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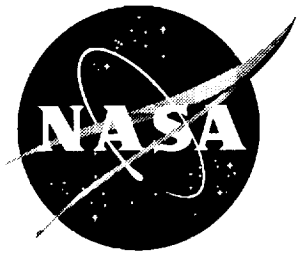

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December 1999

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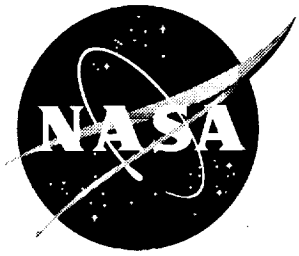

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Abstract

The data for longitudinal non-dimensional aerodynamic coefficients in the High Speed Research Cycle 2B aerodynamic database was modeled using polynomial expressions identified with an orthogonal function modeling technique. The discrepancy between the tabular aerodynamic data and the polynomial models was tested and shown to be less than 15 percent for drag, lift, and pitching moment coefficients over the entire flight envelope. Most of this discrepancy was traced to smoothing local measurement noise and to the omission of mass case 5 data in the modeling process. A simulation check case showed that the polynomial models provided a compact and accurate representation of the nonlinear aerodynamic dependencies contained in the HSR Cycle 2B tabular aerodynamic database.

Nomenclature

b_w	wing span, ft
CD	drag coefficient
CL	lift coefficient
CM	pitching moment coefficient
GW	gross weight, lbm
h_r	height above the ground, ft
HSR	High Speed Research
M	Mach number
PSE	predicted square error
$\bar{q}$	dynamic pressure, lbf/ft^2
α	angle of attack, degrees
β	sideslip angle, degrees
δ_e	elevator deflection, degrees
δ_{GEAR}	landing gear deflection, degrees
δ_{LE_i}	ith leading edge flap deflection, $i \in (1,2,3,4)$, degrees
δ_s	symmetric stabilator deflection, degrees
δ_{SP_i}	ith spoiler deflection, $i \in (1,2,3,4)$, degrees
δ_{TE_i}	ith trailing edge flap deflection, $i \in (1,2,3,4,5,6,7,8)$, degrees
δ_{LE_i}	vortex flap deflection, degrees
$W_{o_{sp}}/W_C l_i$	ith engine, $i \in (1,2,3,4,5,6,7,8)$, mass flow spillage ratio relative to cruise

I. Introduction

The High Speed Research (HSR) Cycle 2B aerodynamic database[1] is a large collection of tabular data from wind tunnel tests and aeroelastic calculations, which relates state and control variables to non-dimensional aerodynamic coefficients. These aerodynamic coefficients represent the non-dimensionalized aerodynamic forces and moments acting on the airplane, and are therefore important for dynamics and control studies, and for simulation. Modeling the nonlinear relationship between state and control variables and the non-dimensional aerodynamic coefficients using a closed analytic form with smooth derivatives can be very useful. Example applications include robust control, dynamic inversion, trajectory optimization, and smooth linearization of the nonlinear equations of motion for transfer function identification or linear control design.

In this work, the technique described in Ref. [2] was used to model the longitudinal non-dimensional aerodynamic coefficients using polynomial models. Ref. [1] specifies the component build-up for each non-dimensional aerodynamic coefficient, along with the independent variables that influence each component and the range of independent variable values contained in the data. The orthogonal function modeling technique described in Ref. [2] was used to model each component of each non-dimensional coefficient individually with a power series expansion in the appropriate independent variables. Separate model structures were identified for the subsonic and supersonic data, mainly because of step changes in slope contained in the data for many component functions at or near Mach 1. The result was a power series expansion for each component of each non-dimensional longitudinal aerodynamic coefficient that was valid over the entire range of the independent variables in the HSR aerodynamic database, except that separate expressions were identified for subsonic and supersonic data.

II. Polynomial Modeling

Each component function of the non-dimensional longitudinal aerodynamic coefficients in the HSR Cycle 2B aerodynamic database depends on between one and five independent variables, which are state and control variables. The orthogonal function modeling technique generates orthogonal modeling functions from the data for the independent variables, and uses a statistical criterion of predicted square error (PSE)[3] to select which of the orthogonal functions should be used to model the component function data from the HSR Cycle 2B aerodynamic database. The PSE balances the reduction in mean square fit error (i.e., the mean squared error between the model and the data) with the number of terms in the model. An effective balance fits the data as closely as is warranted by the information content in the data without overfitting, which is equivalent to fitting the noise. Once the model structure is determined using the orthogonal functions, each retained orthogonal function is decomposed into an ordinary polynomial expansion in the independent variables. This latter step can be done to the accuracy of the computing machinery because of the way that the orthogonal modeling functions are generated from the independent variable data. Combining common terms in the ordinary polynomial expressions for each orthogonal function in the model results finally in a single polynomial expansion in the independent variables for the component function model. More details of the orthogonal function modeling technique can be found in Ref. [2].

The amount of tabular data for the longitudinal non-dimensional aerodynamic coefficients in the HSR Cycle 2B database is very large, including some 624,838 data points and 74 component functions for the drag coefficient, 455,444 data points and 71 component functions for the lift coefficient, and 428,194 data points and 79 component functions for the pitching moment coefficient. The build-up of the drag coefficient in terms of component functions is defined on page 7. Analogous expressions for the lift coefficient and the pitching moment coefficient appear on pages 27 and 46, respectively. The subsonic polynomial expansions for each component function of the drag coefficient are given in Table 1, and the supersonic expansions are given in Table 2. Table 3 contains the coefficient values for the parameters that appear in the expansions given in Tables 1 and 2. Analogous information arranged in the same fashion for the lift coefficient and the pitching moment coefficient is given in Tables 4-6 and 7-9, respectively.

Extended static testing was performed for the polynomial models of the longitudinal aerodynamic coefficients. This involved 1000 random selections of independent variable values using a uniform probability distribution over the valid range of each independent variable, and computing the drag, lift, and pitching moment coefficients using the HSR aerodynamic database and using the identified polynomial models. The discrepancy between the non-dimensional aerodynamic coefficient values computed by the polynomial models and the values from the HSR Cycle 2B aerodynamic database was less than 15% for all longitudinal aerodynamic coefficient polynomial models. The discrepancy was

traced mainly to smoothing of local data features in the HSR aerodynamic database (including measurement noise), and the omission of mass case M05 (Ref. [1]) in the polynomial modeling. M05 corresponds to the operating empty weight plus full wing fuel with a gross weight of 646,458 lb. The heaviest mass case is M13, which corresponds to maximum taxi weight at a forward c.g. location. M13 has partial wing fuel and a gross weight of 649,914 lb. Mass cases M05 and M13 are very close in gross weight but very different in fuel and mass distribution. This causes all of the rigid to elastic corrections, which are a strong function of wing fuel, to be discontinuous near these weights when viewed as a function of gross weight. The remaining mass cases allowed a good fit in approximating mass condition (total and distribution) as a function of the single parameter of gross weight.

Finally, the polynomial models were incorporated into the Ref. H Matlab/Simulink simulation, so that the longitudinal aerodynamics could be calculated using either the HSR cycle 2B aerodynamic database or the identified polynomial models. The Ref. H Matlab/Simulink simulation trim routine was also modified to generate trim cases using the polynomial models. This latter task was required so that comparisons of maneuvers using the HSR aerodynamic database versus using the polynomial models could be done properly.

A subsonic simulation check case was run using the HSR aerodynamic database versus using the polynomial models. The maneuver was a stabilator doublet at Mach 0.8 and 25,000 feet altitude. Figure 1 shows good agreement in the time histories for the simulation output variables using the polynomial models for the longitudinal aerodynamics compared to using the HSR Cycle 2B tabular aerodynamic database. The bias in the stabilator deflection for the polynomial model simulation run reflects the trim difference seen at this flight condition. In general, state and control values for trim differ when using the polynomial models for the longitudinal aerodynamics compared to using the HSR Cycle 2B tabular aerodynamic database, because the polynomial models sacrifice local detail to match significant trends in the aerodynamic database with compact polynomial expressions.

III. Acknowledgments

This research was conducted at the NASA Langley Research Center under NASA contract NAS1-19000.

IV. References

1. Dornfeld, G., Lanier, J., Milligan, K., Parker, J., Phillips, B., Stephens, A., "High Speed Civil Transport Reference H-Cycle 2B Simulation Data Base," NASA Contract NAS1-20220.

2. Morelli, E.A. : Global Nonlinear Aerodynamic Modeling using Multivariate Orthogonal Functions. *Journal of Aircraft*, Vol. 32, No. 2, March-April 1995, pp. 270-77.

3. Barron, A.R., "Predicted Squared Error : A Criterion for Automatic Model Selection," *Self-Organizing Methods in Modeling*, Farlow, S.J., Ed., Marcel Dekker, Inc., New York, 1984, pp. 87-104.

V. Polynomial Model Specification Tables

The input data is limited to the modeled ranges as listed below:

$-4<\alpha<32$

$.24<M<2.6$

$0<\bar{q}<1200$

$279080<GW<649914$

$-32<\beta<32$

$0<\delta_{LE}<50$

$-40<\delta_{TE}<40$

$0<\delta_{VF}<90$

$0<\delta_{SP}<60$

$0.1<\frac{h_r}{b_w}<.932046$

$0<W_{o_{SP}}/W_C l<1$

$-15<\delta_s<15$

$-30<\delta_e<30$

$0<\delta_{GEAR}<90$

Some components are built by placing special limits on certain variables as follows:

$\alpha_1 = -4<\alpha<26$

$\alpha_2 = -4<\alpha<12$

$M_1 = .3<M<2.6$

$M_2 = .24<M<.65$

$M_3 = 1.65<M<2.41$

$M_4 = 1.6<M<2.6$

$\beta_1 = -6<\beta<6$

$\beta_2 = -20<\beta<20$

$\beta_3 = ABS(\beta)$

$\delta 1_{TE} = 0<\delta_{TE}<40$

Dynamic pressure and gross weight were scaled as follows to better condition their magnitudes for the polynomial fit routine:

$\bar{q}_s = \bar{q}/100$

$GW_s = GW/100000$

CD Model Definition

CD = CD_TOC + CD_HL + CD_SP + CD_GE + CD_US + CD_GR + CD_TAIL +
CD_Q * QHAT + CD_QD * QDHAT + CD_AD * ADHAT

where

CD_TOC = CDR + DCDE + CDBR + CDRJD

CD_HL = CD_LE + CD_TE + CDVFR

CD_LE = CDLE1R + CDLE1E + CDLE2R + CDLE2E
+ CDLE3R + CDLE3E + CDLE4R + CDLE4E

CD_TE = CDTEBR + (CDTE1R+CDTE1E)*KDTE1 + (CDTE2R+CDTE2E)*KDTE2
+ (CDTE3R+CDTE3E)*KDTE3+ (CDTE4R+CDTE4E)*KDTE4
+ (CDTE5R+CDTE5E)*KDTE5+ (CDTE6R+CDTE6E)*KDTE6
+ (CDTE7R+CDTE7E)*KDTE7 + (CDTE8R+CDTE8E)*KDTE8

IF M< 0.45 THEN
CD_SP = CDSP1R + CDSP2R + CDSP3R + CDSP4R
ELSE
CD_SP = 0.0

CD_GE = CDGR

CD_US = CD1_US + CD4_US + CD12_US + CD34_US

CD_GR = CDLGR * KLLGR

CD_TAIL = CDDSR + CDDER + CDTHLR + DECDDS * DSTAB + DECDDE * DELEV

CD_Q = CDQR + CDQRJD + CDQTER + CDQLER + CDQE

CD_QD = CDQDR + CDQDE

CD_AD = CDADR + CDADE

The expressions for these variables are given in Table 1 for CD subsonic and in Table 2 for CD supersonic.

Table 1 - CD Subsonic

COMPONENT	MODEL
CDR	$C_0 + C_1\alpha_1 + C_2\alpha_1^2 + C_3M + C_4\alpha_1M + C_5\alpha_1^2M + C_6M^2$
DCDE	$C_0\bar{q}_s + C_1\bar{q}_sGW_s + C_2\bar{q}_s\alpha_1 + C_3\bar{q}_s\alpha_1GW_s + C_4\bar{q}_sM_1$ $+C_5\bar{q}_sM_1GW_s + C_6\bar{q}_s\alpha_1M_1 + C_7\bar{q}_s\alpha_1M_1GW_s$ $+C_8\bar{q}_s\alpha_1^2 + C_9\bar{q}_s\alpha_1^2GW_s + C_{10}\bar{q}_s^2 + C_{11}\bar{q}_s^2\alpha_1$
CDBR	$C_0\beta_2 + C_1\alpha\beta_2 + C_2\beta_2M + C_3\alpha\beta_2M + C_4\alpha^2\beta_2 + C_5\alpha^2\beta_2M$ $+C_6\beta_2M^2 + C_7\alpha\beta_2M^2 + C_8\alpha^2\beta_2M^2 + C_9\beta_2^2 + C_{10}\alpha\beta_2^2$
CDRJD	$C_0 + C_1\alpha_1 + C_2M_1 + C_3\alpha_1M_1 + C_4M_1^2 + C_5\alpha_1M_1^2 + C_6\alpha_1^2$
CDLE1R	$C_0\delta_{LE_1} + C_1\alpha\delta_{LE_1} + C_2\delta_{LE_1}^2 + C_3\alpha^2\delta_{LE_1} + C_4\alpha\delta_{LE_1}^2 + C_5\alpha^2\delta_{LE_1}^2$ $+C_6\delta_{LE_1}M + C_7\delta_{LE_1}\delta l_{TE_L} + C_8\alpha\delta_{LE_1}M + C_9\delta_{LE_1}^2M$ $+C_{10}\alpha\delta_{LE_1}^2M + C_{11}\alpha^2\delta_{LE_1}M$
CDLE2R	$C_0\delta_{LE_2} + C_1\alpha\delta_{LE_2} + C_2\delta_{LE_2}^2 + C_3\alpha^2\delta_{LE_2} + C_4\alpha\delta_{LE_2}^2 + C_5\alpha^2\delta_{LE_2}^2$ $+C_6\delta_{LE_2}\delta l_{TE_L} + C_7\delta_{LE_2}M + C_8\alpha\delta_{LE_2}M + C_9\delta_{LE_2}^2M + C_{10}\alpha\delta_{LE_2}^2M$
CDLE3R	$C_0\delta_{LE_3} + C_1\alpha\delta_{LE_3} + C_2\delta_{LE_3}^2 + C_3\alpha^2\delta_{LE_3} + C_4\alpha\delta_{LE_3}^2 + C_5\alpha^2\delta_{LE_3}^2$ $+C_6\delta_{LE_3}\delta l_{TE_R} + C_7\delta_{LE_3}M + C_8\alpha\delta_{LE_3}M + C_9\delta_{LE_3}^2M + C_{10}\alpha\delta_{LE_3}^2M$
CDLE4R	$C_0\delta_{LE_4} + C_1\alpha\delta_{LE_4} + C_2\delta_{LE_4}^2 + C_3\alpha^2\delta_{LE_4} + C_4\alpha\delta_{LE_4}^2 + C_5\alpha^2\delta_{LE_4}^2$ $+C_6\delta_{LE_4}M + C_7\delta_{LE_4}\delta l_{TE_R} + C_8\alpha\delta_{LE_4}M + C_9\delta_{LE_4}^2M$ $+C_{10}\alpha\delta_{LE_4}^2M + C_{11}\alpha^2\delta_{LE_4}M$
CDLE1E	$C_0\delta_{LE_1} + C_1\alpha_1\delta_{LE_1} + C_2\bar{q}_s\delta_{LE_1} + C_3\alpha_1\bar{q}_s\delta_{LE_1} + C_4M_1\delta_{LE_1} + C_5\alpha_1M_1\delta_{LE_1}$
CDLE2E	$C_0\delta_{LE_2} + C_1GW_s\delta_{LE_2} + C_2\alpha_1\delta_{LE_2} + C_3M_1\delta_{LE_2} + C_4\alpha_1M_1\delta_{LE_2}$ $+C_5\bar{q}_s\delta_{LE_2} + C_6\bar{q}_sGW_s\delta_{LE_2} + C_7\alpha_1GW_s\delta_{LE_2} + C_8\bar{q}_sM_1\delta_{LE_2}$
CDLE3E	$C_0\delta_{LE_3} + C_1GW_s\delta_{LE_3} + C_2\alpha_1\delta_{LE_3} + C_3M_1\delta_{LE_3} + C_4\alpha_1M_1\delta_{LE_3}$ $+C_5\bar{q}_s\delta_{LE_3} + C_6\bar{q}_sGW_s\delta_{LE_3} + C_7\alpha_1GW_s\delta_{LE_3} + C_8\bar{q}_sM_1\delta_{LE_3}$
CDLE4E	$C_0\delta_{LE_4} + C_1\alpha_1\delta_{LE_4} + C_2\bar{q}_s\delta_{LE_4} + C_3\alpha_1\bar{q}_s\delta_{LE_4} + C_4M_1\delta_{LE_4} + C_5\alpha_1M_1\delta_{LE_4}$

CDTEBR	if $\delta_{TE_{AVG}}$ <0 or M>=0.3 0.0 else $C_0M_2 + C_1\alpha M_2 + C_2\beta^2M_2 + C_3\alpha^2M_2 + C_4\alpha\beta^2M_2$ $+C_5M_2^2 + C_6\alpha M_2^2 + C_7\alpha^2M_2^2$
CDTE1R	$C_0\delta_{TE_1} + C_1\alpha\delta_{TE_1} + C_2\delta_{TE_1}^2 + C_3\alpha\delta_{TE_1}^2 + C_4\delta_{TE_1}M$ $+C_5\alpha\delta_{TE_1}M + C_6\delta_{LE_L}\delta_{TE_1}^2$
CDTE2R	$C_0\delta_{TE_2} + C_1\alpha\delta_{TE_2} + C_2\delta_{TE_2}^2 + C_3\alpha\delta_{TE_2}^2 + C_4\delta_{TE_2}M + C_5\alpha\delta_{TE_2}M$ $+C_6\delta_{TE_2}^2M + C_7\delta_{LE_L}\delta_{TE_2}^2 + C_8\alpha\delta_{LE_L}\delta_{TE_2}^2$
CDTE3R	$C_0\delta_{TE_3} + C_1\alpha\delta_{TE_3} + C_2\delta_{TE_3}^2 + C_3\alpha\delta_{TE_3}^2 + C_4\delta_{TE_3}M + C_5\alpha\delta_{TE_3}M$ $+C_6\delta_{LE_L}\delta_{TE_3}^2 + C_7\delta_{TE_3}^2M$
CDTE4R	$C_0\delta_{TE_4} + C_1\alpha\delta_{TE_4} + C_2\delta_{TE_4}^2 + C_3\alpha\delta_{TE_4}^2 + C_4\delta_{TE_4}M + C_5\alpha\delta_{TE_4}M$ $+C_6\delta_{TE_4}^2M + C_7\delta_{LE_L}\delta_{TE_4}^2$
CDTE5R	$C_0\delta_{TE_5} + C_1\alpha\delta_{TE_5} + C_2\delta_{TE_5}^2 + C_3\alpha\delta_{TE_5}^2 + C_4\delta_{TE_5}M + C_5\alpha\delta_{TE_5}M$ $+C_6\delta_{TE_5}^2M + C_7\delta_{LE_R}\delta_{TE_5}^2$
CDTE6R	$C_0\delta_{TE_6} + C_1\alpha\delta_{TE_6} + C_2\delta_{TE_6}^2 + C_3\alpha\delta_{TE_6}^2 + C_4\delta_{TE_6}M + C_5\alpha\delta_{TE_6}M$ $+C_6\delta_{LE_R}\delta_{TE_6}^2 + C_7\delta_{TE_6}^2M$
CDTE7R	$C_0\delta_{TE_7} + C_1\alpha\delta_{TE_7} + C_2\delta_{TE_7}^2 + C_3\alpha\delta_{TE_7}^2 + C_4\delta_{TE_7}M + C_5\alpha\delta_{TE_7}M$ $+C_6\delta_{TE_7}^2M + C_7\delta_{LE_R}\delta_{TE_7}^2 + C_8\alpha\delta_{LE_R}\delta_{TE_7}^2$
CDTE8R	$C_0\delta_{TE_8} + C_1\alpha\delta_{TE_8} + C_2\delta_{TE_8}^2 + C_3\alpha\delta_{TE_8}^2 + C_4\delta_{TE_8}M$ $+C_5\alpha\delta_{TE_8}M + C_6\delta_{LE_R}\delta_{TE_8}^2$
CDTE1E	$C_0\delta_{TE_1} + C_1\alpha_1\delta_{TE_1} + C_2\bar{q}_s\delta_{TE_1} + C_3\alpha_1\bar{q}_s\delta_{TE_1} + C_4M_1\delta_{TE_1} + C_5\alpha_1M_1\delta_{TE_1}$ $+C_6\bar{q}_s^2\delta_{TE_1} + C_7\bar{q}_sM_1\delta_{TE_1} + C_8\bar{q}_s^2M_1\delta_{TE_1} + C_9\alpha_1\bar{q}_s^2\delta_{TE_1}$
CDTE2E	$C_0\delta_{TE_2} + C_1\alpha_1\delta_{TE_2} + C_2\bar{q}_s\delta_{TE_2} + C_3\alpha_1\bar{q}_s\delta_{TE_2} + C_4M_1\delta_{TE_2}$ $+C_5\alpha_1M_1\delta_{TE_2} + C_6\bar{q}_sM_1\delta_{TE_2} + C_7\alpha_1\bar{q}_sM_1\delta_{TE_2}$

CDTE3E	$C_0\delta_{TE_3} + C_1\alpha_1\delta_{TE_3} + C_2\bar{q}_s\delta_{TE_3} + C_3\alpha_1\bar{q}_s\delta_{TE_3} + C_4M_1\delta_{TE_3} + C_5\alpha_1M_1\delta_{TE_3}$ $+C_6\bar{q}_sM_1\delta_{TE_3} + C_7\alpha_1\bar{q}_sM_1\delta_{TE_3} + C_8GW_s\delta_{TE_3}$
CDTE4E	$C_0\delta_{TE_4} + C_1M_1\delta_{TE_4} + C_2\alpha_1\delta_{TE_4} + C_3\alpha_1M_1\delta_{TE_4} + C_4GW_s\delta_{TE_4} + C_5\bar{q}_s\delta_{TE_4}$ $+C_6\bar{q}_sGW_s\delta_{TE_4} + C_7\alpha_1GW_s\delta_{TE_4} + C_8\bar{q}_sM_1\delta_{TE_4}$
CDTE5E	$C_0\delta_{TE_5} + C_1M_1\delta_{TE_5} + C_2\alpha_1\delta_{TE_5} + C_3\alpha_1M_1\delta_{TE_5} + C_4GW_s\delta_{TE_5} + C_5\bar{q}_s\delta_{TE_5}$ $+C_6\bar{q}_sGW_s\delta_{TE_5} + C_7\alpha_1GW_s\delta_{TE_5} + C_8\bar{q}_sM_1\delta_{TE_5}$
CDTE6E	$C_0\delta_{TE_6} + C_1\alpha_1\delta_{TE_6} + C_2\bar{q}_s\delta_{TE_6} + C_3\alpha_1\bar{q}_s\delta_{TE_6} + C_4M_1\delta_{TE_6} + C_5\alpha_1M_1\delta_{TE_6}$ $+C_6\bar{q}_sM_1\delta_{TE_6} + C_7\alpha_1\bar{q}_sM_1\delta_{TE_6} + C_8GW_s\delta_{TE_6}$
CDTE7E	$C_0\delta_{TE_7} + C_1\alpha_1\delta_{TE_7} + C_2\bar{q}_s\delta_{TE_7} + C_3\alpha_1\bar{q}_s\delta_{TE_7} + C_4M_1\delta_{TE_7}$ $+C_5\alpha_1M_1\delta_{TE_7} + C_6\bar{q}_sM_1\delta_{TE_7} + C_7\alpha_1\bar{q}_sM_1\delta_{TE_7}$
CDTE8E	$C_0\delta_{TE_8} + C_1\alpha_1\delta_{TE_8} + C_2\bar{q}_s\delta_{TE_8} + C_3\alpha_1\bar{q}_s\delta_{TE_8} + C_4M_1\delta_{TE_8} + C_5\alpha_1M_1\delta_{TE_8}$ $+C_6\bar{q}_s^2\delta_{TE_8} + C_7\bar{q}_sM_1\delta_{TE_8} + C_8\bar{q}_s^2M_1\delta_{TE_8} + C_9\alpha_1\bar{q}_s^2\delta_{TE_8}$
KDTE1	if M<.3 and $\delta_{TE_{234}}>0$ $C_0\delta l_{TE_{234}} + C_1\delta l_{TE_{234}}^2 + C_2\alpha\delta l_{TE_{234}} + C_3\alpha\delta l_{TE_{234}}^2 + C_4\delta_{LE_L}\delta l_{TE_{234}}$ $+C_5\alpha\delta_{LE_L}\delta l_{TE_{234}} + C_6\delta_{LE_L}^2\delta l_{TE_{234}} + C_7\alpha\delta_{LE_L}^2\delta l_{TE_{234}} + 1$ else 1.0
KDTE2	if M<.3 and $\delta_{TE_{134}}>0$ $C_0\delta l_{TE_{134}} + C_1\delta l_{TE_{134}}^2 + C_2\alpha\delta l_{TE_{134}} + C_3\alpha\delta l_{TE_{134}}^2 + C_4\delta_{LE_L}\delta l_{TE_{134}}$ $+C_5\alpha\delta_{LE_L}\delta l_{TE_{134}} + C_6\delta_{LE_L}^2\delta l_{TE_{134}} + C_7\alpha\delta_{LE_L}^2\delta l_{TE_{134}} + 1$ else 1.0
KDTE3	if M<.3 and $\delta_{TE_{124}}>0$ $C_0\delta l_{TE_{124}} + C_1\delta l_{TE_{124}}^2 + C_2\alpha\delta l_{TE_{124}} + C_3\alpha\delta l_{TE_{124}}^2 + C_4\delta_{LE_L}\delta l_{TE_{124}}$ $+C_5\alpha\delta_{LE_L}\delta l_{TE_{124}} + C_6\delta_{LE_L}^2\delta l_{TE_{124}} + C_7\alpha\delta_{LE_L}^2\delta l_{TE_{124}} + 1$ else 1.0

