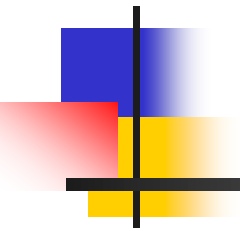


LewInt; a GUI and Analysis Toolset for LEWICE 3.2.2

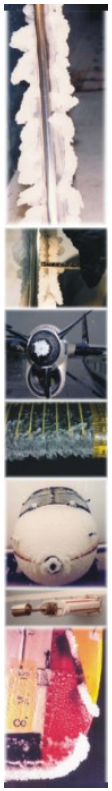
American Kestrel Company LLC

Dave Parkins

DParkins@AmericanKestrelCo.com

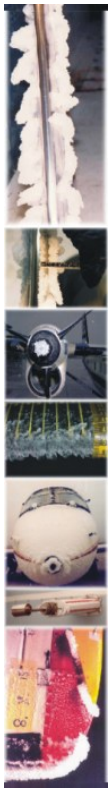
607-882-9407

Overview



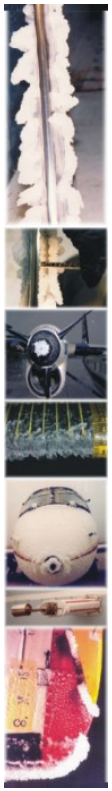
- Introduction
- History
- Features
- Topology of LewInt
- Example: determining critical hold shape
- Current State
- Questions

Introduction



- Began as an automated plotting tool written in MATLAB.
- Evolved into an internal tool to facilitate analysis, improve accuracy and organize ice accretion analysis.
- Based on industry feedback was offered as a commercial product.
- NASA interest in interface resulted in Space Act allowing direct and international distribution of LEWICE by American Kestrel.

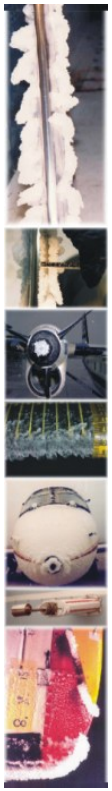
International Distribution



LewInt with LEWICE 3.2.2 is available through a NASA Space act for international distribution.

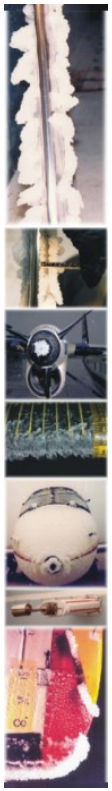
- Note: Licensee acknowledges and agrees that the Program(s) are subject to U.S. laws governing the export and/or re-export of Program(s) including, but not limited to, the Export Administration Regulations, regulations promulgating financial transaction restrictions administered by the Office of Foreign Asset Controls of the U.S. Department of the Treasury, the International Emergency Economic Powers Act, the United States Export Administration Act, the United States Trading with the Enemy Act, and all regulations, orders and licenses issued thereunder.

History



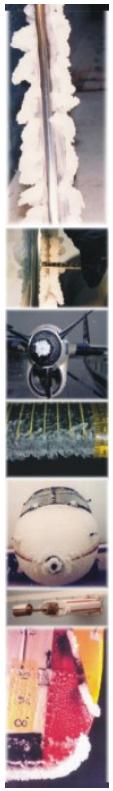
- LEWICE Validation report 01/99
- Initial demonstration of LewInt ~2003
- LEWICE v 3.2.2 released 2006?
- Initial LewInt announcement 9/24/2007
- Space Act SAA3-989 Signed 5/2008
- Alpha LewInt released 2/18/2009
- Version 0.9.4 released 3/14/2009
- Version 1.01 released 9/8/2011
- Version 1.04 released 1/1/2012

