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DATA ANALYSIS

by Dr. Fu-Shang Wei
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KAMAN AEROSPACE COPPORATION

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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16. Abstract

Higher harmonic deflection control of the servo flap can be adjusted to reduce blade bending moment and hub shears of an MCTR.

The objective of this report presents MCTR wind tunnel test plan and test data which includes generation of rotor parameters of interest as functions of collective and multicyclic servo flap deflections. It also includes optimizing servo flap deflections to obtain minimum vibration for various flight conditions.

Results provide functional relationship between rotor performance, blade vibratory loads and dual-control settings and indicate that multicyclic control produced significant reductions in blade flatwise bending moments and blade root actuator control loads. Higher harmonic terms of servo flap deflection are found to be most pronounced in flatwise bending moment, transmission vertical vibration and pitch link vibratory load equations. The existing test hardware represents a satisfactory configuration for demonstrating MCTR technology and defining a data base for additional wind tunnel testing.

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PREFACE

This program, which utilized wind tunnel test results of the Multicyclic Controllable Twist Rotor to optimize rotor performance characteristics was performed by Kaman Aerospace Corporation, Division of Kaman Corporation, Bloomfield, Connecticut, under Contract No. NAS2-8726, for the Ames Directorate, U. S. Army Air Mobility Research and Development Laboratory, Moffett Field, California.

The program was conducted under the technical direction of Mr. John L. McCloud, III, Staff Scientist, NASA-Ames Research Center.

At Kaman, the program was conducted under the cognizance of Mr. H. E. Howes, who is the CTR Program Manager. The program was conducted in the Research Department, managed by Dr. A. Z. Lemnios, Director of Research and Technology.

Mr. A. Weisbrich, co-author of the report, was responsible for the analysis of the data, the generation of the regression equations, and optimization using CONMIN. Mr. Weisbrich left Kaman before completion of the program. Dr. F. S. Wei, co-author of the report, completed the technical study. This work was done under the supervision of Mr. R. Jones.

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INTRODUCTION

Analytical studies (References 1 and 2) of a multicyclic controllable twist rotor (MCTR) have shown that rotor blade bending moments and hub shears, a major source of helicopter vibrations, may be largely attenuated through optimized higher harmonic deflections of the servo flap.

To verify these positive analytical predictions, the present wind tunnel test of an MCTR was planned and executed in 1976. The objective of this program includes generation of predictive mathematical relationships of rotor parameters of interest (such as vibration, horsepower and blade bending moment) as functions of collective and multicyclic servo flap deflections. It also includes optimizing servo flap deflections to obtain minimum vibration for various conditions of velocity, shaft angle and root end collective and remain within specified constraints on other rotor parameters, such as horsepower and bending moments.

To accomplish the above-mentioned objectives, a full-scale model of an MCTR system was designed, fabricated and tested in NASA Ames 40x80-foot wind tunnel facility. The theoretical studies and previous wind tunnel test of the CTR in the NASA Ames 40x80-foot wind tunnel are well described in References 3 and 4, respectively. The Controllable Twist Rotor (CTR) described in Reference 4 was modified to a multicyclic controllable twist rotor.

TEST PROGRAM

ROTOR SYSTEM DESCRIPTION

The MCTR system as configured for wind tunnel test (Figure 1) included rotor blades, rotor head and associated controls. Those components were all fabricated, adapted and modified by Kaman, and interfaced with a test module supplied by Army/NASA at the Ames Research Center. A readily available and adaptable CTR hardware system existed and was previously tested in the NASA Ames 40x80-foot wind tunnel (Reference 4). It was easily modified and used as a multicyclic controllable twist rotor. Modification of the CTR hardware to accommodate transformation to an MCTR consisted primarily of additional turret head controls, such as actuators and input linkage components, for multicyclic actuation of the servo flap. Appendix A fully describes the system.

ROTOR QUALIFICATION TESTS

Prior to entry of a rotor for testing in the NASA Ames 40x80-foot wind tunnel facility, whirl tower tests, tunnel shake tests and bench tests normally must be successfully completed. However, the MCTR system hardware additions to the CTR were minimal and did not affect results of prior extensive whirl tower tests or shake tests conducted on the CTR (Reference 4). Therefore, these tests on the MCTR were not required. Furthermore, MCTR test operating conditions were planned within previously tested CTR wind tunnel test conditions. Therefore, the comprehensive and successful wind tunnel shake tests conducted at the Ames Research Center's 40x80-foot full scale wind tunnel with CTR also applied to the MCTR. The reason for such shake tests is to insure stable operating conditions for a rotor, the test pod, the test pod support struts, and the balance frame configuration, and to evaluate rotor performance and blade dynamic behavior. Details of CTR shake tests are presented in Reference 4, and details of shake test procedure, the data analysis, and the test results for the rotor hub are presented in References 5 and 6.

BENCH TEST

Bench tests of the MCTR were conducted at Kaman. This involved thorough checkout of all components in the MCTR turret head assembly. Blade servo flap loads were simulated with springs and counterweights on the walking beams while rods for collective servo flap input remained fixed at a pre-set collective input level. All mechanical linkage and control rod mechanisms were checked for travel with subsequent electronic inputs activated to check out proper phasing, amplitude and harmonic input to actuators in the MCTR turret head assembly. Concurrent bench test checks of the hydraulic system for the turret head assembly revealed an oil cooling problem which was remedied by adding a cooling unit to the top of the turret head.

Thereupon, endurance tests were conducted on all these components to establish an adequate and safe baseline for operating cycles. Finally, installation and set-up procedures were established and tunnel build-up check out procedures implemented. Additional details of these procedures are given in Reference 7.

MCTR TEST PLAN

The effect of numerous independent variables, including wind tunnel speed, rotor shaft angle, root end collective pitch and servo flap multicyclic deflections δ_0, δ_{1s}, δ_{1c}, δ_{2s}, δ_{2c}, δ_{3s}, δ_{3c}, δ_{4s}, δ_{4c}, on dependent variables of interest (i.e., measured vibration, flatwise blade bending moments, pitch link loads and horsepower) must be assessed in testing an MCTR. With three levels of the independent variable to determine the dependence of the performance response variables on the dependent variables, 531,441 (3^{12}) combinations of the 12 independent variables, are necessary to exhaust all permutations. More traditional testing methods which involve varying one independent variable at a time are obviously impractical and too time consuming. Statistical techniques and experimental designs were thus planned for the wind tunnel test of the MCTR.

The test plan was based on a test methodology called multiple balance which reduced the number of test points required to less than 500 out of a possible 531,441. Therein, design and randomization of test points virtually eliminate confounding of results under subsequential analysis of variance (ANOVA) and regression analysis (confounding is the inability to distinguish which variable or interaction is responsible for an observed effect).

Replication of each test point would also allow calculation of residuals which account for all variation in a dependent variable not explained by the independent variables selected. Ranges of the controlled variables were selected, based on previous analytical data, to provide sufficient information for establishing mathematical models of the main effects, non-linearities, and principal interactions of the controlled variables on the dependent variables of interest. Appendix B, Table B-1, delineates the planned test conditions.

Because of practical time restrictions for access of wind tunnel facilities and difficulties in quickly varying parameters, such as tunnel velocity and rotor shaft angle, randomization of test points was sacrificed somewhat, together with replication. Independent variables such as wind tunnel velocity and rotor shaft angle were instead sequentially varied throughout the modified test plan. Also, due to limitations of rotor load during testing, certain prescribed control input values from the test plan had to be modified for operating safety reasons. Unfortunately, this did not permit the benefits of an analysis of variance method to be realized for speedy and sure identification of independent variables and their interactions which significantly affect any particular dependent variable under consideration.

WIND TUNNEL PERFORMANCE TESTS

Before installation of the MCTR blades on the rotor test apparatus module, aerodynamic forces and moment tares were obtained of the module and rotor head without blade grips. These tares were incorporated mathematically into the NASA-Ames data reduction computer algorithm for rotor performance. The reduced rotor performance data thus reflect only the forces and moments generated by the MCTR blades.

Steady-state tests to evaluate rotor performance, blade dynamic behavior and control sensitivity were conducted at wind tunnel speeds of 41 kts, 80 kts, 120 kts, and 135 kts and at a rotor tip speed of 686 fps. Longitudinal and lateral cyclic pitches at the blade root were varied to maintain zero (± 0.2 degrees) longitudinal and lateral cyclic flapping. Root collective pitch angle and servo flap pitch angles were independently controlled.

As on the CTR, a limitation was imposed on the MCTR test program because of the use of existing flightworthy hardware. The standard H-34 lag dampers that were installed on the rotor head had an internal relief valve that opens above 1750 pounds. At this force level, the lag damper force is constant and does not vary with lag velocity; i.e., the damping is frictional, rather than viscous above this load level. The reduction in equivalent viscous damping above this point causes the rotor to approach its mechanical instability boundary. To avoid this instability region for the MCTR blades, blade lag amplitudes were continuously monitored and were usually maintained at less than ± 0.5 degrees of 1/rev motion.

The dependent variables measured and monitored during the test included the rotor aerodynamic force and moment characteristics, blade stresses, blade root motions, servo flap stresses, control loads, control motion, and support module accelerations. Details are given in Appendix B. Rotor aerodynamic characteristics were measured directly on the main balance in the Ames 40x80-foot wind tunnel. The raw performance data was automatically corrected for tare values by the NASA-Ames data-reduction computer code. This corrected data was reduced to standard wind-axis aerodynamic force and moment coefficients by the same program. Rotor power and torque were independently measured by strain gages on the main driveshaft and by yawing and rolling moments on the main balance. All four blades were fully instrumented with strain gages for stress measurements and angulators at the blade root for blade motions. Data were recorded from all four instrumented blades. Strain gage locations and measurements on the blades and the servo flap are shown in Figure 2. The blade angulators measured flapping, feathering and lagging angles.

Longitudinal, lateral and vertical accelerations were measured in the module by accelerometers, as illustrated in Figure 3. Additional details on instrumentation and the control system are given in Reference 8 and Appendices B and C.

DATA ACQUISITION AND REDUCTION

Several systems were used during the wind tunnel test to acquire test data. Those systems and their functions are synopsized below:

Datex I - Used primarily for tunnel balance data. Also interfaced other selected inputs to the computer.

Peak-to-Peak Display - Used as a test monitor for critical parameters. Provided a permanent record of peak-to-peak levels.

Dynamic Analysis System - Used for on-line analysis during rig resonance tests and for control optimization.

High Speed Data Acquisition System - Digitized and recorded all test parameters on digital tape.

Dynamic Recording System - Recorded all test parameters on analog tape. Operated continuously during test as a backup for safety considerations.

Oscillograph - Recorded all critical parameters for test monitoring and to check the validity of the data on the other systems.

A complete listing of parameters recorded and monitored is given in Appendix B.

Actual testing of the MCTR in the wind tunnel was accomplished with a two-shift operation. A combination of Kaman and NASA Ames personnel interfaced during test operation to handle the various monitoring and control functions in the wind tunnel control room. The procedure of arriving at a test plan point during the wind tunnel run entailed:

a. Bringing rotor to operating rpm with pre-set steady root end control and servo flap collective and 1/rev controls while maintaining zero flapping with root end cyclic

b. Increasing wind velocity in tunnel to desired speed, again, maintaining zero flapping

c. Setting rotor shaft angle to desired level, maintaining zero flapping

d. Advancing servo flap higher harmonic controls to prescribed test level while maintaining zero flapping of rotor. Amplitudes and phases of 2/rev, 3/rev and 4/rev were each gradually adjusted while the close monitoring of rotor parameters was maintained to assure safety of operation.

Shutdown procedure consisted of reversing the above steps.

DISCUSSION OF TEST DATA

The MCTR wind tunnel test parameters of interest are presented in Table I. Many parameters were recorded and monitored only for operating safety and check-back purposes. Duplication of instrumentation on more than one rotor blade of various outputs of interest was carried out to circumvent failure of any single instrument or monitoring device. Based on screening of raw data time history plots for signal break up, blade number four outputs were established as being most suitable for analysis.

Raw data was filtered to minimize deleterious effects of high frequency noise by a Bessel filter. Subsequently, those data are put on magnetic tape for selective retrieval of data for analysis. Table II illustrates a sample output test data point from the wind tunnel runs. Appropriate rotor parameters were harmonically analyzed over eight revolutions, and mean, half peak-to-peak, and harmonic values were recorded. Fifty-three percent of the test data was analyzed as if the rotor were operating at 293 rpm, rather than the actual 200 rpm. This resulted in a correction which was 6 degrees per revolution (in lag) too large for all parameters.

The parameters of principal interest are the servo flap control deflections (collective through 4 per revolution), vibratory flatwise bending moments, pitch link vibratory load, rotor profile torque coefficient, horsepower, transmission mounted vertical accelerometer vibrations, rotor thrust, and propulsive force coefficients at specified velocity, shaft angle and root end collective. Table III provides a composite listing of data selectively transformed from the data tapes. Note that the data used for the flatwise bending moments, pitch link load, etc., are the one-half peak-to-peak values from the raw data analysis. Table IV gives an overview of all test conditions.

The flatwise vibratory bending moment was selected as an analysis parameter because it is a measure of blade life. The maximum flatwise bending moments were obtained at Station 283. This station was chosen for data analysis of bending moment. Actual endurance limit of the rotor blade in flatwise bending, as reported in Reference 4 for the CTR wind tunnel investigation, was ± 7730 in.-lb peak-to-peak at Station 283.64. Pitch link vibratory load is another measure of rotor performance in that it is an indicator of stall flutter. The signals used to measure the pitch link load were obtained from strain gages on the rotating-star portion of the control swashplate. The ratio of profile power coefficient to the solidity characterizes the aerodynamic efficiency of the rotor and may also define the onset of rotor stall. The total rotor power was measured independently with two separate systems, the main balance frame in the wind tunnel and the torque strain gages on the rotor shaft. All force and moment data from the balance were reduced to dimensionless coefficients by the NASA-Ames data reduction computer program. Because the test procedure resulted in variations in lift force and propulsive force in contrast to the theoretical work, a profile power coefficient was calculated at each test point from these coefficients. The profile torque coefficient was calculated from the total torque coefficient by means of the following equation:

$$\frac{C_{Q_o}}{\sigma} = \frac{C_Q}{\sigma} - \left(\frac{C_{L_R}}{\sigma}\right)^2 \frac{\sigma}{2\mu} - \left(\frac{C_{X_R}}{\sigma}\right) \mu$$

ANALYTICAL METHODS

The best procedure in doing an analysis on large random wind tunnel test data is considered as curve fitting. The Rotor Multicyclic Analysis, (References 2 and 9) and REGRESS Analysis have this curve fitting ability to obtain a multivariate regression equation for modeling behavior of rotor parameters and also can be used as an optimization method on the regression output to determine optimal rotor control settings.

ROTOR MULTICYCLIC ANALYSIS

Rotor Multicyclic Analysis (ROMULAN) is a second phase computer program developed at AMES which is concerned with the analysis of the results of several performance and oscillating load parameters by a typical rotor performance calculation. The main idea of ROMULAN is based on the concept of a transfer matrix which calculates the linear relationships between several output parameters and selected input parameters by least squares regression techniques. The only restriction of this program is that the input and output elements have a linear relationship. ROMULAN performs weighting of selected output parameters, and calculates inputs necessary to achieve a minimum of a root mean square summation of selected weighted output parameters. It also performs a correlation analysis of the basic output vectors, as well as correlations of various root-sum-of-squares combinations and point-by-point comparisons. The latter assume several of the output elements are harmonic components of some function.

REGRESSION MODELING

ROMULAN calculates relationships between output parameters and selected input parameters on a purely linear basis. However, the effect of higher order interaction terms in such relationships can be of interest and also significance. The effects of these higher order interactions can be evaluated using the REGRESS computer program.

REGRESS is considered for analysis of test data to determine and isolate independent variables or combinations such that it was most significant in affecting a particular response parameter. Because REGRESS permits a stepwise or term-by-term inspection of each model equation, it became the predominant regression tool.

The regression model equations of rotor parameters were subsequently developed based on engineering judgement and past regression modeling of the CTR test data. The basic model form of each regression equation is:

$$
\begin{aligned}
Y_j = {} & A_{oj} + A_{1j} X_1 + A_{2j} X_2 + A_{3j} X_3 + \ldots \\
& + \ldots + A_{11j} X_1^2 + A_{22j} X_2^2 + \ldots + A_{nnj} X_n^2 \\
& + \ldots + A_{12j} X_1 X_2 + S_{13j} X_1 X_3 + \ldots \\
& + \ldots + A_{nmj} X_n X_m
\end{aligned}
$$

where Y_j are the dependent response variables ($j = 1$ to m)

X_i are the independent variables ($i = 1$ to n)

A_{ij} are the coefficients of the independent variables

Table V lists all the terms considered in the behavioral modeling of rotor parameters. These terms include the servo flap deflection (collective, 1/rev, 2/rev, 3/rev, 4/rev, sine and cosine components), rotor lift coefficient (CLR) and propulsive coefficient (CXR). Rotor parameters of interest (dependent variables) are tabulated in Table I. These include flatwise bending moment, pitch link vibratory load, horsepower, rotor torque coefficient, and transmission vertical accelerometer (vibration) output.

REGRESS can be used to analyze the effect of servo flap harmonic components, their squares and cross products on the dependent variables. In addition to servo flap deflections, rotor lift, propulsive coefficients, and their squares and cross products were also used as independent variables. REGRESS chooses terms from the entered equation on the basis of relative combination made to predict the behavior of appropriate dependent variables under consideration. Quantitative contribution made to the sum of squares (multiple correlation coefficient) by REGRESS determined the final terms of the model equations for each rotor parameter. Table VI provides a summary of rotor parameter equations, such as coefficient, terms and multiple correlation coefficients, with conditions for which they apply. Because of the amount of these data, they were not considered adequate for regression modeling at V = 80 knots condition. The multiple correlation coefficients for rotor parameter model equations under various ranges of conditions at V = 120 knots are given in Table VII. The test data consisted of results at V = 120 knots, $\alpha_s = -6°$, $\theta_o = 10°$ of all conditions investigated (Table IV, a, b, c phases). Correlation coefficients of the model equations are degraded as one proceeds from a-models to c-models. In i = 1 models, only servo flap deflection terms were considered. In i = 3 models, CXR and CLR terms were included into each of the model equations, in addition to servo flap deflection terms. It is evident from Table VII that the correlation coefficients are highly improved with the inclusion of the CXR and CLR terms.

When examining the independent variable terms of the model equations in Table VI, horsepower (HP), rotor torque coefficient (C_{Q_o}), and rotor propulsive coefficient are predominant in models a-3, b-3 and c-3 as anticipated. The servo flap collective is also a major influencing factor in models a-1 and b-1 in these parameters. Higher harmonic terms of servo flap deflection are found to be most pronounced in the flatwise bending moment (BMF), transmission vertical vibration (TRVT) and pitch link vibratory load (PLV) equations. As noted above, the regression model improved correlation coefficients by introducing CLR and CXR terms into model equations. Since this permitted optimization at desired lift and propulsion level, only models including these terms (i = 3) were considered for optimization. Furthermore, since the c-models were more global than either a-models or b-models, c-3 models were chosen for optimization on servo flap controls.

Table VIII provides a composite listing comparing the actual test data of the rotor parameters with the estimated values determined by regression model equations. The predictive capability of the model equations for the various rotor parameters was considered fair to good, as compared to the values listed in Table VIII.

When attempting to compare present data and models with that of the 1975 wind tunnel investigation on the Controllable Twist Rotor, one is very limited in doing so, insofar as conditions tested in the CTR test did not coincide with MCTR conditions, except for the V = 120 kt, $\alpha_s = -8°$, $\theta_0 = 10°$, 12° conditions. However, the models generated do not completely coincide for similar conditions tested. Furthermore, CTR wind tunnel test data was analyzed using the SURGEN regression routine. Unlike REGRESS, it does not have the ability to identify and sequentially select terms from prescribed model equations and determine those which are most influential in predicting rotor parameters. Examining relative importance of terms in equations of a given parameter from both tests is thus not possible.

In MCTR regression model equations, the rotor parameters of interest are achieved to at least 88.6% or better correlation when all 57 terms of servo flap interaction are exhausted. Tables VI and VII are the lists of model equations and multiple correlation coefficients which were obtained when using the first ten to twenty most significant terms (except PLL (b-3), PLL (c-3) model equations which are more than 20 terms). These simplified regression model equations were used to give a more detailed insight of the future MCTR design factors, and also gave better correlation than the 57 term MCTR regression equations when compared to CTR regression equations. Thus, the multiple correlation coefficients of the less terms model equations reduced to 80.1% or better correlated to wind tunnel test data.

Table IX illustrates results of comparing the flatwise bending moment equations at station 283 for both the CTR and MCTR within the nominal control range and at a condition investigated in both tests. The fifteen term MCTR regression model equation gives better correlation with the CTR than the forty term MCTR regression model equation. Therefore, the comparison here is based on the fifteen term regression model equation. The models give comparable results under the indicated controls. Variation of predictions may be attributed to differing model multiple correlation coefficients. One may thus conclude that the models generated from both sets of test data are mutually supportive in behavioral predictability.

OPTIMIZATION OF REGRESSION RESULTS

In the optimization of the regression equations, two procedures were used. The first procedure was an optimization code designated CONMIN (Reference 10) and the second, a feedback control system. These two procedures were done because of two major reasons. First, the CONMIN optimization depends on the initial conditions for optimization, whereas a study of a feedback control system reported, in Reference 11, that only one optimum condition existed. The reason for only one optimum in that study is because of the assumptions that higher harmonic control did not affect trim and a variation of collective and first harmonic servo flap inputs was not required. Therefore, the collective and first harmonic effects are theoretically lumped into constant terms and higher harmonic inputs have no influence on collective and first harmonic inputs. The linear regression model of each independent rotor parameter expands to only 27 higher harmonic coefficients for the independent control variables, such that all the higher harmonic inputs are utilized to trim the higher harmonic effects of the rotor. Second, if an optimization method is fabricated for a test vehicle, the CONMIN procedure requires regression type equations. Thus, exhaustive testing and analysis must be done to determine the regression equations for the vehicle. However, once this is done, optimum conditions could be predetermined and control requirements pre-selected. The feedback control system, if fabricated, does not require regression equations, but would optimize on measured parameters during flight.

CONMIN

A constrained minimization or optimization code designated CONMIN was used to determine optimum servo flap control settings at specified trimmed flight conditions which minimizes a desired rotor parameter while constraining other rotor parameters within desired bounds. Table X and Appendix E illustrate the typical CONMIN optimization plans for MCTR. Regression model equations can have multiple minimums under certain desired constraint conditions. Hence, many different servo flap control settings may satisfy the constraint requirements. For this reason, CONMIN results depend on the initial servo flap control settings. This is similar to the CTR optimization process where many intersecting contours are established. A three-dimensional optimum servo flap control region specifies multiple control combinations satisfying prescribed constraints (Reference 4).

With MCTR one deals with a 9-dimensional space. The visual presentation of optimized results by means of contours is no longer practical or possible. CONMIN provides specific servo flap control values for desired conditions and constraints. It is, therefore, the responsbility of the experienced engineers to choose those controls which might be the best to meet the needs of a particular situation. Table XI presents the results of the CONMIN optimization. Optimum servo flap controls are given which minimize horsepower while constraining flatwise bending moment, pitch link vibratory load, transmission vertical vibration and root end collective within the prescribed bounds. Because the choice of initial conditions can affect the optimum value of the objective function, the objective function was also constrained to a given level to obtain a desirable optimum value for the objective function. A reason for choosing horsepower as a parameter to be minimized may be attributed to the rationale that by minimizing energy input (horsepower) requirements into the system, one may also reduce the dissipated energy (i.e., vibration) within the system. The prescribed upper bounds on vibration in the CONMIN search for optimum servo flap controls further assures appropriate vibration level.

FEEDBACK CONTROL SYSTEM

CONMIN optimization program depends on the initially chosen servo flap deflections which would generate "local minimum" instead of the best optimization within a 9-dimensional space. Those initially chosen servo flap deflections used as initial conditions input to the CONMIN program are obtained from flight trimmed vehicle. Reference 11 has shown that the optimum region of a dual control rotor was uniquely determined by providing higher harmonic control to the controllable flap on the rotor blade through feedback of selected independent parameters. The study work was extended to arrive at a preliminary circuit design that would condition the selected parameters, weigh limiting factors and provide a proper output signal to the multicycle control actuators. The rotor parameters and limits are used as a measure of the effectiveness and determination of secondary control optimization. Multicyclic control was investigated with the trimmed rotor gross weight and propulsive force corresponding to CLR = 0.092 and CXR = 0.0071.

The REGRESS predictive model is used here under the trimmed case to generate a closed-loop circuit. Servo flap deflections, thrust and drag coefficients are used as independent variables. Each dependent variable can be expressed in quadratic form in terms of the independent control variables which are calculated from the predictive model. With these models, a tradeoff study was made to establish a region of flap control that would produce value of the rotor parameter that meets the criteria established.

CONTROL FUNCTION

The purpose of the multicyclic control is to minimize certain parameters to the greatest extent possible while keeping others within acceptable limits. To accomplish this with feedback control, the definition of an "optimization" parameter as a function of the various controlled parameters is required. Feedback is then used to vary certain controlling, or independent variables, in such a way to minimize the optimization parameter. A more important criterion will be the ease and repeatability with which the parameters can be measured on an operating rotor system. Here the selected control parameters are:

Bending Moment (BMF)

Horsepower (HP)

Pitch Link Vibratory Load (PLV)

Transmission Vertical Vibratory Load (TRVT)

The function of the feedback control system is to determine the effect of each independent variable (x's) on the controlled parameters (y's) and thus, on the optimization parameter (P). The system then manipulates the x's to minimize P. Mathematically, the general case is:

Optimization Function

$$P = f(y_1, y_2, y_3, y_4)$$

Change in P

$$\Delta P = \sum_{k=1}^{4} \frac{\partial P}{\partial y_k} \Delta y_k$$

where:

$$\Delta y_k = g_k (x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9, x_{10}, x_{11})$$

$$\Delta y_k = \sum_{i=1}^{9} \frac{\partial y_k}{\partial x_i} \Delta x_i$$

$$\Delta P = \sum_{k=1}^{4} \frac{\partial P}{\partial y_k} \sum_{i=1}^{9} \frac{\partial y_k}{\partial x_i} \Delta x_i$$

The change in P caused by changes in a particular x_i is:

$$\Delta P_i = \sum_{k=1}^{4} \frac{\partial P}{\partial y_k} \cdot \frac{\partial y_k}{\partial x_i} \cdot \Delta x_i$$

and the sensitivity of P to changes in a particular x_i is:

$$S_i = \frac{\Delta P_i}{\Delta x_i} = \sum_{k=1}^{4} \frac{\partial P}{\partial y_k} \cdot \frac{\partial y_k}{\partial x_i}$$

From this, it can be seen that the feedback control system requires two kinds of information. The first is the relative importance of each of the controlled variables. The second is the sensitivity of each of the controlled variables to changes in each of the independent variables. The first is determined by the characteristics of the defined optimization function; and the second is determined by the rotor characteristics.

OPTIMIZATION PARAMETER

The optimization parameter provides an integrated measure of the "goodness" of the rotor operation as described by measurement of each of the controlled parameters. In effect, it provides a measure of the relative value of changes in each of the controlled parameters. An optimization parameter has been used as follows:

$$P = f_1\ (BMF) + f_2\ (HP) + f_3\ (PLV) + f_4\ (TRVT)$$

The individual functions associated with each of the controllable parameters have been established with individual thresholds based on practical operation point of view as follows:

a. Maximum out-of-plane bending moment $\leq$ 7000 in.-lb

b. Rotor horsepower $\leq$ 750 HP

c. Maximum pitch link vibratory load $\leq$ 350 lbs

d. Transmission vertical vibratory load $\leq$ 0.5 lb

Bending Moment

$BMF \leq 3500$ $$f_1\ (BMF) = 37 + 100 \left[\frac{BMF}{3500} - 1\right]^2$$

$BMF > 3500$ $$f_1\ (BMF) = 37 + 100 \left[\frac{BMF}{3500} - 1\right]^2 + 10 \left[\frac{BMF - 3500}{500}\right]^4$$

Horsepower

$HP \leq 750$ $$f_2\ (HP) = 20 \left[\frac{HP}{750} - 1\right]^2$$

$HP > 750$ $$f_2\ (HP) = 20 \left[\frac{HP}{750} - 1\right]^2 + 10 \left[\frac{HP - 750}{25}\right]^4$$

Pitch Link Vibratory Load

$PLV \leq 350$ $$f_3\ (PLV) = 30 \left[\frac{PLV}{350} - 1\right]^2$$

$PLV > 350$ $$f_3\ (PLV) = 30 \left[\frac{PLV}{350} - 1\right]^2 + 10 \left[\frac{PLV - 350}{35}\right]^4$$

Transmission Vertical Vibratory Load

TRVT $$f_4\ (TRVT) = 100 \left[\frac{TRVT}{0.5}\right]^2$$

The normalizing functions are as follows:

$(Nf)_1$ = BMF/3500

$(Nf)_2$ = HP/750

$(Nf)_3$ = PLV/350

$(Nf)_4$ = TRVT/0.5

Figure 4 provides plots of the magnitudes and normalized slopes of each of these individual functions.

It is desired to keep bending moment, horsepower and pitch link vibratory load below their thresholds of 7000 in.-lb peak-to-peak, 750 HP, and 350 lbs. Operation above the thresholds becomes undesirable at a very rapid rate. The 7000 in.-lb peak-to-peak bending moment was selected on the basis of the calculated infinite blade life. A large decrease of TRVT is considered more valuable as a tradeoff than BMF, HP and PLV under the threshold values. The search strategies based on a feedback control system are listed in Appendix D.

The use of this particular optimization function here is not a limitation on the applicability of the results. It represents a variety of subfunctions. The effect of some other optimization functions are discussed in Reference 11.

For the multicyclic flap concept, the range of cyclic control is limited to ± 5 degrees for each harmonic, such that the resultant maximum deflection for second and higher harmonic controls is ± 8 degrees. The restriction of the resultant of the 2nd and higher harmonic input to a maximum of 8 degrees is to prevent excessive flap deflection. Two different control ranges are established as the bases:

a. Steady $\delta_0 = -1°$

First harmonic sine and cosine $\delta_{1s} = 3°$, $\delta_{1c} = 5°$

$$\left.\begin{array}{ll} \text{Second harmonic sine and cosine} & \delta_2 = +5° \text{ to } -5° \\ \text{Third harmonic sine and cosine} & \delta_3 = +5° \text{ to } -5° \\ \text{Fourth harmonic sine and cosine} & \delta_4 = +5° \text{ to } -5° \end{array}\right\} \text{Random selection}$$

b. Steady $\delta_0 = +10°$ to $-10°$

$$\left.\begin{array}{ll} \text{First harmonic sine and cosine} & \delta_1 = +5° \text{ to } -5° \\ \text{Second harmonic sine and cosine} & \delta_2 = +5° \text{ to } -5° \\ \text{Third harmonic sine and cosine} & \delta_3 = +5° \text{ to } -5° \\ \text{Fourth harmonic sine and cosine} & \delta_4 = +5° \text{ to } -5° \end{array}\right\} \text{Random selection}$$

The reduction of transmission vertical vibration is of primary interest. The model for TRVT is used to predict higher harmonic controls which achieve minimum vibration.

Table XII shows the results of the control feedback optimization. Each case here presents a high decrease of TRVT keeping BMF, HP and PLV under the threshold values.

COMPARISONS OF TEST WITH THEORY

In the design stages of the MCTR, an analysis was performed to evaluate rotor performance and blade dynamic behavior. Also, an analysis was made using selected test points as trimmed conditions and rotor performance, and blade dynamic behavior was determined. In these analyses, the Kaman-developed 6F program was used. This aeroelastic loads digital computer program was developed to account for six blade response modes. The response modes include blade flapping, blade feathering, blade lagging, blade flapwise bending, blade torsion, and control flap feathering. The blade feathering and control flap feathering modes incorporate control system stiffness so that control loads can be calculated. The program retains all non-linear coefficients in the equations of motion and uses tabular airfoil data.

In MCTR regression model equations analysis, the multiple correlation coefficients of the rotor parameters of interest (such as blade bending moment, horsepower, pitch link vibratory load and transmission vertical vibratory load) are achieved from 88.6% to 98.5% correlations between theory and wind tunnel test data by using 57 terms of servo flap deflections, their squares and their cross products from collective to 4/rev harmonic. The results are also investigated to compare the flatwise bending moment equations at blade station 283 for both the CTR and MCTR predictive models within the nominal control range.

During the design phase of the technology demonstrator, aeroelastic analyses were conducted to substantiate the design and to define the ranges of servo flap controls required for optimum operation. An in-depth analysis that was performed to evaluate rotor performance and blade dynamic behavior of an MCTR is reported in Reference 2. The aeroelastic analyses were made at a wind speed of 120 knots and at a tip speed of 613 fps. The MCTR was analyzed at this wind speed for three levels of vertical force, 11,500 lbs, 12,500 lbs, and 13,500 lbs, and sufficient propulsive force to fly a helicopter with an equivalent flat-plate drag area of 20 square feet. As noted previously, the wind tunnel tests were conducted at wind speeds of 80 and 120 knots, and at tip speeds of 586 fps. Because of the nature of wind tunnel testing, the MCTR was tested at many levels of vertical force and propulsive force, which are comparable to the substantiating aeroelastic analyses previously conducted. The operating conditions of Reference 2 do not differ significantly from the MCTR technology demonstrator reported herein so that a direct comparison can be made from that study to this wind tunnel test program by interpolation of the regression model equations derived from test data.

In the testing, higher harmonic terms of servo flap deflection are found to be most important in the flatwise bending moment, transmission vertical vibratory load and pitch link vibratory load equations. Blade flatwise bending moments and root actuator control loads are greatly reduced by introducing higher harmonic servo flap controls at various flight conditions.

Table XIII shows the comparison between test and analysis. It is seen from this table that the analysis predicted the required pitch horn control reasonably well when compared with the wind tunnel. Prediction of rotor horsepower by 6F aeroelastic program analysis was 3% to 6% lower than the measure from wind tunnel test due to optimistic spar drag coefficient inputs. The analysis also compares well with performance. The analytical program used to obtain the regression equations in the design stage was perfectly adequate to predict trends of the rotor.

CONCLUSIONS

The objectives of the full-scale multicyclic controllable twist rotor wind tunnel test program were to generate information that would relate to predictions and to provide a data base for advancing the state-of-the-art. Defined goals were specified at the outset and were used as a checklist to measure the success of the test results:

1. Demonstrate the MCTR principle through the use of existing CTR hardware
2. Establish functional relationships between rotor performance, blade vibratory loads, and control settings
3. Provide a firm data base for future tests over an expanded test envelope
4. Correlate the test results with predictions
5. Compare the test results with previously CTR-tested rotors.

The MCTR wind tunnel test program conclusions are summarized as follows:

1. Multicyclic control produced significant reductions in blade flatwise bending moments and blade root actuator control loads at various forward flight conditions.
2. The existing test hardware represents a satisfactory configuration for demonstrating MCTR technology and defining a data base for additional wind-tunnel testing.
3. Functional relationships have been generated between rotor performance, blade vibratory loads, and dual-control settings.
4. The regression model improved correlation coefficients by introducing CLR and CXR terms into model equations. The rotor propulsive coefficients are predominant in horsepower (HP) and rotor torque coefficient (C_{Q_O}) equations.
5. The servo flap collective term is also a major influencing factor in horsepower (HP) and rotor torque coefficient (C_{Q_O}) in models a-1 and b-1. With only δ_O one term existing, the multiple correlation coefficient can do 62.5% or better in horsepower and rotor torque coefficent equations.
6. Higher harmonic terms of servo flap deflection are found to be most pronounced in modifying the flatwise bending moment (BMF), transmission vertical vibration (TRVT) and pitch link vibratory load (PLV).

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Figure 1. MCTR in 40 x 80-foot Wind Tunnel.

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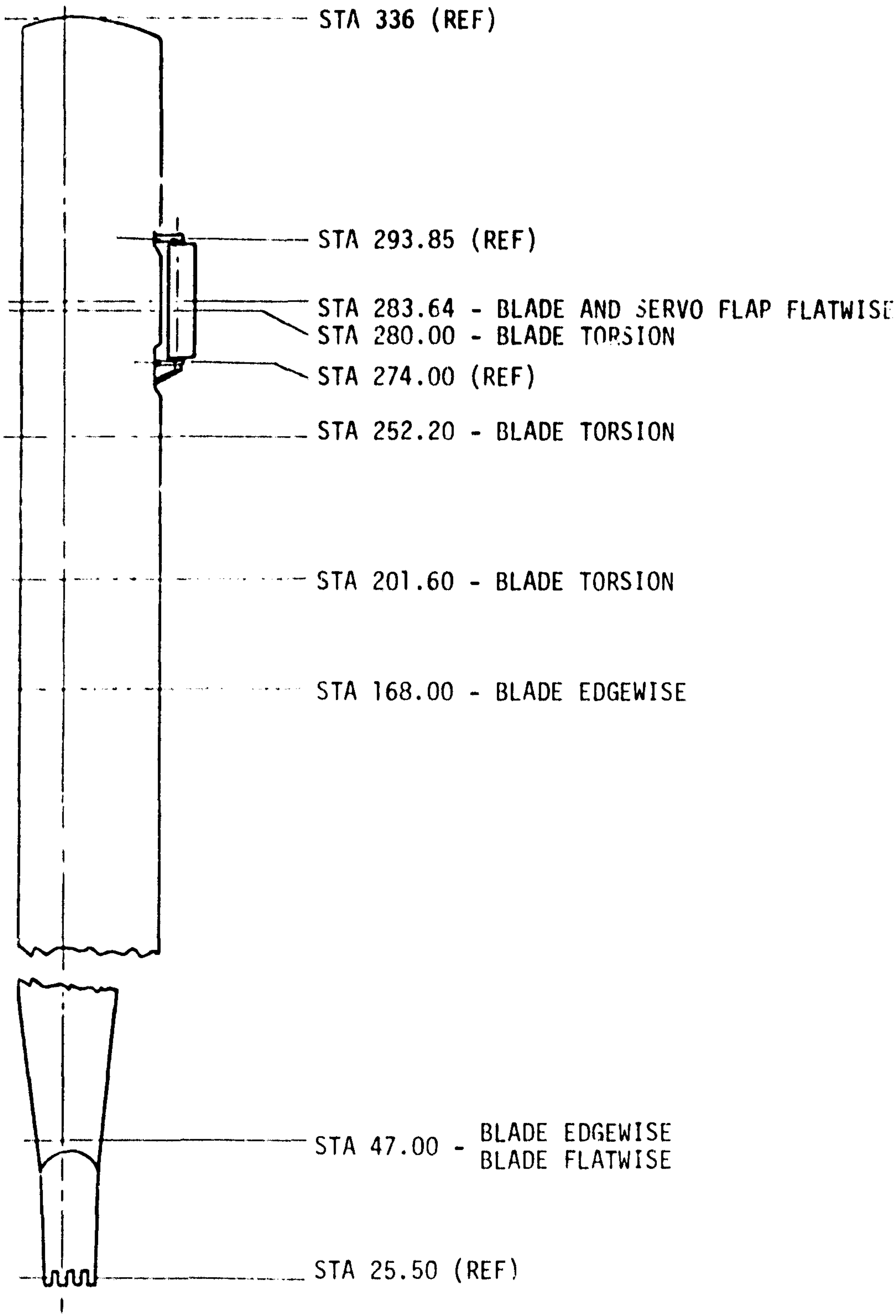
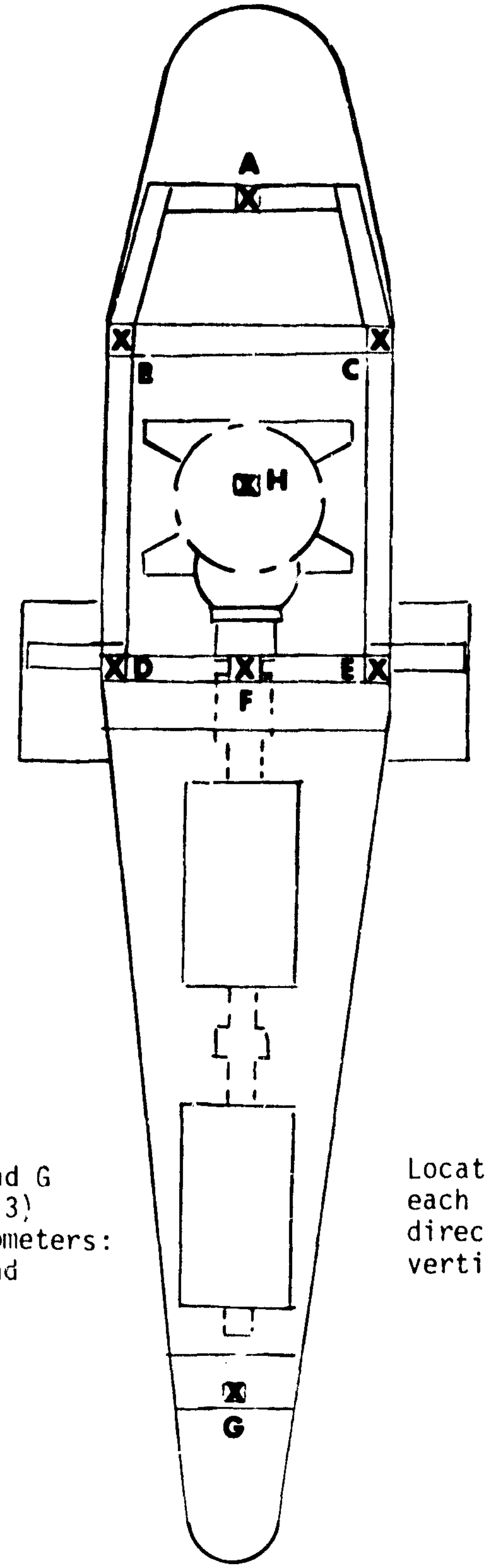


Figure 2. MCTR Blade Strain Gage Locations.



Locations A, H, F and G each contain three (3) directional accelerometers: vertical, lateral and longitudinal.

Locations B, C, D and E each contain two (2) directional accelerometers: vertical and lateral.

Figure 3. Accelerometer Locations.

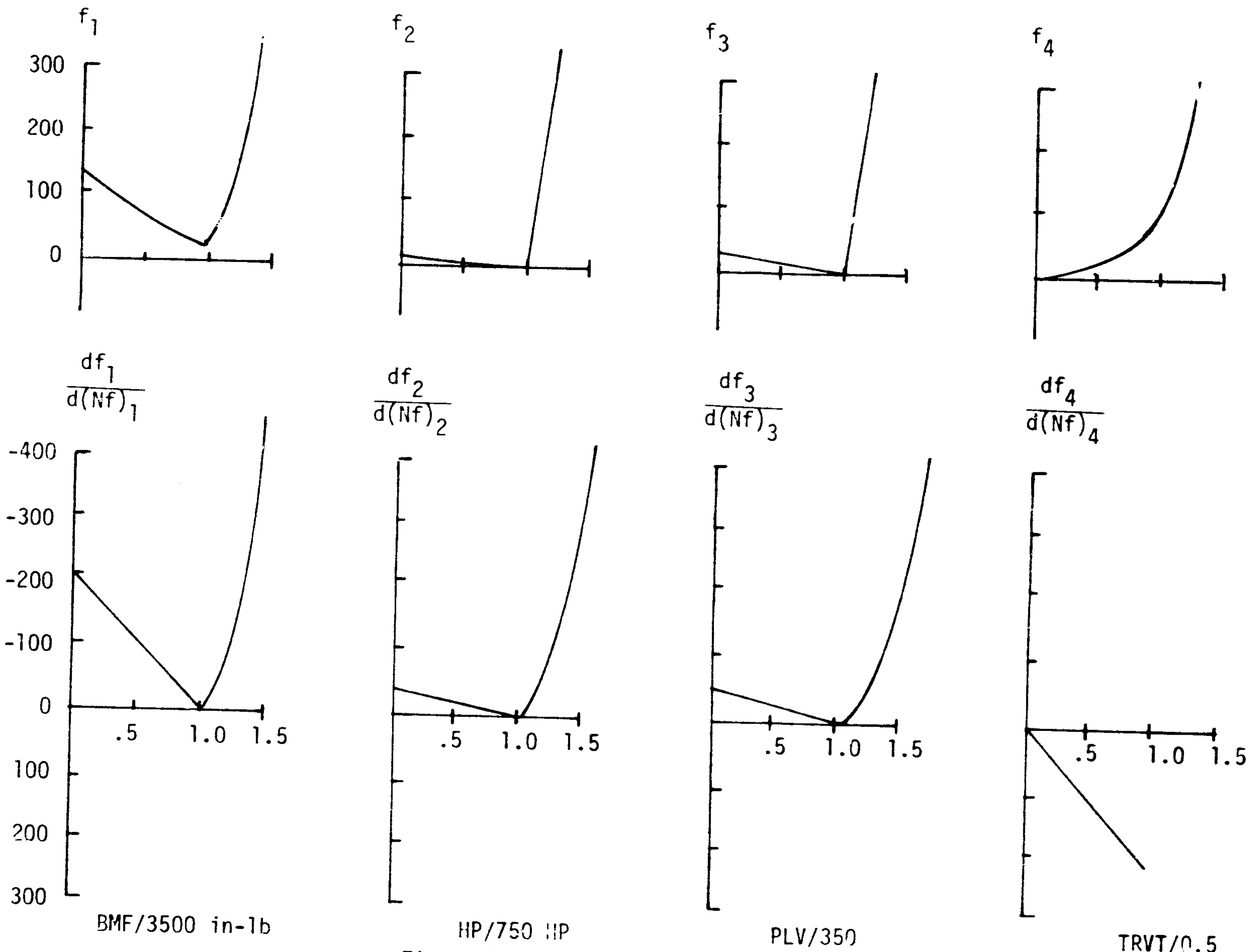


Figure 4. Optimization Functions.

