | 1.82E+06 | 5.24E+06 | -2.46E+06 | 1.99E+06 | 5.07E+06 | -3.40E+05 | -2.61E+05 | -4.29E+05 | -1.97E+05 | -4.46E+05 | -2.50E+05 | -2.96E+05 | -2.43E+05 |
| **29.30** | 2.80E+06 | 1.31E+07 | -1.33E+07 | 2.32E+06 | 6.37E+06 | -3.29E+06 | 2.90E+06 | 6.91E+06 | -2.51E+05 | -1.69E+05 | -2.95E+05 | -2.70E+05 | -3.01E+05 | -3.06E+05 | -2.81E+05 | -3.08E+05 |
| **39.06** | 3.79E+06 | 1.24E+07 | -1.27E+07 | 3.42E+06 | 8.44E+06 | -4.01E+06 | 3.88E+06 | 8.58E+06 | -3.25E+05 | -3.71E+05 | -3.16E+05 | -3.61E+05 | -2.93E+05 | -2.53E+05 | -2.84E+05 | -3.37E+05 |
| **48.83** | 4.75E+06 | 1.31E+07 | -1.21E+07 | 4.49E+06 | 1.08E+07 | -4.80E+06 | 4.37E+06 | 1.04E+07 | -1.23E+06 | -9.61E+05 | -3.55E+05 | -2.69E+05 | -1.37E+06 | -1.07E+06 | -3.56E+05 | -3.49E+05 |
| **58.59** | 5.85E+06 | 1.16E+07 | -1.19E+07 | 5.24E+06 | 1.14E+07 | -5.67E+06 | 4.80E+06 | 1.22E+07 | -2.41E+05 | -2.58E+05 | -3.41E+05 | -3.64E+05 | -3.61E+05 | -3.51E+05 | -3.78E+05 | -3.79E+05 |
| **68.36** | 6.96E+06 | 1.09E+07 | -1.12E+07 | 7.03E+06 | 1.24E+07 | -6.33E+06 | 5.55E+06 | 1.29E+07 | -4.31E+05 | -6.12E+05 | -4.13E+05 | -5.42E+05 | -4.22E+05 | -4.49E+05 | -5.05E+05 | -3.34E+05 |
| **78.13** | 7.37E+06 | 1.03E+07 | -1.11E+07 | 7.38E+06 | 1.43E+07 | -6.70E+06 | 5.34E+06 | 1.55E+07 | -2.25E+05 | -2.90E+05 | -2.86E+05 | -2.45E+05 | -2.17E+05 | -2.37E+05 | -2.40E+05 | -3.68E+05 |
| **87.89** | 8.46E+06 | 9.49E+06 | -1.03E+07 | 8.60E+06 | 1.54E+07 | -7.47E+06 | 6.09E+06 | 1.62E+07 | -2.37E+05 | -1.97E+05 | -2.46E+05 | -1.67E+05 | -1.53E+05 | -3.63E+05 | -2.28E+05 | -2.02E+05 |
| **97.66** | 9.31E+06 | 8.93E+06 | -1.02E+07 | 1.02E+07 | 1.63E+07 | -7.32E+06 | 6.37E+06 | 1.75E+07 | -4.26E+05 | -2.69E+05 | -3.05E+05 | -2.26E+05 | -3.18E+05 | -3.28E+05 | -4.02E+05 | -3.99E+05 |
| **107.42** | 1.07E+07 | 8.16E+06 | -9.46E+06 | 1.07E+07 | 1.73E+07 | -7.85E+06 | 6.30E+06 | 1.91E+07 | -2.55E+05 | -3.69E+05 | -2.90E+05 | -3.19E+05 | -3.95E+05 | -3.45E+05 | -3.09E+05 | -2.78E+05 |
| **117.19** | 1.23E+07 | 7.02E+06 | -8.93E+06 | 1.27E+07 | 1.83E+07 | -8.27E+06 | 6.51E+06 | 2.01E+07 | -2.52E+05 | -3.37E+05 | -3.31E+05 | -2.25E+05 | -3.21E+05 | -2.19E+05 | -2.43E+05 | -2.45E+05 |
| **126.95** | 1.34E+07 | 5.51E+06 | -8.26E+06 | 1.51E+07 | 1.87E+07 | -8.34E+06 | 7.20E+06 | 2.07E+07 | -2.67E+05 | -3.41E+05 | -3.53E+05 | -4.60E+05 | -3.35E+05 | -5.24E+05 | -2.50E+05 | -4.66E+05 |
| **136.72** | 1.38E+07 | 5.73E+06 | -7.59E+06 | 1.56E+07 | 1.95E+07 | -8.08E+06 | 7.34E+06 | 2.09E+07 | -1.19E+05 | -3.07E+05 | -1.57E+05 | -2.71E+05 | -2.74E+05 | -2.36E+05 | -1.45E+05 | -2.50E+05 |
| **146.48** | 1.54E+07 | 5.97E+06 | -7.70E+06 | 1.65E+07 | 2.09E+07 | -8.29E+06 | 7.02E+06 | 2.17E+07 | -2.40E+05 | -4.17E+05 | -1.86E+05 | -3.02E+05 | -4.01E+05 | -3.29E+05 | -1.74E+05 | -2.59E+05 |
| **156.25** | 1.67E+07 | 4.98E+06 | -7.34E+06 | 1.80E+07 | 2.15E+07 | -8.17E+06 | 7.27E+06 | 2.18E+07 | -2.32E+05 | -2.57E+05 | -3.63E+05 | -2.84E+05 | -3.98E+05 | -3.20E+05 | -3.15E+05 | -2.83E+05 |
| **166.02** | 1.68E+07 | 5.11E+06 | -6.56E+06 | 1.84E+07 | 2.15E+07 | -7.32E+06 | 7.20E+06 | 2.19E+07 | -1.86E+05 | -4.72E+05 | -2.65E+05 | -4.95E+05 | -2.28E+05 | -4.05E+05 | -2.03E+05 | -4.69E+05 |
| **175.78** | 1.69E+07 | 6.29E+06 | -4.30E+06 | 1.71E+07 | 2.17E+07 | -7.11E+06 | 7.56E+06 | 2.14E+07 | -3.07E+05 | -2.24E+05 | -2.56E+05 | -2.50E+05 | -3.92E+05 | -4.77E+05 | -3.54E+05 | -2.06E+05 |
| **185.55** | 1.89E+07 | 3.74E+06 | -6.02E+06 | 2.15E+07 | 2.24E+07 | -7.89E+06 | 6.94E+06 | 2.31E+07 | -1.64E+05 | -2.03E+05 | -2.35E+05 | -2.28E+05 | -1.98E+05 | -1.67E+05 | -1.35E+05 | -2.65E+05 |
| **195.31** | 2.03E+07 | 2.65E+06 | -5.74E+06 | 2.21E+07 | 2.27E+07 | -7.93E+06 | 7.12E+06 | 2.36E+07 | -2.20E+05 | -2.02E+05 | -1.51E+05 | -1.80E+05 | -1.58E+05 | -1.98E+05 | -1.92E+05 | -2.38E+05 |
| **205.08** | 2.13E+07 | 2.05E+06 | -5.64E+06 | 2.27E+07 | 2.31E+07 | -8.09E+06 | 7.04E+06 | 2.34E+07 | -2.50E+05 | -4.84E+05 | -2.94E+05 | -5.73E+05 | -2.59E+05 | -5.26E+05 | -2.22E+05 | -4.70E+05 |
| **214.84** | 2.24E+07 | 1.99E+06 | -5.05E+06 | 2.42E+07 | 2.35E+07 | -7.77E+06 | 7.54E+06 | 2.35E+07 | -1.43E+05 | -2.22E+05 | -1.93E+05 | -1.80E+05 | -1.70E+05 | -2.33E+05 | -1.86E+05 | -2.84E+05 |
| **224.61** | 2.36E+07 | 1.58E+06 | -4.53E+06 | 2.56E+07 | 2.42E+07 | -7.63E+06 | 7.15E+06 | 2.38E+07 | -2.03E+05 | -1.90E+05 | -1.75E+05 | -1.62E+05 | -1.66E+05 | -2.29E+05 | -2.05E+05 | -1.25E+05 |
| **234.38** | 2.47E+07 | 1.05E+06 | -4.65E+06 | 2.65E+07 | 2.41E+07 | -7.32E+06 | 7.38E+06 | 2.38E+07 | -1.73E+05 | -2.75E+05 | -1.30E+05 | -2.81E+05 | -1.45E+05 | -1.86E+05 | -1.96E+05 | -2.80E+05 |
| **244.14** | 2.55E+07 | 5.16E+05 | -3.86E+06 | 2.67E+07 | 2.36E+07 | -7.42E+06 | 6.82E+06 | 2.41E+07 | -1.86E+05 | -2.45E+05 | -1.71E+05 | -2.84E+05 | -1.94E+05 | -3.28E+05 | -1.99E+05 | -2.34E+05 |
| **253.91** | 2.51E+07 | 9.87E+05 | -3.84E+06 | 2.88E+07 | 2.37E+07 | -6.22E+06 | 7.00E+06 | 2.34E+07 | -4.01E+05 | -1.00E+06 | -2.90E+05 | -4.47E+05 | -6.42E+05 | -9.04E+05 | -2.38E+05 | -3.53E+05 |
| **263.67** | 2.83E+07 | -1.05E+06 | -4.48E+06 | 2.94E+07 | 2.39E+07 | -5.42E+06 | 7.44E+06 | 2.28E+07 | -2.81E+05 | -3.02E+05 | -2.20E+05 | -3.33E+05 | -2.74E+05 | -5.01E+05 | -2.81E+05 | -2.60E+05 |
| **273.44** | 2.80E+07 | 8.74E+04 | -3.68E+06 | 2.99E+07 | 2.31E+07 | -4.40E+06 | 7.79E+06 | 2.18E+07 | -3.03E+05 | -2.02E+05 | -1.85E+05 | -2.14E+05 | -2.01E+05 | -2.63E+05 | -2.77E+05 | -3.79E+05 |
| **283.20** | 2.90E+07 | -1.75E+05 | -3.16E+06 | 3.08E+07 | 2.39E+07 | -4.60E+06 | 7.40E+06 | 2.21E+07 | -1.77E+05 | -2.46E+05 | -1.40E+05 | -2.09E+05 | -1.63E+05 | -3.11E+05 | -2.36E+05 | -2.14E+05 |
| **292.97** | 3.03E+07 | -3.92E+04 | -3.47E+06 | 3.06E+07 | 2.40E+07 | -4.99E+06 | 7.09E+06 | 2.20E+07 | -1.98E+05 | -3.52E+05 | -2.21E+05 | -3.26E+05 | -1.98E+05 | -1.73E+05 | -2.18E+05 | -2.39E+05 |
| **302.73** | 3.14E+07 | -3.55E+05 | -3.37E+06 | 3.09E+07 | 2.34E+07 | -4.39E+06 | 7.27E+06 | 2.10E+07 | -2.78E+05 | -3.56E+05 | -1.59E+05 | -2.02E+05 | -1.98E+05 | -2.26E+05 | -2.06E+05 | -2.57E+05 |
| **312.50** | 3.12E+07 | 5.14E+05 | -2.56E+06 | 3.06E+07 | 2.33E+07 | -4.87E+06 | 6.72E+06 | 2.25E+07 | -2.72E+05 | -2.37E+05 | -1.81E+05 | -2.36E+05 | -1.99E+05 | -2.58E+05 | -3.02E+05 | -1.84E+05 |
| **322.27** | 3.31E+07 | 4.63E+05 | -3.56E+06 | 3.23E+07 | 2.46E+07 | -3.84E+06 | 5.72E+06 | 2.19E+07 | -3.60E+05 | -2.78E+05 | -2.75E+05 | -3.24E+05 | -3.56E+05 | -3.48E+05 | -3.32E+05 | -2.55E+05 |
| **332.03** | 3.51E+07 | -2.05E+06 | -4.84E+06 | 3.30E+07 | 2.28E+07 | -4.68E+06 | 7.07E+06 | 2.29E+07 | -1.12E+06 | -6.82E+05 | -4.78E+05 | -3.31E+05 | -5.98E+05 | -6.36E+05 | -6.76E+05 | -5.00E+05 |
| **341.80** | 3.28E+07 | 8.84E+05 | -2.23E+06 | 3.17E+07 | 2.34E+07 | -5.62E+06 | 8.51E+06 | 2.16E+07 | -7.53E+05 | -3.53E+05 | -5.62E+05 | -2.57E+05 | -5.75E+05 | -4.58E+05 | -5.66E+05 | -3.83E+05 |

## Table A19. 50% PR, $\omega$ = 10,200 RPM, and high-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***f*** | ***Re Hxx*** | ***Re Hxy*** | ***Re Hyx*** | ***Re Hyy*** | ***Im Hxx*** | ***Im Hxy*** | ***Im Hyx*** | ***Im Hyy*** | ***Re eHxx*** | ***Re eHxy*** | ***Re eHyx*** | ***Re eHyy*** | ***Im eHxx*** | ***Im eHxy*** | ***Im eHyx*** | ***Im eHyy*** |
| **9.77** | -1.31E+06 | -1.81E+06 | 2.86E+06 | -4.86E+05 | 2.13E+06 | -1.85E+05 | 2.16E+05 | 2.56E+06 | -2.51E+05 | -1.38E+05 | -3.11E+05 | -1.48E+05 | -3.07E+05 | -1.96E+05 | -3.39E+05 | -1.84E+05 |
| **19.53** | -3.53E+05 | -2.41E+06 | 2.26E+06 | 4.65E+05 | 5.02E+06 | -3.46E+05 | -2.60E+05 | 5.03E+06 | -2.59E+05 | -1.73E+05 | -2.72E+05 | -1.98E+05 | -2.35E+05 | -1.57E+05 | -1.99E+05 | -2.21E+05 |
| **29.30** | 1.35E+05 | -1.87E+06 | 2.37E+06 | 5.78E+05 | 6.83E+06 | -4.51E+05 | 4.39E+05 | 6.90E+06 | -2.10E+05 | -3.05E+05 | -1.93E+05 | -2.58E+05 | -3.30E+05 | -3.30E+05 | -2.43E+05 | -2.53E+05 |
| **39.06** | 9.01E+05 | -1.95E+06 | 3.17E+06 | 1.51E+06 | 8.71E+06 | -1.05E+06 | 5.37E+05 | 8.85E+06 | -2.22E+05 | -3.06E+05 | -3.24E+05 | -2.52E+05 | -2.54E+05 | -2.50E+05 | -3.53E+05 | -3.18E+05 |
| **48.83** | 2.10E+06 | -2.18E+06 | 2.84E+06 | 2.54E+06 | 1.03E+07 | -1.65E+06 | 9.15E+05 | 1.07E+07 | -4.15E+05 | -3.02E+05 | -4.23E+05 | -2.06E+05 | -4.84E+05 | -3.94E+05 | -3.83E+05 | -2.30E+05 |
| **58.59** | 2.95E+06 | -2.50E+06 | 2.78E+06 | 4.01E+06 | 1.18E+07 | -1.46E+06 | 9.71E+05 | 1.25E+07 | -1.74E+05 | -2.87E+05 | -3.52E+05 | -4.18E+05 | -2.41E+05 | -2.22E+05 | -3.13E+05 | -2.90E+05 |
| **68.36** | 3.63E+06 | -2.22E+06 | 3.95E+06 | 4.46E+06 | 1.31E+07 | -1.16E+06 | 6.94E+05 | 1.43E+07 | -2.84E+05 | -3.80E+05 | -6.28E+05 | -4.50E+05 | -2.31E+05 | -2.89E+05 | -5.39E+05 | -5.61E+05 |
| **78.13** | 4.55E+06 | -2.32E+06 | 3.49E+06 | 6.05E+06 | 1.47E+07 | -1.51E+06 | 7.53E+05 | 1.57E+07 | -1.57E+05 | -3.96E+05 | -3.46E+05 | -3.67E+05 | -1.85E+05 | -2.16E+05 | -2.64E+05 | -2.30E+05 |
| **87.89** | 6.00E+06 | -2.61E+06 | 3.27E+06 | 7.31E+06 | 1.59E+07 | -2.12E+06 | 9.51E+05 | 1.72E+07 | -2.69E+05 | -2.62E+05 | -1.04E+05 | -2.21E+05 | -2.93E+05 | -2.44E+05 | -2.21E+05 | -2.68E+05 |
| **97.66** | 7.28E+06 | -3.07E+06 | 3.22E+06 | 8.49E+06 | 1.74E+07 | -2.07E+06 | 6.40E+05 | 1.79E+07 | -1.66E+05 | -3.38E+05 | -4.31E+05 | -3.21E+05 | -3.37E+05 | -2.39E+05 | -1.85E+05 | -3.44E+05 |
| **107.42** | 9.27E+06 | -3.61E+06 | 2.37E+06 | 1.03E+07 | 1.79E+07 | -1.79E+06 | 1.51E+06 | 1.83E+07 | -3.16E+05 | -3.26E+05 | -5.15E+05 | -3.50E+05 | -5.40E+05 | -2.32E+05 | -3.63E+05 | -2.56E+05 |