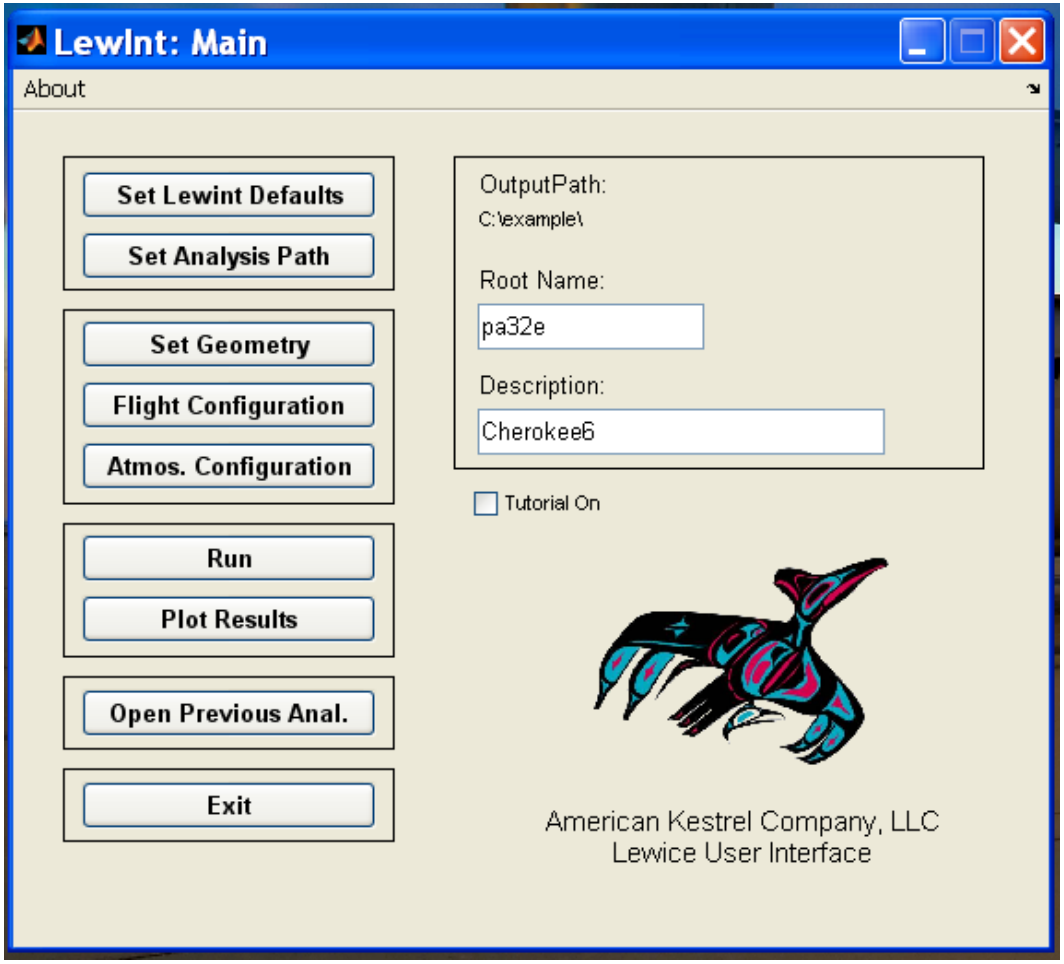
Features



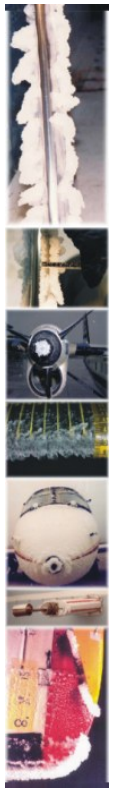
- GUI driven operation of LEWICE
- Can run up 64 icing runs sequentially.
- Organizes analysis results through root name and run index.
- Checks LEWINT input/flags/values for validity
- Automated plotting with descriptive titles.
- Plots have fixed 1:1 aspect ratio when appropriate.
- Overlay of ice traces.