TABLE I. MCTR WIND TUNNEL TEST PARAMETERS

INDEPENDENT VARIABLES	(COMPUTER CODE)	
Servo Flap Deflections (#4 Blade)		
δ_0	(D0)	
δ_{1c}	(D1C)	
δ_{1s}	(D1S)	
δ_{2c}	(D2C)	
δ_{2s}	(D2S)	
δ_{3c}	(D3C)	
δ_{3s}	(D3S)	
δ_{4c}	(D4C)	
δ_{4s}	(D4S)	
Pitch Horn Collective, θ_0 (deg.)	(THETA)	
Rotor Shaft Angle, α_s (deg.)	(ALPHA)	
Velocity of Wind, (knots)	(VEL)	
Rotor Thrust Coefficient, C_{LR}/σ	(CLR)	
Rotor X Force Coefficient, C_{XR}/σ	(CXR)	
DEPENDENT VARIABLES		**UNITS**
Flatwise Bending Moment, 1/2 peak-to-peak, @ Station 283, #4 Blade	(BMF)	in.-lb
Horsepower, mean	(HP)	-
Transmission Vertical Accelerometer, 1/2 peak-to-peak	(TRVT)	g
Transmission Vertical Accelerometer, 4/rev magnitude	(4/R)	g
Pitch Link Load	(PLL)	lbs
Pitch Link Load Vibration, 1/2 peak-to-peak	(PLV)	lbs
Rotor Torque Coefficient, $C_{Q_0}/\sigma \times 100$	(CQ0)	-
OTHER NOMENCLATURE		
Test Run Number	(RUN)	
Test Point Number	(PT)	

TABLE II. SAMPLE OUTPUT OF TEST DATA POINTS

TEST NO. 456 RUN NO. 28 POINT NO. 4 CHANNEL NO. 18 FLATWISE 283-1

HARMONIC	COSINE	SINE	MAGNITUDE	PHASE
0	-1015.1404	0.0	1015.1404	180.0000
1	377.1023	-1534.2732	1579.9368	-76.1912
2	-711.8066	-151.5174	727.7559	-167.9832
3	321.5962	2050.4126	2075.4795	81.0860
4	-825.6526	641.5347	1045.5550	142.1527
5	251.3359	164.0769	300.1543	33.1369
6	-159.2236	-293.0872	333.5456	-118.5152
7	-508.9244	27.7123	509.6785	176.8831
8	70.7756	150.9365	166.7064	64.8776
9	55.3178	-38.1256	67.1058	-34.5778
10	135.3270	-1.6105	135.3365	-0.6818

	MEAN	HALF PEAK TO PEAK
ORIGINAL DATA	-1015.1138	4215.6719
SMOOTHED DATA	-1015.1309	4200.3438

TABLE III. LIST OF MCTR WIND TUNNEL TEST DATA

DU	D1C	D1S	D2C	D2S	D3C	D3S	D4C	D4S	BMF	PLV	HP	TRVT	-4/R	CLR	CXR	CQO	VEL	ALPHA	THETA	RUN-PT
-2.46	-2.228	-2.218	1.342	0.590	0.047	0.146	-0.072	-0.184	2347.	122.	588.	0.050	0.023	.0792	.00829	.181	80	-6	8	24- 2
-2.64	-2.138	1.689	0.202	0.133	1.649	-1.899	0.259	1.142	2681.	265.	583.	0.075	0.040	.0744	.00814	.190	80	-6	8	24- 3
-5.09	1.525	-0.275	-1.783	1.747	-1.503	-2.231	0.269	1.015	3644.	249.	648.	0.082	0.073	.0854	.00911	.193	80	-6	8	24- 4
-4.81	1.456	-0.422	2.647	1.032	1.443	-2.182	-0.041	-0.770	3388.	323.	683.	0.106	0.070	.0875	.00882	.219	80	-6	8	24- 5
-7.19	-0.227	0.016	-1.219	-0.387	-0.697	-1.159	0.090	0.456	4197.	295.	756.	0.111	0.087	.0977	.01058	.211	80	-6	8	24- 6
-4.00	3.083	1.424	2.674	0.689	1.338	0.000	-0.896	0.658	2119.	273.	576.	0.072	0.035	.0763	.00751	.206	80	-6	8	26- 5
-8.73	1.743	0.036	-0.856	-2.548	1.542	0.136	0.038	0.049	2879.	293.	741.	0.090	0.053	.0961	.01051	.213	80	-6	8	26- 6
-8.59	-0.017	1.828	-1.535	2.301	1.423	0.176	0.157	-0.635	4315.	331.	773.	0.113	0.055	.0950	.01026	.254	80	-6	8	26- 7
-8.72	-2.676	-1.311	-0.731	-2.722	-1.958	-1.898	-0.173	-0.161	5815.	473.	836.	0.186	0.158	.0963	.01075	.266	80	-6	8	26- 8
-6.08	1.291	-2.243	2.636	0.672	-1.032	0.613	-1.649	0.770	2793.	155.	627.	0.105	0.080	.0859	.00874	.208	80	-6	8	26- 9
-2.78	1.570	-2.205	1.361	0.587	-0.047	0.124	0.312	-0.592	3181.	142.	711.	0.053	0.025	.0970	.01006	.181	80	-6	10	24- 7
-2.57	-0.314	-0.048	-0.366	-2.610	-0.674	-1.079	0.467	-1.147	5006.	324.	744.	0.146	0.126	.0983	.0105[?]	.196	80	-6	10	24- 8
-5.29	-2.131	-0.054	-0.763	1.144	2.529	0.975	0.710	-1.364	4566.	352.	877.	0.142	0.111	.1083	.01199	.244	80	-6	10	24- 9
-7.16	1.733	0.045	1.236	-0.598	-1.497	0.589	1.251	0.054	3920.	172.	892.	0.068	0.034	.1148	.01258	.215	80	-6	10	24-10
-6.41	1.492	-2.317	2.729	0.772	-1.052	0.671	-1.100	0.676	3331.	170.	816.	0.080	0.062	.1051	.01151	.222	80	-6	10	26-10
-6.42	-0.914	-2.281	2.664	0.611	-1.766	-1.768	0.208	-0.906	5015.	217.	834.	0.160	0.121	.1091	.01154	.218	80	-6	10	26-11
-6.14	-2.611	-1.534	2.721	0.603	-1.030	0.861	-0.114	-0.776	4574.	174.	826.	0.106	0.059	.1068	.01163	.223	80	-6	10	26-12
-6.26	-1.540	1.875	-1.438	2.033	-1.111	0.696	-0.218	-0.052	4733.	369.	823.	0.153	0.095	.0982	.01189	.256	80	-6	10	26-13
-7.63	1.478	-1.566	-0.707	-2.222	2.685	0.268	0.664	0.100	3274.	320.	855.	0.140	0.088	.1078	.01165	.256	80	-6	10	26-14
-8.79	2.131	1.327	-1.533	2.247	2.700	0.273	-1.044	0.956	3644.	347.	899.	0.099	0.027	.1071	.01276	.269	80	-6	10	26-15
-6.54	3.527	-0.500	-1.500	2.076	-1.099	0.669	-0.297	-0.320	4441.	258.	764.	0.118	0.076	.0993	.01097	.220	80	-6	10	26-18
-6.74	5.623	-1.328	-1.591	2.077	-1.137	0.625	-0.178	-0.301	4190.	260.	735.	0.102	0.071	.0985	.01080	.202	80	-6	10	26-19
-9.12	4.023	1.167	-1.771	2.411	2.528	0.265	-1.089	1.182	3508.	324.	869.	0.100	0.037	.1059	.01208	.249	80	-6	10	26-21
-7.33	2.496	0.116	-1.469	1.982	-1.123	0.461	-1.163	-0.391	5960.	497.	800.	0.334	0.273	.1066	.01262	.258	80	-6	10	26-22
-3.09	1.732	1.683	-0.062	-1.366	-0.629	-1.096	-0.798	-0.964	5021.	315.	877.	0.132	0.122	.1120	.01264	.210	80	-6	12	24-11
-4.48	1.729	-0.795	2.685	0.640	2.674	0.280	0.322	-0.904	4132.	393.	904.	0.168	0.100	.1085	.01181	.285	80	-6	12	26-16
-9.02	2.310	1.336	-1.506	2.240	2.825	0.293	-1.140	0.945	4503.	377.	1024.	0.092	0.023	.1138	.01471	.318	80	-6	12	26-17
-2.54	-0.052	1.768	0.062	0.037	-1.155	0.413	-0.330	0.318	2594.	222.	579.	0.101	0.073	.0671	.00915	.185	80	-8	8	25- 1
-2.61	-1.907	1.545	-1.229	-0.154	2.599	0.479	0.350	0.586	2189.	258.	630.	0.091	0.060	.0694	.00953	.193	80	-8	8	25- 2
-4.98	0.220	1.681	-0.804	1.021	1.299	0.332	0.027	-0.074	2626.	232.	712.	0.052	0.018	.0766	.01129	.202	80	-8	8	25- 3
-4.83	-2.502	-1.894	1.496	0.481	2.803	0.613	0.583	1.057	2272.	272.	746.	0.132	0.098	.0818	.01169	.210	80	-8	8	25- 4
-7.06	-0.353	-1.836	-0.249	-1.129	2.730	0.483	-1.023	1.016	1907.	255.	821.	0.046	0.023	.0896	.01345	.225	80	-8	8	25- 5
-7.45	-0.476	-1.678	-0.198	-1.338	1.318	-2.460	0.353	-1.456	5813.	438.	878.	0.702	0.167	.0911	.01269	.250	80	-8	8	25- 6
-4.39	-0.524	-2.103	0.098	0.008	0.537	2.632	-0.534	0.591	1525.	167.	588.	0.081	0.057	.0691	.00763	.190	80	-8	8	26-28
-3.96	-0.741	-2.094	0.155	0.107	1.112	-2.425	-0.860	0.835	2193.	179.	598.	0.097	0.068	.0696	.00935	.201	80	-8	8	26-29
-2.99	-0.472	-2.002	-1.192	-0.280	-1.761	-1.979	-1.635	0.691	4655.	333.	796.	0.152	0.121	.0893	.01247	.215	80	-8	10	25- 7
-5.41	-0.058	-0.123	1.346	0.500	0.290	2.824	1.380	-0.268	3386.	309.	915.	0.108	0.082	.1016	.01469	.226	80	-8	10	25- 8
-5.44	-0.475	-2.122	1.100	-0.844	0.319	2.841	1.191	-0.247	2739.	173.	913.	0.080	0.052	.1026	.01479	.422	80	-8	10	25- 9
-5.36	-0.353	-2.197	1.511	0.527	-1.252	0.622	0.411	0.953	2471.	101.	894.	0.054	0.016	.1035	.01502	.216	80	-8	10	25-10
-3.04	1.658	-0.446	-0.866	1.030	0.047	-0.020	0.188	-1.015	3833.	187.	754.	0.081	0.050	.0883	.01173	.207	80	-8	10	25-11
-4.41	-0.228	-0.212	-0.353	-1.159	0.533	2.639	0.592	1.089	1799.	219.	758.	0.101	0.064	.0902	.01304	.198	80	-8	10	26-30
-4.53	0.095	1.419	-0.668	1.188	2.621	0.353	-0.041	-0.765	3277.	335.	779.	0.094	0.072	.0889	.01299	.222	80	-8	10	26-31
-6.61	1.948	1.571	-0.143	-0.059	0.717	2.745	0.118	-1.560	3383.	238.	840.	0.050	0.015	.0971	.01422	.219	80	-8	10	26-32
-6.53	-1.839	2.150	-0.567	-0.221	1.117	-2.419	1.174	-0.781	5241.	411.	915.	0.170	0.151	.0992	.01496	.255	80	-8	10	26-33
-8.48	-0.141	-0.012	1.100	-1.137	-1.302	0.656	-0.458	0.174	3763.	205.	967.	0.127	0.104	.1095	.01639	.241	80	-8	10	26-34
-8.96	0.177	1.578	1.227	-1.202	-1.059	-0.557	-0.430	0.385	4094.	275.	974.	0.129	0.106	.1098	.01661	.243	80	-8	10	26-35
-3.22	1.753	-0.378	-0.851	1.354	0.031	0.004	0.259	-1.072	4413.	206.	955.	0.093	0.073	.1065	.01557	.215	80	-8	12	25-12
-3.29	-3.130	1.616	1.015	-0.740	2.592	0.546	-0.363	0.255	3197.	271.	979.	0.086	0.051	.1086	.01579	.225	80	-8	12	25-13
-6.57	-1.838	2.371	-0.085	-1.184	-0.597	-0.938	0.039	-0.716	5684.	351.	1024.	0.195	0.146	.1106	.01726	.276	80	-8	12	26- 1
-8.76	1.967	2.110	1.691	0.421	0.057	0.048	0.495	0.867	4023.	252.	1024.	0.081	0.025	.1195	.01817	.291	80	-8	12	26- 2
-9.67	0.529	1.888	-0.723	1.134	0.521	2.643	0.098	-0.130	3521.	394.	1024.	0.100	0.006	.1108	.01883	.329	80	-8	12	26- 3
-8.96	-0.300	-0.218	1.258	-0.901	1.421	0.309	0.421	0.941	4113.	368.	1024.	0.145	0.055	.1203	.01733	.315	80	-8	12	26- 4
-4.36	0.017	-0.358	0.901	-0.937	0.482	2.395	-1.031	0.982	2407.	148.	927.	0.111	0.074	.1103	.01650	.205	80	-8	12	26-36
-4.49	-1.831	1.674	-0.682	1.191	0.450	2.592	1.395	-0.314	3496.	368.	968.	0.102	0.054	.1080	.01668	.260	80	-8	12	26-37
-6.52	1.567	-0.200	0.018	0.091	1.347	0.270	1.124	-0.318	4220.	249.	1021.	0.139	0.094	.1171	.01737	.238	80	-8	12	26-38

TABLE III. LIST OF MCTR WIND TUNNEL TEST DATA (continued)

CO	D1C	D1S	C2C	D2S	D3C	D3S	D4C	D4S	BMF	PLV	HP	TRVT	--4/R	CLR	CXR	CWO	VEL	ALPHA	THETA	RUN-PT
-7.26	1.828	2.290	-0.228	-1.212	1.331	0.430	-0.127	-0.216	4572.	302.	1024.	0.133	0.074	.1185	.01697	.274	80	-8	12	30- 1
-3.48	-2.268	0.037	-0.791	1.025	1.240	0.317	0.236	0.347	2649.	229.	855.	0.068	0.036	.0865	.01545	.219	80	-10	10	30- 2
-5.72	1.616	1.751	-1.239	-0.254	1.496	0.380	0.214	-1.130	3903.	242.	930.	0.128	0.083	.0921	.01542	.236	80	-10	10	30- 3
-7.91	1.104	-1.548	-0.629	-2.362	-2.386	0.598	0.455	1.021	2527.	254.	1024.	0.066	0.048	.1035	.01879	.261	80	-10	10	30- 4
-7.99	1.069	-2.056	1.066	-0.843	-1.857	-1.842	-1.145	-1.035	5148.	290.	1024.	0.199	0.176	.1051	.01896	.254	80	-10	10	30- 5
-8.14	1.608	2.173	1.129	-1.153	-1.167	0.602	0.331	-1.228	4071.	221.	1024.	0.136	0.100	.1043	.01868	.243	80	-10	10	30- 6
-7.84	-2.882	-1.511	2.733	0.622	-1.628	-1.819	0.236	-0.947	4573.	288.	1024.	0.206	0.166	.1083	.01956	.271	80	-10	10	30- 7
-3.65	1.631	-0.327	2.437	0.882	1.318	0.258	-0.286	0.162	2782.	273.	1024.	0.066	0.035	.1023	.01821	.239	80	-10	12	30- 8
-3.48	-2.400	-1.466	0.123	-0.034	-2.116	1.012	-1.296	-0.727	5434.	315.	1024.	0.191	0.162	.1062	.01948	.233	80	-10	12	30- 9
-5.20	1.262	-1.790	-0.548	-2.339	-0.738	-0.943	1.289	-0.169	4226.	298.	1024.	0.144	0.125	.1055	.01926	.247	80	-10	12	30-10
-5.92	-2.514	-1.760	1.196	-0.978	-0.732	-0.865	-0.621	0.235	4081.	243.	1024.	0.141	0.124	.1124	.02085	.265	80	-10	12	30-11
-2.68	2.015	1.049	1.131	-0.776	1.515	-1.476	1.032	-0.043	3592.	374.	604.	0.188	0.133	.0466	.00377	.304	120	-6	8	20- 1
-4.96	0.310	-0.181	-0.093	-1.229	-0.205	2.729	0.435	-1.162	2890.	193.	661.	0.077	0.053	.0629	.00600	.270	120	-6	8	20- 2
-7.27	2.189	-2.179	-0.869	1.033	1.131	-1.260	-0.055	1.113	3678.	296.	752.	0.122	0.087	.0702	.00677	.312	120	-6	8	20- 3
-7.39	0.443	1.873	1.549	0.622	-0.703	-1.049	-0.079	1.068	3639.	349.	775.	0.161	0.136	.0709	.00705	.317	120	-6	8	20- 4
-7.35	-0.352	-0.214	2.723	1.311	0.644	0.381	-0.154	-0.271	4154.	385.	841.	0.147	0.106	.0718	.00751	.358	120	-6	8	20- 5
-3.12	1.784	-0.577	-0.403	-1.178	1.141	-2.438	0.699	0.906	2907.	295.	575.	0.155	0.096	.0531	.00397	.289	120	-6	8	23- 8
-2.79	-0.589	-1.565	-0.334	-2.613	-2.355	0.685	0.260	-0.553	3752.	279.	587.	0.085	0.067	.0798	.00757	.184	120	-6	8	24- 1
-7.59	5.792	-0.434	-0.061	0.216	0.063	0.102	-0.122	-0.184	3045.	286.	738.	0.102	0.060	.0728	.00712	.321	120	-6	9	26-27
-7.91	6.230	-0.447	-1.582	1.953	-0.982	0.362	-1.382	-0.628	6362.	465.	655.	0.318	0.234	.0774	.00824	.352	120	-6	11	26-26
-3.11	1.755	-0.428	0.113	0.007	0.048	0.078	-0.103	-0.085	3217.	219.	687.	0.109	0.065	.0704	.00615	.286	120	-6	10	16- 1
-5.35	1.760	-0.161	0.188	0.009	0.059	0.091	-0.185	-0.099	4180.	270.	784.	0.181	0.135	.0802	.00746	.308	120	-6	10	16- 2
-5.28	1.633	-0.324	2.128	-2.160	0.067	0.097	-0.242	-0.008	4180.	334.	623.	0.167	0.130	.0623	.00764	.329	120	-6	10	16- 3
-7.45	1.831	-0.120	2.279	-2.203	0.072	0.105	-0.277	-0.005	4572.	373.	940.	0.210	0.152	.0894	.00900	.363	120	-6	10	16- 4
-5.81	1.727	-0.318	2.196	-2.176	1.276	-0.193	-0.275	-0.106	4455.	372.	871.	0.178	0.139	.0860	.00814	.355	120	-6	10	16- 5
-4.36	1.824	-0.343	0.160	0.028	0.036	0.086	-0.127	-0.083	3601.	229.	726.	0.138	0.080	.0860	.00814	.355	120	-6	10	16- 6
-5.59	1.875	0.549	2.247	-2.126	1.270	-0.224	0.719	0.242	3903.	379.	844.	0.138	0.127	.0832	.00787	.363	120	-6	10	16- 7
-5.60	1.853	-0.365	2.293	-2.035	1.249	-0.208	0.731	0.235	3804.	351.	871.	0.197	0.123	.0834	.00814	.352	120	-6	10	16- 8
-4.45	-0.766	0.861	2.291	-2.031	0.853	-0.196	0.723	0.395	3809.	378.	617.	0.160	0.108	.0802	.00782	.326	120	-6	10	16- 9
-4.38	-0.805	0.907	2.230	-2.116	-1.183	0.440	0.662	0.457	3602.	294.	777.	0.162	0.109	.0778	.00780	.312	120	-6	10	16-10
-6.61	-0.733	1.162	2.404	-2.179	-1.185	0.440	0.588	0.424	4160.	463.	907.	0.215	0.161	.0848	.00907	.347	120	-6	10	16-11
-6.63	-0.797	1.077	3.341	0.037	-1.208	0.371	0.676	0.202	4052.	320.	900.	0.203	0.133	.0858	.00923	.345	120	-6	10	16-12
-7.80	-0.711	1.203	3.473	0.033	-1.200	0.416	0.497	0.205	4696.	378.	975.	0.241	0.152	.0875	.01001	.371	120	-6	10	16-13
-6.66	-0.752	1.058	3.364	0.044	-1.262	0.385	0.165	0.739	3823.	297.	905.	0.183	0.124	.0868	.00926	.337	120	-6	10	16-14
-6.70	-2.576	1.527	3.413	0.101	-1.189	0.473	0.078	0.759	4393.	391.	926.	0.236	0.169	.0859	.00921	.356	120	-6	10	16-15
-3.70	2.014	-0.346	0.136	-0.000	0.040	0.079	-0.104	-0.094	3229.	228.	746.	0.101	0.063	.0706	.00712	.300	120	-6	10	17- 1
-5.71	1.963	-0.130	0.159	-0.020	0.063	0.098	-0.209	-0.087	4165.	200.	608.	0.169	0.132	.0803	.00769	.311	120	-6	10	17- 2
-6.60	2.123	-0.135	0.267	-0.039	0.032	0.112	-0.217	-0.093	4683.	330.	860.	0.213	0.165	.0807	.00860	.338	120	-6	10	17- 3
-6.69	2.074	-0.222	1.758	-0.728	0.040	0.057	-0.237	-0.068	4212.	344.	909.	0.146	0.110	.0870	.00871	.343	120	-6	10	17- 4
-6.64	2.078	-0.331	1.870	-0.823	0.586	-0.192	-0.235	-0.161	4790.	389.	908.	0.189	0.129	.0843	.00875	.351	120	-6	10	17- 5
-6.83	2.087	-0.340	1.935	-0.714	0.628	-0.164	0.582	0.492	3939.	338.	898.	0.125	0.090	.0863	.00882	.343	120	-6	10	17- 6
-5.24	-0.739	-0.646	1.888	-0.669	0.646	-0.164	0.545	0.605	3612.	317.	847.	0.129	0.088	.0816	.00830	.358	120	-6	10	17- 7
-5.16	-0.856	-0.568	1.809	-0.837	-1.591	0.825	0.447	0.570	3682.	271.	911.	0.178	0.129	.0799	.00820	.308	120	-6	10	17- 8
-5.21	-2.571	-0.224	1.852	-0.851	-1.562	0.633	0.362	0.542	3579.	328.	851.	0.205	0.155	.0793	.00803	.335	120	-6	10	17- 9
-5.19	-2.413	-0.217	1.159	1.349	-1.613	0.857	0.591	0.657	4081.	368.	839.	0.190	0.145	.0761	.00822	.333	120	-6	10	17-10
-5.34	-0.683	-0.558	0.570	-1.739	-1.556	0.774	0.454	0.644	3776.	345.	611.	0.243	0.164	.0797	.00809	.322	120	-6	10	17-11
-5.34	-0.458	-0.582	0.242	0.010	0.101	0.107	-0.248	-0.097	4947.	363.	811.	0.231	0.162	.0769	.00809	.330	120	-6	10	17-12
-5.28	-0.532	-0.723	1.138	1.423	-1.632	0.743	-0.169	1.059	4047.	342.	802.	0.207	0.164	.0772	.00818	.312	120	-6	10	17-13
-5.25	-0.594	-0.560	1.093	1.342	-1.683	0.813	0.724	-0.288	3882.	288.	807.	0.171	0.128	.0769	.00811	.319	120	-6	10	17-14
-5.29	-0.611	-0.521	1.338	1.855	-1.675	0.851	0.786	-0.289	4224.	296.	804.	0.183	0.135	.0787	.00805	.311	120	-6	10	17-15
-5.32	-0.630	-0.578	1.327	1.799	-2.242	1.077	0.788	-0.255	4261.	318.	805.	0.199	0.145	.0774	.00800	.313	120	-6	10	17-16
-5.34	-0.668	-0.548	1.308	1.797	-2.251	1.098	1.229	-0.371	4148.	302.	608.	0.183	0.127	.0789	.00799	.314	120	-6	10	17-17
-5.36	-0.670	-0.618	1.462	1.750	-2.245	-0.554	1.180	-0.443	5133.	364.	618.	0.248	0.181	.0759	.00804	.338	120	-6	10	17-18
-5.37	-0.571	-0.664	1.341	1.877	-0.944	2.385	1.319	-0.392	3762.	359.	813.	0.112	0.027	.0807	.00805	.316	120	-6	10	17-19
-5.38	-0.423	-0.859	1.404	1.924	0.109	2.573	1.418	-0.431	4451.	441.	837.	0.172	0.074	.0784	.00807	.334	120	-6	10	17-20

TABLE III. LIST OF MCTR WIND TUNNEL TEST DATA (continued)

CO	D1C	D1S	C2C	D2S	D3C	D3S	D4C	D4S	BPF	PLV	HP	TRVT	—4/R	CLR	CAR	CQO	VEL	ALPHA	THETA	RUN-PT
-5.36	-0.375	-0.946	1.452	1.970	1.002	2.360	1.448	-0.457	5098.	518.	849.	0.228	0.130	.0776	.00805	.345	120	-6	10	17-21
-5.45	-0.652	-0.752	1.963	1.333	-0.897	2.381	1.321	-0.471	3738.	339.	813.	0.113	0.034	.0817	.00801	.311	120	-6	10	17-22
-5.44	-0.439	-0.674	0.393	2.198	-0.909	2.400	1.301	-0.355	3974.	362.	812.	0.106	0.033	.0776	.00550	.317	120	-6	10	17-23
-3.86	2.000	-0.315	0.149	0.043	0.044	0.113	-0.104	-0.133	3556.	236.	741.	0.137	0.080	.0765	.00701	.294	120	-6	10	18- 1
-3.91	2.002	-0.252	0.143	0.038	0.048	0.120	-0.116	-0.135	3693.	245.	738.	0.136	0.084	.0764	.00705	.302	120	-6	10	18- 2
-5.19	2.133	-0.101	0.193	0.047	0.045	0.126	-0.141	-0.158	4118.	256.	809.	0.171	0.109	.0804	.00803	.304	120	-6	10	18- 3
-5.19	2.127	-0.143	0.196	0.042	0.045	0.124	-0.151	-0.158	4037.	260.	800.	0.168	0.119	.0801	.00790	.305	120	-6	10	18- 4
-4.08	2.004	-0.592	2.007	-0.253	0.013	0.046	-0.154	-0.142	3674.	324.	784.	0.130	0.073	.0775	.00712	.316	120	-6	10	18- 5
-5.42	2.030	-0.345	2.081	-0.270	0.048	0.067	-0.225	-0.143	4182.	336.	829.	0.173	0.110	.0841	.00784	.332	120	-6	10	18- 6
-4.98	2.203	-0.623	2.066	-0.312	1.565	-0.164	0.039	-0.417	4400.	413.	850.	0.177	0.114	.0810	.00776	.358	120	-6	10	18- 7
-4.90	2.283	-0.608	2.094	0.030	1.590	-0.194	0.059	-0.412	4323.	429.	858.	0.188	0.122	.0800	.00791	.362	120	-6	10	18- 8
-4.97	2.150	-0.600	2.149	0.191	1.659	-0.195	-0.002	1.658	3600.	361.	860.	0.161	0.082	.0820	.00801	.367	120	-6	10	18- 9
-4.76	-2.291	-2.896	2.296	0.263	1.237	1.363	-0.130	1.839	2912.	322.	897.	0.133	0.059	.0858	.00900	.336	120	-6	10	18-10
-4.92	2.233	-0.449	2.091	0.167	1.111	1.200	-0.072	1.631	4103.	373.	836.	0.169	0.095	.0807	.00813	.311	120	-6	10	18-11
-4.94	2.181	-0.379	2.061	0.002	1.034	1.269	0.002	-0.130	3387.	348.	823.	0.139	0.061	.0815	.00794	.309	120	-6	10	18-12
-4.69	2.081	-0.446	1.975	-0.307	1.460	-0.246	0.073	-0.360	4465.	430.	843.	0.181	0.113	.0813	.00771	.359	120	-6	10	18-13
-4.72	2.011	-0.343	2.003	0.023	0.023	0.055	-0.139	-0.135	3771.	340.	614.	0.139	0.077	.0809	.00796	.313	120	-6	10	18-14
-4.79	2.114	-0.128	0.198	0.039	0.045	0.111	-0.156	-0.122	3745.	259.	786.	0.148	0.112	.0781	.00807	.298	120	-6	10	18-15
-4.83	1.990	-0.355	2.154	-0.370	0.000	0.064	-0.197	-0.129	3830.	342.	815.	0.156	0.099	.0813	.00804	.318	120	-6	10	18-16
-7.23	2.176	-0.036	2.285	-0.407	0.071	0.066	-0.259	-0.169	4875.	401.	979.	0.212	0.145	.0878	.00924	.366	120	-6	10	18-17
-7.14	2.030	-2.251	2.330	-0.370	0.121	0.123	-0.331	-0.219	4898.	335.	953.	0.216	0.140	.0691	.00939	.336	120	-6	10	18-18
-5.85	0.090	-2.173	2.337	0.031	0.140	0.190	-0.262	-0.305	4699.	332.	922.	0.239	0.143	.0672	.00919	.366	120	-6	10	18-19
-5.81	0.014	-2.203	3.196	-0.092	0.164	0.256	-0.361	-0.249	4705.	342.	928.	0.207	0.135	.0674	.00922	.355	120	-6	10	18-20
-5.94	0.233	-2.324	0.930	2.865	-0.072	0.183	-0.201	-0.150	5221.	338.	891.	0.213	0.134	.0829	.00901	.362	120	-6	10	18-21
-6.02	2.060	-2.560	0.852	2.550	-0.140	0.087	-0.088	-0.135	4275.	300.	863.	0.160	0.087	.0842	.00872	.336	120	-6	10	18-22
-6.03	1.967	-2.515	0.673	2.123	-0.078	0.132	-0.141	-0.133	4334.	284.	854.	0.178	0.111	.0846	.00818	.342	120	-6	10	18-23
-5.96	1.874	-2.169	2.178	-0.411	0.114	0.034	-0.254	-0.181	4610.	305.	882.	0.191	0.127	.0863	.00885	.345	120	-6	10	18-24
-5.84	2.017	-0.241	2.116	-0.476	0.115	0.083	-0.190	-0.081	4351.	351.	876.	0.182	0.117	.0867	.00885	.341	120	-6	10	18-25
-6.09	2.205	-0.468	0.630	2.018	0.007	0.136	-0.088	-0.159	4433.	315.	849.	0.182	0.101	.0822	.00819	.361	120	-6	10	18-26
-5.74	0.600	-2.056	0.201	0.098	0.017	0.064	-0.146	-0.200	4359.	310.	848.	0.204	0.151	.0823	.00794	.344	120	-6	10	19- 1
-5.63	0.427	-2.128	0.251	0.124	-0.650	2.087	-0.214	-0.149	3254.	142.	823.	0.099	0.073	.0838	.00811	.306	120	-6	10	19- 2
-5.69	0.557	-0.168	0.192	0.012	-0.690	2.101	-0.183	-0.158	3258.	206.	822.	0.103	0.078	.0831	.00809	.303	120	-6	10	19- 3
-5.79	0.638	-0.403	0.408	2.021	-0.746	2.092	-0.117	-0.007	3229.	330.	829.	0.078	0.035	.0817	.00802	.312	120	-6	10	19- 4
-5.69	0.573	0.012	-0.109	-1.976	-0.683	2.036	-0.153	-0.266	3412.	228.	829.	0.151	0.109	.0803	.00840	.309	120	-6	10	19- 5
-5.79	0.265	0.039	2.178	-0.283	-1.963	0.551	-0.221	-0.204	4223.	299.	835.	0.221	0.177	.0863	.00808	.324	120	-6	10	19- 6
-5.78	0.313	-0.010	2.221	-0.321	-2.926	0.199	-0.209	-0.247	4837.	328.	846.	0.260	0.218	.0833	.00836	.333	120	-6	10	19- 7
-5.57	1.930	-2.155	2.151	-0.053	0.054	0.079	-0.164	-0.211	3815.	269.	839.	0.150	0.094	.0846	.00798	.330	120	-6	10	19- 8
-6.61	0.256	-2.124	2.286	-0.014	0.111	0.197	-0.188	-0.324	4455.	263.	915.	0.198	0.134	.0873	.00899	.345	120	-6	10	19- 9
-6.62	0.556	-2.273	0.133	2.153	-0.064	0.142	-0.167	-0.142	4879.	321.	881.	0.227	0.158	.0916	.00812	.363	120	-6	10	19-10
-3.37	0.291	-0.223	0.123	0.038	0.025	0.068	-0.074	-0.108	3415.	215.	703.	0.126	0.092	.0744	.00670	.287	120	-6	10	19-11
-3.35	1.931	-0.173	0.102	0.061	0.015	0.098	-0.067	-0.096	3098.	211.	590.	0.106	0.065	.0730	.00524	.292	120	-6	10	19-12
-5.62	1.983	0.110	0.180	0.055	0.007	0.114	-0.111	-0.177	4018.	250.	792.	0.163	0.118	.0831	.00776	.305	120	-6	10	19-13
-3.46	1.959	1.525	0.114	-0.013	-0.021	0.052	-0.076	-0.128	3147.	257.	690.	0.106	0.067	.0702	.00627	.293	120	-6	10	19-14
-3.39	1.909	-0.074	-0.093	-1.890	0.027	0.127	-0.093	-0.157	3392.	239.	699.	0.132	0.102	.0742	.00630	.290	120	-6	10	19-15
-3.42	2.137	-0.381	-1.829	0.223	0.097	-0.066	-0.100	-0.155	3207.	257.	681.	0.111	0.084	.0706	.00626	.281	120	-6	10	19-16
-3.51	2.057	-0.595	0.224	2.007	-0.004	0.056	-0.026	-0.055	2818.	302.	694.	0.084	0.033	.0710	.00612	.296	120	-6	10	19-17
-3.51	1.857	0.444	2.015	-0.105	-0.007	0.018	-0.091	-0.140	2509.	232.	724.	0.101	0.058	.0754	.00613	.324	120	-6	10	19-18
-3.49	2.013	-0.336	0.132	-0.017	-2.005	0.396	-0.127	-0.088	3766.	251.	687.	0.157	0.124	.0731	.00646	.272	120	-6	10	19-19
[illegible]	2.116	-0.460	0.019	0.031	0.350	2.054	-0.085	-0.081	2702.	248.	698.	0.068	0.027	.0732	.00631	.281	120	-6	10	19-20
[illegible]	2.032	-0.517	0.070	0.094	2.032	-0.319	-0.040	-0.137	3836.	340.	723.	0.141	0.097	.0730	.00616	.324	120	-6	10	19-21
[illegible]	[illegible]	-0.457	0.176	0.001	-0.234	-1.958	-0.091	-0.126	4510.	321.	725.	0.197	0.160	.0718	.00634	.323	120	-6	10	19-22
[illegible]	2.071	-0.442	0.105	0.103	-0.066	-0.026	-0.075	2.127	3054.	257.	686.	0.091	0.061	.0733	.00654	.275	120	-6	10	19-23
-3.54	2.027	-0.519	0.179	0.002	0.014	0.129	2.190	-0.263	4815.	302.	709.	0.197	0.139	.0732	.00615	.308	120	-6	10	19-24
-3.46	1.927	-0.486	0.054	-0.104	0.163	0.060	-0.321	-2.399	5895.	335.	[illegible]	0.261	0.225	.0724	.00620	.333	120	-6	10	19-25
-3.42	1.922	-0.468	0.033	0.005	0.085	-0.027	-2.402	-0.006	5251.	300.	710.	0.219	0.180	.0726	.00643	.300	120	-6	10	19-26

TABLE III. LIST OF MCTR WIND TUNNEL TEST DATA (continued)

CO	D1C	D1S	D2C	D2S	D3C	D3S	D4C	D4S	BPF	PLV	HP	TRVT	—4/R	CLR	CAR	CQO	VEL	ALPHA	THETA	RUN-PT
-3.10	-1.651	-2.291	-0.754	0.825	0.343	-0.428	-1.132	0.129	3863.	338.	764.	0.179	0.131	.0693	.00735	.305	120	-6	10	20- 6
-3.11	-1.222	1.456	-1.845	1.390	-1.326	0.310	-0.307	0.492	4789.	431.	734.	0.197	0.131	.0642	.00689	.292	120	-6	10	20- 7
-5.37	2.213	-0.149	-0.024	-1.360	0.657	0.093	-1.128	0.217	3813.	279.	787.	0.192	0.139	.0784	.00758	.305	120	-6	10	20- 8
-5.19	-1.560	-2.063	-0.965	-0.221	-0.281	2.809	0.065	1.103	3131.	323.	856.	0.089	0.021	.0787	.00863	.333	120	-6	10	20- 9
-5.45	-1.378	1.842	0.257	-0.450	-0.617	0.250	-0.126	-0.115	4528.	433.	651.	0.262	0.197	.0734	.00806	.361	120	-6	10	20-10
-7.97	2.478	2.033	-0.567	-0.387	-0.239	-0.462	0.959	0.143	5394.	445.	902.	0.236	0.175	.0804	.00840	.365	120	-6	10	20-11
-2.59	1.515	-2.459	-0.889	-2.422	-1.139	0.666	0.320	1.173	3000.	207.	697.	0.139	0.079	.0725	.00645	.280	120	-6	10	23- 1
-5.19	-0.169	-0.368	1.654	0.599	2.763	0.420	-0.593	0.723	3620.	434.	873.	0.100	0.053	.0811	.00809	.362	120	-6	10	23- 2
-7.51	2.388	-0.468	1.706	0.332	0.057	0.110	1.009	-0.426	4559.	360.	938.	0.174	0.134	.0842	.00824	.333	120	-6	10	23- 3
-5.04	0.847	1.400	-1.587	1.675	-2.426	1.347	0.274	1.206	5574.	464.	790.	0.306	0.222	.0678	.00737	.340	120	-6	10	23- 4
-7.24	2.369	0.167	-1.026	2.134	-1.031	0.444	-1.267	-0.340	5756.	484.	632.	0.323	0.249	.0704	.00777	.333	120	-6	10	26-23
-7.73	6.209	-0.495	-1.625	1.963	-1.071	0.365	-1.356	-0.461	5807.	429.	757.	0.294	0.232	.0725	.00740	.339	120	-6	10	26-24
-7.95	6.293	-0.441	-1.584	1.955	-0.961	0.395	-1.415	-0.577	6209.	476.	841.	0.333	0.258	.0722	.00715	.326	120	-6	10	26-25
-8.19	2.293	0.016	0.347	0.073	0.092	0.168	-0.149	-0.274	4636.	360.	940.	0.241	0.147	.0825	.00904	.364	120	-6	10	28- 1
-7.94	2.531	-0.309	-0.774	2.581	-0.635	-1.077	0.843	0.312	4969.	373.	939.	0.213	0.147	.0787	.00885	.357	120	-6	10	28- 2
-8.29	6.219	-0.552	-0.953	3.135	-0.649	-1.309	1.017	0.352	4037.	310.	843.	0.147	0.093	.0785	.00823	.353	120	-6	10	28- 3
-8.03	5.685	-0.659	-0.308	1.659	-0.271	-0.479	0.343	-0.053	4049.	306.	648.	0.141	0.101	.0828	.00829	.349	120	-6	10	28- 4
-7.79	5.708	-0.469	0.680	-2.364	1.186	1.241	-1.002	-0.777	3808.	301.	882.	0.145	0.107	.0872	.00830	.365	120	-6	10	28- 5
-8.02	5.748	-0.708	-0.022	0.355	0.457	-0.041	-0.520	-0.080	3803.	290.	854.	0.126	0.097	.0843	.00832	.355	120	-6	10	28- 6
-8.03	2.414	-0.166	0.363	0.139	0.175	0.037	-0.195	-0.117	4613.	342.	892.	0.223	0.149	.0813	.00899	.361	120	-6	10	28- 7
-3.43	-2.379	-0.517	0.287	0.041	0.133	0.058	-0.204	-0.141	3522.	304.	750.	0.140	0.125	.0713	.00729	.321	120	-6	10	28- 8
-3.41	-2.490	-0.522	-0.761	2.393	-0.439	-0.972	0.546	0.289	3978.	358.	734.	0.173	0.135	.0663	.00717	.316	120	-6	10	28- 9
-3.29	-2.370	0.653	1.270	-2.364	0.677	1.044	-0.868	-0.610	3510.	309.	757.	0.153	0.134	.0698	.00746	.326	120	-6	10	28-10
-3.32	-2.342	0.851	0.827	-1.141	0.389	0.638	-0.414	-0.235	3671.	290.	718.	0.136	0.114	.0694	.00736	.320	120	-6	10	28-11
-3.32	-2.469	0.781	1.170	-0.911	0.366	0.623	-0.418	-0.263	3700.	308.	735.	0.137	0.119	.0716	.00729	.315	120	-6	10	28-12
-3.26	-2.315	0.660	0.378	-1.259	0.432	0.532	-0.430	-0.239	3778.	328.	735.	0.154	0.122	.0677	.00740	.315	120	-6	10	28-13
-3.41	-2.495	0.784	1.316	-1.011	0.325	0.625	-0.437	-0.253	3617.	284.	753.	0.130	0.108	.0726	.00720	.322	120	-6	10	28-14
-3.83	3.622	-0.357	0.180	0.130	0.027	0.055	-0.028	-0.129	3317.	234.	727.	0.121	0.088	.0728	.00729	.305	120	-6	10	28-15
-3.04	-0.216	-2.789	2.876	0.796	-0.915	-0.722	-1.127	0.645	4443.	236.	915.	0.210	0.165	.0783	.00938	.320	120	-6	12	23- 5
-8.20	0.277	1.601	-0.407	-0.297	-0.241	0.148	-0.229	-0.324	4463.	379.	866.	0.226	0.166	.0833	.00942	.314	120	-6	12	21- 2
-8.18	2.259	-2.200	0.095	-0.638	0.063	0.006	0.119	-0.455	4024.	210.	877.	0.180	0.122	.0863	.00855	.330	120	-6	12	21- 3
-8.25	2.047	-2.175	0.008	-1.130	0.066	-0.021	0.196	-0.629	4229.	243.	843.	0.209	0.140	.0879	.00920	.358	120	-6	12	21- 4
-9.26	1.469	-0.462	1.259	-0.665	0.373	-0.308	-0.553	-0.172	4087.	368.	921.	0.223	0.139	.0884	.01038	.345	120	-6	12	21- 5
-9.28	1.535	-0.391	1.373	-0.711	-0.0 3	0.023	0.193	-0.592	4323.	317.	952.	0.179	0.136	.0842	.00923	.345	120	-6	12	21- 6
-9.55	1.476	1.564	0.246	-0.103	-1.2 5	0.290	0.417	-0.084	3936.	335.	898.	0.214	0.135	.0868	.00793	.337	120	-6	12	21- 7
-11.21	2.525	-0.205	-0.796	0.773	-0.006	0.090	-0.162	0.198	4749.	355.	966.	0.234	0.153	.0897	.01026	.407	120	-6	12	21- 8
-3.14	0.203	-0.702	-1.381	1.889	1.090	-2.270	0.575	1.028	5461.	438.	884.	0.196	0.124	.0895	.00904	.356	120	-6	12	23- 6
-3.01	1.803	-0.763	-0.333	-1.188	1.175	-2.465	0.683	0.920	2962.	314.	571.	0.155	0.092	.0797	.00814	.307	120	-6	12	23- 7
-10.52	2.423	1.213	1.839	0.862	2.393	1.110	-1.045	0.227	4077.	518.	1018.	0.121	0.053	.0423	.00467	.297	120	-8	8	21- 9
-3.03	1.573	-2.310	1.104	-0.810	-0.574	-1.164	0.357	-1.082	3992.	264.	588.	0.192	0.143	.0393	.00535	.270	120	-8	8	21-10
-7.79	-1.605	0.036	-1.120	-0.461	-0.285	2.461	-0.526	-0.852	3154.	245.	573.	0.121	0.049	.0435	.00566	.277	120	-8	8	21-11
-10.16	2.302	1.356	-2.037	1.532	0.107	-0.030	-0.113	-0.040	2852.	309.	612.	0.112	0.092	.0403	.00562	.276	120	-8	8	21-12
-10.12	0.208	-2.103	1.174	-0.691	1.253	0.691	-1.134	0.296	2276.	198.	703.	0.088	0.054	.0509	.00715	.294	120	-8	8	21-13
-2.54	1.852	-2.209	-0.920	0.934	0.041	-0.127	-1.123	0.371	2665.	170.	521.	0.123	0.080	.0521	.00419	.253	120	-8	8	22- 9
-2.59	7.013	1.173	-0.148	-0.103	-0.208	2.449	-0.003	-0.133	2649.	287.	515.	0.098	0.066	.0491	.00408	.249	120	-8	8	22-10
-4.99	1.997	1.623	0.226	-0.110	-2.029	1.278	-0.037	0.039	4635.	386.	637.	0.230	0.197	.0623	.00529	.292	120	-8	8	22-11
-7.32	2.077	-1.916	-1.135	-0.500	-1.180	0.146	0.112	-0.568	5352.	321.	704.	0.245	0.200	.0705	.00538	.306	120	-8	8	22-12
-7.31	0.121	0.110	1.323	-0.926	-1.105	0.353	0.215	-0.640	4983.	329.	775.	0.232	0.186	.0750	.00717	.323	120	-8	8	22-13
-5.27	2.043	-0.557	-0.803	1.079	-0.910	-0.864	-1.365	-0.535	5640.	392.	644.	0.268	0.223	.0419	.00432	.297	120	-8	8	23- 9
-7.69	2.229	-0.156	1.115	-1.330	0.056	0.140	0.515	0.978	2500.	269.	775.	0.035	0.049	.0492	.00558	.314	120	-8	8	23-10
-7.51	0.969	1.883	-0.731	1.030	0.705	2.836	-0.081	-0.716	3420.	344.	790.	0.078	0.050	.0599	.00511	.331	120	-8	8	23-11
-7.57	-1.460	2.064	0.405	-0.211	0.102	0.136	-0.240	0.016	4732.	506.	652.	0.228	0.181	.0592	.00779	.326	120	-8	8	23-12
-8.35	1.877	-2.216	-0.130	-1.296	-0.495	-1.190	-0.452	-0.466	4277.	278.	744.	0.198	0.160	.0629	.00776	.314	120	-8	10	21-14
-8.17	0.458	-0.495	-1.902	1.559	0.048	-0.018	-0.883	-1.303	4370.	360.	722.	0.189	0.160	.0602	.00725	.297	120	-6	10	21-15
-8.11	-1.963	-2.240	2.379	1.268	-2.412	0.551	-1.429	0.213	4176.	281.	789.	0.226	0.182	.0669	.00938	.292	120	-6	10	21-16

TABLE III. LIST OF MCTR WIND TUNNEL TEST DATA (continued)