| **117.19** | 9.59E+06 | -3.40E+06 | 3.56E+06 | 1.13E+07 | 1.85E+07 | -1.76E+06 | 6.53E+05 | 1.96E+07 | -3.64E+05 | -3.04E+05 | -3.40E+05 | -2.52E+05 | -3.26E+05 | -3.27E+05 | -3.91E+05 | -3.06E+05 |
| **126.95** | 1.13E+07 | -3.93E+06 | 4.60E+06 | 1.24E+07 | 2.01E+07 | -1.84E+06 | 5.61E+05 | 2.08E+07 | -3.23E+05 | -7.35E+05 | -1.93E+05 | -5.56E+05 | -2.56E+05 | -5.68E+05 | -3.48E+05 | -7.35E+05 |
| **136.72** | 1.18E+07 | -3.92E+06 | 4.12E+06 | 1.37E+07 | 2.09E+07 | -1.78E+06 | 1.33E+06 | 2.10E+07 | -2.89E+05 | -4.17E+05 | -3.45E+05 | -4.96E+05 | -3.05E+05 | -4.01E+05 | -4.18E+05 | -5.57E+05 |
| **146.48** | 1.32E+07 | -3.60E+06 | 4.76E+06 | 1.46E+07 | 2.14E+07 | -1.58E+06 | 3.93E+05 | 2.13E+07 | -6.91E+05 | -7.54E+05 | -5.21E+05 | -8.54E+05 | -3.67E+05 | -6.70E+05 | -5.17E+05 | -5.65E+05 |
| **156.25** | 1.42E+07 | -2.94E+06 | 6.06E+06 | 1.47E+07 | 2.27E+07 | -1.66E+06 | 7.75E+05 | 2.29E+07 | -1.26E+06 | -1.19E+06 | -8.16E+05 | -9.21E+05 | -7.39E+05 | -9.82E+05 | -8.13E+05 | -1.09E+06 |
| **166.02** | 1.72E+07 | -2.14E+06 | 5.14E+06 | 1.78E+07 | 2.64E+07 | -2.59E+06 | -2.27E+03 | 2.08E+07 | -3.00E+06 | -8.54E+06 | -2.36E+06 | -8.73E+06 | -3.02E+06 | -1.18E+07 | -2.69E+06 | -8.16E+06 |
| **175.78** | 1.63E+07 | -1.34E+06 | 8.57E+06 | 1.34E+07 | 2.34E+07 | 1.02E+06 | -6.03E+04 | 2.12E+07 | -2.11E+06 | -2.56E+06 | -1.64E+06 | -2.62E+06 | -1.61E+06 | -2.61E+06 | -1.68E+06 | -2.31E+06 |
| **185.55** | 2.21E+07 | -2.45E+06 | 4.27E+06 | 1.75E+07 | 2.27E+07 | -6.56E+05 | 2.53E+05 | 2.25E+07 | -4.39E+05 | -6.75E+05 | -6.41E+05 | -8.27E+05 | -7.39E+05 | -8.11E+05 | -5.19E+05 | -8.28E+05 |
| **195.31** | 1.90E+07 | -4.69E+06 | 4.14E+06 | 2.16E+07 | 2.33E+07 | -1.05E+06 | 4.53E+05 | 2.32E+07 | -5.18E+05 | -5.19E+05 | -3.51E+05 | -3.33E+05 | -3.01E+05 | -5.36E+05 | -3.93E+05 | -4.33E+05 |
| **205.08** | 2.19E+07 | -3.70E+06 | 4.23E+06 | 2.10E+07 | 2.38E+07 | -6.84E+05 | 9.89E+05 | 2.34E+07 | -2.98E+05 | -8.00E+05 | -3.56E+05 | -1.25E+06 | -3.51E+05 | -1.07E+06 | -4.01E+05 | -8.07E+05 |
| **214.84** | 2.25E+07 | -4.37E+06 | 2.77E+06 | 2.45E+07 | 2.30E+07 | 1.31E+05 | 5.93E+05 | 2.37E+07 | -2.23E+05 | -5.08E+05 | -2.13E+05 | -3.87E+05 | -3.47E+05 | -4.11E+05 | -2.54E+05 | -4.86E+05 |
| **224.61** | 2.21E+07 | -3.89E+06 | 3.57E+06 | 2.54E+07 | 2.31E+07 | 1.91E+05 | 6.70E+05 | 2.33E+07 | -1.38E+05 | -2.14E+05 | -3.85E+05 | -2.93E+05 | -2.93E+05 | -3.20E+05 | -2.18E+05 | -3.20E+05 |
| **234.38** | 2.39E+07 | -3.58E+06 | 4.04E+06 | 2.51E+07 | 2.36E+07 | 8.73E+05 | 9.95E+05 | 2.32E+07 | -2.17E+05 | -3.54E+05 | -2.77E+05 | -3.56E+05 | -1.63E+05 | -4.02E+05 | -2.93E+05 | -2.20E+05 |
| **244.14** | 2.52E+07 | -3.08E+06 | 4.36E+06 | 2.60E+07 | 2.36E+07 | 1.09E+06 | 2.59E+05 | 2.35E+07 | -1.84E+05 | -2.01E+05 | -2.48E+05 | -2.05E+05 | -2.25E+05 | -3.77E+05 | -2.17E+05 | -2.30E+05 |
| **253.91** | 2.52E+07 | -1.36E+06 | 4.00E+06 | 2.77E+07 | 2.27E+07 | 2.19E+06 | 6.05E+05 | 2.29E+07 | -4.37E+05 | -1.03E+06 | -3.11E+05 | -3.49E+05 | -5.81E+05 | -9.58E+05 | -2.88E+05 | -3.04E+05 |
| **263.67** | 2.64E+07 | -1.74E+06 | 3.51E+06 | 2.81E+07 | 2.29E+07 | 7.98E+05 | 6.45E+05 | 2.21E+07 | -2.98E+05 | -3.85E+05 | -2.03E+05 | -2.42E+05 | -3.21E+05 | -4.19E+05 | -2.46E+05 | -3.16E+05 |
| **273.44** | 2.64E+07 | -1.41E+06 | 3.03E+06 | 2.84E+07 | 2.26E+07 | 7.59E+05 | 8.35E+05 | 2.14E+07 | -3.15E+05 | -3.15E+05 | -2.48E+05 | -2.50E+05 | -2.80E+05 | -3.60E+05 | -1.82E+05 | -4.24E+05 |
| **283.20** | 2.74E+07 | -8.12E+05 | 4.12E+06 | 2.81E+07 | 2.36E+07 | 1.68E+05 | 1.27E+06 | 2.11E+07 | -2.22E+05 | -4.30E+05 | -1.51E+05 | -2.99E+05 | -1.99E+05 | -2.36E+05 | -2.67E+05 | -2.40E+05 |
| **292.97** | 2.74E+07 | -1.44E+06 | 4.45E+06 | 2.86E+07 | 2.42E+07 | -4.83E+05 | -8.80E+04 | 2.26E+07 | -2.41E+05 | -4.14E+05 | -2.25E+05 | -2.21E+05 | -2.61E+05 | -3.49E+05 | -2.24E+05 | -3.03E+05 |
| **302.73** | 2.98E+07 | -9.56E+05 | 3.73E+06 | 2.99E+07 | 2.35E+07 | 1.41E+06 | 5.60E+05 | 2.14E+07 | -3.84E+05 | -3.45E+05 | -3.02E+05 | -2.52E+05 | -2.81E+05 | -4.78E+05 | -2.07E+05 | -3.24E+05 |
| **312.50** | 2.99E+07 | -2.66E+05 | 4.45E+06 | 2.91E+07 | 2.38E+07 | 4.31E+05 | 1.35E+06 | 2.24E+07 | -4.47E+05 | -2.83E+05 | -2.25E+05 | -2.79E+05 | -3.01E+05 | -4.25E+05 | -3.75E+05 | -3.65E+05 |
| **322.27** | 3.14E+07 | 5.78E+05 | 3.70E+06 | 3.10E+07 | 2.32E+07 | 1.62E+06 | -1.59E+06 | 2.15E+07 | -6.08E+05 | -3.76E+05 | -2.33E+05 | -4.08E+05 | -4.43E+05 | -3.99E+05 | -4.98E+05 | -3.72E+05 |
| **332.03** | 3.00E+07 | 1.07E+06 | 3.03E+06 | 3.10E+07 | 2.28E+07 | 9.21E+05 | -7.75E+05 | 2.12E+07 | -6.85E+05 | -6.36E+05 | -6.62E+05 | -6.27E+05 | -7.90E+05 | -7.91E+05 | -7.56E+05 | -7.97E+05 |
| **341.80** | 3.54E+07 | -1.29E+06 | 3.73E+06 | 3.13E+07 | 2.22E+07 | -3.91E+06 | 2.35E+06 | 2.29E+07 | -3.79E+06 | -3.03E+06 | -2.79E+06 | -2.42E+06 | -4.79E+06 | -3.59E+06 | -4.01E+06 | -2.78E+06 |

## Table A20. 50% PR, $\omega$ = 15,350 RPM, and high-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***f*** | ***Re Hxx*** | ***Re Hxy*** | ***Re Hyx*** | ***Re Hyy*** | ***Im Hxx*** | ***Im Hxy*** | ***Im Hyx*** | ***Im Hyy*** | ***Re eHxx*** | ***Re eHxy*** | ***Re eHyx*** | ***Re eHyy*** | ***Im eHxx*** | ***Im eHxy*** | ***Im eHyx*** | ***Im eHyy*** |
| **9.77** | -1.26E+06 | 4.07E+06 | -3.30E+06 | -7.95E+05 | 2.52E+06 | -8.66E+05 | 4.36E+05 | 2.80E+06 | -4.03E+05 | -1.50E+05 | -3.60E+05 | -2.10E+05 | -2.86E+05 | -2.03E+05 | -3.51E+05 | -1.46E+05 |
| **19.53** | -2.69E+05 | 3.54E+06 | -3.62E+06 | -2.44E+05 | 5.26E+06 | -1.87E+06 | 4.57E+05 | 5.62E+06 | -3.99E+05 | -2.58E+05 | -3.15E+05 | -1.24E+05 | -3.68E+05 | -2.46E+05 | -4.02E+05 | -2.81E+05 |
| **29.30** | 3.67E+05 | 3.58E+06 | -3.45E+06 | 5.34E+05 | 7.64E+06 | -1.84E+06 | 1.53E+06 | 7.94E+06 | -3.75E+05 | -4.13E+05 | -2.09E+05 | -3.28E+05 | -3.68E+05 | -3.34E+05 | -2.31E+05 | -3.87E+05 |
| **39.06** | 1.31E+06 | 2.99E+06 | -3.06E+06 | 2.37E+06 | 9.48E+06 | -2.53E+06 | 1.80E+06 | 1.01E+07 | -2.40E+05 | -3.60E+05 | -2.71E+05 | -2.42E+05 | -2.87E+05 | -2.67E+05 | -2.10E+05 | -2.03E+05 |
| **48.83** | 2.83E+06 | 3.07E+06 | -2.46E+06 | 3.12E+06 | 1.09E+07 | -2.71E+06 | 2.63E+06 | 1.11E+07 | -3.29E+05 | -2.54E+05 | -2.82E+05 | -1.66E+05 | -4.03E+05 | -2.13E+05 | -3.03E+05 | -2.32E+05 |
| **58.59** | 4.07E+06 | 2.56E+06 | -2.34E+06 | 3.97E+06 | 1.27E+07 | -3.27E+06 | 3.02E+06 | 1.24E+07 | -3.74E+05 | -3.42E+05 | -3.85E+05 | -3.10E+05 | -3.06E+05 | -3.64E+05 | -3.30E+05 | -4.33E+05 |
| **68.36** | 4.31E+06 | 1.98E+06 | -1.72E+06 | 6.03E+06 | 1.40E+07 | -3.58E+06 | 2.29E+06 | 1.43E+07 | -4.10E+05 | -5.78E+05 | -8.21E+05 | -3.47E+05 | -3.72E+05 | -5.59E+05 | -3.78E+05 | -5.12E+05 |
| **78.13** | 5.68E+06 | 1.20E+06 | -1.39E+06 | 7.14E+06 | 1.48E+07 | -3.83E+06 | 2.97E+06 | 1.68E+07 | -3.45E+05 | -1.99E+05 | -5.67E+05 | -3.69E+05 | -2.15E+05 | -3.58E+05 | -2.96E+05 | -4.60E+05 |
| **87.89** | 7.25E+06 | 1.05E+06 | -1.11E+06 | 8.25E+06 | 1.65E+07 | -4.40E+06 | 2.90E+06 | 1.80E+07 | -3.01E+05 | -3.88E+05 | -1.88E+05 | -2.30E+05 | -2.79E+05 | -2.48E+05 | -2.95E+05 | -2.32E+05 |
| **97.66** | 8.60E+06 | 9.59E+05 | -5.56E+05 | 9.96E+06 | 1.82E+07 | -4.42E+06 | 3.35E+06 | 1.86E+07 | -2.03E+05 | -2.28E+05 | -2.85E+05 | -2.33E+05 | -2.51E+05 | -2.87E+05 | -3.31E+05 | -2.40E+05 |
| **107.42** | 9.76E+06 | -1.54E+05 | -2.40E+05 | 1.18E+07 | 1.82E+07 | -4.25E+06 | 3.75E+06 | 1.98E+07 | -3.12E+05 | -3.43E+05 | -2.94E+05 | -4.59E+05 | -2.91E+05 | -2.43E+05 | -5.48E+05 | -3.19E+05 |
| **117.19** | 1.16E+07 | -1.91E+05 | -2.79E+05 | 1.31E+07 | 1.89E+07 | -4.27E+06 | 3.55E+06 | 1.99E+07 | -1.83E+05 | -2.45E+05 | -2.77E+05 | -2.89E+05 | -3.37E+05 | -2.86E+05 | -3.18E+05 | -2.04E+05 |
| **126.95** | 1.27E+07 | -1.33E+06 | 3.81E+05 | 1.40E+07 | 1.98E+07 | -4.98E+06 | 3.25E+06 | 2.10E+07 | -3.53E+05 | -5.36E+05 | -1.99E+05 | -4.07E+05 | -2.90E+05 | -4.49E+05 | -3.72E+05 | -4.18E+05 |
| **136.72** | 1.33E+07 | -1.08E+06 | 8.08E+05 | 1.55E+07 | 2.07E+07 | -4.35E+06 | 3.62E+06 | 2.17E+07 | -2.54E+05 | -3.58E+05 | -2.26E+05 | -3.09E+05 | -2.92E+05 | -3.15E+05 | -2.01E+05 | -2.58E+05 |
| **146.48** | 1.46E+07 | -1.14E+06 | 8.71E+05 | 1.64E+07 | 2.10E+07 | -4.24E+06 | 3.45E+06 | 2.16E+07 | -2.99E+05 | -2.93E+05 | -4.70E+05 | -3.35E+05 | -3.16E+05 | -2.84E+05 | -1.74E+05 | -1.87E+05 |
| **156.25** | 1.55E+07 | -6.14E+05 | 1.46E+06 | 1.68E+07 | 2.15E+07 | -4.03E+06 | 3.12E+06 | 2.21E+07 | -5.31E+05 | -4.63E+05 | -4.48E+05 | -3.57E+05 | -4.35E+05 | -2.20E+05 | -3.40E+05 | -2.44E+05 |
| **166.02** | 2.61E+07 | -6.54E+06 | -8.11E+06 | 2.62E+07 | 3.61E+07 | -2.78E+07 | -8.54E+06 | 4.26E+07 | -8.67E+05 | -1.21E+06 | -6.84E+05 | -9.32E+05 | -8.29E+05 | -1.56E+06 | -8.26E+05 | -1.76E+06 |
| **175.78** | 1.65E+07 | 1.80E+06 | 3.76E+06 | 1.63E+07 | 2.11E+07 | -1.88E+06 | 4.41E+06 | 2.02E+07 | -3.86E+05 | -2.83E+05 | -3.57E+05 | -4.07E+05 | -3.38E+05 | -2.31E+05 | -3.07E+05 | -4.13E+05 |
| **185.55** | 2.43E+07 | -8.08E+05 | 1.76E+06 | 1.90E+07 | 2.58E+07 | -2.15E+06 | 5.27E+06 | 2.29E+07 | -5.60E+05 | -3.76E+05 | -4.75E+05 | -4.13E+05 | -6.56E+05 | -4.54E+05 | -3.23E+05 | -5.80E+05 |
| **195.31** | 2.09E+07 | -2.48E+06 | -1.72E+05 | 2.40E+07 | 2.26E+07 | -3.33E+06 | 3.38E+06 | 2.32E+07 | -3.65E+05 | -3.46E+05 | -4.79E+05 | -3.18E+05 | -2.95E+05 | -3.02E+05 | -4.88E+05 | -4.65E+05 |
| **205.08** | 2.26E+07 | -2.81E+06 | 6.57E+05 | 2.30E+07 | 2.27E+07 | -2.71E+06 | 3.27E+06 | 2.33E+07 | -4.61E+05 | -5.37E+05 | -4.55E+05 | -7.34E+05 | -3.61E+05 | -7.85E+05 | -3.14E+05 | -4.38E+05 |