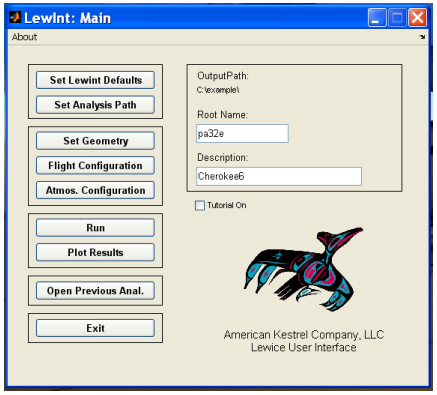
Menu – Topology

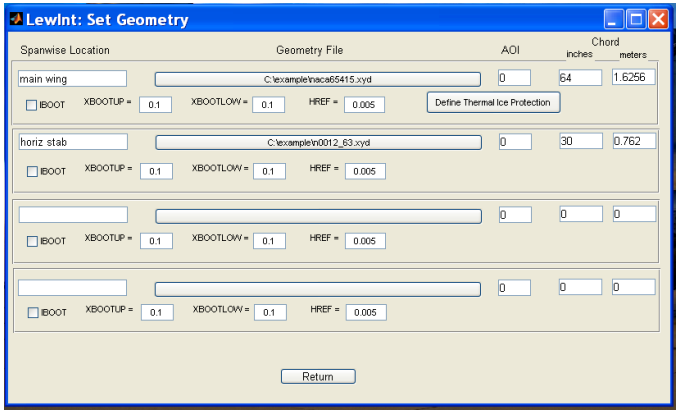


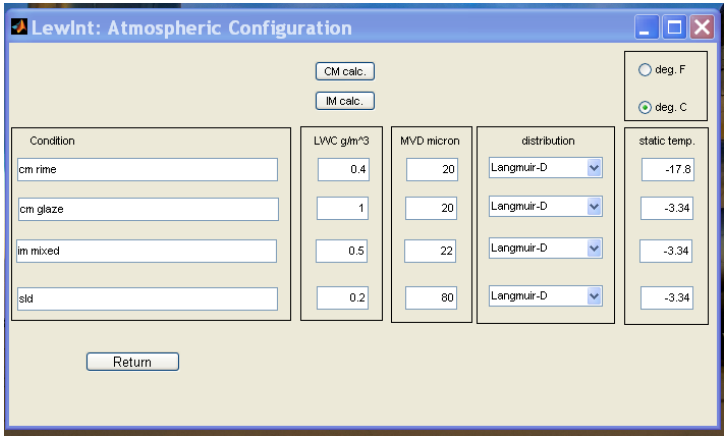


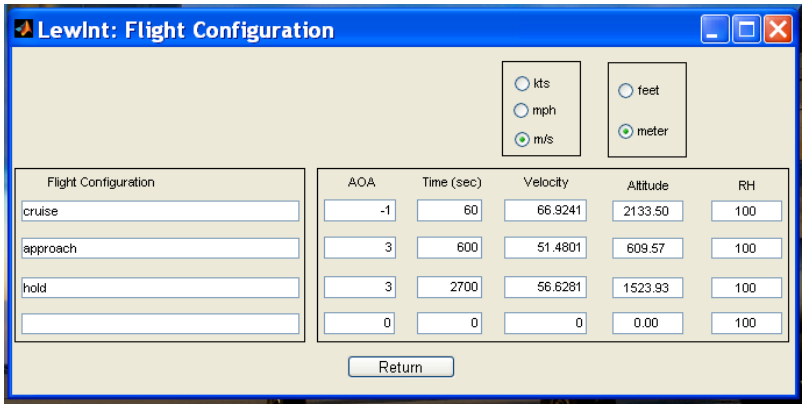
Menu – Topology (group 2)



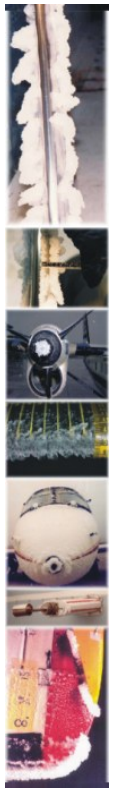


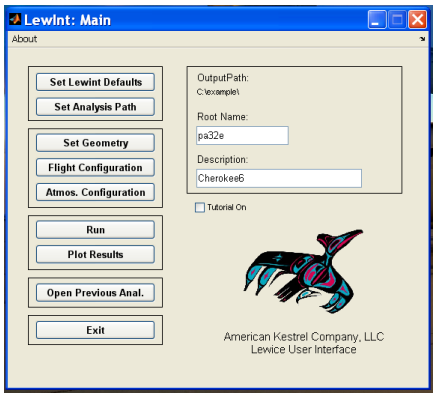


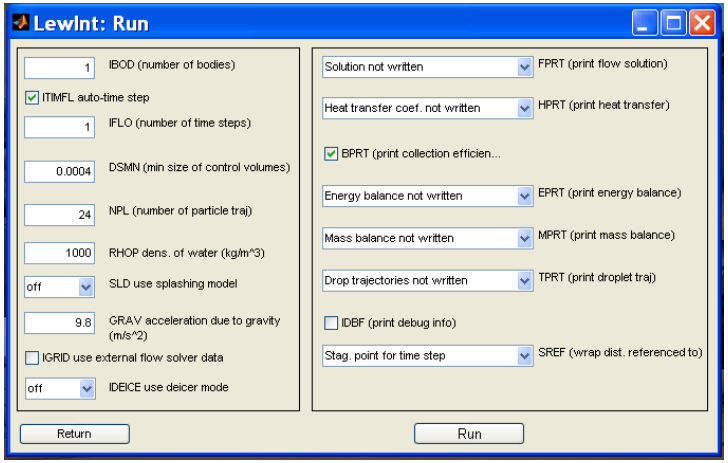


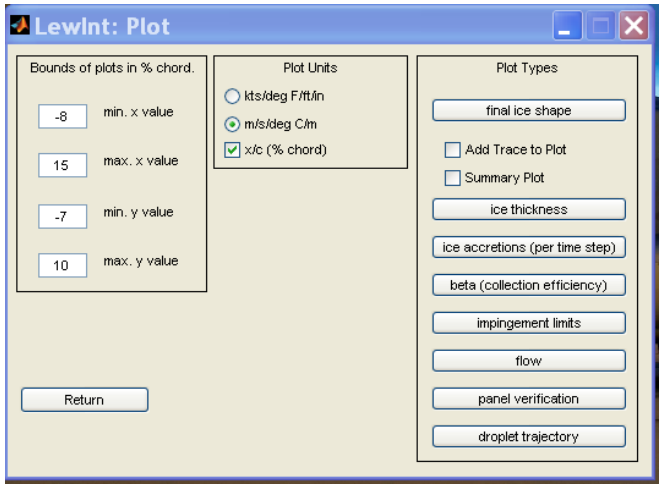


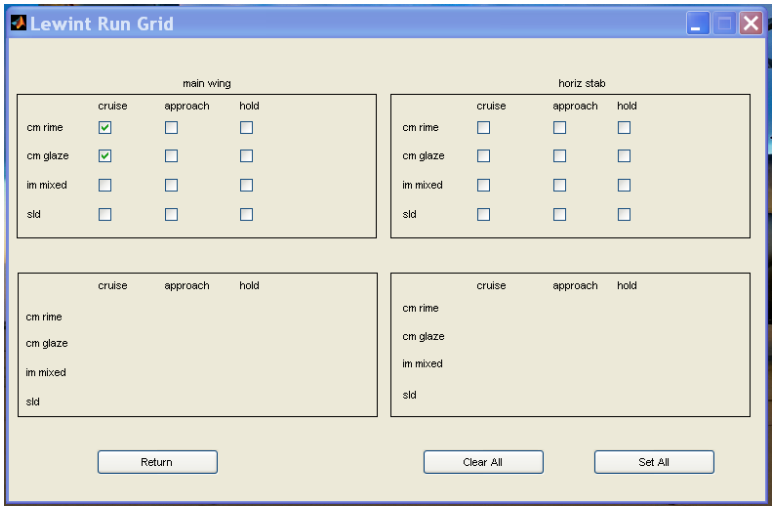
Menu – Topology (group 3)