KDTE4	if M<.3 and $\delta_{TE_{123}}>0$ $C_0\delta l_{TE_{123}} + C_1\delta l_{TE_{123}}{}^2 + C_2\alpha\delta l_{TE_{123}} + C_3\alpha\delta l_{TE_{123}}{}^2 + C_4\delta_{LE_L}\delta l_{TE_{123}}$ $+C_5\alpha\delta_{LE_L}\delta l_{TE_{123}} + C_6\delta_{LE_L}{}^2\delta l_{TE_{123}} + C_7\alpha\delta_{LE_L}{}^2\delta l_{TE_{123}} + 1$ else 1.0
KDTE5	if M<.3 and $\delta_{TE_{678}}>0$ $C_0\delta l_{TE_{678}} + C_1\delta l_{TE_{678}}{}^2 + C_2\alpha\delta l_{TE_{678}} + C_3\alpha\delta l_{TE_{678}}{}^2 + C_4\delta_{LE_R}\delta l_{TE_{678}}$ $+C_5\alpha\delta_{LE_R}\delta l_{TE_{678}} + C_6\delta_{LE_R}{}^2\delta l_{TE_{678}} + C_7\alpha\delta_{LE_R}{}^2\delta l_{TE_{678}} + 1$ else 1.0
KDTE6	if M<.3 and $\delta_{TE_{578}}>0$ $C_0\delta l_{TE_{578}} + C_1\delta l_{TE_{578}}{}^2 + C_2\alpha\delta l_{TE_{578}} + C_3\alpha\delta l_{TE_{578}}{}^2 + C_4\delta_{LE_R}\delta l_{TE_{578}}$ $+C_5\alpha\delta_{LE_R}\delta l_{TE_{578}} + C_6\delta_{LE_R}{}^2\delta l_{TE_{578}} + C_7\alpha\delta_{LE_R}{}^2\delta l_{TE_{578}} + 1$ else 1.0
KDTE7	if M<.3 and $\delta_{TE_{568}}>0$ $C_0\delta l_{TE_{568}} + C_1\delta l_{TE_{568}}{}^2 + C_2\alpha\delta l_{TE_{568}} + C_3\alpha\delta l_{TE_{568}}{}^2 + C_4\delta_{LE_R}\delta l_{TE_{568}}$ $+C_5\alpha\delta_{LE_R}\delta l_{TE_{568}} + C_6\delta_{LE_R}{}^2\delta l_{TE_{568}} + C_7\alpha\delta_{LE_R}{}^2\delta l_{TE_{568}} + 1$ else 1.0
KDTE8	if M<.3 and $\delta_{TE_{567}}>0$ $C_0\delta l_{TE_{567}} + C_1\delta l_{TE_{567}}{}^2 + C_2\alpha\delta l_{TE_{567}} + C_3\alpha\delta l_{TE_{567}}{}^2 + C_4\delta_{LE_R}\delta l_{TE_{567}}$ $+C_5\alpha\delta_{LE_R}\delta l_{TE_{567}} + C_6\delta_{LE_R}{}^2\delta l_{TE_{567}} + C_7\alpha\delta_{LE_R}{}^2\delta l_{TE_{567}} + 1$ else 1.0

CDVFR	if M<=.5 $C_0\delta_{VF} + C_1\beta^2\delta_{VF} + C_2\alpha\delta_{VF} + C_3\alpha\beta^2\delta_{VF} + C_4M_2\delta_{VF}$ $+C_5\delta l_{TE_{AVG}}\delta_{VF} + C_6\alpha^2\delta_{VF} + C_7\alpha M_2\delta_{VF} + C_8\alpha\delta l_{TE_{AVG}}\delta_{VF}$ $+C_9M_2\delta l_{TE_{AVG}}\delta_{VF} + C_{10}\delta l_{TE_{AVG}}{}^2\delta_{VF} + C_{11}\alpha^2M_2\delta_{VF}$ $+C_{12}\alpha M_2\delta l_{TE_{AVG}}\delta_{VF} + C_{13}\alpha\delta l_{TE_{AVG}}{}^2\delta_{VF}$ else 0.0
CDSP1R	$C_0\delta_{SP_1} + C_1\delta l_{TE_{AVG}}\delta_{SP_1} + C_2\delta l_{TE_{AVG}}{}^2\delta_{SP_1} + C_3\alpha\delta_{SP_1} + C_4\delta_{LE_{AVG}}\delta_{SP_1}$ $+C_5\delta_{LE_{AVG}}{}^2\delta_{SP_1} + C_6\delta_{SP_1}{}^2 + C_7\delta_{LE_{AVG}}\delta_{SP_1}{}^2$
CDSP2R	$C_0\delta_{SP_2} + C_1\alpha\delta_{SP_2} + C_2\alpha^2\delta_{SP_2} + C_3\delta l_{TE_{AVG}}\delta_{SP_2} + C_4\alpha\delta l_{TE_{AVG}}\delta_{SP_2}$ $+C_5\delta_{LE_{AVG}}\delta_{SP_2} + C_6\delta_{LE_{AVG}}{}^2\delta_{SP_2} + C_7\alpha\delta_{LE_{AVG}}\delta_{SP_2} + C_8\delta_{LE_{AVG}}\delta l_{TE_{AVG}}\delta_{SP_2}$
CDSP3R	$C_0\delta_{SP_3} + C_1\alpha\delta_{SP_3} + C_2\alpha^2\delta_{SP_3} + C_3\delta l_{TE_{AVG}}\delta_{SP_3} + C_4\alpha\delta l_{TE_{AVG}}\delta_{SP_3}$ $+C_5\delta_{LE_{AVG}}\delta_{SP_3} + C_6\delta_{LE_{AVG}}{}^2\delta_{SP_3} + C_7\alpha\delta_{LE_{AVG}}\delta_{SP_3} + C_8\delta_{LE_{AVG}}\delta l_{TE_{AVG}}\delta_{SP_3}$
CDSP4R	$C_0\delta_{SP_4} + C_1\delta l_{TE_{AVG}}\delta_{SP_4} + C_2\delta l_{TE_{AVG}}{}^2\delta_{SP_4} + C_3\alpha\delta_{SP_4} + C_4\delta_{LE_{AVG}}\delta_{SP_4}$ $+C_5\delta_{LE_{AVG}}{}^2\delta_{SP_4} + C_6\delta_{SP_4}{}^2 + C_7\delta_{LE_{AVG}}\delta_{SP_4}{}^2$
CDGR	if $\frac{h_r}{b_w}$<0.932 $C_0 + C_1\alpha_1 + C_2\frac{h_r}{b_w} + C_3\alpha_1\frac{h_r}{b_w} + C_4\left[\frac{h_r}{b_w}\right]^2 + C_5\alpha_1\left[\frac{h_r}{b_w}\right]^2 + C_6\alpha_1{}^2$ $+C_7\delta l_{TE_{AVG}} + C_8\alpha_1\delta l_{TE_{AVG}} + C_9\alpha_1{}^2\delta l_{TE_{AVG}} + C_{10}\delta l_{TE_{AVG}}\frac{h_r}{b_w}$ $+C_{11}\alpha_1\delta l_{TE_{AVG}}\frac{h_r}{b_w} + C_{12}\alpha_1{}^2\frac{h_r}{b_w}$ else 0.0
CDUS1	$C_0 + C_1\alpha_2 + C_2\alpha_2{}^2 + C_3\beta_1 + C_4\alpha_2\beta_1 + C_5M_4 + C_6\alpha_2M_4$
KDUS1	$C_0 + C_1\frac{W_{O_{SP}}}{W_C l_1} + C_2\left[\frac{W_{O_{SP}}}{W_C l_1}\right]^2 + C_3M_3 + C_4M_3{}^2$

CDUS4	$C_0 + C_1\alpha_2 + C_2\alpha_2^{\,2} + C_3\beta_1 + C_4\alpha_2\beta_1 + C_5M_4 + C_6\alpha_2M_4$
KDUS4	$C_0 + C_1\frac{W_{O_{SP}}}{W_C l_4} + C_2\left[\frac{W_{O_{SP}}}{W_C l_4}\right]^2 + C_3M_3 + C_4M_3^{\,2}$
CDUS12	$C_0 + C_1\alpha_2 + C_2M_4 + C_3\alpha_2M_4 + C_4\alpha_2^{\,2} + C_5\alpha_2^{\,2}M_4$ $+C_6\beta_1 + C_7M_4^{\,2} + C_8\alpha_2M_4^{\,2}$
KDUS12	$C_0 + C_1\frac{W_{O_{SP}}}{W_C l_{1,2}} + C_2M_3 + C_3\left[\frac{W_{O_{SP}}}{W_C l_{1,2}}\right]^2 + C_4\frac{W_{O_{SP}}}{W_C l_{1,2}}M_3 + C_5\left[\frac{W_{O_{SP}}}{W_C l_{1,2}}\right]^2 M_3$
CDUS34	$C_0 + C_1\alpha_2 + C_2M_4 + C_3\alpha_2M_4 + C_4\alpha_2^{\,2} + C_5\alpha_2^{\,2}M_4$ $+C_6\beta_1 + C_7M_4^{\,2} + C_8\alpha_2M_4^{\,2}$
KDUS34	$C_0 + C_1\frac{W_{O_{SP}}}{W_C l_{3,4}} + C_2M_3 + C_3\left[\frac{W_{O_{SP}}}{W_C l_{3,4}}\right]^2 + C_4\frac{W_{O_{SP}}}{W_C l_{3,4}}M_3 + C_5\left[\frac{W_{O_{SP}}}{W_C l_{3,4}}\right]^2 M_3$
CD1_US	if flus1=1 and flus2=1 0.0 else if flus1=1 KDUS1*CDUS1 else 0.0
CD4_US	if flus3=1 and flus4=1 0.0 else if flus4=1 KDUS4*CDUS4 else 0.0
CD12_US	if flus1=1 and flus2=1 KDUS12*CDUS12 else 0.0

CD34_US	if flus3=1 and flus4=1 KDUS34*CDUS34 else 0.0
CDLGR	$C_0 + C_1\alpha_1 + C_2\alpha_1^2 + C_3\alpha_1^3 + C_4\alpha_1^4 + C_5\alpha_1^5$
KLLGR	$C_0 + C_1\delta_{GEAR} + C_2\delta_{GEAR}^2 + C_3\delta_{GEAR}^3$
CDDSR	$C_0\delta_s + C_1\alpha_1\delta_s + C_2\delta_s^2$
CDDER	$C_0\delta_e + C_1\alpha_1\delta_e + C_2\delta_e^2 + C_3\alpha_1\delta_e^2 + C_4M\delta_e^2 + C_5M\delta_e + C_6\alpha_1M\delta_e$
CDTHLR	if M<.65 & $\delta_{TE_{AVG}}$>0.0 & δ_s~=0.0 $C_0\delta_s\delta_{TE_{AVG}} + C_1\delta_{TE_{AVG}} + C_2\alpha\delta_{TE_{AVG}} + C_3\alpha^2\delta_{TE_{AVG}}$ $+C_4\alpha^3\delta_{TE_{AVG}} + C_5\delta_{TE_{AVG}}^2 + C_6\alpha\delta_{TE_{AVG}}^2$ $+C_7\alpha^2\delta_{TE_{AVG}}^2 + C_8\delta_s^2\delta_{TE_{AVG}} + C_9\alpha\delta_s^2\delta_{TE_{AVG}}$ else 0.0
DECDDS	$C_0\bar{q}_s + C_1\alpha_1\bar{q}_s + C_2\bar{q}_sM_1 + C_3\alpha_1\bar{q}_sM_1 + C_4\bar{q}_s^2 + C_5\alpha_1\bar{q}_s^2$ $+C_6\bar{q}_sGW_s + C_7\bar{q}_sM_1GW_s + C_8\bar{q}_sGW_s^2 + C_9\bar{q}_sM_1GW_s^2$ $+C_{10}\alpha_1\bar{q}_sGW_s + C_{11}\alpha_1\bar{q}_sM_1GW_s$
DECDDE	$C_0\bar{q}_s + C_1\alpha_1\bar{q}_s + C_2\bar{q}_sM_1 + C_3\alpha_1\bar{q}_sM_1 + C_4\bar{q}_sM_1^2$ $+C_5\alpha_1\bar{q}_sM_1^2 + C_6\bar{q}_sGW_s + C_7\bar{q}_sM_1GW_s$
CDQR	$C_0 + C_1\alpha + C_2M + C_3\alpha M + C_4M^2 + C_5\alpha M^2$
CDQRJD	$C_0 + C_1\alpha_1 + C_2M_1 + C_3M_1^2 + C_4\alpha_1M_1 + C_5\alpha_1M_1^2$
CDQTER	$C_0\delta_{TE_{AVG}} + C_1M\delta_{TE_{AVG}} + C_2M^2\delta_{TE_{AVG}} + C_3\alpha_1\delta_{TE_{AVG}}$ $+C_4\alpha_1M\delta_{TE_{AVG}} + C_5\alpha_1M^2\delta_{TE_{AVG}}$
CDQLER	$C_0\delta_{LE_{AVG}} + C_1\alpha_1\delta_{LE_{AVG}} + C_2M\delta_{LE_{AVG}}$
CDQE	$C_0\bar{q}_s + C_1\alpha_1\bar{q}_s + C_2\bar{q}_sM_1 + C_3\alpha_1\bar{q}_sM_1 + C_4\bar{q}_sGW_s + C_5\alpha_1\bar{q}_sGW_s$ $+C_6\bar{q}_sM_1^2 + C_7\alpha_1\bar{q}_sM_1^2 + C_8\bar{q}_s^2 + C_9\bar{q}_s^2M_1 + C_{10}\alpha_1\bar{q}_s^2$
CDQDR	$C_0 + C_1\alpha_1 + C_2M_1 + C_3\alpha_1M_1 + C_4M_1^2 + C_5\alpha_1M_1^2 + C_6M_1^3$

CDQDE	$C_0\bar{q}_s + C_1\alpha_1\bar{q}_s + C_2\bar{q}_sM_1 + C_3\alpha_1\bar{q}_sM_1 + C_4\bar{q}_sM_1^2 + C_5\alpha_1\bar{q}_sM_1^2$ $+C_6\bar{q}_sGW_s + C_7\alpha_1\bar{q}_sGW_s + C_8\bar{q}_sM_1GW_s + C_9\alpha_1\bar{q}_sM_1GW_s$ $+C_{10}\bar{q}_sM_1^3 + C_{11}\bar{q}_sM_1^2GW_s$
CDADR	$C_0 + C_1\alpha_1 + C_2M_1 + C_3\alpha_1M_1 + C_4M_1^2 + C_5\alpha_1M_1^2$
CDADE	$C_0\bar{q}_s + C_1\alpha_1\bar{q}_s + C_2M_1\bar{q}_s + C_3\alpha_1M_1\bar{q}_s + C_4M_1^2\bar{q}_s + C_5\alpha_1M_1^2\bar{q}_s$ $+C_6\bar{q}_sGW_s + C_7M_1\bar{q}_sGW_s + C_8M_1^3\bar{q}_s + C_9\alpha_1\bar{q}_sGW_s$ $+C_{10}\alpha_1M_1\bar{q}_sGW_s + C_{11}M_1^2\bar{q}_sGW_s$

Table 2 - CD Supersonic

COMPONENT	MODEL
CDR	$C_0 + C_1\alpha_1 + C_2\alpha_1^2 + C_3M + C_4\alpha_1M + C_5\alpha_1^2M + C_6M^2 + C_7\alpha_1M^2$
DCDE	$C_0\bar{q}_s + C_1\bar{q}_sGW_s + C_2\bar{q}_s\alpha_1 + C_3\bar{q}_s\alpha_1GW_s + C_4\bar{q}_sM_1$ $+C_5\bar{q}_sM_1GW_s + C_6\bar{q}_s\alpha_1M_1 + C_7\bar{q}_s\alpha_1M_1GW_s + C_8\bar{q}_s^2$ $+C_9\bar{q}_s^2\alpha_1 + C_{10}\bar{q}_s\alpha_1^2 + C_{11}\bar{q}_s\alpha_1^2GW_s + C_{12}\bar{q}_s^2M_1$
CDBR	$C_0\beta_2 + C_1\alpha\beta_2 + C_2\beta_2^2 + C_3\alpha\beta_2^2 + C_4\beta_2M + C_5\beta_2M^2$ $+C_6\alpha\beta_2M + C_7\alpha\beta_2M^2 + C_8\alpha^2\beta_2$
CDRJD	$C_0 + C_1\alpha_1 + C_2M_1 + C_3\alpha_1M_1 + C_4M_1^2 + C_5\alpha_1M_1^2 + C_6\alpha_1^2$
CDLE1R	$C_0\delta_{LE_1} + C_1M\delta_{LE_1} + C_2\alpha\delta_{LE_1} + C_3M\alpha\delta_{LE_1} + C_4M^2\delta_{LE_1} + C_5M^2\alpha\delta_{LE_1}$ $+C_6\alpha^2\delta_{LE_1} + C_7M\alpha^2\delta_{LE_1} + C_8M^3\delta_{LE_1} + C_9\delta_{LE_1}\delta l_{TE_L} + C_{10}M\delta_{LE_1}\delta l_{TE_L}$
CDLE2R	$C_0\delta_{LE_2} + C_1M\delta_{LE_2} + C_2\alpha\delta_{LE_2} + C_3M\alpha\delta_{LE_2} + C_4\alpha^2\delta_{LE_2}$ $+C_5M\alpha^2\delta_{LE_2} + C_6\delta_{LE_2}\delta l_{TE_L} + C_7M\delta_{LE_2}\delta l_{TE_L}$
CDLE3R	$C_0\delta_{LE_3} + C_1M\delta_{LE_3} + C_2\alpha\delta_{LE_3} + C_3M\alpha\delta_{LE_3} + C_4\alpha^2\delta_{LE_3}$ $+C_5M\alpha^2\delta_{LE_3} + C_6\delta_{LE_3}\delta l_{TE_R} + C_7M\delta_{LE_3}\delta l_{TE_R}$
CDLE4R	$C_0\delta_{LE_4} + C_1M\delta_{LE_4} + C_2\alpha\delta_{LE_4} + C_3M\alpha\delta_{LE_4} + C_4M^2\delta_{LE_4} + C_5M^2\alpha\delta_{LE_4}$ $+C_6\alpha^2\delta_{LE_4} + C_7M\alpha^2\delta_{LE_4} + C_8M^3\delta_{LE_4} + C_9\delta_{LE_4}\delta l_{TE_R} + C_{10}M\delta_{LE_4}\delta l_{TE_R}$
CDLE1E	$C_0\delta_{LE_1} + C_1M_1\delta_{LE_1} + C_2\alpha_1\delta_{LE_1} + C_3\alpha_1M_1\delta_{LE_1} + C_4\bar{q}_s\delta_{LE_1}$ $+C_5\bar{q}_sM_1\delta_{LE_1} + C_6\alpha_1\bar{q}_s\delta_{LE_1}$
CDLE2E	$C_0\delta_{LE_2} + C_1\alpha_1\delta_{LE_2} + C_2\bar{q}_s\delta_{LE_2} + C_3\alpha_1\bar{q}_s\delta_{LE_2}$
CDLE3E	$C_0\delta_{LE_3} + C_1\alpha_1\delta_{LE_3} + C_2\bar{q}_s\delta_{LE_3} + C_3\alpha_1\bar{q}_s\delta_{LE_3}$
CDLE4E	$C_0\delta_{LE_4} + C_1M_1\delta_{LE_4} + C_2\alpha_1\delta_{LE_4} + C_3\alpha_1M_1\delta_{LE_4} + C_4\bar{q}_s\delta_{LE_4}$ $+C_5\bar{q}_sM_1\delta_{LE_4} + C_6\alpha_1\bar{q}_s\delta_{LE_4}$
CDTEBR	0.0
CDTE1R	$C_0\delta_{TE_1} + C_1\alpha\delta_{TE_1} + C_2\delta_{TE_1}^2 + C_3\alpha\delta_{TE_1}^2 + C_4\delta_{TE_1}^2M$ $+C_5\alpha\delta_{TE_1}^2M + C_6\delta_{TE_1}M$

CDTE2R	$C_0\delta_{TE_2} + C_1\alpha\delta_{TE_2} + C_2{\delta_{TE_2}}^2 + C_3\alpha{\delta_{TE_2}}^2 + C_4\delta_{TE_2}M + C_5{\delta_{TE_2}}^2M$ $+C_6\alpha{\delta_{TE_2}}^2M + C_7\alpha\delta_{TE_2}M + C_8\delta_{LE_L}\delta_{TE_2}{}^2 + C_9\alpha\delta_{LE_L}\delta_{TE_2}{}^2$
CDTE3R	$C_0\delta_{TE_3} + C_1\alpha\delta_{TE_3} + C_2{\delta_{TE_3}}^2 + C_3\alpha{\delta_{TE_3}}^2 + C_4{\delta_{TE_3}}^2M$ $+C_5\alpha{\delta_{TE_3}}^2M + C_6\delta_{TE_3}M$
CDTE4R	$C_0\delta_{TE_4} + C_1\alpha\delta_{TE_4} + C_2{\delta_{TE_4}}^2 + C_3\alpha{\delta_{TE_4}}^2 + C_4\delta_{TE_4}M + C_5\alpha\delta_{TE_4}M$
CDTE5R	$C_0\delta_{TE_5} + C_1\alpha\delta_{TE_5} + C_2{\delta_{TE_5}}^2 + C_3\alpha{\delta_{TE_5}}^2 + C_4\delta_{TE_5}M + C_5\alpha\delta_{TE_5}M$
CDTE6R	$C_0\delta_{TE_6} + C_1\alpha\delta_{TE_6} + C_2{\delta_{TE_6}}^2 + C_3\alpha{\delta_{TE_6}}^2 + C_4{\delta_{TE_6}}^2M$ $+C_5\alpha{\delta_{TE_6}}^2M + C_6\delta_{TE_6}M$
CDTE7R	$C_0\delta_{TE_7} + C_1\alpha\delta_{TE_7} + C_2{\delta_{TE_7}}^2 + C_3\alpha{\delta_{TE_7}}^2 + C_4\delta_{TE_7}M + C_5{\delta_{TE_7}}^2M$ $+C_6\alpha{\delta_{TE_7}}^2M + C_7\alpha\delta_{TE_7}M + C_8\delta_{LE_R}\delta_{TE_7}{}^2 + C_9\alpha\delta_{LE_R}\delta_{TE_7}{}^2$
CDTE8R	$C_0\delta_{TE_8} + C_1\alpha\delta_{TE_8} + C_2{\delta_{TE_8}}^2 + C_3\alpha{\delta_{TE_8}}^2 + C_4{\delta_{TE_8}}^2M$ $+C_5\alpha{\delta_{TE_8}}^2M + C_6\delta_{TE_8}M$
CDTE1E	$C_0\delta_{TE_1} + C_1M_1\delta_{TE_1} + C_2\alpha_1\delta_{TE_1} + C_3\bar{q}_s\delta_{TE_1} + C_4\alpha_1M_1\delta_{TE_1}$ $+C_5\bar{q}_sM_1\delta_{TE_1} + C_6\alpha_1\bar{q}_s\delta_{TE_1} + C_7{\bar{q}_s}^2\delta_{TE_1} + C_8\alpha_1{\bar{q}_s}^2\delta_{TE_1}$
CDTE2E	$C_0\delta_{TE_2} + C_1\alpha_1\delta_{TE_2} + C_2\bar{q}_s\delta_{TE_2} + C_3\alpha_1\bar{q}_s\delta_{TE_2} + C_4M_1\delta_{TE_2}$ $+C_5\alpha_1M_1\delta_{TE_2} + C_6\bar{q}_sM_1\delta_{TE_2} + C_7\alpha_1\bar{q}_sM_1\delta_{TE_2}$
CDTE3E	$C_0\delta_{TE_3} + C_1\alpha_1\delta_{TE_3} + C_2M_1\delta_{TE_3} + C_3\alpha_1M_1\delta_{TE_3} + C_4\bar{q}_s\delta_{TE_3}$ $+C_5\alpha_1\bar{q}_s\delta_{TE_3} + C_6\bar{q}_sM_1\delta_{TE_3} + C_7\alpha_1\bar{q}_sM_1\delta_{TE_3}$
CDTE4E	$C_0\delta_{TE_4} + C_1M_1\delta_{TE_4} + C_2\alpha_1\delta_{TE_4} + C_3\alpha_1M_1\delta_{TE_4} + C_4\bar{q}_s\delta_{TE_4}$ $+C_5\bar{q}_sM_1\delta_{TE_4} + C_6\alpha_1\bar{q}_s\delta_{TE_4}$
CDTE5E	$C_0\delta_{TE_5} + C_1M_1\delta_{TE_5} + C_2\alpha_1\delta_{TE_5} + C_3\alpha_1M_1\delta_{TE_5} + C_4\bar{q}_s\delta_{TE_5}$ $+C_5\bar{q}_sM_1\delta_{TE_5} + C_6\alpha_1\bar{q}_s\delta_{TE_5}$
CDTE6E	$C_0\delta_{TE_6} + C_1\alpha_1\delta_{TE_6} + C_2M_1\delta_{TE_6} + C_3\alpha_1M_1\delta_{TE_6} + C_4\bar{q}_s\delta_{TE_6}$ $+C_5\alpha_1\bar{q}_s\delta_{TE_6} + C_6\bar{q}_sM_1\delta_{TE_6} + C_7\alpha_1\bar{q}_sM_1\delta_{TE_6}$
CDTE7E	$C_0\delta_{TE_7} + C_1\alpha_1\delta_{TE_7} + C_2\bar{q}_s\delta_{TE_7} + C_3\alpha_1\bar{q}_s\delta_{TE_7} + C_4M_1\delta_{TE_7}$ $+C_5\alpha_1M_1\delta_{TE_7} + C_6\bar{q}_sM_1\delta_{TE_7} + C_7\alpha_1\bar{q}_sM_1\delta_{TE_7}$