| **214.84** | 2.32E+07 | -2.42E+06 | 5.13E+05 | 2.70E+07 | 2.24E+07 | -2.31E+06 | 3.04E+06 | 2.36E+07 | -3.92E+05 | -3.40E+05 | -5.09E+05 | -2.94E+05 | -2.30E+05 | -4.26E+05 | -3.09E+05 | -3.43E+05 |
| **224.61** | 2.40E+07 | -2.68E+06 | 7.66E+05 | 2.71E+07 | 2.35E+07 | -2.26E+06 | 3.39E+06 | 2.28E+07 | -4.73E+05 | -2.94E+05 | -3.18E+05 | -2.50E+05 | -4.74E+05 | -3.92E+05 | -4.86E+05 | -2.35E+05 |
| **234.38** | 2.50E+07 | -1.65E+06 | 1.53E+06 | 2.71E+07 | 2.26E+07 | -1.52E+06 | 4.55E+06 | 2.29E+07 | -5.28E+05 | -3.94E+05 | -5.36E+05 | -4.63E+05 | -6.60E+05 | -4.53E+05 | -5.27E+05 | -4.15E+05 |
| **244.14** | 2.53E+07 | -1.45E+06 | 2.21E+06 | 2.74E+07 | 2.24E+07 | -1.39E+06 | 3.86E+06 | 2.27E+07 | -9.14E+05 | -6.78E+05 | -8.77E+05 | -7.34E+05 | -1.01E+06 | -9.28E+05 | -8.47E+05 | -7.08E+05 |
| **253.91** | 2.14E+07 | 1.43E+06 | 2.81E+06 | 2.73E+07 | 2.14E+07 | -2.40E+06 | 7.37E+06 | 2.11E+07 | -7.48E+06 | -7.25E+06 | -5.50E+06 | -3.55E+06 | -6.60E+06 | -4.39E+06 | -6.85E+06 | -6.02E+06 |
| **263.67** | 2.65E+07 | -5.43E+05 | 1.90E+06 | 2.91E+07 | 2.21E+07 | -1.22E+06 | 4.21E+06 | 2.07E+07 | -1.85E+06 | -1.21E+06 | -1.85E+06 | -1.33E+06 | -1.94E+06 | -1.40E+06 | -1.68E+06 | -1.28E+06 |
| **273.44** | 2.68E+07 | 4.90E+05 | 1.91E+06 | 2.96E+07 | 2.22E+07 | -8.06E+05 | 4.43E+06 | 2.03E+07 | -8.34E+05 | -5.76E+05 | -6.38E+05 | -6.14E+05 | -8.43E+05 | -7.10E+05 | -7.10E+05 | -8.22E+05 |
| **283.20** | 2.77E+07 | 1.06E+06 | 2.03E+06 | 2.94E+07 | 2.31E+07 | -2.04E+06 | 3.45E+06 | 2.02E+07 | -4.25E+05 | -5.14E+05 | -5.48E+05 | -5.95E+05 | -5.10E+05 | -5.65E+05 | -6.27E+05 | -5.67E+05 |
| **292.97** | 2.84E+07 | -1.32E+04 | 2.17E+06 | 2.97E+07 | 2.33E+07 | -2.76E+06 | 2.70E+06 | 2.17E+07 | -4.52E+05 | -4.53E+05 | -4.29E+05 | -3.59E+05 | -3.97E+05 | -4.10E+05 | -4.24E+05 | -3.87E+05 |
| **302.73** | 3.04E+07 | 3.19E+05 | 2.14E+06 | 3.08E+07 | 2.30E+07 | -9.69E+05 | 2.83E+06 | 2.07E+07 | -4.93E+05 | -3.54E+05 | -3.81E+05 | -3.15E+05 | -3.80E+05 | -4.05E+05 | -3.70E+05 | -4.35E+05 |
| **312.50** | 3.02E+07 | 2.99E+05 | 2.67E+06 | 3.02E+07 | 2.36E+07 | -2.30E+06 | 3.32E+06 | 2.14E+07 | -5.03E+05 | -4.33E+05 | -4.33E+05 | -3.03E+05 | -4.36E+05 | -5.28E+05 | -4.10E+05 | -3.23E+05 |
| **322.27** | 3.27E+07 | 1.48E+06 | 2.04E+06 | 3.19E+07 | 2.31E+07 | -7.72E+04 | 1.68E+06 | 2.11E+07 | -3.77E+05 | -1.87E+05 | -4.70E+05 | -3.20E+05 | -4.14E+05 | -4.12E+05 | -4.74E+05 | -3.44E+05 |
| **332.03** | 3.25E+07 | 3.30E+06 | 8.72E+05 | 3.20E+07 | 2.54E+07 | -3.08E+05 | 7.18E+05 | 2.03E+07 | -4.12E+05 | -4.08E+05 | -2.82E+05 | -3.01E+05 | -5.36E+05 | -3.53E+05 | -3.22E+05 | -3.83E+05 |
| **341.80** | 4.40E+07 | 2.41E+06 | -7.12E+05 | 3.27E+07 | 3.39E+07 | -8.88E+06 | 1.66E+06 | 2.22E+07 | -6.54E+05 | -3.91E+05 | -3.78E+05 | -2.47E+05 | -5.83E+05 | -5.30E+05 | -4.14E+05 | -3.78E+05 |

## Table A21. 50% PR, $\omega$ = 20,200 RPM, and high-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***f*** | ***Re Hxx*** | ***Re Hxy*** | ***Re Hyx*** | ***Re Hyy*** | ***Im Hxx*** | ***Im Hxy*** | ***Im Hyx*** | ***Im Hyy*** | ***Re eHxx*** | ***Re eHxy*** | ***Re eHyx*** | ***Re eHyy*** | ***Im eHxx*** | ***Im eHxy*** | ***Im eHyx*** | ***Im eHyy*** |
| **9.77** | -1.55E+06 | 1.10E+07 | -1.05E+07 | -1.43E+06 | 3.30E+06 | -1.73E+06 | 6.68E+05 | 3.08E+06 | -3.89E+05 | -3.14E+05 | -3.58E+05 | -2.38E+05 | -3.95E+05 | -2.49E+05 | -4.29E+05 | -2.38E+05 |
| **19.53** | -1.95E+05 | 9.91E+06 | -1.09E+07 | -1.01E+05 | 6.00E+06 | -3.01E+06 | 1.96E+06 | 5.89E+06 | -3.10E+05 | -2.37E+05 | -3.38E+05 | -1.49E+05 | -3.67E+05 | -3.55E+05 | -3.01E+05 | -2.46E+05 |
| **29.30** | 4.99E+05 | 9.43E+06 | -9.98E+06 | 8.95E+05 | 8.13E+06 | -4.18E+06 | 3.30E+06 | 8.24E+06 | -3.32E+05 | -3.09E+05 | -2.52E+05 | -2.99E+05 | -4.94E+05 | -3.78E+05 | -3.85E+05 | -4.67E+05 |
| **39.06** | 1.40E+06 | 8.79E+06 | -9.52E+06 | 2.27E+06 | 1.02E+07 | -4.28E+06 | 4.48E+06 | 1.02E+07 | -2.08E+05 | -2.18E+05 | -3.23E+05 | -3.11E+05 | -3.45E+05 | -2.70E+05 | -3.34E+05 | -2.84E+05 |
| **48.83** | 2.65E+06 | 9.28E+06 | -8.16E+06 | 3.56E+06 | 1.22E+07 | -5.00E+06 | 5.03E+06 | 1.23E+07 | -1.46E+06 | -1.10E+06 | -4.77E+05 | -4.03E+05 | -1.46E+06 | -1.36E+06 | -4.96E+05 | -4.77E+05 |
| **58.59** | 4.78E+06 | 7.94E+06 | -8.01E+06 | 4.54E+06 | 1.34E+07 | -5.86E+06 | 5.26E+06 | 1.40E+07 | -4.03E+05 | -4.38E+05 | -5.27E+05 | -4.41E+05 | -3.84E+05 | -4.29E+05 | -4.32E+05 | -4.73E+05 |
| **68.36** | 6.09E+06 | 6.53E+06 | -7.39E+06 | 5.58E+06 | 1.44E+07 | -7.07E+06 | 4.99E+06 | 1.64E+07 | -4.35E+05 | -5.45E+05 | -6.47E+05 | -3.11E+05 | -6.34E+05 | -3.88E+05 | -4.34E+05 | -5.73E+05 |
| **78.13** | 7.15E+06 | 6.21E+06 | -6.25E+06 | 7.52E+06 | 1.58E+07 | -6.91E+06 | 5.82E+06 | 1.65E+07 | -2.42E+05 | -3.62E+05 | -3.06E+05 | -2.87E+05 | -4.07E+05 | -3.76E+05 | -2.28E+05 | -3.49E+05 |
| **87.89** | 8.12E+06 | 5.74E+06 | -6.35E+06 | 9.23E+06 | 1.72E+07 | -7.12E+06 | 5.98E+06 | 1.84E+07 | -4.80E+05 | -3.55E+05 | -3.23E+05 | -3.00E+05 | -2.64E+05 | -3.19E+05 | -2.68E+05 | -2.27E+05 |
| **97.66** | 9.10E+06 | 5.19E+06 | -5.72E+06 | 1.09E+07 | 1.89E+07 | -7.54E+06 | 6.58E+06 | 1.93E+07 | -4.17E+05 | -5.52E+05 | -3.39E+05 | -2.27E+05 | -8.26E+05 | -4.79E+05 | -2.48E+05 | -2.59E+05 |
| **107.42** | 1.08E+07 | 3.63E+06 | -4.35E+06 | 1.25E+07 | 1.86E+07 | -7.64E+06 | 6.72E+06 | 2.03E+07 | -2.82E+05 | -3.65E+05 | -7.09E+05 | -4.18E+05 | -5.56E+05 | -4.12E+05 | -3.13E+05 | -4.41E+05 |
| **117.19** | 1.23E+07 | 2.69E+06 | -4.39E+06 | 1.41E+07 | 1.91E+07 | -7.38E+06 | 6.93E+06 | 2.04E+07 | -3.85E+05 | -3.04E+05 | -4.09E+05 | -3.05E+05 | -3.68E+05 | -2.35E+05 | -6.06E+05 | -3.07E+05 |
| **126.95** | 1.38E+07 | 1.87E+06 | -2.87E+06 | 1.54E+07 | 2.01E+07 | -7.11E+06 | 6.44E+06 | 2.06E+07 | -3.02E+05 | -4.88E+05 | -4.52E+05 | -3.32E+05 | -6.28E+05 | -5.01E+05 | -2.64E+05 | -5.60E+05 |
| **136.72** | 1.49E+07 | 1.67E+06 | -2.22E+06 | 1.65E+07 | 2.07E+07 | -7.50E+06 | 6.58E+06 | 2.16E+07 | -3.64E+05 | -2.92E+05 | -6.24E+05 | -3.21E+05 | -2.26E+05 | -2.81E+05 | -4.29E+05 | -3.11E+05 |
| **146.48** | 1.61E+07 | 1.55E+06 | -2.40E+06 | 1.78E+07 | 2.05E+07 | -6.76E+06 | 6.91E+06 | 2.10E+07 | -3.30E+05 | -2.83E+05 | -3.65E+05 | -3.67E+05 | -2.72E+05 | -2.77E+05 | -3.03E+05 | -3.10E+05 |
| **156.25** | 1.72E+07 | 1.88E+06 | -1.13E+06 | 1.84E+07 | 2.29E+07 | -6.70E+06 | 6.80E+06 | 2.20E+07 | -5.35E+05 | -4.42E+05 | -5.34E+05 | -3.14E+05 | -5.23E+05 | -3.24E+05 | -5.28E+05 | -3.39E+05 |
| **166.02** | 2.43E+07 | -3.66E+06 | -6.67E+06 | 2.54E+07 | 2.64E+07 | -1.07E+07 | 3.20E+06 | 2.54E+07 | -6.99E+05 | -1.13E+06 | -5.84E+05 | -3.90E+05 | -3.88E+05 | -8.62E+05 | -4.64E+05 | -6.48E+05 |
| **175.78** | 1.79E+07 | 4.54E+06 | 2.03E+06 | 1.70E+07 | 2.07E+07 | -4.89E+06 | 7.83E+06 | 2.01E+07 | -4.32E+05 | -2.83E+05 | -4.29E+05 | -3.32E+05 | -4.30E+05 | -3.65E+05 | -4.04E+05 | -3.53E+05 |
| **185.55** | 2.64E+07 | 1.44E+06 | -6.48E+05 | 2.00E+07 | 2.48E+07 | -6.43E+06 | 7.99E+06 | 2.25E+07 | -1.78E+05 | -2.81E+05 | -2.69E+05 | -3.84E+05 | -5.77E+05 | -3.27E+05 | -5.28E+05 | -3.38E+05 |
| **195.31** | 2.21E+07 | -4.07E+05 | -2.42E+06 | 2.40E+07 | 2.26E+07 | -5.96E+06 | 6.20E+06 | 2.29E+07 | -4.21E+05 | -2.37E+05 | -3.84E+05 | -2.71E+05 | -2.25E+05 | -2.44E+05 | -2.33E+05 | -3.37E+05 |
| **205.08** | 2.31E+07 | -8.28E+05 | -1.71E+06 | 2.49E+07 | 2.26E+07 | -6.39E+06 | 6.26E+06 | 2.20E+07 | -3.30E+05 | -5.06E+05 | -4.62E+05 | -5.66E+05 | -3.79E+05 | -5.83E+05 | -5.60E+05 | -5.64E+05 |
| **214.84** | 2.50E+07 | -8.54E+05 | -2.20E+06 | 2.90E+07 | 2.21E+07 | -5.03E+06 | 6.17E+06 | 2.31E+07 | -3.18E+05 | -2.92E+05 | -3.11E+05 | -3.48E+05 | -3.04E+05 | -4.00E+05 | -3.44E+05 | -3.74E+05 |
| **224.61** | 2.51E+07 | -4.07E+05 | -4.70E+05 | 2.83E+07 | 2.24E+07 | -4.64E+06 | 6.38E+06 | 2.23E+07 | -2.12E+05 | -1.87E+05 | -2.88E+05 | -2.15E+05 | -3.82E+05 | -2.72E+05 | -3.24E+05 | -2.11E+05 |
| **234.38** | 2.60E+07 | -1.81E+05 | -1.10E+05 | 2.85E+07 | 2.20E+07 | -4.15E+06 | 6.68E+06 | 2.18E+07 | -3.14E+05 | -2.89E+05 | -2.13E+05 | -2.10E+05 | -2.28E+05 | -2.33E+05 | -2.11E+05 | -2.73E+05 |
| **244.14** | 2.67E+07 | 1.81E+05 | 8.33E+05 | 2.86E+07 | 2.21E+07 | -3.76E+06 | 6.11E+06 | 2.14E+07 | -2.83E+05 | -1.86E+05 | -1.27E+05 | -2.82E+05 | -3.25E+05 | -3.92E+05 | -2.97E+05 | -2.65E+05 |
| **253.91** | 2.69E+07 | 1.95E+06 | -3.90E+04 | 3.07E+07 | 2.10E+07 | -2.36E+06 | 5.83E+06 | 2.10E+07 | -5.44E+05 | -1.05E+06 | -3.41E+05 | -4.31E+05 | -6.76E+05 | -8.87E+05 | -3.41E+05 | -3.77E+05 |
| **263.67** | 2.85E+07 | 1.08E+06 | -4.78E+05 | 3.07E+07 | 2.13E+07 | -3.54E+06 | 5.56E+06 | 2.01E+07 | -5.74E+05 | -3.50E+05 | -3.55E+05 | -2.79E+05 | -3.65E+05 | -5.73E+05 | -3.95E+05 | -3.18E+05 |
| **273.44** | 2.78E+07 | 2.03E+06 | 8.07E+04 | 3.05E+07 | 2.06E+07 | -3.00E+06 | 6.47E+06 | 1.93E+07 | -5.53E+05 | -3.92E+05 | -3.38E+05 | -3.87E+05 | -4.00E+05 | -3.57E+05 | -3.47E+05 | -3.86E+05 |
| **283.20** | 2.83E+07 | 2.01E+06 | 1.29E+06 | 2.95E+07 | 2.27E+07 | -4.80E+06 | 5.77E+06 | 1.93E+07 | -3.26E+05 | -4.98E+05 | -4.03E+05 | -3.43E+05 | -4.18E+05 | -5.08E+05 | -2.84E+05 | -3.92E+05 |
| **292.97** | 2.85E+07 | 1.07E+06 | 1.46E+06 | 3.05E+07 | 2.32E+07 | -5.15E+06 | 4.49E+06 | 2.13E+07 | -4.14E+05 | -6.00E+05 | -5.48E+05 | -3.52E+05 | -5.82E+05 | -4.65E+05 | -2.43E+05 | -4.37E+05 |
| **302.73** | 3.07E+07 | 2.09E+06 | 6.23E+05 | 3.14E+07 | 2.20E+07 | -3.32E+06 | 5.11E+06 | 1.96E+07 | -4.53E+05 | -6.02E+05 | -4.85E+05 | -4.26E+05 | -8.16E+05 | -5.96E+05 | -5.51E+05 | -5.47E+05 |