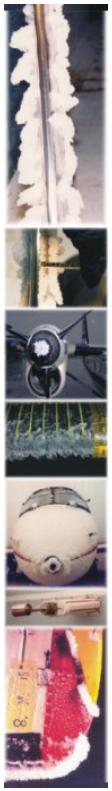






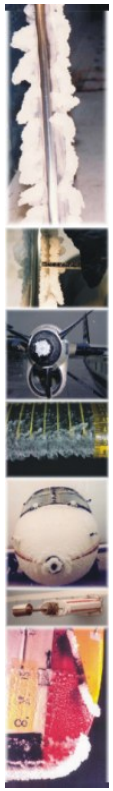


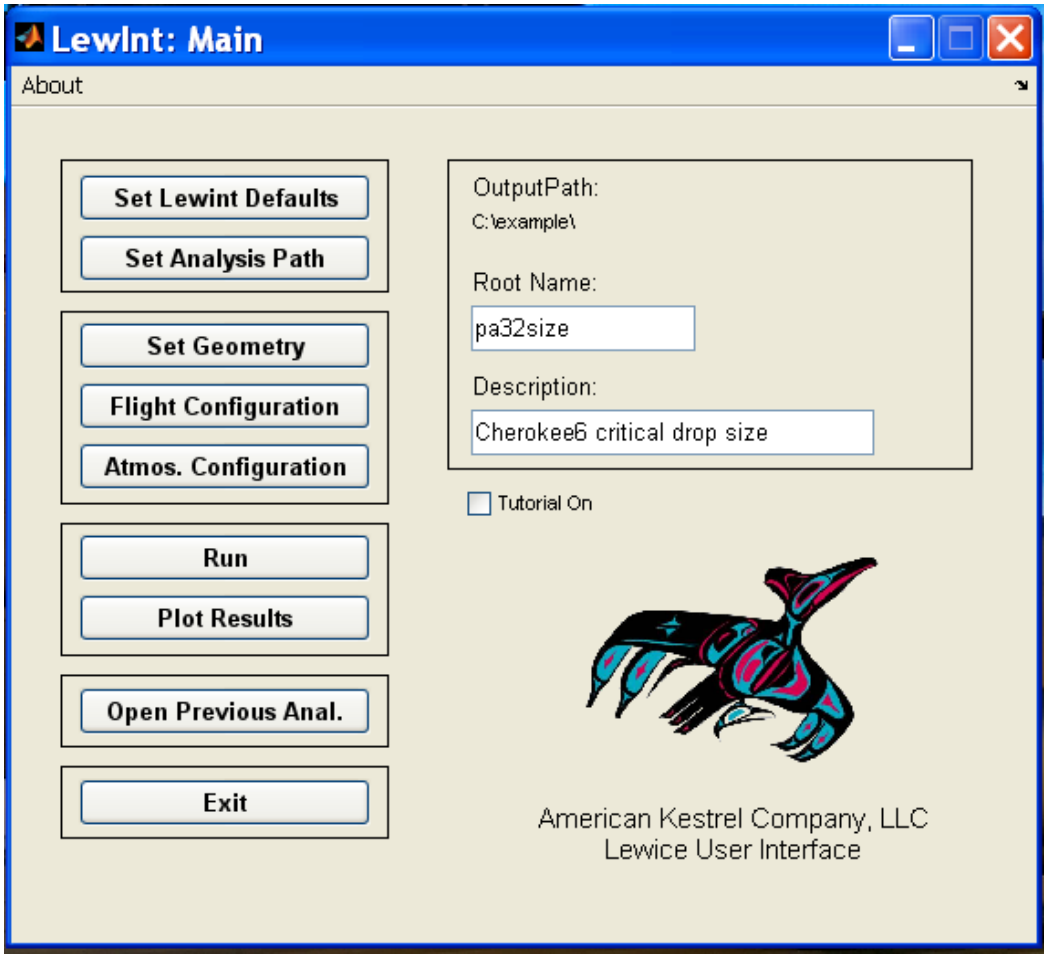
Example: Determining Critical Hold Ice Shape



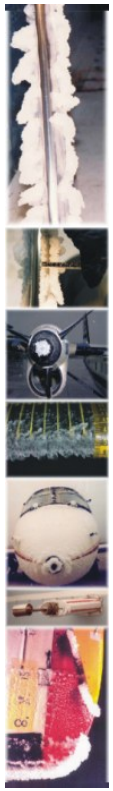
- Use the PA32 wing.
- Assume a “typical”150 KTAS hold speed.
- Determine the critical drop size for a mono-dispersed distribution.
- Determine the critical drop temperature/LWC combination (Lang-A).
- Re run critical config. at with Langmuir-D distribution