CO	D1C	D1S	D2C	D2S	D3C	D3S	D4C	D4S	BPF	PLV	HP	TRVT	-4/R	CLR	CXR	CQO	VEL	ALPHA	THETA	RUN-PT
-10.50	2.423	-0.330	0.121	0.042	1.160	0.693	1.059	0.102	3748.	302.	831.	0.168	0.111	.0665	.00929	.327	120	-8	10	21-17
-12.79	2.190	-2.108	2.762	1.271	-1.359	0.407	0.445	-1.389	4579.	318.	977.	0.193	0.159	.0805	.01097	.384	120	-8	10	21-18
-12.83	2.620	-1.086	0.195	0.122	1.128	0.659	-0.145	0.276	3600.	264.	960.	0.110	0.079	.0789	.01130	.327	120	-8	10	21-19
-6.11	0.624	1.548	0.078	-1.239	1.220	0.675	-0.128	0.434	3716.	355.	944.	0.126	0.091	.0747	.01080	.332	120	-8	10	22-1
-2.95	1.838	-0.150	-0.293	-2.625	-0.441	-1.106	-1.169	0.402	5129.	305.	708.	0.237	0.186	.0741	.00646	.301	120	-8	10	22-14
-2.80	-1.836	-0.122	1.185	0.287	-0.909	0.254	0.416	-0.821	4634.	275.	784.	0.169	0.148	.0641	.00842	.304	120	-8	10	29-18
-3.10	-0.057	-1.709	-0.335	-2.465	-2.103	0.394	0.084	-0.445	4871.	338.	780.	0.191	0.163	.0650	.00847	.296	120	-8	10	29-19
-5.71	-1.028	1.746	-0.138	-2.117	1.264	2.485	0.432	1.130	3205.	421.	952.	0.151	0.057	.0696	.01091	.332	120	-8	10	29-20
-3.43	2.041	1.528	-0.855	0.727	-0.596	-1.041	0.583	0.110	4522.	319.	905.	0.183	0.121	.0760	.01020	.319	120	-8	12	22-2
-3.25	0.326	-0.366	1.310	0.512	-0.534	2.560	0.229	-0.581	2805.	289.	978.	0.067	0.018	.0825	.01143	.303	120	-8	12	22-3
-3.32	0.445	1.692	-0.136	-1.335	-0.452	2.571	-0.098	-0.193	2792.	220.	915.	0.070	0.045	.0817	.01106	.292	120	-8	12	22-4
-3.38	0.523	1.746	-0.1[illegible]7	-2.674	0.099	0.118	-0.547	0.112	4025.	371.	927.	0.209	0.161	.0776	.01081	.328	120	-8	12	22-5
-4.36	0.642	1.826	0.224	-0.176	-2.531	0.436	-1.322	0.548	5236.	442.	971.	0.323	0.249	.0796	.02137	.326	120	-8	12	22-6
-4.45	-1.553	1.915	2.694	1.117	-1.222	0.279	-1.419	0.326	4371.	407.	1026.	0.219	0.166	.0863	.01236	.332	120	-8	12	22-7
-5.32	0.473	-0.180	0.232	0.034	1.037	1.059	-0.632	0.301	3479.	354.	1026.	0.153	0.090	.0863	.01226	.349	120	-8	12	22-8
-5.29	0.285	-0.215	2.568	1.096	1.214	0.704	-0.976	0.703	3263.	373.	1027.	0.078	0.046	.0893	.01238	.364	120	-8	12	29-21
-4.99	0.559	-2.077	-1.477	1.699	-0.147	1.252	-0.108	1.098	3145.	291.	1007.	0.099	0.036	.0802	.01234	.328	120	-8	12	29-22
-5.12	0.127	-2.154	2.503	1.123	-0.212	1.490	0.162	-1.293	4724.	326.	1027.	0.167	0.116	.0894	.01245	.367	120	-8	12	29-23
-1.70	-0.302	-2.113	-1.161	-0.350	0.006	-0.038	-0.468	0.306	2342.	158.	534.	0.081	0.054	.0326	.00435	.275	120	-10	8	27-1
-1.75	-0.600	-2.370	0.920	-0.970	-0.688	-0.991	-0.056	-0.586	3759.	252.	587.	0.162	0.115	.0345	.00429	.295	120	-10	8	27-2
-4.19	1.920	-2.355	-1.777	1.894	-2.333	1.078	-0.138	-0.568	4330.	314.	626.	0.185	0.151	.0397	.00563	.291	120	-10	8	27-3
-4.26	0.145	1.446	2.614	0.769	-0.884	-1.020	0.645	-0.675	4111.	447.	707.	0.187	0.137	.0436	.00616	.335	120	-10	8	27-4
-4.30	-1.701	0.643	-0.772	0.871	0.508	-0.558	-0.696	-0.542	4829.	362.	731.	0.191	0.152	.0452	.00701	.322	120	-10	8	27-5
-6.30	2.379	-0.614	-1.731	2.080	2.642	0.564	0.027	0.607	3429.	361.	770.	0.113	0.069	.0474	.00735	.325	120	-10	8	27-6
-6.31	-1.773	0.543	-0.321	-1.268	-2.368	1.004	0.433	1.208	4457.	366.	850.	0.183	0.150	.0544	.00937	.323	120	-10	8	27-7
-6.21	-1.745	0.388	-0.052	-0.964	0.138	-0.116	-1.037	0.623	4934.	307.	849.	0.203	0.181	.0514	.00929	.333	120	-10	8	27-8
-2.35	-1.836	-0.276	0.204	-0.007	0.119	0.011	-0.192	-0.042	3432.	258.	796.	0.142	0.110	.0533	.00917	.310	120	-10	10	27-9
-4.70	2.411	1.712	0.099	-0.036	0.064	0.025	-0.136	-0.092	3619.	307.	852.	0.134	0.114	.0592	.00979	.323	120	-10	10	27-10
-6.92	2.416	1.887	0.202	-0.027	0.053	0.072	-0.160	-0.110	4182.	349.	992.	0.189	0.144	.0685	.01229	.363	120	-10	10	27-11
-6.82	0.698	1.986	0.345	-0.055	0.056	0.048	-0.127	-0.150	4420.	404.	1010.	0.207	0.163	.0660	.01244	.369	120	-10	10	27-12
-4.06	-1.665	-0.025	-0.053	-1.137	2.297	1.127	0.078	1.147	3326.	309.	795.	0.137	0.105	.0534	.00884	.330	120	-10	10	28-16
-4.91	1.939	1.607	-1.037	-0.551	-0.489	-1.091	-0.121	-0.076	4219.	362.	831.	0.195	0.169	.0569	.00950	.309	120	-10	10	29-1
-4.89	1.895	1.577	0.105	-0.157	-0.534	-1.110	-0.978	-0.907	5246.	419.	853.	0.267	0.236	.0590	.00947	.340	120	-10	10	29-2
-7.22	-1.653	2.127	1.697	0.509	-1.368	0.388	-1.319	0.448	4477.	397.	1027.	0.223	0.197	.0686	.01307	.364	120	-10	10	29-3
-7.34	0.204	-1.982	1.438	0.664	-0.093	2.814	-1.302	-0.758	3882.	212.	1026.	0.120	0.098	.0747	.01329	.335	120	-10	10	29-12
-7.41	2.126	0.046	1.321	-0.817	-2.394	0.703	-0.022	0.400	3636.	256.	1004.	0.174	0.151	.0722	.01266	.333	120	-10	10	29-13
-5.03	0.253	-0.012	-0.272	-2.368	-1.091	0.433	1.050	0.115	3558.	291.	886.	0.142	0.117	.0629	.01083	.319	120	-10	10	29-14
-5.16	2.254	-2.331	-0.923	0.971	-0.365	2.460	0.017	0.457	2632.	232.	874.	0.084	0.067	.0622	.01047	.284	120	-10	10	29-15
-2.80	-1.956	-1.728	-0.275	-2.259	0.024	2.507	-0.115	0.034	1983.	206.	798.	0.052	0.035	.0555	.00963	.296	120	-10	10	29-16
-2.95	0.141	1.576	1.030	0.309	-2.129	0.728	0.426	-1.159	3804.	338.	755.	0.175	0.152	.0529	.00850	.311	120	-10	10	29-17
-3.01	1.974	-0.431	1.336	0.355	-0.215	2.481	-0.647	0.230	3450.	288.	883.	0.113	0.087	.0688	.01147	.301	120	-10	12	29-4
-3.00	2.067	-0.676	1.309	0.474	2.267	0.996	0.369	-0.858	3955.	437.	944.	0.187	0.130	.0681	.01112	.389	120	-10	12	29-5
-4.14	0.303	-2.125	-0.789	0.915	-1.327	0.319	-0.001	-0.896	4580.	292.	943.	0.202	0.162	.0734	.01327	.318	120	-10	12	29-6
-5.80	0.311	0.090	0.042	-1.424	-1.336	0.413	-0.024	0.318	4057.	344.	1013.	0.218	0.172	.0757	.01450	.344	120	-10	12	29-7
-6.24	0.300	0.197	0.096	-1.388	-2.616	0.770	-0.067	0.373	4267.	348.	995.	0.234	0.191	.0775	.01436	.355	120	-10	12	29-8
-6.25	0.274	-2.002	0.242	0.103	-0.090	2.701	-1.237	-0.959	4216.	353.	1027.	0.171	0.128	.0793	.01532	.344	120	-10	12	29-9
-2.88	-1.728	-1.522	-0.839	-0.317	0.004	1.300	0.189	-0.387	3982.	279.	938.	0.170	0.126	.0697	.01275	.339	120	-10	12	29-10
-3.06	-1.794	-1.950	-1.759	1.731	-0.222	2.459	0.168	-0.572	3416.	297.	1004.	0.071	0.056	.0714	.01258	.319	120	-10	12	29-11
-2.77	1.184	-1.952	1.948	0.797	0.054	0.395	-0.810	0.343	3097.	275.	985.	0.074	0.037	.0718	.01210	.340	120	-10	12	29-24

TABLE IV. MCTR WIND TUNNEL TEST POINT AND CONDITION COMPILATION

VELOCITY (KNOTS)	α_s (DEG)	θ_o (DEG)	AVAILABLE TEST POINTS
80	- 6	8	11
		10	15
		12	10
	- 8	8	10
		10	11
		12	11
	- 10	8	--
		10	6
		12	5
120	- 6	8	6
		10	122
		12	11
	- 8	8	15
		10	11
		12	10
	- 10	8	8
		10	14
		12	9

CONDITION CODE μ = 0.33	V (KTS)	α_S (DEG)	θ_0 (DEG)
a - i	120	- 6	10
b - i	120	- 6	8, 10, 12
c - i	120	- 6, - 8, - 10	8, 10, 12

i	Independent variables considered in equation
1	$\delta_0 - \delta_{4S}$
2	$\delta_0 - \delta_{4S}$, θ_0 (Not analyzed)
3	$\delta_0 - \delta_{4S}$, CLR, CXR

TABLE V. INDEPENDENT VARIABLE CODE KEY					
VARIABLE NUMBER	VARIABLE	VARIABLE NUMBER	VARIABLE	VARIABLE NUMBER	VARIABLE
1	δ_0	20	$\delta_{1C}\ \delta_{1S}$	40	δ_{2S}^2
2	δ_{1C}	21	$\delta_{1C}\ \delta_{2C}$	41	$\delta_{2S}\ \delta_{3C}$
3	δ_{1S}	22	$\delta_{1C}\ \delta_{2S}$	42	$\delta_{2S}\ \delta_{3S}$
4	δ_{2C}	23	$\delta_{1C}\ \delta_{3C}$	43	$\delta_{2S}\ \delta_{4C}$
5	δ_{2S}	24	$\delta_{1C}\ \delta_{3S}$	44	$\delta_{2S}\ \delta_{4S}$
6	δ_{3C}	25	$\delta_{1C}\ \delta_{4C}$	45	δ_{3C}^2
7	δ_{3S}	26	$\delta_{1C}\ \delta_{4S}$	46	$\delta_{3C}\ \delta_{3S}$
8	δ_{4C}	27	δ_{1S}^2	47	$\delta_{3C}\ \delta_{4C}$
9	δ_{4S}	28	$\delta_{1S}\ \delta_{2C}$	48	$\delta_{3C}\ \delta_{4S}$
10	δ_0^2	29	$\delta_{1S}\ \delta_{2S}$	49	δ_{3S}^2
11	$\delta_0\ \delta_{1C}$	30	$\delta_{1S}\ \delta_{3C}$	50	$\delta_{3S}\ \delta_{4C}$
12	$\delta_0\ \delta_{1S}$	31	$\delta_{1S}\ \delta_{3S}$	51	$\delta_{3S}\ \delta_{4S}$
13	$\delta_0\ \delta_{2C}$	32	$\delta_{1S}\ \delta_{4C}$	52	δ_{4C}^2
14	$\delta_0\ \delta_{2S}$	33	$\delta_{1S}\ \delta_{4S}$	53	$\delta_{4C}\ \delta_{4S}$
15	$\delta_0\ \delta_{3C}$	34	δ_{2C}^2	54	δ_{4S}^2
16	$\delta_0\ \delta_{3S}$	35	$\delta_{2C}\ \delta_{2S}$	62	CLR
17	$\delta_0\ \delta_{4C}$	36	$\delta_{2C}\ \delta_{3C}$	55	CLR^2
18	$\delta_0\ \delta_{4S}$	37	$\delta_{2C}\ \delta_{3S}$	63	CXR
19	δ_{1C}^2	38	$\delta_{2C}\ \delta_{4C}$	56	CXR^2
		39	$\delta_{2C}\ \delta_{4S}$	57	CLR*CXR

TABLE VI. REGRESSION MODELS

BMF (a-1)

```
FOR 14 VARIABLES ENTERED
  MULTIPLE CORRELATION COEFFICIENT...      0.916
       (ADJUSTED FOR D.F.)...........      0.905
  F-VALUE FOR ANALYSIS OF VARIANCE...     38.358
  STANDARD ERROR OF ESTIMATE.........    293.288
       (ADJUSTED FOR D.F.)...........    311.079
```

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
10	-11.52840	15.88538	-0.726
33	327.21655	50.94110	6.423
52	354.60596	35.28447	10.050
54	274.90894	38.11928	7.212
7	-353.80469	41.53012	-8.519
28	-45.19469	17.29762	-2.613
2	-161.70319	19.75624	-8.185
47	322.63452	48.70642	6.624
18	149.17683	19.02193	7.842
51	504.20435	82.77505	6.091
45	90.13812	19.95268	4.518
4	-106.44173	28.27472	-3.765
26	91.27338	30.96436	2.948
1	-451.41504	176.47675	-2.558
INTERCEPT	2191.16602		

TABLE VI. REGRESSION MODELS (continued)

PLL (a-1)

```
FOR 14 VARIABLES ENTERED
  MULTIPLE CORRELATION COEFFICIENT...      0.983
        (ADJUSTED FOR D.F.)............    0.981
  F-VALUE FOR ANALYSIS OF VARIANCE...    214.920
  STANDARD ERROR OF ESTIMATE.........      4.974
        (ADJUSTED FOR D.F.)............    5.276
```

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
1	-35.88011	3.34274	-10.734
11	-1.13244	0.23467	-4.826
15	-0.39847	0.11713	-3.402
12	0.39831	0.10134	3.930
4	-5.22105	2.01641	-2.589
2	-11.08245	1.17398	-9.440
21	0.21098	0.24717	0.854
33	-3.10981	0.73080	-4.255
35	1.41616	0.34331	4.125
13	-1.89517	0.36108	-5.249
10	-2.02143	0.33622	-6.012
25	1.04737	0.30749	3.406
41	1.05362	0.40720	2.587
37	-1.11154	0.61196	-1.816
INTERCEPT	14.81932		

TABLE VI. REGRESSION MODELS (continued)

HP (a-1)

```
FOR 6 VARIABLES ENTERED
  MULTIPLE CORRELATION COEFFICIENT...     0.976
       (ADJUSTED FOR D.F.)...........     0.975
  F-VALUE FOR ANALYSIS OF VARIANCE...   368.438
  STANDARD ERROR OF ESTIMATE.........    16.153
       (ADJUSTED FOR D.F.)...........    16.510
```

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
1	-47.88176	1.59657	-29.990
13	-2.85433	0.29903	-9.545
27	4.70904	0.85952	5.479
36	8.22306	1.03990	7.908
11	1.83151	0.19429	9.427
21	2.28745	0.64978	3.520
INTERCEPT	554.20947		

TABLE VI. REGRESSION MODELS (continued)

TRVT (a-1)

```
FOR 13 VARIABLES ENTERED
  MULTIPLE CORRELATION COEFFICIENT...     0.899
       (ADJUSTED FOR D.F.)............    0.887
  F-VALUE FOR ANALYSIS OF VARIANCE...    33.792
  STANDARD ERROR OF ESTIMATE.........     0.024
       (ADJUSTED FOR D.F.)............    0.025
```

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
1	-0.02499	0.00202	-12.398
15	0.00488	0.00074	6.603
49	-0.00568	0.00226	-2.516
36	0.01298	0.00220	5.889
52	0.01733	0.00285	6.092
11	0.00239	0.00027	8.694
47	0.02358	0.00403	5.851
9	-0.02721	0.00460	-5.910
54	0.01490	0.00294	5.065
45	0.00751	0.00171	4.399
7	-0.02430	0.00492	-4.936
25	-0.00569	0.00151	-3.761
48	-0.01245	0.00373	-3.333
INTERCEPT	0.04805		

TABLE VI. REGRESSION MODELS (continued)

CQO (a-1)

FOR 9 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.906
(ADJUSTED FOR D.F.)........... 0.901
F-VALUE FOR ANALYSIS OF VARIANCE... 56.456
STANDARD ERROR OF ESTIMATE......... 0.011
(ADJUSTED FOR D.F.)........... 0.011

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
1	-0.01550	0.00088	-17.609
6	0.01152	0.00116	9.896
2	-0.00514	0.00068	-7.603
7	-0.00817	0.00139	-5.871
45	0.00256	0.00068	3.761
39	-0.00745	0.00134	-5.546
54	0.00424	0.00135	3.134
34	0.00118	0.00043	2.767
26	-0.00211	0.00087	-2.443
INTERCEPT	0.24949		

TABLE VI. REGRESSION MODELS (continued)

BMF (a-3)

FOR 16 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0.926
(ADJUSTED FOR D.F.)...........	0.915
F-VALUE FOR ANALYSIS OF VARIANCE...	37.991
STANDARD ERROR OF ESTIMATE.........	278.805
(ADJUSTED FOR D.F.)...........	298.602

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
10	-32.33427	16.64067	-1.943
33	304.89502	49.61964	6.145
52	342.06128	34.98804	9.777
54	268.37891	36.38094	7.377
7	-336.66406	39.78186	-8.463
28	-38.77379	16.97258	-2.284
2	-89.13074	28.69072	-3.107
47	302.26270	47.30783	6.389
18	145.88553	18.10811	8.056
51	460.95532	80.30998	5.740
45	82.82631	20.36580	4.067
4	-50.86955	40.04474	-1.270
26	75.91814	29.77808	2.549
1	-621.43042	196.68054	-3.160
62	-67624.50000	18848.77344	-3.588
57	3315954.00000	1274817.00000	2.601
INTERCEPT	5060.21875		

TABLE VI. REGRESSION MODELS (continued)

PLL (a-3)

FOR 9 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0.985
(ADJUSTED FOR D.F.)...........	0.984
F-VALUE FOR ANALYSIS OF VARIANCE...	393.959
STANDARD ERROR OF ESTIMATE.........	4.591
(ADJUSTED FOR D.F.)...........	4.756

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
63	14092.80078	1439.35400	9.791
31	-1.81817	0.52328	-3.475
4	2.92509	0.48106	6.080
1	-8.39580	0.87962	-9.545
2	-3.11756	0.41542	-7.505
12	0.38834	0.09280	4.184
15	-0.38878	0.09840	-3.951
47	-1.85487	0.70306	-2.638
25	0.56141	0.27366	2.051
INTERCEPT	-12.16365		

TABLE VI. REGRESSION MODELS (continued)

HP (a-3)

FOR 7 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0.979
(ADJUSTED FOR D.F.)...........	0.978
F-VALUE FOR ANALYSIS OF VARIANCE...	363.963
STANDARD ERROR OF ESTIMATE.........	15.097
(ADJUSTED FOR D.F.)...........	15.500

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
56	1591578.00000	307421.81250	5.177
1	-33.38795	3.11639	-10.714
15	-0.75688	0.48625	-1.557
13	-2.32648	0.31797	-7.317
36	6.70957	1.42001	4.725
11	1.06875	0.22668	4.715
27	3.14386	0.84646	3.714
INTERCEPT	531.67725		

TABLE VI. REGRESSION MODELS (continued)

TRVT (a-3)

FOR 14 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.878
(ADJUSTED FOR D.F.)........... 0.862
F-VALUE FOR ANALYSIS OF VARIANCE... 24.762
STANDARD ERROR OF ESTIMATE......... 0.026
(ADJUSTED FOR D.F.)........... 0.028

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
1	-0.08090	0.01741	-4.647
62	-5.36528	0.90100	-5.955
49	-0.00639	0.00225	-2.845
10	-0.00429	0.00152	-2.829
34	0.00309	0.00119	2.600
52	0.01961	0.00341	5.758
19	-0.00256	0.00046	-5.520
53	0.03175	0.01256	2.527
54	0.01166	0.00334	3.488
18	0.00680	0.00129	5.283
51	0.02646	0.00683	3.876
47	0.01855	0.00442	4.199
45	0.00688	0.00189	3.648
31	0.01074	0.00421	2.548
INTERCEPT	0.29357		

TABLE VI. REGRESSION MODELS (continued)

PLV (a-3)

FOR 18 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.909
(ADJUSTED FOR D.F.)............ 0.893
F-VALUE FOR ANALYSIS OF VARIANCE... 26.231
STANDARD ERROR OF ESTIMATE......... 29.402
(ADJUSTED FOR D.F.)............ 31.804

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
1	-50.02069	3.89545	-12.841
30	-0.46781	4.60500	-0.102
55	-42016.32422	8802.75391	-4.773
4	26.01192	10.61681	2.450
36	13.80782	2.27194	6.078
50	35.90221	5.17626	6.936
45	11.82486	2.12837	5.556
47	16.46040	5.24652	3.137
11	3.97374	0.69591	5.710
7	-18.04105	4.76679	-3.785
26	-7.31311	2.66274	-2.746
21	9.64190	1.81709	5.306
34	10.51993	2.44171	4.308
46	12.56050	4.48549	2.800
13	6.86484	2.42092	2.836
12	-1.84554	0.63789	-2.893
19	2.54118	0.94358	2.693
52	9.17538	3.84648	2.385
INTERCEPT	317.55640		

TABLE VI. REGRESSION MODELS (continued)

CQO (a-3)

FOR 9 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0.908
(ADJUSTED FOR D.F.)...........	0.901
F-VALUE FOR ANALYSIS OF VARIANCE...	56.496
STANDARD ERROR OF ESTIMATE.........	0.011
(ADJUSTED FOR D.F.)...........	0.011

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
1	-0.01550	0.00088	-17.609
6	0.01152	0.00116	9.896
2	-0.00514	0.00068	-7.603
7	-0.00817	0.00139	-5.871
45	0.00256	0.00068	3.761
39	-0.00745	0.00134	-5.546
54	0.00424	0.00135	3.134
34	0.00118	0.00043	2.767
26	-0.00211	0.00087	-2.443
INTERCEPT	0.24949		

TABLE VI. REGRESSION MODELS (continued)

BMF (b-1)

FOR 14 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0.829
(ADJUSTED FOR D.F.)...........	0.809
F-VALUE FOR ANALYSIS OF VARIANCE...	19.123
STANDARD ERROR OF ESTIMATE.........	420.479
(ADJUSTED FOR D.F.)...........	442.141

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
1	-168.88148	25.30363	-6.674
52	350.30615	50.58382	6.925
49	-124.40158	23.06554	-5.393
5	225.10410	35.63477	6.317
53	456.65308	178.94162	2.552
19	-15.68178	7.43018	-2.111
18	69.81409	16.39125	4.259
35	-81.02997	30.21204	-2.682
54	220.27138	53.52124	4.116
45	82.45363	26.07677	3.162
47	267.73779	68.82402	3.890
34	31.05569	15.75141	1.972
39	-154.63606	57.89529	-2.671
2	-59.36702	29.81641	-1.991
INTERCEPT	3034.66821		

TABLE VI. REGRESSION MODELS (continued)

PLL (b-1)

FOR 19 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.924
(ADJUSTED FOR D.F.)........... 0.912
F-VALUE FOR ANALYSIS OF VARIANCE... 36.165
STANDARD ERROR OF ESTIMATE......... 12.719
(ADJUSTED FOR D.F.)........... 13.655

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
13	-4.13311	0.66294	-6.234
1	-51.14510	4.13570	-12.367
10	-4.20888	0.34752	-12.111
18	-16.44018	1.57174	-10.464
9	-63.90195	7.58171	-8.428
51	-12.55823	1.94529	-6.456
33	-5.96111	1.92299	-3.100
31	-3.40863	1.58511	-2.150
39	-8.95206	1.88377	-4.752
19	-0.08628	0.39313	-0.219
2	-20.91418	3.41923	-6.117
43	-4.99484	1.59539	-3.131
35	4.38102	0.81044	5.406
11	-3.72352	0.76113	-4.892
4	-12.71943	3.82554	-3.325
50	-6.96449	2.22189	-3.134
44	-5.62270	2.28464	-2.461
16	-0.33127	0.40615	-2.047
36	1.13042	0.79594	1.420
INTERCEPT	-11.36210		

TABLE VI. REGRESSION MODELS (continued)

HP (b-1)

```
FOR 9 VARIABLES ENTERED
  MULTIPLE CORRELATION COEFFICIENT...      0.911
      (ADJUSTED FOR D.F.)...........       0.909
  F-VALUE FOR ANALYSIS OF VARIANCE...     68.530
  STANDARD ERROR OF ESTIMATE.........     35.507
      (ADJUSTED FOR D.F.)...........      36.600
```

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
1	-37.07495	2.03492	-18.219
4	-0.02886	5.03000	-0.006
28	-7.77263	1.82639	-4.256
2	-9.00673	1.96954	-4.573
51	17.40414	4.65522	3.739
34	9.15971	2.03606	4.499
29	-9.21476	2.16603	-4.254
21	4.77651	1.41011	3.387
42	-5.33290	2.23112	-2.390
INTERCEPT	596.14819		

TABLE VI. <u>REGRESSION MODELS</u> (continued)

TRVT (b-1)

FOR 14 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.879
(ADJUSTED FOR D.F.)........... 0.866
F-VALUE FOR ANALYSIS OF VARIANCE... 29.691
STANDARD ERROR OF ESTIMATE......... 0.026
(ADJUSTED FOR D.F.)........... 0.027

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
1	-0.04360	0.00762	-5.720
15	0.00413	0.00070	5.901
7	-0.02400	0.00374	-6.416
25	-0.00539	0.00152	-3.536
52	0.02093	0.00303	6.912
11	0.00197	0.00027	7.361
36	0.00781	0.00215	3.632
47	0.02756	0.00408	6.756
31	0.01390	0.00304	4.574
51	0.02098	0.00401	5.233
18	0.00595	0.00098	6.100
54	0.01311	0.00315	4.167
10	-0.00213	0.00064	-3.337
45	0.00575	0.00172	3.334
INTERCEPT	0.[illegible]0905		

TABLE VI. REGRESSION MODELS (continued)

CQO (b-1)

FOR 10 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.839
(ADJUSTED FOR D.F.)............ 0.826
F-VALUE FOR ANALYSIS OF VARIANCE... 29.968
STANDARD ERROR OF ESTIMATE......... 0.016
(ADJUSTED FOR D.F.)............ 0.017

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
1	-0.01166	0.00095	-12.215
6	0.02780	0.00641	4.339
34	0.00217	0.00059	3.691
15	0.00339	0.00120	2.815
39	-0.00630	0.00184	-3.425
2	-0.00323	0.00090	-3.580
7	-0.02356	0.00657	-3.583
41	-0.0029[illegible]	0.00110	-2.694
51	0.00688	0.00230	2.997
16	-0.00356	0.00127	-2.804
INTERCEPT	0.26465		

TABLE VI. REGRESSION MODELS (continued)

PLV (b-3)

```
FOR 19 VARIABLES ENTERED
  MULTIPLE CORRELATION COEFFICIENT...      0.878
       (ADJUSTED FOR D.F.)...........      0.857
  F-VALUE FOR ANALYSIS OF VARIANCE...     20.650
  STANDARD ERROR OF ESTIMATE.........     33.830
       (ADJUSTED FOR D.F.)...........     36.319
```

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
34	6.53160	1.35310	4.827
36	14.73876	1.99376	7.392
5	19.55617	3.37914	5.787
3	23.40242	3.56730	6.560
52	18.02675	4.02345	4.480
56	2631595.00000	375696.56250	7.005
45	9.62290	2.15317	4.469
47	14.73067	5.73425	2.569
39	-15.97964	3.96946	-4.026
55	-22381.27344	5976.77734	-3.745
23	7.14470	2.00060	3.571
35	-7.74755	2.73671	-2.831
44	-7.97003	5.92125	-1.346
54	14.10827	4.23850	3.329
41	10.59965	2.74288	3.864
26	-9.23109	2.70776	-3.409
42	11.34775	3.18102	3.567
16	2.20104	0.78656	2.798
40	4.18003	1.62503	2.572
INTERCEPT	264.81201		

TABLE VI. REGRESSION MODELS (continued)

BMF (b-3)

```
FOR 15 VARIABLES ENTERED
  MULTIPLE CORRELATION COEFFICIENT...     0.868
  ------ (ADJUSTED FOR D.F.)...........   0.852
  F-VALUE FOR ANALYSIS OF VARIANCE...    24.758
  STANDARD ERROR OF ESTIMATE.........   374.087
  ------ (ADJUSTED FOR D.F.)...........   394.968
```

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
1	-352.53906	119.99779	-2.938
52	358.57715	44.30473	8.093
49	-124.49873	20.36275	-6.114
5	161.87633	31.40639	5.154
53	277.93555	147.46275	1.885
56	50087312.00000	10262613.00000	4.881
9	-252.42131	76.82299	-3.286
47	321.87354	58.14436	5.536
45	85.45930	23.22188	3.680
54	269.06519	48.08656	5.595
39	-203.74185	47.60649	-4.280
33	146.91083	53.09288	2.767
35	-62.32120	26.22378	-2.376
10	-29.90230	9.66285	-3.101
57	-3756982.00000	1271972.00000	-2.954
INTERCEPT	2131.19116		

TABLE VI. REGRESSION MODELS (continued)

PLL (b-3)

FOR 36 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.961
(ADJUSTED FOR D.F.)........... 0.947
F-VALUE FOR ANALYSIS OF VARIANCE... 33.218
STANDARD ERROR OF ESTIMATE......... 10.020
(ADJUSTED FOR D.F.)........... 11.627

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
13	-4.92283	0.64065	-7.684
1	-50.77469	4.86478	-10.437
10	-3.91564	0.44389	-8.821
55	-57178.85547	36222.63281	-1.579
18	-14.59957	1.63052	-8.954
9	-55.56354	7.49424	-7.417
3	-1.49535	1.69377	-0.883
51	-10.21565	2.40360	-4.250
63	8156.96094	12786.70313	0.638
31	-4.51396	1.74741	-2.583
50	-7.64020	2.56247	-2.982
39	-6.84805	1.52976	-4.477
19	-0.25410	0.40429	-0.629
41	-0.47448	0.94310	-0.503
16	-6.62812	1.34249	-4.937
44	-7.02689	2.14962	-3.269
20	1.62721	0.82102	1.983
56	-4889287.00000	3404492.00000	-1.436
57	922126.50000	725407.75000	1.271
35	0.55661	0.90751	0.613
4	-17.07286	3.85519	-4.429
33	-2.12408	2.00158	-1.061
49	-1.85202	1.03633	-1.787
15	-4.91286	1.12481	-4.368
6	-19.58951	5.60396	-3.496
14	-4.74546	0.76842	-6.176
5	-24.41081	4.18530	-5.833
7	-25.64265	6.74211	-3.803
53	-10.30502	5.45282	-1.890
36	-3.26760	1.24631	-2.622
28	-1.47232	0.89887	-1.638
32	3.53490	2.07352	1.705
2	-13.33801	3.77542	-3.533
11	-2.61847	0.79781	-3.282
30	-3.44163	1.64329	-2.094
42	-2.23333	1.20052	-1.860
INTERCEPT	3.15962		

TABLE VI. REGRESSION MODELS (continued)

HP (b-3)

FOR 5 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.928
(ADJUSTED FOR D.F.)........... 0.926
F-VALUE FOR ANALYSIS OF VARIANCE... 163.251
STANDARD ERROR OF ESTIMATE......... 31.463
(ADJUSTED FOR D.F.)........... 31.936

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
56	3115729.00000	267734.31250	11.637
1	-51.58096	9.38911	-5.494
4	8.98894	2.72790	3.295
10	-3.20068	0.78232	-4.091
46	10.93693	3.13143	3.493
INTERCEPT	434.32129		

TABLE VI. REGRESSION MODELS (continued)

TRVT (b-3)

FOR 14 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.875
(ADJUSTED FOR D.F.)........... 0.866
F-VALUE FOR ANALYSIS OF VARIANCE... 29.651
STANDARD ERROR OF ESTIMATE......... 0.026
(ADJUSTED FOR D.F.)........... 0.027

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
1	-0.04360	0.00762	-5.720
15	0.00413	0.00070	5.901
7	-0.02400	0.00374	-6.416
25	-0.00539	0.00152	-3.536
52	0.02093	0.00303	6.912
11	0.00197	0.00027	7.361
36	0.00781	0.00215	3.632
47	0.02756	0.00408	6.756
31	0.01390	0.00304	4.574
51	0.02098	0.00401	5.233
18	0.00595	0.00098	6.100
54	0.01311	0.00315	4.167
10	-0.00213	0.00064	-3.337
45	0.00575	0.00172	3.334
INTERCEPT	0.00905		

TABLE VI. REGRESSION MODELS (continued)

CQO (b-3)

```
FOR 10 VARIABLES ENTERED
  MULTIPLE CORRELATION COEFFICIENT...     0.880
       (ADJUSTED FOR D.F.)...........     0.871
  F-VALUE FOR ANALYSIS OF VARIANCE...    43.126
  STANDARD ERROR OF ESTIMATE.........     0.014
       (ADJUSTED FOR D.F.)...........     0.015
```

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
56	981.00171	111.24538	8.818
6	0.02584	0.00589	4.385
41	-0.00424	0.00097	-4.364
15	0.00282	0.00107	2.633
1	-0.00387	0.00105	-3.688
48	-0.00854	0.00212	-4.029
7	-0.00537	0.00145	-3.703
45	0.00264	0.00090	2.941
44	-0.00749	0.00211	-3.547
30	-0.00460	0.00154	-2.996
INTERCEPT	0.24304		

TABLE VI. REGRESSION MODELS (continued)

θ_0 (b-3)

FOR 16 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0.901
(ADJUSTED FOR D.F.)...........	0.888
F-VALUE FOR ANALYSIS OF VARIANCE...	32.902
STANDARD ERROR OF ESTIMATE.........	0.330
(ADJUSTED FOR D.F.)...........	0.350

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
56	116943.93750	34951.83203	3.346
13	0.08725	0.01697	5.142
1	1.03064	0.11272	9.143
10	0.07901	0.00920	8.591
62	196.82721	49.29451	3.993
41	-0.12212	0.02370	-5.152
40	-0.02365	0.01511	-1.565
44	-0.07682	0.05205	-1.476
31	0.08260	0.03282	2.517
18	0.25473	0.03860	6.599
9	1.07567	0.19103	5.631
57	-18726.73828	6778.51563	-2.763
30	-0.11629	0.03795	-3.064
4	0.30949	0.09616	3.219
11	0.03294	0.01082	3.043
2	0.14243	0.06577	2.165
INTERCEPT	2.14310		

TABLE VI. REGRESSION MODELS (continued)

PLV (c-3)

FOR 18 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.828
(ADJUSTED FOR D.F.)............ 0.821
F-VALUE FOR ANALYSIS OF VARIANCE... 24.078
STANDARD ERROR OF ESTIMATE......... 38.598
(ADJUSTED FOR D.F.)............ 40.333

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
3	26.55951	2.39563	11.087
5	15.24629	2.45271	6.216
36	16.74075	1.87135	8.946
34	6.33576	1.19107	5.319
45	9.10341	1.60789	5.662
40	4.86320	1.42433	3.414
26	-6.73338	2.79754	-2.407
47	13.52521	4.02198	3.363
1	-21.57013	6.06787	-3.555
50	14.78062	3.77315	3.917
7	-26.95424	3.95542	-6.815
63	5134.81641	1532.41040	3.351
49	6.26719	1.79581	3.490
2	-9.03797	2.02177	-4.470
25	-7.99992	2.13583	-3.746
21	3.88037	1.28289	3.025
52	9.84728	3.90456	2.522
10	-1.13154	0.46040	-2.458
INTERCEPT	185.19930		

TABLE VI. REGRESSION MODELS (continued)

BMF (c-3)

```
FOR 15 VARIABLES ENTERED
  MULTIPLE CORRELATION COEFFICIENT...      0.801
       (ADJUSTED FOR D.F.)...........      0.784
  F-VALUE FOR ANALYSIS OF VARIANCE...     22.305
  STANDARD ERROR OF ESTIMATE.........    468.656
       (ADJUSTED FOR D.F.)...........    485.752
```

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
49	-25.07428	21.48367	-1.167
52	255.29501	46.53308	5.486
33	127.66479	45.67184	2.795
26	-39.08418	36.31873	-1.076
14	-18.09050	4.94200	-3.661
62	14117.99609	2980.02808	4.738
7	-352.44360	46.15259	-7.636
6	-180.54701	38.69202	-4.666
36	109.21431	25.03380	4.363
1	-370.00928	75.33676	-4.911
10	-22.82124	5.77657	-3.951
9	-312.53491	70.67435	-4.422
54	170.69981	49.70067	3.435
2	-97.32465	23.82230	-4.085
25	-89.26509	25.36920	-3.519
INTERCEPT	1749.87354		

TABLE VI. REGRESSION MODELS (continued)

HP (c-3)

```
FOR  8 VARIABLES ENTERED
  MULTIPLE CORRELATION COEFFICIENT...     0.940
      (ADJUSTED FOR D.F.)............     0.938
  F-VALUE FOR ANALYSIS OF VARIANCE...   183.326
  STANDARD ERROR OF ESTIMATE.........    38.384
      (ADJUSTED FOR D.F.)............    39.067
```

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
57	205332.00000	36126.62500	5.684
1	-9.40968	1.40248	-6.709
63	26501.55469	3380.16479	7.840
4	14.06202	2.44381	5.754
15	-2.51565	0.44711	-5.626
5	10.75703	2.31295	4.651
12	-1.59607	0.38142	-4.184
51	13.42356	3.63162	3.696
INTERCEPT	417.39331		

TABLE VI. <u>REGRESSION MODELS</u> (continued)

TRVT (c-3)

```
FOR 14 VARIABLES ENTERED
  MULTIPLE CORRELATION COEFFICIENT...      0.839
       (ADJUSTED FOR D.F.)............     0.827
  F-VALUE FOR ANALYSIS OF VARIANCE...     31.872
  STANDARD ERROR OF ESTIMATE.........      0.031
       (ADJUSTED FOR D.F.)............     0.032
```

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
15	0.00280	0.00045	6.262
7	-0.02734	0.00239	-11.452
25	-0.00820	0.00153	-5.349
1	-0.02242	0.00498	-4.505
47	0.02038	0.00308	6.611
10	-0.00115	0.00038	-2.985
2	-0.00848	0.00154	-5.502
52	0.01453	0.00303	4.800
36	0.00633	0.00166	3.816
45	0.00614	0.00133	4.630
9	-0.02564	0.00435	-5.894
62	0.91035	0.19762	4.606
51	0.01178	0.00327	3.607
12	-0.00098	0.00031	-3.179
INTERCEPT	0.02291		

TABLE VI. REGRESSION MODELS (continued)

CQO (c-3)

FOR 10 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0.819
(ADJUSTED FOR D.F.)............	0.810
F-VALUE FOR ANALYSIS OF VARIANCE...	39.249
STANDARD ERROR OF ESTIMATE.........	0.017
(ADJUSTED FOR D.F.)............	0.017

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
57	81.64810	6.63961	12.297
7	-0.00685	0.00128	-5.348
1	-0.00354	0.00062	-5.691
6	0.01937	0.00360	5.386
15	0.00219	0.00062	3.557
30	-0.00355	0.00099	-3.594
41	-0.00284	0.00086	-3.281
8	0.00594	0.00192	3.088
26	-0.00337	0.00116	-2.912
45	0.00169	0.00071	2.374
INTERCEPT	0.25554		

TABLE VI. REGRESSION MODELS (continued)

PLL (c-3)

FOR 36 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.837
(ADJUSTED FOR D.F.)............ 0.798
F-VALUE FOR ANALYSIS OF VARIANCE... 10.753
STANDARD ERROR OF ESTIMATE......... 21.895
(ADJUSTED FOR D.F.)............ 24.081

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
1	-43.66034	3.98954	-10.944
11	-1.72088	0.59921	-2.872
10	-3.07678	0.32985	-9.328
62	-291.75220	512.68628	-0.569
13	-2.01169	0.28586	-7.037
63	-17271.47656	4807.58584	3.593
2	-10.62089	3.43417	-3.093
18	-6.88403	1.61981	-4.250
51	-10.24952	2.82814	-3.624
57	-196363.06250	67130.06250	-2.925
52	-3.93051	2.36062	-1.665
44	-5.63394	2.82684	-1.993
3	-2.20965	1.64716	-1.341
39	-6.18454	2.27265	-2.721
16	-3.62781	1.11597	-3.251
45	-3.76712	1.07231	-3.513
41	3.88838	1.40383	2.770
26	-5.48015	1.98744	-2.757
48	8.13443	2.71949	2.991
15	1.25731	0.40292	3.121
7	-13.40469	5.72102	-2.343
25	2.41625	1.28783	1.876
14	-4.59702	1.10349	-4.166
37	-2.99048	1.67602	-1.784
47	-4.49256	2.43956	-1.842
5	-19.23837	5.77092	-3.334
22	-3.40413	1.01334	-3.359
20	-2.40512	0.96264	-2.498
9	-12.64099	8.27550	-1.528
35	-2.61251	1.35738	-1.925
40	-2.24800	1.06627	-2.108
29	-1.86193	1.30730	-1.424
36	1.98999	1.33009	1.496
42	-2.68631	1.50399	-1.786
50	3.30474	2.73886	1.207
30	-1.66348	1.56899	-1.060
INTERCEPT	5.97730		

TABLE VI. REGRESSION MODELS (continued)

θ_0 (c-3)

```
FOR 8 VARIABLES ENTERED
  MULTIPLE CORRELATION COEFFICIENT...      0.890
     (ADJUSTED FOR D.F.)...........        0.885
  F-VALUE FOR ANALYSIS OF VARIANCE...     92.072
  STANDARD ERROR OF ESTIMATE.........      0.501
     (ADJUSTED FOR D.F.)...........        0.510
```

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
57	6682.06250	408.23828	16.368
1	0.63906	0.07893	8.096
13	0.03425	0.00499	6.869
10	0.03887	0.00603	6.448
56	-8117.98438	2070.61426	-3.921
41	-0.08494	0.02532	-3.354
16	0.01977	0.00711	2.780
52	0.10133	0.04880	2.076
INTERCEPT	8.70127		

TABLE VII. MODEL EQUATION MULTIPLE CORRELATION COEFFICIENT

i - Equation Independent Variables Code

	CONDITION CODE		
	1	2	3
BMF			
a	.916	----	.926
b	.829	----	.868
c	----	----	.801
PLL			
a	.983	----	.985
b	.924	----	.961
c	----	----	.940
HP			
a	.976	----	.979
b	.911	----	.928
c	----	----	.940
TRVT			
a	.899	----	.878
b	.879	----	.879
c	----	----	.839
CQO			
a	.908	----	.908
b	.839	----	.880
c	----	----	.819

CONDITION CODE $\mu = 0.33$	V (KTS)	α_S (DEG)	θ_0 (DEG)
a - i	120	- 6	10
b - i	120	- 6	8, 10, 12
c - i	120	- 6, - 8, - 10	8, 10, 12

i	Independent variables considered in equation
1	$\delta_0 - \delta_{4S}$
2	$\delta_0 - \delta_{4S}$, θ_0 (Not analyzed)
3	$\delta_0 - \delta_{4S}$, CLR, CXR

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES

BMF (a-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	3217.00000	3051.86182	165.13818	0.71
2	4180.00000	4014.06689	165.93311	0.71
3	4180.00000	3806.81201	373.18799	1.60
4	4572.00000	4409.30859	162.69141	0.70
5	4455.00000	4430.04297	24.95703	0.11
6	3601.00000	3721.85791	-120.85791	-0.52
7	3903.00000	4173.97266	-270.97266	-1.16
8	3804.00000	4103.40625	-299.40625	-1.28
9	3809.00000	4034.44141	-225.44141	-0.97
10	3602.00000	3518.61230	83.38770	0.36
11	4160.00000	4170.19922	-10.19922	-0.04
12	4052.00000	4116.73828	-64.73828	-0.28
13	4696.00000	4571.04297	124.95703	0.54
14	3823.00000	4129.26953	-306.26953	-1.31
15	4393.00000	4163.61719	229.38281	0.98
16	3229.00000	3331.34277	-102.34277	-0.44
17	4165.00000	4077.97485	87.02515	0.37
18	4683.00000	4393.21484	289.78516	1.24
19	4212.00000	4378.09766	-166.09766	-0.71
20	4790.00000	4726.26563	63.73438	0.27
21	3939.00000	3755.69629	183.30371	0.79
22	3612.00000	3670.86792	-58.86792	-0.25
23	3681.00000	3629.38110	51.61890	0.22
24	3979.00000	3859.15625	119.84375	0.51
25	4081.00000	4235.80078	-154.80078	-0.66
26	3776.00000	3911.32764	-135.32764	-0.58
27	4947.00000	4420.60938	526.39063	2.26
28	4047.00000	4058.29370	-11.29370	-0.05
29	3882.00000	4219.40234	-337.40234	-1.45
30	4224.00000	4075.99194	148.00806	0.63
31	4261.00000	4037.22070	223.77930	0.96
32	4148.00000	4087.60645	60.39355	0.26
33	5133.00000	5078.27734	54.72266	0.23
34	3762.00000	3838.23853	-76.23853	-0.33
35	4451.00000	4382.67969	68.32031	0.29
36	5098.00000	5020.59375	77.40625	0.33
37	3738.00000	3638.12329	99.87671	0.43
38	3874.00000	4156.27734	-282.27734	-1.21
39	3556.00000	3445.97705	110.02295	0.47
40	3693.00000	3475.17554	217.82446	0.93
41	4118.00000	4014.95459	103.04541	0.44
42	4037.00000	3998.17334	38.82666	0.17
43	3674.00000	3382.94067	291.05933	1.25
44	4182.00000	4014.13965	167.86035	0.72
45	4400.00000	4444.69922	-44.69922	-0.19
46	4323.00000	4483.54688	-160.54688	-0.69
47	3600.00000	3268.80713	331.19287	1.42
48	2912.00000	2936.97021	-24.97021	-0.11
49	4103.00000	4127.89063	-24.89063	-0.11
50	3387.00000	3468.88330	-81.88330	-0.35
51	4465.00000	4301.36719	163.63281	0.70
52	3771.00000	3753.89453	17.10547	0.07
53	3745.00000	3902.76538	-157.76538	-0.68
54	3830.00000	3791.78662	38.21338	0.16
55	4875.00000	4746.21094	128.78906	0.55
56	4898.00000	4805.22266	92.77734	0.40
57	4699.00000	4787.94531	-88.94531	-0.38
58	4705.00000	4701.20703	3.79297	0.02
59	5221.00000	4855.80469	365.19531	1.56
60	4275.00000	4477.20313	-202.20313	-0.87