| **312.50** | 3.17E+07 | 1.69E+06 | 1.47E+06 | 3.15E+07 | 2.40E+07 | -3.79E+06 | 4.03E+06 | 2.03E+07 | -1.24E+06 | -7.22E+05 | -5.98E+05 | -7.44E+05 | -8.94E+05 | -1.01E+06 | -1.09E+06 | -5.66E+05 |
| **322.27** | 3.22E+07 | 3.50E+06 | 5.95E+05 | 3.20E+07 | 2.26E+07 | -3.04E+06 | 3.69E+06 | 2.00E+07 | -2.37E+06 | -1.00E+06 | -7.46E+05 | -9.75E+05 | -1.05E+06 | -1.27E+06 | -2.00E+06 | -9.99E+05 |
| **332.03** | 3.37E+07 | 4.75E+06 | -8.50E+06 | 2.99E+07 | 1.42E+07 | -6.94E+06 | 6.77E+06 | 1.98E+07 | -8.87E+06 | -4.94E+06 | -6.41E+06 | -3.63E+06 | -5.58E+06 | -5.29E+06 | -5.22E+06 | -4.25E+06 |
| **341.80** | 3.16E+07 | 4.62E+06 | -6.71E+06 | 3.00E+07 | 1.19E+07 | -8.63E+06 | 1.04E+07 | 1.95E+07 | -4.38E+06 | -2.98E+06 | -4.90E+06 | -1.77E+06 | -5.90E+06 | -2.36E+06 | -1.64E+06 | -2.09E+06 |

## Table A22. 60% PR, $\omega$ = 10,200 RPM, and high-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***f*** | ***Re Hxx*** | ***Re Hxy*** | ***Re Hyx*** | ***Re Hyy*** | ***Im Hxx*** | ***Im Hxy*** | ***Im Hyx*** | ***Im Hyy*** | ***Re eHxx*** | ***Re eHxy*** | ***Re eHyx*** | ***Re eHyy*** | ***Im eHxx*** | ***Im eHxy*** | ***Im eHyx*** | ***Im eHyy*** |
| **9.77** | 8.44E+05 | -1.53E+06 | 2.59E+06 | 1.66E+06 | 2.06E+06 | -1.66E+05 | -1.09E+05 | 2.28E+06 | -4.23E+05 | -2.31E+05 | -3.08E+05 | -2.00E+05 | -2.77E+05 | -1.92E+05 | -3.17E+05 | -2.09E+05 |
| **19.53** | 1.47E+06 | -2.03E+06 | 2.03E+06 | 2.26E+06 | 4.44E+06 | -4.21E+05 | -1.16E+05 | 4.58E+06 | -2.05E+05 | -1.70E+05 | -3.14E+05 | -2.54E+05 | -2.50E+05 | -1.38E+05 | -2.68E+05 | -1.42E+05 |
| **29.30** | 1.73E+06 | -1.76E+06 | 2.07E+06 | 2.82E+06 | 6.28E+06 | -6.94E+05 | 2.59E+05 | 6.93E+06 | -2.66E+05 | -3.30E+05 | -2.78E+05 | -3.13E+05 | -2.39E+05 | -4.58E+05 | -2.55E+05 | -3.03E+05 |
| **39.06** | 2.49E+06 | -1.70E+06 | 2.69E+06 | 3.16E+06 | 8.30E+06 | -6.94E+05 | 6.00E+05 | 8.46E+06 | -2.11E+05 | -4.71E+05 | -1.89E+05 | -1.95E+05 | -2.44E+05 | -3.26E+05 | -2.93E+05 | -2.63E+05 |
| **48.83** | 3.54E+06 | -1.60E+06 | 2.49E+06 | 3.85E+06 | 9.19E+06 | -1.18E+06 | 4.97E+05 | 9.79E+06 | -4.90E+05 | -3.54E+05 | -2.74E+05 | -2.49E+05 | -3.17E+05 | -2.98E+05 | -3.11E+05 | -2.97E+05 |
| **58.59** | 4.55E+06 | -1.81E+06 | 2.52E+06 | 4.68E+06 | 1.10E+07 | -1.74E+06 | 1.17E+06 | 1.19E+07 | -2.26E+05 | -4.10E+05 | -3.22E+05 | -5.71E+05 | -2.90E+05 | -3.27E+05 | -4.72E+05 | -3.39E+05 |
| **68.36** | 5.01E+06 | -2.94E+06 | 3.50E+06 | 6.19E+06 | 1.19E+07 | -1.08E+06 | 3.22E+05 | 1.38E+07 | -2.40E+05 | -6.34E+05 | -5.01E+05 | -6.56E+05 | -2.28E+05 | -6.94E+05 | -4.42E+05 | -5.46E+05 |
| **78.13** | 6.03E+06 | -2.29E+06 | 2.88E+06 | 7.69E+06 | 1.41E+07 | -1.41E+06 | 8.65E+05 | 1.56E+07 | -1.85E+05 | -3.03E+05 | -1.78E+05 | -2.83E+05 | -2.28E+05 | -2.69E+05 | -2.96E+05 | -2.81E+05 |
| **87.89** | 7.00E+06 | -2.28E+06 | 2.86E+06 | 8.87E+06 | 1.56E+07 | -1.90E+06 | 6.21E+05 | 1.65E+07 | -2.93E+05 | -2.01E+05 | -1.43E+05 | -2.80E+05 | -1.91E+05 | -2.28E+05 | -2.53E+05 | -1.92E+05 |
| **97.66** | 8.30E+06 | -2.28E+06 | 2.90E+06 | 9.78E+06 | 1.70E+07 | -1.75E+06 | 8.68E+05 | 1.79E+07 | -1.46E+05 | -3.68E+05 | -3.19E+05 | -2.71E+05 | -2.08E+05 | -2.50E+05 | -3.95E+05 | -5.16E+05 |
| **107.42** | 9.57E+06 | -2.86E+06 | 3.22E+06 | 1.13E+07 | 1.80E+07 | -2.11E+06 | 1.11E+06 | 1.88E+07 | -3.33E+05 | -5.80E+05 | -6.42E+05 | -3.85E+05 | -3.98E+05 | -3.59E+05 | -6.63E+05 | -4.83E+05 |
| **117.19** | 1.09E+07 | -3.00E+06 | 3.49E+06 | 1.26E+07 | 1.94E+07 | -2.23E+06 | 3.88E+05 | 1.96E+07 | -4.51E+05 | -4.33E+05 | -3.65E+05 | -2.36E+05 | -2.33E+05 | -3.63E+05 | -4.86E+05 | -3.19E+05 |
| **126.95** | 1.11E+07 | -3.38E+06 | 3.40E+06 | 1.30E+07 | 1.94E+07 | -1.83E+06 | 1.17E+06 | 1.90E+07 | -4.88E+05 | -1.09E+06 | -3.16E+05 | -8.59E+05 | -4.49E+05 | -8.72E+05 | -5.83E+05 | -8.14E+05 |
| **136.72** | 1.27E+07 | -3.01E+06 | 3.22E+06 | 1.51E+07 | 2.07E+07 | -1.54E+06 | 9.32E+05 | 2.10E+07 | -3.56E+05 | -6.39E+05 | -5.51E+05 | -7.70E+05 | -6.12E+05 | -6.38E+05 | -3.98E+05 | -6.83E+05 |
| **146.48** | 1.33E+07 | -2.97E+06 | 3.37E+06 | 1.60E+07 | 2.07E+07 | -1.06E+06 | 5.48E+05 | 2.25E+07 | -5.03E+05 | -9.81E+05 | -9.58E+05 | -1.01E+06 | -1.17E+06 | -1.05E+06 | -5.49E+05 | -1.03E+06 |
| **156.25** | 1.35E+07 | -2.60E+06 | 4.26E+06 | 1.69E+07 | 2.24E+07 | -1.14E+06 | 6.04E+05 | 2.21E+07 | -1.22E+06 | -1.68E+06 | -1.87E+06 | -1.89E+06 | -2.29E+06 | -1.73E+06 | -1.64E+06 | -1.38E+06 |
| **166.02** | 1.54E+07 | 2.06E+07 | -5.15E+06 | 2.05E+07 | 1.59E+07 | 6.73E+06 | 6.28E+06 | -1.18E+06 | -9.09E+06 | -1.91E+07 | -5.49E+06 | -1.97E+07 | -7.10E+06 | -1.96E+07 | -9.58E+06 | -1.72E+07 |
| **175.78** | 1.69E+07 | 1.80E+06 | 6.45E+06 | 1.38E+07 | 2.23E+07 | 6.81E+05 | 1.47E+05 | 2.01E+07 | -4.68E+06 | -2.64E+06 | -2.24E+06 | -4.69E+06 | -3.28E+06 | -5.84E+06 | -4.47E+06 | -3.16E+06 |
| **185.55** | 1.89E+07 | -2.64E+06 | 2.85E+06 | 1.87E+07 | 2.32E+07 | -5.20E+05 | 1.57E+06 | 2.31E+07 | -1.63E+06 | -1.09E+06 | -1.03E+06 | -1.16E+06 | -5.31E+05 | -1.53E+06 | -1.13E+06 | -1.04E+06 |
| **195.31** | 2.03E+07 | -4.19E+06 | 2.04E+06 | 2.32E+07 | 2.37E+07 | -6.37E+05 | 7.91E+05 | 2.36E+07 | -6.32E+05 | -7.64E+05 | -1.08E+06 | -5.25E+05 | -9.96E+05 | -7.17E+05 | -3.92E+05 | -8.64E+05 |
| **205.08** | 2.12E+07 | -3.61E+06 | 2.60E+06 | 2.21E+07 | 2.36E+07 | -1.65E+06 | 6.48E+05 | 2.52E+07 | -3.68E+05 | -1.08E+06 | -9.51E+05 | -9.26E+05 | -9.70E+05 | -1.37E+06 | -5.79E+05 | -1.35E+06 |
| **214.84** | 2.30E+07 | -4.43E+06 | 2.86E+06 | 2.60E+07 | 2.49E+07 | -5.22E+05 | 4.95E+05 | 2.52E+07 | -1.82E+05 | -5.78E+05 | -5.97E+05 | -2.67E+05 | -7.43E+05 | -4.08E+05 | -1.94E+05 | -5.70E+05 |
| **224.61** | 2.38E+07 | -3.59E+06 | 3.26E+06 | 2.67E+07 | 2.51E+07 | 3.56E+05 | 1.19E+06 | 2.45E+07 | -5.12E+05 | -3.34E+05 | -1.97E+05 | -3.01E+05 | -2.54E+05 | -3.54E+05 | -6.36E+05 | -3.59E+05 |
| **234.38** | 2.42E+07 | -3.53E+06 | 3.71E+06 | 2.71E+07 | 2.48E+07 | 5.54E+05 | 1.68E+06 | 2.46E+07 | -6.06E+05 | -3.85E+05 | -2.47E+05 | -3.65E+05 | -1.43E+05 | -3.61E+05 | -3.49E+05 | -4.41E+05 |
| **244.14** | 2.51E+07 | -2.83E+06 | 4.39E+06 | 2.73E+07 | 2.57E+07 | 3.98E+05 | 1.28E+06 | 2.49E+07 | -4.61E+05 | -4.00E+05 | -2.63E+05 | -3.02E+05 | -2.36E+05 | -4.86E+05 | -3.70E+05 | -3.28E+05 |
| **253.91** | 2.59E+07 | -1.14E+06 | 4.17E+06 | 2.92E+07 | 2.42E+07 | 1.53E+06 | 1.01E+06 | 2.41E+07 | -6.38E+05 | -1.05E+06 | -4.52E+05 | -4.26E+05 | -5.49E+05 | -1.05E+06 | -2.35E+05 | -4.25E+05 |
| **263.67** | 2.81E+07 | -2.32E+06 | 3.13E+06 | 3.00E+07 | 2.37E+07 | 6.33E+05 | 5.14E+05 | 2.37E+07 | -2.68E+05 | -4.42E+05 | -5.42E+05 | -3.53E+05 | -4.09E+05 | -4.73E+05 | -2.39E+05 | -4.35E+05 |
| **273.44** | 2.68E+07 | -1.39E+06 | 3.41E+06 | 2.99E+07 | 2.40E+07 | 3.98E+05 | 1.14E+06 | 2.30E+07 | -2.80E+05 | -3.33E+05 | -3.45E+05 | -3.87E+05 | -3.26E+05 | -2.36E+05 | -3.00E+05 | -5.11E+05 |
| **283.20** | 2.80E+07 | -1.59E+06 | 3.97E+06 | 3.00E+07 | 2.58E+07 | -2.12E+05 | 1.23E+06 | 2.20E+07 | -3.28E+05 | -4.07E+05 | -3.33E+05 | -3.91E+05 | -2.74E+05 | -3.30E+05 | -3.97E+05 | -3.86E+05 |
| **292.97** | 2.83E+07 | -2.20E+06 | 4.07E+06 | 2.98E+07 | 2.56E+07 | 4.58E+04 | 1.52E+05 | 2.39E+07 | -2.65E+05 | -3.86E+05 | -2.83E+05 | -3.05E+05 | -2.61E+05 | -3.55E+05 | -3.64E+05 | -2.21E+05 |
| **302.73** | 3.04E+07 | -1.69E+06 | 3.23E+06 | 3.14E+07 | 2.54E+07 | 1.53E+06 | 6.05E+05 | 2.28E+07 | -4.30E+05 | -3.36E+05 | -2.32E+05 | -2.88E+05 | -1.99E+05 | -4.07E+05 | -4.62E+05 | -2.92E+05 |
| **312.50** | 3.11E+07 | -8.86E+05 | 4.14E+06 | 3.09E+07 | 2.62E+07 | 9.97E+05 | 1.14E+06 | 2.29E+07 | -4.02E+05 | -3.28E+05 | -4.92E+05 | -2.16E+05 | -3.25E+05 | -3.77E+05 | -2.60E+05 | -4.15E+05 |
| **322.27** | 3.25E+07 | -2.54E+05 | 4.48E+06 | 3.23E+07 | 2.57E+07 | 2.45E+06 | -5.46E+05 | 2.38E+07 | -3.11E+05 | -2.54E+05 | -5.09E+05 | -4.13E+05 | -3.19E+05 | -4.02E+05 | -2.67E+05 | -3.19E+05 |
| **332.03** | 3.31E+07 | 4.72E+05 | 2.46E+06 | 3.25E+07 | 2.60E+07 | 1.53E+06 | -1.63E+06 | 2.23E+07 | -3.59E+05 | -4.67E+05 | -4.11E+05 | -4.72E+05 | -4.93E+05 | -4.64E+05 | -2.92E+05 | -5.19E+05 |
| **341.80** | 4.09E+07 | -3.82E+06 | 2.77E+06 | 3.42E+07 | 3.24E+07 | -4.89E+06 | -1.57E+05 | 2.45E+07 | -1.00E+06 | -1.17E+06 | -6.70E+05 | -9.01E+05 | -6.75E+05 | -2.12E+06 | -5.04E+05 | -1.41E+06 |

## Table A23. 60% PR, $\omega$ = 15,350 RPM, and high-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *f* | *Re Hxx* | *Re Hxy* | *Re Hyx* | *Re Hyy* | *Im Hxx* | *Im Hxy* | *Im Hyx* | *Im Hyy* | *Re eHxx* | *Re eHxy* | *Re eHyx* | *Re eHyy* | *Im eHxx* | *Im eHxy* | *Im eHyx* | *Im eHyy* |
| **9.77** | 7.18E+05 | 3.87E+06 | -3.24E+06 | 1.32E+06 | 1.96E+06 | -8.16E+05 | 7.06E+05 | 2.71E+06 | -3.14E+05 | -2.35E+05 | -4.13E+05 | -1.57E+05 | -3.84E+05 | -2.62E+05 | -4.06E+05 | -3.04E+05 |
| **19.53** | 1.43E+06 | 3.68E+06 | -3.42E+06 | 1.81E+06 | 4.76E+06 | -1.58E+06 | 5.02E+05 | 4.80E+06 | -3.60E+05 | -2.19E+05 | -3.30E+05 | -1.28E+05 | -2.29E+05 | -3.09E+05 | -2.54E+05 | -2.44E+05 |
| **29.30** | 1.44E+06 | 3.89E+06 | -3.46E+06 | 2.91E+06 | 6.86E+06 | -1.57E+06 | 1.47E+06 | 7.43E+06 | -3.05E+05 | -3.51E+05 | -2.62E+05 | -3.03E+05 | -3.45E+05 | -3.73E+05 | -2.17E+05 | -2.16E+05 |
| **39.06** | 2.26E+06 | 3.39E+06 | -3.00E+06 | 3.58E+06 | 8.87E+06 | -2.37E+06 | 1.63E+06 | 9.21E+06 | -2.70E+05 | -3.23E+05 | -2.88E+05 | -2.23E+05 | -2.91E+05 | -2.58E+05 | -2.40E+05 | -3.04E+05 |