Where and Who





Geometry



LewInt: Set Geometry

Spanwise Location	Geometry File	AOI	Chord inches	Chord meters
wing	C:\example\naca65415.xyd	0	64	1.6256
horiz stab	C:\example\n0012_63.xyd	0	30	0.762
		0	0	0
		0	0	0

IBOOT XBOOTUP = 0.1 XBOOTLOW = 0.1 HREF = 0.005 Define Thermal Ice Protection

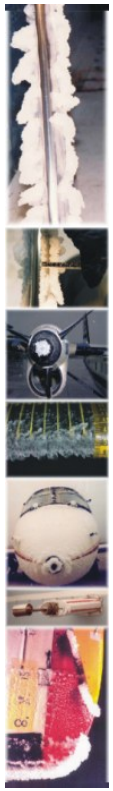
IBOOT XBOOTUP = 0.1 XBOOTLOW = 0.1 HREF = 0.005

IBOOT XBOOTUP = 0.1 XBOOTLOW = 0.1 HREF = 0.005

IBOOT XBOOTUP = 0.1 XBOOTLOW = 0.1 HREF = 0.005

Return

Flight Configuration



LewInt: Flight Configuration

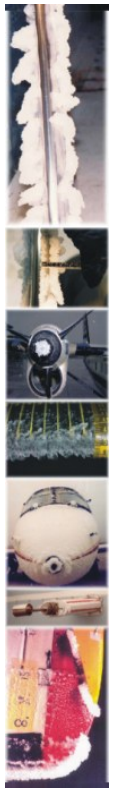
kts
mph
m/s

feet
meter

Flight Configuration	AOA	Time (sec)	Velocity	Altitude	RH
hold	-1	2700	150	7000.00	100
	3	600	100	2000.00	100
	3	2700	110	5000.00	100
	0	0	0	0.00	100

Return

Atmospheric Conditions



LewInt: Atmospheric Configuration

CM calc.

IM calc.