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

BMF (a-3)

61	4334.00000	4242.35938	91.64063	0.39
62	4610.00000	4406.68750	203.31250	0.87
63	4351.00000	4227.23047	123.76953	0.53
64	4433.00000	4313.64453	119.35547	0.51
65	4359.00000	4419.81641	-60.81641	-0.26
66	3254.00000	3262.80884	-8.80884	-0.04
67	3258.00000	3180.27466	77.72534	0.33
68	3229.00000	3292.66602	-63.66602	-0.27
69	3412.00000	3518.94824	-106.94824	-0.46
70	4223.00000	4231.72266	-8.72266	-0.04
71	4837.00000	4983.03516	-146.03516	-0.63
72	3815.00000	4137.13281	-322.13281	-1.38
73	4455.00000	4920.82813	-465.82813	-2.00
74	4879.00000	4550.94922	328.05078	1.41
75	3415.00000	3509.19873	-94.19873	-0.40
76	3098.00000	3186.56982	-88.56982	-0.38
77	4018.00000	4161.83594	-143.83594	-0.62
78	3147.00000	3227.00269	-80.00269	-0.34
79	3392.00000	3389.50635	2.49365	0.01
80	3207.00000	3458.30640	-251.30640	-1.08
81	2818.00000	3242.67212	-424.67212	-1.82
82	2909.00000	3095.24390	-186.24390	-0.80
83	3706.00000	3644.68091	61.31909	0.26
84	2702.00000	2695.09985	6.90015	0.03
85	3836.00000	3524.42017	311.57983	1.33
86	4510.00000	4309.74609	200.25391	0.86
87	3054.00000	3179.04810	-125.04810	-0.54
88	4815.00000	4559.23047	255.76953	1.10
89	5895.00000	5951.75000	-56.75000	-0.24
90	5251.00000	5468.25391	-217.25391	-0.93
91	3863.00000	3854.33667	8.66333	0.04
92	4789.00000	4426.01172	362.98828	1.56
93	3813.00000	3963.82886	-150.82886	-0.65
94	3131.00000	3095.90527	35.09473	0.15
95	4528.00000	4898.71484	-370.71484	-1.59
96	5394.00000	5158.94141	235.05859	1.01
97	3000.00000	2926.71777	73.28223	0.31
98	3620.00000	3783.61963	-163.61963	-0.70
99	4999.00000	4983.00391	15.99609	0.07
100	5574.00000	5550.04297	23.95703	0.10
101	5756.00000	5954.73828	-198.73828	-0.85
102	5807.00000	5799.19141	7.80859	0.03
103	6209.00000	5891.35938	317.64063	1.36
104	4636.00000	4902.97656	-266.97656	-1.14
105	4969.00000	5020.53516	-51.53516	-0.22
106	4037.00000	4109.28125	-72.28125	-0.31
107	4049.00000	4307.03516	-258.03516	-1.11
108	3808.00000	3802.66040	5.33960	0.02
109	3803.00000	3917.98584	-114.98584	-0.49
110	4613.00000	4688.05859	-75.05859	-0.32
111	3922.00000	4010.56030	-88.56030	-0.38
112	3978.00000	4189.53516	-211.53516	-0.91
113	3910.00000	3691.09326	218.90674	0.94
114	3671.00000	3654.60571	16.39429	0.07
115	3700.00000	3619.75513	80.24487	0.34
116	3778.00000	3804.42456	-26.42456	-0.11
117	3617.00000	3606.56812	10.43188	0.04
118	3317.00000	3667.68579	-350.68579	-1.50

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLV (a-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	219.00000	240.07396	-21.07396	-1.00
2	270.00000	270.30493	-0.30493	-0.01
3	334.00000	312.69287	21.30713	1.01
4	373.00000	379.71875	-6.71875	-0.32
5	372.00000	394.21704	-22.21704	-1.05
6	229.00000	224.10909	4.89091	0.23
7	379.00000	393.06982	-14.06982	-0.67
8	351.00000	386.58374	-35.58374	-1.68
9	378.00000	362.69556	15.30444	0.72
10	294.00000	285.41431	8.58569	0.41
11	403.00000	385.27979	17.72021	0.84
12	320.00000	346.90796	-26.90796	-1.27
13	378.00000	374.83569	3.16431	0.15
14	297.00000	332.00317	-35.00317	-1.65
15	391.00000	369.61890	21.38110	1.01
16	228.00000	245.76120	-17.76120	-0.84
17	280.00000	284.94263	-4.94263	-0.23
18	330.00000	319.41724	10.58276	0.50
19	344.00000	334.70337	9.29663	0.44
20	389.00000	372.27271	16.72729	0.79
21	338.00000	309.89453	28.10547	1.33
22	317.00000	316.07324	0.92676	0.04
23	271.00000	266.15845	4.84155	0.23
24	328.00000	342.09497	-14.09497	-0.67
25	368.00000	373.82153	-5.82153	-0.28
26	345.00000	347.06763	-2.06763	-0.10
27	363.00000	340.69727	22.30273	1.05
28	342.00000	326.92188	15.07813	0.71
29	288.00000	294.46533	-6.46533	-0.31
30	296.00000	294.58667	1.41333	0.07
31	318.00000	299.20044	18.79956	0.89
32	302.00000	307.15039	-5.15039	-0.24
33	364.00000	343.03442	20.96558	0.99
34	359.00000	356.06396	2.93604	0.14
35	441.00000	437.59229	3.40771	0.16
36	518.00000	505.07813	12.92188	0.61
37	339.00000	328.42822	10.57178	0.50
38	362.00000	386.27954	-24.27954	-1.15
39	236.00000	220.67276	15.32724	0.72
40	243.00000	224.27887	18.72113	0.89
41	256.00000	271.57275	-15.57275	-0.74
42	260.00000	270.16577	-10.16577	-0.48
43	324.00000	315.14648	8.85352	0.42
44	336.00000	313.37891	22.62109	1.07
45	413.00000	420.11768	-7.11768	-0.34
46	428.00000	437.50073	-9.50073	-0.45
47	361.00000	353.23999	7.76001	0.37
48	322.00000	323.83496	-1.83496	-0.09
49	373.00000	368.00415	4.99585	0.24
50	348.00000	379.87573	-31.87573	-1.51
51	430.00000	400.69849	29.30151	1.39
52	340.00000	322.99316	17.00684	0.80
53	259.00000	258.80225	0.19775	0.01
54	342.00000	327.34009	14.65991	0.69
55	401.00000	379.74316	21.25684	1.01
56	335.00000	321.77222	13.22778	0.63
57	332.00000	308.66479	23.33521	1.10
58	342.00000	326.25513	15.74487	0.74

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLV (a-3)

59	300.00000	315.10913	-7.10913	-0.34
60	300.00000	323.96240	-23.96240	-1.13
61	284.00000	273.61914	10.38086	0.49
62	305.00000	316.40112	-11.40112	-0.54
63	361.00000	347.25903	13.74097	0.65
64	315.00000	313.85034	1.14966	0.05
65	310.00000	298.84033	11.15967	0.53
66	142.00000	148.90408	-6.90408	-0.33
67	206.00000	223.12589	-17.12589	-0.81
68	330.00000	319.86914	10.13086	0.48
69	228.00000	226.49748	1.50252	0.07
70	299.00000	279.14478	19.85522	0.94
71	328.00000	362.57397	-34.57397	-1.63
72	269.00000	289.86572	-20.86572	-0.99
73	263.00000	302.77075	-39.77075	-1.88
74	321.00000	312.79419	8.20581	0.39
75	215.00000	220.12437	-5.12437	-0.24
76	211.00000	221.97028	-10.97028	-0.52
77	250.00000	290.10181	-40.10181	-1.90
78	257.00000	251.10895	5.89105	0.28
79	239.00000	226.73221	12.26779	0.58
80	257.00000	253.20952	3.79048	0.18
81	302.00000	301.86816	0.13184	0.01
82	282.00000	310.11353	-28.11353	-1.33
83	251.00000	227.66472	23.33528	1.10
84	248.00000	242.45137	5.54863	0.26
85	340.00000	307.90015	32.09985	1.52
86	321.00000	325.96362	-4.96362	-0.23
87	257.00000	260.99512	-3.99512	-0.19
88	302.00000	296.29541	5.70459	0.27
89	335.00000	339.94238	-4.94238	-0.23
90	300.00000	315.85693	-15.85693	-0.75
91	338.00000	322.41260	15.58740	0.74
92	431.00000	424.18701	6.81299	0.32
93	279.00000	290.58667	-11.58667	-0.55
94	323.00000	318.79517	4.20483	0.20
95	433.00000	436.11255	-3.11255	-0.15
96	445.00000	445.04688	-0.04688	-0.00
97	207.00000	211.55959	-4.55959	-0.22
98	404.00000	415.22534	-11.22534	-0.53
99	360.00000	369.12378	-9.12378	-0.43
100	464.00000	466.85962	-2.85962	-0.14
101	484.00000	463.26367	20.73633	0.98
102	429.00000	443.66504	-14.66504	-0.69
103	476.00000	463.67725	12.32275	0.58
104	360.00000	370.67139	-10.67139	-0.50
105	373.00000	376.56567	-3.56567	-0.17
106	310.00000	302.19141	7.80859	0.37
107	306.00000	316.98242	-10.98242	-0.52
108	301.00000	288.69995	12.30005	0.58
109	290.00000	296.70117	-6.70117	-0.32
110	342.00000	345.34253	-3.34253	-0.16
111	304.00000	312.05176	-8.05176	-0.38
112	358.00000	375.50000	-17.50000	-0.83
113	309.00000	309.55835	-0.55835	-0.03
114	290.00000	304.63843	-14.63843	-0.69
115	308.00000	291.53027	16.46973	0.78
116	328.00000	322.53003	5.46997	0.26
117	284.00000	295.05981	-11.05981	-0.52
118	234.00000	246.63852	-12.63852	-0.60

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLL (a-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	94.00000	93.80090	0.19910	0.05
2	136.00000	137.13464	-1.13464	-0.27
3	137.00000	141.02888	-4.02888	-0.97
4	179.00000	176.55621	2.44379	0.59
5	147.00000	153.17178	-6.17178	-1.49
6	117.00000	132.24641	-15.24641	-3.68
7	144.00000	146.39923	-2.39923	-0.58
8	149.00000	150.57733	-1.57733	-0.38
9	142.00000	138.66751	3.33249	0.80
10	138.00000	138.01213	-0.01213	-0.00
11	170.00000	172.42291	-2.42291	-0.58
12	179.00000	182.14757	-3.14757	-0.76
13	199.00000	197.67998	1.32002	0.32
14	178.00000	182.34789	-4.34789	-1.05
15	181.00000	184.63759	-3.63759	-0.88
16	110.00000	111.68315	-1.68315	-0.41
17	146.00000	142.44914	3.55086	0.86
18	158.00000	159.33115	-1.33115	-0.32
19	171.00000	167.72766	3.27234	0.79
20	169.00000	168.94864	0.05136	0.01
21	175.00000	172.85338	2.14662	0.52
22	165.00000	157.61636	7.38364	1.78
23	160.00000	154.91359	5.08641	1.23
24	166.00000	163.55605	2.44395	0.59
25	157.00000	156.57523	0.42477	0.10
26	148.00000	152.48535	-4.48535	-1.08
27	145.00000	151.72200	-6.72200	-1.62
28	150.00000	152.25795	-2.25795	-0.54
29	156.00000	151.78258	4.21742	1.02
30	150.00000	152.65262	-2.65262	-0.64
31	150.00000	152.04193	-2.04193	-0.49
32	149.00000	152.07986	-3.07986	-0.74
33	156.00000	154.19708	1.80292	0.43
34	154.00000	154.81769	-0.81769	-0.20
35	159.00000	157.52831	1.47169	0.36
36	153.00000	158.91096	-5.91096	-1.43
37	160.00000	158.63031	1.36969	0.33
38	156.00000	149.81889	6.18111	1.49
39	116.00000	113.04161	2.95839	0.71
40	117.00000	114.07016	2.92984	0.71
41	142.00000	139.91960	2.08040	0.50
42	142.00000	138.67851	3.32149	0.80
43	125.00000	120.44096	4.55904	1.10
44	146.00000	147.13321	-1.13321	-0.27
45	144.00000	140.99486	3.00514	0.72
46	142.00000	143.67039	-1.67039	-0.40
47	147.00000	147.02756	-0.02756	-0.01
48	184.00000	182.25443	1.74557	0.42
49	141.00000	147.15730	-6.15730	-1.49
50	143.00000	144.69643	-1.69643	-0.41
51	142.00000	138.30826	3.69174	0.89
52	144.00000	139.14442	4.85558	1.17
53	142.00000	135.71774	6.28226	1.52
54	141.00000	141.18118	-0.18118	-0.04
55	183.00000	179.99803	3.00197	0.72
56	193.00000	186.34593	6.65407	1.61
57	176.00000	177.24049	-1.24049	-0.30
58	182.00000	180.88800	1.11200	0.27
59	169.00000	172.04919	-3.04919	-0.74
60	162.00000	164.16684	-2.16684	-0.52

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLL (a-3)

61	162.00000	157.68008	4.31992	1.04
62	170.00000	167.51910	2.48090	0.60
63	164.00000	162.38599	1.61401	0.39
64	159.00000	154.08795	4.91205	1.19
65	148.00000	152.36859	-4.36859	-1.05
66	160.00000	161.55511	-1.55511	-0.38
67	156.00000	149.98338	6.01662	1.45
68	152.00000	151.41846	0.58154	0.14
69	152.00000	152.12184	-0.12184	-0.03
70	155.00000	154.64783	0.35217	0.08
71	155.00000	155.32893	-0.32893	-0.08
72	145.00000	154.65544	-9.65544	-2.33
73	181.00000	181.88869	-0.88869	-0.21
74	164.00000	161.55272	2.44728	0.59
75	110.00000	110.42009	-0.42009	-0.10
76	97.00000	97.39784	-0.39784	-0.10
77	140.00000	141.97147	-1.97147	-0.48
78	96.00000	97.63431	-1.63431	-0.39
79	98.00000	98.64290	-0.64290	-0.16
80	99.00000	95.38770	3.61230	0.87
81	99.00000	99.18617	-0.18617	-0.04
82	101.00000	101.43050	-0.43050	-0.10
83	99.00000	98.95047	0.04953	0.01
84	100.00000	102.12674	-2.12674	-0.51
85	102.00000	101.69553	0.30447	0.07
86	100.00000	98.62373	1.37627	0.33
87	100.00000	101.26692	-1.26692	-0.31
88	103.00000	102.94044	0.05956	0.01
89	100.00000	98.95839	1.04161	0.25
90	98.00000	97.33948	0.66052	0.16
91	122.00000	123.17406	-1.17406	-0.28
92	104.00000	106.79581	-2.79581	-0.67
93	135.00000	134.80453	0.19547	0.05
94	168.00000	168.37724	-0.37724	-0.09
95	149.00000	148.95567	0.04433	0.01
96	162.00000	159.28925	2.71075	0.65
97	100.00000	97.60382	2.39618	0.58
98	165.00000	165.92264	-0.92264	-0.22
99	186.00000	183.17430	2.82570	0.68
100	117.00000	115.34854	1.65146	0.40
101	144.00000	136.54384	7.45616	1.80
102	133.00000	122.83415	10.16585	2.45
103	106.00000	121.24442	-15.24442	-3.68
104	171.00000	172.66370	-1.66370	-0.40
105	157.00000	160.91093	-3.91093	-0.94
106	153.00000	153.89653	-0.89653	-0.22
107	156.00000	157.88725	-1.88725	-0.46
108	163.00000	162.40424	0.59576	0.14
109	162.00000	159.69507	2.30493	0.56
110	169.00000	172.13210	-3.13210	-0.76
111	129.00000	130.95982	-1.95982	-0.47
112	124.00000	123.90323	0.09677	0.02
113	128.00000	128.58476	-0.58476	-0.14
114	133.00000	128.20612	4.79388	1.16
115	130.00000	128.58133	1.41867	0.34
116	126.00000	128.48720	-2.48720	-0.60
117	133.00000	128.90736	4.09264	0.99
118	113.00000	121.23514	-8.23514	-1.99

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

HP (a-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	687.00000	686.82056	0.17944	0.01
2	784.00000	790.69604	-6.69604	-0.51
3	823.00000	824.70313	-1.70313	-0.13
4	940.00000	932.25269	7.74731	0.59
5	871.00000	874.73462	-3.73462	-0.28
6	726.00000	772.04248	-46.04248	-3.49
7	844.00000	854.61450	-10.61450	-0.80
8	871.00000	862.70752	8.29248	0.63
9	817.00000	809.76782	7.23218	0.55
10	777.00000	790.30640	-13.30640	-1.01
11	907.00000	903.76660	3.23340	0.24
12	900.00000	911.65063	-11.65063	-0.88
13	975.00000	976.30933	-1.30933	-0.10
14	905.00000	914.15503	-9.15503	-0.69
15	926.00000	924.19189	1.80811	0.14
16	746.00000	725.20996	20.79004	1.57
17	808.00000	806.80054	1.19946	0.09
18	860.00000	858.83154	1.16846	0.09
19	910.00000	889.97681	20.02319	1.52
20	908.00000	900.44141	7.55859	0.57
21	898.00000	903.89575	-5.89575	-0.45
22	847.00000	846.18188	0.81812	0.06
23	811.00000	817.66431	-6.66431	-0.50
24	851.00000	837.24170	13.75830	1.04
25	839.00000	823.08813	15.91187	1.21
26	811.00000	823.21069	-12.21069	-0.92
27	811.00000	821.35205	-10.35205	-0.78
28	802.00000	809.99146	-7.99146	-0.61
29	807.00000	807.59277	-0.59277	-0.04
30	804.00000	806.49634	-2.49634	-0.19
31	805.00000	804.28711	0.71289	0.05
32	808.00000	805.11572	2.88428	0.22
33	818.00000	807.94409	10.05591	0.76
34	813.00000	817.44043	-4.44043	-0.34
35	837.00000	833.90454	3.09546	0.23
36	849.00000	852.44849	-3.44849	-0.26
37	813.00000	823.03906	-10.03906	-0.76
38	812.00000	816.36841	-4.36841	-0.33
39	741.00000	728.65234	12.34766	0.94
40	738.00000	731.06689	6.93311	0.53
41	809.00000	796.29102	12.70898	0.96
42	800.00000	793.30127	6.69873	0.51
43	784.00000	772.14185	11.85815	0.90
44	829.00000	832.88770	-3.88770	-0.29
45	850.00000	846.05444	3.94556	0.30
46	858.00000	853.39453	4.60547	0.35
47	860.00000	844.28735	15.71265	1.19
48	897.00000	905.94189	-8.94189	-0.68
49	836.00000	822.81592	13.18408	1.00
50	823.00000	831.33228	-8.33228	-0.63
51	843.00000	833.55371	9.44629	0.72
52	814.00000	810.82715	3.17285	0.24
53	786.00000	783.72534	2.27466	0.17
54	815.00000	819.39795	-4.39795	-0.33
55	929.00000	930.61865	-1.61865	-0.12
56	953.00000	953.85571	-0.85571	-0.06
57	922.00000	904.25391	17.74609	1.34
58	928.00000	920.06763	7.93237	0.60
59	891.00000	881.97998	9.02002	0.68
60	863.00000	872.13086	-9.13086	-0.69

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

HP (a-3)

61	854.00000	856.25122	-2.25122	-0.17
62	882.00000	896.76343	-14.76343	-1.12
63	876.00000	872.75488	3.24512	0.25
64	849.00000	835.59326	13.40674	1.02
65	848.00000	839.31836	8.68164	0.66
66	823.00000	822.74121	0.25879	0.02
67	822.00000	818.74512	3.25488	0.25
68	829.00000	814.29395	14.70605	1.11
69	829.00000	831.29565	-2.29565	-0.17
70	835.00000	830.78296	4.21704	0.32
71	846.00000	835.15552	10.84448	0.82
72	839.00000	861.55151	-22.55151	-1.71
73	915.00000	923.17383	-8.17383	-0.62
74	881.00000	876.06299	4.93701	0.37
75	703.00000	711.94873	-8.94873	-0.68
76	690.00000	694.99438	-4.99438	-0.38
77	792.00000	805.74902	-13.74902	-1.04
78	690.00000	708.91895	-18.91895	-1.43
79	699.00000	696.03687	2.96313	0.22
80	681.00000	681.41211	-0.41211	-0.03
81	694.00000	700.24878	-6.24878	-0.47
82	724.00000	733.07910	-9.07910	-0.69
83	687.00000	704.93750	-17.93750	-1.36
84	688.00000	691.54321	-3.54321	-0.27
85	723.00000	721.84033	1.15967	0.09
86	725.00000	712.72314	12.27686	0.93
87	686.00000	685.82397	0.17603	0.01
88	709.00000	702.58179	6.41821	0.49
89	726.00000	716.70630	9.29370	0.70
90	710.00000	701.13745	8.86255	0.67
91	764.00000	746.28369	17.71631	1.34
92	734.00000	736.27710	-2.27710	-0.17
93	787.00000	789.38135	-2.38135	-0.18
94	856.00000	850.72583	5.27417	0.40
95	851.00000	840.83081	10.16919	0.77
96	902.00000	898.33081	3.66919	0.28
97	697.00000	684.85767	12.14233	0.92
98	873.00000	885.19263	-12.19263	-0.92
99	938.00000	931.24634	6.75366	0.51
100	790.00000	795.29932	-5.29932	-0.40
101	802.00000	833.95703	-31.95703	-2.42
102	757.00000	786.94263	-29.94263	-2.27
103	841.00000	787.74658	53.25342	4.03
104	940.00000	924.63574	15.36426	1.16
105	909.00000	897.06885	11.93115	0.90
106	843.00000	847.63965	-4.63965	-0.35
107	848.00000	856.04565	-8.04565	-0.61
108	882.00000	884.99878	-2.99878	-0.23
109	854.00000	862.76587	-8.76587	-0.66
110	892.00000	917.04883	-25.04883	-1.90
111	750.00000	738.50659	11.49341	0.87
112	734.00000	741.71753	-7.71753	-0.58
113	757.00000	749.62671	7.37329	0.56
114	718.00000	742.88159	-24.88159	-1.88
115	735.00000	741.77222	-6.77222	-0.51
116	735.00000	739.11353	-4.11353	-0.31
117	753.00000	743.94849	9.05151	0.69
118	727.00000	739.24072	-12.24072	-0.93

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

TRVT (a-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	0.10900	0.10100	0.00800	0.49
2	0.18100	0.16838	0.01262	0.77
3	0.16700	0.16065	0.00634	0.39
4	0.21000	0.20094	0.00906	0.55
5	0.17800	0.18976	-0.01176	-0.72
6	0.13800	0.13321	0.00479	0.29
7	0.18800	0.18481	0.00319	0.20
8	0.19700	0.17808	0.01892	1.16
9	0.16000	0.16977	-0.00977	-0.60
10	0.16200	0.15998	0.00202	0.12
11	0.21500	0.22290	-0.00790	-0.48
12	0.20300	0.19940	0.00360	0.22
13	0.24100	0.23236	0.00864	0.53
14	0.18300	0.20358	-0.02058	-1.26
15	0.23600	0.22137	0.01463	0.89
16	0.10100	0.11591	-0.01491	-0.91
17	0.16900	0.17390	-0.00490	-0.30
18	0.21300	0.19101	0.02199	1.34
19	0.14800	0.18736	-0.03936	-2.40
20	0.18900	0.19730	-0.00830	-0.51
21	0.12500	0.14508	-0.02008	-1.23
22	0.12900	0.14462	-0.01562	-0.95
23	0.17800	0.17395	0.00405	0.25
24	0.20500	0.20039	0.00461	0.28
25	0.19000	0.21534	-0.02534	-1.55
26	0.24300	0.22477	0.01823	1.11
27	0.23100	0.20493	0.02607	1.59
28	0.20700	0.20182	0.00518	0.32
29	0.17100	0.18567	-0.01467	-0.90
30	0.18300	0.17546	0.00754	0.46
31	0.19900	0.17828	0.02072	1.26
32	0.18300	0.17300	0.01000	0.61
33	0.24800	0.25011	-0.00211	-0.13
34	0.11200	0.12078	-0.00878	-0.54
35	0.17200	0.16110	0.01090	0.67
36	0.22800	0.21974	0.00826	0.50
37	0.11300	0.11574	-0.00274	-0.17
38	0.10600	0.12750	-0.02150	-1.31
39	0.13700	0.12578	0.01122	0.69
40	0.13600	0.12750	0.00850	0.52
41	0.17100	0.15921	0.01179	0.72
42	0.16800	0.15983	0.00817	0.50
43	0.13000	0.12469	0.00531	0.32
44	0.17300	0.15989	0.01311	0.80
45	0.17700	0.19637	-0.01937	-1.18
46	0.18800	0.19733	-0.00933	-0.57
47	0.16100	0.13275	0.02825	1.72
48	0.13300	0.13492	-0.00192	-0.12
49	0.16900	0.17766	-0.00866	-0.53
50	0.13900	0.14816	-0.00916	-0.56
51	0.18100	0.18381	-0.00281	-0.17
52	0.13900	0.14140	-0.00240	-0.15
53	0.14800	0.14922	-0.00122	-0.07
54	0.15600	0.14432	0.01168	0.71
55	0.21200	0.19978	0.01222	0.75
56	0.21600	0.20809	0.00791	0.48
57	0.20900	0.20054	0.00846	0.52
58	0.20700	0.19841	0.00859	0.52
59	0.21300	0.20418	0.00882	0.54
60	0.16000	0.17310	-0.01310	-0.80

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

TRVT (a-3)

61	0.17800	0.17124	0.00676	0.41
62	0.19100	0.18101	0.00999	0.61
63	0.18200	0.16662	0.01538	0.94
64	0.18200	0.16409	0.01791	1.09
65	0.20400	0.20422	-0.00022	-0.01
66	0.09900	0.09561	0.00339	0.21
67	0.10300	0.11056	-0.00756	-0.46
68	0.07800	0.07991	-0.00191	-0.12
69	0.15100	0.16591	-0.01491	-0.91
70	0.22100	0.20830	0.01270	0.78
71	0.26000	0.28170	-0.02170	-1.32
72	0.1[illegible]000	0.16637	-0.01637	-1.00
73	0.18800	0.21857	-0.03057	-1.87
74	0.22700	0.21766	0.00934	0.57
75	0.12600	0.12876	-0.00276	-0.17
76	0.10600	0.10978	-0.00378	-0.23
77	0.16300	0.17496	-0.01196	-0.73
78	0.10600	0.11045	-0.00445	-0.27
79	0.13200	0.13871	-0.00671	-0.41
80	0.11100	0.12939	-0.01839	-1.12
81	0.08400	0.09583	-0.01183	-0.72
82	0.10100	0.10616	-0.00516	-0.31
83	0.15700	0.15706	-0.00006	-0.00
84	0.06800	0.05245	0.01555	0.95
85	0.14100	0.12639	0.01461	0.89
86	0.19700	0.18591	0.01109	0.68
87	0.09100	0.10406	-0.01306	-0.80
88	0.19700	0.19480	0.00220	0.13
89	0.26100	0.25987	0.00113	0.07
90	0.21900	0.21799	0.00101	0.06
91	0.17900	0.18374	-0.00474	-0.29
92	0.19700	0.18882	0.00818	0.50
93	0.19200	0.19405	-0.00205	-0.12
94	0.08900	0.08620	0.00280	0.17
95	0.26200	0.27241	-0.01041	-0.64
96	0.23600	0.23518	0.00082	0.05
97	0.13900	0.14254	-0.00354	-0.22
98	0.10000	0.10675	-0.00675	-0.41
99	0.17400	0.17077	0.00323	0.20
100	0.30600	0.29495	0.01105	0.67
101	0.32300	0.34902	-0.02602	-1.59
102	0.29400	0.30457	-0.01057	-0.65
103	0.33300	0.30785	0.02515	1.54
104	0.24100	0.22619	0.01481	0.90
105	0.21300	0.22652	-0.01352	-0.83
106	0.14700	0.14127	0.00573	0.35
107	0.14100	0.15144	-0.01044	-0.64
108	0.14500	0.14571	-0.00071	-0.04
109	0.12600	0.14090	-0.01490	-0.91
110	0.22300	0.21197	0.01103	0.67
111	0.14000	0.15779	-0.01779	-1.09
112	0.17300	0.16723	0.00577	0.35
113	0.15300	0.14749	0.00551	0.34
114	0.13600	0.13330	0.00270	0.16
115	0.13700	0.13208	0.00492	0.30
116	0.15400	0.14207	0.01193	0.73
117	0.13000	0.13497	-0.00497	-0.30
118	0.12100	0.13735	-0.01635	-1.00

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

CQO (a-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	0.28600	0.28807	-0.00207	-0.26
2	0.30800	0.31700	-0.00900	-1.14
3	0.32900	0.32665	0.00235	0.30
4	0.36300	0.36037	0.00263	0.33
5	0.35500	0.36357	-0.00857	-1.09
6	0.35500	0.33033	0.02467	3.13
7	0.36300	0.35235	0.01065	1.35
8	0.35200	0.34936	0.00264	0.33
9	0.32600	0.33571	-0.00971	-1.23
10	0.31200	0.30845	0.00355	0.45
11	0.34700	0.34952	-0.00252	-0.32
12	0.34500	0.35160	-0.00660	-0.84
13	0.37100	0.37623	-0.00523	-0.66
14	0.33700	0.33066	0.00634	0.80
15	0.35600	0.35667	-0.00067	-0.09
16	0.30000	0.29521	0.00479	0.61
17	0.31100	0.31892	-0.00792	-1.00
18	0.33800	0.33438	0.00362	0.46
19	0.34300	0.34655	-0.00355	-0.45
20	0.35100	0.34985	0.00115	0.15
21	0.34300	0.35095	-0.00795	-1.01
22	0.33800	0.33271	0.00529	0.67
23	0.30800	0.30789	0.00011	0.01
24	0.33500	0.33553	-0.00053	-0.07
25	0.33300	0.33874	-0.00574	-0.73
26	0.32200	0.32077	0.00123	0.16
27	0.33000	0.32526	0.00474	0.60
28	0.31200	0.30724	0.00476	0.60
29	0.31900	0.31611	0.00289	0.37
30	0.31100	0.31157	-0.00057	-0.07
31	0.31300	0.30657	0.00643	0.82
32	0.31400	0.31495	-0.00095	-0.12
33	0.33800	0.33859	-0.00059	-0.07
34	0.31600	0.31462	0.00138	0.18
35	0.33400	0.32666	0.00734	0.93
36	0.34500	0.34787	-0.00287	-0.36
37	0.31100	0.30637	0.00463	0.59
38	0.31700	0.32825	-0.01125	-1.43
39	0.29400	0.29612	-0.00212	-0.27
40	0.30200	0.29605	0.00595	0.75
41	0.30400	0.31499	-0.01099	-1.39
42	0.30500	0.31388	-0.00888	-1.13
43	0.31600	0.31298	0.00302	0.38
44	0.33200	0.33312	-0.00112	-0.14
45	0.35800	0.36037	-0.00237	-0.30
46	0.36200	0.36044	0.00156	0.20
47	0.34700	0.34376	0.00324	0.41
48	0.33600	0.33568	0.00032	0.04
49	0.31100	0.31384	-0.00284	-0.36
50	0.30900	0.31524	-0.00624	-0.79
51	0.35900	0.36076	-0.00176	-0.22
52	0.31300	0.31910	-0.00610	-0.77
53	0.29800	0.30816	-0.01016	-1.29
54	0.31800	0.32181	-0.00381	-0.48
55	0.36400	0.35212	0.01188	1.51
56	0.36600	0.36007	0.00593	0.75
57	0.34600	0.35453	-0.00853	-1.08
58	0.35500	0.34780	0.00720	0.91
59	0.34200	0.34674	-0.00474	-0.60
60	0.33600	0.36139	-0.00539	[illegible]

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

CQO (a-3)

61	0.34200	0.34258	-0.00058	-0.07
62	0.34500	0.34631	-0.00131	-0.17
63	0.34100	0.33517	0.00583	0.74
64	0.34100	0.32924	0.01176	1.49
65	0.34400	0.33973	0.00427	0.54
66	0.30600	0.30762	-0.00162	-0.21
67	0.30300	0.30788	-0.00488	-0.62
68	0.31200	0.31215	-0.00015	-0.02
69	0.30900	0.30808	0.00092	0.12
70	0.32400	0.33081	-0.00681	-0.86
71	0.33300	0.32985	0.00315	0.40
72	0.33800	0.33788	0.00012	0.02
73	0.34500	0.35797	-0.01297	-1.64
74	0.36300	0.34865	0.01435	1.82
75	0.28700	0.29050	-0.00350	-0.44
76	0.29200	0.29137	0.00063	0.08
77	0.30500	0.31884	-0.01384	-1.75
78	0.29300	0.29312	-0.00012	-0.02
79	0.29000	0.29671	-0.00671	-0.85
80	0.28100	0.27290	0.00810	1.03
81	0.29600	0.29484	0.00116	0.15
82	0.32400	0.32156	0.00244	0.31
83	0.27200	0.28054	-0.00854	-1.08
84	0.28100	0.27220	0.00880	1.12
85	0.32400	0.32616	-0.00216	-0.27
86	0.32300	0.31877	0.00423	0.54
87	0.27500	0.27813	-0.00313	-0.40
88	0.30800	0.31163	-0.00363	-0.46
89	0.33300	0.33340	-0.00040	-0.05
90	0.30000	0.29873	0.00127	0.16
91	0.30500	0.31057	-0.00557	-0.71
92	0.29200	0.30042	-0.00842	-1.07
93	0.30500	0.29997	0.00503	0.64
94	0.33300	0.33372	-0.00072	-0.09
95	0.36100	0.34958	0.01142	1.45
96	0.36500	0.36229	0.00271	0.34
97	0.28000	0.27918	0.00082	0.10
98	0.36200	0.36108	0.00092	0.12
99	0.38300	0.37116	0.01184	1.50
100	0.34000	0.33412	0.00588	0.75
101	0.33300	0.33798	-0.00498	-0.63
102	0.33900	0.33071	0.00829	1.05
103	0.32600	0.33015	-0.00415	-0.53
104	0.36400	0.36720	-0.00320	-0.41
105	0.35700	0.36173	-0.00473	-0.60
106	0.35300	0.35012	0.00288	0.36
107	0.34900	0.35535	-0.00635	-0.80
108	0.36500	0.36115	0.00385	0.49
109	0.35500	0.36002	-0.00502	-0.64
110	0.36100	0.35982	0.00118	0.15
111	0.32100	0.31099	0.01001	1.27
112	0.31600	0.31616	-0.00016	-0.02
113	0.32600	0.32752	-0.00152	-0.19
114	0.32000	0.31893	0.00107	0.14
115	0.31500	0.31607	-0.00107	-0.14
116	0.31500	0.32332	-0.00832	-1.05
117	0.32200	0.31525	0.00675	0.86
118	0.30500	0.29569	0.00932	1.18

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

BMF (b-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	3592.00000	3634.17871	-42.17871	-0.14
2	2890.00000	2739.29224	150.70776	0.49
3	3678.00000	3753.55005	-75.55005	-0.25
4	3639.00000	3768.60718	-129.60718	-0.43
5	4154.00000	4212.72656	-58.72656	-0.19
6	2907.00000	2929.92603	-22.92603	-0.08
7	3752.00000	3997.95972	-245.95972	-0.81
8	3045.00000	3499.31128	-454.31128	-1.49
9	3217.00000	3057.31494	159.68506	0.52
10	4180.00000	3983.56665	196.43335	0.64
11	4180.00000	3855.74512	324.25488	1.06
12	4572.00000	4074.18311	497.81689	1.63
13	4455.00000	4199.70703	255.29297	0.84
14	3601.00000	3873.24951	-272.24951	-0.89
15	3903.00000	4145.57813	-242.57813	-0.80
16	3804.00000	4157.24219	-353.24219	-1.16
17	3809.00000	4324.04297	-515.04297	-1.69
18	3602.00000	3820.05542	-218.05542	-0.72
19	4160.00000	4042.07959	117.92041	0.39
20	4052.00000	4236.43750	-184.43750	-0.61
21	4696.00000	4362.84375	333.15625	1.09
22	3823.00000	4127.88672	-304.88672	-1.00
23	4393.00000	4125.80469	267.19531	0.88
24	3229.00000	3378.43750	-149.43750	-0.49
25	4165.00000	4084.39160	80.60840	0.26
26	4683.00000	4380.44531	302.55469	0.99
27	4212.00000	4261.66797	-49.66797	-0.16
28	4790.00000	4424.69531	365.30469	1.20
29	3939.00000	3948.86572	-9.86572	-0.03
30	3612.00000	3964.71387	-352.71387	-1.16
31	3681.00000	3738.77563	-57.77563	-0.19
32	3979.00000	3777.68433	201.31567	0.66
33	4081.00000	3898.98169	182.01831	0.60
34	3776.00000	3759.56177	16.43823	0.05
35	4947.00000	4235.00000	712.00000	2.34
36	4047.00000	3994.35376	52.64624	0.17
37	3882.00000	4069.63892	-187.63892	-0.62
38	4224.00000	4073.99634	150.00366	0.49
39	4261.00000	3975.17676	285.82324	0.94
40	4148.00000	4109.75781	38.24219	0.13
41	5133.00000	4815.00781	317.99219	1.04
42	3762.00000	3926.67041	-164.67041	-0.54
43	4451.00000	4345.20703	105.79297	0.35
44	5098.00000	4924.59766	173.40234	0.57
45	3738.00000	3978.56885	-240.56885	-0.79
46	3874.00000	3966.14722	-92.14722	-0.30
47	3556.00000	3436.58643	119.41357	0.39
48	3693.00000	3477.57324	215.42676	0.71
49	4118.00000	4090.31299	27.68701	0.09
50	4037.00000	4053.26294	-16.26294	-0.05
51	3674.00000	3500.36963	173.63037	0.57
52	4182.00000	3958.14502	223.85498	0.73
53	4400.00000	4378.37891	21.62109	0.07
54	4323.00000	4423.71875	-100.71875	-0.33
55	3600.00000	3197.86157	402.13843	1.32
56	2912.00000	2971.73438	-59.73438	-0.20
57	4103.00000	3866.05127	236.94873	0.78
58	3387.00000	3678.12378	-291.12378	-0.96
59	[illegible].00000	4249.10156	215.89844	0.71

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

RMF (b-3)

60	3771.00000	3851.50039	-80.50039	-0.27
61	3745.00000	3976.34863	-231.34863	-0.76
62	3830.00000	3947.16260	-117.16260	-0.38
63	4875.00000	4568.93750	306.06250	1.00
64	4898.00000	4732.30469	165.69531	0.54
65	4699.00000	4779.13672	-80.13672	-0.26
66	4705.00000	4893.37109	-188.37109	-0.62
67	5221.00000	4793.77734	427.22266	1.40
68	4275.00000	4675.92188	-400.92188	-1.32
69	4334.00000	4353.55469	-19.55469	-0.06
70	4610.00000	4513.62500	96.37500	0.32
71	4351.00000	4311.74219	39.25781	0.13
72	4433.00000	4412.61328	20.38672	0.07
73	4359.00000	4125.73828	233.26172	0.77
74	3254.00000	3015.61890	238.38110	0.78
75	3258.00000	3475.17114	-217.17114	-0.71
76	3229.00000	3494.87061	-265.87061	-0.87
77	3412.00000	3560.46948	-148.46948	-0.49
78	4223.00000	4407.65141	-184.65141	-0.61
79	4837.00000	5107.66016	-270.66016	-0.89
80	3815.00000	4167.65234	-352.65234	-1.16
81	4455.00000	4655.21094	-200.21094	-0.66
82	4879.00000	4579.28125	299.71875	0.98
83	3415.00000	3518.93506	-103.93506	-0.34
84	3098.00000	3089.81445	8.18555	0.03
85	4018.00000	4148.37891	-130.37891	-0.43
86	3147.00000	3262.25684	-115.25684	-0.38
87	3392.00000	3286.08228	105.91772	0.35
88	3207.00000	3649.34302	-442.34302	-1.45
89	2818.00000	2984.23804	-166.23804	-0.55
90	2909.00000	3015.56763	-106.56763	-0.35
91	3706.00000	3454.58228	251.41772	0.82
92	2702.00000	2455.33447	246.66553	0.81
93	3836.00000	3625.68457	210.31543	0.69
94	4510.00000	4040.95850	469.04150	1.54
95	3054.00000	3208.36035	-154.36035	-0.51
96	4815.00000	4542.41406	272.58594	0.89
97	5895.00000	6098.30078	-203.30078	-0.67
98	5251.00000	5522.50391	-271.50391	-0.89
99	3863.00000	3916.61694	-53.61694	-0.18
100	4789.00000	4547.95703	241.04297	0.79
101	3813.00000	4298.58984	-485.58984	-1.59
102	3131.00000	3310.30371	-179.30371	-0.59
103	4528.00000	4461.92969	66.07031	0.22
104	5394.00000	4672.78906	721.21094	2.37
105	3000.00000	2784.43018	215.56982	0.71
106	3620.00000	3850.88794	-230.88794	-0.76
107	4999.00000	4801.95703	197.04297	0.65
108	5574.00000	5530.48828	43.51172	0.14
109	5756.00000	5802.20703	-46.20703	-0.15
110	5807.00000	5826.83594	-19.83594	-0.07
111	6209.00000	5870.77734	338.22266	1.11
112	4636.00000	4511.68750	124.31250	0.41
113	4969.00000	5344.72266	-375.72266	-1.23
114	4037.00000	4183.44531	-146.44531	-0.48
115	4049.00000	4117.03906	-68.03906	-0.22
116	3808.00000	3848.87988	-40.87988	-0.13
117	3803.00000	4050.73535	-247.73535	-0.81
118	4613.00000	4444.81641	168.18359	0.55
119	3922.00000	3787.05273	134.94727	0.44

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

BMF (b-3)

120	3978.00000	4656.98828	-678.98828	-2.23
121	3910.00000	3636.53320	273.46680	0.90
122	3671.00000	3617.59448	53.40552	0.18
123	3700.00000	3641.01587	58.98413	0.19
124	3778.00000	3603.72363	174.27637	0.57
125	3617.00000	3666.35645	-49.35645	-0.16
126	3317.00000	3725.71167	-408.71167	-1.34
127	6362.00000	6109.09375	252.90625	0.83
128	4443.00000	4462.16016	-19.16016	-0.06
129	4463.00000	5023.69922	-560.69922	-1.84
130	4024.00000	4079.21655	-55.21655	-0.18
131	4229.00000	4289.77344	-60.77344	-0.20
132	4087.00000	4562.41797	-475.41797	-1.56
133	4323.00000	4232.46484	90.53516	0.30
134	3936.00000	4445.25391	-509.25391	-1.67
135	4749.00000	4439.44531	309.55469	1.02
136	5461.00000	5057.38281	403.61719	1.32
~~137~~	~~2962.00000~~	~~3109.28882~~	~~-147.28882~~	-0.48

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLV (b-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	374.00000	374.31299	-0.31299	-0.01
2	193.00000	185.95291	7.04709	0.26
3	296.00000	314.00732	-18.00732	-0.65
4	349.00000	357.64429	-8.64429	-0.31
5	385.00000	399.08618	-14.08618	-0.51
6	290.00000	303.35034	-13.35034	-0.48
7	279.00000	286.55127	-7.55127	-0.27
8	286.00000	290.39258	-4.39258	-0.16
9	219.00000	217.68858	1.31142	0.05
10	270.00000	278.57642	-8.57642	-0.31
11	334.00000	319.31006	14.68994	0.53
12	373.00000	358.27832	14.72168	0.53
13	372.00000	381.51831	-9.51831	-0.35
14	229.00000	255.73480	-26.73480	-0.97
15	379.00000	401.66650	-22.66650	-0.82
16	351.00000	374.36914	-23.36914	-0.85
17	378.00000	395.78174	-17.78174	-0.64
18	294.00000	318.12500	-24.12500	-0.88
19	403.00000	375.33545	27.66455	1.00
20	320.00000	351.46484	-31.46484	-1.14
21	378.00000	370.06372	7.93628	0.29
22	297.00000	328.18774	-31.18774	-1.13
23	391.00000	355.68311	35.31689	1.28
24	228.00000	249.76820	-21.76820	-0.79
25	280.00000	286.96069	-6.96069	-0.25
26	330.00000	312.70239	17.29761	0.63
27	344.00000	328.14014	15.85986	0.58
28	389.00000	360.58936	28.41064	1.03
29	338.00000	312.16357	25.83643	0.94
30	317.00000	320.62793	-3.62793	-0.13
31	271.00000	279.07202	-8.07202	-0.29
32	328.00000	341.18604	-13.18604	-0.48
33	368.00000	350.22021	17.77979	0.64
34	345.00000	327.32153	17.67847	0.64
35	363.00000	319.25610	43.74390	1.59
36	342.00000	314.56299	27.43701	1.00
37	288.00000	295.76611	-7.76611	-0.28
38	296.00000	302.35083	-6.35083	-0.23
39	318.00000	299.46533	18.53467	0.67
40	302.00000	301.47974	0.52026	0.02
41	364.00000	326.34082	37.65918	1.37
42	359.00000	359.09204	-0.09204	-0.00
43	441.00000	436.81592	4.18408	0.15
44	518.00000	503.04224	14.95776	0.54
45	339.00000	350.92285	-11.92285	-0.43
46	362.00000	361.42993	0.57007	0.02
47	236.00000	242.79500	-6.79500	-0.25
48	243.00000	246.18179	-3.18179	-0.12
49	256.00000	285.04004	-29.04004	-1.05
50	260.00000	282.36963	-22.36963	-0.81
51	324.00000	299.84473	24.15527	0.88
52	336.00000	325.58911	10.41089	0.38
53	413.00000	413.81445	-0.81445	-0.03
54	428.00000	431.95239	-3.95239	-0.14
55	361.00000	343.59717	17.40283	0.63
56	322.00000	317.21655	4.78345	0.17
57	373.00000	374.26416	-1.26416	-0.05
58	348.00000	387.44141	-39.44141	-1.43