CDTE8E	$C_0\delta_{TE_8} + C_1M_1\delta_{TE_8} + C_2\alpha_1\delta_{TE_8} + C_3\bar{q}_s\delta_{TE_8} + C_4\alpha_1M_1\delta_{TE_8}$ $+C_5\bar{q}_sM_1\delta_{TE_8} + C_6\alpha_1\bar{q}_s\delta_{TE_8} + C_7\bar{q}_s{}^2\delta_{TE_8} + C_8\alpha_1\bar{q}_s{}^2\delta_{TE_8}$
KDTE1	1.0
KDTE2	1.0
KDTE3	1.0
KDTE4	1.0
KDTE5	1.0
KDTE6	1.0
KDTE7	1.0
KDTE8	1.0
CDVFR	0.0
CDGR	if $\frac{h_r}{b_w}<0.932$ $C_0 + C_1\alpha_1 + C_2\frac{h_r}{b_w} + C_3\alpha_1\frac{h_r}{b_w} + C_4\left[\frac{h_r}{b_w}\right]^2 + C_5\alpha_1\left[\frac{h_r}{b_w}\right]^2 + C_6\alpha_1{}^2$ $+C_7\delta l_{TE_{AVG}} + C_8\alpha_1\delta l_{TE_{AVG}} + C_9\alpha_1{}^2\delta l_{TE_{AVG}} + C_{10}\delta l_{TE_{AVG}}\frac{h_r}{b_w}$ $+C_{11}\alpha_1\delta l_{TE_{AVG}}\frac{h_r}{b_w} + C_{12}\alpha_1{}^2\frac{h_r}{b_w}$ else 0.0
CDUS1	$C_0 + C_1\alpha_2 + C_2\alpha_2{}^2 + C_3\beta_1 + C_4\alpha_2\beta_1 + C_5M_4 + C_6\alpha_2M_4$
KDUS1	$C_0 + C_1\frac{W_{OSP}}{W_Cl_1} + C_2\left[\frac{W_{OSP}}{W_Cl_1}\right]^2 + C_3M_3 + C_4M_3{}^2$
CDUS4	$C_0 + C_1\alpha_2 + C_2\alpha_2{}^2 + C_3\beta_1 + C_4\alpha_2\beta_1 + C_5M_4 + C_6\alpha_2M_4$
KDUS4	$C_0 + C_1\frac{W_{OSP}}{W_Cl_4} + C_2\left[\frac{W_{OSP}}{W_Cl_4}\right]^2 + C_3M_3 + C_4M_3{}^2$

CDUS12	$C_0 + C_1\alpha_2 + C_2M_4 + C_3\alpha_2M_4 + C_4{\alpha_2}^2 + C_5{\alpha_2}^2M_4$ $+C_6\beta 1 + C_7{M_4}^2 + C_8\alpha_2{M_4}^2$
KDUS12	$C_0 + C_1\frac{W_{OSP}}{W_C l_{1,2}} + C_2M_3 + C_3\left[\frac{W_{OSP}}{W_C l_{1,2}}\right]^2 + C_4\frac{W_{OSP}}{W_C l_{1,2}}M_3 + C_5\left[\frac{W_{OSP}}{W_C l_{1,2}}\right]^2 M_3$
CDUS34	$C_0 + C_1\alpha_2 + C_2M_4 + C_3\alpha_2M_4 + C_4{\alpha_2}^2 + C_5{\alpha_2}^2M_4$ $+C_6\beta_1 + C_7{M_4}^2 + C_8\alpha_2{M_4}^2$
KDUS34	$C_0 + C_1\frac{W_{OSP}}{W_C l_{3,4}} + C_2M_3 + C_3\left[\frac{W_{OSP}}{W_C l_{3,4}}\right]^2 + C_4\frac{W_{OSP}}{W_C l_{3,4}}M_3 + C_5\left[\frac{W_{OSP}}{W_C l_{3,4}}\right]^2 M_3$
CD1_US	if flus1=1 and flus2=1 0.0 else if flus1=1 kdus1*cdus1 else 0.0
CD4_US	if flus3=1 and flus4=1 0.0 else if flus4=1 kdus4*cdus4 else 0.0
CD12_US	if flus1=1 and flus2=1 kdus12*cdus12 else 0.0

CD34_US	if flus3=1 and flus4=1 klus34*clus34 else 0.0
CDLGR	$C_0 + C_1\alpha_1 + C_2{\alpha_1}^2 + C_3{\alpha_1}^3 + C_4{\alpha_1}^4 + C_5{\alpha_1}^5$
KLLGR	$C_0 + C_1\delta_{GEAR} + C_2{\delta_{GEAR}}^2 + C_3{\delta_{GEAR}}^3$
CDDSR	$C_0\delta_s + C_1\alpha_1\delta_s + C_2{\delta_s}^2 + C_3M{\delta_s}^2 + C_4M\delta_s + C_5\alpha_1M\delta_s$ $+C_6M^2\delta_s + C_7\alpha_1M^2\delta_s + C_8\alpha_1{\delta_s}^2 + C_9{\alpha_1}^2\delta_s$
CDDER	$C_0{\delta_e}^2 + C_1\delta_e + C_2\alpha_1\delta_e + C_3M{\delta_e}^2 + C_4M\delta_e + C_5\alpha_1M\delta_e + C_6M^2{\delta_e}^2$ $+C_7{\delta_e}^3 + C_8M{\delta_e}^3 + C_9\alpha_1{\delta_e}^2 + C_{10}\alpha_1M{\delta_e}^2 + C_{11}\alpha_1{\delta_e}^3 + C_{12}M^2\delta_e$
CDTHLR	0.0
DECDDS	$C_0\bar{q}_s + C_1\alpha_1\bar{q}_s + C_2\bar{q}_sM_1 + C_3\alpha_1\bar{q}_sM_1 + C_4\bar{q}_sGW_s + C_5\bar{q}_sGW_s^2$ $+C_6\alpha_1\bar{q}_sGW_s + C_7\alpha_1\bar{q}_sGW_s^2 + C_8\bar{q}_sM_1GW_s + C_9\alpha_1\bar{q}_sM_1GW_s$ $+C_{10}\bar{q}_s^2 + C_{11}\bar{q}_s^2M_1 + C_{12}\alpha_1\bar{q}_s^2 + C_{13}\alpha_1\bar{q}_s^2M_1$
DECDDE	$C_0\bar{q}_s + C_1\alpha_1\bar{q}_s + C_2\bar{q}_sM_1 + C_3\alpha_1\bar{q}_sM_1 + C_4\bar{q}_sM_1^2 + C_5\alpha_1\bar{q}_sM_1^2$ $+C_6\bar{q}_s^2 + C_7\alpha_1\bar{q}_s^2 + C_8\bar{q}_s^2M_1 + C_9\alpha_1\bar{q}_s^2M_1$
CDQR	$C_0 + C_1\alpha + C_2M + C_3\alpha M + C_4M^2 + C_5\alpha M^2$
CDQRJD	$C_0 + C_1\alpha_1 + C_2M_1 + C_3\alpha_1M_1 + C_4M_1^2 + C_5\alpha_1M_1^2$
CDQTER	$C_0\delta_{TE_{AVG}} + C_1\alpha_1\delta_{TE_{AVG}} + C_2M\delta_{TE_{AVG}} + C_3M^2\delta_{TE_{AVG}}$ $+C_4{\alpha_1}^2\delta_{TE_{AVG}} + C_5\alpha_1M\delta_{TE_{AVG}}$
CDQLER	$C_0\delta_{LE_{AVG}} + C_1M\delta_{LE_{AVG}} + C_2\alpha_1\delta_{LE_{AVG}} + C_3\alpha_1M\delta_{LE_{AVG}} + C_4M^2\delta_{LE_{AVG}}$ $+C_5{\alpha_1}^2\delta_{LE_{AVG}} + C_6{\alpha_1}^2M\delta_{LE_{AVG}} + C_7\alpha_1M^2\delta_{LE_{AVG}}$
CDQE	$C_0\bar{q}_s + C_1\alpha_1\bar{q}_s + C_2\bar{q}_sM_1 + C_3\alpha_1\bar{q}_sM_1 + C_4\bar{q}_sM_1^2 + C_5\alpha_1\bar{q}_sM_1^2$ $+C_6\bar{q}_s^2 + C_7\alpha_1\bar{q}_s^2 + C_8\bar{q}_s^2M_1 + C_9\alpha_1\bar{q}_s^2M_1$
CDQDR	$C_0 + C_1\alpha_1 + C_2M_1 + C_3\alpha_1M_1 + C_4M_1^2 + C_5\alpha_1M_1^2 + C_6M_1^3$

CDQDE	$C_0\bar{q}_s + C_1\bar{q}_sM_1 + C_2\bar{q}_sGW_s + C_3\alpha_1\bar{q}_s + C_4\alpha_1\bar{q}_sM_1 + C_5\bar{q}_sM_1^2$ $+C_6\alpha_1\bar{q}_sGW_s + C_7\bar{q}_sM_1GW_s + C_8\alpha_1\bar{q}_sM_1GW_s + C_9\alpha_1\bar{q}_sM_1^2$ $+C_{10}\bar{q}_s^2 + C_{11}\alpha_1\bar{q}_s^2 + C_{12}\bar{q}_s^2M_1 + C_{13}\alpha_1\bar{q}_s^2M_1 + C_{14}\bar{q}_sM_1^2GW_s$
CDADR	$C_0 + C_1M_1 + C_2\alpha_1 + C_3\alpha_1M_1 + C_4M_1^2 + C_5\alpha_1M_1^2 + C_6M_1^3 + C_7\alpha_1M_1^3$
CDADE	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2\alpha_1\bar{q}_s + C_3\alpha_1M_1\bar{q}_s + C_4M_1^2\bar{q}_s + C_5M_1^3\bar{q}_s + C_6\bar{q}_s^2$ $+C_7\alpha_1\bar{q}_s^2 + C_8M_1\bar{q}_s^2 + C_9\alpha_1M_1\bar{q}_s^2 + C_{10}\alpha_1M_1^2\bar{q}_s + C_{11}\alpha_1M_1^3\bar{q}_s$

Table 3 - CD Coefficients

Coef. No.	cdr subsonic	cdr supersonic	dcde subsonic	dcde supersonic	cdbr subsonic	cdbr supersonic
C_0	5.9219e-02	-8.0589e-02	4.9716e-04	-1.2241e-03	1.0029e-04	-8.5215e-05
C_1	9.5047e-04	1.9460e-02	-4.7350e-05	2.7350e-05	5.7372e-04	-1.2639e-04
C_2	-1.3329e-04	2.2858e-03	-1.3906e-04	4.5171e-04	-1.0153e-03	5.5949e-07
C_3	-1.8197e-01	1.1758e-01	7.5707e-06	-1.1873e-04	-9.4194e-04	-2.3421e-06
C_4	-3.3822e-03	-3.4610e-02	-2.8739e-04	7.1919e-04	-3.7646e-05	-9.2169e-05
C_5	1.0826e-03	-7.8366e-04	2.9740e-05	-2.2430e-05	6.7649e-05	5.5854e-05
C_6	2.5182e-05	-3.3708e-02	5.6199e-04	-2.4488e-04	6.3732e-04	1.4192e-04
C_7	1.4050e-01	1.1262e-02	-8.8712e-05	5.1301e-05	3.8071e-04	-3.5623e-05
C_8			1.3478e-05	1.1792e-04	-3.1641e-05	-7.5994e-07
C_9			-2.0756e-06	7.5504e-06	7.3141e-06	
C_{10}			-8.7991e-06	4.7438e-06	-2.3888e-06	
C_{11}			4.7975e-06	-9.9378e-07		
C_{12}				-6.3682e-05		

Coef. No.	cdrjd subsonic	cdrjd supersonic	cdle1r,cdle4r subsonic	cdle1r,cdle4r supersonic	cdle2r,cdle3r subsonic	cdle2r,cdle3r supersonic
C_0	-5.7270e-04	-1.5929e-03	9.0645e-04	-4.0722e-03	1.5239e-04	7.0151e-05
C_1	5.4615e-04	1.2896e-03	-1.8575e-04	7.7580e-03	-3.7883e-05	-3.7045e-05
C_2	-6.3546e-04	4.8768e-04	-1.3703e-05	-3.6165e-04	-2.3624e-06	-3.1414e-05
C_3	3.9298e-04	-3.6035e-04	4.3387e-06	3.5365e-04	9.4538e-07	1.4906e-05
C_4			3.3680e-06	-4.5408e-03	5.9264e-07	4.6914e-07
C_5			-1.0585e-07	-7.7535e-05	-1.8780e-08	-2.2099e-07
C_6			-1.0705e-03	1.8830e-06	-6.1246e-07	-1.4816e-06
C_7			-3.4882e-06	-1.0365e-06	-1.7449e-04	8.1555e-07
C_8			1.7998e-05	8.2789e-04	1.0243e-05	
C_9			2.0647e-05	-7.1393e-06	3.5193e-06	
C_{10}			-1.4748e-06	3.9299e-06	-2.5138e-07	
C_{11}			1.5034e-06			

Coef. No.	cdle1e,cdle4e subsonic	cdle1e,cdle4e supersonic	cdle2e,cdle3e subsonic	cdle2e,cdle3e supersonic	cdtebr	cdte1r,cdte8r subsonic
C_0	-7.4236e-06	1.1297e-04	-2.1361e-05	1.5152e-08	1.6661e-04	-5.4835e-05
C_1	2.9594e-06	-6.2130e-05	9.6410e-07	1.7750e-08	-2.0023e-05	1.6242e-05
C_2	-2.4083e-07	-1.5354e-05	1.1712e-06	1.9086e-07	-3.5460e-07	9.1764e-06
C_3	-1.4054e-06	7.7779e-06	1.9577e-05	-1.2781e-07	1.5430e-06	-2.9264e-07
C_4	1.0211e-05	-2.2682e-05	-9.7219e-07		-6.4475e-08	4.7669e-05
C_5	-5.7961e-06	1.2828e-05	2.4939e-06		-2.8428e-06	2.0929e-05
C_6		-7.2170e-07	-1.9163e-07		1.8652e-06	-7.6617e-08
C_7			-8.2429e-08		-1.1758e-07	
C_8			-1.9740e-06			

Coef. No.	cdte1r,cdte8r supersonic	cdte2r,cdte7r subsonic	cdte2r,cdte7r supersonic	cdte3r,cdte6r subsonic	cdte3r,cdte6r supersonic	cdte4r,cdte5r subsonic
C_0	1.5040e-04	-9.5935e-05	-6.6331e-06	-7.0579e-05	2.4007e-04	-7.4307e-05
C_1	1.3710e-05	2.7638e-05	4.8947e-05	2.1135e-05	1.8905e-05	2.2148e-05
C_2	1.7903e-05	6.0800e-06	3.0774e-05	7.4315e-06	2.7241e-05	7.8006e-06
C_3	-6.4307e-07	-2.2848e-07	-9.7416e-07	-3.6843e-07	-9.7813e-07	-3.8881e-07
C_4	-6.3074e-06	7.8654e-05	-4.5561e-06	6.5151e-05	-9.2713e-06	7.3818e-05
C_5	2.5394e-07	3.6860e-05	-1.2430e-05	2.4367e-05	3.6701e-07	2.4195e-05
C_6	-8.9039e-05	8.6636e-06	4.7494e-07	-9.4854e-08	-1.3721e-04	6.4751e-06
C_7		3.3726e-08	-1.4704e-05	6.1801e-06		-9.7378e-08
C_8		-1.1842e-08	1.4092e-07			
C_9			-1.0066e-08			

Coef. No.	cdte4r,cdte5r supersonic	cdte1e,cdte8e subsonic	cdte1e,cdte8e supersonic	cdte2e,cdte7e subsonic	cdte2e,cdte7e supersonic	cdte3e,cdte6e subsonic
C_0	3.0517e-05	-1.6543e-04	1.0380e-04	-2.2814e-06	2.0119e-05	4.6035e-05
C_1	4.8549e-06	1.3674e-05	-5.9317e-05	1.9540e-06	-1.3522e-05	1.0695e-06
C_2	7.8085e-06	1.0131e-04	-2.4379e-05	2.0316e-06	-8.7138e-06	6.5186e-07
C_3	-1.9725e-07	-1.0275e-05	-5.3568e-06	-1.4201e-06	5.6555e-06	-3.8957e-08
C_4	-2.4230e-05	2.5261e-04	1.1379e-05	6.5929e-06	1.1479e-06	3.4861e-06
C_5	7.2580e-06	-2.3430e-05	2.1498e-05	-5.4994e-06	-4.8393e-06	-2.1043e-06
C_6		-7.9359e-06	-4.6441e-06	6.9646e-06	-6.1731e-08	2.4078e-06
C_7		-1.3942e-04	-4.4865e-06	-4.1926e-06	1.8531e-06	-1.6377e-06
C_8		1.2244e-05	4.0786e-07			-1.0019e-05
C_9		3.0802e-07				

Coef. No.	cdte3e,cdte6e supersonic	cdte4e,cdte5e subsonic	cdte4e,cdte5e supersonic	kdte1... kdte8	cdvfr	cdsp1r,cdsp4r
C_0	2.4696e-06	-1.1604e-04	2.8929e-05	3.4888e-02	4.4022e-06	1.1521e-05
C_1	-2.9897e-06	7.6189e-05	-1.5742e-05	-8.6820e-04	3.5729e-08	-3.8366e-06
C_2	-1.0593e-06	1.1452e-05	-3.4459e-06	1.3837e-03	4.3056e-05	8.0519e-08
C_3	1.2861e-06	-8.2810e-06	1.8206e-06	-2.5681e-05	-3.3941e-08	-8.7605e-07
C_4	4.0328e-06	1.3536e-05	-6.1965e-06	1.1135e-04	-5.8809e-05	3.2278e-06
C_5	-2.3819e-06	2.3683e-05	3.4897e-06	-2.2824e-05	1.4196e-05	-3.4039e-08
C_6	-1.5251e-06	-2.7969e-06	-2.0391e-07	-2.2671e-06	-1.0516e-06	5.0025e-07
C_7	9.3386e-07	-1.2281e-06		4.6473e-07	3.7774e-06	-2.5958e-08
C_8		-1.5306e-05			-2.5740e-06	
C_9					1.8412e-06	
C_{10}					-3.7153e-07	
C_{11}					-4.7406e-08	
C_{12}					-8.1712e-08	
C_{13}					6.5096e-08	

Coef. No.	cdsp2r,cdsp3r	cdgr	kdus1,kdus4	cdus1	cdus4	kdus12,kdus34
C_0	1.5617e-05	2.9981e-03	-2.3087e+00	3.4825e-03	3.4825e-03	-1.9080e-01
C_1	-3.4764e-06	3.4557e-03	1.7631e+00	2.8075e-04	2.8075e-04	3.2603e-01
C_2	1.3285e-07	-4.8776e-03	-7.3588e-01	-1.6264e-05	-1.6264e-05	9.8605e-02
C_3	3.4086e-07	-8.0412e-03	2.2088e+00	2.9881e-05	-2.9881e-05	9.5825e-01
C_4	-4.8994e-08	2.5453e-03	-5.1743e-01	-7.4703e-06	7.4703e-06	5.3229e-01
C_5	2.2429e-06	4.1357e-03		-3.3996e-06	-3.3996e-06	-6.8509e-01
C_6	-2.8275e-08	-3.8036e-05		4.7876e-05	4.7876e-05	
C_7	-3.0070e-08	-4.5810e-04				
C_8	-2.0408e-08	6.9472e-05				
C_9		-1.4859e-06				
C_{10}		4.6541e-04				
C_{11}		-4.2310e-05				
C_{12}		6.8268e-05				

Coef. No.	cdus12	cdus34	cdlgr	kllgr	cddsr subsonic	cddsr supersonic
C_0	1.3054e-02	1.3054e-02	8.9375e-03	1.1637e-02	-6.2723e-05	6.0706e-04
C_1	-1.3663e-03	-1.3663e-03	-1.1045e-03	2.0340e-02	8.3582e-05	-2.5907e-05
C_2	-4.9325e-03	-4.9325e-03	7.2114e-09	3.2122e-04	5.4094e-05	9.4403e-05
C_3	1.4493e-03	1.4493e-03	3.0395e-05	-4.7576e-06		-2.0330e-05
C_4	3.5981e-05	3.5981e-05	-2.6043e-06			-5.5860e-04
C_5	-2.1621e-05	-2.1621e-05	5.6633e-08			1.4743e-04
C_6	-3.4789e-05	3.4789e-05				1.0109e-04
C_7	1.0385e-03	1.0385e-03				-4.0162e-05
C_8	-2.5963e-04	-2.5963e-04				3.8116e-07
C_9						3.7865e-07

Coef. No.	cldcr subsonic	cldcr supersonic	cdthlr	decdds subsonic	decdds supersonic	decdde subsonic
C_0	-6.0282e-05	9.9308e-05	-1.2253e-05	7.8275e-05	1.5313e-05	2.3305e-05
C_1	4.2918e-05	7.2054e-04	-1.1381e-04	2.3268e-06	-7.8620e-06	-7.3815e-06
C_2	1.3512e-05	7.4928e-05	3.0203e-05	-1.0821e-04	-6.0513e-06	-3.6279e-05
C_3	-2.8589e-07	-7.4506e-05	-1.5093e-07	-5.4231e-06	8.5240e-07	1.0376e-05
C_4	9.6399e-06	-6.7445e-04	-6.3081e-08	2.0027e-07	-1.6066e-06	1.2367e-05
C_5	1.2717e-05	-1.6584e-05	1.6253e-06	-1.0259e-07	2.1872e-07	-1.3130e-05
C_6	1.5981e-05	1.5124e-05	-1.2351e-06	-3.5364e-05	2.2863e-06	-2.8975e-06
C_7		-5.3848e-07	6.4236e-08	5.1913e-05	-1.9307e-07	4.2925e-06
C_8		2.5261e-07	1.1424e-07	3.6291e-06	2.7764e-07	
C_9		-5.0333e-07	-3.3343e-08	-5.3765e-06	-2.3458e-07	
C_{10}		2.7706e-07		-2.2744e-07	3.7990e-07	
C_{11}		-1.1587e-08		5.5304e-07	-2.0912e-07	
C_{12}		1.3989e-04			-2.2375e-07	
C_{13}					1.2317e-07	

Coef. No.	decdde supersonic	cdqr subsonic	cdqr supersonic	cdqrjd subsonic	cdqrjd supersonic	cdqter subsonic
C_0	1.7225e-05	-2.5792e-02	-9.7690e-02	-2.6317e-03	2.2861e-02	3.4956e-03
C_1	-3.7181e-05	5.1515e-02	1.6174e-01	-3.1118e-04	-3.1525e-03	-6.8093e-03
C_2	-1.0351e-05	9.1943e-04	6.8926e-02	-1.0512e-02	-1.4835e-02	8.5331e-03
C_3	2.7587e-05	-3.4933e-02	-1.0649e-01	1.2443e-02	4.4804e-03	7.0473e-05
C_4	1.4967e-06	-6.3689e-03	-1.2868e-02	-6.8371e-04	2.7233e-03	-3.8260e-04
C_5	-5.3500e-06	5.0552e-02	2.0492e-02	7.8205e-04	-1.1007e-03	5.1412e-04
C_6	-5.9794e-07					
C_7	6.4630e-07					
C_8	2.3347e-07					
C_9	-2.4572e-07					

Coef. No.	cdqter supersonic	cdqler subsonic	cdqler supersonic	cdqe subsonic	cdqe supersonic	cdqdr subsonic
C_0	3.6960e-02	-3.5260e-03	-8.9443e-03	8.1090e-03	1.4972e-02	6.7590e-01
C_1	9.8227e-05	8.8006e-05	8.2710e-03	-4.9225e-04	-5.8966e-03	-2.4503e-02
C_2	-3.0372e-02	-6.9680e-04	2.0163e-04	-1.5790e-02	-1.0752e-02	-3.9194e+00
C_3	6.6602e-03		-1.6126e-04	2.6739e-03	3.7762e-03	1.0239e-01
C_4	1.0267e-05		-1.7586e-03	7.3624e-05	1.9143e-03	6.5547e+00
C_5	1.3920e-04		3.3176e-06	-1.0319e-04	-6.5585e-04	-1.1865e-01
C_6			-1.8262e-06	9.2675e-03	-5.1938e-04	-3.3274e+00
C_7			3.8451e-05	-2.9902e-03	1.5741e-04	
C_8				-5.1536e-04	2.1939e-04	
C_9				7.8355e-04	-5.8357e-05	
C_{10}				1.7758e-05		

Coef. No.	cdqdr supersonic	cdqde subsonic	cdqde supersonic	cdadr subsonic	cdadr supersonic	cdade subsonic
C_0	-2.1926e+00	1.2008e-01	-6.0306e-02	-2.0381e-02	3.4041e-01	9.1470e-02
C_1	-1.4770e-01	-3.5768e-03	6.3592e-02	1.0751e-02	-5.0497e-01	-1.6115e-03
C_2	4.0544e+00	-8.0980e-01	1.0613e-02	1.2194e-02	-1.3717e-01	-6.3399e-01
C_3	1.2836e-01	1.7735e-02	3.3351e-03	4.4749e-02	1.8621e-01	1.5390e-02
C_4	-2.3325e+00	1.5708e+00	-3.7466e-03	-1.3199e-02	2.5090e-01	1.2368e+00
C_5	-2.8949e-02	-2.6176e-02	-1.6568e-02	-5.2587e-02	-8.6051e-02	-2.0895e-02
C_6	4.2447e-01	1.3693e-02	6.8147e-04		-4.0661e-02	1.1622e-02
C_7		-4.5505e-04	-1.3293e-02		1.3362e-02	-4.4260e-02
C_8		-5.3375e-02	-2.7594e-04			-7.0891e-01
C_9		1.4255e-03	9.1891e-04			-5.5059e-04
C_{10}		-8.9595e-01	1.4663e-03			9.6198e-04
C_{11}		4.2345e-02	-2.8699e-04			3.5307e-02
C_{12}			-4.7178e-04			
C_{13}			1.2749e-04			
C_{14}			3.6870e-03			

Coef. No.	cdade supersonic
C_0	4.8073e-02
C_1	-1.2144e-01
C_2	2.1644e-02
C_3	-3.0100e-02
C_4	7.0890e-02
C_5	-1.1859e-02
C_6	3.9332e-03
C_7	-3.5757e-04
C_8	-1.6515e-03
C_9	1.5014e-04
C_{10}	1.4864e-02
C_{11}	-2.5143e-03

CL Model Definition

CL = CL_TOC + CL_HL + CL_SP + CL_GE + CL_US + CL_GR + CL_TAIL +
CL_Q * QHAT + CL_QD * QDHAT + CL_AD * ADHAT

where

CL_TOC = CLR + DCLE + CLBR

CL_HL = CL_LE + CL_TE + CLVR

CL_LE = CLLE1R*CLLE1ER + CLLE2R*CLLE2ER
+ CLLE3R*CLLE3ER + CLLE4R*CLLE4ER

CL_TE = CLTEBR + CLTE1R*CLTE1ER*KLTE1 + CLTE2R*CLTE2ER*KLTE2
+ CLTE3R*CLTE3ER*KLTE3 + CLTE4R*CLTE4ER*KLTE4
+ CLTE5R*CLTE5ER*KLTE5 + CLTE6R*CLTE6ER*KLTE6
+ CLTE7R*CLTE7ER*KLTE7 + CLTE8R*CLTE8ER*KLTE8

IF M< 0.45 THEN
CL_SP = CLSP1R + CLSP2R + CLSP3R + CLSP4R
ELSE
CL_SP = 0.0

CL_GE = CLGR

CL_US = CL1_US + CL4_US + CL12_US + CL34_US

CL_GR = CLLGR * KLLGR

CL_TAIL = CLTR + CLTHLR + (CLTR - CLTR_ZS) * CLHSE + (CLTR - CLTR_ZE) * CLHEE

CL_Q = CLQR + CLQRJD + CLQTER + CLQLER + CLQE

CL_QD = CLQDR + CLQDE

CL_AD = CLADR + CLADE

The expressions for these variables are given in Table 4 for CL subsonic and in Table 5 for CL supersonic.