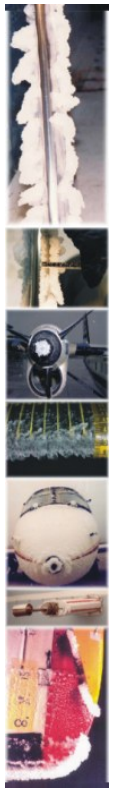
deg. F

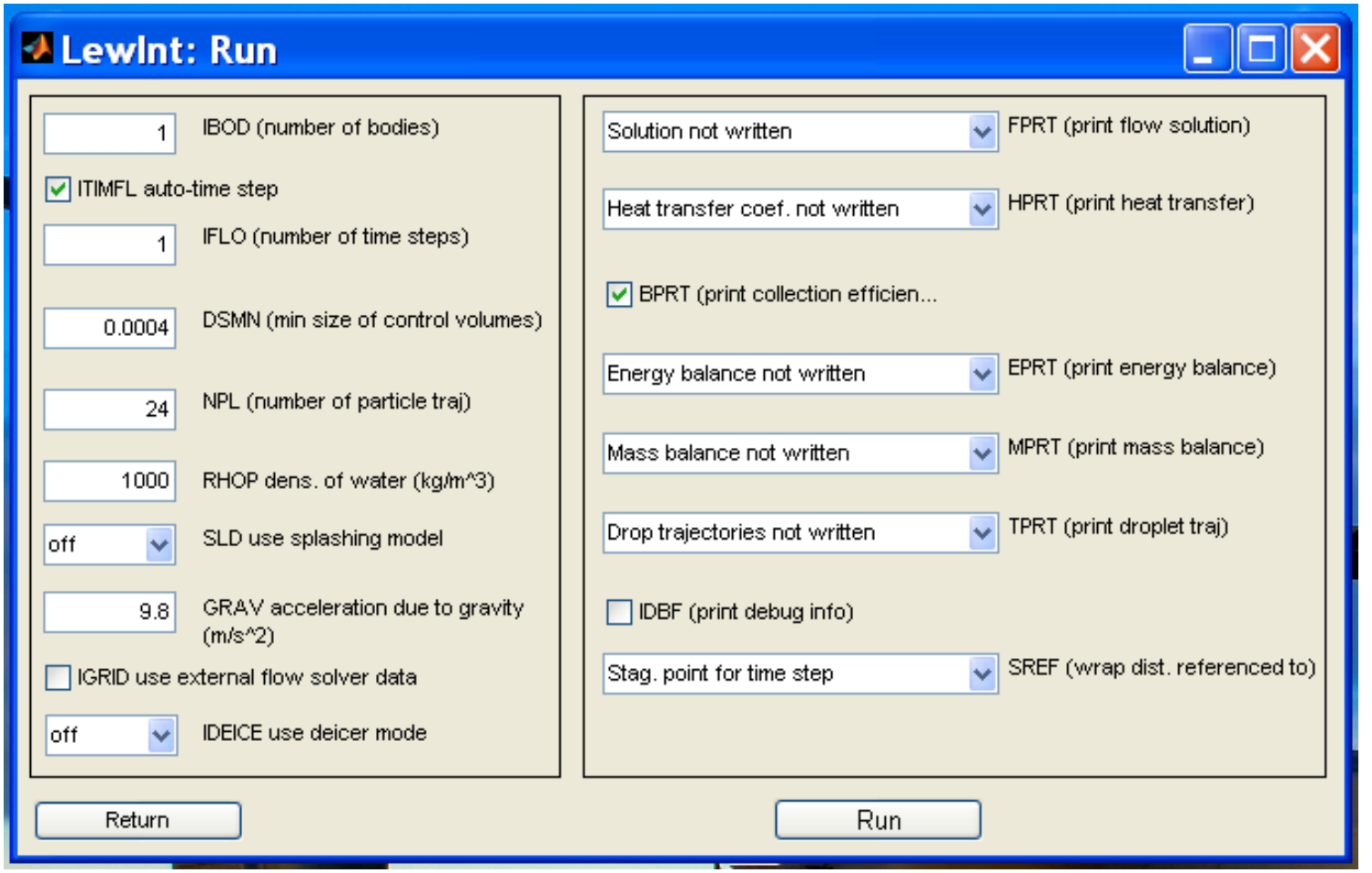
deg. C

Condition	LWC g/m^3	MVD micron	distribution	static temp.
d3	0.54	20	single size (Lan...	24
d4	0.48	22.5	single size (Lan...	24
d5	0.41	25	single size (Lan...	24
d6	0.36	27.5	single size (Lan...	24