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLV (b-3)

59	430.00000	404.46167	25.53833	0.93
60	340.00000	324.90503	15.09497	0.55
61	259.00000	282.32227	-23.32227	-0.85
62	342.00000	327.51025	14.48975	0.53
63	401.00000	370.78101	30.21899	1.10
64	335.00000	313.94141	21.05859	0.76
65	332.00000	306.37207	25.62793	0.93
66	342.00000	345.37769	-3.37769	-0.12
67	308.00000	329.20703	-21.20703	-0.77
68	300.00000	323.54321	-23.54321	-0.85
69	284.00000	275.40723	8.59277	0.31
70	305.00000	303.57983	1.42017	0.05
71	361.00000	345.93018	15.06982	0.55
72	315.00000	341.77759	-26.77759	-0.97
73	310.00000	252.27782	57.72218	2.09
74	142.00000	171.08826	-29.08826	-1.06
75	206.00000	233.74919	-27.74919	-1.01
76	330.00000	313.03296	16.96704	0.62
77	228.00000	222.62401	5.17599	0.19
78	299.00000	305.53052	-6.53052	-0.24
79	328.00000	360.29199	-32.29199	-1.17
80	269.00000	289.96558	-20.96558	-0.76
81	263.00000	299.72412	-36.72412	-1.33
82	321.00000	290.74512	30.25488	1.10
83	215.00000	242.89751	-27.89751	-1.01
84	211.00000	224.99091	-13.99091	-0.51
85	250.00000	293.09692	-43.09692	-1.56
86	257.00000	254.71410	2.28590	0.08
87	239.00000	218.01837	20.98163	0.76
88	257.00000	247.94992	9.05008	0.33
89	302.00000	279.75415	22.24585	0.81
90	282.00000	279.56885	2.43115	0.09
91	251.00000	218.94803	32.05197	1.16
92	248.00000	220.84435	27.15565	0.99
93	340.00000	309.35229	30.64771	1.11
94	321.00000	306.71021	14.28979	0.52
95	257.00000	254.54094	2.45906	0.09
96	302.00000	310.48584	-8.48584	-0.31
97	335.00000	352.20337	-17.20337	-0.62
98	300.00000	314.40723	-14.40723	-0.52
99	338.00000	324.04297	13.95703	0.51
100	431.00000	426.40918	4.59082	0.17
101	279.00000	300.88330	-21.88330	-0.79
102	323.00000	332.95459	-9.95459	-0.36
103	433.00000	390.52734	42.47266	1.54
104	445.00000	388.79199	56.20801	2.04
105	207.00000	193.21643	13.78357	0.50
106	404.00000	421.63672	-17.63672	-0.64
107	360.00000	338.87183	21.12817	0.77
108	464.00000	474.27563	-10.27563	-0.37
109	484.00000	448.53491	35.46509	[illegible]
110	429.00000	448.85767	-19.85767	-0.72
111	476.00000	451.00391	24.99609	0.91
112	360.00000	328.24707	31.75293	1.15
113	373.00000	383.76611	-10.76611	-0.39
114	310.00000	319.95874	-9.95874	-0.36
115	306.00000	310.66089	-4.66089	-0.17
116	301.00000	294.68286	6.31714	0.23
117	290.00000	311.85767	-21.85767	-0.79
118	342.00000	327.84033	14.15967	0.51
119	304.00000	305.66357	-1.66357	-0.06

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLV (b-3)

120	358.00000	419.41333	-61.41333	-2.23
121	309.00000	295.43628	13.56372	0.45
122	290.00000	301.00391	-11.00391	-0.40
123	308.00000	293.92090	14.07910	0.51
124	328.00000	311.48706	16.51294	0.60
125	284.[illegible]	[illegible]	[illegible]	[illegible]
126	234.00000	263.11475	-29.11475	-1.06
127	465.00000	460.76416	4.23584	0.15
128	286.00000	300.60400	-14.60400	-0.53
129	379.00000	439.50269	-60.50269	-2.19
130	210.00000	226.33939	-16.33939	-0.59
131	243.00000	246.08717	-3.08717	-0.11
132	368.00000	383.93750	-15.93750	-0.58
133	317.00000	335.71021	-18.71021	-0.68
134	335.00000	377.93677	-42.93677	-1.56
135	355.00000	330.60742	24.39258	0.88
136	438.00000	394.51611	43.48389	1.58
137	314.00000	325.04785	-11.04785	-0.40

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLL (b-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	106.00000	108.15807	-2.15807	-0.23
2	176.00000	170.28267	5.71733	0.60
3	213.00000	215.04614	-2.04614	-0.21
4	215.00000	211.55757	3.44243	0.36
5	227.00000	227.27827	-0.27827	-0.03
6	130.00000	130.81497	-0.81497	-0.09
7	127.00000	123.48219	3.51781	0.37
8	154.00000	169.05612	-15.05612	-1.58
9	94.00000	98.43114	-4.43114	-0.46
10	136.00000	139.35060	-3.35060	-0.35
11	137.00000	148.47641	-11.47641	-1.20
12	179.00000	156.90117	22.09883	2.32
13	147.00000	147.40820	-0.40820	-0.04
14	117.00000	113.79237	3.20763	0.34
15	144.00000	149.25197	-5.25197	-0.55
16	149.00000	152.92351	-3.92351	-0.41
17	142.00000	140.94446	1.05554	0.11
18	138.00000	152.47014	-14.47014	-1.52
19	170.00000	163.74922	6.25078	0.65
20	179.00000	184.04463	-5.04463	-0.53
21	199.00000	191.05371	7.94629	0.83
22	178.00000	183.90227	-5.90227	-0.62
23	181.00000	181.28683	-0.28683	-0.03
24	110.00000	121.61545	-11.61545	-1.22
25	146.00000	145.90649	0.09351	0.01
26	158.00000	157.24500	0.75500	0.08
27	171.00000	165.49585	5.50415	0.58
28	169.00000	166.12306	2.87694	0.30
29	175.00000	183.61768	-8.61768	-0.90
30	165.00000	162.96915	2.03085	0.21
31	160.00000	155.33545	4.66455	0.49
32	166.00000	163.77628	2.22372	0.23
33	157.00000	149.99274	7.00726	0.73
34	148.00000	154.48111	-6.48111	-0.68
35	145.00000	147.15800	-2.15800	-0.23
36	150.00000	152.73482	-2.73482	-0.29
37	156.00000	157.54515	-1.54515	-0.16
38	150.00000	156.62833	-6.62833	-0.69
39	150.00000	153.22061	-3.22061	-0.34
40	149.00000	151.38702	-2.38702	-0.25
41	156.00000	159.62192	-3.62192	-0.36
42	154.00000	148.68820	5.31180	0.56
43	159.00000	158.57898	0.42102	0.04
44	153.00000	163.53658	-10.53658	-1.10
45	160.00000	156.45181	3.54819	0.37
46	156.00000	149.32309	6.67691	0.70
47	116.00000	112.94807	3.05193	0.32
48	117.00000	114.77997	2.22003	0.23
49	142.00000	139.34439	2.65561	0.28
50	142.00000	139.35580	2.64420	0.28
51	125.00000	121.02327	3.97673	0.42
52	146.00000	150.34024	-4.34024	-0.45
53	144.00000	139.71652	4.28348	0.45
54	142.00000	142.80479	-0.80479	-0.08
55	147.00000	154.68382	-7.68382	-0.81
56	184.00000	178.57060	5.42940	0.57
57	141.00000	134.05359	6.94641	0.73
58	143.00000	154.26341	-11.26341	-1.18
59	142.00000	131.91322	10.08678	1.06

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLL (b-3)

60	144.00000	139.00754	4.99246	0.52
61	142.00000	136.93881	5.06119	0.53
62	141.00000	142.24377	-1.24377	-0.13
63	183.00000	179.25870	3.74130	0.39
64	193.00000	182.88220	10.11780	1.06
65	176.00000	174.02432	1.97568	0.21
66	182.00000	188.53923	-6.53923	-0.69
67	169.00000	166.94545	2.05455	0.22
68	162.00000	160.09538	1.90462	0.20
69	162.00000	157.86501	4.13499	0.44
70	170.00000	165.98639	4.01361	0.42
71	164.00000	163.63721	0.36279	0.04
72	159.00000	163.85835	-4.85835	-0.51
73	148.00000	140.64563	7.35437	0.77
74	160.00000	170.79292	-10.79292	-1.13
75	156.00000	156.41528	-0.41528	-0.04
76	152.00000	162.53661	-10.53661	-1.10
77	152.00000	146.97839	5.02161	0.53
78	155.00000	153.59653	1.40347	0.15
79	155.00000	149.39969	5.60031	0.59
80	145.00000	156.71609	-11.71609	-1.23
81	181.00000	179.01598	1.98402	0
82	164.00000	162.50134	1.49866	
83	110.00000	113.84654	-3.84654	.40
84	97.00000	97.57664	-0.57664	0.06
85	140.00000	143.61287	-3.61287	-0.38
86	96.00000	106.16006	-10.16006	-1.06
87	98.00000	108.09952	-10.09952	-1.06
88	99.00000	96.28366	2.71634	0.28
89	99.00000	85.45956	13.54044	1.41
90	101.00000	91.92455	9.07545	0.95
91	99.00000	93.03796	5.96204	0.62
92	100.00000	93.92120	6.07880	0.64
93	102.00000	91.99944	10.00056	1.05
94	100.00000	94.86464	5.13536	0.54
95	100.00000	90.98753	9.01247	0.94
96	103.00000	106.94637	-3.94637	-0.41
97	100.00000	103.26428	-3.26428	-0.34
98	98.00000	99.17946	-1.17946	-0.12
99	122.00000	120.05367	1.94633	0.20
100	104.00000	104.52539	-0.52539	-0.06
101	135.00000	144.09383	-9.09383	-0.95
102	168.00000	172.02248	-4.02248	-0.42
103	149.00000	140.79266	8.20734	0.86
104	162.00000	147.05147	14.94853	1.57
105	100.00000	99.12756	0.87244	0.09
106	165.00000	168.01459	-3.01459	-0.32
107	186.00000	173.70552	12.29448	1.29
108	117.00000	118.75800	-1.75800	-0.18
109	144.00000	139.96455	4.03545	0.42
110	133.00000	119.41447	13.58553	1.42
111	106.00000	118.34972	-12.34972	-1.29
112	171.00000	149.44640	21.55360	2.26
113	157.00000	156.77899	0.22101	0.02
114	153.00000	156.09058	-3.09058	-0.32
115	156.00000	153.18185	2.81815	0.30
116	163.00000	158.37996	4.62004	0.48
117	162.00000	170.87840	-8.87840	-0.93
118	169.00000	160.62732	8.37268	0.88
119	129.00000	129.65337	-0.65337	-0.07

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TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLL (b-3)

120	124.00000	121.44189	2.55811	0.27
121	128.00000	130.80209	-2.80209	-0.29
122	133.00000	127.49092	5.50908	0.58
123	130.00000	126.84209	3.15791	0.33
124	126.00000	126.97314	-0.97314	-0.10
125	133.00000	128.68243	4.21757	0.45
126	113.00000	130.24881	-17.24881	-1.81
127	110.00000	108.56107	1.43893	0.15
128	96.00000	102.07703	-6.07703	-0.64
129	63.00000	73.10948	-10.10948	-1.06
130	79.00000	94.72864	-15.72864	-1.65
131	73.00000	63.04543	9.95457	1.04
132	90.00000	115.77724	-25.77724	-2.70
133	100.00000	108.18182	-8.18182	-0.86
134	85.00000	103.22992	-18.22992	-1.91
135	106.00000	93.06804	12.93196	1.35
136	72.00000	84.25089	-12.25089	-1.28
137	127.00000	117.03816	9.96184	1.04

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

HP (b-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	604.00000	626.40552	-22.40552	-0.93
2	661.00000	682.41577	-21.41577	-0.89
3	752.00000	769.92676	-17.92676	-0.74
4	776.00000	770.91675	5.08325	0.21
5	841.00000	866.41626	-25.41626	-1.05
6	576.00000	530.56830	45.43170	1.88
7	587.00000	607.24658	-20.24658	-0.84
8	738.00000	762.14087	-44.14087	-1.83
9	687.00000	677.46973	9.53027	0.39
10	784.00000	796.25244	-12.25244	-0.51
11	823.00000	829.99146	-6.59146	-0.29
12	940.00000	925.49292	14.50708	0.60
13	871.00000	881.19653	-10.19653	-0.42
14	726.00000	799.19189	-73.19189	-3.03
15	844.00000	862.45850	-18.45850	-0.76
16	871.00000	855.26929	15.73071	0.65
17	817.00000	835.70776	-18.70776	-0.77
18	777.00000	786.96191	-9.96191	-0.41
19	907.00000	898.40088	8.59912	0.36
20	900.00000	915.92822	-15.92822	-0.66
21	975.00000	972.88916	2.11084	0.09
22	905.00000	908.45020	-3.45020	-0.14
23	926.00000	922.06641	3.93359	0.16
24	746.00000	711.95215	34.04785	1.41
25	808.00000	807.14526	0.85474	0.04
26	860.00000	851.17139	8.82861	0.37
27	909.00000	885.01050	23.98950	0.99
28	908.00000	889.11353	18.88647	0.78
29	898.00000	889.67920	8.32080	0.34
30	847.00000	842.32471	4.67529	0.19
31	811.00000	824.98438	-13.98438	-0.58
32	851.00000	844.08813	6.91187	0.29
33	839.00000	820.56226	18.43774	0.76
34	811.00000	805.60547	5.39453	0.22
35	811.00000	817.42847	-6.42847	-0.27
36	802.00000	811.11304	-9.11304	-0.38
37	807.00000	805.43970	1.56030	0.06
38	804.00000	812.88721	-8.88721	-0.37
39	805.00000	802.15430	2.84570	0.12
40	808.00000	803.45679	4.54321	0.19
41	818.00000	812.26855	5.73145	0.24
42	813.00000	815.99805	-2.99805	-0.12
43	837.00000	827.75439	9.24561	0.38
44	849.00000	852.30005	-3.30005	-0.14
45	813.00000	820.66284	-7.66284	-0.32
46	812.00000	812.33813	-0.33813	-0.01
47	741.00000	732.37793	8.62207	0.36
48	738.00000	734.24292	3.75708	0.16
49	809.00000	802.22998	6.77002	0.28
50	800.00000	798.23145	1.76855	0.07
51	784.00000	765.38672	18.61328	0.77
52	829.00000	836.57568	-7.57568	-0.31
53	850.00000	844.09839	5.90161	0.24
54	858.00000	848.33203	9.66797	0.40
55	860.00000	825.14844	34.85156	1.44
56	897.00000	907.37476	-10.37476	-0.43
57	836.00000	840.74292	-4.74292	-0.20
58	823.00000	827.78394	-4.78394	-0.20
59	843.00000	837.96753	5.03247	0.21

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

HP (5-3)

60	814.00000	807.96533	6.03467	0.25
61	786.00000	787.72681	-1.72681	-0.07
62	815.00000	818.73120	-3.73120	-0.15
63	929.00000	917.47168	11.52832	0.48
64	953.00000	956.47998	-3.47998	-0.14
65	922.00000	916.64136	5.35864	0.22
66	928.00000	942.51685	-14.51685	-0.60
67	891.00000	891.01416	-0.01416	-0.00
68	863.00000	871.73389	-8.73389	-0.36
69	854.00000	856.46362	-2.46362	-0.10
70	882.00000	902.17212	-20.17212	-0.83
71	876.00000	874.66016	1.33984	0.06
72	849.00000	844.36401	4.63599	0.19
73	848.00000	821.97266	26.02734	1.08
74	823.00000	822.70166	0.29834	0.01
75	822.00000	819.21240	2.78760	0.12
76	829.00000	791.54712	37.45288	1.55
77	829.00000	823.46362	5.53638	0.23
78	835.00000	843.33154	-8.33154	-0.34
79	846.00000	839.41943	6.58057	0.27
80	839.00000	861.91675	-22.91675	-0.95
81	915.00000	919.36401	-4.36401	-0.18
82	881.00000	865.03052	15.96948	0.66
83	703.00000	715.95044	-12.95044	-0.54
84	690.00000	696.18311	-6.18311	-0.26
85	792.00000	806.72583	-14.72583	-0.61
86	690.00000	690.02661	-0.02661	-0.00
87	699.00000	672.41040	26.58960	1.10
88	681.00000	687.91724	-6.91724	-0.29
89	694.00000	709.18359	-15.18359	-0.63
90	724.00000	732.86670	-8.86670	-0.37
91	687.00000	696.47534	-9.47534	-0.39
92	688.00000	696.42285	-8.42285	-0.35
93	723.00000	742.56470	-19.56470	-0.81
94	725.00000	699.37646	25.62354	1.06
95	686.00000	708.70337	-22.70337	-0.94
96	709.00000	681.54688	27.45313	1.14
97	726.00000	725.93115	0.06885	0.00
98	710.00000	719.32886	-9.32886	-0.39
99	764.00000	750.98682	13.01318	0.54
100	734.00000	721.79492	12.20508	0.50
101	787.00000	792.31763	-5.31763	-0.22
102	856.00000	862.86938	-6.86938	-0.28
103	851.00000	812.37524	38.62476	1.60
104	902.00000	873.56470	28.43530	1.18
105	697.00000	671.60132	25.39868	1.05
106	873.00000	862.75488	10.24512	0.42
107	938.00000	908.32349	29.67651	1.23
108	790.00000	787.04980	2.95020	0.12
109	802.00000	809.70117	-7.70117	-0.32
110	757.00000	804.33716	-47.33716	-1.96
111	841.00000	793.83496	47.16504	1.95
112	940.00000	892.56152	47.43848	1.96
113	909.00000	912.62738	-3.62738	-0.16
114	843.00000	853.42651	-10.42651	-0.43
115	848.00000	852.34546	-4.34546	-0.18
116	882.00000	878.48535	3.51465	0.15
117	854.00000	851.71069	2.28931	0.09
118	892.00000	887.86035	4.13965	0.17
119	750.00000	739.57129	10.42871	0.43

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

HP (b-3)

120	734.00000	786.94971	-52.94971	-2.19
121	757.00000	728.52686	28.47314	1.18
122	718.00000	738.17114	-20.17114	-0.83
123	735.00000	746.32007	-11.32007	-0.47
124	735.00000	725.96411	9.03589	0.37
125	753.00000	749.17578	3.82422	0.16
126	727.00000	734.36963	-7.36963	-0.30
127	855.00000	838.96606	16.03394	0.66
128	915.00000	892.62744	22.37256	0.93
129	866.00000	919.84717	-53.84717	-2.23
130	877.00000	857.26147	19.73853	0.82
131	843.00000	863.36572	-20.36572	-0.84
132	921.00000	972.59497	-51.59497	-2.13
133	952.00000	914.45215	37.54785	1.55
134	898.00000	935.93237	-37.93237	-1.57
135	966.00000	946.40967	19.59033	0.81
136	884.00000	836.76709	47.23291	1.95
137	571.00000	640.75513	-69.75513	-2.88

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

TRVT (b-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	0.18800	0.18912	-0.00112	-0.06
2	0.07700	0.07000	0.00700	0.35
3	0.12200	0.13309	-0.01109	-0.55
4	0.16100	0.16355	-0.00255	-0.13
5	0.14700	0.16227	-0.01527	-0.76
6	0.15500	0.15604	-0.00104	-0.05
7	0.08500	0.09800	-0.01300	-0.65
8	0.10200	0.11067	-0.00867	-0.43
9	0.10900	0.10003	0.00897	0.45
10	0.18100	0.16384	0.01716	0.85
11	0.16700	0.15026	0.01674	0.83
12	0.21000	0.18014	0.02986	1.49
13	0.17800	0.17976	-0.00176	-0.09
14	0.13800	0.15180	-0.01380	-0.69
15	0.18800	0.18634	0.00166	0.08
16	0.19700	0.18558	0.01142	0.57
17	0.16000	0.19263	-0.03263	-1.62
18	0.16200	0.18380	-0.02180	-1.08
19	0.21500	0.21617	-0.00117	-0.06
20	0.20300	0.20067	0.00233	0.12
21	0.24100	0.21147	0.02953	1.47
22	0.18300	0.21227	-0.02927	-1.46
23	0.23600	0.21861	0.01739	0.87
24	0.10100	0.12435	-0.02335	-1.16
25	0.16900	0.17042	-0.00142	-0.07
26	0.21300	0.19639	0.01661	0.83
27	0.14800	0.17837	-0.03037	-1.51
28	0.18900	0.18439	0.00461	0.23
29	0.12500	0.15733	-0.03233	-1.61
30	0.12900	0.16254	-0.03354	-1.67
31	0.17800	0.18044	-0.00244	-0.12
32	0.20500	0.20154	0.00346	0.17
33	0.19000	0.19047	-0.00047	-0.02
34	0.24300	0.21085	0.03215	1.60
35	0.23100	0.19358	0.03742	1.86
36	0.20700	0.19406	0.01294	0.64
37	0.17100	0.18125	-0.01025	-0.51
38	0.18300	0.17867	0.00433	0.22
39	0.19900	0.18369	0.01531	0.76
40	0.18300	0.17144	0.01156	0.57
41	0.24800	0.23654	0.01146	0.57
42	0.11200	0.12702	-0.01502	-0.75
43	0.17200	0.16030	0.01170	0.58
44	0.22800	0.21468	0.01332	0.66
45	0.11300	0.13177	-0.01877	-0.93
46	0.10600	0.11177	-0.00577	-0.29
47	0.13700	0.12334	0.01366	0.68
48	0.13600	0.12564	0.01036	0.52
49	0.17100	0.16701	0.00399	0.20
50	0.16800	0.16484	0.00316	0.16
51	0.13000	0.12088	0.00912	0.45
52	0.17300	0.15116	0.02184	1.09
53	0.17700	0.18710	-0.01010	-0.50
54	0.14800	0.15120	-0.00320	-0.16
55	0.16100	0.12475	0.03625	1.80
56	0.13300	0.13395	-0.00095	-0.05
57	0.16900	0.16650	0.00250	0.12
58	0.13900	0.15511	-0.01611	-0.80
59	0.18100	0.17751	0.00349	0.17

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

TRVT (b-3)

60	0.13900	0.14501	-0.00601	-0.30
61	0.14800	0.16199	-0.01399	-0.70
62	0.15600	0.14766	0.00834	0.41
63	0.21200	0.18758	0.02442	1.22
64	0.21600	0.20962	0.00638	0.32
65	0.20900	0.21132	-0.00232	-0.12
66	0.20700	0.21042	-0.00342	-0.17
67	0.21300	0.20455	0.00845	0.42
68	0.16000	0.18523	-0.02523	-1.26
69	0.17800	0.17298	0.00502	0.25
70	0.19100	0.18985	0.00115	0.06
71	0.18200	0.17607	0.00593	0.30
72	0.18200	0.16979	0.01221	0.61
73	0.20400	0.19150	0.01250	0.62
74	0.09900	0.09711	0.00189	0.09
75	0.10300	0.12722	-0.02422	-1.20
76	0.07800	0.09649	-0.01849	-0.92
77	0.15100	0.16456	-0.01356	-0.67
78	0.22100	0.21749	0.00351	0.17
79	0.26000	0.28592	-0.02592	-1.29
80	0.15000	0.16003	-0.01003	-0.50
81	0.18800	0.20149	-0.01349	-0.67
82	0.22700	0.19184	0.03516	1.75
83	0.12600	0.12738	-0.00138	-0.07
84	0.10600	0.10415	0.00185	0.09
85	0.16300	0.17163	-0.00863	-0.43
86	0.10600	0.11173	-0.00573	-0.29
87	0.13200	0.11499	0.01701	0.85
88	0.11100	0.12989	-0.01889	-0.94
89	0.08400	0.10001	-0.01601	-0.80
90	0.10100	0.10109	-0.00009	-0.00
91	0.15700	0.15034	0.00666	0.33
92	0.06800	0.03559	0.03241	1.61
93	0.14100	0.14218	-0.00118	-0.06
94	0.19700	0.19460	0.00240	0.12
95	0.09100	0.11726	-0.02626	-1.31
96	0.19700	0.19513	0.00187	0.09
97	0.26100	0.26357	-0.00257	-0.13
98	0.21900	0.22145	-0.00245	-0.12
99	0.17900	0.18275	-0.00375	-0.19
100	0.19700	0.19877	-0.00177	-0.09
101	0.19200	0.20841	-0.01641	-0.82
102	0.08900	0.09509	-0.00609	-0.30
103	0.26200	0.24044	0.02156	1.07
104	0.23600	0.21103	0.02497	1.24
105	0.13900	0.12974	0.00926	0.46
106	0.10000	0.10440	-0.00440	-0.22
107	0.17400	0.16324	0.01076	0.54
108	0.30600	0.29317	0.01283	0.64
109	0.32300	0.33294	-0.00994	-0.49
110	0.29400	0.30039	-0.00639	-0.32
111	0.33300	0.29958	0.03342	1.66
112	0.24100	0.20261	0.03839	1.91
113	0.21300	0.23701	-0.02401	-1.19
114	0.14700	0.15193	-0.00493	-0.25
115	0.14100	0.14043	0.00057	0.03
116	0.14500	0.15701	-0.01201	-0.60
117	0.12600	0.14495	-0.01895	-0.94
118	0.22300	0.20001	0.02299	1.14
119	0.14000	0.141[illegible]	-0.00189	-0.09

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TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

TRVT (b-3)

120	0.17300	0.19407	-0.02107	-1.05
121	0.15300	0.14378	0.00922	0.46
122	0.13600	0.13461	0.00139	0.07
123	0.13700	0.13188	0.00512	0.25
124	0.15400	0.13749	0.01651	0.82
125	0.13000	0.13312	-0.00312	-0.16
126	0.12100	0.14543	-0.02443	-1.22
127	0.31800	0.32139	-0.00339	-0.17
128	0.21000	0.21294	-0.00294	-0.15
129	0.22600	0.26788	-0.04188	-2.08
130	0.18000	0.18932	-0.00932	-0.46
131	0.20900	0.20792	0.00108	0.05
132	0.22000	0.24418	-0.02418	-1.20
133	0.17900	0.17256	0.00644	0.32
134	0.21400	0.24930	-0.03530	-1.76
135	0.20400	0.18340	0.02060	1.03
136	0.19600	0.16732	0.02868	1.43
137	0.15500	0.15428	0.00072	0.04

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

CQO (5-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	0.30400	0.30411	-0.00011	-0.01
2	0.27000	0.26125	0.00875	0.76
3	0.31200	0.31905	-0.00705	-0.61
4	0.31700	0.31548	0.00152	0.13
5	0.35800	0.35875	-0.00075	-0.07
6	0.28900	0.29288	-0.00388	-0.34
7	0.18400	0.19445	-0.01045	-0.91
8	0.32100	0.33033	-0.00933	-0.81
9	0.28600	0.27990	0.00610	0.53
10	0.30800	0.31888	-0.01088	-0.95
11	0.32900	0.32676	0.00224	0.20
12	0.36300	0.34778	0.01522	1.33
13	0.3[illegible]500	0.35550	-0.00050	-0.04
14	0.3[illegible]00	0.33294	0.02206	1.92
15	0.36300	0.35377	0.00923	0.80
16	0.35200	0.35423	-0.00223	-0.19
17	0.32600	0.34225	-0.01625	-1.42
18	0.31200	0.31300	-0.00100	-0.09
19	0.34700	0.35228	-0.00528	-0.46
20	0.34500	0.34711	-0.00211	-0.18
21	0.37100	0.37508	-0.00408	-0.36
22	0.33700	0.34330	-0.00630	-0.55
23	0.35600	0.35533	0.00067	0.06
24	0.30000	0.29774	0.00226	0.20
25	0.31100	0.31878	-0.00778	-0.68
26	0.33800	0.33206	0.00594	0.52
27	0.34300	0.34338	-0.00038	-0.03
28	0.35100	0.34135	0.00965	0.84
29	0.34300	0.35686	-0.01386	-1.21
30	0.33800	0.34024	-0.00224	-0.20
31	0.30800	0.30589	0.00211	0.18
32	0.33500	0.32552	0.00948	0.83
33	0.33300	0.32528	0.00772	0.67
34	0.32200	0.32596	-0.00396	-0.35
35	0.33000	0.32081	0.00919	0.80
36	0.31200	0.29935	0.01265	1.10
37	0.31900	0.31676	0.00224	0.20
38	0.31100	0.31750	-0.00650	-0.57
39	0.31300	0.31209	0.00091	0.08
40	0.31400	0.31348	0.00052	0.05
41	0.33800	0.33633	0.00167	0.15
42	0.31600	0.31454	0.00146	0.13
43	0.33400	0.32746	0.00654	0.57
44	0.34500	0.34835	-0.00335	-0.29
45	0.31100	0.31098	0.00002	0.00
46	0.31700	0.32118	-0.00418	-0.36
47	0.29400	0.30238	-0.00838	-0.73
48	0.30200	0.30232	-0.00032	-0.03
49	0.30400	0.31769	-0.01369	-1.19
50	0.30500	0.31656	-0.01156	-1.01
51	0.31600	0.31096	0.00504	0.44
52	0.33200	0.33962	-0.00762	-0.67
53	0.35800	0.35778	0.00022	0.02
54	0.36200	0.35783	0.00417	0.36
55	0.34700	0.33390	0.01310	1.14
56	0.33600	0.33982	-0.00382	-0.33
57	0.31100	0.30436	0.00664	0.58
58	0.30900	0.32795	-0.01895	-1.65
59	0.35900	0.35792	0.00108	0.09
60	0.31300	0.32269	-0.00969	-0.85

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

CQO (b-3)

61	0.29800	0.31589	-0.01789	-1.56
62	0.31800	0.32385	-0.00585	-0.51
63	0.36400	0.34695	0.01705	1.49
64	0.36600	0.36291	0.00309	0.27
65	0.34600	0.34751	-0.00151	-0.13
66	0.35500	0.34964	0.00536	0.47
67	0.34200	0.35414	-0.01214	-1.06
68	0.33600	0.33988	-0.00388	-0.34
69	0.34200	0.34089	0.00111	0.10
70	0.34500	0.34275	0.00225	0.20
71	0.34100	0.33605	0.00495	0.43
72	0.34100	0.33385	0.00715	0.62
73	0.34400	0.32235	0.02165	1.89
74	0.30600	0.31101	-0.00501	-0.44
75	0.30300	0.31944	-0.01644	-1.43
76	0.31200	0.31708	-0.00508	-0.44
77	0.30900	0.31043	-0.00143	-0.13
78	0.32400	0.33613	-0.01213	-1.06
79	0.33300	0.32352	0.00948	0.83
80	0.33800	0.34028	-0.00228	-0.20
81	0.34500	0.35312	-0.00812	-0.71
82	0.36300	0.33986	0.02314	2.02
83	0.28700	0.29514	-0.00814	-0.71
84	0.29200	0.29260	-0.00060	-0.05
85	0.30500	0.31776	-0.01276	-1.11
86	0.29300	0.29188	0.00112	0.10
87	0.29000	0.29648	-0.00648	-0.57
88	0.28100	0.26906	0.01194	1.04
89	0.29600	0.28161	0.01439	1.26
90	0.32400	0.31596	0.00804	0.70
91	0.27200	0.26828	0.00372	0.32
92	0.28100	0.26972	0.01128	0.98
93	0.32400	0.33665	-0.01265	-1.10
94	0.32300	0.31714	0.00586	0.51
95	0.27500	0.28649	-0.01149	-1.00
96	0.30800	0.31251	-0.00451	-0.39
97	0.33300	0.33598	-0.00298	-0.26
98	0.30000	0.29839	0.00161	0.14
99	0.30500	0.30577	-0.00077	-0.07
100	0.29200	0.30005	-0.00805	-0.70
101	0.30500	0.30806	-0.00306	-0.27
102	0.33300	0.33438	-0.00138	-0.12
103	0.36100	0.33681	0.02419	2.11
104	0.36500	0.34834	0.01666	1.45
105	0.28000	0.27093	0.00907	0.79
106	0.36200	0.36100	0.00100	0.09
107	0.38300	0.36037	0.02263	1.97
108	0.34000	0.33926	0.00074	0.06
109	0.33300	0.33904	-0.00604	-0.53
110	0.33900	0.33258	0.00642	0.56
111	0.32600	0.32665	-0.00065	-0.06
112	0.36400	0.34782	0.01618	1.41
113	0.35700	0.36460	-0.00760	-0.66
114	0.35300	0.35670	-0.00370	-0.32
115	0.34900	0.35558	-0.00658	-0.57
116	0.36500	0.36481	0.00019	0.02
117	0.35500	0.35647	-0.00147	-0.13
118	0.36100	0.35078	0.01022	0.89
119	0.32100	0.31161	0.00939	0.82

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

CQO (b-3)

120	0.31600	0.32973	-0.01373	-1.20
121	0.32600	0.31774	0.00826	0.72
122	0.32000	0.32102	-0.00102	-0.09
123	0.31500	0.31639	-0.00139	-0.12
124	0.31500	0.32760	-0.01260	-1.10
125	0.32200	0.31158	0.01042	0.91
126	0.30500	0.29969	0.00531	0.46
127	0.35200	0.34749	0.00451	0.39
128	0.32000	0.32866	-0.00866	-0.76
129	0.31400	0.33331	-0.01931	-1.68
130	0.33000	0.35204	-0.02204	-1.92
131	0.35800	0.34352	0.01448	1.26
132	0.34500	0.36413	-0.01913	-1.67
133	0.34500	0.35477	-0.00977	-0.85
134	0.38700	0.39372	-0.00672	-0.59
135	0.40700	0.39513	0.01187	1.04
136	0.35600	0.34636	0.00964	0.84
137	0.38700	0.38455	0.00245	0.21

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

θ_0 (b-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	8.00000	7.75274	0.24726	1.11
2	8.00000	8.10163	-0.10163	-0.46
3	8.00000	7.96243	0.03757	0.17
4	8.00000	7.96742	0.03258	0.15
5	8.00000	8.37167	-0.37167	-1.68
6	8.00000	8.29805	-0.29805	-1.34
7	8.00000	8.27929	-0.27929	-1.26
8	9.00000	9.00797	-0.00797	-0.04
9	10.00000	9.87432	0.12568	0.57
10	10.00000	9.86452	0.13548	0.61
11	10.00000	9.71098	0.28902	1.30
12	10.00000	10.40316	-0.40316	-1.82
13	10.00000	10.16142	-0.16142	-0.73
14	10.00000	10.68073	-0.68073	-3.07
15	10.00000	9.89512	0.10488	0.47
16	10.00000	9.97623	0.02377	0.11
17	10.00000	10.16698	-0.16698	-0.75
18	10.00000	9.73782	0.26218	1.18
19	10.00000	10.22827	-0.22827	-1.03
20	10.00000	9.81512	0.18488	0.83
21	10.00000	10.01509	-0.01509	-0.07
22	10.00000	10.04051	-0.04051	-0.18
23	10.00000	10.04572	-0.04572	-0.21
24	10.00000	9.98936	0.01064	0.05
25	10.00000	9.83298	0.16702	0.75
26	10.00000	10.04396	-0.04396	-0.20
27	10.00000	10.02264	-0.02264	-0.10
28	10.00000	10.01695	-0.01695	-0.08
29	10.00000	9.77779	0.22221	1.00
30	10.00000	10.01020	-0.01020	-0.05
31	10.00000	10.00366	-0.00366	-0.02
32	10.00000	9.94085	0.05915	0.27
33	10.00000	9.98972	0.01028	0.05
34	10.00000	9.84968	0.15032	0.68
35	10.00000	9.94548	0.05452	0.25
36	10.00000	9.97337	0.02663	0.12
37	10.00000	9.92069	0.07931	0.36
38	10.00000	9.93253	0.06747	0.30
39	10.00000	10.04892	-0.04892	-0.22
40	10.00000	10.05856	-0.05856	-0.26
41	10.00000	9.96381	0.03619	0.16
42	10.00000	10.12806	-0.12806	-0.58
43	10.00000	9.92775	0.07225	0.33
44	10.00000	9.84065	0.15935	0.72
45	10.00000	9.84344	0.15656	0.71
46	10.00000	10.21899	-0.21899	-0.99
47	10.00000	10.10993	-0.10993	-0.50
48	10.00000	10.08380	-0.08380	-0.38
49	10.00000	10.06093	-0.06093	-0.27
50	10.00000	10.01333	-0.01333	-0.06
51	10.00000	10.02670	-0.02670	-0.12
52	10.00000	9.92622	0.07378	0.33
53	10.00000	10.14078	-0.14078	-0.63
54	10.00000	10.14653	-0.14653	-0.66
55	10.00000	9.79366	0.20634	0.93
56	10.00000	10.24957	-0.24957	-1.13
57	10.00000	10.04351	-0.04351	-0.20
58	10.00000	9.82844	0.17156	0.77
59	10.00000	10.26637	-0.26637	-1.20

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

θ_o (b-3)

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
61	10.00000	10.11929	-0.11929	-0.54
62	10.00000	10.05538	-0.05538	-0.25
63	10.00000	9.95855	0.04145	0.19
64	10.00000	10.10555	-0.10555	-0.48
65	10.00000	9.97516	0.02484	0.11
66	10.00000	9.80172	0.19828	0.89
67	10.00000	9.97687	0.02313	0.10
68	10.00000	10.17526	-0.17526	-0.79
69	10.00000	10.12525	-0.12525	-0.56
70	10.00000	10.11213	-0.11213	-0.51
71	10.00000	9.99460	0.00540	0.02
72	10.00000	9.62659	0.37341	1.68
73	10.00000	10.13735	-0.13735	-0.62
74	10.00000	9.83716	0.16284	0.73
75	10.00000	10.12557	-0.12557	-0.57
76	10.00000	9.91243	0.08757	0.39
77	10.00000	9.99276	0.00724	0.03
78	10.00000	10.02782	-0.02782	-0.13
79	10.00000	10.05255	-0.05255	-0.24
80	10.00000	10.02922	-0.02922	-0.13
81	10.00000	9.87691	0.12309	0.55
82	10.00000	9.79566	0.20434	0.92
83	10.00000	10.00459	-0.00459	-0.02
84	10.00000	9.93978	0.06022	0.27
85	10.00000	9.88603	0.11397	0.51
86	10.00000	9.51921	0.48079	2.17
87	10.00000	9.44777	0.55223	2.49
88	10.00000	9.98051	0.01949	0.09
89	10.00000	10.09620	-0.09620	-0.43
90	10.00000	10.06965	-0.06965	-0.31
91	10.00000	9.99425	0.00575	0.03
92	10.00000	10.10358	-0.10358	-0.47
93	10.00000	10.31936	-0.31936	-1.44
94	10.00000	10.19921	-0.19921	-0.90
95	10.00000	10.23671	-0.23671	-1.07
96	10.00000	10.06049	-0.06049	-0.27
97	10.00000	9.81218	0.18782	0.85
98	10.00000	10.11744	-0.11744	-0.53
99	10.00000	10.02835	-0.02835	-0.13
100	10.00000	10.00340	-0.00340	-0.02
101	10.00000	9.80272	0.19728	0.89
102	10.00000	9.91410	0.08590	0.39
103	10.00000	10.04084	-0.04084	-0.18
104	10.00000	10.27189	-0.27189	-1.23
105	10.00000	9.95506	0.04494	0.20
106	10.00000	9.67018	0.32982	1.49
107	10.00000	10.09102	-0.09102	-0.41
108	10.00000	9.91323	0.08677	0.39
109	10.00000	9.95288	0.04712	0.21
110	10.00000	10.13861	-0.13861	-0.62
111	10.00000	10.08201	-0.08201	-0.37
112	10.00000	10.56748	-0.56748	-2.56
113	10.00000	10.13129	-0.13129	-0.59
114	10.00000	9.89422	0.10578	0.48
115	10.00000	9.99184	0.00816	0.04
116	10.00000	10.07166	-0.07166	-0.32
117	10.00000	9.66289	0.33711	1.52
118	10.00000	10.30851	-0.30851	-1.39
119	10.00000	9.85916	0.14084	0.63

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

θ_0 (b-3)

120	10.00000	10.01282	-0.01282	-0.06
121	10.00000	9.99296	0.00704	0.03
122	10.00000	10.09649	-0.09649	-0.44
123	10.00000	10.05784	-0.05784	-0.26
124	10.00000	10.09326	-0.09326	-0.42
125	10.00000	9.94816	0.05184	0.23
126	10.00000	9.99090	0.00910	0.04
127	11.00000	10.85165	0.14835	0.67
128	12.00000	11.89037	0.10963	0.49
129	12.00000	11.89862	0.10138	0.46
130	12.00000	11.53140	0.46860	2.11
131	12.00000	12.12982	-0.12982	-0.59
132	12.00000	11.66978	0.33022	1.49
133	12.00000	11.64703	0.35297	1.59
134	12.00000	11.93476	0.06524	0.29
135	12.00000	12.16862	-0.16862	-0.76
136	12.00000	11.85161	0.14839	0.67
137	12.00000	11.82597	0.17403	0.78

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLV (c-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	374.00000	373.20825	0.79175	0.02
2	193.00000	209.97093	-16.97093	-0.51
3	296.00000	293.49731	2.50269	0.08
4	349.00000	394.91992	-45.91992	-1.39
5	385.00000	402.01807	-17.01807	-0.51
6	295.00000	314.32251	-19.32251	-0.58
7	279.00000	316.18262	-37.18262	-1.12
8	286.00000	282.72925	3.27075	0.10
9	219.00000	230.60443	-11.60443	-0.35
10	270.00000	278.36377	-8.36377	-0.25
11	334.00000	298.96631	35.03369	1.06
12	373.00000	339.68140	33.31860	1.01
13	372.00000	376.41992	-4.41992	-0.13
14	229.00000	257.06934	-28.06934	-0.85
15	379.00000	402.36475	-23.36475	-0.71
16	351.00000	380.23242	-29.23242	-0.88
17	378.00000	415.18604	-37.18604	-1.12
18	294.00000	310.83228	-16.83228	-0.51
19	403.00000	352.94897	50.05103	1.51
20	320.00000	368.08105	-48.08105	-1.45
21	378.00000	385.47559	-7.47559	-0.23
22	297.00000	339.96484	-42.96484	-1.30
23	391.00000	353.93335	37.06665	1.12
24	228.00000	242.64342	-14.64342	-0.44
25	280.00000	282.83472	-2.83472	-0.09
26	330.00000	297.72974	32.27026	0.97
27	344.00000	324.42603	19.57397	0.59
28	389.00000	356.66357	32.33643	0.98
29	338.00000	342.68311	-4.68311	-0.14
30	317.00000	350.46631	-33.46631	-1.01
31	271.00000	261.53247	9.46753	0.29
32	328.00000	306.39819	21.60181	0.65
33	368.00000	325.83813	42.16187	1.27
34	345.00000	293.55664	51.44336	1.55
35	363.00000	302.23071	60.76929	1.83
36	342.00000	278.95654	63.04346	1.90
37	288.00000	300.29053	-12.29053	-0.37
38	296.00000	312.73535	-16.73535	-0.51
39	318.00000	307.37378	10.62622	0.32
40	302.00000	316.43848	-14.43848	-0.44
41	364.00000	348.23218	15.76782	0.48
42	359.00000	355.10693	3.89307	0.12
43	441.00000	420.78247	20.21753	0.61
44	518.00000	485.09717	32.90283	0.99
45	339.00000	336.43872	2.56128	0.08
46	362.00000	368.49170	-6.49170	-0.20
47	236.00000	247.58673	-11.58673	-0.35
48	243.00000	250.28914	-7.28914	-0.22
49	256.00000	278.81152	-22.81152	-0.69
50	260.00000	277.10962	-17.10962	-0.52
51	324.00000	297.11890	26.88110	0.81
52	336.00000	326.38574	9.61426	0.29
53	413.00000	408.32983	4.67017	0.14
54	428.00000	425.31763	2.68237	0.08
55	361.00000	377.36743	-16.36743	-0.49
56	322.00000	322.89282	-0.89282	-0.03
57	373.00000	363.69165	9.30835	0.28
58	348.00000	368.12378	-20.12378	-0.61
59	430.00000	403.12891	[illegible]	[illegible]

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLV (c-3)

60	340.00000	321.55664	18.44336	0.56
61	259.00000	272.11108	-13.11108	-0.40
62	342.00000	320.21118	21.78882	0.66
63	401.00000	372.57959	28.42041	0.86
64	335.00000	313.75659	21.24341	0.64
65	332.00000	303.72290	28.27710	0.85
66	342.00000	333.66113	8.33887	0.25
67	308.00000	319.78809	-11.78809	-0.36
68	300.00000	341.06372	-41.06372	-1.24
69	284.00000	296.51685	-12.51685	-0.38
70	305.00000	299.53027	5.46973	0.17
71	361.00000	337.50903	23.49097	0.71
72	315.00000	347.46167	-32.46167	-0.98
73	310.00000	255.99069	54.00931	1.63
74	142.00000	205.84515	-63.84515	-1.93
75	206.00000	251.89529	-45.89529	-1.39
76	330.00000	317.08740	12.91260	0.39
77	228.00000	234.11185	-6.11185	-0.18
78	299.00000	306.87280	-7.87280	-0.24
79	328.00000	350.76147	-22.76147	-0.69
80	269.00000	296.01025	-27.01025	-0.82
81	263.00000	302.52344	-39.52344	-1.19
82	321.00000	288.46606	32.53394	0.98
83	215.00000	263.56323	-48.56323	-1.47
84	211.00000	238.96399	-27.96399	-0.84
85	250.00000	290.99731	-40.99731	-1.24
86	257.00000	286.87622	-29.87622	-0.90
87	239.00000	216.99167	22.00833	0.66
88	257.00000	240.85722	16.14278	0.49
89	302.00000	294.64648	7.35352	0.22
90	282.00000	290.27222	-8.27222	-0.25
91	251.00000	256.88232	-5.88232	-0.18
92	248.00000	235.21219	12.78781	0.39
93	340.00000	304.58057	35.41943	1.07
94	321.00000	311.56299	9.43701	0.28
95	257.00000	223.77100	33.22900	1.00
96	302.00000	304.43066	-2.43066	-0.07
97	335.00000	354.65112	-19.65112	-0.59
98	300.00000	324.95996	-24.95996	-0.75
99	338.00000	288.92432	49.07568	1.48
100	431.00000	427.12402	3.87598	0.12
101	279.00000	275.13452	3.86548	0.12
102	323.00000	318.21802	4.78198	0.14
103	433.00000	404.74585	28.25415	0.85
104	445.00000	378.21924	66.78076	2.02
105	207.00000	202.63199	4.36801	0.13
106	404.00000	384.01270	19.98730	0.60
107	360.00000	355.34766	4.65234	0.14
108	464.00000	454.12305	9.87695	0.30
109	484.00000	415.34985	68.65015	2.07
110	429.00000	441.94067	-12.94067	-0.39
111	476.00000	454.51221	21.48779	0.65
112	360.00000	322.33228	37.66772	1.14
113	373.00000	362.35791	10.64209	0.32
114	310.00000	319.86743	-9.86743	-0.30
115	306.00000	310.58789	-4.58789	-0.14
116	301.00000	318.97729	-17.97729	-0.54
117	290.00000	311.15283	-21.15283	-0.64
118	342.00000	316.94360	25.05640	0.76
119	304.00000	314.76172	-10.76172	-0.32