Table 4 - CL Subsonic

COMPONENT	MODEL
CLR	$C_0 + C_1\alpha + C_2M + C_3\alpha^2 + C_4\alpha M + C_5M^2$
DCLE	$C_0 + C_1\alpha + C_2\alpha^2 + C_3\bar{q}_s + C_4\alpha\bar{q}_s + C_5\alpha^2\bar{q}_s + C_6M + C_7\alpha M$ $+C_8\alpha^2M + C_9GW_s + C_{10}\alpha GW_s + C_{11}\alpha^2GW_s + C_{12}M\bar{q}_s$
CLBR	$C_0 + C_1\alpha + C_2\beta^2 + C_3\alpha\beta^2 + C_4M + C_5\alpha^2$ $+C_6\alpha M + C_7\alpha^2M + C_8M^2 + C_9\alpha M^2$
CLLE1R	$C_0 + C_1\delta_{LE_1} + C_2\delta l_{TE_L} + C_3\delta_{LE_1}\delta l_{TE_L} + C_4\delta l_{TE_L}{}^2 + C_5\delta_{LE_1}\delta l_{TE_L}{}^2$ $+C_6\alpha + C_7\alpha\delta l_{TE_L} + C_8\alpha\delta_{LE_1} + C_9\alpha\delta_{LE_1}\delta l_{TE_L} + C_{10}M$ $+C_{11}\delta_{LE_1}M + C_{12}\delta l_{TE_L}M + C_{13}\delta_{LE_1}\delta l_{TE_L}M$
CLLE2R	$C_0\delta_{LE_2} + C_1\delta_{LE_2}M + C_2\delta_{LE_2}\delta l_{TE_L}$
CLLE3R	$C_0\delta_{LE_3} + C_1\delta_{LE_3}M + C_2\delta_{LE_3}\delta l_{TE_R}$
CLLE4R	$C_0 + C_1\delta_{LE_4} + C_2\delta l_{TE_R} + C_3\delta_{LE_4}\delta l_{TE_R} + C_4\delta l_{TE_R}{}^2 + C_5\delta_{LE_4}\delta l_{TE_R}{}^2$ $+C_6\alpha + C_7\alpha\delta l_{TE_R} + C_8\alpha\delta_{LE_4} + C_9\alpha\delta_{LE_4}\delta l_{TE_R} + C_{10}M$ $+C_{11}\delta_{LE_4}M + C_{12}\delta l_{TE_R}M + C_{13}\delta_{LE_4}\delta l_{TE_R}M$
CLLE1ER	$C_0\bar{q}_s + C_1\alpha_1\bar{q}_s + C_2\bar{q}_sM_1 + C_3\alpha_1\bar{q}_sM_1 + C_4\bar{q}_sGW_s$ $+C_5\alpha_1\bar{q}_sGW_s + C_6\alpha_1{}^2\bar{q}_s + C_7\bar{q}_s{}^2 + C_8\bar{q}_sM_1GW_s + 1$
CLLE2ER	$C_0\bar{q}_s + C_1\alpha_1\bar{q}_s + C_2\bar{q}_sGW_s + C_3\alpha_1\bar{q}_sGW_s + C_4\bar{q}_sM_1 + C_5\alpha_1\bar{q}_sM_1$ $+C_6\bar{q}_sM_1GW_s + C_7\alpha_1\bar{q}_sM_1GW_s + C_8\alpha_1{}^2\bar{q}_s + C_9\alpha_1{}^2\bar{q}_sGW_s + 1$
CLLE3ER	CLLE2ER
CLLE4ER	CLLE1ER
CLTEBR	if $\delta_{TE_{AVG}} < 0$ or $M >= 0.3$ 0.0 else $C_0\delta_{TE_{AVG}} + C_1\beta_2\delta_{TE_{AVG}} + C_2\alpha\delta_{TE_{AVG}} + C_3\alpha^2\delta_{TE_{AVG}}$ $+C_4\delta_{TE_{AVG}}{}^2 + C_5\alpha\delta_{TE_{AVG}}{}^2$

CLTE1R	$C_0\delta_{TE_1} + C_1\delta_{TE_1}M + C_2{\delta_{TE_1}}^2 + C_3\alpha\delta_{TE_1} + C_4{\delta_{TE_1}}^2M + C_5\alpha{\delta_{TE_1}}^2 + C_6\alpha\delta_{TE_1}M$
CLTE2R	$C_0\delta_{TE_2} + C_1\delta_{TE_2}M + C_2{\delta_{TE_2}}^2 + C_3\alpha\delta_{TE_2} + C_4{\delta_{TE_2}}^2M + C_5\alpha{\delta_{TE_2}}^2 + C_6\alpha{\delta_{TE_2}}^2M + C_7\alpha\delta_{TE_2}M$
CLTE3R	$C_0\delta_{TE_3} + C_1\delta_{TE_3}M + C_2{\delta_{TE_3}}^2 + C_3\alpha\delta_{TE_3} + C_4{\delta_{TE_3}}^2M$
CLTE4R	$C_0\delta_{TE_4} + C_1\delta_{TE_4}M + C_2\alpha\delta_{TE_4} + C_3{\delta_{TE_4}}^2 + C_4{\delta_{TE_4}}^2M + C_5\alpha{\delta_{TE_4}}^2 + C_6\alpha{\delta_{TE_4}}^2M$
CLTE5R	$C_0\delta_{TE_5} + C_1\delta_{TE_5}M + C_2\alpha\delta_{TE_5} + C_3{\delta_{TE_5}}^2 + C_4{\delta_{TE_5}}^2M + C_5\alpha{\delta_{TE_5}}^2 + C_6\alpha{\delta_{TE_5}}^2M$
CLTE6R	$C_0\delta_{TE_6} + C_1\delta_{TE_6}M + C_2{\delta_{TE_6}}^2 + C_3\alpha\delta_{TE_6} + C_4{\delta_{TE_6}}^2M$
CLTE7R	$C_0\delta_{TE_7} + C_1\delta_{TE_7}M + C_2{\delta_{TE_7}}^2 + C_3\alpha\delta_{TE_7} + C_4{\delta_{TE_7}}^2M + C_5\alpha{\delta_{TE_7}}^2 + C_6\alpha{\delta_{TE_7}}^2M + C_7\alpha\delta_{TE_7}M$
CLTE8R	$C_0\delta_{TE_8} + C_1\delta_{TE_8}M + C_2{\delta_{TE_8}}^2 + C_3\alpha\delta_{TE_8} + C_4{\delta_{TE_8}}^2M + C_5\alpha{\delta_{TE_8}}^2 + C_6\alpha\delta_{TE_8}M$
CLTE1ER	$C_0\bar{q}_s + C_1{\bar{q}_s}^2 + C_2M_1\bar{q}_s + 1$
CLTE2ER	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2{M_1}^2\bar{q}_s + C_3{\bar{q}_s}^2 + C_4\bar{q}_sGW_s + 1$
CLTE3ER	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2\bar{q}_sGW_s + C_3{M_1}^2\bar{q}_s + C_4{\bar{q}_s}^2 + 1$
CLTE4ER	$C_0\bar{q}_s + C_1\bar{q}_sGW_s + C_2M_1\bar{q}_s + C_3{M_1}^2\bar{q}_s + C_4{\bar{q}_s}^2 + 1$
CLTE5ER	$C_0\bar{q}_s + C_1\bar{q}_sGW_s + C_2M_1\bar{q}_s + C_3{M_1}^2\bar{q}_s + C_4{\bar{q}_s}^2 + 1$
CLTE6ER	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2\bar{q}_sGW_s + C_3{M_1}^2\bar{q}_s + C_4{\bar{q}_s}^2 + 1$
CLTE7ER	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2{M_1}^2\bar{q}_s + C_3{\bar{q}_s}^2 + C_4\bar{q}_sGW_s + 1$
CLTE8ER	$C_0\bar{q}_s + C_1{\bar{q}_s}^2 + C_2M_1\bar{q}_s + 1$

KLTE1	if M<.3 and $\delta_{TE_{234}}>20$ $C_0 + C_1\alpha + C_2\delta_{TE_{234}} + C_3\alpha^2 + C_4\delta_{LE_L} + C_5\alpha\delta_{LE_L}$ $+C_6\alpha\delta_{TE_{234}} + C_7\alpha^2\delta_{TE_{234}} + 1$ else 1.0
KLTE2	if M<.3 and $\delta_{TE_{134}}>20$ $C_0 + C_1\alpha + C_2\delta_{TE_{134}} + C_3\alpha^2 + C_4\delta_{LE_L} + C_5\alpha\delta_{LE_L}$ $+C_6\alpha\delta_{TE_{134}} + C_7\alpha^2\delta_{TE_{134}} + 1$ else 1.0
KLTE3	if M<.3 and $\delta_{TE_{124}}>20$ $C_0 + C_1\alpha + C_2\delta_{TE_{124}} + C_3\alpha^2 + C_4\delta_{LE_L} + C_5\alpha\delta_{LE_L}$ $+C_6\alpha\delta_{TE_{124}} + C_7\alpha^2\delta_{TE_{124}} + 1$ else 1.0
KLTE4	if M<.3 and $\delta_{TE_{123}}>20$ $C_0 + C_1\alpha + C_2\delta_{TE_{123}} + C_3\alpha^2 + C_4\delta_{LE_L} + C_5\alpha\delta_{LE_L}$ $+C_6\alpha\delta_{TE_{123}} + C_7\alpha^2\delta_{TE_{123}} + 1$ else 1.0
KLTE5	if M<.3 and $\delta_{TE_{678}}>20$ $C_0 + C_1\alpha + C_2\delta_{TE_{678}} + C_3\alpha^2 + C_4\delta_{LE_R} + C_5\alpha\delta_{LE_R}$ $+C_6\alpha\delta_{TE_{678}} + C_7\alpha^2\delta_{TE_{678}} + 1$ else 1.0

KLTE6	if M<.3 and $\delta_{TE_{578}}$>20 $C_0 + C_1\alpha + C_2\delta_{TE_{578}} + C_3\alpha^2 + C_4\delta_{LE_R} + C_5\alpha\delta_{LE_R}$ $+C_6\alpha\delta_{TE_{578}} + C_7\alpha^2\delta_{TE_{578}} + 1$ else 1.0
KLTE7	if M<.3 and $\delta_{TE_{568}}$>20 $C_0 + C_1\alpha + C_2\delta_{TE_{568}} + C_3\alpha^2 + C_4\delta_{LE_R} + C_5\alpha\delta_{LE_R}$ $+C_6\alpha\delta_{TE_{568}} + C_7\alpha^2\delta_{TE_{568}} + 1$ else 1.0
KLTE8	if M<.3 and $\delta_{TE_{567}}$>20 $C_0 + C_1\alpha + C_2\delta_{TE_{567}} + C_3\alpha^2 + C_4\delta_{LE_R} + C_5\alpha\delta_{LE_R}$ $+C_6\alpha\delta_{TE_{567}} + C_7\alpha^2\delta_{TE_{567}} + 1$ else 1.0
CLVR	if M<=.5 $C_0\delta_{VF} + C_1\alpha\delta_{VF} + C_2\delta 1_{TE_{AVG}}\delta_{VF} + C_3\alpha\delta 1_{TE_{AVG}}\delta_{VF} + C_4\delta 1_{TE_{AVG}}{}^2\delta_{VF}$ $+C_5\alpha\delta 1_{TE_{AVG}}{}^2\delta_{VF} + C_6\beta 3\delta_{VF} + C_7\alpha\beta 3\delta_{VF} + C_8\beta 3\delta 1_{TE_{AVG}}\delta_{VF}$ $+C_9\alpha\beta 3\delta 1_{TE_{AVG}}\delta_{VF} + C_{10}\beta 3\delta 1_{TE_{AVG}}{}^2\delta_{VF}$ else 0.0
CLSP1R	$C_0\delta_{SP_1} + C_1\delta 1_{TE_{AVG}}\delta_{SP_1} + C_2\alpha\delta_{SP_1} + C_3\delta_{LE_{AVG}}\delta_{SP_1}$
CLSP2R	$C_0\delta_{SP_2} + C_1\alpha\delta_{SP_2} + C_2\delta 1_{TE_{AVG}}\delta_{SP_2} + C_3\delta_{LE_{AVG}}\delta_{SP_2}$
CLSP3R	$C_0\delta_{SP_3} + C_1\alpha\delta_{SP_3} + C_2\delta 1_{TE_{AVG}}\delta_{SP_3} + C_3\delta_{LE_{AVG}}\delta_{SP_3}$
CLSP4R	$C_0\delta_{SP_4} + C_1\delta 1_{TE_{AVG}}\delta_{SP_4} + C_2\alpha\delta_{SP_4} + C_3\delta_{LE_{AVG}}\delta_{SP_4}$

CLGR	$C_0 + C_1\frac{h_r}{b_w} + C_2\alpha_1 + C_3\alpha_1^2 + C_4\left[\frac{h_r}{b_w}\right]^2 + C_5\alpha_1\frac{h_r}{b_w} + C_6\alpha_1^2\frac{h_r}{b_w}$ $+C_7\delta l_{TE_{AVG}} + C_8\frac{h_r}{b_w}\delta l_{TE_{AVG}} + C_9\alpha_1\left[\frac{h_r}{b_w}\right]^2 + C_{10}\alpha_1\delta l_{TE_{AVG}}$
CLUS1	$C_0 + C_1\alpha_2 + C_2M_4 + C_3\alpha_2M_4 + C_4M_4^2 + C_5\beta_1 + C_6\beta_1M_4$ $+C_7\beta_1M_4^2 + C_8\alpha_2M_4^2$
KLUS1	$C_0 + C_1\frac{W_{O_{SP}}}{W_C l_1} + C_2\left[\frac{W_{O_{SP}}}{W_C l_1}\right]^2 + C_3M_3 + C_4\frac{W_{O_{SP}}}{W_C l_1}M_3 + C_5\left[\frac{W_{O_{SP}}}{W_C l_1}\right]^2 M_3$
CLUS4	$C_0 + C_1\alpha_2 + C_2M_4 + C_3\alpha_2M_4 + C_4M_4^2 + C_5\beta_1 + C_6\beta_1M_4$ $+C_7\beta_1M_4^2 + C_8\alpha_2M_4^2$
KLUS4	$C_0 + C_1\frac{W_{O_{SP}}}{W_C l_4} + C_2\left[\frac{W_{O_{SP}}}{W_C l_4}\right]^2 + C_3M_3 + C_4\frac{W_{O_{SP}}}{W_C l_4}M_3 + C_5\left[\frac{W_{O_{SP}}}{W_C l_4}\right]^2 M_3$
CLUS12	$C_0 + C_1\alpha_2 + C_2M_4 + C_3\alpha_2M_4 + C_4M_4^2 + C_5\alpha_2M_4^2 + C_6\beta_1 + C_7\beta_1M_4$
KLUS12	$C_0 + C_1\frac{W_{O_{SP}}}{W_C l_{1,2}} + C_2\left[\frac{W_{O_{SP}}}{W_C l_{1,2}}\right]^2 + C_3M_3$
CLUS34	$C_0 + C_1\alpha_2 + C_2M_4 + C_3\alpha_2M_4 + C_4M_4^2 + C_5\alpha_2M_4^2 + C_6\beta_1 + C_7\beta_1M_4$
KLUS34	$C_0 + C_1\frac{W_{O_{SP}}}{W_C l_{3,4}} + C_2\left[\frac{W_{O_{SP}}}{W_C l_{3,4}}\right]^2 + C_3M_3$
CL1_US	if flus1=1 and flus2=1 0.0 else if flus1=1 KLUS1*CLUS1 else 0.0

CL4_US	if flus3=1 and flus4=1 0.0 else if flus4=1 KLUS4*CLUS4 else 0.0
CL12_US	if flus1=1 and flus2=1 KLUS12*CLUS12 else 0.0
CL34_US	if flus3=1 and flus4=1 KLUS34*CLUS34 else 0.0
CLLGR	$C_0 + C_1\alpha_1 + C_2{\alpha_1}^2 + C_3{\alpha_1}^3 + C_4{\alpha_1}^4$
KLLGR	$C_0 + C_1\delta_{GEAR} + C_2{\delta_{GEAR}}^2 + C_3{\delta_{GEAR}}^3$
CLTHLR	if M<.65 $C_0\delta l_{TE_{AVG}} + C_1\alpha\delta l_{TE_{AVG}} + C_2\alpha^2\delta l_{TE_{AVG}}$ $+C_3{\delta l_{TE_{AVG}}}^2 + C_4\alpha{\delta l_{TE_{AVG}}}^2$ else 0.0
CLHEE	$C_0 + C_1\bar{q}_s + C_2M_1 + C_3{M_1}^2 + C_4\bar{q}_sM_1 + C_5\bar{q}_s{M_1}^2 + C_6{\bar{q}_s}^2 + C_7{\bar{q}_s}^2M_1$
CLTR	$C_0\delta_e + C_1\delta_s + C_2M\delta_e + C_3M\delta_s + C_4\delta_e\delta_s + C_5$ $+C_6M + C_7M^2 + C_8\alpha_1\delta_e + C_9{\delta_e}^2$
CLTR_ZS	$C_0\delta_e + C_1M\delta_e + C_2 + C_3M + C_4M^2 + C_5\alpha_1\delta_e + C_6{\delta_e}^2$
CLTR_ZE	$C_0\delta_s + C_1M\delta_s + C_2 + C_3M + C_4M^2$
CLHSE	$C_0 + C_1\bar{q}_s + C_2M_1 + C_3\bar{q}_sM_1 + C_4GW_s + C_5\bar{q}_sGW_s$

CLQR	$C_0 + C_1M + C_2M^2$
CLQRJD	$C_0 + C_1M_1 + C_2M_1^2$
CLQTER	$C_0\delta_{TE_{AVG}} + C_1M\delta_{TE_{AVG}} + C_2\alpha_1\delta_{TE_{AVG}} + C_3\alpha_1M\delta_{TE_{AVG}}$ $+C_4M^2\delta_{TE_{AVG}} + C_5\alpha_1M^2\delta_{TE_{AVG}}$
CLQLER	$C_0\delta_{LE_{AVG}} + C_1\alpha_1\delta_{LE_{AVG}}$
CLQE	$C_0 + C_1GW_s + C_2\bar{q}_s + C_3\bar{q}_sGW_s + C_4M_1 + C_5M_1^2$ $+C_6M_1\bar{q}_s + C_7M_1^2\bar{q}_s + C_8M_1GW_s$
CLQDR	$C_0 + C_1M_1 + C_2M_1^2$
CLQDE	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2M_1^2\bar{q}_s + C_3\bar{q}_sGW_s + C_4M_1\bar{q}_sGW_s$ $+C_5M_1^3\bar{q}_s + C_6M_1^2\bar{q}_sGW_s$
CLADR	$C_0 + C_1M_1 + C_2M_1^2 + C_3M_1^3$
CLADE	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2M_1^2\bar{q}_s + C_3M_1^3\bar{q}_s + C_4\bar{q}_sGW_s$ $+C_5M_1\bar{q}_sGW_s + C_6M_1^2\bar{q}_sGW_s$

Table 5 - CL Supersonic

COMPONENT	MODEL
CLR	$C_0 + C_1\alpha + C_2M + C_3\alpha M + C_4M^2 + C_5\alpha^2$
DCLE	$C_0 + C_1M + C_2\alpha + C_3\alpha^2 + C_4\alpha M + C_5\alpha^2M + C_6GWS$ $+C_7\bar{q}s + C_8\bar{q}sGWS + C_9\alpha\bar{q}s + C_{10}\alpha^2\bar{q}s + C_{11}M^2$
CLBR	$C_0 + C_1\beta^2 + C_2\alpha + C_3\alpha\beta^2 + C_4M + C_5\alpha M$
CLLE1R	$C_0\delta_{LE_1} + C_1\delta_{LE_1}\delta l_{TE_L} + C_2\delta_{LE_1}{}^2 + C_3\delta_{LE_1}{}^2\delta l_{TE_L} + C_4\delta_{LE_1}\delta l_{TE_L}{}^2$
CLLE2R	$C_0\delta_{LE_2} + C_1\delta_{LE_2}M + C_2\delta_{LE_2}\delta l_{TE_L}$
CLLE3R	$C_0\delta_{LE_3} + C_1\delta_{LE_3}M + C_2\delta_{LE_3}\delta l_{TE_R}$
CLLE4R	$C_0\delta_{LE_4} + C_1\delta_{LE_4}\delta l_{TE_R} + C_2\delta_{LE_4}{}^2 + C_3\delta_{LE_4}{}^2\delta l_{TE_R} + C_4\delta_{LE_4}\delta l_{TE_R}{}^2$
CLLE1ER	$C_0\bar{q}_s + C_1\bar{q}_sM_1 + C_2\alpha_1\bar{q}_s + C_3\alpha_1\bar{q}_sM_1 + C_4\bar{q}_sGW_s + C_5\bar{q}_s{}^2$ $+C_6\bar{q}_sM_1GW_s + C_7\bar{q}_s{}^2M_1 + C_8\alpha_1{}^2\bar{q}_s + C_9\alpha_1{}^2\bar{q}_sM_1 + 1$
CLLE2ER	$C_0\bar{q}_s + C_1\alpha_1\bar{q}_s + C_2\bar{q}_sM_1 + C_3\alpha_1\bar{q}_sM_1 + C_4\bar{q}_sGW_s + C_5\alpha_1\bar{q}_sGW_s$ $+C_6\bar{q}_sM_1GW_s + C_7\alpha_1\bar{q}_sM_1GW_s + C_8\alpha_1{}^2\bar{q}_s + C_9\alpha_1{}^2\bar{q}_sGW_s + 1$
CLLE3ER	CLLE2ER
CLLE4ER	CLLE1ER
CLTEBR	if $\delta_{TE_{AVG}}$ <0 or M>=0.3 0.0 else $C_0\delta_{TE_{AVG}} + C_1\beta_2\delta_{TE_{AVG}} + C_2\alpha\delta_{TE_{AVG}} + C_3\alpha^2\delta_{TE_{AVG}}$ $+C_4\delta_{TE_{AVG}}{}^2 + C_5\alpha\delta_{TE_{AVG}}{}^2$
CLTE1R	$C_0\delta_{TE_1} + C_1\delta_{TE_1}{}^2 + C_2\delta_{TE_1}M + C_3\alpha\delta_{TE_1}{}^2 + C_4\delta_{TE_1}{}^2M$ $+C_5\alpha\delta_{TE_1}{}^2M + C_6\delta_{LE_L}\delta_{TE_1}{}^2$
CLTE2R	$C_0\delta_{TE_2} + C_1\delta_{TE_2}{}^2 + C_2\delta_{TE_2}M + C_3\delta_{TE_2}{}^2M + C_4\alpha\delta_{TE_2}{}^2$ $+C_5\alpha\delta_{TE_2}{}^2M + C_6\delta_{LE_L}\delta_{TE_2}{}^2$