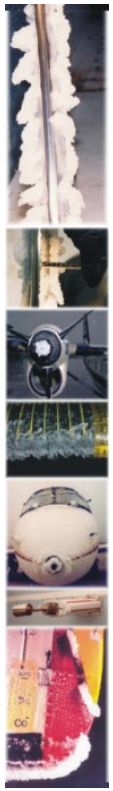
Return

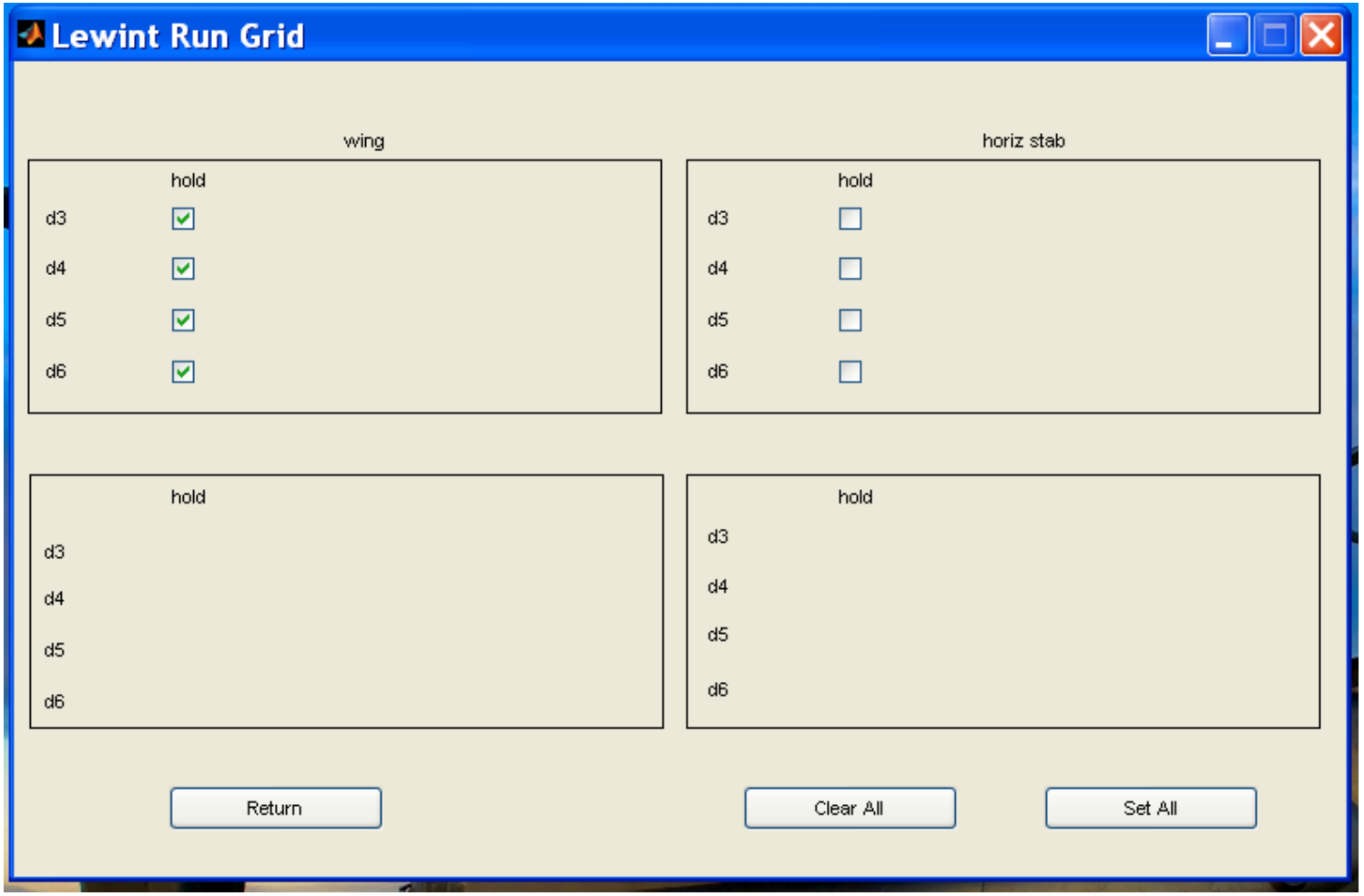
Setting Up to Run



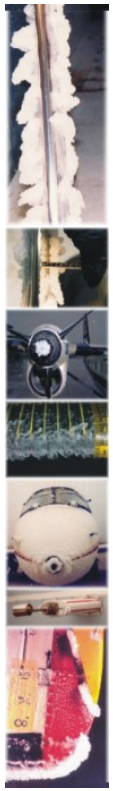


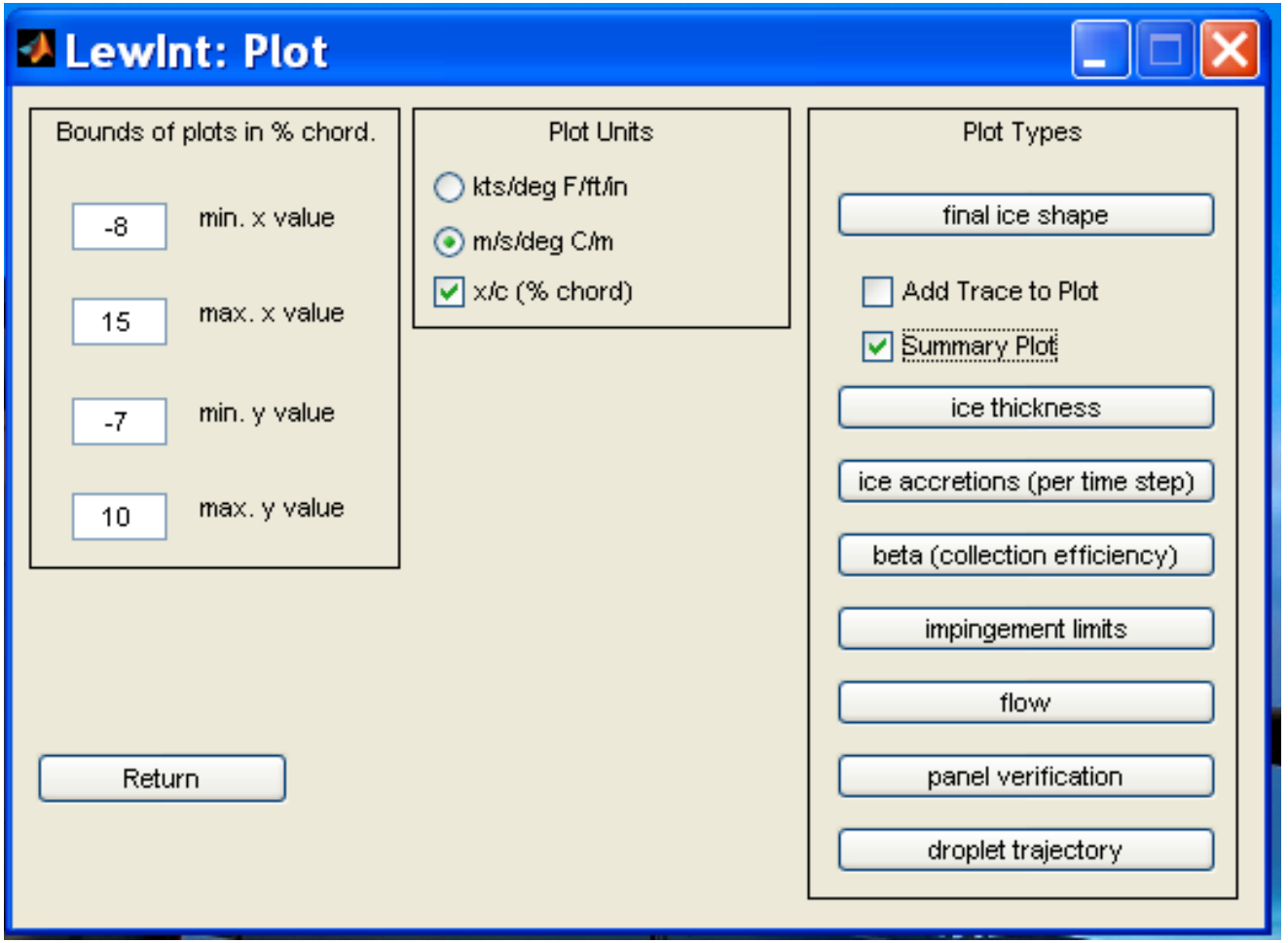
Run Matrix



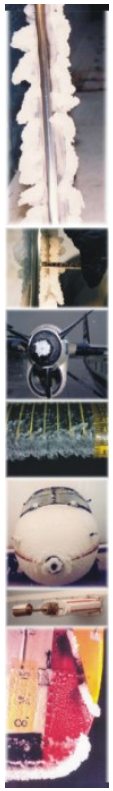

Lewint Run Grid
wing
hold
d3
d4
d5
d6
horiz stab
hold
d3
d4
d5
d6
hold
d3
d4
d5
d6
hold
d3
d4
d5
d6
Return
Clear All
Set All