| **48.83** | 3.83E+06 | 3.12E+06 | -2.61E+06 | 4.33E+06 | 1.05E+07 | -2.84E+06 | 2.00E+06 | 1.06E+07 | -4.23E+05 | -2.94E+05 | -4.15E+05 | -1.76E+05 | -2.99E+05 | -3.16E+05 | -3.78E+05 | -2.04E+05 |
| **58.59** | 4.85E+06 | 2.91E+06 | -2.42E+06 | 5.68E+06 | 1.19E+07 | -2.74E+06 | 2.57E+06 | 1.22E+07 | -3.01E+05 | -3.48E+05 | -3.51E+05 | -3.93E+05 | -2.08E+05 | -4.11E+05 | -4.51E+05 | -2.34E+05 |
| **68.36** | 7.02E+06 | 2.30E+06 | -1.85E+06 | 7.25E+06 | 1.28E+07 | -3.53E+06 | 1.97E+06 | 1.53E+07 | -6.46E+05 | -7.39E+05 | -6.50E+05 | -4.00E+05 | -7.11E+05 | -5.93E+05 | -5.09E+05 | -6.55E+05 |
| **78.13** | 6.37E+06 | 1.95E+06 | -2.25E+06 | 8.58E+06 | 1.46E+07 | -3.50E+06 | 2.30E+06 | 1.59E+07 | -2.61E+05 | -2.92E+05 | -3.11E+05 | -5.10E+05 | -1.93E+05 | -3.23E+05 | -2.81E+05 | -3.12E+05 |
| **87.89** | 7.51E+06 | 1.42E+06 | -1.55E+06 | 9.66E+06 | 1.55E+07 | -4.03E+06 | 2.91E+06 | 1.70E+07 | -3.39E+05 | -2.85E+05 | -3.70E+05 | -2.87E+05 | -2.55E+05 | -3.44E+05 | -3.20E+05 | -3.72E+05 |
| **97.66** | 8.67E+06 | 1.36E+06 | -8.51E+05 | 1.01E+07 | 1.73E+07 | -4.28E+06 | 2.60E+06 | 1.79E+07 | -3.26E+05 | -2.75E+05 | -3.84E+05 | -3.59E+05 | -3.71E+05 | -3.06E+05 | -3.23E+05 | -3.05E+05 |
| **107.42** | 1.06E+07 | 1.12E+06 | -9.60E+05 | 1.27E+07 | 1.81E+07 | -3.96E+06 | 4.15E+06 | 1.98E+07 | -3.29E+05 | -3.02E+05 | -3.44E+05 | -5.33E+05 | -3.75E+05 | -3.06E+05 | -6.00E+05 | -4.79E+05 |
| **117.19** | 1.14E+07 | 6.47E+05 | -1.03E+06 | 1.41E+07 | 1.94E+07 | -4.41E+06 | 2.70E+06 | 1.97E+07 | -3.72E+05 | -2.04E+05 | -3.84E+05 | -3.19E+05 | -3.28E+05 | -3.20E+05 | -3.96E+05 | -2.87E+05 |
| **126.95** | 1.34E+07 | -7.97E+05 | -8.25E+05 | 1.50E+07 | 1.95E+07 | -4.09E+06 | 3.05E+06 | 2.15E+07 | -3.18E+05 | -3.19E+05 | -3.88E+05 | -5.77E+05 | -2.93E+05 | -4.52E+05 | -3.86E+05 | -3.96E+05 |
| **136.72** | 1.35E+07 | -1.85E+05 | 4.41E+05 | 1.62E+07 | 2.05E+07 | -3.87E+06 | 4.04E+06 | 2.08E+07 | -4.04E+05 | -4.71E+05 | -5.52E+05 | -2.50E+05 | -3.18E+05 | -5.04E+05 | -3.06E+05 | -4.54E+05 |
| **146.48** | 1.40E+07 | -2.12E+04 | 2.35E+03 | 1.71E+07 | 2.12E+07 | -3.61E+06 | 3.05E+06 | 2.19E+07 | -2.01E+05 | -3.45E+05 | -4.70E+05 | -4.59E+05 | -2.57E+05 | -2.43E+05 | -3.23E+05 | -4.13E+05 |
| **156.25** | 1.51E+07 | 1.10E+05 | 6.53E+05 | 1.75E+07 | 2.15E+07 | -3.91E+06 | 3.41E+06 | 2.21E+07 | -5.63E+05 | -3.56E+05 | -8.52E+05 | -4.76E+05 | -3.49E+05 | -3.00E+05 | -4.26E+05 | -3.98E+05 |
| **166.02** | 2.54E+07 | -9.12E+06 | -6.43E+06 | 2.83E+07 | 3.15E+07 | -1.28E+07 | -4.32E+06 | 2.93E+07 | -4.75E+05 | -1.16E+06 | -7.28E+05 | -6.52E+05 | -7.33E+05 | -1.67E+06 | -4.48E+05 | -7.16E+05 |
| **175.78** | 1.61E+07 | 2.25E+06 | 3.65E+06 | 1.63E+07 | 2.20E+07 | -1.91E+06 | 5.07E+06 | 2.10E+07 | -3.58E+05 | -3.68E+05 | -3.92E+05 | -7.10E+05 | -3.21E+05 | -3.14E+05 | -3.18E+05 | -4.21E+05 |
| **185.55** | 1.95E+07 | -1.66E+06 | -2.88E+05 | 1.95E+07 | 2.37E+07 | -3.30E+06 | 3.19E+06 | 2.31E+07 | -3.28E+05 | -3.58E+05 | -2.39E+05 | -4.12E+05 | -3.41E+05 | -3.37E+05 | -3.54E+05 | -3.61E+05 |
| **195.31** | 2.09E+07 | -1.81E+06 | -2.02E+05 | 2.38E+07 | 2.33E+07 | -3.76E+06 | 2.63E+06 | 2.40E+07 | -3.95E+05 | -4.32E+05 | -4.07E+05 | -3.28E+05 | -3.59E+05 | -4.04E+05 | -3.01E+05 | -4.12E+05 |
| **205.08** | 2.13E+07 | -1.55E+06 | 1.68E+05 | 2.29E+07 | 2.34E+07 | -3.35E+06 | 3.01E+06 | 2.38E+07 | -5.15E+05 | -1.07E+06 | -7.25E+05 | -7.81E+05 | -5.05E+05 | -8.23E+05 | -4.30E+05 | -9.26E+05 |
| **214.84** | 2.33E+07 | -2.08E+06 | -4.82E+05 | 2.77E+07 | 2.35E+07 | -2.95E+06 | 3.47E+06 | 2.45E+07 | -4.07E+05 | -5.91E+05 | -4.53E+05 | -4.35E+05 | -3.69E+05 | -6.20E+05 | -4.30E+05 | -4.41E+05 |
| **224.61** | 2.39E+07 | -1.71E+06 | 6.66E+05 | 2.77E+07 | 2.39E+07 | -2.21E+06 | 4.40E+06 | 2.38E+07 | -5.67E+05 | -4.74E+05 | -4.11E+05 | -4.11E+05 | -6.47E+05 | -5.56E+05 | -5.99E+05 | -4.34E+05 |
| **234.38** | 2.51E+07 | -1.06E+06 | 1.96E+06 | 2.78E+07 | 2.43E+07 | -1.93E+06 | 4.37E+06 | 2.39E+07 | -7.61E+05 | -5.78E+05 | -6.17E+05 | -6.26E+05 | -8.92E+05 | -7.94E+05 | -8.83E+05 | -6.79E+05 |
| **244.14** | 2.59E+07 | -1.09E+06 | 2.50E+06 | 2.84E+07 | 2.46E+07 | -2.12E+06 | 2.77E+06 | 2.40E+07 | -1.46E+06 | -1.15E+06 | -7.06E+05 | -1.30E+06 | -1.19E+06 | -1.50E+06 | -1.68E+06 | -1.17E+06 |
| **253.91** | 1.66E+07 | 5.78E+06 | 7.05E+06 | 8.48E+06 | 2.62E+07 | -2.34E+07 | 1.18E+07 | 2.38E+07 | -1.31E+07 | -9.25E+06 | -1.31E+07 | -1.13E+07 | -1.44E+07 | -1.27E+07 | -1.22E+07 | -8.43E+06 |
| **263.67** | 2.95E+07 | -7.64E+04 | -3.18E+05 | 3.07E+07 | 2.21E+07 | -1.08E+06 | 2.34E+06 | 2.21E+07 | -2.82E+06 | -2.01E+06 | -2.59E+06 | -2.03E+06 | -2.59E+06 | -2.48E+06 | -2.36E+06 | -1.90E+06 |
| **273.44** | 2.72E+07 | 7.38E+05 | 1.37E+06 | 3.04E+07 | 2.28E+07 | -1.38E+06 | 3.91E+06 | 2.13E+07 | -1.11E+06 | -8.55E+05 | -8.20E+05 | -1.11E+06 | -1.14E+06 | -1.24E+06 | -9.86E+05 | -9.35E+05 |
| **283.20** | 2.76E+07 | 7.33E+05 | 2.51E+06 | 3.02E+07 | 2.48E+07 | -2.55E+06 | 3.79E+06 | 2.14E+07 | -4.91E+05 | -9.13E+05 | -6.35E+05 | -6.33E+05 | -8.93E+05 | -6.94E+05 | -5.08E+05 | -8.35E+05 |
| **292.97** | 2.83E+07 | 2.96E+04 | 2.64E+06 | 3.04E+07 | 2.51E+07 | -2.98E+06 | 2.66E+06 | 2.26E+07 | -5.28E+05 | -7.11E+05 | -4.35E+05 | -4.16E+05 | -6.66E+05 | -5.40E+05 | -4.72E+05 | -5.39E+05 |
| **302.73** | 3.03E+07 | 7.06E+05 | 1.51E+06 | 3.18E+07 | 2.40E+07 | -8.36E+05 | 2.89E+06 | 2.14E+07 | -6.15E+05 | -4.47E+05 | -4.64E+05 | -3.92E+05 | -5.65E+05 | -5.43E+05 | -4.43E+05 | -5.24E+05 |
| **312.50** | 3.13E+07 | 9.82E+05 | 2.96E+06 | 3.15E+07 | 2.55E+07 | -1.75E+06 | 2.88E+06 | 2.21E+07 | -7.74E+05 | -4.76E+05 | -4.07E+05 | -3.99E+05 | -4.22E+05 | -6.12E+05 | -5.34E+05 | -2.87E+05 |
| **322.27** | 3.25E+07 | 1.93E+06 | 2.70E+06 | 3.27E+07 | 2.41E+07 | -6.57E+05 | 1.94E+06 | 2.25E+07 | -6.77E+05 | -4.28E+05 | -3.34E+05 | -3.65E+05 | -3.76E+05 | -3.82E+05 | -5.58E+05 | -3.17E+05 |
| **332.03** | 3.09E+07 | 3.31E+06 | 1.39E+06 | 3.27E+07 | 2.71E+07 | -1.81E+06 | 9.91E+05 | 2.17E+07 | -5.22E+05 | -5.10E+05 | -3.13E+05 | -2.81E+05 | -4.96E+05 | -5.14E+05 | -4.83E+05 | -4.65E+05 |
| **341.80** | 4.39E+07 | -1.73E+05 | -4.08E+05 | 3.36E+07 | 3.62E+07 | -8.38E+06 | 1.24E+06 | 2.31E+07 | -4.68E+05 | -5.25E+05 | -6.17E+05 | -3.35E+05 | -1.16E+06 | -6.04E+05 | -5.00E+05 | -3.83E+05 |

## Table A24. 60% PR, $\omega$ = 20,200 RPM, and high-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *f* | *Re Hxx* | *Re Hxy* | *Re Hyx* | *Re Hyy* | *Im Hxx* | *Im Hxy* | *Im Hyx* | *Im Hyy* | *Re eHxx* | *Re eHxy* | *Re eHyx* | *Re eHyy* | *Im eHxx* | *Im eHxy* | *Im eHyx* | *Im eHyy* |
| **9.77** | 1.14E+05 | 1.03E+07 | -9.84E+06 | 8.41E+05 | 2.74E+06 | -1.55E+06 | 7.55E+05 | 2.81E+06 | -3.99E+05 | -3.21E+05 | -5.05E+05 | -2.31E+05 | -5.16E+05 | -2.17E+05 | -4.38E+05 | -2.53E+05 |
| **19.53** | 7.19E+05 | 9.89E+06 | -1.01E+07 | 1.38E+06 | 5.38E+06 | -2.55E+06 | 1.78E+06 | 5.24E+06 | -3.39E+05 | -2.57E+05 | -3.28E+05 | -2.18E+05 | -3.71E+05 | -1.77E+05 | -3.02E+05 | -2.99E+05 |
| **29.30** | 1.49E+06 | 9.04E+06 | -1.03E+07 | 2.69E+06 | 7.09E+06 | -3.13E+06 | 2.84E+06 | 7.85E+06 | -2.81E+05 | -3.35E+05 | -3.39E+05 | -4.37E+05 | -3.38E+05 | -3.85E+05 | -3.05E+05 | -2.41E+05 |
| **39.06** | 3.22E+06 | 8.62E+06 | -9.09E+06 | 3.23E+06 | 9.29E+06 | -3.93E+06 | 3.59E+06 | 9.54E+06 | -2.89E+05 | -3.07E+05 | -4.47E+05 | -2.51E+05 | -3.56E+05 | -2.70E+05 | -2.25E+05 | -2.86E+05 |
| **48.83** | 3.85E+06 | 7.40E+06 | -8.57E+06 | 4.56E+06 | 1.19E+07 | -4.95E+06 | 4.03E+06 | 1.12E+07 | -1.68E+06 | -1.18E+06 | -4.72E+05 | -3.70E+05 | -1.66E+06 | -1.58E+06 | -5.86E+05 | -3.79E+05 |
| **58.59** | 5.07E+06 | 7.39E+06 | -7.83E+06 | 5.55E+06 | 1.23E+07 | -5.50E+06 | 5.14E+06 | 1.26E+07 | -3.72E+05 | -3.74E+05 | -4.60E+05 | -3.50E+05 | -3.41E+05 | -3.86E+05 | -4.80E+05 | -5.43E+05 |
| **68.36** | 7.09E+06 | 6.27E+06 | -7.65E+06 | 6.77E+06 | 1.37E+07 | -6.49E+06 | 4.35E+06 | 1.55E+07 | -6.35E+05 | -3.81E+05 | -1.27E+06 | -6.97E+05 | -7.54E+05 | -9.02E+05 | -3.99E+05 | -5.90E+05 |
| **78.13** | 7.64E+06 | 6.65E+06 | -7.13E+06 | 8.11E+06 | 1.52E+07 | -6.89E+06 | 5.40E+06 | 1.64E+07 | -3.33E+05 | -4.50E+05 | -3.17E+05 | -3.09E+05 | -3.80E+05 | -3.77E+05 | -4.15E+05 | -5.08E+05 |
| **87.89** | 8.50E+06 | 5.42E+06 | -5.76E+06 | 8.91E+06 | 1.61E+07 | -7.32E+06 | 5.80E+06 | 1.71E+07 | -2.46E+05 | -1.84E+05 | -2.47E+05 | -2.80E+05 | -3.82E+05 | -4.13E+05 | -4.68E+05 | -3.27E+05 |
| **97.66** | 9.93E+06 | 6.06E+06 | -5.76E+06 | 1.14E+07 | 1.67E+07 | -6.52E+06 | 5.98E+06 | 1.80E+07 | -9.43E+05 | -8.77E+05 | -6.61E+05 | -3.46E+05 | -8.41E+05 | -7.21E+05 | -4.75E+05 | -5.11E+05 |
| **107.42** | 1.05E+07 | 4.39E+06 | -5.01E+06 | 1.28E+07 | 1.79E+07 | -6.58E+06 | 7.78E+06 | 1.87E+07 | -2.47E+05 | -3.16E+05 | -7.78E+05 | -4.24E+05 | -4.50E+05 | -4.74E+05 | -5.03E+05 | -3.24E+05 |
| **117.19** | 1.22E+07 | 3.64E+06 | -4.77E+06 | 1.35E+07 | 1.91E+07 | -7.14E+06 | 6.39E+06 | 2.02E+07 | -5.77E+05 | -2.60E+05 | -2.56E+05 | -2.25E+05 | -4.19E+05 | -3.93E+05 | -3.85E+05 | -2.00E+05 |
| **126.95** | 1.44E+07 | 3.72E+06 | -4.44E+06 | 1.50E+07 | 2.01E+07 | -7.36E+06 | 5.97E+06 | 2.10E+07 | -2.69E+05 | -6.45E+05 | -2.31E+05 | -5.45E+05 | -3.99E+05 | -5.08E+05 | -4.68E+05 | -4.95E+05 |
| **136.72** | 1.43E+07 | 2.89E+06 | -3.23E+06 | 1.62E+07 | 2.04E+07 | -6.70E+06 | 6.16E+06 | 2.10E+07 | -2.78E+05 | -3.34E+05 | -2.88E+05 | -2.72E+05 | -4.18E+05 | -2.46E+05 | -3.64E+05 | -3.83E+05 |
| **146.48** | 1.54E+07 | 3.10E+06 | -3.54E+06 | 1.72E+07 | 2.06E+07 | -6.66E+06 | 5.71E+06 | 2.18E+07 | -5.16E+05 | -3.26E+05 | -3.05E+05 | -3.67E+05 | -3.62E+05 | -2.57E+05 | -3.60E+05 | -4.10E+05 |