CLTE3R	$C_0\delta_{TE_3} + C_1 + C_2\delta_{TE_3}M + C_3{\delta_{TE_3}}^2 + C_4\alpha + C_5M$ $+C_6{\delta_{TE_3}}^2M + C_7\delta_{LE_L}$
CLTE4R	$C_0\delta_{TE_4} + C_1 + C_2\alpha + C_3{\delta_{TE_4}}^2 + C_4\delta_{LE_L} + C_5\alpha\delta_{TE_4} + C_6\delta_{TE_4}M$ $+C_7\alpha\delta_{TE_4}M + C_8M + C_9{\delta_{TE_4}}^2M + C_{10}\alpha\delta_{LE_L}$
CLTE5R	$C_0\delta_{TE_5} + C_1 + C_2\alpha + C_3{\delta_{TE_5}}^2 + C_4\delta_{LE_R} + C_5\alpha\delta_{TE_5} + C_6\delta_{TE_5}M$ $+C_7\alpha\delta_{TE_5}M + C_8M + C_9{\delta_{TE_5}}^2M + C_{10}\alpha\delta_{LE_R}$
CLTE6R	$C_0\delta_{TE_6} + C_1 + C_2\delta_{TE_6}M + C_3{\delta_{TE_6}}^2 + C_4\alpha + C_5M$ $+C_6{\delta_{TE_6}}^2M + C_7\delta_{LE_R}$
CLTE7R	$C_0\delta_{TE_7} + C_1{\delta_{TE_7}}^2 + C_2\delta_{TE_7}M + C_3{\delta_{TE_7}}^2M + C_4\alpha{\delta_{TE_7}}^2$ $+C_5\alpha{\delta_{TE_7}}^2M + C_6\delta_{LE_R}{\delta_{TE_7}}^2$
CLTE8R	$C_0\delta_{TE_8} + C_1{\delta_{TE_8}}^2 + C_2\delta_{TE_8}M + C_3\alpha{\delta_{TE_8}}^2 + C_4{\delta_{TE_8}}^2M$ $+C_5\alpha{\delta_{TE_8}}^2M + C_6\delta_{LE_R}{\delta_{TE_8}}^2$
CLTE1ER	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2{\bar{q}_s}^2 + C_3M_1{}^2\bar{q}_s + C_4M_1{\bar{q}_s}^2 + C_5\bar{q}_sGW_s + 1$
CLTE2ER	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2{\bar{q}_s}^2 + C_3M_1{\bar{q}_s}^2 + C_4M_1{}^2\bar{q}_s + 1$
CLTE3ER	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2M_1{}^2\bar{q}_s + C_3{\bar{q}_s}^2 + C_4M_1{\bar{q}_s}^2 + C_5\bar{q}_sGW_s + 1$
CLTE4ER	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2M_1{}^2\bar{q}_s + C_3\bar{q}_sGW_s + C_4M_1\bar{q}_sGW_s$ $+C_5{\bar{q}_s}^2 + C_6M_1{\bar{q}_s}^2 + C_7M_1{}^2{\bar{q}_s}^2 + C_8{\bar{q}_s}^2GW_s + 1$
CLTE5ER	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2M_1{}^2\bar{q}_s + C_3\bar{q}_sGW_s + C_4M_1\bar{q}_sGW_s$ $+C_5{\bar{q}_s}^2 + C_6M_1{\bar{q}_s}^2 + C_7M_1{}^2{\bar{q}_s}^2 + C_8{\bar{q}_s}^2GW_s + 1$
CLTE6ER	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2M_1{}^2\bar{q}_s + C_3{\bar{q}_s}^2 + C_4M_1{\bar{q}_s}^2 + C_5\bar{q}_sGW_s + 1$
CLTE7ER	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2{\bar{q}_s}^2 + C_3M_1{\bar{q}_s}^2 + C_4M_1{}^2\bar{q}_s + 1$
CLTE8ER	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2{\bar{q}_s}^2 + C_3M_1{}^2\bar{q}_s + C_4M_1{\bar{q}_s}^2 + C_5\bar{q}_sGW_s + 1$
KLTE1	1.0
KLTE2	1.0
KLTE3	1.0
KLTE4	1.0

KLTE5	1.0
KLTE6	1.0
KLTE7	1.0
KLTE8	1.0
CLVR	0.0
CLGR	$C_0 + C_1\frac{h_r}{b_w} + C_2\alpha_1 + C_3\alpha_1^2 + C_4\left[\frac{h_r}{b_w}\right]^2 + C_5\alpha_1\frac{h_r}{b_w} + C_6\alpha_1^2\frac{h_r}{b_w}$ $+C_7\delta l_{TE_{AVG}} + C_8\frac{h_r}{b_w}\delta l_{TE_{AVG}} + C_9\alpha_1\left[\frac{h_r}{b_w}\right]^2 + C_{10}\alpha_1\delta l_{TE_{AVG}}$
CLUS1	$C_0 + C_1\alpha_2 + C_2M_4 + C_3\alpha_2M_4 + C_4M_4^2 + C_5\beta_1 + C_6\beta_1M_4$ $+C_7\beta_1M_4^2 + C_8\alpha_2M_4^2$
KLUS1	$C_0 + C_1\frac{W_{O_{SP}}}{W_C l_1} + C_2\left[\frac{W_{O_{SP}}}{W_C l_1}\right]^2 + C_3M_3 + C_4\frac{W_{O_{SP}}}{W_C l_1}M_3 + C_5\left[\frac{W_{O_{SP}}}{W_C l_1}\right]^2 M_3$
CLUS4	$C_0 + C_1\alpha_2 + C_2M_4 + C_3\alpha_2M_4 + C_4M_4^2 + C_5\beta_1 + C_6\beta_1M_4$ $+C_7\beta_1M_4^2 + C_8\alpha_2M_4^2$
KLUS4	$C_0 + C_1\frac{W_{O_{SP}}}{W_C l_4} + C_2\left[\frac{W_{O_{SP}}}{W_C l_4}\right]^2 + C_3M_3 + C_4\frac{W_{O_{SP}}}{W_C l_4}M_3 + C_5\left[\frac{W_{O_{SP}}}{W_C l_4}\right]^2 M_3$
CLUS12	$C_0 + C_1\alpha_2 + C_2M_4 + C_3\alpha_2M_4 + C_4M_4^2 + C_5\alpha_2M_4^2 + C_6\beta_1 + C_7\beta_1M_4$
KLUS12	$C_0 + C_1\frac{W_{O_{SP}}}{W_C l_{1,2}} + C_2\left[\frac{W_{O_{SP}}}{W_C l_{1,2}}\right]^2 + C_3M_3$
CLUS34	$C_0 + C_1\alpha_2 + C_2M_4 + C_3\alpha_2M_4 + C_4M_4^2 + C_5\alpha_2M_4^2 + C_6\beta_1 + C_7\beta_1M_4$
KLUS34	$C_0 + C_1\frac{W_{O_{SP}}}{W_C l_{3,4}} + C_2\left[\frac{W_{O_{SP}}}{W_C l_{3,4}}\right]^2 + C_3M_3$

CL1_US	if flus1=1 and flus2=1 0.0 else if flus1=1 KLUS1*CLUS1 else 0.0
CL4_US	if flus3=1 and flus4=1 0.0 else if flus4=1 KLUS4*CLUS4 else 0.0
CL12_US	if flus1=1 and flus2=1 KLUS12*CLUS12 else 0.0
CL34_US	if flus3=1 and flus4=1 KLUS34*CLUS34 else 0.0
CLLGR	$C_0 + C_1\alpha_1 + C_2\alpha_1^2 + C_3\alpha_1^3 + C_4\alpha_1^4$
KLLGR	$C_0 + C_1\delta_{GEAR} + C_2\delta_{GEAR}^2 + C_3\delta_{GEAR}^3$
CLTHLR	0.0
CLHEE	$C_0 + C_1\bar{q}_s + C_2M_1 + C_3M_1^2 + C_4\bar{q}_sM_1 + C_5\bar{q}_sM_1^2 + C_6\bar{q}_s^2 + C_7\bar{q}_s^2M_1$
CLTR	$C_0\delta_s + C_1\delta_e + C_2M\delta_e + C_3M\delta_s + C_4M^2\delta_e + C_5M^2\delta_s$ $+C_6\alpha_1\delta_e + C_7\alpha_1M\delta_e$
CLTR_ZS	$C_0\delta_e + C_1M\delta_e + C_2M^2\delta_e + C_3\alpha_1\delta_e + C_4\alpha_1M\delta_e$

CLTR_ZE	$C_0\delta_s + C_1M\delta_s + C_2M^2\delta_s$
CLHSE	$C_0 + C_1M_1 + C_2\bar{q}_s + C_3\bar{q}_sM_1 + C_4M_1^2 + C_5\bar{q}_sM_1^2$ $+C_6\bar{q}_s^2 + C_7\bar{q}_s^2M_1 + C_8GW_s$
CLQR	$C_0 + C_1M + C_2M^2 + C_3\alpha + C_4M^3 + C_5\alpha M$
CLQRJD	$C_0 + C_1M_1 + C_2M_1^2$
CLQTER	$C_0\delta_{TE_{AVG}} + C_1\alpha_1\delta_{TE_{AVG}} + C_2M\delta_{TE_{AVG}} + C_3\alpha_1M\delta_{TE_{AVG}} + C_4M^2\delta_{TE_{AVG}}$
CLQLER	$C_0\delta_{LE_{AVG}} + C_1\alpha_1\delta_{LE_{AVG}} + C_2M\delta_{LE_{AVG}} + C_3\alpha_1M\delta_{LE_{AVG}}$ $+C_4M^2\delta_{LE_{AVG}} + C_5M^3\delta_{LE_{AVG}}$
CLQE	$C_0 + C_1\bar{q}_s + C_2M_1 + C_3M_1\bar{q}_s + C_4\bar{q}_s^2 + C_5M_1^2 + C_6GW_s$ $+C_7M_1GW_s + C_8M_1\bar{q}_s^2 + C_9\bar{q}_sGW_s + C_{10}M_1\bar{q}_sGW_s$
CLQDR	$C_0 + C_1M_1 + C_2M_1^2 + C_3M_1^3$
CLQDE	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2\bar{q}_sGW_s + C_3M_1\bar{q}_sGW_s + C_4M_1^2\bar{q}_s + C_5\bar{q}_s^2$ $+C_6M_1\bar{q}_s^2 + C_7M_1^2\bar{q}_sGW_s + C_8M_1^2\bar{q}_s^2 + C_9M_1^3\bar{q}_s$ $+C_{10}M_1^3\bar{q}_sGW_s + C_{11}M_1^3\bar{q}_s^2 + C_{12}M_1^4\bar{q}_s$
CLADR	$C_0 + C_1M_1 + C_2M_1^2 + C_3M_1^3$
CLADE	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2\bar{q}_s^2 + C_3M_1\bar{q}_s^2 + C_4\bar{q}_sGW_s + C_5M_1\bar{q}_sGW_s$ $+C_6M_1^2\bar{q}_s + C_7M_1^2\bar{q}_sGW_s + C_8\bar{q}_sGW_s^2 + C_9M_1^2\bar{q}_s^2$ $+C_{10}M_1\bar{q}_sGW_s^2 + C_{11}M_1\bar{q}_sGW_s + C_{12}M_1\bar{q}_sGW_s^2$

Table 6 - CL Coefficients

Coef. No.	clr subsonic	clr supersonic	dcle subsonic	dcle supersonic	clbr subsonic	clbr supersonic
C_0	1.0054e-01	4.8982e-01	5.6163e-02	1.1293e-01	5.6051e-02	6.4226e-03
C_1	5.2951e-02	7.5717e-02	4.6063e-03	-1.0245e-01	8.9949e-03	-1.4252e-05
C_2	-6.2877e-01	-5.6808e-01	-1.6451e-04	4.6935e-03	1.0156e-05	-3.3965e-03
C_3	-3.7661e-04	-1.5382e-02	-9.6193e-03	-1.8650e-04	-1.6654e-05	-1.4412e-05
C_4	1.3316e-02	1.4745e-01	3.7497e-03	-3.8776e-03	-2.3730e-01	-3.1216e-03
C_5	5.7287e-01	-2.8594e-04	-1.3392e-04	1.3848e-04	-6.8230e-04	1.5535e-03
C_6			-3.9151e-02	-1.6244e-04	6.6325e-04	
C_7			1.6346e-02	4.5317e-03	8.0342e-04	
C_8			-5.8377e-04	-1.1854e-03	1.9771e-01	
C_9			-8.8192e-06	4.1522e-04	-1.4122e-02	
C_{10}			-2.9815e-03	-1.4829e-05		
C_{11}			1.0648e-04	2.6243e-02		
C_{12}			9.3621e-03			

Coef. No.	clle1r,clle4r subsonic	clle1r,clle4r supersonic	clle2r,clle3r	clle1er subsonic	clle1er supersonic	clle2er subsonic
C_0	-2.2084e-02	-6.5994e-04	-9.3972e-05	3.7074e-01	7.5541e-01	-2.4595e-02
C_1	3.6096e-04	-1.9811e-04	-1.0425e-04	-3.3574e-03	-3.0410e-01	1.1791e-02
C_2	2.2293e-03	-1.9616e-05	4.9999e-06	8.0147e-01	-3.9872e-03	1.0930e-02
C_3	-1.0577e-04	3.2505e-06		-3.4768e-02	1.3171e-03	-1.8546e-03
C_4	-4.2284e-05	2.7460e-06		-2.2017e-02	-3.4500e-02	4.3033e-01
C_5	1.9096e-06			3.8315e-03	-1.7494e-02	-2.6123e-02
C_6	5.5851e-05			-5.5917e-04	1.3214e-02	-6.4294e-02
C_7	-3.1915e-06			-7.7566e-03	6.8555e-03	3.8656e-03
C_8	-2.6251e-05			-5.6702e-02	-1.6820e-04	-3.8236e-04
C_9	1.5001e-06				9.2589e-05	5.2038e-05
C_{10}	2.2757e-02					
C_{11}	-1.0277e-03					
C_{12}	-1.3004e-03					
C_{13}	5.8728e-05					

Coef. No.	clle2er supersonic	cltebr	clte1r,clte8r subsonic	clte1r,clte8r supersonic	clte2r,clte7r subsonic	clte2r,clte7r supersonic
C_0	1.8299e+00	-9.7125e-04	8.6132e-04	1.2165e-03	1.7015e-03	2.3313e-03
C_1	-1.1409e-01	-2.6311e-06	1.2553e-03	-8.1564e-08	1.8076e-03	-1.5309e-06
C_2	-7.4914e-01	1.8796e-04	9.2933e-06	-4.0758e-04	-7.8642e-06	-8.3546e-04
C_3	4.7791e-02	-4.4907e-06	-2.7650e-05	-1.4370e-06	-7.2670e-05	9.5848e-07
C_4	-1.6187e-01	2.6131e-05	-1.5404e-05	2.3484e-07	6.7824e-06	-2.7040e-06
C_5	1.3304e-02	-1.8665e-06	-3.6291e-07	5.5306e-07	1.1983e-06	1.0783e-06
C_6	6.4301e-02		1.7908e-05	-1.1576e-07	-2.5211e-06	-1.7997e-07
C_7	-5.8455e-03				6.5106e-05	
C_8	-9.5995e-04					
C_9	5.2841e-04					

Coef. No.	clte3r,clte6r subsonic	clte3r,clte6r supersonic	clte4r,clte5r subsonic	clte4r,clte5r supersonic	clte1er,clte8er subsonic	clte1er,clte8er supersonic
C_0	8.8091e-04	1.8202e-03	9.7202e-04	1.0359e-03	-2.2428e-01	-8.7618e-01
C_1	1.8996e-03	9.0955e-03	1.9310e-03	7.5750e-03	8.8848e-03	4.9579e-01
C_2	6.5007e-06	-6.1005e-04	-2.4213e-05	-9.3945e-05	-5.2289e-02	2.8510e-02
C_3	-2.2121e-05	-3.2881e-05	2.7571e-06	-1.7135e-05		-9.1565e-02
C_4	-2.0608e-05	-3.9694e-04	-5.6745e-06	-4.3265e-05		-7.7279e-03
C_5		-1.7311e-03	2.2544e-07	-3.2641e-05		1.7631e-03
C_6		1.3106e-05	-1.0436e-06	-2.5155e-04		
C_7		-1.7685e-04		1.7968e-05		
C_8				-3.4814e-03		
C_9				6.3299e-06		
C_{10}				-1.0409e-05		

Coef. No.	clte2er,clte7er subsonic	clte2er,clte7er supersonic	clte3er,clte6er subsonic	clte3er,clte6er supersonic	clte4er,clte5er subsonic	clte4er,clte5er supersonic
C_0	-1.2440e-01	-3.6939e-01	-1.2520e-02	-2.2396e-01	8.5766e-03	-2.4342e-01
C_1	2.0179e-01	1.7334e-01	1.5205e-01	1.6443e-01	-1.0270e-02	3.0050e-01
C_2	-1.9642e-01	1.3727e-02	-7.8304e-03	-3.2604e-02	1.7398e-01	-7.8803e-02
C_3	1.8777e-03	-4.2553e-03	-1.6270e-01	4.7993e-03	-1.7891e-01	-1.3889e-02
C_4	-3.2643e-03	-2.5664e-02	5.5646e-04	-1.9199e-03	6.4079e-04	3.9243e-03
C_5				-2.0166e-03		1.0454e-02
C_6						-1.2270e-02
C_7						3.0480e-03
C_8						1.6703e-04

Coef. No.	klte1... klte8	clvfr	clsp1r,clsp4r	clsp2r,clsp3r	clgr	clus1
C_0	-5.8679e-02	-2.2179e-04	1.2785e-05	-2.2595e-04	4.2000e-02	5.9085e-02
C_1	3.4180e-03	2.4947e-05	-6.9706e-06	1.3677e-05	-1.3905e-01	-5.6163e-03
C_2	3.1059e-03	6.4251e-05	3.0711e-06	-6.4186e-06	1.6898e-02	-4.3552e-02
C_3	1.0141e-04	-3.1367e-06	-1.8054e-06	-1.5646e-06	-4.9589e-04	4.3868e-03
C_4	1.6769e-04	-1.5558e-06			9.9442e-02	9.1933e-03
C_5	-4.6829e-05	7.9760e-08			-2.6616e-02	6.6405e-03
C_6	2.8386e-04	1.8686e-05			5.5258e-04	-6.1992e-03
C_7	-1.0138e-05	-1.1745e-06			1.8735e-03	1.4030e-03
C_8		-3.5464e-06			-1.6859e-03	-8.8610e-04
C_9		9.1624e-08			9.4809e-03	
C_{10}		7.1719e-08			-3.2474e-05	

Coef. No.	klus1,klus4	clus4	clus12	klus12,klus34	clus34	cllgr
C_0	-6.1262e-02	5.9085e-02	5.8104e-02	-1.1046e-01	5.8104e-02	-7.1621e-03
C_1	2.2921e+00	-5.6163e-03	-1.0288e-02	1.3650e+00	-1.0288e-02	1.4238e-03
C_2	-1.2961e+00	-4.3552e-02	-3.6534e-02	-3.8050e-01	-3.6534e-02	6.3666e-04
C_3	3.0921e-02	4.3868e-03	8.7298e-03	5.8255e-02	8.7298e-03	-8.0061e-05
C_4	-3.7111e-01	9.1933e-03	7.5025e-03		7.5025e-03	2.0237e-06
C_5	3.7111e-01	-6.6405e-03	-1.8756e-03		-1.8756e-03	
C_6		6.1992e-03	-8.2218e-04		8.2218e-04	
C_7		-1.4030e-03	3.2070e-04		-3.2070e-04	
C_8		-8.8610e-04				

Coef. No.	kllgr	cltr subsonic	cltr supersonic	clthlr	clhse subsonic	clhse supersonic
C_0	1.1637e-02	2.2219e-03	9.3089e-03	2.9131e-04	2.2910e-03	5.7068e-02
C_1	2.0340e-02	4.4206e-03	8.4982e-03	-1.0352e-05	2.1758e-02	-5.0168e-02
C_2	3.2122e-04	8.6703e-04	-6.4653e-03	-1.1512e-06	-4.9145e-03	1.5114e-01
C_3	-4.7576e-06	7.5300e-04	-4.8329e-03	-1.7886e-05	1.8804e-02	-1.6449e-01
C_4		-7.9723e-06	1.3230e-03	1.2776e-06	-3.9263e-04	1.3736e-02
C_5		-6.1452e-03	8.1942e-04		-1.4217e-03	3.4255e-02
C_6		3.4856e-02	-3.3350e-05			-1.2118e-03
C_7		-3.0246e-02	1.4758e-05			9.2862e-04
C_8		-8.0998e-06				-3.2427e-03
C_9		-3.9150e-06				

Coef. No.	clhee	clqr subsonic	clqr supersonic	clqjdr subsonic	clqjdr supersonic	clqter subsonic
C_0	9.8952e-02	2.6316e+00	1.9509e+01	1.1606e-01	2.4242e-01	3.9425e-04
C_1	-1.0529e-01	-1.7627e+00	-2.5402e+01	-6.4135e-02	-1.1064e-01	1.1832e-03
C_2	-1.9312e-01	2.5677e+00	1.1901e+01	8.7209e-02	1.7661e-02	1.3065e-04
C_3	6.5453e-02		-1.2214e-02			-9.8934e-04
C_4	-9.4892e-02		-1.8898e+00			-1.2621e-03
C_5	3.0318e-02		2.0536e-02			1.3329e-03
C_6	6.5953e-04					

C_7	2.0327e-03					

Coef. No.	clqter supersonic	clqler subsonic	clqler supersonic	clqe subsonic	clqe supersonic	clqdr subsonic
C_0	1.9133e-02	-2.0540e-04	-1.7438e-02	-2.2330e-01	-4.3711e-01	-1.4138e+00
C_1	2.5656e-04	1.2622e-04	4.0049e-04	4.1876e-02	-1.3899e-01	5.9047e+00
C_2	-1.9982e-02		3.0738e-02	4.2752e-02	5.7368e-01	-6.8424e+00
C_3	3.3952e-04		-1.6147e-04	-1.9619e-02	4.2806e-02	
C_4	5.7418e-03		-1.7107e-02	3.5279e-01	9.7907e-03	
C_5			3.0853e-03	-1.1079e-01	-1.6189e-01	
C_6				2.4324e-01	-2.3256e-02	
C_7				-2.2051e-01	8.9862e-03	
C_8				-6.3241e-02	-3.7091e-03	
C_9					-1.4952e-02	
C_{10}					6.3785e-03	

Coef. No.	clqdr supersonic	clqde subsonic	clqde supersonic	cladr subsonic	cladr supersonic	clade subsonic
C_0	-2.0583e+01	5.1812e-01	1.7099e+00	2.0791e+00	-7.8755e+00	4.6581e-01
C_1	2.9072e+01	-3.8712e+00	-3.5159e+00	-5.8902e+00	1.0685e+01	-2.9345e+00
C_2	-1.3954e+01	8.0037e+00	3.0842e-01	1.1266e+01	-4.9345e+00	6.2990e+00
C_3	2.2155e+00	5.0636e-02	-4.5460e-01	-7.3914e+00	7.6594e-01	-4.3900e+00
C_4		-2.1999e-01	2.5989e+00			3.2742e-02
C_5		-5.5251e+00	-1.5249e-01			-1.9802e-01
C_6		2.4729e-01	2.3178e-01			2.0742e-01
C_7			2.2339e-01			
C_8			-1.1479e-01			
C_9			-8.3622e-01			
C_{10}			-3.6173e-02			
C_{11}			1.8581e-02			
C_{12}			9.9537e-02			

Coef. No.	clade supersonic
C_0	-7.6682e-02
C_1	8.8681e-02
C_2	-1.2074e-02
C_3	8.9250e-03
C_4	6.0598e-02
C_5	-4.1791e-02
C_6	-2.1345e-02
C_7	7.0837e-03
C_8	-2.9312e-03
C_9	-1.7356e-03
C_{10}	1.1475e-03
C_{11}	-2.6219e-02
C_{12}	2.7214e-03

CM Model Definition

CM = CM_TOC + CM_HL + CM_SP + CM_GE + CM_US + CM_GR + CM_TAIL
+ CM_Q * QHAT + CM_QD * QDHAT + CM_AD * ADHAT

where

CM_TOC = CMR + DCME + CMBR

CM_HL = CM_LE + CM_TE + CMVFR

CM_LE = CMLE1R + CMLE1E + CMLE2R + CMLE2E
+ CMLE3R+CMLE3E+CMLE4R+CMLE4E

CM_TE = CMTEBR + (CMTE1R+CMTE1E)*KMTE1 + (CMTE2R+CMTE2E)*KMTE2
+ (CMTE3R+CMTE3E)*KMTE3 + (CMTE4R+CMTE4E)*KMTE4
+ (CMTE5R+CMTE5E)*KMTE5 + (CMTE6R+CMTE6E)*KMTE6
+ (CMTE7R+CMTE7E)*KMTE7 + (CMTE8R+CMTE8E)*KMTE8

IF M< 0.45 THEN
CM_SP = CMSP1R + CMSP2R + CMSP3R + CMSP4R
ELSE
CM_SP = 0.0

CM_GE = CMGR

CM_US = CM1_US + CM4_US + CM12_US + CM34_US

CM_GR = CMLGR * KLLGR

CM_TAIL = CMTR + CMTHLR + (CMTR - CMTR_ZS) * CMHSE
+ (CMTR - CMTR_ZE)*CMHEE

CM_Q = CMQR + CMQLER + CMQTER + CMQE

CM_QD = CMQDR + CMQDE

CM_AD = CMADR + CMADE

The equations for these variables are computed in Table 7 for CM subsonic and in Table 8 for CM supersonic.