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLV (c-3)

120	358.00000	420.04590	-62.04590	-1.87
121	309.00000	314.08936	-5.08936	-0.15
122	290.00000	313.79199	-23.79199	-0.72
123	308.00000	310.79712	-2.79712	-0.08
124	328.00000	320.66066	7.31934	0.22
125	284.00000	312.94263	-28.94263	-0.87
126	234.00000	266.76221	-32.76221	-0.99
127	465.00000	457.75171	7.24829	0.22
128	286.00000	278.09644	7.90356	0.24
129	379.00000	420.67017	-41.67017	-1.26
130	210.00000	231.07452	-21.07452	-0.64
131	243.00000	237.25919	5.74081	0.17
132	368.00000	365.67310	2.32690	0.07
133	317.00000	335.38086	-18.38086	-0.56
134	335.00000	375.19336	-40.19336	-1.21
135	355.00000	310.66187	44.33813	1.34
136	438.00000	393.54004	44.45996	1.34
137	314.00000	316.50220	-2.50220	-0.08
138	518.00000	507.44385	10.55615	0.32
139	264.00000	287.08179	-23.08179	-0.70
140	245.00000	242.82098	2.17902	0.07
141	309.00000	363.37891	-54.37891	-1.64
142	198.00000	216.70404	-18.70404	-0.56
143	176.00000	211.14020	-35.14020	-1.06
144	287.00000	244.12369	42.87631	1.29
145	386.00000	392.41235	-6.41235	-0.19
146	321.00000	248.61432	72.38568	2.19
147	329.00000	323.75635	5.24365	0.16
148	382.00000	384.36597	-2.36597	-0.07
149	269.00000	250.84586	18.15414	0.55
150	344.00000	357.66675	-13.66675	-0.41
151	506.00000	424.73975	81.26025	2.45
152	278.00000	326.07349	-48.07349	-1.45
153	360.00000	384.58716	-24.58716	-0.74
154	281.00000	287.50195	-6.50195	-0.20
155	302.00000	323.18042	-21.18042	-0.64
156	318.00000	296.85059	21.14941	0.64
157	264.00000	262.76074	1.23926	0.04
158	365.00000	374.73828	-9.73828	-0.29
159	305.00000	310.00903	-5.00903	-0.15
160	275.00000	298.61011	-23.61011	-0.71
161	338.00000	299.67554	38.32446	1.16
162	421.00000	407.89917	13.10083	0.40
163	319.00000	327.08887	-8.08887	-0.24
164	289.00000	293.54590	-4.54590	-0.14
165	220.00000	272.13257	-52.13257	-1.57
166	371.00000	333.21826	37.78174	1.14
167	442.00000	444.12671	-2.12671	-0.06
168	407.00000	397.33496	9.66504	0.29
169	354.00000	328.42456	25.57544	0.77
170	373.00000	416.02148	-43.02148	-1.30
171	291.00000	341.63940	-50.63940	-1.53
172	326.00000	360.46021	-34.46021	-1.04
173	158.00000	178.81540	-20.81540	-0.63
174	252.00000	242.62141	9.37859	0.28
175	314.00000	285.66919	28.33081	0.86
176	447.00000	388.49219	58.50781	1.77
177	362.00000	341.34155	20.65845	0.62
178	361.00000	356.11230	4.88770	0.15
179	366.00000	403.97852	-37.97852	-1.15
180	307.00000	338.41724	-31.41724	-0.95
181	258.00000	245.30234	12.69766	0.38

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLV (c-3)

182	307.00000	297.38623	9.61377	0.29
183	349.00000	372.06543	-23.06543	-0.70
184	404.00000	389.11182	14.88818	0.45
185	309.00000	343.34106	-34.34106	-1.04
186	362.00000	342.19507	19.80493	0.60
187	419.00000	450.06836	-31.06836	-0.94
188	397.00000	413.03687	-16.03687	-0.48
189	212.00000	260.96851	-48.96851	-1.48
190	256.00000	284.48950	-28.48950	-0.86
191	291.00000	291.24961	-0.24961	-0.01
192	232.00000	247.89034	-15.89034	-0.48
193	206.00000	178.64119	27.35881	0.83
194	338.00000	304.09570	33.90430	1.02
195	288.00000	276.52637	11.47363	0.35
196	437.00000	421.45874	15.54126	0.47
197	292.00000	301.13721	-9.13721	-0.28
198	344.00000	336.94971	7.05029	0.21
199	348.00000	384.37305	-36.37305	-1.10
200	353.00000	250.85001	102.14999	3.08
201	279.00000	258.38354	20.61646	0.62
202	297.00000	307.75708	-10.75708	-0.32
203	275.00000	263.97095	11.02905	0.33

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

BMF (c-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	3592.00000	3364.53662	227.46338	0.58
2	2890.00000	2902.27539	-12.27539	-0.03
3	3678.00000	3482.54834	195.45166	0.50
4	3639.00000	4343.61719	-704.61719	-1.81
5	4154.00000	4413.91406	-259.91406	-0.67
6	2907.00000	3038.84204	-131.84204	-0.34
7	3752.00000	4587.75781	-835.75781	-2.14
8	3045.00000	3559.74463	-514.74463	-1.32
9	3217.00000	3221.21045	-4.21045	-0.01
10	4180.00000	4027.94800	152.05200	0.39
11	4180.00000	3821.81934	358.18066	0.92
12	4572.00000	4160.51953	411.48047	1.05
13	4455.00000	4258.25781	196.74219	0.50
14	3601.00000	3920.63599	-319.63599	-0.82
15	3903.00000	3988.35889	-85.35889	-0.22
16	3804.00000	3876.52734	-72.52734	-0.19
17	3809.00000	4420.41016	-611.41016	-1.57
18	3602.00000	3617.37354	-15.37354	-0.04
19	4160.00000	4032.79126	127.20874	0.33
20	4052.00000	4250.89844	-198.89844	-0.51
21	4696.00000	4388.09766	307.90234	0.79
22	3823.00000	4053.85718	-230.85718	-0.59
23	4393.00000	3992.57080	400.42920	1.03
24	3229.00000	3361.79517	-132.79517	-0.34
25	4165.00000	4050.03320	114.96680	0.29
26	4683.00000	4137.86328	545.13672	1.40
27	4212.00000	4276.58594	-64.58594	-0.17
28	4790.00000	4370.92969	419.07031	1.07
29	3939.00000	4006.06128	-67.06128	-0.17
30	3612.00000	4203.94141	-591.94141	-1.52
31	3681.00000	3542.91016	138.08984	0.35
32	3979.00000	3801.83691	177.16309	0.45
33	4081.00000	3769.25098	311.74902	0.80
34	3776.00000	3826.42432	-50.42432	-0.13
35	4947.00000	4252.88672	694.11328	1.78
36	4047.00000	3724.96240	322.03760	0.82
37	3882.00000	4099.71484	-217.71484	-0.56
38	4224.00000	4107.75781	116.24219	0.30
39	4261.00000	3963.93115	297.06885	0.76
40	4148.00000	4233.07813	-85.07813	-0.22
41	5133.00000	5045.30859	87.69141	0.22
42	3762.00000	3972.18188	-210.18188	-0.54
43	4451.00000	4345.10156	105.89844	0.27
44	5098.00000	4928.70313	169.29688	0.43
45	3738.00000	3845.03174	-107.03174	-0.27
46	3874.00000	4165.78906	-291.78906	-0.75
47	3556.00000	3561.04712	-5.04712	-0.01
48	3693.00000	3582.14669	110.85331	0.28
49	4118.00000	3968.20874	149.79126	0.38
50	4037.00000	3961.97729	75.02271	0.19
51	3674.00000	3662.42456	11.57544	0.03
52	4182.00000	4173.61328	8.38672	0.02
53	4400.00000	4415.51953	-15.51953	-0.04
54	4323.00000	4470.19531	-147.19531	-0.38
55	3600.00000	3583.62500	16.37500	0.04
56	2912.00000	3043.81689	-131.81689	-0.34
57	4103.00000	3575.42920	527.57080	1.35
58	3387.00000	3770.05347	-383.05347	-0.98
59	4465.00000	4366.56250	98.43750	0.25

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

BMF (c-3)

60	3771.00000	3931.61572	-160.61572	-0.41
61	3745.00000	3819.15869	-74.15869	-0.19
62	3830.00000	3972.13965	-142.13965	-0.36
63	4875.00000	4558.66406	316.33594	0.81
64	4898.00000	4546.80469	351.19531	0.90
65	4699.00000	4512.23047	186.76953	0.48
66	4705.00000	4588.34375	116.65625	0.30
67	5221.00000	4272.44141	948.55859	2.43
68	4275.00000	4504.98438	-229.98438	-0.59
69	4334.00000	4386.60547	-52.60547	-0.13
70	4610.00000	4300.67188	309.32813	0.79
71	4351.00000	4165.54688	165.45313	0.42
72	4433.00000	4369.93359	43.06641	0.11
73	4359.00000	4278.49609	80.50391	0.21
74	3254.00000	3521.27075	-267.27075	-0.68
75	3258.00000	3627.65454	-369.65454	-0.95
76	3229.00000	3732.47485	-503.47485	-1.29
77	3412.00000	3409.25952	2.74048	0.01
78	4223.00000	4457.21484	-234.21484	-0.60
79	4837.00000	4851.09766	-14.09766	-0.04
80	3815.00000	4227.41797	-412.41797	-1.06
81	4455.00000	4580.26563	-125.26563	-0.32
82	4879.00000	4409.11328	469.88672	1.20
83	3415.00000	3713.67041	-298.67041	-0.77
84	3078.00000	3334.26270	-236.26270	-0.61
85	4018.00000	4092.23657	-74.23657	-0.19
86	3147.00000	3407.59619	-260.59619	-0.67
87	3392.00000	3275.58350	116.41650	0.30
88	3207.00000	3699.37964	-492.37964	-1.26
89	2818.00000	3381.06934	-563.06934	-1.44
90	2909.00000	3452.15332	-543.15332	-1.39
91	3706.00000	3933.12915	-227.12915	-0.58
92	2702.00000	2759.27197	-57.27197	-0.15
93	3836.00000	3438.91553	397.08447	1.02
94	4510.00000	4189.50000	320.50000	0.82
95	3054.00000	3113.69019	-59.69019	-0.15
96	4815.00000	4473.46484	341.53516	0.87
97	5895.00000	6136.30469	-241.30469	-0.62
98	5251.00000	5516.78906	-265.78906	-0.68
99	3863.00000	4070.96387	-207.96387	-0.53
100	4789.00000	4540.82422	248.17578	0.64
101	3813.00000	4268.95313	-455.95313	-1.17
102	3131.00000	3141.00952	-10.00952	-0.03
103	4528.00000	4656.17578	-128.17578	-0.33
104	5394.00000	4650.86328	743.13672	1.90
105	3000.00000	2535.62134	464.37866	1.19
106	3620.00000	3589.86865	30.13135	0.08
107	4999.00000	4768.68750	230.31250	0.59
108	5574.00000	5088.55859	485.44141	1.24
109	5756.00000	5203.37109	552.62891	1.42
110	5807.00000	5882.23047	-75.23047	-0.19
111	6209.00000	5976.91016	232.08984	0.59
112	4636.00000	4348.04688	287.95313	0.74
113	4969.00000	5001.70703	-32.70703	-0.08
114	4037.00000	4221.69531	-184.69531	-0.47
115	4049.00000	4164.08594	-115.08594	-0.29
116	3808.00000	4051.59424	-243.59424	-0.62
117	3803.00000	4041.96338	-238.96338	-0.61
118	4613.00000	4244.10156	368.89844	0.95
119	3922.00000	4093.89453	-171.89453	-0.44

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

BMF (c-3)

120	3978.00000	4891.03906	-913.03906	-2.34
121	3910.00000	3821.53638	88.46362	0.23
122	3671.00000	3720.33545	-49.33545	-0.13
123	3700.00000	3685.41943	14.58057	0.04
124	3778.00000	3890.03906	-112.03906	-0.29
125	3617.00000	3731.09839	-114.09839	-0.29
126	3317.00000	3732.60278	-415.60278	-1.06
127	6362.00000	6091.14453	270.85547	0.69
128	4443.00000	4044.60059	398.39941	1.02
129	4463.00000	4898.32422	-435.32422	-1.12
130	4024.00000	4168.28906	-144.28906	-0.37
131	4229.00000	4213.69922	15.30078	0.04
132	4087.00000	4620.22656	-533.22656	-1.37
133	4323.00000	4536.80859	-213.80859	-0.55
134	3936.00000	4512.23828	-576.23828	-1.48
135	4749.00000	4057.00659	691.99341	1.77
136	5461.00000	4840.91016	620.08984	1.59
137	2962.00000	3531.09521	-569.09521	-1.46
138	4077.00000	3883.20313	193.79688	0.50
139	3982.00000	4467.06250	-485.06250	-1.24
140	3154.00000	2895.76099	258.23901	0.66
141	2852.00000	3842.75415	-990.75415	-2.54
142	2276.00000	2953.49219	-677.49219	-1.74
143	2665.00000	3044.54175	-379.54175	-0.97
144	2649.00000	1982.94434	666.05566	1.71
145	4635.00000	4534.81641	100.18359	0.26
146	5352.00000	4340.27734	1011.72266	2.59
147	4983.00000	4442.01563	540.98438	1.39
148	5640.00000	5053.52734	586.47266	1.50
149	2500.00000	2721.87720	-221.87720	-0.57
150	3420.00000	3378.42896	41.57104	0.11
151	4732.00000	4323.17188	408.82813	1.05
152	4277.00000	4364.07422	-87.07422	-0.22
153	4370.00000	5096.12500	-726.12500	-1.86
154	4176.00000	4556.97656	-380.97656	-0.98
155	3748.00000	4074.92896	-326.92896	-0.84
156	4979.00000	4958.60547	20.39453	0.05
157	3600.00000	3015.70703	584.29297	1.50
158	3716.00000	3834.60693	-118.60693	-0.30
159	5129.00000	4652.78516	476.21484	1.22
160	4034.00000	4031.27832	2.72168	0.01
161	4871.00000	4301.67969	569.32031	1.46
162	3205.00000	3498.07300	-293.07300	-0.75
163	4522.00000	4298.48828	223.51172	0.57
164	2805.00000	2852.94824	-47.94824	-0.12
165	2792.00000	2949.18384	-157.18384	-0.40
166	4025.00000	4058.85229	-33.85229	-0.09
167	5236.00000	5926.37500	-690.37500	-1.77
168	4371.00000	4172.93750	198.06250	0.51
169	3979.00000	3730.84204	248.15796	0.64
170	3263.00000	4070.26196	-807.26196	-2.07
171	3144.00000	3788.73901	-644.73901	-1.65
172	4724.00000	4753.13672	-29.13672	-0.07
173	2342.00000	2599.59570	-257.59570	-0.66
174	3758.00000	3704.92407	53.07593	0.14
175	4330.00000	4291.48828	38.51172	0.10
176	4111.00000	3994.52344	116.47656	0.30
177	4829.00000	4530.23438	298.76563	0.77
178	3429.00000	3365.42334	63.57666	0.16
179	4457.00000	4400.86328	56.13672	0.14
180	4934.00000	4142.40234	791.59766	2.03

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

BMF (c-3)

181	3432.00000	3280.14800	151.85200	0.39
182	3619.00000	3442.45679	176.54321	0.45
183	4182.00000	4043.53076	138.46924	0.35
184	4420.00000	4263.06641	156.93359	0.40
185	3326.00000	3024.69702	301.30298	0.77
186	4219.00000	4262.81250	-43.81250	-0.11
187	5246.00000	5290.06250	-44.06250	-0.11
188	4477.00000	4416.85938	60.14063	0.15
189	3882.00000	4017.23975	-135.23975	-0.35
190	3636.00000	3797.80518	-161.80518	-0.41
191	3558.00000	3598.66479	-40.66479	-0.10
192	2632.00000	3058.72877	-426.72877	-1.09
193	1983.00000	2044.10205	-61.10205	-0.16
194	3804.00000	3665.96167	138.03833	0.35
195	3450.00000	2784.07617	665.92383	1.71
196	3955.00000	3762.77832	192.22168	0.49
197	4580.00000	4709.89844	-129.89844	-0.33
198	4057.00000	4155.79688	-98.79688	-0.25
199	4267.00000	4613.10156	-346.10156	-0.89
200	4216.00000	3978.97729	237.02271	0.61
201	3982.00000	3634.91333	347.08667	0.89
202	3416.00000	3135.22949	280.77051	0.72
203	3097.00000	3087.29541	9.70459	0.02

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLL (c-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	106.00000	94.91316	11.08684	0.51
2	176.00000	179.00404	-3.00404	-0.14
3	213.00000	205.88792	7.11208	0.33
4	215.00000	212.32857	2.67143	0.12
5	227.00000	212.21870	14.78130	0.68
6	130.00000	131.62578	-1.62578	-0.07
7	127.00000	93.13785	33.86215	1.56
8	154.00000	179.35794	-25.35794	-1.17
9	94.00000	107.63609	-13.63609	-0.63
10	136.00000	137.64413	-1.64413	-0.08
11	137.00000	158.55017	-21.55017	-0.99
12	179.00000	151.89409	27.10591	1.25
13	147.00000	135.51662	11.48338	0.53
14	117.00000	110.43359	6.56641	0.30
15	144.00000	143.65439	0.34561	0.02
16	149.00000	152.83028	-3.83028	-0.18
17	142.00000	137.82076	4.17924	0.19
18	138.00000	154.85017	-16.85017	-0.77
19	170.00000	176.54861	-6.54861	-0.30
20	179.00000	185.17184	-6.17184	-0.28
21	199.00000	198.07309	0.92691	0.04
22	178.00000	179.49974	-1.49974	-0.07
23	181.00000	199.81259	-18.81259	-0.86
24	110.00000	124.63594	-14.63594	-0.67
25	146.00000	142.21149	3.78851	0.17
26	158.00000	151.41858	6.58142	0.30
27	171.00000	157.03218	13.96782	0.64
28	169.00000	156.57954	12.42046	0.57
29	175.00000	175.68596	-0.68596	-0.03
30	165.00000	163.99898	1.00102	0.05
31	160.00000	158.43840	1.56160	0.07
32	166.00000	163.89310	2.10690	0.10
33	157.00000	158.44647	-1.44647	-0.07
34	148.00000	157.07912	-9.07912	-0.42
35	145.00000	148.09792	-3.09792	-0.14
36	150.00000	132.52814	17.47186	0.80
37	156.00000	154.24568	1.75432	0.08
38	150.00000	149.46024	0.53976	0.02
39	150.00000	147.37697	2.62303	0.12
40	149.00000	147.36681	1.63319	0.08
41	156.00000	144.12532	11.87468	0.55
42	154.00000	158.60985	-4.60985	-0.21
43	159.00000	160.26247	-1.26247	-0.06
44	153.00000	150.60062	2.39938	0.11
45	160.00000	168.03346	-8.03346	-0.37
46	156.00000	162.04977	-6.04977	-0.28
47	116.00000	116.75479	-0.75479	-0.03
48	117.00000	117.79134	-0.79134	-0.04
49	142.00000	135.06520	6.99480	0.32
50	142.00000	135.71556	6.28444	0.29
51	125.00000	139.95679	-14.95679	-0.69
52	146.00000	152.52861	-6.52861	-0.30
53	144.00000	138.50903	5.49097	0.25
54	142.00000	141.74179	0.25821	0.01
55	147.00000	160.41025	-13.41025	-0.62
56	184.00000	167.14130	16.85870	0.78
57	141.00000	123.98872	17.01128	0.78
58	143.00000	141.78221	1.21779	0.06
59	142.00000	133.98106	8.01894	0.37

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLL (c-3)

60	144.00000	144.47440	-0.47440	-0.02
61	142.00000	133.94905	8.05095	0.37
62	141.00000	149.19061	-8.19061	-0.38
63	183.00000	162.62885	20.37115	0.94
64	193.00000	178.73322	14.26678	0.66
65	176.00000	162.81821	13.18179	0.61
66	182.00000	175.37456	6.62544	0.30
67	169.00000	164.17490	4.82510	0.22
68	162.00000	153.96910	8.03090	0.37
69	162.00000	156.61443	5.38557	0.25
70	170.00000	172.41154	-2.41154	-0.11
71	164.00000	158.99796	5.00204	0.23
72	159.00000	146.02847	12.97153	0.60
73	148.00000	142.38234	5.61766	0.26
74	160.00000	164.19836	-4.19836	-0.19
75	156.00000	157.14432	-1.14432	-0.05
76	152.00000	148.36185	3.63815	0.17
77	152.00000	158.68721	-6.68721	-0.31
78	155.00000	147.72333	7.27667	0.33
79	155.00000	140.96782	14.03218	0.65
80	145.00000	171.39299	-26.39299	-1.21
81	181.00000	168.37257	12.62743	0.58
82	164.00000	167.25328	-3.25328	-0.15
83	110.00000	113.08301	-3.08301	-0.14
84	97.00000	107.02528	-10.02528	-0.46
85	140.00000	139.56544	0.43456	0.02
86	96.00000	105.07352	-9.07352	-0.42
87	98.00000	114.14195	-16.14195	-0.74
88	99.00000	100.17451	-1.17451	-0.05
89	99.00000	94.25777	4.74223	0.22
90	101.00000	124.25763	-23.25763	-1.07
91	99.00000	103.30145	-4.30145	-0.20
92	100.00000	109.20795	-9.20795	-0.42
93	102.00000	96.37846	5.62154	0.26
94	100.00000	115.64427	-15.64427	-0.72
95	100.00000	93.17433	6.82567	0.31
96	103.00000	77.98421	25.01579	1.15
97	100.00000	107.79080	-7.79080	-0.36
98	98.00000	100.06897	-2.06897	-0.10
99	122.00000	135.51656	-13.51656	-0.62
100	104.00000	128.24585	-24.24585	-1.11
101	135.00000	136.76083	-1.76083	-0.08
102	168.00000	163.61443	4.38557	0.20
103	149.00000	161.55563	-12.55563	-0.58
104	162.00000	138.31821	23.68179	1.09
105	100.00000	108.80861	-8.80861	-0.40
106	165.00000	164.63681	0.36319	0.02
107	186.00000	179.84483	6.15517	0.28
108	117.00000	111.26988	5.73012	0.26
109	144.00000	144.02870	-0.02870	-0.00
110	133.00000	124.25174	8.74826	0.40
111	106.00000	123.58084	-17.58084	-0.81
112	171.00000	147.79701	23.20299	1.07
113	157.00000	165.26131	-8.26131	-0.38
114	153.00000	153.90013	-0.90013	-0.04
115	156.00000	158.41365	-2.41365	-0.11
116	163.00000	132.54649	30.45351	1.40
117	162.00000	150.63708	11.36292	0.52
118	169.00000	154.98643	14.01357	0.64
119	129.00000	132.73988	-3.73988	-0.17

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLL (c-3)

120	124.00000	140.60568	-16.60568	-0.76
121	128.00000	118.07521	9.92479	0.46
122	133.00000	134.45885	-1.45885	-0.07
123	130.00000	135.61435	-5.61435	-0.26
124	126.00000	129.48718	-3.48718	-0.16
125	133.00000	136.37035	-3.37035	-0.15
126	113.00000	126.50021	-13.50021	-0.62
127	110.00000	117.41759	-7.41759	-0.34
128	96.00000	109.01048	-13.01048	-0.60
129	63.00000	115.65489	-52.65489	-2.42
130	79.00000	132.26073	-53.26073	-2.45
131	73.00000	107.52428	-34.52428	-1.59
132	90.00000	113.32994	-23.32994	-1.07
133	100.00000	131.27347	-31.27347	-1.44
134	85.00000	144.75107	-59.75107	-2.75
135	106.00000	110.70580	-4.70580	-0.22
136	72.00000	95.25826	-23.25826	-1.07
137	127.00000	106.30954	20.69046	0.95
138	100.00000	176.82383	-76.82383	-3.53
139	126.00000	158.10449	-32.10449	-1.48
140	150.00000	175.32004	-25.32004	-1.16
141	163.00000	169.12358	-6.12358	-0.28
142	184.00000	183.02863	0.97137	0.04
143	123.00000	104.27759	18.72241	0.86
144	114.00000	89.95509	24.04491	1.11
145	164.00000	136.33966	27.66034	1.27
146	209.00000	149.97726	59.02274	2.71
147	226.00000	163.87871	62.12129	2.86
148	171.00000	144.92165	26.07835	1.20
149	221.00000	244.06502	-23.06502	-1.06
150	234.00000	201.53169	32.46831	1.49
151	241.00000	193.83269	47.16731	2.17
152	114.00000	119.44443	-5.44443	-0.25
153	120.00000	124.35251	-4.35251	-0.20
154	140.00000	177.64316	-37.64316	-1.73
155	150.00000	191.00229	-41.00229	-1.89
156	201.00000	180.45705	20.54295	0.94
157	200.00000	123.88306	76.11694	3.50
158	179.00000	152.88995	26.11005	1.20
159	106.00000	117.13283	-11.13283	-0.51
160	135.00000	132.75459	2.24541	0.10
161	131.00000	131.48514	-0.48514	-0.02
162	188.00000	177.70004	10.29996	0.47
163	87.00000	82.13905	4.86095	0.22
164	109.00000	106.71925	2.28075	0.10
165	106.00000	109.75674	-3.75674	-0.17
166	92.00000	115.73212	-23.73212	-1.09
167	101.00000	92.42741	8.57259	0.39
168	132.00000	120.91081	11.08919	0.51
169	137.00000	133.45325	3.54675	0.16
170	153.00000	140.66231	12.33769	0.57
171	133.00000	145.58827	-12.58827	-0.58
172	158.00000	167.82167	-9.82167	-0.45
173	137.00000	111.49826	25.50174	1.17
174	136.00000	117.95485	18.04515	0.83
175	175.00000	160.47636	14.52364	0.67
176	180.00000	196.86537	-16.86537	-0.78
177	205.00000	167.28140	37.71860	1.73
178	212.00000	194.21623	17.78377	0.82
179	252.00000	230.65698	21.34302	0.98
180	246.00000	221.00224	24.99776	1.15

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

PLL (c-3)

181	145.00000	150.02173	-5.02173	-0.23
182	157.00000	163.04381	-6.04381	-0.28
183	203.00000	176.07285	26.92715	1.24
184	217.00000	188.67601	28.32399	1.30
185	140.00000	178.42218	-38.42218	-1.77
186	148.00000	159.50571	-11.50571	-0.53
187	145.00000	148.43335	-3.43335	-0.16
188	231.00000	213.73126	17.26874	0.79
189	227.00000	215.25024	11.74976	0.54
190	211.00000	209.94763	1.05237	0.05
191	175.00000	174.60297	0.39703	0.02
192	164.00000	198.36871	-34.36871	-1.58
193	148.00000	145.36240	2.63760	0.12
194	125.00000	159.33466	-34.33466	-1.58
195	98.00000	91.07574	6.92426	0.32
196	92.00000	104.92523	-12.92523	-0.59
197	133.00000	141.47467	-8.47467	-0.39
198	151.00000	176.71858	-25.71858	-1.18
199	158.00000	174.46590	-16.46590	-0.76
200	173.00000	186.28401	-13.28401	-0.61
201	123.00000	115.54564	7.45436	0.34
202	135.00000	130.53777	4.46223	0.21
203	107.00000	114.15002	-7.15002	-0.33

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

HP (c-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	604.00000	553.68530	50.31470	1.52
2	661.00000	672.16992	-11.16992	-0.34
3	752.00000	737.90479	14.09521	0.42
4	776.00000	821.63110	-45.63110	-1.38
5	841.00000	873.91162	-32.91162	-0.99
6	576.00000	530.76758	45.23242	1.36
7	587.00000	695.58081	-108.58081	-3.27
8	738.00000	781.99146	-43.99146	-1.33
9	687.00000	677.20288	9.79712	0.30
10	784.00000	790.48364	-6.48364	-0.20
11	823.00000	811.39209	11.60791	0.35
12	940.00000	935.23120	4.76880	0.14
13	87[illegible].00000	873.64233	-2.64233	-0.08
14	726.00000	804.60815	-78.60815	-2.37
15	844.00000	850.89746	-6.89746	-0.21
16	871.00000	847.36597	23.63403	0.71
17	817.00000	829.56641	-12.56641	-0.38
18	777.00000	810.10034	-33.10034	-1.00
19	907.00000	896.53711	10.46289	0.32
20	900.00000	916.82104	-16.82104	-0.51
21	975.00000	962.85327	12.14673	0.37
22	905.00000	941.42676	-36.42676	-1.10
23	926.00000	905.62695	20.37305	0.61
24	746.00000	729.28247	16.71753	0.50
25	808.00000	806.41943	1.58057	0.05
26	860.00000	860.70264	-0.70264	-0.02
27	909.00000	904.43872	4.56128	0.14
28	908.00000	912.46094	-4.46094	-0.13
29	898.00000	903.61108	-5.61108	-0.17
30	847.00000	844.17114	2.82886	0.09
31	811.00000	822.53491	-11.53491	-0.35
32	851.00000	818.49170	32.50830	0.98
33	839.00000	814.86865	24.13135	0.73
34	811.00000	798.02832	12.97168	0.39
35	811.00000	805.37671	5.62329	0.17
36	802.00000	845.51392	-43.51392	-1.31
37	807.00000	804.69727	2.30273	0.07
38	804.00000	808.27881	-4.27881	-0.13
39	805.00000	796.98828	8.01172	0.24
40	808.00000	798.45264	9.54736	0.29
41	818.00000	810.62549	7.37451	0.22
42	813.00000	819.68872	-6.68872	-0.20
43	837.00000	842.20850	-5.20850	-0.16
44	849.00000	863.07227	-14.07227	-0.42
45	813.00000	821.91748	-8.91748	-0.27
46	812.00000	811.47949	0.52051	0.02
47	741.00000	734.13623	6.86377	0.21
48	738.00000	736.94702	1.05298	0.03
49	809.00000	810.35132	-1.35132	-0.04
50	800.00000	804.41675	-4.41675	-0.13
51	784.00000	764.71899	19.28101	0.58
52	829.00000	844.66089	-15.66089	-0.47
53	850.00000	847.71289	2.28711	0.07
54	858.00000	858.06421	-0.06421	-0.00
55	860.00000	835.70947	24.29053	0.73
56	897.00000	894.06299	2.93701	0.09
57	836.00000	864.24097	-28.24097	-0.85
58	823.00000	845.40625	-22.40625	-0.68
59	843.00000	840.16864	2.83136	0.09
60	814.00000	826.53369	-12.53369	-0.38

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

HP (c-3)

61	786.00000	801.53657	-15.53657	-0.47
62	815.00000	833.95264	-18.95264	-0.57
63	929.00000	960.97803	-31.97803	-0.96
64	953.00000	932.82300	20.17700	0.61
65	922.00000	902.59888	19.40112	0.58
66	928.00000	926.36646	1.63354	0.05
67	891.00000	908.12085	-17.12085	-0.52
68	863.00000	907.88501	-44.88501	-1.35
69	854.00000	866.87720	-12.87720	-0.39
70	882.00000	882.71826	-0.71826	-0.02
71	876.00000	899.35474	-23.35474	-0.70
72	849.00000	852.80957	-3.80957	-0.11
73	848.00000	801.74438	46.25562	1.39
74	823.00000	796.10791	26.89209	0.81
75	822.00000	809.36890	12.63110	0.38
76	829.00000	814.57764	14.42236	0.43
77	829.00000	806.08691	22.91309	0.69
78	835.00000	826.20752	8.79248	0.27
79	846.00000	814.44116	31.55884	0.95
80	839.00000	843.21191	-4.21191	-0.13
81	915.00000	897.41064	17.58936	0.53
82	881.00000	842.94531	38.05469	1.15
83	703.00000	729.18115	-26.18115	-0.79
84	690.00000	685.46313	4.53687	0.14
85	792.00000	809.00146	-17.00146	-0.51
86	690.00000	686.09912	3.90088	0.12
87	699.00000	671.54248	27.45752	0.83
88	681.00000	680.78809	0.21191	0.01
89	694.00000	698.04126	-4.04126	-0.12
90	724.00000	704.92798	19.07202	0.57
91	687.00000	680.14233	6.85767	0.21
92	688.00000	689.26904	-1.26904	-0.04
93	723.00000	703.80811	19.19189	0.58
94	725.00000	693.84277	31.15723	0.94
95	686.00000	716.06592	-30.06592	-0.91
96	709.00000	736.75464	-27.75464	-0.84
97	726.00000	708.04370	17.95630	0.54
98	710.00000	724.51660	-14.51660	-0.44
99	764.00000	744.16846	19.83154	0.60
100	734.00000	724.23120	9.76880	0.29
101	787.00000	790.11450	-3.11450	-0.09
102	856.00000	834.75659	21.24341	0.64
103	851.00000	799.62451	51.37549	1.55
104	902.00000	864.46851	37.53149	1.13
105	697.00000	667.44580	29.55420	0.89
106	873.00000	873.72583	-0.72583	-0.02
107	938.00000	921.16797	16.83203	0.51
108	790.00000	797.78857	-7.78857	-0.23
109	802.00000	807.55322	-5.55322	-0.17
110	757.00000	792.05664	-35.05664	-1.06
111	841.00000	788.47144	52.52856	1.58
112	940.00000	905.26196	34.73804	1.05
113	909.00000	863.42114	45.57886	1.37
114	843.00000	823.52319	19.47681	0.59
115	848.00000	843.30322	4.69678	0.14
116	882.00000	907.68628	-25.68628	-0.77
117	854.00000	876.21582	-22.21582	-0.67
118	892.00000	902.02734	-10.02734	-0.30
119	750.00000	752.21851	-2.21851	-0.07

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

HP (c-3)

120	734.00000	783.70557	-49.70557	-1.50
121	757.00000	764.21240	-7.21240	-0.22
122	716.00000	756.15186	-38.15186	-1.15
123	735.00000	757.60669	-22.60669	-0.68
124	735.00000	749.46777	-14.46777	-0.44
125	753.00000	756.23047	-3.23047	-0.10
126	727.00000	758.48608	-31.48608	-0.95
127	855.00000	836.17090	18.82910	0.57
128	915.00000	873.15601	41.84399	1.26
129	866.00000	890.62036	-24.62036	-0.74
130	877.00000	824.02710	52.97290	1.60
131	843.00000	836.71582	6.28418	0.19
132	921.00000	978.95044	-57.95044	-1.75
133	952.00000	919.31519	32.68481	0.99
134	898.00000	926.61108	-28.61108	-0.86
135	966.00000	928.90063	37.09937	1.12
136	884.00000	855.54297	28.45703	0.86
137	571.00000	726.77002	-155.77002	-4.70
138	1018.00000	902.30225	115.69775	3.49
139	588.00000	642.85254	-54.85254	-1.65
140	573.00000	581.50049	-8.50049	-0.26
141	612.00000	683.05078	-71.05078	-2.14
142	703.00000	758.90308	-55.90308	-1.69
143	521.00000	571.92993	-50.92993	-1.54
144	515.00000	541.80640	-26.80640	-0.81
145	637.00000	661.77075	-24.77075	-0.75
146	704.00000	675.47339	28.52661	0.86
147	775.00000	768.34668	6.65332	0.20
148	644.00000	621.92236	22.07764	0.67
149	775.00000	725.73560	49.26440	1.49
150	790.00000	799.55786	-9.55786	-0.29
151	852.00000	791.35425	60.64575	1.83
152	744.00000	733.44800	10.55200	0.32
153	722.00000	731.07397	-9.07397	-0.27
154	789.00000	811.02393	-22.02393	-0.66
155	831.00000	889.54834	-58.54834	-1.77
156	977.00000	958.55103	18.44897	0.56
157	960.00000	979.31787	-19.31787	-0.58
158	944.00000	964.87036	-20.87036	-0.63
159	708.00000	644.06226	63.93774	1.93
160	784.00000	793.55127	-9.55127	-0.29
161	780.00000	721.93311	58.06689	1.75
162	952.00000	967.00732	-15.00732	-0.45
163	905.00000	852.53320	52.46680	1.58
164	978.00000	913.68237	64.31763	1.94
165	915.00000	913.40259	1.59741	0.05
166	927.00000	903.38281	23.61719	0.71
167	971.00000	958.13867	12.86133	0.39
168	1026.00000	1026.63770	-0.63770	-0.02
169	1026.00000	999.10254	26.89746	0.81
170	1027.00000	1084.97241	-57.97241	-1.75
171	1007.00000	1000.46826	6.53174	0.20
172	1027.00000	1022.86011	4.13989	0.12
173	534.00000	576.34717	-42.34717	-1.28
174	587.00000	569.07739	17.92261	0.54
175	626.00000	648.27417	-22.27417	-0.67
176	707.00000	715.23706	-8.23706	-0.25
177	731.00000	731.87061	-0.87061	-0.03
178	770.00000	754.03955	15.96045	0.48
179	850.00000	838.08325	11.91675	0.36
180	849.00000	801.41724	47.58276	1.43

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

HP (c-3)

181	796.00000	806.94336	-10.94336	-0.33
182	852.00000	852.41504	-0.41504	-0.01
183	992.00000	1014.31714	-22.31714	-0.67
184	1010.00000	1005.68213	4.31787	0.13
185	795.00000	801.46436	-6.46436	-0.19
186	831.00000	833.25977	-2.25977	-0.07
187	853.00000	867.23779	-14.23779	-0.43
188	1027.00000	1035.24219	-8.24219	-0.25
189	1026.00000	1012.75049	13.24951	0.40
190	1004.00000	1005.56592	-1.56592	-0.05
191	886.00000	884.78223	1.21777	0.04
192	874.00000	887.35376	-13.35376	-0.40
193	798.00000	797.38916	0.61084	0.02
194	755.00000	724.04956	30.95044	0.93
195	883.00000	896.59473	-13.59473	-0.41
196	944.00000	916.18164	27.81836	0.84
197	943.00000	979.53882	-36.53882	-1.10
198	1013.00000	1029.25146	-16.25146	-0.49
199	995.00000	1024.84253	-29.84253	-0.90
200	1027.00000	1038.32886	-11.32886	-0.34
201	998.00000	961.11206	36.88794	1.11
202	1004.00000	977.48877	26.51123	0.80
203	985.00000	947.68921	37.31079	1.12

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

TRVT (c-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	0.18800	0.14694	0.04106	1.47
2	0.07700	0.06971	0.00729	0.26
3	0.12200	0.12750	-0.00550	-0.20
4	0.16100	0.19233	-0.03133	-1.12
5	0.14700	0.17109	-0.02409	-0.86
6	0.15500	0.13956	0.01544	0.55
7	0.08500	0.15894	-0.07394	-2.65
8	0.10200	0.11866	-0.01666	-0.60
9	0.10900	0.11720	-0.00820	-0.29
10	0.18100	0.16775	0.01325	0.48
11	0.16700	0.15345	0.01355	0.49
12	0.21000	0.18340	0.02660	0.95
13	0.17800	0.19255	-0.01455	-0.52
14	0.13800	0.15766	-0.01966	-0.70
15	0.18800	0.18508	0.00292	0.10
16	0.19700	0.18351	0.01349	0.48
17	0.16000	0.22127	-0.06127	-2.20
18	0.16200	0.17154	-0.00954	-0.34
19	0.21500	0.20434	0.01066	0.38
20	0.20300	0.21124	-0.00824	-0.30
21	0.24100	0.21988	0.02112	0.76
22	0.18300	0.20559	-0.02259	-0.81
23	0.23600	0.20657	0.02943	1.06
24	0.10100	0.12501	-0.02401	-0.86
25	0.16900	0.16954	-0.00054	-0.02
26	0.21300	0.17688	0.03612	1.30
27	0.14800	0.17683	-0.02883	-1.03
28	0.18900	0.18258	0.00642	0.23
29	0.12500	0.16709	-0.04209	-1.51
30	0.12900	0.19474	-0.06574	-2.36
31	0.17800	0.15776	0.02024	0.73
32	0.20500	0.17692	0.02808	1.01
33	0.19000	0.16507	0.02493	0.89
34	0.24300	0.17358	0.06942	2.49
35	0.23100	0.18212	0.04888	1.75
36	0.20700	0.17367	0.03333	1.20
37	0.17100	0.17738	-0.00638	-0.23
38	0.18300	0.18200	0.00100	0.04
39	0.19900	0.17984	0.01916	0.69
40	0.18300	0.18352	-0.00052	-0.02
41	0.24800	0.25153	-0.00353	-0.13
42	0.11200	0.13539	-0.02339	-0.84
43	0.17200	0.15710	0.01490	0.53
44	0.22800	0.20566	0.02234	0.80
45	0.11300	0.12723	-0.01423	-0.51
46	0.10600	0.13791	-0.03191	-1.14
47	0.13700	0.13534	0.00166	0.06
48	0.13600	0.13648	-0.00048	-0.02
49	0.17100	0.16135	0.00965	0.35
50	0.16800	0.16118	0.00682	0.24
51	0.13000	0.12763	0.00237	0.08
52	0.17300	0.15992	0.01308	0.47
53	0.17700	0.18667	-0.00967	-0.35
54	0.18800	0.18687	0.00113	0.04
55	0.16100	0.13870	0.02230	0.80
56	0.13300	0.13585	-0.00285	-0.10
57	0.16900	0.14555	0.02345	0.84
58	0.13900	0.13764	0.00136	0.05
59	0.18100	0.18102	-0.00002	-0.00

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

TRVT (c-3)

60	0.13900	0.14484	-0.00584	-0.21
61	0.14800	0.15190	-0.00390	-0.14
62	0.15600	0.14613	0.00987	0.35
63	0.21200	0.18666	0.02534	0.91
64	0.21600	0.18678	0.02922	1.05
65	0.20900	0.19359	0.01541	0.55
66	0.20700	0.19166	0.01534	0.55
67	0.21300	0.17455	0.03845	1.38
68	0.16000	0.19161	-0.03161	-1.13
69	0.17800	0.18500	-0.00700	-0.25
70	0.19100	0.17434	0.01666	0.60
71	0.18200	0.16346	0.01854	0.66
72	0.18200	0.17709	0.00491	0.18
73	0.20400	0.19110	0.01290	0.46
74	0.09900	0.12137	-0.02237	-0.80
75	0.10300	0.13583	-0.03283	-1.18
76	0.07800	0.13374	-0.05574	-2.00
77	0.15100	0.14099	0.01001	0.36
78	0.22100	0.21683	0.00417	0.15
79	0.26000	0.26315	-0.00315	-0.11
80	0.15000	0.16670	-0.01670	-0.60
81	0.16800	0.15677	-0.00877	-0.31
82	0.22700	0.18156	0.04544	1.63
83	0.12600	0.15018	-0.02418	-0.87
84	0.10600	0.12157	-0.01557	-0.56
85	0.16300	0.17099	-0.00799	-0.29
86	0.10600	0.12365	-0.01765	-0.63
87	0.13200	0.12796	0.00404	0.14
88	0.11100	0.14925	-0.03825	-1.37
89	0.08400	0.12444	-0.04044	-1.45
90	0.10100	0.11569	-0.01469	-0.53
91	0.15700	0.16216	-0.00516	-0.18
92	0.06800	0.07891	-0.01091	-0.39
93	0.14100	0.15216	-0.01116	-0.40
94	0.19700	0.17597	0.02103	0.75
95	0.09100	0.12195	-0.03095	-1.11
96	0.19700	0.18771	0.00929	0.33
97	0.26100	0.25853	0.00247	0.09
98	0.21900	0.22714	-0.00814	-0.29
99	0.17900	0.16375	0.01525	0.55
100	0.19700	0.19015	0.00685	0.25
101	0.19200	0.19487	-0.00287	-0.10
102	0.08900	0.08877	0.00023	0.01
103	0.26200	0.22908	0.03292	1.18
104	0.23600	0.21385	0.02215	0.79
105	0.13900	0.10910	0.02990	1.07
106	0.10000	0.08980	0.01020	0.37
107	0.17400	0.19129	-0.01729	-0.62
108	0.30600	0.26572	0.04028	1.44
109	0.32300	0.26975	0.05325	1.91
110	0.29400	0.30204	-0.00804	-0.29
111	0.33300	0.30874	0.02426	0.87
112	0.24100	0.19303	0.04797	1.72
113	0.21300	0.20667	0.00633	0.23
114	0.14700	0.14191	0.00509	0.18
115	0.14100	0.14913	-0.00813	-0.29
116	0.14500	0.17049	-0.02549	-0.91
117	0.12600	0.15193	-0.02593	-0.93
118	0.22300	0.18404	0.03856	1.40
119	0.14000	0.16397	-0.02397	-0.86

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

TRVT (c-3)