| **156.25** | 1.68E+07 | 3.19E+06 | -2.11E+06 | 1.75E+07 | 2.22E+07 | -6.10E+06 | 5.90E+06 | 2.19E+07 | -3.98E+05 | -2.74E+05 | -3.49E+05 | -3.81E+05 | -5.24E+05 | -3.36E+05 | -6.93E+05 | -3.96E+05 |
| **166.02** | 2.21E+07 | -2.15E+06 | -6.05E+06 | 2.40E+07 | 2.39E+07 | -6.48E+06 | 4.36E+06 | 2.30E+07 | -2.75E+05 | -6.10E+05 | -4.35E+05 | -8.91E+05 | -3.40E+05 | -6.64E+05 | -3.36E+05 | -6.84E+05 |
| **175.78** | 1.73E+07 | 5.73E+06 | 1.00E+06 | 1.62E+07 | 2.15E+07 | -4.72E+06 | 7.00E+06 | 2.17E+07 | -3.75E+05 | -6.56E+05 | -6.06E+05 | -3.20E+05 | -5.36E+05 | -4.14E+05 | -2.91E+05 | -3.11E+05 |
| **185.55** | 2.52E+07 | 2.85E+06 | -7.95E+05 | 1.97E+07 | 2.56E+07 | -5.86E+06 | 7.48E+06 | 2.30E+07 | -4.54E+05 | -2.33E+05 | -3.62E+05 | -1.39E+05 | -9.06E+05 | -2.84E+05 | -3.64E+05 | -2.87E+05 |
| **195.31** | 2.15E+07 | 7.11E+05 | -2.21E+06 | 2.43E+07 | 2.29E+07 | -5.84E+06 | 6.17E+06 | 2.30E+07 | -2.79E+05 | -2.75E+05 | -1.75E+05 | -2.25E+05 | -3.15E+05 | -3.09E+05 | -4.10E+05 | -3.22E+05 |
| **205.08** | 2.27E+07 | 2.28E+05 | -2.58E+06 | 2.37E+07 | 2.31E+07 | -6.69E+06 | 5.65E+06 | 2.34E+07 | -2.84E+05 | -5.22E+05 | -3.14E+05 | -6.84E+05 | -3.69E+05 | -6.17E+05 | -3.94E+05 | -6.92E+05 |
| **214.84** | 2.40E+07 | -2.81E+04 | -2.64E+06 | 2.78E+07 | 2.23E+07 | -5.51E+06 | 6.15E+06 | 2.38E+07 | -3.37E+05 | -1.97E+05 | -2.54E+05 | -1.88E+05 | -4.68E+05 | -4.09E+05 | -2.12E+05 | -3.23E+05 |
| **224.61** | 2.45E+07 | 2.62E+05 | -1.57E+06 | 2.77E+07 | 2.26E+07 | -4.66E+06 | 6.58E+06 | 2.29E+07 | -3.38E+05 | -1.78E+05 | -3.05E+05 | -1.56E+05 | -3.41E+05 | -2.68E+05 | -2.19E+05 | -1.71E+05 |
| **234.38** | 2.59E+07 | 5.64E+05 | -9.26E+05 | 2.78E+07 | 2.26E+07 | -4.22E+06 | 6.51E+06 | 2.30E+07 | -3.24E+05 | -3.36E+05 | -1.82E+05 | -3.00E+05 | -3.86E+05 | -3.18E+05 | -2.01E+05 | -2.56E+05 |
| **244.14** | 2.63E+07 | 8.75E+05 | -2.86E+04 | 2.83E+07 | 2.26E+07 | -3.85E+06 | 6.51E+06 | 2.27E+07 | -3.36E+05 | -2.38E+05 | -1.48E+05 | -2.67E+05 | -2.77E+05 | -2.97E+05 | -2.64E+05 | -2.19E+05 |
| **253.91** | 2.65E+07 | 2.32E+06 | 9.12E+02 | 2.98E+07 | 2.23E+07 | -3.10E+06 | 5.90E+06 | 2.22E+07 | -4.99E+05 | -1.01E+06 | -2.08E+05 | -3.91E+05 | -6.65E+05 | -8.95E+05 | -3.77E+05 | -3.65E+05 |
| **263.67** | 2.84E+07 | 1.69E+06 | -6.97E+05 | 3.03E+07 | 2.19E+07 | -3.42E+06 | 6.14E+06 | 2.18E+07 | -4.30E+05 | -3.73E+05 | -4.28E+05 | -2.61E+05 | -5.55E+05 | -5.61E+05 | -2.79E+05 | -3.25E+05 |
| **273.44** | 2.75E+07 | 2.43E+06 | -3.77E+05 | 3.07E+07 | 2.15E+07 | -2.96E+06 | 6.33E+06 | 2.02E+07 | -3.75E+05 | -4.56E+05 | -3.47E+05 | -3.62E+05 | -4.39E+05 | -4.14E+05 | -3.15E+05 | -4.00E+05 |
| **283.20** | 2.80E+07 | 3.04E+06 | 9.80E+05 | 2.93E+07 | 2.33E+07 | -4.83E+06 | 5.79E+06 | 2.03E+07 | -3.79E+05 | -4.49E+05 | -2.67E+05 | -4.22E+05 | -3.50E+05 | -5.39E+05 | -3.93E+05 | -3.94E+05 |
| **292.97** | 2.81E+07 | 1.47E+06 | 6.42E+05 | 3.06E+07 | 2.39E+07 | -5.36E+06 | 5.01E+06 | 2.21E+07 | -6.11E+05 | -5.31E+05 | -4.38E+05 | -3.45E+05 | -3.89E+05 | -4.63E+05 | -3.91E+05 | -3.87E+05 |
| **302.73** | 3.05E+07 | 2.21E+06 | 7.39E+04 | 3.18E+07 | 2.31E+07 | -3.30E+06 | 5.17E+06 | 2.09E+07 | -8.23E+05 | -5.57E+05 | -4.08E+05 | -4.43E+05 | -6.11E+05 | -6.23E+05 | -5.75E+05 | -4.18E+05 |
| **312.50** | 3.09E+07 | 2.49E+06 | 5.86E+05 | 3.09E+07 | 2.45E+07 | -4.17E+06 | 5.58E+06 | 2.12E+07 | -9.98E+05 | -9.35E+05 | -8.33E+05 | -5.57E+05 | -1.11E+06 | -7.46E+05 | -7.73E+05 | -6.97E+05 |
| **322.27** | 3.18E+07 | 4.14E+06 | 5.12E+05 | 3.17E+07 | 2.42E+07 | -3.30E+06 | 3.83E+06 | 2.12E+07 | -1.65E+06 | -1.14E+06 | -1.47E+06 | -9.25E+05 | -1.86E+06 | -1.09E+06 | -1.50E+06 | -1.03E+06 |
| **332.03** | 2.68E+07 | 1.71E+06 | 2.34E+06 | 3.38E+07 | 3.01E+07 | -3.40E+06 | 7.78E+06 | 2.25E+07 | -6.70E+06 | -4.93E+06 | -9.94E+06 | -5.95E+06 | -1.35E+07 | -8.26E+06 | -4.33E+06 | -3.61E+06 |
| **341.80** | 3.45E+07 | 1.29E+06 | -3.76E+05 | 3.24E+07 | 2.34E+07 | -6.79E+06 | 6.03E+06 | 2.23E+07 | -5.94E+06 | -3.80E+06 | -6.35E+06 | -2.47E+06 | -8.60E+06 | -3.39E+06 | -4.11E+06 | -2.68E+06 |

## Table A25. 70% PR, $\omega$ = 10,200 RPM, and high-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *f* | *Re Hxx* | *Re Hxy* | *Re Hyx* | *Re Hyy* | *Im Hxx* | *Im Hxy* | *Im Hyx* | *Im Hyy* | *Re eHxx* | *Re eHxy* | *Re eHyx* | *Re eHyy* | *Im eHxx* | *Im eHxy* | *Im eHyx* | *Im eHyy* |
| **9.77** | 1.86E+06 | -7.93E+05 | 1.56E+06 | 2.43E+06 | 1.68E+06 | -1.51E+05 | 5.71E+04 | 2.10E+06 | -3.80E+05 | -1.70E+05 | -2.91E+05 | -2.31E+05 | -4.07E+05 | -2.82E+05 | -3.70E+05 | -2.56E+05 |
| **19.53** | 2.27E+06 | -8.38E+05 | 1.52E+06 | 2.63E+06 | 4.07E+06 | -7.21E+05 | -1.32E+05 | 4.13E+06 | -3.67E+05 | -2.50E+05 | -2.62E+05 | -2.73E+05 | -2.60E+05 | -1.77E+05 | -2.40E+05 | -2.22E+05 |
| **29.30** | 2.65E+06 | -8.95E+05 | 1.46E+06 | 3.45E+06 | 5.77E+06 | -4.61E+05 | 2.99E+05 | 5.79E+06 | -1.94E+05 | -2.96E+05 | -2.05E+05 | -3.02E+05 | -2.47E+05 | -2.77E+05 | -2.08E+05 | -4.28E+05 |
| **39.06** | 3.28E+06 | -7.05E+05 | 1.57E+06 | 4.04E+06 | 7.68E+06 | -8.07E+05 | 4.26E+05 | 7.76E+06 | -2.47E+05 | -3.56E+05 | -2.74E+05 | -2.56E+05 | -2.66E+05 | -2.30E+05 | -2.71E+05 | -2.51E+05 |
| **48.83** | 3.93E+06 | -6.63E+05 | 1.96E+06 | 4.38E+06 | 9.26E+06 | -1.67E+06 | 5.64E+05 | 9.53E+06 | -3.57E+05 | -3.27E+05 | -2.82E+05 | -2.74E+05 | -2.72E+05 | -3.07E+05 | -3.64E+05 | -2.13E+05 |
| **58.59** | 4.50E+06 | -1.39E+06 | 1.53E+06 | 5.26E+06 | 1.03E+07 | -1.73E+06 | 9.79E+05 | 1.15E+07 | -2.75E+05 | -3.49E+05 | -4.02E+05 | -5.60E+05 | -2.38E+05 | -4.27E+05 | -3.55E+05 | -2.37E+05 |
| **68.36** | 5.47E+06 | -8.48E+05 | 2.48E+06 | 4.96E+06 | 1.19E+07 | -1.07E+06 | 3.74E+05 | 1.34E+07 | -3.76E+05 | -5.67E+05 | -5.39E+05 | -2.68E+05 | -3.27E+05 | -4.67E+05 | -3.42E+05 | -6.75E+05 |
| **78.13** | 5.72E+06 | -1.71E+06 | 2.04E+06 | 7.54E+06 | 1.32E+07 | -1.86E+06 | 3.94E+05 | 1.46E+07 | -2.45E+05 | -3.77E+05 | -1.65E+05 | -3.33E+05 | -2.38E+05 | -2.59E+05 | -1.86E+05 | -3.06E+05 |
| **87.89** | 6.72E+06 | -1.61E+06 | 2.14E+06 | 8.08E+06 | 1.47E+07 | -1.89E+06 | 7.49E+05 | 1.62E+07 | -2.28E+05 | -2.40E+05 | -1.54E+05 | -1.65E+05 | -1.22E+05 | -2.25E+05 | -1.96E+05 | -2.83E+05 |
| **97.66** | 7.48E+06 | -1.33E+06 | 2.58E+06 | 9.25E+06 | 1.66E+07 | -1.69E+06 | 6.96E+05 | 1.73E+07 | -2.84E+05 | -2.06E+05 | -2.98E+05 | -2.82E+05 | -3.49E+05 | -2.35E+05 | -3.59E+05 | -2.54E+05 |
| **107.42** | 8.98E+06 | -1.88E+06 | 1.16E+06 | 1.05E+07 | 1.72E+07 | -2.16E+06 | 5.01E+05 | 1.84E+07 | -2.12E+05 | -2.49E+05 | -3.18E+05 | -4.42E+05 | -3.60E+05 | -3.63E+05 | -4.15E+05 | -3.23E+05 |
| **117.19** | 1.00E+07 | -2.08E+06 | 1.98E+06 | 1.18E+07 | 1.88E+07 | -2.53E+06 | 6.26E+05 | 1.97E+07 | -4.43E+05 | -2.43E+05 | -2.80E+05 | -2.30E+05 | -2.05E+05 | -3.86E+05 | -1.56E+05 | -2.81E+05 |
| **126.95** | 1.07E+07 | -2.07E+06 | 2.61E+06 | 1.22E+07 | 1.90E+07 | -2.64E+06 | 1.30E+06 | 2.02E+07 | -2.20E+05 | -4.26E+05 | -1.87E+05 | -4.49E+05 | -2.49E+05 | -5.75E+05 | -1.95E+05 | -6.66E+05 |
| **136.72** | 1.17E+07 | -1.82E+06 | 2.41E+06 | 1.39E+07 | 2.02E+07 | -1.82E+06 | 1.18E+06 | 2.10E+07 | -1.29E+05 | -2.12E+05 | -3.75E+05 | -2.00E+05 | -2.59E+05 | -4.19E+05 | -2.41E+05 | -2.87E+05 |
| **146.48** | 1.24E+07 | -1.45E+06 | 2.22E+06 | 1.45E+07 | 2.06E+07 | -1.85E+06 | 4.67E+05 | 2.19E+07 | -3.35E+05 | -3.90E+05 | -2.20E+05 | -3.52E+05 | -2.27E+05 | -3.65E+05 | -2.15E+05 | -3.35E+05 |
| **156.25** | 1.26E+07 | -1.54E+05 | 2.58E+06 | 1.48E+07 | 2.21E+07 | -2.59E+06 | 8.63E+05 | 2.19E+07 | -3.52E+05 | -3.62E+05 | -3.35E+05 | -4.92E+05 | -2.63E+05 | -5.53E+05 | -3.29E+05 | -5.75E+05 |
| **166.02** | 1.94E+07 | -1.12E+07 | -2.23E+06 | 2.22E+07 | 2.25E+07 | -4.01E+06 | -1.74E+06 | 3.33E+07 | -7.21E+05 | -1.13E+06 | -6.38E+05 | -3.04E+06 | -4.55E+05 | -3.38E+06 | -6.68E+05 | -2.26E+06 |
| **175.78** | 1.26E+07 | -6.59E+05 | 4.56E+06 | 1.50E+07 | 2.18E+07 | 1.59E+06 | 3.29E+06 | 2.26E+07 | -4.50E+05 | -7.91E+05 | -5.32E+05 | -4.80E+05 | -4.91E+05 | -6.51E+05 | -4.41E+05 | -8.80E+05 |
| **185.55** | 2.16E+07 | -1.16E+06 | 3.40E+06 | 1.63E+07 | 2.57E+07 | -1.71E+06 | 2.30E+06 | 2.43E+07 | -1.87E+05 | -2.72E+05 | -2.74E+05 | -3.64E+05 | -1.57E+05 | -2.48E+05 | -2.98E+05 | -4.53E+05 |
| **195.31** | 1.87E+07 | -2.97E+06 | 1.29E+06 | 2.15E+07 | 2.52E+07 | -1.95E+06 | 6.56E+05 | 2.54E+07 | -2.89E+05 | -3.66E+05 | -1.73E+05 | -2.31E+05 | -1.98E+05 | -2.37E+05 | -2.86E+05 | -3.50E+05 |
| **205.08** | 1.98E+07 | -3.53E+06 | 1.83E+06 | 2.21E+07 | 2.46E+07 | -1.30E+06 | 1.68E+06 | 2.53E+07 | -2.59E+05 | -8.97E+05 | -2.18E+05 | -5.28E+05 | -3.62E+05 | -4.37E+05 | -2.23E+05 | -5.75E+05 |
| **214.84** | 2.12E+07 | -3.82E+06 | 1.65E+06 | 2.62E+07 | 2.57E+07 | -1.22E+06 | 9.93E+05 | 2.70E+07 | -1.18E+05 | -2.48E+05 | -1.59E+05 | -2.36E+05 | -2.50E+05 | -3.02E+05 | -1.76E+05 | -2.27E+05 |
| **224.61** | 2.19E+07 | -2.95E+06 | 2.70E+06 | 2.53E+07 | 2.60E+07 | -9.79E+05 | 1.56E+06 | 2.60E+07 | -2.39E+05 | -1.56E+05 | -2.05E+05 | -2.48E+05 | -1.91E+05 | -2.38E+05 | -2.22E+05 | -2.20E+05 |
| **234.38** | 2.26E+07 | -2.80E+06 | 2.79E+06 | 2.55E+07 | 2.60E+07 | -6.23E+05 | 1.92E+06 | 2.66E+07 | -3.06E+05 | -2.01E+05 | -1.77E+05 | -2.58E+05 | -1.75E+05 | -3.07E+05 | -1.69E+05 | -2.19E+05 |
| **244.14** | 2.36E+07 | -2.17E+06 | 3.49E+06 | 2.62E+07 | 2.68E+07 | -6.68E+05 | 1.49E+06 | 2.67E+07 | -1.71E+05 | -1.75E+05 | -1.93E+05 | -3.37E+05 | -1.36E+05 | -2.87E+05 | -1.37E+05 | -2.88E+05 |