Table 7 - CM Subsonic

COMPONENT	MODEL
CMR	$C_0 + C_1M + C_2\alpha + C_3\alpha M + C_4M^2 + C_5\alpha M^2 + C_6M^3 + C_7\alpha^2$
DCME	$C_0 + C_1\bar{q}_s + C_2\alpha + C_3\alpha\bar{q}_s + C_4GW_s + C_5\bar{q}_sGW_s$ $+C_6M + C_7\alpha GW_s + C_8M\bar{q}_s + C_9\alpha\bar{q}_sGW_s$ $+C_{10}M^2 + C_{11}M^2\bar{q}_s + C_{12}\alpha^2 + C_{13}\alpha M + C_{14}\alpha^2M$
CMBR	$C_0\beta_3^{\,2} + C_1\beta_3^{\,2}M + C_2\alpha_1\beta_3^{\,2} + C_3\alpha_1\beta_3^{\,2}M + C_4\beta_3^{\,2}M^2 + C_5\alpha_1\beta_3^{\,2}M^2$
CMLE1R	$C_0\delta_{LE_1} + C_1\alpha\delta_{LE_1} + C_2\delta_{LE_1}M + C_3\alpha\delta_{LE_1}M + C_4\alpha^2\delta_{LE_1} + C_5\alpha^2\delta_{LE_1}M$ $+C_6\delta_{LE_1}M^2 + C_7\delta_{LE_1}\delta l_{TE_L} + C_8\alpha\delta_{LE_1}\delta l_{TE_L} + C_9\delta_{LE_1}^{\,2}$
CMLE2R	$C_0\delta_{LE_2} + C_1\alpha\delta_{LE_2} + C_2\alpha^2\delta_{LE_2} + C_3\delta_{LE_2}M + C_4\alpha\delta_{LE_2}M + C_5\alpha^2\delta_{LE_2}M$
CMLE3R	$C_0\delta_{LE_3} + C_1\alpha\delta_{LE_3} + C_2\alpha^2\delta_{LE_3} + C_3\delta_{LE_3}M + C_4\alpha\delta_{LE_3}M + C_5\alpha^2\delta_{LE_3}M$
CMLE4R	$C_0\delta_{LE_4} + C_1\alpha\delta_{LE_4} + C_2\delta_{LE_4}M + C_3\alpha\delta_{LE_4}M + C_4\alpha^2\delta_{LE_4} + C_5\alpha^2\delta_{LE_4}M$ $+C_6\delta_{LE_4}M^2 + C_7\delta_{LE_4}\delta l_{TE_R} + C_8\alpha\delta_{LE_4}\delta l_{TE_R} + C_9\delta_{LE_4}^{\,2}$
CMLE1E	$C_0\delta_{LE_1} + C_1\bar{q}_s\delta_{LE_1} + C_2M_1\delta_{LE_1} + C_3M_1\bar{q}_s\delta_{LE_1} + C_4GW_s\delta_{LE_1}$ $+C_5\bar{q}_sGW_s\delta_{LE_1} + C_6M_1^{\,2}\delta_{LE_1} + C_7M_1^{\,2}\bar{q}_s\delta_{LE_1}$
CMLE2E	$C_0\delta_{LE_2} + C_1\bar{q}_s\delta_{LE_2} + C_2GW_s\delta_{LE_2} + C_3\bar{q}_sGW_s\delta_{LE_2}$ $+C_4M_1\delta_{LE_2} + C_5M_1\bar{q}_s\delta_{LE_2} + C_6M_1GW_s\delta_{LE_2}$ $+C_7M_1\bar{q}_sGW_s\delta_{LE_2} + C_8M_1^{\,2}\delta_{LE_2} + C_9M_1^{\,2}\bar{q}_s\delta_{LE_2}$
CMLE3E	$C_0\delta_{LE_3} + C_1\bar{q}_s\delta_{LE_3} + C_2GW_s\delta_{LE_3} + C_3\bar{q}_sGW_s\delta_{LE_3}$ $+C_4M_1\delta_{LE_3} + C_5M_1\bar{q}_s\delta_{LE_3} + C_6M_1GW_s\delta_{LE_3}$ $+C_7M_1\bar{q}_sGW_s\delta_{LE_3} + C_8M_1^{\,2}\delta_{LE_3} + C_9M_1^{\,2}\bar{q}_s\delta_{LE_3}$
CMLE4E	$C_0\delta_{LE_4} + C_1\bar{q}_s\delta_{LE_4} + C_2M_1\delta_{LE_4} + C_3M_1\bar{q}_s\delta_{LE_4} + C_4GW_s\delta_{LE_4}$ $+C_5\bar{q}_sGW_s\delta_{LE_4} + C_6M_1^{\,2}\delta_{LE_4} + C_7M_1^{\,2}\bar{q}_s\delta_{LE_4}$

CMTEBR	if $\delta_{TE_{AVG}}$ <0 or M>=0.3 0.0 else $C_0M_2 + C_1\alpha M_2 + C_2M_2^2 + C_3\alpha^2M_2 + C_4\alpha M_2^2 + C_5\beta^2M_2$ $+C_6\alpha^2M_2^2 + C_7\alpha\beta^2M_2 + C_8\alpha^2\beta^2M_2 + C_9\beta^2M_2^2$
CMTE1R	$C_0\delta_{TE_1} + C_1\delta_{TE_1}M + C_2\delta_{TE_1}^2 + C_3\alpha\delta_{TE_1}^2 + C_4\delta_{TE_1}^2M$ $+C_5\alpha\delta_{TE_1} + C_6\alpha\delta_{TE_1}^2M + C_7\alpha\delta_{TE_1}M$
CMTE2R	$C_0\delta_{TE_2} + C_1\delta_{TE_2}M + C_2\delta_{TE_2}^2 + C_3\alpha\delta_{TE_2}^2 + C_4\alpha\delta_{TE_2}$ $+C_5\delta_{TE_2}^3 + C_6\delta_{TE_2}^2M + C_7\alpha\delta_{TE_2}^2M$
CMTE3R	$C_0\delta_{TE_3} + C_1\delta_{TE_3}M + C_2\alpha\delta_{TE_3} + C_3\delta_{TE_3}^2 + C_4\delta_{TE_3}^2M$ $+C_5\alpha\delta_{TE_3}^2 + C_6\alpha\delta_{TE_3}^2M$
CMTE4R	$C_0\delta_{TE_4} + C_1\delta_{TE_4}M + C_2\delta_{TE_4}M^2 + C_3\alpha\delta_{TE_4} + C_4\alpha\delta_{TE_4}M$ $+C_5\delta_{TE_4}^2 + C_6\delta_{TE_4}^2M + C_7\delta_{TE_4}^2M^2$
CMTE5R	$C_0\delta_{TE_5} + C_1\delta_{TE_5}M + C_2\delta_{TE_5}M^2 + C_3\alpha\delta_{TE_5} + C_4\alpha\delta_{TE_5}M$ $+C_5\delta_{TE_5}^2 + C_6\delta_{TE_5}^2M + C_7\delta_{TE_5}^2M^2$
CMTE6R	$C_0\delta_{TE_6} + C_1\delta_{TE_6}M + C_2\alpha\delta_{TE_6} + C_3\delta_{TE_6}^2 + C_4\delta_{TE_6}^2M$ $+C_5\alpha\delta_{TE_6}^2 + C_6\alpha\delta_{TE_6}^2M$
CMTE7R	$C_0\delta_{TE_7} + C_1\delta_{TE_7}M + C_2\delta_{TE_7}^2 + C_3\alpha\delta_{TE_7}^2 + C_4\alpha\delta_{TE_7}$ $+C_5\delta_{TE_7}^3 + C_6\delta_{TE_7}^2M + C_7\alpha\delta_{TE_7}^2M$
CMTE8R	$C_0\delta_{TE_8} + C_1\delta_{TE_8}M + C_2\delta_{TE_8}^2 + C_3\alpha\delta_{TE_8}^2 + C_4\delta_{TE_8}^2M$ $+C_5\alpha\delta_{TE_8} + C_6\alpha\delta_{TE_8}^2M + C_7\alpha\delta_{TE_8}M$
CMTE1E	$C_0\delta_{TE_1} + C_1\bar{q}_s\delta_{TE_1} + C_2M_1\delta_{TE_1} + C_3M_1^2\delta_{TE_1} + C_4\bar{q}_s^2\delta_{TE_1}$ $+C_5M_1\bar{q}_s\delta_{TE_1} + C_6M_1^2\bar{q}_s\delta_{TE_1} + C_7M_1\bar{q}_s^2\delta_{TE_1}$
CMTE2E	$C_0\delta_{TE_2} + C_1\bar{q}_s\delta_{TE_2} + C_2M_1\delta_{TE_2} + C_3M_1\bar{q}_s\delta_{TE_2} + C_4M_1^2\delta_{TE_2}$ $+C_5M_1^2\bar{q}_s\delta_{TE_2} + C_6GW_s\delta_{TE_2} + C_7\bar{q}_s^2\delta_{TE_2} + C_8\bar{q}_sGW_s\delta_{TE_2}$

CMTE3E	$C_0\delta_{TE_3} + C_1M_1\delta_{TE_3} + C_2M_1^2\delta_{TE_3} + C_3GW_s\delta_{TE_3} + C_4\bar{q}_s\delta_{TE_3} + C_5M_1\bar{q}_s\delta_{TE_3}$ $+C_6\bar{q}_sGW_s\delta_{TE_3} + C_7M_1^2\bar{q}_s\delta_{TE_3} + C_8M_1GW_s\delta_{TE_3} + C_9\bar{q}_s^2\delta_{TE_3}$
CMTE4E	$C_0\delta_{TE_4} + C_1M_1\delta_{TE_4} + C_2GW_s\delta_{TE_4} + C_3\bar{q}_s\delta_{TE_4} + C_4\bar{q}_sGW_s\delta_{TE_4}$ $+C_5M_1\bar{q}_s\delta_{TE_4} + C_6M_1^2\delta_{TE_4} + C_7M_1^2\bar{q}_s\delta_{TE_4} + C_8M_1GW_s\delta_{TE_4}$ $+C_9M_1\bar{q}_sGW_s\delta_{TE_4}$
CMTE5E	$C_0\delta_{TE_5} + C_1M_1\delta_{TE_5} + C_2GW_s\delta_{TE_5} + C_3\bar{q}_s\delta_{TE_5} + C_4\bar{q}_sGW_s\delta_{TE_5}$ $+C_5M_1\bar{q}_s\delta_{TE_5} + C_6M_1^2\delta_{TE_5} + C_7M_1^2\bar{q}_s\delta_{TE_5} + C_8M_1GW_s\delta_{TE_5}$ $+C_9M_1\bar{q}_sGW_s\delta_{TE_5}$
CMTE6E	$C_0\delta_{TE_6} + C_1M_1\delta_{TE_6} + C_2M_1^2\delta_{TE_6} + C_3GW_s\delta_{TE_6} + C_4\bar{q}_s\delta_{TE_6} + C_5M_1\bar{q}_s\delta_{TE_6}$ $+C_6\bar{q}_sGW_s\delta_{TE_6} + C_7M_1^2\bar{q}_s\delta_{TE_6} + C_8M_1GW_s\delta_{TE_6} + C_9\bar{q}_s^2\delta_{TE_6}$
CMTE7E	$C_0\delta_{TE_7} + C_1\bar{q}_s\delta_{TE_7} + C_2M_1\delta_{TE_7} + C_3M_1\bar{q}_s\delta_{TE_7} + C_4M_1^2\delta_{TE_7}$ $+C_5M_1^2\bar{q}_s\delta_{TE_7} + C_6GW_s\delta_{TE_7} + C_7\bar{q}_s^2\delta_{TE_7} + C_8\bar{q}_sGW_s\delta_{TE_7}$
CMTE8E	$C_0\delta_{TE_8} + C_1\bar{q}_s\delta_{TE_8} + C_2M_1\delta_{TE_8} + C_3M_1^2\delta_{TE_8} + C_4\bar{q}_s^2\delta_{TE_8}$ $+C_5M_1\bar{q}_s\delta_{TE_8} + C_6M_1^2\bar{q}_s\delta_{TE_8} + C_7M_1\bar{q}_s^2\delta_{TE_8}$
KMTE1	if M<.4 and $\delta_{TE_{234}}>0$ $C_0\delta l_{TE_{234}} + C_1\delta l_{TE_{234}}^2 + C_2\delta l_{TE_{234}}^3 + C_3\alpha\delta l_{TE_{234}} + C_4\alpha\delta l_{TE_{234}}^2$ $+C_5\alpha\delta l_{TE_{234}}^3 + C_6\delta_{LE_L}\delta l_{TE_{234}} + C_7\alpha^2\delta l_{TE_{234}} + C_8\alpha\delta_{LE_L}\delta l_{TE_{234}} + 1$ else 1.0
KMTE2	if M<.4 and $\delta_{TE_{134}}>0$ $C_0\delta l_{TE_{134}} + C_1\delta l_{TE_{134}}^2 + C_2\delta l_{TE_{134}}^3 + C_3\alpha\delta l_{TE_{134}} + C_4\alpha\delta l_{TE_{134}}^2$ $+C_5\alpha\delta l_{TE_{134}}^3 + C_6\delta_{LE_L}\delta l_{TE_{134}} + C_7\alpha^2\delta l_{TE_{134}} + C_8\alpha\delta_{LE_L}\delta l_{TE_{134}} + 1$ else 1.0

KMTE3	if M<.4 and $\delta_{TE_{124}}>0$ $C_0\delta l_{TE_{124}} + C_1\delta l_{TE_{124}}^{\ 2} + C_2\delta l_{TE_{124}}^{\ 3} + C_3\alpha\delta l_{TE_{124}} + C_4\alpha\delta l_{TE_{124}}^{\ 2}$ $+C_5\alpha\delta l_{TE_{124}}^{\ 3} + C_6\delta_{LE_L}\delta l_{TE_{124}} + C_7\alpha^2\delta l_{TE_{124}} + C_8\alpha\delta_{LE_L}\delta l_{TE_{124}} + 1$ else 1.0
KMTE4	if M<.4 and $\delta_{TE_{123}}>0$ $C_0\delta l_{TE_{123}} + C_1\delta l_{TE_{123}}^{\ 2} + C_2\delta l_{TE_{123}}^{\ 3} + C_3\alpha\delta l_{TE_{123}} + C_4\alpha\delta l_{TE_{123}}^{\ 2}$ $+C_5\alpha\delta l_{TE_{123}}^{\ 3} + C_6\delta_{LE_L}\delta l_{TE_{123}} + C_7\alpha^2\delta l_{TE_{123}} + C_8\alpha\delta_{LE_L}\delta l_{TE_{123}} + 1$ else 1.0
KMTE5	if M<.4 and $\delta_{TE_{678}}>0$ $C_0\delta l_{TE_{678}} + C_1\delta l_{TE_{678}}^{\ 2} + C_2\delta l_{TE_{678}}^{\ 3} + C_3\alpha\delta l_{TE_{678}} + C_4\alpha\delta l_{TE_{678}}^{\ 2}$ $+C_5\alpha\delta l_{TE_{678}}^{\ 3} + C_6\delta_{LE_R}\delta l_{TE_{678}} + C_7\alpha^2\delta l_{TE_{678}} + C_8\alpha\delta_{LE_R}\delta l_{TE_{678}} + 1$ else 1.0
KMTE6	if M<.4 and $\delta_{TE_{578}}>0$ $C_0\delta l_{TE_{578}} + C_1\delta l_{TE_{578}}^{\ 2} + C_2\delta l_{TE_{578}}^{\ 3} + C_3\alpha\delta l_{TE_{578}} + C_4\alpha\delta l_{TE_{578}}^{\ 2}$ $+C_5\alpha\delta l_{TE_{578}}^{\ 3} + C_6\delta_{LE_R}\delta l_{TE_{578}} + C_7\alpha^2\delta l_{TE_{578}} + C_8\alpha\delta_{LE_R}\delta l_{TE_{578}} + 1$ else 1.0
KMTE7	if M<.4 and $\delta_{TE_{568}}>0$ $C_0\delta l_{TE_{568}} + C_1\delta l_{TE_{568}}^{\ 2} + C_2\delta l_{TE_{568}}^{\ 3} + C_3\alpha\delta l_{TE_{568}} + C_4\alpha\delta l_{TE_{568}}^{\ 2}$ $+C_5\alpha\delta l_{TE_{568}}^{\ 3} + C_6\delta_{LE_R}\delta l_{TE_{568}} + C_7\alpha^2\delta l_{TE_{568}} + C_8\alpha\delta_{LE_R}\delta l_{TE_{568}} + 1$ else 1.0

KMTE8	if M<.4 and $\delta_{TE_{567}}>0$ $C_0\delta l_{TE_{567}} + C_1\delta l_{TE_{567}}^{\ 2} + C_2\delta l_{TE_{567}}^{\ 3} + C_3\alpha\delta l_{TE_{567}} + C_4\alpha\delta l_{TE_{567}}^{\ 2}$ $+C_5\alpha\delta l_{TE_{567}}^{\ 3} + C_6\delta_{LE_R}\delta l_{TE_{567}} + C_7\alpha^2\delta l_{TE_{567}} + C_8\alpha\delta_{LE_R}\delta l_{TE_{567}} + 1$ else 1.0
CMVFR	if M<=.5 $C_0\delta_{VF} + C_1\alpha\delta_{VF} + C_2\delta l_{TE_{AVG}}\delta_{VF} + C_3\alpha\delta l_{TE_{AVG}}\delta_{VF} + C_4M_2\delta_{VF}$ $+C_5\alpha M_2\delta_{VF} + C_6\beta^2\delta_{VF} + C_7M_2^{\ 2}\delta_{VF} + C_8\alpha M_2^{\ 2}\delta_{VF}$ $+C_9\beta^2\delta l_{TE_{AVG}}\delta_{VF} + C_{10}\alpha\beta^2\delta_{VF} + C_{11}\alpha^2\delta_{VF} + C_{12}\alpha^2\delta l_{TE_{AVG}}\delta_{VF}$ else 0.0
CMSP1R	$C_0\delta_{SP_1} + C_1\delta l_{TE_{AVG}}\delta_{SP_1} + C_2\alpha\delta_{SP_1} + C_3\alpha\delta l_{TE_{AVG}}\delta_{SP_1} + C_4\delta l_{TE_{AVG}}^{\ 2}\delta_{SP_1}$ $+C_5\delta_{SP_1}^{\ 2} + C_6\delta l_{TE_{AVG}}\delta_{SP_1}^{\ 2} + C_7\delta_{LE_{AVG}}\delta_{SP_1} + C_8\delta_{LE_{AVG}}^{\ 2}\delta_{SP_1}$
CMSP2R	$C_0\delta_{SP_2} + C_1\alpha\delta_{SP_2} + C_2\delta l_{TE_{AVG}}\delta_{SP_2} + C_3\alpha\delta l_{TE_{AVG}}\delta_{SP_2}$ $+C_4\delta_{LE_{AVG}}\delta_{SP_2} + C_5\delta_{SP_2}^{\ 2} + C_6\delta l_{TE_{AVG}}\delta_{SP_2}^{\ 2}$
CMSP3R	$C_0\delta_{SP_3} + C_1\alpha\delta_{SP_3} + C_2\delta l_{TE_{AVG}}\delta_{SP_3} + C_3\alpha\delta l_{TE_{AVG}}\delta_{SP_3}$ $+C_4\delta_{LE_{AVG}}\delta_{SP_3} + C_5\delta_{SP_3}^{\ 2} + C_6\delta l_{TE_{AVG}}\delta_{SP_3}^{\ 2}$
CMSP4R	$C_0\delta_{SP_4} + C_1\delta l_{TE_{AVG}}\delta_{SP_4} + C_2\alpha\delta_{SP_4} + C_3\alpha\delta l_{TE_{AVG}}\delta_{SP_4} + C_4\delta l_{TE_{AVG}}^{\ 2}\delta_{SP_4}$ $+C_5\delta_{SP_4}^{\ 2} + C_6\delta l_{TE_{AVG}}\delta_{SP_4}^{\ 2} + C_7\delta_{LE_{AVG}}\delta_{SP_4} + C_8\delta_{LE_{AVG}}^{\ 2}\delta_{SP_4}$

CMGR	if $\frac{h_r}{b_w}<0.932$ $C_0+C_1\frac{h_r}{b_w}+C_2\alpha_1+C_3\delta l_{TE_{AVG}}+C_4\alpha_1\delta l_{TE_{AVG}}+C_5{\alpha_1}^2$ $+C_6\alpha_1\left[\frac{h_r}{b_w}\right]+C_7\left[\frac{h_r}{b_w}\right]^2+C_8\left[\frac{h_r}{b_w}\right]\delta l_{TE_{AVG}}+C_9{\delta l_{TE_{AVG}}}^2$ $+C_{10}{\alpha_1}^2\frac{h_r}{b_w}+C_{11}{\alpha_1}^2\delta l_{TE_{AVG}}+C_{12}\alpha_1\left[\frac{h_r}{b_w}\right]^2+C_{13}\alpha_1\left[\frac{h_r}{b_w}\right]\delta l_{TE_{AVG}}$ $+C_{14}\alpha_1{\delta l_{TE_{AVG}}}^2+C_{15}\left[\frac{h_r}{b_w}\right]^2\delta l_{TE_{AVG}}+C_{16}{\alpha_1}^2\left[\frac{h_r}{b_w}\right]^2$ $+C_{17}{\alpha_1}^2{\delta l_{TE_{AVG}}}^2+C_{18}{\alpha_1}^2\left[\frac{h_r}{b_w}\right]\delta l_{TE_{AVG}}$ else 0.0
CMUS1	$C_0+C_1\alpha_2+C_2\beta_1+C_3M_4+C_4\alpha_2\beta_1+C_5\alpha_2M_4+C_6{M_4}^2$ $+C_7\beta_1M_4+C_8\beta_1{M_4}^2+C_9{\alpha_2}^2+C_{10}{\alpha_2}^2M_4+C_{11}\alpha_2{M_4}^2$ $+C_{12}{\alpha_2}^2{M_4}^2+C_{13}{\beta_1}^2+C_{14}\alpha_2{\beta_1}^2$
KMUS1	$C_0+C_1\frac{W_{OSP}}{W_C l_1}+C_2\left[\frac{W_{OSP}}{W_C l_1}\right]^2+C_3M_3$
CMUS4	$C_0+C_1\alpha_2+C_2\beta_1+C_3M_4+C_4\alpha_2\beta_1+C_5\alpha_2M_4+C_6{M_4}^2$ $+C_7\beta_1M_4+C_8\beta_1{M_4}^2+C_9{\alpha_2}^2+C_{10}{\alpha_2}^2M_4+C_{11}\alpha_2{M_4}^2$ $+C_{12}{\alpha_2}^2{M_4}^2+C_{13}{\beta_1}^2+C_{14}\alpha_2{\beta_1}^2$
KMUS4	$C_0+C_1\frac{W_{OSP}}{W_C l_4}+C_2\left[\frac{W_{OSP}}{W_C l_4}\right]^2+C_3M_3$
CMUS12	$C_0+C_1\alpha_2+C_2M_4+C_3\alpha_2M_4+C_4\beta_1+C_5{M_4}^2+C_6{\alpha_2}^2$ $+C_7\alpha_2\beta_1+C_8\alpha_2{M_4}^2+C_9{\beta_1}^2+C_{10}{\beta_1}^2M_4+C_{11}\alpha_2{\beta_1}^2$
KMUS12	$C_0+C_1\frac{W_{OSP}}{W_C l_{1,2}}+C_2\left[\frac{W_{OSP}}{W_C l_{1,2}}\right]^2$

CMUS34	$C_0 + C_1\alpha_2 + C_2M_4 + C_3\alpha_2M_4 + C_4\beta_1 + C_5M_4^2 + C_6\alpha_2^2$ $+C_7\alpha_2\beta_1 + C_8\alpha_2M_4^2 + C_9\beta_1^2 + C_{10}\beta_1^2M_4 + C_{11}\alpha_2\beta_1^2$
KMUS34	$C_0 + C_1\frac{W_{OSP}}{W_C l_{3,4}} + C_2\left[\frac{W_{OSP}}{W_C l_{3,4}}\right]^2$
CM1_US	if flus1=1 and flus2=1 0.0 else if flus1=1 KMUS1*CMUS1 else 0.0
CM4_US	if flus3=1 and flus4=1 0.0 else if flus4=1 KMUS4*CMUS4 else 0.0
CM12_US	if flus1=1 and flus2=1 KMUS12*CMUS12 else 0.0
CM34_US	if flus3=1 and flus4=1 KMUS34*CMUS34 else 0.0
CMLGR	$C_0 + C_1\alpha_1 + C_2\alpha_1^2 + C_3\alpha_1^3 + C_4\alpha_1^4$
KLLGR	$C_0 + C_1\delta_{GEAR} + C_2\delta_{GEAR}^2 + C_3\delta_{GEAR}^3$

CMTHLR	if M<.65 & $\delta_{TE_{AVG}}$>0.0 & δ_s~=0.0 $C_0\delta_{TE_{AVG}} + C_1\delta_s{}^2\delta_{TE_{AVG}} + C_2\delta_s\delta_{TE_{AVG}} + C_3\alpha\delta_s\delta_{TE_{AVG}}$ $+C_4\alpha\delta_{TE_{AVG}} + C_5\alpha^2\delta_{TE_{AVG}} + C_6\delta_{TE_{AVG}}{}^2$ $+C_7\alpha\delta_{TE_{AVG}}{}^2 + C_8\delta_s\delta_{TE_{AVG}}{}^2 + C_9\alpha^2\delta_s\delta_{TE_{AVG}} + C_{10}\delta_s{}^3\delta_{TE_{AVG}}$ else 0.0
CMTR	$C_0\delta_e + C_1\delta_s + C_2M\delta_e$
CMTR_ZS	$C_0\delta_e + C_1M\delta_e$
CMTR_ZE	$C_0\delta_s$
CMHSE	$C_0 + C_1\bar{q}_s + C_2M + C_3\bar{q}_sM + C_4GW_s + C_5\bar{q}_sGW_s$
CMHEE	$C_0 + C_1\bar{q}_s + C_2M + C_3\bar{q}_sM$
CMQR	$C_0 + C_1M + C_2M^2$
CMQTER	$C_0\delta_{TE_{AVG}} + C_1\alpha_1\delta_{TE_{AVG}} + C_2M\delta_{TE_{AVG}} + C_3\alpha_1M\delta_{TE_{AVG}}$
CMQLER	$C_0\delta_{LE_{AVG}} + C_1\alpha_1\delta_{LE_{AVG}} + C_2M\delta_{LE_{AVG}} + C_2\alpha_1M\delta_{LE_{AVG}}$
CMQE	$C_0\bar{q}_s + C_1\bar{q}_sGW_s + C_2M_1\bar{q}_s + C_3\bar{q}_s{}^2 + C_4M_1\bar{q}_s{}^2$ $+C_5M_1\bar{q}_sGW_s + C_6M_1{}^2\bar{q}_s$
CMQDR	$C_0 + C_1M_1 + C_2M_1{}^2$
CMQDE	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2M_1{}^2\bar{q}_s + C_3\bar{q}_sGW_s + C_4M_1{}^3\bar{q}_s + C_5M_1\bar{q}_sGW_s$
CMADR	$C_0 + C_1M + C_2M^2$
CMADE	$C_0\bar{q}_s + C_1M\bar{q}_s + C_2M^2\bar{q}_s + C_3M^3\bar{q}_s + C_4\bar{q}_sGW_s + C_5M\bar{q}_sGW_s$ $+C_6M^2\bar{q}_sGW_s + C_7\bar{q}_s{}^2 + C_8M\bar{q}_s{}^2$