120	0.17300	0.19634	-0.02334	-0.84
121	0.15300	0.15752	-0.00452	-0.16
122	0.13600	0.14593	-0.00993	-0.36
123	0.13700	0.14165	-0.00465	-0.17
124	0.15400	0.15737	-0.00337	-0.12
125	0.13000	0.14586	-0.01586	-0.57
126	0.12100	0.15220	-0.03120	-1.12
127	0.31800	0.31493	0.00307	0.11
128	0.21000	0.18241	0.02759	0.99
129	0.22600	0.24532	-0.01932	-0.69
130	0.18000	0.18868	-0.00868	-0.31
131	0.20900	0.19643	0.01257	0.45
132	0.22000	0.21703	0.00297	0.11
133	0.17900	0.20698	-0.02798	-1.00
134	0.21400	0.23649	-0.02249	-0.81
135	0.20400	0.16822	0.03578	1.28
136	0.19600	0.18526	0.01074	0.39
137	0.15500	0.16757	-0.01257	-0.45
138	0.12100	0.09596	0.02504	0.90
139	0.18200	0.19906	-0.01706	-0.61
140	0.12100	0.10227	0.01873	0.67
141	0.11200	0.15562	-0.04362	-1.56
142	0.08800	0.12092	-0.03292	-1.18
143	0.12300	0.12033	0.00267	0.10
144	0.08800	0.02817	0.05983	2.15
145	0.23000	0.24312	-0.01312	-0.47
146	0.24500	0.19422	0.05078	1.82
147	0.23200	0.20917	0.02283	0.82
148	0.26800	0.26312	0.00488	0.18
149	0.08500	0.10467	-0.01967	-0.71
150	0.07800	0.10384	-0.02584	-0.93
151	0.22800	0.18844	0.03956	1.42
152	0.19800	0.23230	-0.03430	-1.23
153	0.18900	0.24718	-0.05819	-2.09
154	0.22600	0.25772	-0.03172	-1.14
155	0.16800	0.16249	0.00551	0.20
156	0.19300	0.18953	0.00347	0.12
157	0.11000	0.10230	0.00770	0.28
158	0.12600	0.15991	-0.03391	-1.22
159	0.23700	0.21386	0.02314	0.83
160	0.16900	0.17077	-0.00177	-0.06
161	0.19100	0.16344	0.02756	0.99
162	0.15100	0.15858	-0.00758	-0.27
163	0.18300	0.18295	0.00005	0.00
164	0.06700	0.06530	0.00170	0.06
165	0.07000	0.[illegible]792	-0.02792	-1.00
166	0.20900	0.[illegible]55	0.02245	0.81
167	0.32300	0.36285	-0.03985	-1.43
168	0.21900	0.20461	0.01439	0.52
169	0.15300	0.14508	0.00792	0.28
170	0.07800	0.12622	-0.04822	-1.73
171	0.09900	0.13102	-0.03202	-1.15
172	0.16700	0.16799	-0.00099	-0.04
173	0.08100	0.10998	-0.02898	-1.04
174	0.16200	0.16002	0.00198	0.07
175	0.18500	0.18024	0.00476	0.17
176	0.18700	0.19095	-0.00395	-0.14
177	0.19100	0.18481	0.00619	0.22
178	0.11300	0.09688	0.01612	0.58
179	0.18300	0.22633	-0.04333	-1.55
180	0.20300	0.16838	0.03462	1.24

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

TRVT (c-3)

181	0.14200	0.12432	0.01768	0.63
182	0.13400	0.13186	0.00214	0.08
183	0.18900	0.17853	0.01047	0.38
184	0.20700	0.19497	0.01203	0.43
185	0.13700	0.12530	0.01170	0.42
[illegible]	0.19500	0.19881	-0.00381	-0.14
187	0.26700	0.26422	0.00278	0.10
188	0.22300	0.24537	-0.02237	-0.80
189	0.12000	0.13526	-0.01526	-0.55
190	0.17400	0.18906	-0.01506	-0.54
191	0.14200	0.15025	-0.00825	-0.30
192	0.08400	0.09985	-0.01585	-0.57
193	0.05200	0.06089	-0.00889	-0.32
194	0.17500	0.16249	0.01251	0.45
195	0.11300	0.06759	0.04541	1.63
196	0.18700	0.16990	0.01710	0.61
197	0.20200	0.20295	-0.00095	-0.03
198	0.21800	0.20138	0.01662	0.60
199	0.23400	0.25137	-0.01737	-0.62
200	0.17100	0.14173	0.02927	1.05
201	0.17000	0.13272	0.03728	1.34
202	0.07100	0.05349	0.01751	0.63
203	0.07400	0.10763	-0.03363	-1.21

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

CQO (c-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	0.30400	0.30488	-0.00088	-0.06
2	0.27000	0.26256	0.00744	0.52
3	0.31200	0.31660	-0.00460	-0.32
4	0.31700	0.32347	-0.00647	-0.45
5	0.35800	0.33761	0.02039	1.43
6	0.28900	0.30325	-0.01425	-1.00
7	0.18400	0.24536	-0.06136	-4.30
8	0.32100	0.32539	-0.00439	-0.31
9	0.28600	0.28928	-0.00328	-0.23
10	0.30800	0.31993	-0.01193	-0.84
11	0.32900	0.32601	0.00299	0.21
12	0.36300	0.35297	0.01003	0.70
13	0.35500	0.36078	-0.00578	-0.41
14	0.35500	0.32715	0.02785	1.95
15	0.36300	0.35149	0.01151	0.81
16	0.35200	0.35528	-0.00328	-0.23
17	0.32600	0.34746	-0.02146	-1.51
18	0.31200	0.30929	0.00271	0.19
19	0.34700	0.34365	0.00335	0.23
20	0.34500	0.35397	-0.00897	-0.63
21	0.37100	0.36908	0.00192	0.13
22	0.33700	0.34388	-0.00688	-0.48
23	0.35600	0.34778	0.00822	0.58
24	0.30000	0.30052	-0.00052	-0.04
25	0.31100	0.32297	-0.01197	-0.84
26	0.33800	0.33393	0.00407	0.29
27	0.34300	0.34753	-0.00453	-0.32
28	0.35100	0.35353	-0.00253	-0.18
29	0.34300	0.35523	-0.01223	-0.86
30	0.33800	0.34696	-0.00896	-0.63
31	0.30800	0.30643	0.00157	0.11
32	0.33500	0.31518	0.01982	1.39
33	0.33300	0.32164	0.01135	0.80
34	0.32200	0.31261	0.00939	0.66
35	0.33000	0.32408	0.00592	0.42
36	0.31200	0.30363	0.00837	0.59
37	0.31900	0.31880	0.00020	0.01
38	0.31100	0.32463	-0.01363	-0.96
39	0.31300	0.31835	-0.00535	-0.38
40	0.31400	0.32353	-0.00953	-0.67
41	0.33800	0.33477	0.00323	0.23
42	0.31600	0.32114	-0.00514	-0.36
43	0.33400	0.32713	0.00687	0.48
44	0.34500	0.34115	0.00385	0.27
45	0.31100	0.31370	-0.00270	-0.19
46	0.31700	0.32482	-0.00782	-0.55
47	0.29400	0.30517	-0.01117	-0.78
48	0.30200	0.30568	-0.00368	-0.26
49	0.30400	0.32387	-0.01987	-1.39
50	0.30500	0.32259	-0.01759	-1.23
51	0.31600	0.31626	-0.00026	-0.02
52	0.33200	0.33583	-0.00383	-0.27
53	0.35800	0.36540	-0.00740	-0.52
54	0.36200	0.36767	-0.00567	-0.40
55	0.34700	0.33557	0.01143	0.80
56	0.33600	0.34240	-0.00640	-0.45
57	0.31100	0.30584	0.00516	0.36
58	0.30900	0.33241	-0.02341	-1.64
59	0.35900	0.36271	-0.00371	-0.26

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

CQO (c-3)

60	0.31300	0.33030	-0.01730	-1.21
61	0.29800	0.31969	-0.02169	-1.52
62	0.31800	0.33126	-0.01326	-0.93
63	0.36400	0.35829	0.00571	0.40
64	0.36600	0.35587	0.01013	0.71
65	0.34600	0.34978	-0.00378	-0.26
66	0.35500	0.35084	0.00415	0.29
67	0.34200	0.34293	-0.00093	-0.07
68	0.33600	0.34480	-0.00880	-0.62
69	0.34200	0.33843	0.00357	0.25
70	0.34500	0.34699	-0.00199	-0.14
71	0.34100	0.34492	-0.00392	-0.27
72	0.34100	0.33935	0.00165	0.12
73	0.34400	0.32683	0.01717	1.20
74	0.30600	0.30279	0.00321	0.23
75	0.30300	0.31326	-0.01026	-0.72
76	0.31200	0.31930	-0.00730	-0.51
77	0.30900	0.30280	0.00620	0.43
78	0.32400	0.32327	0.00073	0.05
79	0.33300	0.32263	0.01037	0.73
80	0.33800	0.33737	0.00063	0.04
81	0.34500	0.34765	-0.00265	-0.19
82	0.36300	0.33186	0.03114	2.18
83	0.28700	0.30347	-0.01647	-1.16
84	0.29200	0.29158	0.00042	0.03
85	0.30500	0.32388	-0.01888	-1.32
86	0.29300	0.28791	0.00509	0.36
87	0.29000	0.28634	0.00366	0.26
88	0.28100	0.28113	-0.00013	-0.01
89	0.29600	0.29642	-0.00042	-0.03
90	0.32400	0.30334	0.02066	1.45
91	0.27200	0.27220	-0.00020	-0.01
92	0.28100	0.27798	0.00302	0.21
93	0.32400	0.33128	-0.00728	-0.51
94	0.32300	0.31131	0.01169	0.82
95	0.27500	0.28391	-0.00891	-0.62
96	0.30800	0.29897	0.00903	0.63
97	0.33300	0.33230	0.00070	0.05
98	0.30000	0.30079	-0.00079	-0.06
99	0.30500	0.32219	-0.01719	-1.21
100	0.29200	0.28956	0.00244	0.17
101	0.30500	0.31377	-0.00877	-0.61
102	0.33300	0.31433	0.01867	1.31
103	0.36100	0.32535	0.03565	2.50
104	0.36500	0.34870	0.01630	1.14
105	0.28000	0.27644	0.00356	0.25
106	0.36200	0.35445	0.00755	0.53
107	0.38300	0.36135	0.02165	1.52
108	0.34000	0.32736	0.01264	0.89
109	0.33300	0.32473	0.00827	0.58
110	0.33900	0.33473	0.00427	0.30
111	0.32600	0.33636	-0.01036	-0.73
112	0.36400	0.34680	0.01720	1.21
113	0.35700	0.35345	0.00355	0.25
114	0.35300	0.35993	-0.00693	-0.49
115	0.34900	0.35412	-0.00512	-0.36
116	0.36500	0.35647	0.00853	0.60
117	0.35500	0.34740	0.00760	0.53
118	0.36100	0.34378	0.01722	1.21
119	0.32100	0.31878	0.00222	0.16

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

CQ0 (c-3)

120	0.31600	0.31893	-0.00293	-0.21
121	0.32600	0.32024	0.00576	0.40
122	0.32000	0.31584	0.00416	0.29
123	0.31500	0.31973	-0.00473	-0.33
124	0.31500	0.31385	0.00115	0.08
125	0.32200	0.31956	0.00244	0.17
126	0.30500	0.30894	-0.00394	-0.28
127	0.35200	0.35005	0.00195	0.14
128	0.32000	0.31433	0.00567	0.40
129	0.31400	0.34712	-0.03312	-2.32
130	0.33000	0.33780	-0.00780	-0.55
131	0.35800	0.33914	0.01886	1.32
132	0.34500	0.36142	-0.01642	-1.15
133	0.34500	0.35323	-0.00823	-0.58
134	0.38700	0.38453	0.00247	0.17
135	0.40700	0.36371	0.04329	3.04
136	0.35600	0.35751	-0.00151	-0.11
137	0.38700	0.35731	0.02969	2.08
138	0.29700	0.28490	0.01210	0.85
139	0.27000	0.29666	-0.02666	-1.87
140	0.27700	0.28701	-0.01001	-0.70
141	0.27400	0.30294	-0.02894	-2.03
142	0.29400	0.30143	-0.00743	-0.52
143	0.25300	0.26229	-0.00929	-0.65
144	0.24900	0.23042	0.01858	1.30
145	0.29200	0.29449	-0.00249	-0.17
146	0.30600	0.29297	0.01303	0.91
147	0.32300	0.31742	0.00558	0.39
148	0.29700	0.28425	0.01275	0.89
149	0.31400	0.30540	0.00860	0.60
150	0.33100	0.32868	0.00232	0.16
151	0.32600	0.32130	0.00470	0.33
152	0.31400	0.31593	-0.00193	-0.14
153	0.29700	0.30679	-0.00979	-0.69
154	0.29200	0.29606	-0.00406	-0.28
155	0.32700	0.34082	-0.01382	-0.97
156	0.38400	0.37764	0.00636	0.45
157	0.32700	0.34362	-0.01662	-1.17
158	0.33200	0.33361	-0.00161	-0.11
159	0.30100	0.29785	0.00315	0.22
160	0.30400	0.31228	-0.00828	-0.58
161	0.29600	0.25951	0.03649	2.56
162	0.33200	0.33467	-0.00267	-0.19
163	0.31900	0.32620	-0.00720	-0.50
164	0.30300	0.31368	-0.01068	-0.75
165	0.29200	0.30716	-0.01516	-1.06
166	0.32800	0.32300	0.00500	0.35
167	0.32600	0.32659	-0.00059	-0.04
168	0.33200	0.34374	-0.01174	-0.82
169	0.34900	0.35458	-0.00558	-0.39
170	0.36400	0.37080	-0.00680	-0.48
171	0.32800	0.33748	-0.00948	-0.67
172	0.36700	0.36244	0.00456	0.32
173	0.27500	0.28061	-0.00561	-0.39
174	0.29500	0.28255	0.01245	0.87
175	0.29100	0.27277	0.01823	1.28
176	0.33500	0.33489	0.00011	0.01
177	0.32200	0.31698	0.00502	0.35
178	0.32500	0.30685	0.01815	1.27
179	0.32300	0.35023	-0.02723	-1.91
180	0.33300	0.32232	0.01068	0.75

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

CQO (c-3)

181	0.31000	0.32375	-0.01375	-0.96
182	0.32300	0.31797	0.00503	0.35
183	0.34300	0.34648	-0.00348	-0.24
184	0.36900	0.34835	0.02065	1.45
185	0.33000	0.34236	-0.01236	-0.87
186	0.30900	0.31311	-0.00411	-0.29
187	0.34000	0.33695	0.00305	0.21
188	0.34400	0.34767	-0.00367	-0.26
189	0.33500	0.34053	-0.00553	-0.39
190	0.33300	0.34923	-0.01623	-1.14
191	0.31900	0.31397	0.00503	0.35
192	0.28400	0.30700	-0.02300	-1.61
193	0.29600	0.28528	0.01072	0.75
194	0.31100	0.30557	0.00543	0.38
195	0.30100	0.28574	0.01526	1.07
196	0.38900	0.38379	0.00521	0.37
197	0.31800	0.32415	-0.00615	-0.43
198	0.34400	0.34164	0.00236	0.17
199	0.35500	0.35106	0.00394	0.28
200	0.34400	0.34153	0.00247	0.17
201	0.33900	0.31911	0.01989	1.39
202	0.31900	0.32200	-0.00300	-0.21
203	0.34000	0.32697	0.01303	0.91

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

θ_0 (c-3)

TABLE OF RESIDUALS

CASE NO.	Y VALUE	Y ESTIMATE	RESIDUAL	RESID/STD ERR
1	8.00000	8.42506	-0.42506	-0.94
2	8.00000	8.04845	-0.04845	-0.11
3	8.00000	8.34567	-0.34567	-0.76
4	8.00000	8.05392	-0.05392	-0.12
5	8.00000	8.29040	-0.29040	-0.64
6	8.00000	8.57352	-0.57352	-1.27
7	8.00000	9.57263	-1.57263	-3.47
8	9.00000	8.87744	0.12256	0.27
9	10.00000	9.71796	0.28204	0.62
10	10.00000	9.94652	0.05348	0.12
11	10.00000	9.57596	0.42404	0.94
12	10.00000	10.42307	-0.42307	-0.93
13	10.00000	10.36206	-0.36206	-0.80
14	10.00000	10.84518	-0.84518	-1.87
15	10.00000	9.96102	0.01898	0.04
16	10.00000	10.11886	-0.11886	-0.26
17	10.00000	10.18543	-0.18543	-0.41
18	10.00000	9.70667	0.29333	0.65
19	10.00000	9.89905	0.10095	0.22
20	10.00000	9.89163	0.10837	0.24
21	10.00000	9.94753	0.05247	0.12
22	10.00000	10.06805	-0.06805	-0.15
23	10.00000	9.63902	0.36098	0.80
24	10.00000	9.89354	0.10646	0.24
25	10.00000	9.97346	0.02654	0.06
26	10.00000	10.25718	-0.25718	-0.57
27	10.00000	10.24139	-0.24139	-0.53
28	10.00000	10.25902	-0.25902	-0.57
29	10.00000	10.09812	-0.09812	-0.22
30	10.00000	10.07897	-0.07897	-0.17
31	10.00000	9.97680	0.02320	0.05
32	10.00000	9.94787	0.05213	0.12
33	10.00000	9.96762	0.03238	0.07
34	10.00000	9.87359	0.12641	0.28
35	10.00000	10.05235	-0.05235	-0.12
36	10.00000	10.29346	-0.29346	-0.65
37	10.00000	9.97592	0.02408	0.05
38	10.00000	10.07396	-0.07396	-0.16
39	10.00000	10.12093	-0.12093	-0.27
40	10.00000	10.11940	-0.11940	-0.26
41	10.00000	10.14768	-0.14768	-0.33
42	10.00000	9.98507	0.01493	0.03
43	10.00000	9.92767	0.07233	0.16
44	10.00000	10.02361	-0.02361	-0.05
45	10.00000	9.68636	0.31364	0.69
46	10.00000	9.97442	0.02558	0.06
47	10.00000	10.03483	-0.03483	-0.08
48	10.00000	10.03259	-0.03259	-0.07
49	10.00000	10.26151	-0.26151	-0.58
50	10.00000	10.18469	-0.18469	-0.41
51	10.00000	9.65403	0.34597	0.76
52	10.00000	9.84325	0.15675	0.35
53	10.00000	10.06045	-0.06045	-0.13
54	10.00000	10.04981	-0.04981	-0.11
55	10.00000	9.77425	0.22575	0.50
56	10.00000	10.33672	-0.33672	-0.74
57	10.00000	10.27223	-0.27223	-0.60
58	10.00000	10.01834	-0.01834	-0.04
59	10.00000	10.10803	[illegible]	[illegible]

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

θ_0 (c-3)

60	10.00000	10.01447	-0.01447	-0.03
61	10.00000	10.27135	-0.27135	-0.60
62	10.00000	9.98285	0.01715	0.04
63	10.00000	10.32962	-0.32962	-0.73
64	10.00000	10.33902	-0.33902	-0.75
65	10.00000	10.37193	-0.37193	-0.82
66	10.00000	10.19936	-0.19936	-0.44
67	10.00000	10.12593	-0.12593	-0.28
68	10.00000	10.23184	-0.23184	-0.51
69	10.00000	10.00763	-0.00763	-0.02
70	10.00000	10.16401	-0.16401	-0.36
71	10.00000	10.23892	-0.23892	-0.53
72	10.00000	10.07683	-0.07683	-0.17
73	10.00000	10.08953	-0.08953	-0.20
74	10.00000	9.73009	0.26991	0.60
75	10.00000	9.88733	0.11267	0.25
76	10.00000	10.02940	-0.02940	-0.06
77	10.00000	9.68963	0.31037	0.69
78	10.00000	10.01999	-0.01999	-0.04
79	10.00000	10.27931	-0.27931	-0.62
80	10.00000	9.71099	0.28901	0.64
81	10.00000	10.12532	-0.12532	-0.28
82	10.00000	9.66102	0.33898	0.75
83	10.00000	10.03697	-0.03697	-0.08
84	10.00000	9.75126	0.24874	0.55
85	10.00000	10.04192	-0.04192	-0.09
86	10.00000	9.55557	0.44443	0.98
87	10.00000	9.53829	0.46171	1.02
88	10.00000	9.95541	0.04459	0.10
89	10.00000	9.84189	0.15811	0.35
90	10.00000	9.37059	0.62941	1.39
91	10.00000	9.78232	0.21768	0.48
92	10.00000	9.79591	0.20409	0.45
93	10.00000	10.06635	-0.06635	-0.15
94	10.00000	9.80919	0.19081	0.42
95	10.00000	10.05034	-0.05034	-0.11
96	10.00000	10.33414	-0.33414	-0.74
97	10.00000	9.67716	0.32284	0.71
98	10.00000	10.11128	-0.11128	-0.25
99	10.00000	9.80361	0.19639	0.43
100	10.00000	9.75148	0.24852	0.55
101	10.00000	9.94353	0.05647	0.12
102	10.00000	9.85912	0.14088	0.31
103	10.00000	9.68867	0.31133	0.69
104	10.00000	10.25627	-0.25627	-0.57
105	10.00000	9.95965	0.04035	0.09
106	10.00000	9.73532	0.26468	0.58
107	10.00000	9.99767	0.00233	0.01
108	10.00000	9.95601	0.04399	0.10
109	10.00000	9.89765	0.10235	0.23
110	10.00000	10.03789	-0.03789	-0.08
111	10.00000	9.94935	0.05065	0.11
112	10.00000	10.51604	-0.51604	-1.14
113	10.00000	10.12347	-0.12347	-0.27
114	10.00000	9.92176	0.07824	0.17
115	10.00000	9.98963	0.01037	0.02
116	10.00000	10.36975	-0.36975	-0.82
117	10.00000	10.15095	-0.15095	-0.33
118	10.00000	10.36867	-0.36867	-0.81
119	10.00000	9.96897	0.03103	0.07

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

θ_n (c-3)

120	10.00000	9.72462	0.27538	0.61
121	10.00000	10.08183	-0.08183	-0.18
122	10.00000	9.95432	0.04568	0.10
123	10.00000	9.96179	0.03821	0.08
124	10.00000	10.01140	-0.01140	-0.03
125	10.00000	9.89015	0.10985	0.24
126	10.00000	10.06278	-0.06278	-0.14
127	11.00000	10.68599	0.31401	0.69
128	12.00000	11.49458	0.50542	1.12
129	12.00000	11.15561	0.84439	1.86
130	12.00000	10.64224	1.35776	3.00
131	12.00000	11.29492	0.70508	1.56
132	12.00000	11.66339	0.33661	0.74
133	12.00000	10.76202	1.23798	2.73
134	12.00000	10.96419	1.03581	2.29
135	12.00000	11.84311	0.15689	0.35
136	12.00000	11.63330	0.36670	0.81
137	12.00000	11.36636	0.63364	1.40
138	8.00000	6.39850	1.60150	3.54
139	8.00000	7.55989	0.44011	0.97
140	8.00000	7.63931	0.36069	0.80
141	8.00000	7.83113	0.16887	0.37
142	8.00000	8.11276	-0.11276	-0.25
143	8.00000	8.59044	-0.59044	-1.30
144	8.00000	8.56692	-0.56692	-1.25
145	8.00000	8.61381	-0.61381	-1.36
146	8.00000	9.02703	-1.02703	-2.27
147	8.00000	8.96231	-0.96231	-2.12
148	8.00000	8.14171	-0.14171	-0.31
149	8.00000	7.00316	0.99684	2.20
150	8.00000	8.81975	-0.81975	-1.81
151	8.00000	8.51631	-0.51631	-1.14
152	10.00000	10.16671	-0.16671	-0.37
153	10.00000	10.01561	-0.01561	-0.03
154	10.00000	9.38670	0.61330	1.35
155	10.00000	9.48757	0.51243	1.13
156	10.00000	10.40395	-0.40395	-0.89
157	10.00000	11.55369	-1.55369	-3.43
158	10.00000	10.72309	-0.72309	-1.60
159	10.00000	9.66536	0.33464	0.74
160	10.00000	10.22861	-0.22861	-0.50
161	10.00000	9.38762	0.61238	1.35
162	10.00000	10.29737	-0.29737	-0.66
163	12.00000	11.95584	0.04416	0.10
164	12.00000	12.34252	-0.34252	-0.76
165	12.00000	11.81004	0.18996	0.42
166	12.00000	11.50009	0.49991	1.10
167	12.00000	11.99983	0.00017	0.00
168	12.00000	12.51185	-0.51185	-1.13
169	12.00000	12.23869	-0.23869	-0.53
170	12.00000	12.15925	-0.15925	-0.35
171	12.00000	11.67344	0.32656	0.72
172	12.00000	11.57833	0.42167	0.93
173	8.00000	8.39843	-0.39843	-0.88
174	8.00000	7.97184	0.02816	0.06
175	8.00000	8.18015	-0.18015	-0.40
176	8.00000	7.71250	0.28750	0.63
177	8.00000	8.83950	-0.83950	-1.85
178	8.00000	7.99191	0.00809	0.02
179	8.00000	8.55041	-0.55041	-1.22
180	8.00000	8.47816	-0.47816	-1.06

TABLE VIII. DATA ACTUAL-MODEL EQUATION ESTIMATED VALUES (continued)

θ_0 (c-3)

181	10.00000	10.12221	-0.12221	-0.27
182	10.00000	9.68670	0.31330	0.69
183	10.00000	10.43876	-0.43876	-0.97
184	10.00000	10.27834	-0.27834	-0.61
185	10.00000	9.51512	0.48488	1.07
186	10.00000	9.84243	0.15757	0.35
187	10.00000	10.24370	-0.24370	-0.54
188	10.00000	10.05239	-0.05239	-0.12
189	10.00000	10.54933	-0.54933	-1.21
190	10.00000	10.42469	-0.42469	-0.94
191	10.00000	10.09194	-0.09194	-0.20
192	10.00000	9.81441	0.18559	0.41
193	10.00000	9.72315	0.27685	0.61
194	10.00000	9.31899	0.68101	1.50
195	12.00000	11.88593	0.11407	0.25
196	12.00000	11.85934	0.14066	0.31
197	12.00000	11.74206	0.25794	0.57
198	12.00000	11.50256	0.49744	1.10
199	12.00000	11.53314	0.46686	1.03
200	12.00000	11.70489	0.29511	0.65
201	12.00000	11.79892	0.20108	0.44
202	12.00000	11.99667	0.00333	0.01
203	12.00000	12.08423	-0.08423	-0.19

TABLE IX. FLATWISE BENDING MOMENT MODEL EQUATIONS (@ STATION 283)

MCTR: For V = 120 kts; α_s = - 6, - 8, - 10 deg; θ_0 = 8, 10, 12 deg (15 terms)

$$
\begin{aligned}
BMF = {} & 1749.8735 - 25.074\ D3S^2 + 255.3\ D4C^2 + 127.66\ (D1S)(D4S) \\
& - 39.08\ (D1C)(D4S) - 18.09\ (D0)(D2S) + 14118.0\ (CLR) \\
& - 352.44\ D3S - 180.55\ D3C + 109.21\ (D2C)(D3C) - 370.0\ D0 \\
& - 22.82\ D0^2 + 312.53\ D4S + 170.7\ D4S^2 - 97.32\ (D1C) \\
& - 89.26\ (D1C)(D4C)
\end{aligned}
$$

Multiple Correlation Coefficient = 0.801

MCTR: For V = 120 kts; α_s = - 6, - 8, - 10 deg; θ_0 = 8, 10, 12 deg (40 terms)

$$
\begin{aligned}
BMF = {} & 720.58 + 24.2757\ (D3S)^2 + 313.03\ (D4C)^2 + 65.42\ (D1S)(D4S) \\
& + 0.551\ (D1C)(D4S) - 32.41\ (D0)(D2S) + 22877.0\ (CLR) - 527.2\ (D3S) \\
& - 282.72\ (D3C) + 87.78\ (D2C)(D3C) - 522.698\ (D0) - 34.329\ (D0)^2 \\
& - 568.26\ (D4S) + 238.198\ (D4S)^2 - 264.18\ (D1C) - 128.29\ (D1C)(D4C) \\
& + 272.996\ (D3C)(D4C) - 39.4\ (D2C)(D4S) - 16.42\ (D0)(D1S) \\
& + 187.7\ (D3S)(D4S) + 66.7\ (D3C)^2 + 146.45\ (D2S)(D4C) \\
& + 14.56\ (D2S)(D3C) + 106.46\ (D1C)(D3S) + 69.78\ (D1C)(D2S) \\
& - 313.91\ (D2C) + 47.74\ (D2C)^2 + 53.06\ (D1C)(D2C) + 45.62\ (D2S)(D3S) \\
& - 29.9\ (D0)(D3C) + 66.47\ (D1S)(D4C) - 180.2\ (D2S) - 24.657\ (D0)(D4C) \\
& - 21.1\ (D0)(D2C) - 51.08\ (D2C)(D4C) - 16.1\ (D1S)(D2C) \\
& - 11.02\ (D0)(D1C) - 23.78\ (D1S)(D2S) - 14.14\ (D2S)^2 \\
& - 37.43\ (D3C)(D4S) + 21.96\ (D2C)(D3S)
\end{aligned}
$$

Multiple Correlation Coefficient = 0.886

TABLE IX. FLATWISE BENDING MOMENT MODEL EQUATIONS (@ STATION 283) (continued)

CTR: For V = 120 kts; α_s = - 8 deg; θ_0 = 10, 12, 14 deg.

$$BMF = 10^3 [3.277 - .2572\ DO - .143\ D1S + .1436\ D1C - 3.2284\ (CLR)(10)$$
$$+ .0106\ DO^2 + .0071\ D1S^2 - .0089\ D1C^2 + 3.8383\ (CLR)^2\ (100)$$
$$+ .0332\ (DO)(D1S) + .0157\ (DO)(D1C) - .0145\ (D1S)(D1C)$$
$$- .0050\ (DO)(D1C)(D1S)]$$

Multiple Correlation Coefficient = 0.97

DiS, DiC --- SIN AND COS COMPONENTS OF SERVO FLAP DEFLECTION (i = 1, 2, 3, 4)

DO --- COLLECTIVE DEFLECTION OF SERVO FLAP

DO	D1C	D1S	BMF(CTR)	BMF(MCTR15)	BMF(MCTR40)
-4.00	2.00	4.00	2509.59	2799.58	2914.00
-4.00	2.00	6.00	2141.59	2799.58	4046.10
-4.00	4.00	4.00	3028.39	2604.94	2474.00
-4.00	4.00	6.00	2262.79	2604.94	3605.96
-2.00	2.00	4.00	2126.39	2293.42	2105.90
-2.00	2.00	6.00	2841.59	2223.42	2171.50
-2.00	4.00	4.00	2017.59	2138.78	2621.[illegible]
-2.00	4.00	6.00	2905.19	2138.78	2687.30
0.00	2.00	4.00	2027.59	2654.70	2022.20
0.00	2.00	6.00	2625.99	2654.70	2022.20
0.00	4.00	4.00	2092.39	2490.06	1494.02
0.00	4.00	6.00	2032.39	2490.06	1494.02

CLR/SIGMA = .08

TABLE X. MCTR CONMIN OPTIMIZATION (for c-3)

$OBJ = TRVT_{MIN}$ = (See Regress Equation)

CONSTRAINTS:

G(1) = BMF = see Regression Model $\leq BMF_{(UB)}$ (i.e., 4000)

G(2) = HP = see Regression Model $\leq HP_{UB}$ (i.e., 800)

G(3) = PLV = see Regression Model $\leq PLV_{UB}$ (i.e., 350)

G(4) = THETA = see Regression Model $\leq 12°$ and $\geq 8°$

G(5) = CQ0 = see Regression Model $\leq CQ0_{UB}$ (i.e., 0.35)

SIDE CONSTRAINTS:

Lower Bound (LB) (Test Range)				Upper Bound (UB) (Test Range)
- 13.0	≤	D0	≤	+ 0
- 2.6	≤	D1C	≤	5.8
- 2.9	≤	D1S	≤	2.1
- 1.95	≤	D2C	≤	3.5
- 2.7	≤	D2S	≤	3.2
- 2.95	≤	D3C	≤	2.8
- 2.5	≤	D3S	≤	2.85
- 2.4	≤	D4C	≤	2.2
- 2.4	≤	D4S	≤	2.15
Desired Value	=	CLR	=	Desired Value
	=	CXR	=	

TABLE XI. CONMIN OPTIMIZATION RESULTS

INDEPENDENT VARIABLE	INITIAL CONDITION	CONMIN RESULTS	INITIAL CONDITION	CONMIN RESULTS	INITIAL CONDITION	CONMIN RESULTS	INITIAL CONDITION	CONMIN RESULTS	INITIAL CONDITION	CONMIN RESULTS	INITIAL CONDITION	CONMIN RESULTS
D0	0.0	- 0.725	- 4.0	- 1.883	- 4.0	- 1.053	- 13.0	- 12.927	- 4.0	- 0.134	- 13.0	- 13.0
D1C	0.0	2.283	- 2.0	- 2.578	2.0	4.232	2.0	2.491	2.0	5.8	2.0	2.973
D1S	0.0	- 0.006	2.0	- 2.90	- 0.1	- 0.760	- 1.0	- 2.90	- 0.1	- 0.913	- 1.0	- 2.90
D2C	0.0	- 0.004	0	- 1.95	0	- 0.448	0.0	- 1.071	0.0	0.056	0.0	- 0.958
D2S	0.0	- 0.015	0	- 1.834	0	- 0.175	0.0	- 0.819	0.0	- 0.508	0.0	- 0.72
D3C	0.0	- 0.087	0	2.574	0	0.017	0.0	- 0.467	0.0	- 1.929	0.0	0.568
D3S	0.0	2.850	0	2.650	0	2.153	0.0	1.170	0.0	2.850	0.0	1.689
D4C	0.0	0.468	0	- 1.496	0	1.544	0.0	0.876	0.0	2.140	0.0	0.712
D4S	0.0	1.799	0	1.371	0	1.413	0.0	1.050	0.0	0.467	0.0	1.478
CLR	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.070	0.070	0.070	0.070
CXR	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.007
DEPENDENT VARIABLE												
HP	760.82	836.09	811.22	783.62	797.82	802.22	862.39	800.07	740.52	717.1[illegible]	905.09	796.54
BMF	2879.3	1509.7	4188.9	1310.8	3799.6	1506.2	3638.0	2477.1	3658.4	1141.9	3496.8	1536.5
TRVT	0.0957	0.0222	0.19182	0.0033	0.1496	0.00382	0.16315	0.09741	0.14056	- 0.13039	0.1540	0.0430
PLV	226.28	179.56	365.65	94.29	273.72	132.20	270.82	173.69	268.59	110.15	265.69	140.64
THETA	12.458	11.997	10.52	12.048	10.524	12.036	10.719	10.913	9.6434	11.966	9.839	9.917

TABLE XII. CONTROL FEEDBACK OPTIMIZATION

INDEPENDENT VARIABLE	INITIAL CONDITION	FEEDBACK RESULT	INITIAL CONDITION	FEEDBACK RESULT	INITIAL CONDITION	FEEDBACK RESULT	INITIAL CONDITION	FEEDBACK RESULT	INITIAL CONDITION	FEEDBACK RESULT
DO	0.0	0.5	3.0	1.5	0.0	- 0.5	- 1.0	- 1.0	- 1.0	- 1.0
D1C	0.0	- 3.0	2.0	4.5	0.0	- 2.0	5.0	5.0	5.0	5.0
D1S	0.0	3.5	3.0	0.0	0.0	1.5	3.0	3.0	3.0	3.0
D2C	0.0	- 1.0	0.0	- 1.0	2.0	- 1.5	0.0	0.8	- 2.0	- 2.0
D2S	0.0	1.0	0.0	- 1.5	3.0	2.5	0.0	- 3.3	3.0	2.8
D3C	0.0	2.0	0.0	- 5.0	2.0	1.0	0.0	- 0.2	1.0	1.2
D3S	0.0	- 0.5	0.0	2.0	1.0	0.5	0.0	- 2.2	0.0	0.0
D4C	0.0	- 0.5	3.0	3.0	0.0	0.0	0.0	- 0.5	0.0	- 0.2
D4S	0.0	- 0.5	3.0	2.5	0.0	0.5	0.0	- 1.0	3.0	3.0
CLR	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092
CXR	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071
DEPENDENT VARIABLE										
BM	2825	3061	3661	2322	1538	2691	2097	3553	3544	3389
HP	696	686	455	691	694	718	506	576	420	419
PLV	165	326	389	311	412	312	205	354	337	314
1000 TRVT	92	1	297	7	23	9	- 15	- 1	25	1

TABLE XIII. TEST AND ANALYSIS CONTROL AND BLADE MOTION COMPARISON						
PARAMETER (Degrees)	TEST 29-3		TEST 28-9		TEST 19-14	
	TEST	ANALYSIS	TEST	ANALYSIS	TEST	ANALYSIS
δ_0	- 7.22	- 7.22	- 3.41	- 3.41	- 3.46	- 3.46
δ_{1s}	2.127	2.127	- .532	- .532	1.52	1.52
δ_{1c}	- 1.653	- 1.653	- 2.49	- 2.49	1.96	1.96
δ_{2s}	.509	.509	2.393	2.393	- .013	- .013
δ_{2c}	1.697	1.697	- .761	- .761	.114	.114
δ_{3s}	.388	.388	- .971	- .971	.052	.052
δ_{3c}	- 1.368	- 1.368	- .489	- .489	- .021	- .021
δ_{4s}	.448	.448	.289	.289	- .128	- .128
δ_{4c}	- 1.319	- 1.319	.546	.546	- .076	- .076
θ_0	10.37	13.08	9.83	10.417	10.24	10.57
θ_{1c}	1.26	.72	.591	.28	- .125	.498
θ_{1s}	- 11.7	- 11.03	- 10.86	- 7.79	- 6.58	- 5.90
β_0	4.19	4.20	3.65	3.56	3.67	3.64
β_{1s}	.36	- .58	.25	.358	.368	- 1.6
β_{1c}	.39	1.17	.49	1.6	.433	.91
HP	1027	983	734	693	690	666

APPENDIX A

DESIGN DESCRIPTION - MULTICYCLIC CONTROLLABLE TWIST ROTOR

Design Description

The MCTR system is comprised primarily of previously tested CTR hardware and components which are fully described in Reference 4. Rotor head components were modified for required transformation of existing CTR hardware to an MCTR. The MCTR system consists of the Multicyclic Control Panel, an electrically driven hydraulic power supply and four electro-hydraulic servo actuators located on the hub and attached to the servo flap walking beams. With the hydraulic system activated and harmonic control de-energized, the servo actuators remain in a fixed neutral position. Turning off hydraulics causes all four actuators to drive to full extension (3.25° down collective). With hydraulics on, the harmonic control can be energized with all amplitude controls set at zero, resulting in zero harmonic control input. 2/rev, 3/rev, and 4/rev amplitude controls can then be varied independently or in any combination. Phase of each harmonic also can be varied from 0° to 360°.

The four servo actuators of the MCTR system are also used to provide a capability for making individual blade track changes while operating the rotor. The controls of the potentiometer for the four blades are located on the control panel and are capable of changing the servo flap angle by approximately $\pm$ 2°.

Rotor Blade/Servo Flap

The feasibility demonstration model of the MCTR was based on the existing pretested Controllable Twist Rotor (CTR) blade hardware. Characteristic description thereof is detailed in Reference 4. No modifications, other than instrumentation, were made on the CTR blade and servo flap for transformation to MCTR design.

Controls/Rotor Head

The basic control system of the CTR used in previous test programs remained unchanged in the MCTR test. The additional higher harmonic control to the servo flap was accomplished by means of additional controls in the control panel shown in Figure A-1. Details of the MCTR control design is given in Reference 8.

The rotor head turret assembly used on the CTR was replaced with one having special capabilities for higher harmonic actuation of the servo flap (see Figure A-2). This capability on the MCTR turret head was made possible by allowing the entire walking beam assembly to translate vertically on the turret housing with respect to the servo flap collective input fixed; the walking beam was then allowed to pivot about a saddle sleeve fixed to the turret in response to the higher harmonic control actuators connected to the latter.

Figure A-1. Control Console for Multicyclic Controllable Twist Rotor.

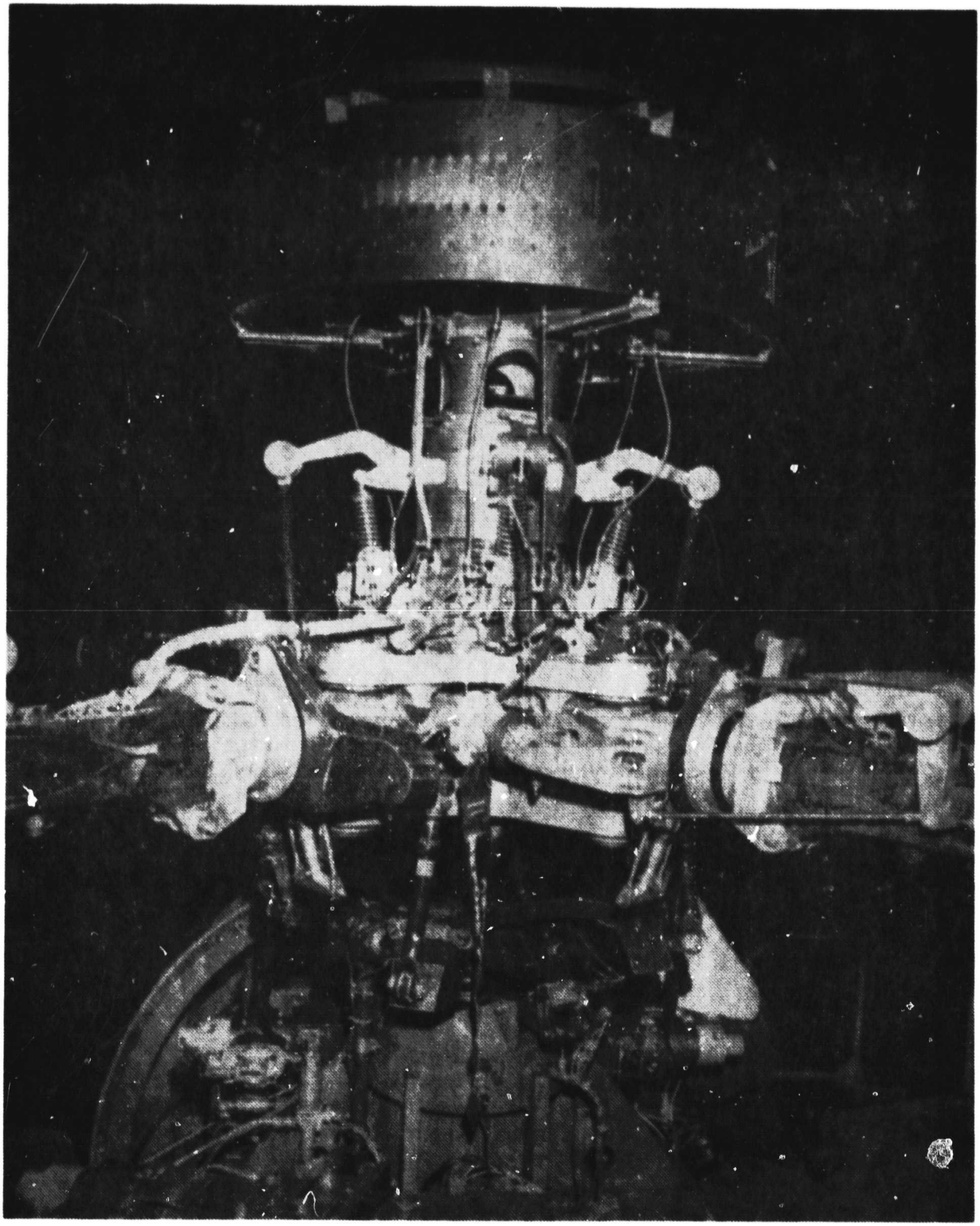

Figure A-2. Multicyclic Controllable Twist Rotor Head.

APPENDIX B

WIND TUNNEL TEST - OPERATIONS DESCRIPTION

MULTICYCLIC CONTROLLABLE TWIST ROTOR

Introduction

The MCTR wind tunnel tests were conducted to demonstrate the ability of using higher harmonic servo-flap control input to reduce rotor vibrations, and to verify analytical predictions with computer techniques used in previous analysis.

A detailed discussion of data results including interpretation, analysis and conclusions is presented in the text of this report. This Appendix presents a description of the wind tunnel interface regarding planning and system integration.

Qualification Plan

Because of extensive successful qualification tests which were conducted on the CTR system, the MCTR is comprised, substantially, of the CTR hardware with modifications which do not affect previous qualification test results. No separate qualification tests for the MCTR were required. Details are given in Reference 4.

Test Plan

The MCTR test plan was based on a test methodology called Multiple Balance. This plan was designed to determine the behavior of the rotor dependent parameters of interest in terms of independent variables of interest with less than 500 data points out of a possible 531,441 (3^{12}) combinations of independent variables at three levels each.

Table B-1 specifies definitions of levels of the test conditions, and Table B-2 lists the examples of corresponding conditions. Additional details of the test plan may be found in Reference 7. Execution of the wind tunnel test was carried out on a two-shift basis with operating personnel from Kaman and NASA Ames.

Instrumentation Design

An instrumentation manual was prepared giving detail data for all Kaman-installed instrumentation and control systems (Reference 8). The latter was used in conjunction with a similar manual supplied by Sikorsky, covering test module systems and with detail instrumentation forms prepared by NASA-Ames. Complete data covering calibrations, set-up data, and the data system interface were included. Table B-3 gives a list of instrumentation used in the test program.