| **253.91** | 2.46E+07 | -7.35E+05 | 3.23E+06 | 2.82E+07 | 2.61E+07 | 5.24E+05 | 1.51E+06 | 2.65E+07 | -4.44E+05 | -9.55E+05 | -2.43E+05 | -3.72E+05 | -6.06E+05 | -8.68E+05 | -2.33E+05 | -4.05E+05 |
| **263.67** | 2.68E+07 | -1.35E+06 | 2.26E+06 | 2.97E+07 | 2.59E+07 | 1.03E+05 | 1.39E+06 | 2.58E+07 | -3.27E+05 | -3.71E+05 | -3.39E+05 | -2.08E+05 | -2.43E+05 | -4.25E+05 | -1.99E+05 | -3.09E+05 |
| **273.44** | 2.56E+07 | -1.00E+06 | 2.76E+06 | 2.98E+07 | 2.57E+07 | 2.95E+05 | 1.61E+06 | 2.49E+07 | -3.37E+05 | -2.41E+05 | -1.66E+05 | -3.18E+05 | -1.90E+05 | -2.82E+05 | -2.08E+05 | -4.30E+05 |
| **283.20** | 2.64E+07 | -1.00E+06 | 3.10E+06 | 2.95E+07 | 2.77E+07 | -6.56E+05 | 1.80E+06 | 2.45E+07 | -2.19E+05 | -2.93E+05 | -1.95E+05 | -2.65E+05 | -2.19E+05 | -3.19E+05 | -2.53E+05 | -2.77E+05 |
| **292.97** | 2.69E+07 | -1.61E+06 | 3.63E+06 | 2.98E+07 | 2.82E+07 | -9.89E+05 | 8.05E+05 | 2.65E+07 | -2.09E+05 | -3.99E+05 | -2.78E+05 | -3.13E+05 | -2.44E+05 | -2.06E+05 | -2.47E+05 | -2.59E+05 |
| **302.73** | 2.96E+07 | -1.06E+06 | 2.71E+06 | 3.11E+07 | 2.76E+07 | 9.87E+05 | 1.15E+06 | 2.55E+07 | -3.49E+05 | -2.45E+05 | -1.89E+05 | -2.46E+05 | -2.77E+05 | -2.52E+05 | -2.22E+05 | -3.02E+05 |
| **312.50** | 3.10E+07 | -8.49E+05 | 3.44E+06 | 3.05E+07 | 2.88E+07 | 1.57E+05 | 1.60E+06 | 2.56E+07 | -2.78E+05 | -2.78E+05 | -2.65E+05 | -2.50E+05 | -2.81E+05 | -2.82E+05 | -2.50E+05 | -2.56E+05 |
| **322.27** | 3.18E+07 | 6.67E+05 | 3.94E+06 | 3.19E+07 | 2.77E+07 | 1.33E+06 | 2.66E+05 | 2.63E+07 | -2.79E+05 | -2.31E+05 | -2.31E+05 | -3.82E+05 | -2.54E+05 | -3.39E+05 | -3.00E+05 | -2.60E+05 |
| **332.03** | 3.16E+07 | 1.06E+06 | 2.25E+06 | 3.26E+07 | 2.80E+07 | -4.35E+04 | -2.21E+04 | 2.58E+07 | -4.58E+05 | -5.94E+05 | -3.11E+05 | -4.96E+05 | -3.09E+05 | -4.09E+05 | -3.01E+05 | -3.73E+05 |
| **341.80** | 4.26E+07 | 2.50E+05 | -1.26E+06 | 3.27E+07 | 4.25E+07 | -2.51E+06 | -2.59E+06 | 2.43E+07 | -7.66E+05 | -1.40E+06 | -5.54E+05 | -1.16E+06 | -1.16E+06 | -9.05E+05 | -8.50E+05 | -6.94E+05 |

## Table A26. 70% PR, $\omega$ = 15,350 RPM, and high-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *f* | *Re Hxx* | *Re Hxy* | *Re Hyx* | *Re Hyy* | *Im Hxx* | *Im Hxy* | *Im Hyx* | *Im Hyy* | *Re eHxx* | *Re eHxy* | *Re eHyx* | *Re eHyy* | *Im eHxx* | *Im eHxy* | *Im eHyx* | *Im eHyy* |
| **9.77** | 1.56E+06 | 4.75E+06 | -3.57E+06 | 2.49E+06 | 2.38E+06 | -6.40E+05 | 1.88E+05 | 2.61E+06 | -4.38E+05 | -2.43E+05 | -3.77E+05 | -2.15E+05 | -3.24E+05 | -2.77E+05 | -2.93E+05 | -2.22E+05 |
| **19.53** | 2.02E+06 | 4.36E+06 | -3.91E+06 | 2.97E+06 | 4.28E+06 | -1.17E+06 | 7.47E+05 | 4.23E+06 | -3.05E+05 | -1.41E+05 | -3.71E+05 | -1.59E+05 | -2.74E+05 | -2.03E+05 | -3.13E+05 | -2.17E+05 |
| **29.30** | 2.72E+06 | 4.27E+06 | -3.71E+06 | 3.37E+06 | 6.08E+06 | -1.51E+06 | 9.01E+05 | 6.61E+06 | -3.25E+05 | -3.89E+05 | -2.42E+05 | -4.22E+05 | -2.59E+05 | -3.66E+05 | -2.22E+05 | -3.19E+05 |
| **39.06** | 3.01E+06 | 4.42E+06 | -3.54E+06 | 4.11E+06 | 8.37E+06 | -2.11E+06 | 1.59E+06 | 8.45E+06 | -2.72E+05 | -3.12E+05 | -3.26E+05 | -2.14E+05 | -2.26E+05 | -3.51E+05 | -1.87E+05 | -3.21E+05 |
| **48.83** | 3.90E+06 | 3.23E+06 | -3.22E+06 | 4.86E+06 | 9.60E+06 | -2.96E+06 | 1.87E+06 | 9.99E+06 | -4.76E+05 | -5.26E+05 | -3.50E+05 | -2.38E+05 | -2.75E+05 | -3.32E+05 | -3.10E+05 | -3.45E+05 |
| **58.59** | 4.79E+06 | 3.00E+06 | -2.88E+06 | 4.99E+06 | 1.07E+07 | -3.21E+06 | 2.61E+06 | 1.16E+07 | -2.83E+05 | -4.30E+05 | -3.65E+05 | -6.79E+05 | -2.56E+05 | -3.64E+05 | -3.04E+05 | -3.86E+05 |
| **68.36** | 6.07E+06 | 2.56E+06 | -2.34E+06 | 6.51E+06 | 1.16E+07 | -3.11E+06 | 1.80E+06 | 1.35E+07 | -5.73E+05 | -4.23E+05 | -4.87E+05 | -5.48E+05 | -4.14E+05 | -4.91E+05 | -3.23E+05 | -7.75E+05 |
| **78.13** | 6.10E+06 | 2.58E+06 | -2.28E+06 | 7.82E+06 | 1.39E+07 | -3.71E+06 | 2.46E+06 | 1.52E+07 | -3.78E+05 | -2.58E+05 | -2.63E+05 | -2.76E+05 | -2.09E+05 | -2.72E+05 | -2.94E+05 | -3.07E+05 |
| **87.89** | 6.76E+06 | 2.49E+06 | -2.38E+06 | 8.75E+06 | 1.50E+07 | -3.58E+06 | 2.21E+06 | 1.63E+07 | -3.96E+05 | -1.60E+05 | -2.10E+05 | -2.01E+05 | -2.57E+05 | -2.52E+05 | -4.04E+05 | -1.89E+05 |
| **97.66** | 8.26E+06 | 1.89E+06 | -2.22E+06 | 9.83E+06 | 1.65E+07 | -4.18E+06 | 2.45E+06 | 1.76E+07 | -2.23E+05 | -3.16E+05 | -2.96E+05 | -2.05E+05 | -5.26E+05 | -2.99E+05 | -1.45E+05 | -3.71E+05 |
| **107.42** | 9.90E+06 | 2.42E+06 | -2.02E+06 | 1.11E+07 | 1.79E+07 | -4.49E+06 | 3.19E+06 | 1.87E+07 | -3.75E+05 | -5.02E+05 | -6.07E+05 | -3.01E+05 | -2.60E+05 | -4.21E+05 | -2.90E+05 | -2.74E+05 |
| **117.19** | 1.06E+07 | 1.33E+06 | -2.22E+06 | 1.29E+07 | 1.92E+07 | -4.22E+06 | 2.80E+06 | 2.00E+07 | -2.39E+05 | -3.31E+05 | -4.29E+05 | -1.91E+05 | -4.28E+05 | -3.50E+05 | -4.49E+05 | -3.40E+05 |
| **126.95** | 1.15E+07 | 8.31E+05 | -1.13E+06 | 1.40E+07 | 1.96E+07 | -4.29E+06 | 3.30E+06 | 2.03E+07 | -3.48E+05 | -6.06E+05 | -2.42E+05 | -4.95E+05 | -3.07E+05 | -7.48E+05 | -2.66E+05 | -3.90E+05 |
| **136.72** | 1.24E+07 | 1.24E+06 | -1.57E+06 | 1.46E+07 | 2.06E+07 | -4.12E+06 | 3.32E+06 | 2.16E+07 | -3.20E+05 | -3.71E+05 | -1.77E+05 | -1.93E+05 | -2.38E+05 | -4.14E+05 | -3.64E+05 | -3.59E+05 |
| **146.48** | 1.32E+07 | 5.11E+05 | -1.08E+06 | 1.62E+07 | 2.08E+07 | -4.56E+06 | 3.68E+06 | 2.17E+07 | -4.41E+05 | -4.05E+05 | -3.53E+05 | -3.67E+05 | -2.73E+05 | -3.26E+05 | -3.12E+05 | -3.88E+05 |
| **156.25** | 1.43E+07 | 9.20E+05 | -1.61E+06 | 1.59E+07 | 2.20E+07 | -4.10E+06 | 2.78E+06 | 2.35E+07 | -2.66E+05 | -6.85E+05 | -3.89E+05 | -3.26E+05 | -4.04E+05 | -5.66E+05 | -2.18E+05 | -5.10E+05 |
| **166.02** | 2.11E+07 | -6.83E+06 | -6.13E+06 | 2.73E+07 | 3.91E+07 | -2.04E+07 | -1.10E+07 | 3.96E+07 | -1.04E+06 | -1.63E+06 | -9.39E+05 | -1.78E+06 | -6.93E+05 | -1.45E+06 | -6.09E+05 | -1.28E+06 |
| **175.78** | 1.51E+07 | 3.68E+06 | 2.48E+06 | 1.46E+07 | 2.26E+07 | -2.40E+06 | 4.69E+06 | 2.24E+07 | -2.37E+05 | -3.38E+05 | -2.70E+05 | -4.36E+05 | -3.00E+05 | -4.36E+05 | -2.49E+05 | -3.31E+05 |
| **185.55** | 2.29E+07 | 8.90E+05 | 1.01E+06 | 1.83E+07 | 2.60E+07 | -4.42E+06 | 4.31E+06 | 2.49E+07 | -3.55E+05 | -4.02E+05 | -4.82E+05 | -2.26E+05 | -2.87E+05 | -2.86E+05 | -3.69E+05 | -3.30E+05 |
| **195.31** | 1.89E+07 | -4.24E+05 | -1.66E+06 | 2.29E+07 | 2.45E+07 | -4.79E+06 | 3.52E+06 | 2.51E+07 | -3.41E+05 | -2.24E+05 | -4.63E+05 | -2.83E+05 | -1.85E+05 | -5.52E+05 | -3.65E+05 | -3.39E+05 |
| **205.08** | 2.05E+07 | -1.41E+06 | -8.59E+05 | 2.23E+07 | 2.44E+07 | -4.77E+06 | 3.99E+06 | 2.51E+07 | -5.77E+05 | -4.64E+05 | -3.67E+05 | -1.10E+06 | -3.37E+05 | -7.88E+05 | -5.45E+05 | -5.60E+05 |
| **214.84** | 2.25E+07 | -9.93E+05 | -1.51E+06 | 2.70E+07 | 2.51E+07 | -3.67E+06 | 3.63E+06 | 2.59E+07 | -3.31E+05 | -4.26E+05 | -3.00E+05 | -2.42E+05 | -2.94E+05 | -2.65E+05 | -3.98E+05 | -2.93E+05 |
| **224.61** | 2.26E+07 | -6.73E+05 | -4.24E+05 | 2.68E+07 | 2.52E+07 | -2.94E+06 | 4.78E+06 | 2.53E+07 | -4.17E+05 | -2.41E+05 | -2.05E+05 | -3.40E+05 | -3.65E+05 | -3.97E+05 | -3.98E+05 | -2.68E+05 |
| **234.38** | 2.43E+07 | -2.08E+05 | 1.14E+06 | 2.68E+07 | 2.62E+07 | -2.56E+06 | 4.78E+06 | 2.53E+07 | -5.07E+05 | -4.52E+05 | -3.50E+05 | -3.78E+05 | -4.65E+05 | -5.88E+05 | -5.48E+05 | -4.63E+05 |
| **244.14** | 2.49E+07 | 8.35E+05 | 1.86E+06 | 2.76E+07 | 2.60E+07 | -2.77E+06 | 3.34E+06 | 2.52E+07 | -8.05E+05 | -5.35E+05 | -7.28E+05 | -5.71E+05 | -9.44E+05 | -9.48E+05 | -7.52E+05 | -6.06E+05 |
| **253.91** | 2.64E+07 | 1.55E+06 | 1.93E+06 | 2.47E+07 | 2.63E+07 | -7.14E+06 | 2.68E+06 | 2.67E+07 | -6.41E+06 | -6.43E+06 | -5.78E+06 | -3.62E+06 | -6.59E+06 | -4.36E+06 | -6.00E+06 | -5.39E+06 |
| **263.67** | 2.80E+07 | 1.30E+06 | -6.45E+03 | 3.01E+07 | 2.45E+07 | -2.02E+06 | 3.10E+06 | 2.36E+07 | -1.45E+06 | -9.33E+05 | -1.57E+06 | -1.02E+06 | -1.65E+06 | -1.32E+06 | -1.32E+06 | -1.04E+06 |
| **273.44** | 2.63E+07 | 1.82E+06 | 2.09E+05 | 3.08E+07 | 2.50E+07 | -1.59E+06 | 4.03E+06 | 2.30E+07 | -7.42E+05 | -4.68E+05 | -4.98E+05 | -7.10E+05 | -7.24E+05 | -7.22E+05 | -5.67E+05 | -5.53E+05 |
| **283.20** | 2.69E+07 | 1.64E+06 | 1.50E+06 | 2.96E+07 | 2.72E+07 | -3.27E+06 | 4.16E+06 | 2.35E+07 | -3.82E+05 | -5.55E+05 | -3.17E+05 | -5.50E+05 | -4.59E+05 | -3.70E+05 | -5.13E+05 | -4.38E+05 |
| **292.97** | 2.74E+07 | 4.61E+05 | 1.63E+06 | 3.05E+07 | 2.73E+07 | -3.04E+06 | 3.24E+06 | 2.50E+07 | -4.08E+05 | -4.13E+05 | -3.19E+05 | -2.92E+05 | -4.18E+05 | -3.67E+05 | -2.68E+05 | -3.14E+05 |
| **302.73** | 2.96E+07 | 1.09E+06 | 5.15E+05 | 3.15E+07 | 2.63E+07 | -1.07E+06 | 3.82E+06 | 2.37E+07 | -3.67E+05 | -3.39E+05 | -4.07E+05 | -3.13E+05 | -5.05E+05 | -3.72E+05 | -3.65E+05 | -3.36E+05 |
| **312.50** | 3.02E+07 | 1.47E+06 | 1.66E+06 | 3.10E+07 | 2.78E+07 | -2.21E+06 | 4.02E+06 | 2.48E+07 | -3.98E+05 | -3.29E+05 | -3.22E+05 | -2.18E+05 | -3.88E+05 | -4.08E+05 | -3.27E+05 | -3.14E+05 |
| **322.27** | 3.21E+07 | 2.51E+06 | 2.13E+06 | 3.27E+07 | 2.68E+07 | -7.46E+05 | 2.59E+06 | 2.53E+07 | -3.63E+05 | -2.30E+05 | -4.10E+05 | -2.96E+05 | -4.40E+05 | -3.95E+05 | -3.13E+05 | -3.57E+05 |
| **332.03** | 2.95E+07 | 3.99E+06 | 1.34E+06 | 3.31E+07 | 2.87E+07 | -8.88E+05 | 2.07E+06 | 2.44E+07 | -3.73E+05 | -4.47E+05 | -4.46E+05 | -3.09E+05 | -3.04E+05 | -2.91E+05 | -3.53E+05 | -4.07E+05 |
| **341.80** | 3.84E+07 | 1.29E+06 | 4.23E+05 | 3.35E+07 | 4.53E+07 | -1.16E+07 | 1.30E+06 | 2.62E+07 | -6.33E+05 | -5.20E+05 | -6.40E+05 | -3.48E+05 | -6.63E+05 | -4.88E+05 | -6.66E+05 | -3.64E+05 |