Table 8 - CM Supersonic

COMPONENT	MODEL
CMR	$C_0 + C_1\alpha + C_2M + C_3\alpha M + C_4M^2 + C_5\alpha M^2$
DCME	$C_0 + C_1M + C_2GW_s + C_3\bar{q}_s + C_4\bar{q}_sGW_s + C_5\alpha + C_6\alpha M$ $+C_7\alpha\bar{q}_s + C_8M\bar{q}_s + C_9\alpha M\bar{q}_s + C_{10}\alpha GW_s + C_{11}\alpha\bar{q}_sGW_s$ $+C_{12}M^2 + C_{13}\bar{q}_s^2 + C_{14}M^2\bar{q}_s + C_{15}\alpha M^2$
CMBR	$C_0\beta_3^2 + C_1\alpha_1\beta_3^2 + C_2\beta_3^2M + C_3\beta_3^2M^2 + C_4\alpha_1\beta_3^2M$ $+C_5\alpha_1\beta_3^2M^2 + C_6\alpha_1^2\beta_3^2$
CMLE1R	$C_0\delta_{LE_1} + C_1\delta_{LE_1}M + C_2\alpha\delta_{LE_1} + C_3\alpha\delta_{LE_1}M + C_4\delta_{LE_1}M^2 + C_5\alpha\delta_{LE_1}M^2$ $+C_6\delta_{LE_1}^2 + C_7\delta_{LE_1}^2M$
CMLE2R	$C_0\delta_{LE_2} + C_1\alpha\delta_{LE_2} + C_2\delta_{LE_2}M + C_3\alpha^2\delta_{LE_2} + C_4\alpha\delta_{LE_2}M$
CMLE3R	$C_0\delta_{LE_3} + C_1\alpha\delta_{LE_3} + C_2\delta_{LE_3}M + C_3\alpha^2\delta_{LE_3} + C_4\alpha\delta_{LE_3}M$
CMLE4R	$C_0\delta_{LE_4} + C_1\delta_{LE_4}M + C_2\alpha\delta_{LE4} + C_3\alpha\delta_{LE_4}M + C_4\delta_{LE_4}M^2 + C_5\alpha\delta_{LE_4}M^2$ $+C_6\delta_{LE_4}^2 + C_7\delta_{LE_4}^2M$
CMLE1E	$C_0\delta_{LE_1} + C_1M_1\delta_{LE_1} + C_2\bar{q}_s\delta_{LE_1} + C_3M_1\bar{q}_s\delta_{LE_1} + C_4GW_s\delta_{LE_1}$ $+C_5\bar{q}_sGW_s\delta_{LE_1} + C_6\bar{q}_s^2\delta_{LE_1} + C_7M_1^2\delta_{LE_1} + C_8M_1^2\bar{q}_s\delta_{LE_1}$ $+C_9M_1\bar{q}_s\delta_{LE_1} + C_{10}M_1\bar{q}_sGW_s\delta_{LE_1} + C_{11}M_1\bar{q}_s^2\delta_{LE_1}$
CMLE2E	$C_0\delta_{LE_2} + C_1\bar{q}_s\delta_{LE_2} + C_2GW_s\delta_{LE_2} + C_3\bar{q}_sGW_s\delta_{LE_2}$ $+C_4M_1\delta_{LE_2} + C_5M_1^2\delta_{LE_2} + C_6M_1\bar{q}_s\delta_{LE_2}$ $+C_7M_1^2\bar{q}_s\delta_{LE_2} + C_8GW_s^2\delta_{LE_2}$
CMLE3E	$C_0\delta_{LE_3} + C_1\bar{q}_s\delta_{LE_3} + C_2GW_s\delta_{LE_3} + C_3\bar{q}_sGW_s\delta_{LE_3}$ $+C_4M_1\delta_{LE_3} + C_5M_1^2\delta_{LE_3} + C_6M_1\bar{q}_s\delta_{LE_3}$ $+C_7M_1^2\bar{q}_s\delta_{LE_3} + C_8GW_s^2\delta_{LE_3}$
CMLE4E	$C_0\delta_{LE_4} + C_1M_1\delta_{LE_4} + C_2\bar{q}_s\delta_{LE_4} + C_3M_1\bar{q}_s\delta_{LE_4} + C_4GW_s\delta_{LE_4}$ $+C_5\bar{q}_sGW_s\delta_{LE_4} + C_6\bar{q}_s^2\delta_{LE_4} + C_7M_1^2\delta_{LE_4} + C_8M_1^2\bar{q}_s\delta_{LE_4}$ $+C_9M_1\bar{q}_s\delta_{LE_4} + C_{10}M_1\bar{q}_sGW_s\delta_{LE_4} + C_{11}M_1\bar{q}_s^2\delta_{LE_4}$

CMTEBR	0.0
CMTE1R	$C_0\delta_{TE_1} + C_1\delta_{TE_1}{}^2 + C_2\delta_{TE_1}M + C_3\delta_{TE_1}{}^2M + C_4\alpha\delta_{TE_1}{}^2$ $+C_5\alpha\delta_{TE_1}{}^2M$
CMTE2R	$C_0\delta_{TE_2} + C_1\delta_{TE_2}M + C_2\delta_{TE_2}{}^2 + C_3\delta_{TE_2}{}^2M + C_4\alpha\delta_{TE_2}{}^2$ $+C_5\alpha\delta_{TE_2}{}^2M + C_6\delta_{TE_2}{}^3$
CMTE3R	$C_0\delta_{TE_3} + C_1\delta_{TE_3}{}^2 + C_2\delta_{TE_3}{}^2M + C_3\delta_{TE_3}M + C_4\alpha\delta_{TE_3}{}^2$ $+C_5\alpha\delta_{TE_3}{}^2M + C_6\alpha\delta_{TE_3} + C_7\alpha\delta_{TE_3}M$
CMTE4R	$C_0\delta_{TE_4} + C_1\delta_{TE_4}M + C_2\alpha\delta_{TE_4} + C_3\alpha\delta_{TE_4}M + C_4\delta_{TE_4}{}^2$ $+C_5\delta_{TE_4}{}^2M + C_6\delta_{TE_4}M^2$
CMTE5R	$C_0\delta_{TE_5} + C_1\delta_{TE_5}M + C_2\alpha\delta_{TE_5} + C_3\alpha\delta_{TE_5}M + C_4\delta_{TE_5}{}^2$ $+C_5\delta_{TE_5}{}^2M + C_6\delta_{TE_5}M^2$
CMTE6R	$C_0\delta_{TE_6} + C_1\delta_{TE_6}{}^2 + C_2\delta_{TE_6}{}^2M + C_3\delta_{TE_6}M + C_4\alpha\delta_{TE_6}{}^2$ $+C_5\alpha\delta_{TE_6}{}^2M + C_6\alpha\delta_{TE_6} + C_7\alpha\delta_{TE_6}M$
CMTE7R	$C_0\delta_{TE_7} + C_1\delta_{TE_7}M + C_2\delta_{TE_7}{}^2 + C_3\delta_{TE_7}{}^2M + C_4\alpha\delta_{TE_7}{}^2$ $+C_5\alpha\delta_{TE_7}{}^2M + C_6\delta_{TE_7}{}^3$
CMTE8R	$C_0\delta_{TE_8} + C_1\delta_{TE_8}{}^2 + C_2\delta_{TE_8}M + C_3\delta_{TE_8}{}^2M + C_4\alpha\delta_{TE_8}{}^2$ $+C_5\alpha\delta_{TE_8}{}^2M$
CMTE1E	$C_0\delta_{TE_1} + C_1M_1\delta_{TE_1} + C_2\bar{q}_s\delta_{TE_1} + C_3M_1\bar{q}_s\delta_{TE_1} + C_4M^2\delta_{TE_1}$ $+C_5\bar{q}_s{}^2\delta_{TE_1} + C_6M_1\bar{q}_s{}^2\delta_{TE_1} + C_7M_1{}^2\bar{q}_s\delta_{TE_1}$
CMTE2E	$C_0\delta_{TE_2} + C_1M_1\delta_{TE_2} + C_2\bar{q}_s\delta_{TE_2} + C_3M_1\bar{q}_s\delta_{TE_2} + C_4M_1{}^2\delta_{TE_2}$ $+C_5M_1{}^2\bar{q}_s\delta_{TE_2} + C_6\bar{q}_s{}^2\delta_{TE_2} + C_7M_1\bar{q}_s{}^2\delta_{TE_2}$
CMTE3E	$C_0\delta_{TE_3} + C_1\bar{q}_s\delta_{TE_3} + C_2M_1\delta_{TE_3} + C_3M_1{}^2\delta_{TE_3} + C_4M_1\bar{q}_s\delta_{TE_3}$ $+C_5M_1{}^2\bar{q}_s\delta_{TE_3} + C_6GW_s\delta_{TE_3} + C_7\bar{q}_s{}^2\delta_{TE_3} + C_8M_1\bar{q}_s{}^2\delta_{TE_3}$ $+C_9\bar{q}_sGW_s\delta_{TE_3} + C_{10}M_1GW_s\delta_{TE_3}$

CMTE4E	$C_0\delta_{TE_4} + C_1M_1\delta_{TE_4} + C_2M_1^2\delta_{TE_4} + C_3\bar{q}_s\delta_{TE_4} + C_4M_1\bar{q}_s\delta_{TE_4}$ $+C_5M_1^2\bar{q}_s\delta_{TE_4} + C_6GW_s\delta_{TE_4} + C_7\bar{q}_sGW_s\delta_{TE_4} + C_8M_1GW_s\delta_{TE_4}$ $+C_9M_1\bar{q}_sGW_s\delta_{TE_4}$
CMTE5E	$C_0\delta_{TE_5} + C_1M_1\delta_{TE_5} + C_2M_1^2\delta_{TE_5} + C_3\bar{q}_s\delta_{TE_5} + C_4M_1\bar{q}_s\delta_{TE_5}$ $+C_5M_1^2\bar{q}_s\delta_{TE_5} + C_6GW_s\delta_{TE_5} + C_7\bar{q}_sGW_s\delta_{TE_5} + C_8M_1GW_s\delta_{TE_5}$ $+C_9M_1\bar{q}_sGW_s\delta_{TE_5}$
CMTE6E	$C_0\delta_{TE_6} + C_1\bar{q}_s\delta_{TE_6} + C_2M_1\delta_{TE_6} + C_3M_1^2\delta_{TE_6} + C_4M_1\bar{q}_s\delta_{TE_6}$ $+C_5M_1^2\bar{q}_s\delta_{TE_6} + C_6GW_s\delta_{TE_6} + C_7\bar{q}_s^2\delta_{TE_6} + C_8M_1\bar{q}_s^2\delta_{TE_6}$ $+C_9\bar{q}_sGW_s\delta_{TE_6} + C_{10}M_1GW_s\delta_{TE_6}$
CMTE7E	$C_0\delta_{TE_7} + C_1M_1\delta_{TE_7} + C_2\bar{q}_s\delta_{TE_7} + C_3M_1\bar{q}_s\delta_{TE_7} + C_4M_1^2\delta_{TE_7}$ $+C_5M_1^2\bar{q}_s\delta_{TE_7} + C_6\bar{q}_s^2\delta_{TE_7} + C_7M_1\bar{q}_s^2\delta_{TE_7}$
CMTE8E	$C_0\delta_{TE_8} + C_1M_1\delta_{TE_8} + C_2\bar{q}_s\delta_{TE_8} + C_3M_1\bar{q}_s\delta_{TE_8} + C_4M^2\delta_{TE_8}$ $+C_5\bar{q}_s^2\delta_{TE_8} + C_6M_1\bar{q}_s^2\delta_{TE_8} + C_7M_1^2\bar{q}_s\delta_{TE_8}$
KMTE1	if M<.4 and $\delta_{TE_{234}}>0$ $C_0\delta l_{TE_{234}} + C_1\delta l_{TE_{234}}^2 + C_2\delta l_{TE_{234}}^3 + C_3\alpha\delta l_{TE_{234}} + C_4\alpha\delta l_{TE_{234}}^2$ $+C_5\alpha\delta l_{TE_{234}}^3 + C_6\delta_{LE_L}\delta l_{TE_{234}} + C_7\alpha^2\delta l_{TE_{234}} + C_8\alpha\delta_{LE_L}\delta l_{TE_{234}} + 1$ else 1.0
KMTE2	if M<.4 and $\delta_{TE_{134}}>0$ $C_0\delta l_{TE_{134}} + C_1\delta l_{TE_{134}}^2 + C_2\delta l_{TE_{134}}^3 + C_3\alpha\delta l_{TE_{134}} + C_4\alpha\delta l_{TE_{134}}^2$ $+C_5\alpha\delta l_{TE_{134}}^3 + C_6\delta_{LE_L}\delta l_{TE_{134}} + C_7\alpha^2\delta l_{TE_{134}} + C_8\alpha\delta_{LE_L}\delta l_{TE_{134}} + 1$ else 1.0

KMTE3	if M<.4 and $\delta_{TE_{124}}>0$ $C_0\delta l_{TE_{124}} + C_1\delta l_{TE_{124}}^{\ 2} + C_2\delta l_{TE_{124}}^{\ 3} + C_3\alpha\delta l_{TE_{124}} + C_4\alpha\delta l_{TE_{124}}^{\ 2}$ $+C_5\alpha\delta l_{TE_{124}}^{\ 3} + C_6\delta_{LE_L}\delta l_{TE_{124}} + C_7\alpha^2\delta l_{TE_{124}} + C_8\alpha\delta_{LE_L}\delta l_{TE_{124}} + 1$ else 1.0
KMTE4	if M<.4 and $\delta_{TE_{123}}>0$ $C_0\delta l_{TE_{123}} + C_1\delta l_{TE_{123}}^{\ 2} + C_2\delta l_{TE_{123}}^{\ 3} + C_3\alpha\delta l_{TE_{123}} + C_4\alpha\delta l_{TE_{123}}^{\ 2}$ $+C_5\alpha\delta l_{TE_{123}}^{\ 3} + C_6\delta_{LE_L}\delta l_{TE_{123}} + C_7\alpha^2\delta l_{TE_{123}} + C_8\alpha\delta_{LE_L}\delta l_{TE_{123}} + 1$ else 1.0
KMTE5	if M<.4 and $\delta_{TE_{678}}>0$ $C_0\delta l_{TE_{678}} + C_1\delta l_{TE_{678}}^{\ 2} + C_2\delta l_{TE_{678}}^{\ 3} + C_3\alpha\delta l_{TE_{678}} + C_4\alpha\delta l_{TE_{678}}^{\ 2}$ $+C_5\alpha\delta l_{TE_{678}}^{\ 3} + C_6\delta_{LE_R}\delta l_{TE_{678}} + C_7\alpha^2\delta l_{TE_{678}} + C_8\alpha\delta_{LE_R}\delta l_{TE_{678}} + 1$ else 1.0
KMTE6	if M<.4 and $\delta_{TE_{578}}>0$ $C_0\delta l_{TE_{578}} + C_1\delta l_{TE_{578}}^{\ 2} + C_2\delta l_{TE_{578}}^{\ 3} + C_3\alpha\delta l_{TE_{578}} + C_4\alpha\delta l_{TE_{578}}^{\ 2}$ $+C_5\alpha\delta l_{TE_{578}}^{\ 3} + C_6\delta_{LE_R}\delta l_{TE_{578}} + C_7\alpha^2\delta l_{TE_{578}} + C_8\alpha\delta_{LE_R}\delta l_{TE_{578}} + 1$ else 1.0
KMTE7	if M<.4 and $\delta_{TE_{568}}>0$ $C_0\delta l_{TE_{568}} + C_1\delta l_{TE_{568}}^{\ 2} + C_2\delta l_{TE_{568}}^{\ 3} + C_3\alpha\delta l_{TE_{568}} + C_4\alpha\delta l_{TE_{568}}^{\ 2}$ $+C_5\alpha\delta l_{TE_{568}}^{\ 3} + C_6\delta_{LE_R}\delta l_{TE_{568}} + C_7\alpha^2\delta l_{TE_{568}} + C_8\alpha\delta_{LE_R}\delta l_{TE_{568}} + 1$ else 1.0

KMTE8	if M<.4 and $\delta_{TE_{567}}>0$ $C_0\delta l_{TE_{567}} + C_1\delta l_{TE_{567}}^{\ 2} + C_2\delta l_{TE_{567}}^{\ 3} + C_3\alpha\delta l_{TE_{567}} + C_4\alpha\delta l_{TE_{567}}^{\ 2}$ $+C_5\alpha\delta l_{TE_{567}}^{\ 3} + C_6\delta_{LE_R}\delta l_{TE_{567}} + C_7\alpha^2\delta l_{TE_{567}} + C_8\alpha\delta_{LE_R}\delta l_{TE_{567}} + 1$ else 1.0
CMVFR	0.0
CMGR	if $\frac{h_r}{b_w}<0.932$ $C_0 + C_1\frac{h_r}{b_w} + C_2\alpha_1 + C_3\delta l_{TE_{AVG}} + C_4\alpha_1\delta l_{TE_{AVG}} + C_5\alpha_1^{\ 2}$ $+C_6\alpha_1\left[\frac{h_r}{b_w}\right] + C_7\left[\frac{h_r}{b_w}\right]^2 + C_8\left[\frac{h_r}{b_w}\right]\delta l_{TE_{AVG}} + C_9\delta l_{TE_{AVG}}^{\ 2}$ $+C_{10}\alpha_1^{\ 2}\frac{h_r}{b_w} + C_{11}\alpha_1^{\ 2}\delta l_{TE_{AVG}} + C_{12}\alpha_1\left[\frac{h_r}{b_w}\right]^2 + C_{13}\alpha_1\left[\frac{h_r}{b_w}\right]\delta l_{TE_{AVG}}$ $+C_{14}\alpha_1\delta l_{TE_{AVG}}^{\ 2} + C_{15}\left[\frac{h_r}{b_w}\right]^2\delta l_{TE_{AVG}} + C_{16}\alpha_1^{\ 2}\left[\frac{h_r}{b_w}\right]^2$ $+C_{17}\alpha_1^{\ 2}\delta l_{TE_{AVG}}^{\ 2} + C_{18}\alpha_1^{\ 2}\left[\frac{h_r}{b_w}\right]\delta l_{TE_{AVG}}$ else 0.0
CMUS1	$C_0 + C_1\alpha_2 + C_2\beta_1 + C_3M_4 + C_4\alpha_2\beta_1 + C_5\alpha_2M_4 + C_6M_4^{\ 2}$ $+C_7\beta_1M_4 + C_8\beta_1M_4^{\ 2} + C_9\alpha_2^{\ 2} + C_{10}\alpha_2^{\ 2}M_4 + C_{11}\alpha_2M_4^{\ 2}$ $+C_{12}\alpha_2^{\ 2}M_4^{\ 2} + C_{13}\beta_1^{\ 2} + C_{14}\alpha_2\beta_1^{\ 2}$
KMUS1	$C_0 + C_1\frac{W_{OSP}}{W_C l_1} + C_2\left[\frac{W_{OSP}}{W_C l_1}\right]^2 + C_3M_3$
CMUS4	$C_0 + C_1\alpha_2 + C_2\beta_1 + C_3M_4 + C_4\alpha_2\beta_1 + C_5\alpha_2M_4 + C_6M_4^{\ 2}$ $+C_7\beta_1M_4 + C_8\beta_1M_4^{\ 2} + C_9\alpha_2^{\ 2} + C_{10}\alpha_2^{\ 2}M_4 + C_{11}\alpha_2M_4^{\ 2}$ $+C_{12}\alpha_2^{\ 2}M_4^{\ 2} + C_{13}\beta_1^{\ 2} + C_{14}\alpha_2\beta_1^{\ 2}$

KMUS4	$C_0 + C_1 \frac{W_{OSP}}{W_C l_4} + C_2 \left[\frac{W_{OSP}}{W_C l_4} \right]^2 + C_3 M_3$
CMUS12	$C_0 + C_1\alpha_2 + C_2 M_4 + C_3\alpha_2 M_4 + C_4\beta_1 + C_5 M_4^{\,2} + C_6\alpha_2^{\,2}$ $+C_7\alpha_2\beta_1 + C_8\alpha_2 M_4^{\,2} + C_9\beta_1^{\,2} + C_{10}\beta_1^{\,2} M_4 + C_{11}\alpha_2\beta_1^{\,2}$
KMUS12	$C_0 + C_1 \frac{W_{OSP}}{W_C l_{1,2}} + C_2 \left[\frac{W_{OSP}}{W_C l_{1,2}} \right]^2$
CMUS34	$C_0 + C_1\alpha_2 + C_2 M_4 + C_3\alpha_2 M_4 + C_4\beta_1 + C_5 M_4^{\,2} + C_6\alpha_2^{\,2}$ $+C_7\alpha_2\beta_1 + C_8\alpha_2 M_4^{\,2} + C_9\beta_1^{\,2} + C_{10}\beta_1^{\,2} M_4 + C_{11}\alpha_2\beta_1^{\,2}$
KMUS34	$C_0 + C_1 \frac{W_{OSP}}{W_C l_{3,4}} + C_2 \left[\frac{W_{OSP}}{W_C l_{3,4}} \right]^2$
CM1_US	if flus1=1 and flus2=1 0.0 else if flus1=1 KMUS1*CMUS1 else 0.0
CM4_US	if flus3=1 and flus4=1 0.0 else if flus4=1 KMUS4*CMUS4 else 0.0
CM12_US	if flus1=1 and flus2=1 KMUS12*CMUS12 else 0.0

CM34_US	if flus3=1 and flus4=1 KMUS34*CMUS34 else 0.0
CMLGR	$C_0 + C_1\alpha_1 + C_2\alpha_1^2 + C_3\alpha_1^3 + C_4\alpha_1^4$
KLLGR	$C_0 + C_1\delta_{GEAR} + C_2\delta_{GEAR}^2 + C_3\delta_{GEAR}^3$
CMTHLR	0.0
CMTR	$C_0\delta_s + C_1\delta_e + C_2M\delta_e + C_3M\delta_s + C_4M^2\delta_e + C_5M^2\delta_s$ $+C_6 + C_7\alpha + C_8M + C_9\alpha M + C_{10}\alpha\delta_e$
CMTR_ZS	$C_0\delta_e + C_1M\delta_e + C_2M^2\delta_e + C_3 + C_4\alpha + C_5M + C_6\alpha M + C_7\alpha\delta_e$
CMTR_ZE	$C_0\delta_s + C_1M\delta_s + C_2M^2\delta_s + C_3 + C_4\alpha + C_5M + C_6\alpha M$
CMHSE	$C_0 + C_1M + C_2\bar{q}_s + C_3\bar{q}_sM + C_4M^2 + C_5\bar{q}_sM^2 + C_6\bar{q}_s^2$ $+C_7\bar{q}_s^2M + C_8GW_s$
CMHEE	$C_0 + C_1\bar{q}_s + C_2M + C_3\bar{q}_sM + C_4\bar{q}_s^2$
CMQR	$C_0 + C_1\alpha + C_2M + C_3\alpha M + C_4M^2$
CMQTER	$C_0\delta_{TE_{AVG}} + C_1\alpha_1\delta_{TE_{AVG}} + C_2M\delta_{TE_{AVG}}$ $+C_3\alpha_1M\delta_{TE_{AVG}} + C_4M^2\delta_{TE_{AVG}}$
CMQLER	$C_0\delta_{LE_{AVG}} + C_1\alpha_1\delta_{LE_{AVG}} + C_2M\delta_{LE_{AVG}} + C_2M^2\delta_{LE_{AVG}}$ $+C_4M^3\delta_{LE_{AVG}} + C_5\alpha_1M\delta_{LE_{AVG}} + C_6\alpha_1M^2\delta_{LE_{AVG}}$
CMQE	$C_0\bar{q}_s + C_1\bar{q}_s^2 + C_2M_1\bar{q}_s + C_3M_1^2\bar{q}_s + C_4\bar{q}_sGW_s$ $+C_5M_1\bar{q}_sGW_s + C_6M_1\bar{q}_s^2$
CMQDR	$C_0 + C_1M_1$
CMQDE	$C_0\bar{q}_s + C_1M_1\bar{q}_s + C_2M_1^2\bar{q}_s + C_3\bar{q}_sGW_s + C_4\bar{q}_s^2 + C_5M_1\bar{q}_sGW_s$ $+C_6M_1^3\bar{q}_s + C_7M_1^4\bar{q}_s + C_8M_1\bar{q}_s^2 + C_9M_1^2\bar{q}_s^2$
CMADR	$C_0 + C_1M + C_2M^2$

CMADE	$C_0\bar{q}_s + C_1M\bar{q}_s + C_2M^2\bar{q}_s + C_3M^3\bar{q}_s + C_4\bar{q}_s^2 + C_5\bar{q}_sGW_s$ $+C_6M\bar{q}_sGW_s + C_7M^4\bar{q}_s + C_8M\bar{q}_s^2 + C_9M^2\bar{q}_s^2$

Table 9 - CM Coefficients

Coef. No.	cmr subsonic	cmr supersonic	cmbr subsonic	cmbr supersonic	dcme subsonic	dcme supersonic
C_0	2.6881e-01	-6.3735e-02	-4.7858e-06	6.3684e-05	-1.2628e-02	1.1482e-02
C_1	-1.6918e+00	2.2457e-03	3.9089e-05	5.5799e-06	-2.8240e-03	-3.9056e-02
C_2	-3.3682e-03	7.6916e-02	6.8597e-07	-3.2757e-05	2.6898e-03	-8.3629e-05
C_3	1.8788e-02	-1.0508e-02	-2.5875e-06	3.4214e-06	-8.8158e-04	-5.0700e-03
C_4	3.0148e+00	-1.9034e-02	-6.9628e-06	-4.8253e-06	-3.9585e-04	1.1726e-04
C_5	-2.3062e-02	3.3251e-03	3.0736e-06	1.3144e-06	3.1366e-04	-2.7585e-03
C_6	-1.6109e+00			1.9696e-08	5.3854e-03	3.9184e-03
C_7	6.4263e-05				1.3332e-06	-9.1219e-04
C_8					2.0854e-02	1.1337e-02
C_9					9.9172e-05	2.4381e-04
C_{10}					1.9262e-04	8.2150e-06
C_{11}					-2.3507e-02	8.0484e-05
C_{12}					-9.1333e-05	1.2362e-02
C_{13}					-3.8747e-03	-2.6482e-04
C_{14}					1.3838e-04	-3.3247e-03
C_{15}						-1.1242e-03