TABLE B-1. TEST CONDITIONS - DEFINITIONS OF LEVELS			
PARAMETER	LEVEL 1	LEVEL 2	LEVEL 3
V (Knots)	80	120	135
α_s (Degrees)	- 4	- 6	- 8
θ_o (Degrees)	10	12	14
δ_{1s} (Degrees)	+ 2	0	- 2
δ_{1c} (Degrees)	0	+ 2	+ 4
δ_2 (Degrees)	0	1	2
ϕ_2 (Degrees)	- 45	0	+ 45
δ_3 (Degrees)	0	1	2
ϕ_3 (Degrees)	- 45	0	+ 45
δ_4 (Degrees)	0	1	0
ϕ_4 (Degrees)	- 45	0	+ 45

TABLE B-2. LISTS OF THE CORRESPONDING TEST CONDITIONS

RUN NO.	V	α_s	θ_o	δ_o	δ_{1s}	δ_{1c}	δ_2	ϕ_2	δ_3	ϕ_3	δ_4	ϕ_4	DATA POINT
RUN 1													
1-1	1	1	1	1	1	3	1	2	1	3	1	2	1
1-2	1	1	3	1	2	3	1	2	3	1	1	3	2
1-3	1	1	3	3	2	3	3	3	3	3	3	3	3
1-4	1	1	2	2	3	2	1	2	1	2	3	1	4
1-5	1	1	2	3	1	3	1	2	3	3	1	2	5
1-6	1	1	1	3	3	2	3	3	3	2	1	1	6
1-7	1	1	1	3	1	2	2	2	1	3	3	1	7
1-8	1	1	2	2	1	1	2	1	1	1	3	3	8
1-9	1	1	3	2	3	1	1	3	1	3	3	2	9
RUN 2													
RUN NO.	V	α_s	θ_o	δ_o	δ_{1s}	δ_{1c}	δ_2	ϕ_2	δ_3	ϕ_3	δ_4	ϕ_4	DATA POINT
2-1	2	2	2	2	2	2	1	3	1	2	1	2	73
2-2	2	2	1	1	3	3	1	2	3	2	2	1	74
2-3	2	2	1	2	3	2	2	3	3	2	3	1	75
2-4	2	2	2	2	2	2	2	3	2	1	3	1	76
2-5	2	2	3	3	1	3	2	3	1	1	3	1	77
2-6	2	2	3	3	3	1	1	3	2	2	3	1	78
2-7	2	2	1	1	2	1	3	3	2	3	3	3	79
2-8	2	2	1	1	2	3	1	1	2	1	2	3	80
2-9	2	2	1	1	1	3	3	2	3	2	1	1	81

TABLE B-3. INSTRUMENTATION LISTS

A. PARAMETER MONITOR LIST FOR SAFE OPERATION

NON-ROTATING

1. Rotor RPM
2. Balance Limits, NASA-Ames
3. Horsepower/Electrical Power (Model) NASA-Ames
4. Fan Electrical Power, NASA-Ames
5. Windspeed
6. Model Hydraulic Pressure/Fault Detection System, NASA-Ames
7. Rotor Shaft Angle

ROTATING

1. Rotor Flapping Angle
2. Blade Edgewise Bending - Station 47
3. Blade Flatwise Bending - Station 47
4. Rotor Shaft Torque
5. Servo Flap Bending
6. Lead/Lag Motion

B. PARAMETER LIST - COMPLETE (RECORDED)

NON-ROTATING

1. Right Lateral Load
2. Left Lateral Load
3. Fore and Aft Load
4. Stationary Scissors Load
5. Azimuth
6. Tunnel Wind Speed, NASA-Ames
7. Rotor Shaft Angle
8. Accelerometers (20 each)

ROTATING

1. Blade Torsion - Station 201
2. Blade Torsion - Station 252

TABLE B-3. INSTRUMENTATION LISTS (continued)

B. PARAMETER LIST - ROTATING (continued)

3. Blade Edgewise Bending - Station 47
4. Blade Edgewise Bending - Station 168
5. Blade Flatwise Bending - Station 47
6. Blade Flatwise Bending - Station 283
7. Blade Pitch Angulator (measured)
8. Blade Flapping Angulator (measured)
9. Blade Lead/Lag Angulator (measured)
10. Servo Flap Flatwise Bending - Station 283
11. Flap Control Outboard
12. Flap Control Load
13. Pitch Link Load
14. Rotor Torque
15. Servo Flap Position (measured)
16. MCTR Actuator Positions

VISUAL

1. Coning
2. Longitudinal Flapping
3. Lateral Flapping
4. Collective Blade Pitch (command)
5. Longitudinal Blade Pitch (command)
6. Lateral Blade Pitch (command)
7. Collective Blade Pitch (measured)
8. Longitudinal Blade Pitch (measured)
9. Lateral Blade Pitch (measured)
10. Longitudinal Flap Position (command)
11. Lateral Flap Position (command)
12. Collective Flap Position (command)
13. Longitudinal Flap Position (measured)
14. Lateral Flap Position (measured)
15. Collective Flap Position (measured)

TABLE B-3. INSTRUMENTATION LISTS (continued)

B. PARAMETER LIST - VISUAL (continued)

16. Rotor RPM
17. Tunnel Windspeed, NASA-Ames
18. Rotor Shaft Angle, NASA-Ames
19. 2/REV Amplitude and Phase
20. 3/REV Amplitude and Phase
21. 4/REV Amplitude and Phase
22. LVDT Signal

APPENDIX C

SYSTEM INTEGRATION

BUILD-UP

MCTR System

Build-up of the wind tunnel MCTR configuration was required to match the systems and components supplied by Kaman, Sikorsky and NASA-Ames. First, the test module had to be dismantled to allow the removal of all systems not used for the MCTR and the installation of MCTR components. Existing instrumentation and control cabling was modified or replaced. Finally, system rigging and interference checks were made. A brief description of some of the considerations in assembling the various systems follows.

Rotor

The rotor head required several parts from the standard test module head. The rotor head supplied by Kaman was a standard H-34 head, modified to incorporate control cranks for the servo-flap and built up with turret assemblies for routing of control rods. Because of strength considerations, the pitch horns and the rotating scissors from the module's pitch horn swashplate were transferred to the MCTR head. Also, instrumentation for the measurement of blade motions was transferred. The head was then installed on the rotor shaft of the test module. The MCTR blades, previously used in the CTR wind tunnel test, were already equipped with blade retentions that would mate with the standard pitch barrel, allowing routine installation of blades.

Test Module

Test module modifications centered around the removal of the module instrumentation slip ring and the fitting and installation of a framework to mount the servo flap rotating swashplate, the control actuators, and the instrumentation slip ring. This assembly required precise alignment to avoid any adverse loading of controls. Fairings to house the control assembly were designed and fabricated by NASA-Ames. Two 1500-horsepower electric motors were installed. The power available with this installation at a rotor speed of 200 rpm was approximately 1300 horsepower.

Controls

Final control rigging involved independent set-up of the pitch horn and servo flap controls. Conventional procedures were used for each system, and control limits were set in accordance with the anticipated control ranges. Extensive interference and control coupling checks were then made for both control systems.

Instrumentation

Instrumentation tasks in the build-up period consisted of: the final installation of transducers, the hook-up of rotor-head wiring for blade and other rotating parameters, the replacement of test module cabling with MCTR cables, and a final checkout of all instrumentation. The instrumentation task required close coordination with NASA-Ames personnel because of the joint responsibility for cabling, control panel wiring and checkout. All required systems were checked and calibrated successfully prior to tunnel entry.

TUNNEL TEST

MCTR System/Tunnel Systems - General

System integration following tunnel entry included model installation and final instrumentation hook-up, followed by checkout and calibration of all data and monitoring systems. A view of the complete model as installed is shown earlier in the report in Figure 1.

The complete tunnel system for the MCTR included: the model, the tunnel fans and wind speed controls, the model control systems, the balance and force measuring system, the data acquisition and processing system, and the test monitoring systems. Following instrumentation hook-up, all parameters were calibrated through the total data system. These parameters were fed into the primary data systems, and selected parameters were fed into the monitoring systems.

MCTR System/Tunnel Systems - Detail

Figure C-1 is a block diagram illustrating, in simplified form, the relationships of MCTR systems to the overall tunnel systems. Within the test module, rotating transducers are fed from the blades, the rotor shaft, and upper controls through the slip ring and then via cabling to the tunnel control room. Stationary transducers below the slip ring provide data for control positions and the condition of critical drive system components for fault-detecting circuitry. Power is also supplied for the 1500-horsepower electric motors and the hydraulic power supplies.

The module is supported on struts that mount to the tunnel balance system. The balance system connects to a scale system that is the force system measuring aerodynamic forces exerted on the model.

Control Room Systems/Functions

The tunnel control room is the focal point for the control of the module and the flow and treatment of all data. Referring again to Figure C-1, the following descriptions are given for the various functional groups and the individual subsystems.

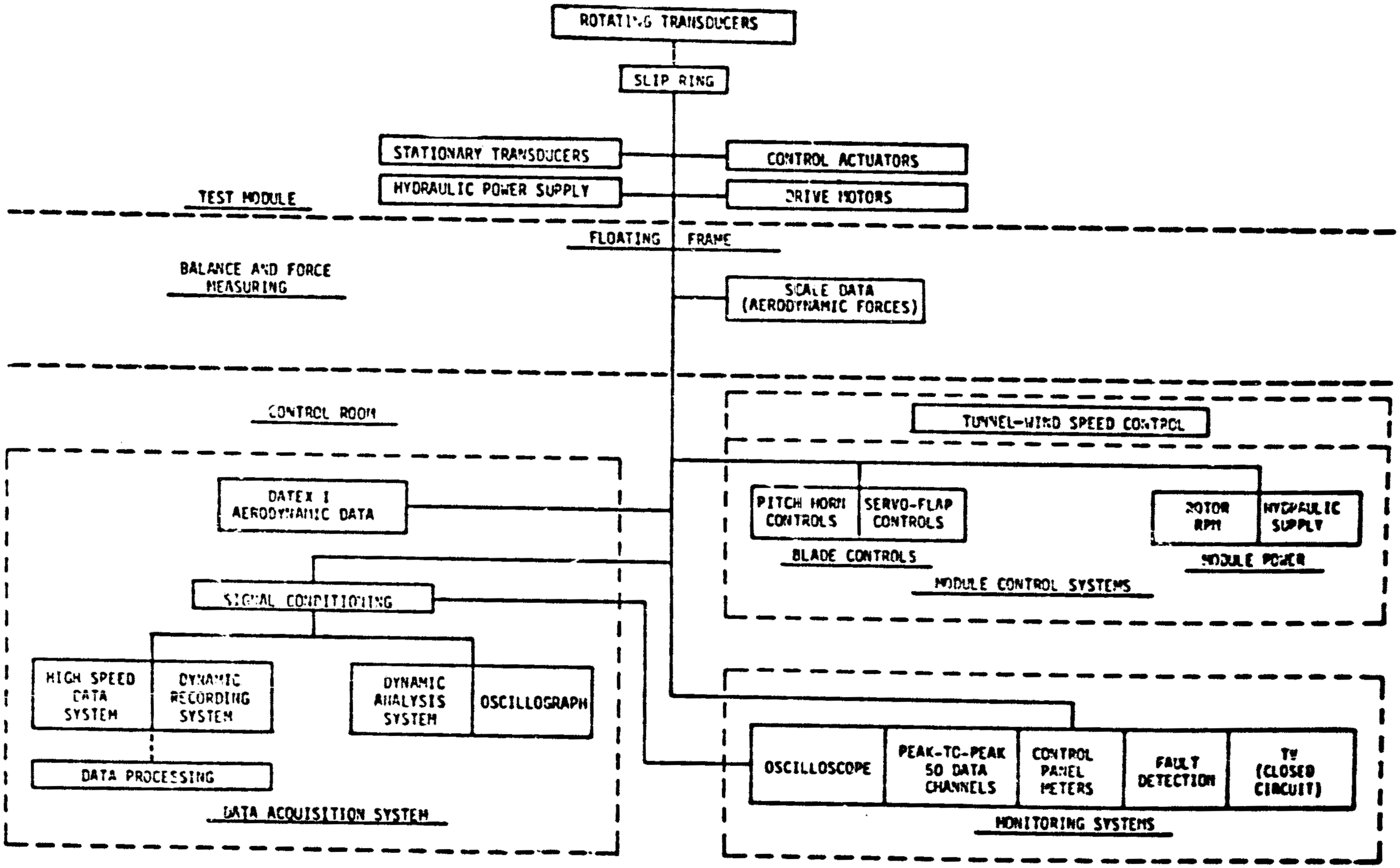

Figure C-1. MCTR Module and Tunnel System.

CONTROL SYSTEMS

Module-Blade Controls

The module blade controls involved two consoles, located side by side, and operated by a NASA-Ames rotor operator. Each console had similar displays and switching functions. The pitch horn console was used to input root pitch collective and cyclic commands, with readouts of the commanded angle, the resulting measured angle at the blade root, and the resulting blade flapping, which is resolved into blade coning, and longitudinal and lateral flapping. The servo flap console performed the same functions and gave similar readouts for collective, 1/Rev, 2/Rev, 3/Rev and 4/Rev angles measured at the servo flap.

Control technique involved commanded inputs to either the pitch horn or the servo flap. Blade flapping meters on the pitch horn console were observed, and the longitudinal and lateral pitch horn controls were used by the operator to achieve a zero-cyclic-flapping condition. When zero-cyclic blade flapping was achieved, readings were taken.

Module - Power

Module power controls consisted of speed controls for the 1500-horsepower rotor-drive motors and for the activating switches for electric motors used to drive the hydraulic power supply for the pitch horn servo controls. Rotor speed was monitored with frequency counters.

Tunnel-Wind Speed Control

Tunnel wind speed was controlled from a room below the main control room. Continuous voice communication was maintained between the two control rooms.

Tunnel air was driven by six 40-foot-diameter fans, powered by six 6000-horsepower electric motors.

MONITORING SYSTEMS

Various monitoring systems were used to control the test conditions. The critical nature of particular parameters determined the type of monitoring system used.

Control Panel Meters

As stated previously, meter displays on the control consoles gave readings for collective and cyclic conditions. The flapping meters were used as a primary test control since zero cyclic flapping had to be maintained to prevent adverse loading conditions.

Oscilloscope

A panel-mounted oscilloscope gave a continuous monitor of a few selected parameters that were known to be critical from either a s[illegible]ility or a loading standpoint.

Peak-to-Peak Display System

The peak-to-peak display system allowed continuous monitoring of all critical channels. The system consisted of 50 peak-to-peak detector circuits, a display in bar-chart format, and a digital printer with controller. Each of the 50 channels had a preset alarm capability, which permitted test operations to continue with only a visual scan to assure that no alarms had been activated without the need for noting specific levels of critical parameters.

For each test point, the digital printer was activated, giving an instantaneous record of peak-to-peak levels for each critical channel.

Fault Detection

Fault detection indicators were located in the module control consoles. These indicators gave warning lights for failures in the lubrication system, the hydraulic system, the controls, and the drive system, and the short circuits in the electrically isolated tunnel balance frame.

Television (Closed Circuit)

Television monitors viewed the module at all times from three stations. Each station had a limited scanning and zoom capability. Each station was recorded on video-tape.

DATA ACQUISITION SYSTEM

The NASA-Ames data acquisition system used for the MCTR tests was made up of several subsystems. All of the systems had been used in previous CTR tests. Following is a brief description of each of the various systems.

Data Acquisition System I (Datex I)

This system takes data from the tunnel scale system. In addition, other data can be input through a special instrumentation system, which interfaces digital panel meters and various switching functions at an operator's console to the master computer. Primary output data is in the form of aerodynamic coefficients, which are both displayed on lamp banks at the operator's console and printed on a teleprinter for each test point. Each test point is established at the operator's console, which energizes other primary data acquisition systems.

High Speed Data System

The High Speed Data Acquisition System (HSDAS) is a data-gathering computer front end. Sixty channels of dynamic data can be input to the system. The HSDAS simultaneously conditions, samples and holds voltages from each source. The samples are multiplexed onto an analog-to-digital converter. Digital values are then transmitted to the master computer for recording on magnetic tape. The HSDAS is considered the primary data acquisition subsystem. It also conditions all signals for other data acquisition systems.

Dynamic Recording System

The Dynamic Recording System (DRS) stores raw data. It receives its signals from the HSDAS and records on analog magnetic tape. The DRS records 56 analog signals and is running continuously during all testing in which the rotor is turning. This system provides a backup to all other systems.

Dynamic Analysis System

The Dynamic Analysis System (DAS) can operate either on-line or off-line as a stand-alone data gathering and analysis system. In the on-line mode, the DAS performs as a quick-look system while the master computer gathers data from the other subsystems. While operating on-line, the system can gather data from all or any two of 32 signal sources and perform a number of time-series analyses in real time. In particular, it can perform histograms, autocorrelation, crosscorrelation, impulse responses, characteristic functions, Fourier transforms, autospectrums, cross-spectrums, and transfer functions. It can perform linear, continuous, or exponential averaging of up to 51,200 samples. Results can be displayed on command on a cathode-ray tube, an X-Y plotter, or a printer.

The DAS was most useful during the initial testing to determine rig resonance, and later the evaluation of control operation ranges.

Oscillograph

A 36-channel, 12-inch, direct-writing oscillograph was used during all test operations. The initial purpose of the oscillograph was for limited immediate review of critical parameters. It was also intended as a check on all parameters to insure that the data being recorded on tape was reliable data. Because of difficulties with primary data systems, it became necessary at the conclusion of the test to base all analysis on the Datex I data and the oscillograph data.

Figure C-2 is a close-up view of consoles used for collective and cyclic control of the pitch horn and servo flap. Figure C-3 is an overall view of panels used for both control and monitoring of the test operations. Looking from right to left, the components are: the rotor speed control station, the

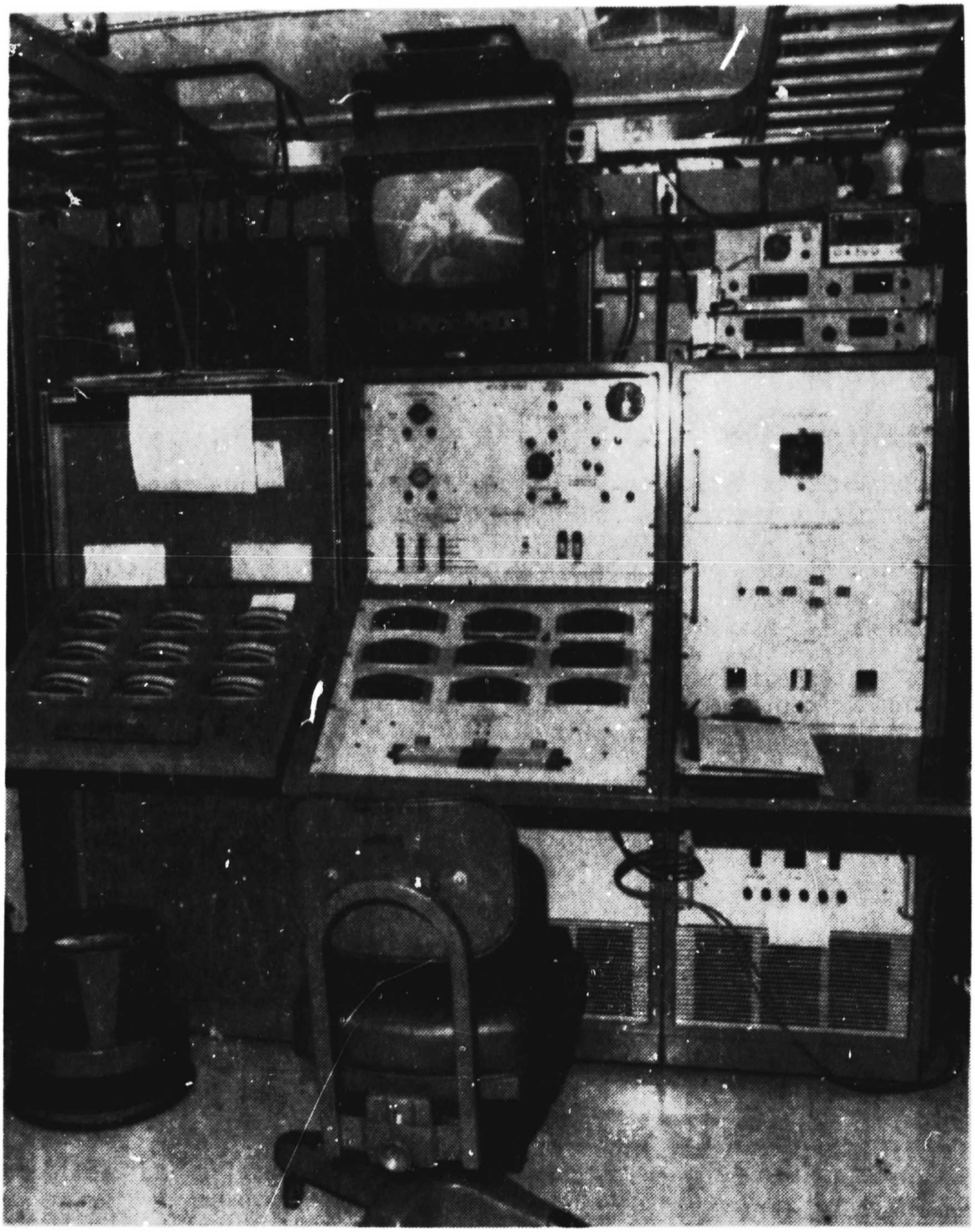

Figure C-2. MCTR Module Control Consoles.

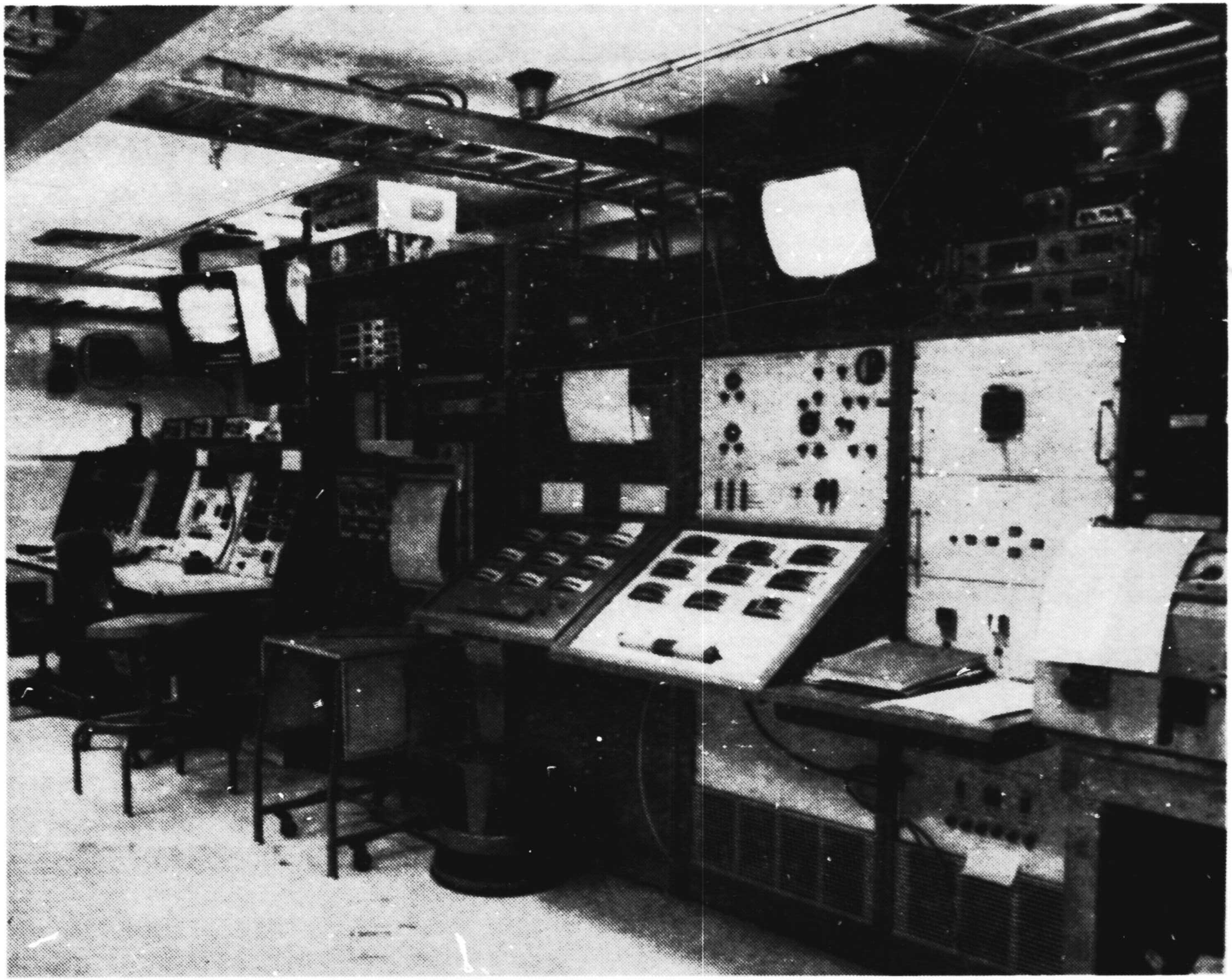

Figure C-3. Wind Tunnel Control Center - MCTR Test.

module electronic console, the pitch horn control console, the servo flap control console, the peak-to-peak detector system, the oscillograph, the oscilloscope and panel meters, and the Datex I operator's control console. Located above the panels are the television monitors. All other data acquisition systems are located at the rear of the control room.

Details of the data analysis for all testing are found in the main body of this report.

APPENDIX D

SEQUENTIAL SEARCH MODEL

The feedback control system requires a strategy to direct its search to find the path from the current operating point to the "best" operating point as defined by the optimization parameter. This strategy is contained in the logic that is used to analyze the measurements from the operating rotor in conjunction with the characteristics of the optimization function to determine which of the independent variables to increment next. Theoretically, the shortest path from a given operating point to the "best" operating point is found by moving at all times in the direction of maximum slope on the (n + 1) dimensional surface relating the n independent variables to the optimization parameter. Movement continues until the slopes in all directions become zero. In a practical system, where movement takes place with a finite increment, the point where all slopes equal zero is not found. Instead, the slope changes sign as the minimum point is passed.

The maximum slope can be accomplished by noting whether the optimization function decreases or increases as a result of each increment of an independent variable. The increment is retained if the optimization function decreases and removed if it increases.

The simulation model was set up to investigate the characteristics of the various alternatives for sequential step searches. Two sequences were investigated: one with a basic cycle of n intervals, wherein each of the independent variables was incremented in turn; and the other with a basic cycle of 2 n intervals, wherein the n independent variables were incremented in the odd numbered intervals and the independent variable having the maximum slope was incremented in the even numbered intervals. Within each of these sequences, four alternatives on the action to be taken if the optimization parameter increases as a result of an increment were investigated. These four alternatives are:

a. Retain the increment and move to the next interval in the cycle

b. Remove the increment and redetermine the operating point without the increment

c. Remove one-half the increment and take the new value of the optimization parameter to be the average of the values with and without the full increment

d. Try an increment of the opposite sign. If the optimization parameter still increases, remove the increment and redetermine the operating point without the increment.

In each case, the slope ($\Delta P/\Delta X$) is determined in each interval and stored for use in determining the direction of the increment the next time the corresponding independent variable is to be incremented. In addition, if the increments with opposite signs both cause the optimization parameter to increase, the slope is set equal to zero, with the sign equal to that of the smaller of the two slopes.

A flow diagram of the computer program used to investigate the sequential search characteristics is shown in Figure D-1, and the listing is given in Table D-1. The first step is to set the initial values of the independent variables and the slopes of the optimization function with respect to these variables. The independent variables are usually any set of arbitrary numbers, and the initial slopes are set to zero. The size of the increment, the degree of lag and the amount of noise are also set as part of the initialization process.

The first step in the actual processing loop is to calculate the controlled variables (y's). Next, the effect of lag is introduced on the basis of the calculated values of the y's, the previous values of the y's, and the lag parameter set as part of the initialization process. These new values of y are stored for use in the next lag calculation. Next, the noise amplitude is generated for each of the y's and the values of y with lag and noise are used to calculate the optimization parameter, P, from the functions of Figure 4. It is the optimization parameter, affected by noise and lag, that is used in the subsequent control action.

The decisions on whether or not P decreased and the basis for selecting the next independent variable to be incremented are bypassed during the first pass so that the next step is to increment the first independent variable in the sequence. During subsequent passes, when P decreases, the change in P is used to calculate the slope of P to be associated with the most recently incremented independent variable. The basis for selecting the next independent variable to be incremented can then be alternated between a fixed sequence and the independent variable with the maximum slope. However, the maximum slope criterion is not used if the maximum slope is less than .01.

If P did not decrease, and if an increment of the opposite sign has already been tried, the increment is removed and a "restart" flag is set so that a new baseline value of P is determined prior to incrementing another independent variable. In addition, the sign of the slope associated with the most recently incremented independent variable is set equal to the smaller of the signs of the slopes determined with positive and negative increments. This aids the search process when the most recently incremented independent variable next comes up in this fixed search sequence. However, the magnitude of the slope is set less than .01, so that it does not become a candidate for incrementing in accordance with the maximum slope criterion. If the reverse increment has not been tried, and if the search strategy being investigated requires that it be dc e, the change in P is used to calculate and store a slope associated with the most recently incremented independent variable, the increment is removed, and one of opposite sign is applied.

Once started, the model is allowed to run for a sufficient number of iterations to characterize its operation. Provisions are made for printing the following information on each iteration cycle:

Each independent variable

Each controlled variable as calculated with lag, with lag and noise

Optimization parameter from calculated controlled variables with lag and with lag and noise

The slope of the optimization parameter associated with each independent variable

Independent variable selected to be incremented and the direction.

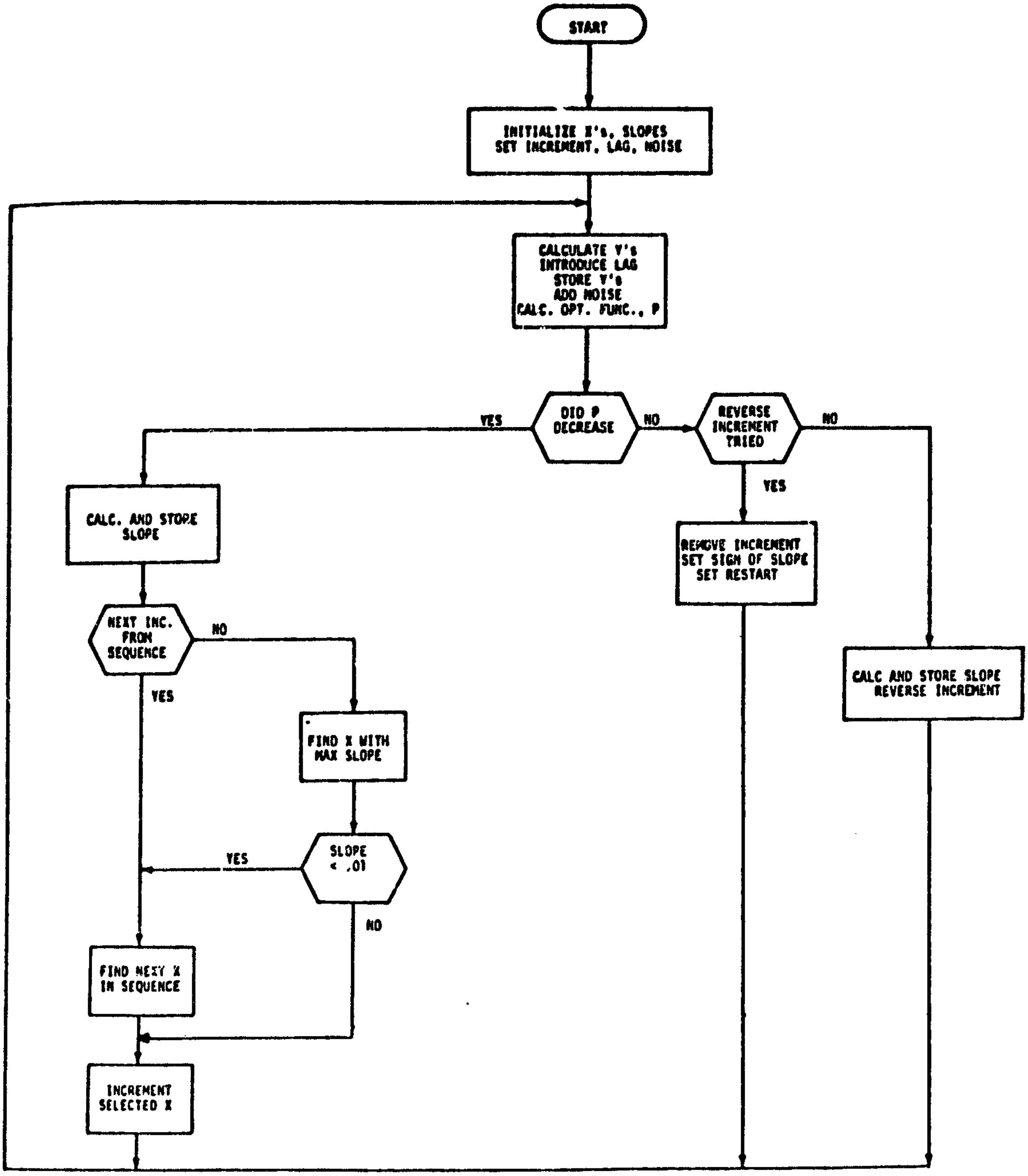

Figure D-1. Sequential Search Model.

TABLE D-1. SEQUENTIAL SEARCH MODEL

```
LIS
TRUT

10   COM X[11],S[9]
20   DATA 0,0,0,0,0,0,0,0,0
30   DATA .092,.0071
40   MAT  READ X
50   DATA 0,0,0,0,0,0,0,0,0
60   MAT  READ S
70   DIM F[4]
80   DATA 720.58,335.091,25.5606,-.01336
90   MAT  READ F
100   FILES COEFF1
110   F1=1
120   F2=N1=N2=1
130   A1=-.5
140   RESTORE 160
150   DIM Z[4],Y[4],H[4],B[4],D[4]
160   DATA 3500,750,350,.5
170   MAT  READ Z
180   U=.0025
190   T=.393
200   REM PRINT F1: 0 ONE P1, 1 NORMAL, 2 ALL Y'S, 3 THREE P1'S
210   REM F2' 0 RESTART, 1 1ST PASS, 2 SEQ, 3 MAX SLOPE, 4 -INCREMENT
220   P2=999
230   DIM R[11]
240   DATA 8,15,21,26,30,33,35,36,36,35,36
250   MAT  READ R
260   DIM M[4,65]
270   MAT  READ #1;M
280   DIM A$[11],B$[11]
290   IMAGE #,2D.2D
300   IMAGE #,X4D
310   IMAGE #,4D
320   GOTO 400
330   PRINT "CHANGE ";
340   INPUT X1,X2
350   IF X1=0 THEN 400
360   IF X1>9 THEN 390
370   X[X1]=X2
380   GOTO 330
390   INPUT X[1],X[2],X[3],X[4],X[5],X[6],X[7],X[8],X[9]
400   IF F1=0 THEN 440
410   PRINT " CT    1C    1S    2C    2S    3C    3S    4C    4S";
420   PRINT " OPT    IM    HP    PLU 1000TRUT";
430   PRINT " OPTN"
440   C1=C2=C3=C4=C5=0
```

TABLE D-1. SEQUENTIAL SEARCH MODEL (continued)

```
450  IF F1=0 THEN 490
460  FOR I=1 TO 9
470  PRINT  USING 290;X[I]
471  IF ABS(X[I])>10 THEN 1739
475  IF ABS(X[I+1])>6 THEN 1739
480  NEXT I
490  REM
500  IF F2#0 THEN 530
510  MAT Y=B
520  GOTO 670
530  FOR K=1 TO 4
540  Y[K]=F[K]
550  FOR I=1 TO 9
560  Y[K]=Y[K]+M[K,I]*X[I]
570  FOR J=1 TO 9
580  Y[K]=Y[K]+M[K,I+J+R[I]]*X[I]*X[J]
590  NEXT J
600  NEXT I
610  Y[K]=Y[K]+M[K,20+R[10]]*X[10]*X[10]
620  Y[K]=Y[K]+M[K,21+R[11]]*X[10]*X[11]
630  Y[K]=Y[K]+M[K,20+R[11]]*X[11]*X[11]
640  Y[K]=Y[K]+M[K,27+R[10]]*X[10]
650  Y[K]=Y[K]+M[K,28+R[10]]*X[11]
660  NEXT K
670  MAT D=Y
680  IF F1=0 THEN 740
690  GOSUB 1620
700  PRINT  USING 300;P1
710  IF F1<2 THEN 730
720  PRINT  USING "5D";Y[1],Y[2],Y[3],1000*Y[4]
730  PRINT  USING "#,2X"
740  REM TIME LAG
750  GOTO 810
760  IF F2=1 THEN 800
770  MAT H=(1-T)*H
780  MAT Y=(T)*Y
790  MAT Y=Y+H
800  MAT H=Y
810  IF F1=0 THEN 840
820  PRINT  USING 300;Y[1],Y[2],Y[3],1000*Y[4]
830  REM
840  GOTO 920
850  C1=C1+Y[4]
860  C2=C2+Y[4]↑2
870  C3=C3+1
880  C4=C4+P1
890  C5=C5+P1↑2
```

TABLE D-1. SEQUENTIAL SEARCH MODEL (continued)

```
900  REM GENERATES AND PRINTS NOISY DATA
910  GOSUB 1520
920  IF F1<2 THEN 980
930  IF F1#2 THEN 950
940  PRINT  USING "#,4DX";P1
950  PRINT
960  PRINT  USING "#,2X"
970  PRINT  USING 300;Y[1],Y[2],Y[3],1000*Y[4]
980  REM
990  IF F1=0 THEN 1010
1000  PRINT " ";
1010  PRINT  USING "#,5D";P1
1020  IF F2<2 THEN 1210
1030  S1=(P1-P2)/A2
1040  IF P1<P2 THEN 1180
1050  PRINT " ";
1060  IF F2=4 THEN 1120
1070  F2=4
1080  S[N3]=S1
1090  M[N3]=S[N3]-2*A2
1100  A2=-A2
1110  GOTO 1410
1120  F2=0
1130  S[N3]=.001*SGN(ABS(S[N3]) MIN ABS(S1))
1140  M[N3]=S[N3]-A2
1150  IF F1=0 THEN 1460
1160  PRINT
1170  GOTO 1460
1180  S[N3]=S1
1190  PRINT "M";
1200  GOTO 1220
1210  PRINT "B";
1220  P2=P1
1230  MAT X=D
1240  IF N2=1 THEN 1350
1250  N2=1
1260  F2=3
1270  N3=T1=0
1280  FOR I=1 TO 9
1290  IF ABS(S[I])<T1 THEN 1320
1300  T1=ABS(S[I])
1310  N3=I
1320  NEXT I
1330  IF T1<.01 THEN 1350
1340  GOTO 1390
```

TABLE D-1. <u>SEQUENTIAL SEARCH MODEL</u> (continued)

```
1350  N2=2
1360  F2=2
1370  N1=N1+1-9*(N1=9)
1380  N3=N1
1390  A2=A1*(SGN(S[N3])+(S[N3]=0))
1400  X[N3]=X[N3]+A2
1410  IF F1=0 THEN 1460
1420  PRINT  USING "#,3D";F2
1430  PRINT  USING "XDS';N3*SGN(A2)
1440  C1=(F2#3)*(C1+1)
1450  IF C1=15 THEN 1740
1460  IF C3<18 THEN 450
1470  IF F1#0 THEN 1500
1480  PRINT
1490  PRINT  USING "3D.D";X[1],X[2],X[3],X[4],X[5],X[6],X[7],X[8],X[9]
1500  GOTO 440
1510  REM ADD NOISY
1520  FOR K=1 TO 4
1530  U1=1
1540  U2=RND(1)+.0002
1550  IF U2<.5002 THEN 1580
1560  U2=U2-.5
1570  U1=-1
1580  U3=1.6201*SQR(LOG(1/U2)-.3)-1.017
1585  U3=U3*U1
1590  Y[K]=Y[K]+U3*Z[K]*U
1600  NEXT K
1610  RETURN
1620  REM CALC OPT FUNCTION
1630  P1=100*(Y[4]/Z[4])↑2
1640  P1=P1+30*(Y[3]/Z[3]-1)↑2
1650  IF Y[3]<Z[3] THEN 1670
1660  P1=P1+10*(10*(Y[3]/Z[3]-1))↑4
1670  P1=P1+20*(Y[2]/Z[2]-1)↑2
1680  IF Y[2]<Z[2] THEN 1700
1690  P1=P1+10*(30*(Y[2]/Z[2]-1))↑4
1700  P1=P1+36.99+100*(Y[1]/Z[1]-1)↑2
1710  IF Y[1]<Z[1] THEN 1730
1720  P1=P1+10*(7*(Y[1]/Z[1]-1))↑4
1730  RETURN
1738  GOTO 1740
1739  PRINT "SERVO-FLAP DEFLECTION IS OUT OF BOUND"
1740  END

STOP
```

APPENDIX E

LISTING OF CONMIN PROGRAM

```
0001          SUBROUTINE ANALIZ(ICALC)
0002          COMMON/CLCBCM/X(11),FX,C(4)
       C      INDEP. VAR. C0,DIC,DIS, ....E4C,E4S,CLP,CXR
       C      OBJECT FUNCTION - TRANSMISSION VERTICAL VIBRATORIES
       C      CONSTRAINT FUNCTIONS - BMF, HP (OR CCO), PLLV, THETA-0
       C      FX=TRVT G1-
       C      FX=TRVT G1-G4=BMF,HP,PLLV,THETA-C (RESPECTIVELY)
       C      A.L. W E I S B R I C H
0003          IF(ICALC.GT.1) GO TO 20
       C      READ/WRITE INITIAL VALUES OF X1-X11
0004          READ(5,5) X
0005        5 FORMAT(8F10.2/3F10.2)
0006          WRITE(6,10) X
0007       10 FORMAT(5X,16HINITIAL X-VALUES/
             *5X,6HX(1) =,F10.3/
             *5X,6HX(2) =,F10.3/
             *5X,6HX(3) =,F10.3/
             *5X,6HX(4) =,F10.3/
             *5X,6HX(5) =,F10.3/
             *5X,6HX(6) =,F10.3/
             *5X,6HX(7) =,F10.3/
             *5X,6HX(8) =,F10.3/
             *5X,6HX(9) =,F10.3/
             *5X,6HX(10)=,F10.3/
             *5X,6HX(11)=,F10.3)
0008          RETURN
0009       20 IF(ICALC.GT.2) GO TO 25
       C      ANALIZE FX=TRVT (MINIMIZE)
0010          FX=.02291+.0028*X(1)*X(6)
             *-.02734*X(7)
             *-.00820*X(2)*X(8)
             *-.02242*X(1)
             *+0.02038*X(6)*X(8)
             *-.00115*X(1)**2
             *-.00848*X(2)
             *+0.01453*X(8)**2
             *+0.00633*X(4)*X(6)
             *+0.00614*X(6)**2
             *-.02564*X(9)
             *+0.91035*X(10)
             *+0.01178*X(7)*X(9)
             *-.00098*X(1)*X(3)
       C      CONSTRAINT BMF
```

```
0011        G(1)=1749.87354-25.07428*X(7)**2
           *+255.29501*X(8)**2
           *+127.66479*X(3)*X(9)
           *-39.08418*X(2)*X(9)
           *-18.0905*X(1)*X(5)
           *+13117.99609*X(10)
           *-352.4436*X(7)
           *-180.54701*X(6)
           *+109.21431*X(4)*X(6)
           *-370.00928*X(1)
           *-22.82124*X(1)**2
           *-312.53491*X(9)
           *+170.69981*X(9)**2
           *-97.?7465*X(2)
           *-69.26509*X(2)*X(8)
      C     CONSTRAINT HP
0012        G(2)=417.39331+205332.0*X(10)*X(11)
           *-9.40928*X(1)
           *+26501.55469*X(11)
           *+14.06202*X(4)
           *-2.51565*X(1)*X(6)
           *+10.75703*X(5)
           *-1.59607*X(1)*X(3)
           *+13.42356*X(7)*X(9)
      C     CONSTRAINT PLLV
0013        G(3)=185.1993+26.59951*X(3)
           *+15.24629*X(5)
           *+16.74075*X(4)*X(6)
           *+6.33576*X(4)**2
           *+9.10341*X(6)**2
           *+4.8632*X(5)**2
           *-6.73338*X(2)*X(9)
           *+13.92521*X(6)*X(8)
           *-21.57013*X(1)
           *+14.78062*X(7)*X(8)
           *-26.95424*X(7)
           *+5134.81641*X(11)
           *+6.26719*X(7)**2
           *-9.03797*X(2)
           *-7.99992*X(2)*X(8)
           *+3.88037*X(2)*X(4)
           *+9.64728*X(8)**2
           *-1.13154*X(1)**2
      C     CONSTRAINT THETA-C
```

```
0014          G(4)=8.70127+6682.0625*X(10)*X(11)
             *+.63906*X(1)
             *+.03425*X(1)*X(4)
             *+.03887*X(1)**2
             *-6117.98438*X(11)**2
             *-.08494*X(5)*X(6)
             *+.01977*X(1)*X(7)
             *+.10133*X(8)**2
0015          RETURN
0016       25 CONTINUE
        C     PRINT RESULTS
0017          WRITE(6,30) X,FX,G
0018       30 FORMAT(////5X,16HANALYSIS RESULTS/
             *5X,6HX(1) =,F10.3/
             *5X,6HX(2) =,F10.3/
             *5X,6HX(3) =,F10.3/
             *5X,6HX(4) =,F10.3/
             *5X,6HX(5) =,F10.3/
             *5X,6HX(6) =,F10.3/
             *5X,6HX(7) =,F10.3/
             *5X,6HX(8) =,F10.3/
             *5X,6HX(9) =,F10.3/
             *5X,6HX(10)=,F10.3/
             *5X,6HX(11)=,F10.3//
             *5X,4HFX =,E12.5/
             *5X,6HG(1) =,E12.5/
             *5X,6HG(2) =,E12.5/
             *5X,6HG(3) =,E12.5/
             *5X,6HG(4) =,E12.5)
0019          RETURN
0020          END
```

LIST OF SYMBOLS

A_{ij}	Coefficients of the independent variables
BMF	Flatwise bending moment
C_{L_R}	Rotor lift coefficient
CLR	C_{L_R}/σ
C_{Q_o}	Blade profile power coefficient
C_{X_R}	Propulsive force coefficient
CXR	C_{X_R}/σ
HP	Horsepower
R	Radius of blade (feet)
P	Optimization parameter
PLV	Pitch link vibratory load
S_i	Sensitivity of optimization parameter to changes in a particular independent variable
TRVT	Transmission vertical vibration
V	Wind tunnel speed (knots)
X_i	Independent variable
Y_j	Dependent response variable
α	Blade section angle of attack (degrees)
α_s	Shaft angle of attack (degrees)
β_o	Rigid body collective flap (degrees)
β_{1s}	Longitudinal cyclic flap (degrees)
β_{1c}	Lateral cyclic flap (degrees)
δ_i	Servo flap collective pitch (degrees)
δ_{1s}, δ_{2s}, δ_{3s}, δ_{4s}	Servo flap longitudinal cyclic pitch (degrees)
δ_{1c}, δ_{2c}, δ_{3c}, δ_{4c}	Servo flap lateral cyclic pitch (degrees)
θ_o	Collective inboard control (degrees)
θ_{1c}	Lateral cyclic pitch control (degrees)
θ_{1s}	Longitudinal cyclic pitch control (degrees)

LIST OF SYMBOLS (continued)

μ	Advance ratio
σ	Rotor solidity
ψ	Rotor azimuth position (degrees)
Ω	Rotor rotational speed (radians/second)