# Table A27. 70% PR, ω =20,200 RPM, and high-negative preswirl.

| | Test Data | | | | | | | | Uncertainties | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *f* | *Re Hxx* | *Re Hxy* | *Re Hyx* | *Re Hyy* | *Im Hxx* | *Im Hxy* | *Im Hyx* | *Im Hyy* | *Re eHxx* | *Re eHxy* | *Re eHyx* | *Re eHyy* | *Im eHxx* | *Im eHxy* | *Im eHyx* | *Im eHyy* |
| **9.77** | 1.60E+06 | 1.03E+07 | -9.57E+06 | 1.46E+06 | 1.79E+06 | -1.37E+06 | 7.44E+05 | 2.51E+06 | -4.48E+05 | -2.66E+05 | -5.28E+05 | -2.67E+05 | -4.51E+05 | -2.89E+05 | -5.65E+05 | -2.76E+05 |
| **19.53** | 2.16E+06 | 1.01E+07 | -9.62E+06 | 2.35E+06 | 4.89E+06 | -1.81E+06 | 9.47E+05 | 4.53E+06 | -3.05E+05 | -1.94E+05 | -4.22E+05 | -3.78E+05 | -3.21E+05 | -2.12E+05 | -4.36E+05 | -3.09E+05 |
| **29.30** | 2.95E+06 | 9.89E+06 | -9.50E+06 | 3.00E+06 | 6.72E+06 | -3.41E+06 | 2.62E+06 | 6.99E+06 | -2.89E+05 | -2.12E+05 | -3.00E+05 | -3.41E+05 | -3.66E+05 | -3.27E+05 | -2.76E+05 | -2.05E+05 |
| **39.06** | 3.24E+06 | 9.51E+06 | -9.29E+06 | 4.11E+06 | 8.23E+06 | -3.29E+06 | 3.36E+06 | 8.85E+06 | -2.75E+05 | -4.43E+05 | -2.65E+05 | -2.30E+05 | -3.47E+05 | -3.15E+05 | -2.38E+05 | -3.77E+05 |
| **48.83** | 3.82E+06 | 7.39E+06 | -8.80E+06 | 4.19E+06 | 1.32E+07 | -8.32E+05 | 3.22E+06 | 9.93E+06 | -1.06E+06 | -5.37E+05 | -5.72E+05 | -1.85E+05 | -5.21E+05 | -7.13E+05 | -4.24E+05 | -4.03E+05 |
| **58.59** | 6.30E+06 | 8.01E+06 | -8.67E+06 | 6.44E+06 | 1.14E+07 | -5.86E+06 | 4.11E+06 | 1.23E+07 | -5.52E+05 | -7.31E+05 | -4.39E+05 | -8.54E+05 | -3.66E+05 | -4.74E+05 | -5.49E+05 | -5.65E+05 |
| **68.36** | 6.98E+06 | 7.81E+06 | -7.28E+06 | 7.10E+06 | 1.25E+07 | -5.02E+06 | 3.90E+06 | 1.35E+07 | -5.89E+05 | -5.04E+05 | -6.98E+05 | -8.10E+05 | -3.99E+05 | -6.54E+05 | -5.17E+05 | -7.02E+05 |
| **78.13** | 7.18E+06 | 7.18E+06 | -7.47E+06 | 7.93E+06 | 1.38E+07 | -5.76E+06 | 4.65E+06 | 1.52E+07 | -4.68E+05 | -3.13E+05 | -3.98E+05 | -2.69E+05 | -2.81E+05 | -4.20E+05 | -2.83E+05 | -4.00E+05 |
| **87.89** | 8.21E+06 | 6.97E+06 | -7.00E+06 | 8.53E+06 | 1.51E+07 | -6.52E+06 | 4.92E+06 | 1.63E+07 | -4.82E+05 | -2.42E+05 | -3.19E+05 | -3.71E+05 | -2.50E+05 | -2.96E+05 | -4.04E+05 | -4.06E+05 |
| **97.66** | 8.21E+06 | 7.39E+06 | -6.43E+06 | 1.06E+07 | 1.87E+07 | -5.26E+06 | 5.76E+06 | 1.79E+07 | -4.62E+05 | -5.30E+05 | -4.70E+05 | -4.06E+05 | -5.46E+05 | -4.27E+05 | -3.45E+05 | -4.10E+05 |
| **107.42** | 1.03E+07 | 5.73E+06 | -6.45E+06 | 1.15E+07 | 1.85E+07 | -7.83E+06 | 5.93E+06 | 1.97E+07 | -3.02E+05 | -4.69E+05 | -3.68E+05 | -4.04E+05 | -6.59E+05 | -2.08E+05 | -4.96E+05 | -4.84E+05 |
| **117.19** | 1.16E+07 | 4.60E+06 | -5.88E+06 | 1.29E+07 | 1.88E+07 | -6.97E+06 | 6.36E+06 | 2.03E+07 | -2.31E+05 | -4.19E+05 | -4.82E+05 | -3.45E+05 | -3.24E+05 | -2.67E+05 | -4.25E+05 | -2.55E+05 |
| **126.95** | 1.30E+07 | 3.04E+06 | -5.35E+06 | 1.42E+07 | 1.88E+07 | -6.91E+06 | 5.82E+06 | 2.13E+07 | -2.75E+05 | -5.73E+05 | -3.92E+05 | -6.20E+05 | -4.88E+05 | -4.54E+05 | -3.08E+05 | -4.34E+05 |
| **136.72** | 1.35E+07 | 4.03E+06 | -4.27E+06 | 1.48E+07 | 2.05E+07 | -6.89E+06 | 5.75E+06 | 2.19E+07 | -1.78E+05 | -5.57E+05 | -2.16E+05 | -3.59E+05 | -3.89E+05 | -2.10E+05 | -2.39E+05 | -3.67E+05 |
| **146.48** | 1.39E+07 | 4.41E+06 | -3.83E+06 | 1.59E+07 | 2.09E+07 | -7.03E+06 | 6.58E+06 | 2.23E+07 | -2.42E+05 | -4.49E+05 | -3.13E+05 | -5.54E+05 | -3.84E+05 | -2.20E+05 | -4.26E+05 | -5.78E+05 |
| **156.25** | 1.60E+07 | 4.06E+06 | -4.00E+06 | 1.64E+07 | 2.19E+07 | -6.62E+06 | 6.10E+06 | 2.33E+07 | -4.89E+05 | -2.35E+05 | -6.24E+05 | -4.05E+05 | -6.75E+05 | -3.33E+05 | -2.47E+05 | -5.14E+05 |
| **166.02** | 2.10E+07 | 6.60E+05 | -7.02E+06 | 2.17E+07 | 2.49E+07 | -9.03E+06 | 4.28E+06 | 2.44E+07 | -3.16E+05 | -7.52E+05 | -5.18E+05 | -5.66E+05 | -3.33E+05 | -4.20E+05 | -4.97E+05 | -4.38E+05 |
| **175.78** | 1.58E+07 | 6.63E+06 | 2.33E+05 | 1.48E+07 | 2.22E+07 | -4.77E+06 | 6.64E+06 | 2.15E+07 | -3.99E+05 | -4.74E+05 | -3.16E+05 | -4.51E+05 | -5.04E+05 | -5.20E+05 | -5.15E+05 | -2.08E+05 |
| **185.55** | 2.30E+07 | 3.25E+06 | -2.45E+06 | 1.69E+07 | 2.28E+07 | -6.43E+06 | 6.02E+06 | 2.40E+07 | -2.66E+05 | -2.76E+05 | -2.36E+05 | -3.53E+05 | -2.81E+05 | -4.38E+05 | -3.16E+05 | -2.34E+05 |
| **195.31** | 2.00E+07 | 1.91E+06 | -3.45E+06 | 2.31E+07 | 2.37E+07 | -6.10E+06 | 6.24E+06 | 2.42E+07 | -3.48E+05 | -2.29E+05 | -3.78E+05 | -2.80E+05 | -2.68E+05 | -2.74E+05 | -3.16E+05 | -1.65E+05 |
| **205.08** | 2.16E+07 | 1.38E+06 | -3.18E+06 | 2.23E+07 | 2.45E+07 | -6.98E+06 | 6.16E+06 | 2.44E+07 | -6.26E+05 | -5.75E+05 | -3.54E+05 | -7.74E+05 | -3.78E+05 | -5.93E+05 | -4.49E+05 | -7.61E+05 |
| **214.84** | 2.36E+07 | 8.70E+05 | -3.98E+06 | 2.65E+07 | 2.41E+07 | -6.30E+06 | 5.63E+06 | 2.52E+07 | -2.20E+05 | -2.78E+05 | -3.12E+05 | -2.34E+05 | -3.03E+05 | -3.45E+05 | -2.55E+05 | -2.42E+05 |
| **224.61** | 2.38E+07 | 8.50E+05 | -2.49E+06 | 2.67E+07 | 2.41E+07 | -5.48E+06 | 6.56E+06 | 2.49E+07 | -2.30E+05 | -1.81E+05 | -1.96E+05 | -2.29E+05 | -2.34E+05 | -2.40E+05 | -3.82E+05 | -3.29E+05 |
| **234.38** | 2.47E+07 | 1.35E+06 | -1.72E+06 | 2.70E+07 | 2.43E+07 | -4.67E+06 | 6.84E+06 | 2.48E+07 | -1.76E+05 | -2.11E+05 | -2.06E+05 | -2.34E+05 | -2.46E+05 | -2.43E+05 | -2.99E+05 | -2.33E+05 |
| **244.14** | 2.54E+07 | 1.66E+06 | -1.46E+06 | 2.77E+07 | 2.46E+07 | -4.71E+06 | 5.97E+06 | 2.50E+07 | -3.24E+05 | -3.68E+05 | -2.32E+05 | -2.60E+05 | -1.70E+05 | -3.26E+05 | -2.68E+05 | -2.75E+05 |
| **253.91** | 2.58E+07 | 3.22E+06 | -1.51E+06 | 2.97E+07 | 2.41E+07 | -3.33E+06 | 6.03E+06 | 2.42E+07 | -5.58E+05 | -1.03E+06 | -2.87E+05 | -3.85E+05 | -6.26E+05 | -9.66E+05 | -2.91E+05 | -3.90E+05 |
| **263.67** | 2.82E+07 | 2.23E+06 | -1.79E+06 | 2.97E+07 | 2.42E+07 | -4.41E+06 | 6.74E+06 | 2.38E+07 | -5.26E+05 | -3.99E+05 | -4.95E+05 | -2.90E+05 | -3.75E+05 | -4.50E+05 | -5.14E+05 | -4.16E+05 |
| **273.44** | 2.69E+07 | 2.81E+06 | -1.25E+06 | 3.06E+07 | 2.33E+07 | -3.61E+06 | 7.15E+06 | 2.24E+07 | -4.41E+05 | -4.85E+05 | -4.70E+05 | -3.13E+05 | -4.42E+05 | -4.28E+05 | -3.50E+05 | -6.67E+05 |
| **283.20** | 2.73E+07 | 3.72E+06 | -4.09E+05 | 2.92E+07 | 2.49E+07 | -5.06E+06 | 6.04E+06 | 2.26E+07 | -3.49E+05 | -4.49E+05 | -3.61E+05 | -4.38E+05 | -4.40E+05 | -5.64E+05 | -3.41E+05 | -4.92E+05 |
| **292.97** | 2.77E+07 | 2.24E+06 | -3.41E+05 | 3.02E+07 | 2.59E+07 | -5.15E+06 | 4.95E+06 | 2.43E+07 | -4.01E+05 | -5.51E+05 | -4.95E+05 | -5.33E+05 | -5.49E+05 | -4.56E+05 | -4.57E+05 | -3.30E+05 |
| **302.73** | 3.01E+07 | 3.36E+06 | -9.23E+05 | 3.16E+07 | 2.59E+07 | -2.93E+06 | 5.59E+06 | 2.30E+07 | -7.04E+05 | -5.41E+05 | -6.16E+05 | -6.34E+05 | -7.79E+05 | -7.12E+05 | -7.10E+05 | -4.51E+05 |
| **312.50** | 3.00E+07 | 3.98E+06 | -2.11E+05 | 3.13E+07 | 2.65E+07 | -4.46E+06 | 6.10E+06 | 2.39E+07 | -1.32E+06 | -5.60E+05 | -6.94E+05 | -8.46E+05 | -7.42E+05 | -1.11E+06 | -1.34E+06 | -6.32E+05 |
| **322.27** | 3.35E+07 | 5.86E+06 | -1.21E+06 | 3.18E+07 | 2.53E+07 | -3.30E+06 | 3.18E+06 | 2.33E+07 | -2.42E+06 | -1.02E+06 | -1.40E+06 | -1.26E+06 | -1.59E+06 | -1.58E+06 | -1.97E+06 | -9.75E+05 |
| **332.03** | 2.74E+07 | 8.48E+06 | -9.51E+06 | 2.85E+07 | 1.73E+07 | -9.14E+06 | 1.15E+07 | 2.27E+07 | -8.13E+06 | -6.83E+06 | -6.27E+06 | -3.52E+06 | -6.24E+06 | -3.68E+06 | -4.63E+06 | -4.72E+06 |
| **341.80** | 2.53E+07 | 9.85E+05 | 2.21E+06 | 3.13E+07 | 2.76E+07 | -9.42E+06 | 1.28E+07 | 2.67E+07 | -2.83E+06 | -2.58E+06 | -5.09E+06 | -2.02E+06 | -6.89E+06 | -3.04E+06 | -1.08E+06 | -2.01E+06 |

# VITA


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