Coef. No.	cmle1r,cmle4r subsonic	cmle1r,cmle4r supersonic	cmle2r,cmle3r subsonic	cmle2r,cmle3r supersonic	cmle1e,cmle4e subsonic	cmle1e,cmle4e supersonic
C_0	-1.9146e-05	2.1386e-04	-7.6745e-06	3.7104e-06	-3.1727e-06	-6.0514e-05
C_1	-1.1494e-05	-1.4328e-04	-4.6077e-06	-4.7411e-06	4.5377e-05	7.9590e-05
C_2	2.7895e-04	-8.7384e-05	6.5894e-08	-3.9878e-06	-3.8327e-05	1.8600e-04
C_3	5.9650e-06	9.3538e-05	7.7206e-06	-1.2392e-07	-5.3549e-05	-1.0029e-04
C_4	3.0482e-07	1.4294e-05	4.7002e-06	2.0421e-06	2.5661e-06	5.0407e-06
C_5	-5.3812e-07	-2.1578e-05	-2.3267e-07		-2.9158e-06	-7.8749e-06
C_6	-2.5176e-04	-3.6356e-06			4.5995e-05	-3.0966e-06
C_7	-6.4409e-07	2.0013e-06			6.5147e-05	-2.2175e-05
C_8	2.3730e-07					1.2196e-05
C_9	-8.1257e-07					-2.2468e-06
C_{10}						2.7554e-06
C_{11}						1.1173e-06

Coef. No.	cmle2e,cmle3e subsonic	cmle2e,cmle3e supersonic	cmtebr	cmte1r,cmte8r subsonic	cmte1r,cmte8r supersonic	cmte2r,cmte7r subsonic
C_0	-2.8445e-07	-8.8722e-06	-1.8787e-04	-2.4250e-04	-5.5064e-04	-3.9181e-04
C_1	7.1197e-07	-3.4933e-06	-1.7412e-05	-5.3863e-04	2.4620e-06	-9.1402e-04
C_2	4.9241e-07	3.0815e-06	8.8580e-06	-3.5210e-07	1.7665e-04	2.5259e-06
C_3	-6.6732e-07	-4.7934e-07	1.5160e-06	-4.3994e-08	-6.7039e-07	-1.8141e-07
C_4	-3.1967e-06	1.3982e-06	-7.4463e-07	1.1779e-06	6.5539e-07	5.0798e-06
C_5	3.6344e-06	-3.6812e-07	2.9217e-06	8.2211e-06	-2.8259e-07	1.0247e-07
C_6	-4.0778e-07	8.7921e-06	1.6485e-08	2.4412e-07		-1.9997e-06
C_7	5.7541e-07	-2.1659e-06	2.4879e-07	-6.9471e-06		5.0460e-07
C_8	2.6649e-06	-2.9695e-07	-1.3769e-08			
C_9	-3.9539e-06		-5.2749e-08			

Coef. No.	cmte2r,cmte7r supersonic	cmte3r,cmte6r subsonic	cmte3r,cmte6r supersonic	cmte4r,cmte5r subsonic	cmte4r,cmte5r supersonic	cmte1e,cmte8e subsonic
C_0	-1.2720e-03	-9.3378e-05	-6.9779e-04	-8.1370e-05	-9.3226e-05	2.2568e-04
C_1	3.5329e-04	-6.2603e-04	2.4548e-06	7.5134e-04	2.7997e-04	9.0652e-05
C_2	4.6525e-06	5.3609e-06	-2.2975e-07	-9.9591e-04	9.6184e-06	-8.8781e-04
C_3	-1.3741e-06	-8.5242e-07	2.1450e-04	-3.2507e-06	-8.1370e-06	7.7038e-04
C_4	1.1784e-06	1.7176e-06	7.1089e-07	7.2202e-06	-3.3253e-06	6.6167e-06
C_5	-5.0991e-07	-1.0821e-07	-3.1810e-07	8.8901e-07	1.8304e-06	-1.1937e-04
C_6	2.0687e-07	2.7686e-07	9.1948e-06	-4.7794e-06	-1.0929e-04	3.0832e-04
C_7			-5.0614e-06	5.0510e-06		-1.7225e-05

Coef. No.	cmte1e,cmte8e supersonic	cmte2e,cmte7e subsonic	cmte2e,cmte7e supersonic	cmte3e,cmte6e subsonic	cmte3e,cmte6e supersonic	cmte4e,cmte5e subsonic
C_0	8.0453e-04	-6.2581e-06	5.5264e-04	4.9215e-05	1.1244e-04	1.1353e-05
C_1	-8.6198e-04	8.8338e-05	-5.8429e-04	-1.1176e-04	1.0944e-04	-4.1555e-05
C_2	5.0005e-04	-1.2708e-04	3.9992e-04	5.2170e-05	-1.5901e-04	-3.4374e-07
C_3	-2.9201e-04	-2.6582e-04	-2.7707e-04	-9.5146e-06	4.7958e-05	1.6681e-05
C_4	2.1938e-04	1.5357e-04	1.4705e-04	7.5191e-06	-9.2453e-05	1.5918e-06
C_5	-2.4018e-05	2.8387e-04	4.8534e-05	-1.2811e-04	1.9389e-05	-1.5009e-04
C_6	9.6771e-06	3.9482e-06	-1.1285e-05	4.4091e-06	1.1447e-05	5.0909e-05
C_7	3.8656e-05	-9.5615e-07	4.5549e-06	1.2755e-04	-2.0883e-06	1.2536e-04
C_8		1.8170e-06		1.4395e-05	8.9845e-07	-8.3169e-07
C_9				-3.3115e-07	9.4752e-07	5.4902e-06
C_{10}					-5.4852e-06	

Coef. No.	cmte4e,cmte5e supersonic	kmte1, kmte8	cmvfr	cmsp1r, cmsp4r	cmsp2r, cmsp3r	cmgr
C_0	7.2219e-05	6.5721e-02	3.1459e-04	-5.0259e-05	-3.3388e-05	-3.8387e-03
C_1	-9.0159e-05	-3.4611e-03	2.4672e-06	5.2199e-06	-1.9063e-07	8.2394e-03
C_2	2.3579e-05	4.6913e-05	8.0666e-06	1.7399e-06	5.1656e-06	-1.2593e-03
C_3	1.0085e-04	-5.9668e-04	3.8891e-07	-1.6692e-07	-1.2240e-07	-1.3060e-03
C_4	-1.3067e-04	3.7324e-05	-7.6392e-04	7.0951e-08	3.5745e-07	2.4630e-04
C_5	3.5279e-05	-6.6008e-07	3.5453e-07	5.0027e-07	6.8164e-07	3.9835e-05
C_6	1.6039e-06	-1.7581e-07	1.0269e-07	-5.7392e-08	-3.4082e-08	9.4271e-04
C_7	4.2911e-06	-3.9929e-06	-1.8233e-06	1.3905e-06		-9.6434e-05
C_8	-5.3967e-07	1.9960e-06	-4.6619e-07	-2.7810e-08		5.6879e-04
C_9	-1.4936e-06		-1.8047e-08			1.9754e-05
C_{10}			1.8446e-08			-2.8262e-05
C_{11}			1.3095e-07			-8.2433e-06
C_{12}			-3.6281e-08			5.6559e-06
C_{13}						-1.1458e-04
C_{14}						-3.5758e-06
C_{15}						2.0679e-06
C_{16}						-1.3492e-07
C_{17}						1.3088e-07

C_{18}						3.3463e-06

Coef. No.	cmus1	kmus1, kmus4	cmus4	cmus12	kmus12, kmus34	cmus34
C_0	1.1268e-02	2.9094e-01	1.1268e-02	1.1921e-02	3.6924e-03	1.1921e-02
C_1	-2.2682e-03	1.5259e+00	-2.2682e-03	3.4974e-03	1.5428e+00	3.4974e-03
C_2	-3.3148e-03	-5.6607e-01	3.3148e-03	-1.1379e-02	-5.6246e-01	-1.1379e-02
C_3	-1.2097e-02	-1.4113e-01	-1.2097e-02	-2.4905e-03		-2.4905e-03
C_4	-2.1164e-05		2.1164e-05	-6.2712e-05		6.2712e-05
C_5	2.5180e-03		2.5180e-03	2.3758e-03		2.3758e-03
C_6	2.8057e-03		2.8057e-03	-1.8513e-05		-1.8513e-05
C_7	2.9824e-03		-2.9824e-03	-2.1431e-05		2.1431e-05
C_8	-6.7035e-04		6.7035e-04	5.0836e-04		5.0836e-04
C_9	3.6946e-04		3.6946e-04	-7.9717e-05		-7.9717e-05
C_{10}	-3.3985e-04		-3.3985e-04	3.6649e-05		3.6649e-05
C_{11}	-6.0579e-04		-6.0579e-04	-2.1218e-06		-2.1218e-06
C_{12}	7.5723e-05		7.5723e-05			
C_{13}	9.8049e-06		9.8049e-06			
C_{14}	-2.4512e-06		-2.4512e-06			

Coef. No.	cmlgr	kllgr	cmtr subsonic	cmtr supersonic	cmthlr	cmhse subsonic
C_0	-7.7667e-04	1.1637e-02	-2.4705e-03	-1.0468e-02	1.4577e-04	2.2910e-03
C_1	-9.2157e-04	2.0340e-02	-5.5046e-03	-9.6216e-03	1.0459e-06	2.1758e-02
C_2	-1.3122e-04	3.2122e-04	-1.1668e-03	7.4571e-03	3.9879e-06	-4.9145e-03
C_3	1.9687e-05	-4.7576e-06		5.2084e-03	1.4511e-07	1.8804e-02
C_4	-5.0657e-07			-1.6006e-03	2.5627e-06	-3.9263e-04
C_5				-8.9697e-04	-4.7563e-07	-1.4217e-03
C_6				6.8782e-03	-3.7085e-06	
C_7				-6.2529e-04	2.6489e-07	
C_8				-2.8785e-03	-2.0952e-07	
C_9				2.6169e-04	1.5583e-08	
C_{10}				5.0690e-06	-2.2626e-08	

Coef. No.	cmhse supersonic	cmhee subsonic	cmhee supersonic	cmqr subsonic	cmqr supersonic	cmqler subsonic
C_0	5.7068e-02	-1.1731e-03	-4.2213e-02	-1.2920e+00	-3.7403e+00	-3.4437e-04
C_1	-5.0168e-02	-7.1055e-02	-2.4771e-01	7.2740e-01	1.7849e-02	8.2344e-05
C_2	1.5114e-01	6.2228e-03	1.8165e-02	-1.1291e+00	2.0515e+00	8.8389e-06
C_3	-1.6449e-01	-6.5912e-02	4.5238e-02		-2.7514e-02	4.8165e-05
C_4	1.3736e-02		4.4326e-03		-4.0822e-01	
C_5	3.4255e-02					
C_6	-1.2118e-03					
C_7	9.2862e-04					
C_8	-3.2427e-03					

Coef. No.	cmqler supersonic	cmqter subsonic	cmqter supersonic	cmqe subsonic	cmqe supersonic	cmqdr subsonic
C_0	1.0216e-02	-1.6016e-03	-1.4229e-02	-1.8594e-02	-3.5030e-02	-1.3023e+00
C_1	2.3496e-04	5.5327e-05	-4.9559e-05	1.5982e-03	-3.7139e-03	2.5578e+00
C_2	-1.8742e-02	2.5866e-04	1.4287e-02	-3.7499e-02	6.5533e-02	-2.8620e+00
C_3	1.0477e-02	-1.5636e-04	-2.0508e-04	9.9234e-04	-1.5867e-02	
C_4	-1.8516e-03		-4.0720e-03	-2.8706e-03	7.7921e-03	
C_5	-1.7568e-04			5.1975e-03	-3.0194e-03	
C_6	4.7856e-05			2.2538e-02	1.1677e-03	

Coef. No.	cmqdr supersonic	cmqde subsonic	cmqde supersonic	cmadr subsonic	cmadr supersonic	cmade subsonic
C_0	-7.1931e-01	-2.9484e-01	1.4527e+00	-1.1007e+00	-7.3272e-01	-1.2345e-01
C_1	2.6494e-01	1.7824e+00	-3.2668e+00	3.6039e+00	8.8351e-01	7.4685e-01
C_2		-3.1510e+00	2.7198e+00	-3.9724e+00	-2.2837e-01	-1.5722e+00
C_3		7.4468e-03	-8.4276e-03			1.0797e+00
C_4		1.8986e+00	1.3443e-02			-7.9265e-03
C_5		-2.0475e-02	3.1160e-03			4.7002e-02
C_6			-9.7741e-01			-4.7815e-02
C_7			1.2761e-01			6.5665e-04
C_8			-1.3456e-02			-1.6161e-03
C_9			3.2263e-03			

Coef. No.	cmade supersonic
C_0	2.1244e+00
C_1	-4.6574e+00
C_2	3.7118e+00
C_3	-1.2800e+00
C_4	1.2792e-02
C_5	5.0466e-08
C_6	-1.9251e-08
C_7	1.6171e-01
C_8	-1.1888e-02
C_9	2.7334e-03

VI. Simulation Time Histories

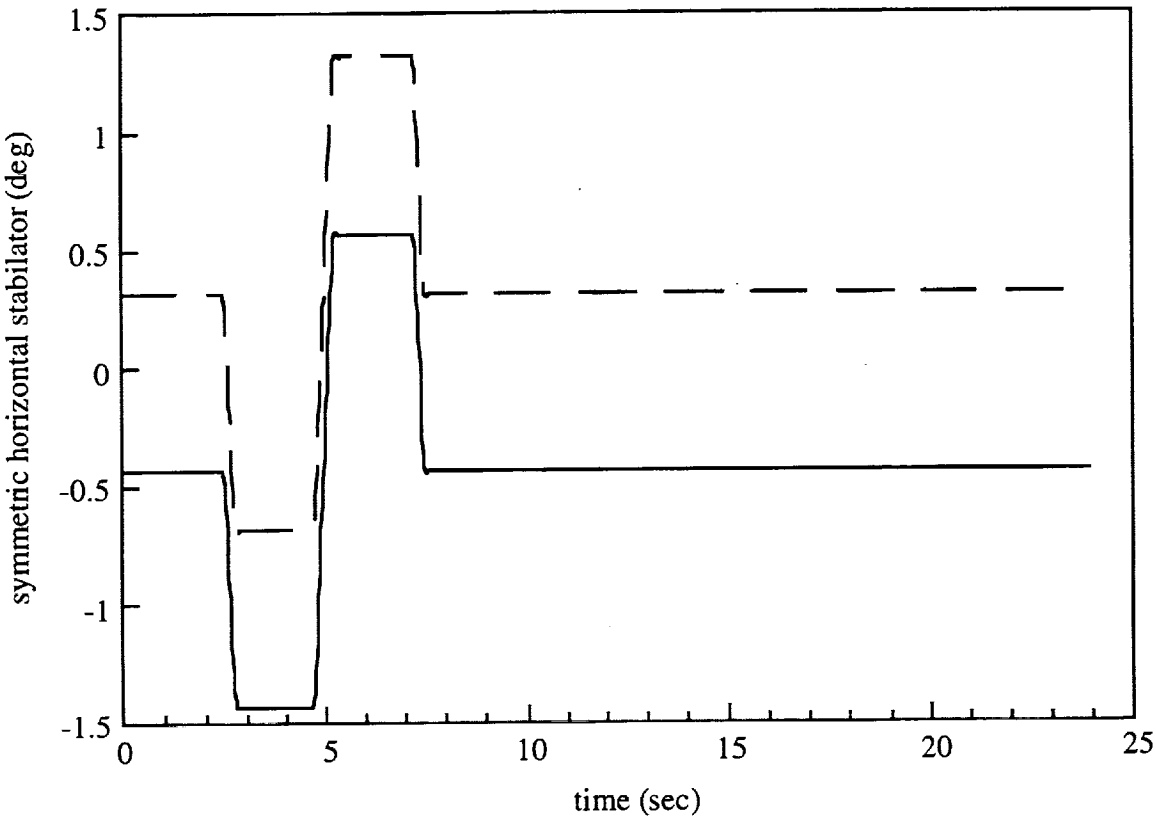


Figure 1. - Stabilator doublet, Mach=0.8, Altitude=25000

aerodynamic database (solid line) vs. polynomial models (dashed line)

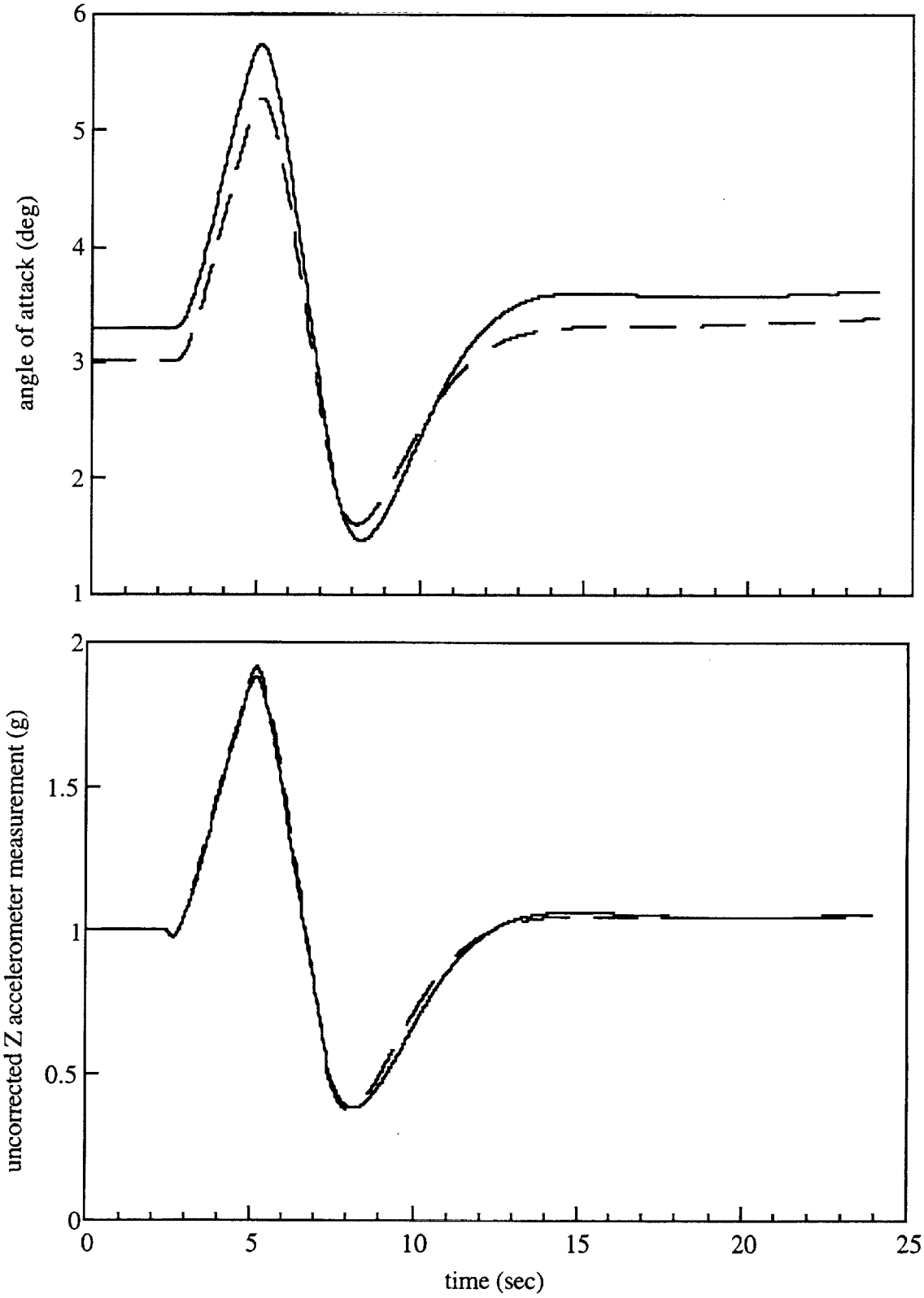
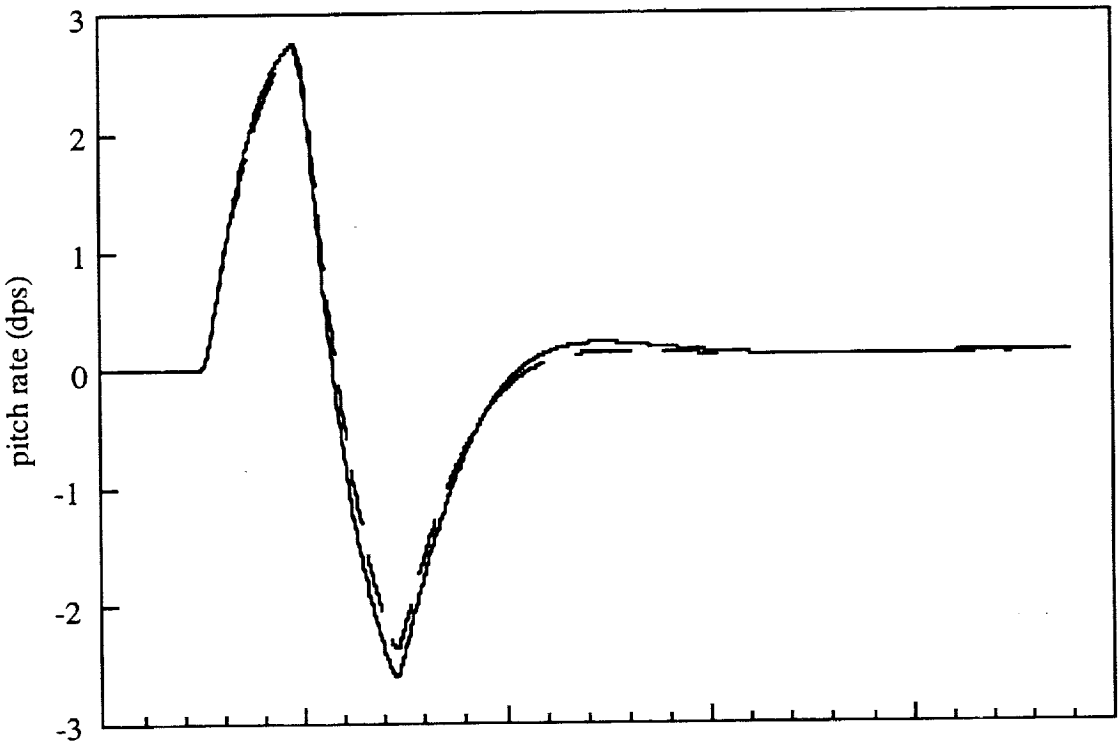

angle of attack (deg)
6
5
4
3
2
1
uncorrected Z accelerometer measurement (g)
2
1.5
1
0.5
0
0
5
10
15
20
25
time (sec)

Figure 1. - Continued



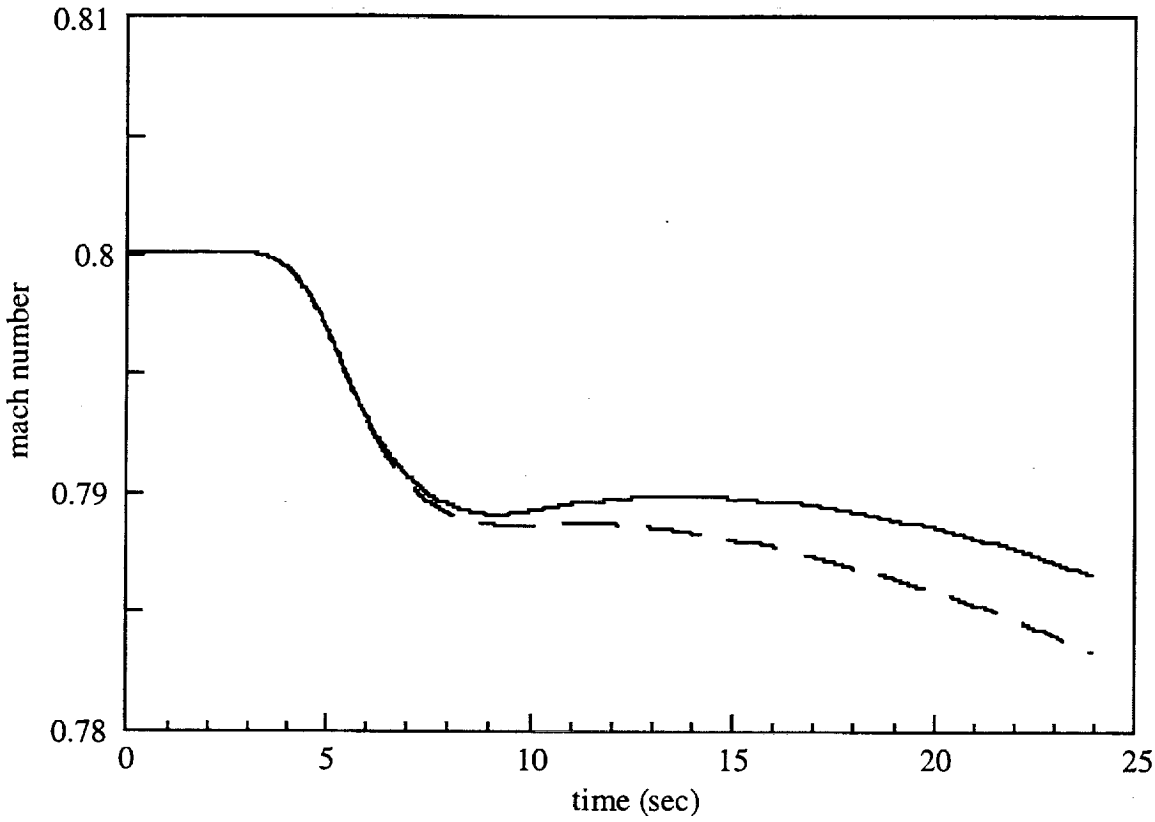


Figure 1. - Concluded.

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13. ABSTRACT ***(Maximum 200 words)***

The data for longitudinal nondimensional, aerodynamic coefficients in the High Speed Research Cycle 2B aerodynamic database were modeled using polynomial expressions identified with an orthogonal function modeling technique. The discrepancy between the tabular aerodynamic data and the polynomial models was tested and shown to be less than 15 percent for drag, lift, and pitching moment coefficients over the entire flight envelope. Most of this discrepancy was traced to smoothing local measurement noise and to the omission of mass case 5 data in the modeling process. A simulation check case showed that the polynomial models provided a compact and accurate representation of the nonlinear aerodynamic dependencies contained in the HSR Cycle 2B tabular aerodynamic database.

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