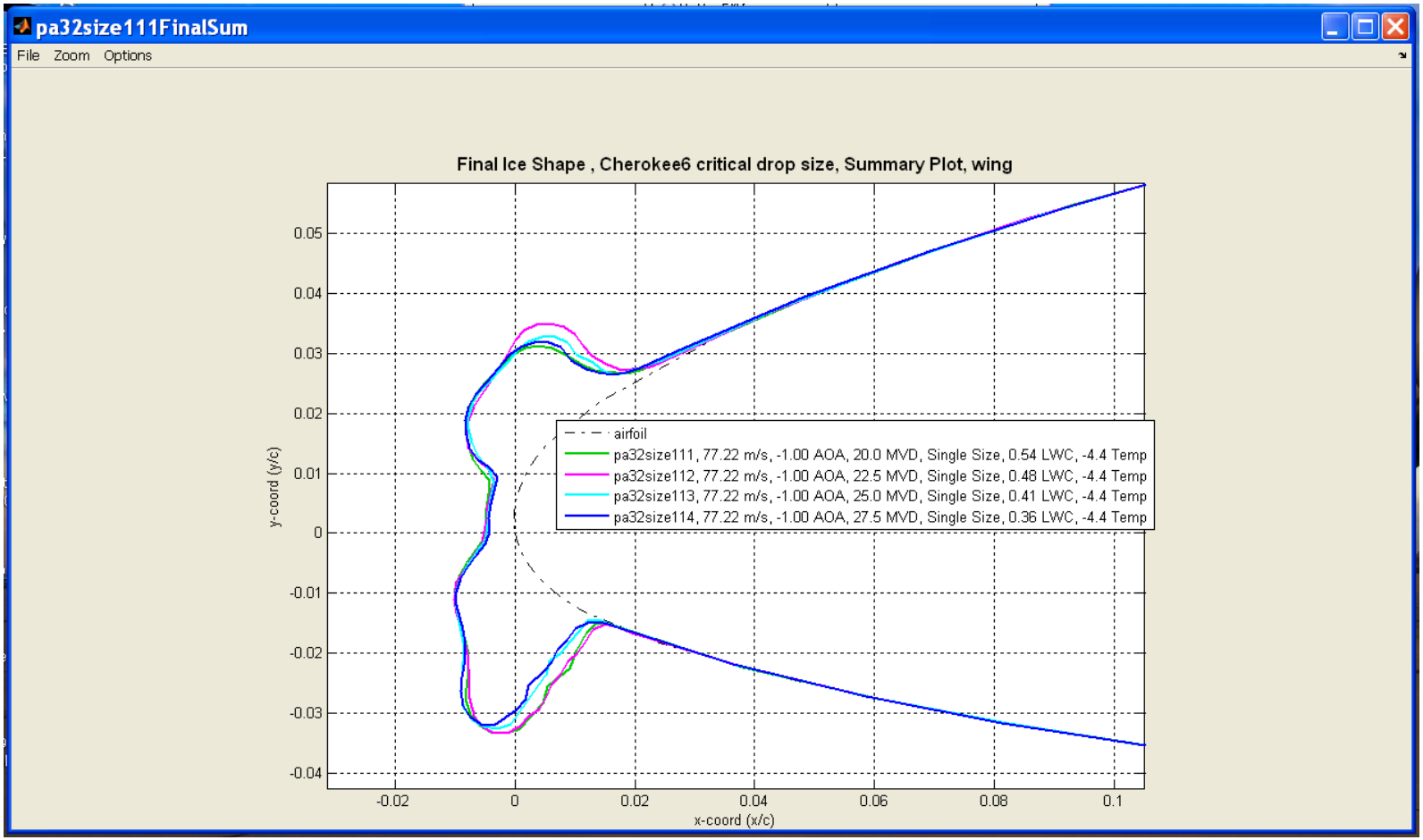
Plotting



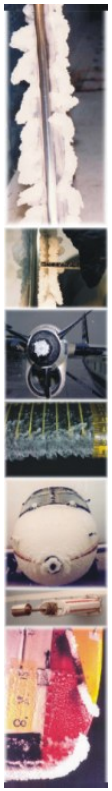

LewInt: Plot
Bounds of plots in % chord.
-8
min. x value
15
max. x value
-7
min. y value
10
max. y value
Plot Units
kts/deg F/ft/in
m/s/deg C/m
x/c (% chord)
Plot Types
final ice shape
Add Trace to Plot
Summary Plot
ice thickness
ice accretions (per time step)
beta (collection efficiency)
impingement limits
flow
panel verification
droplet trajectory
Return

Plotting – Drops Size Search



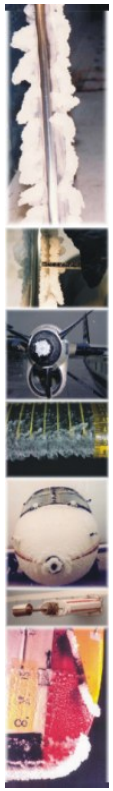


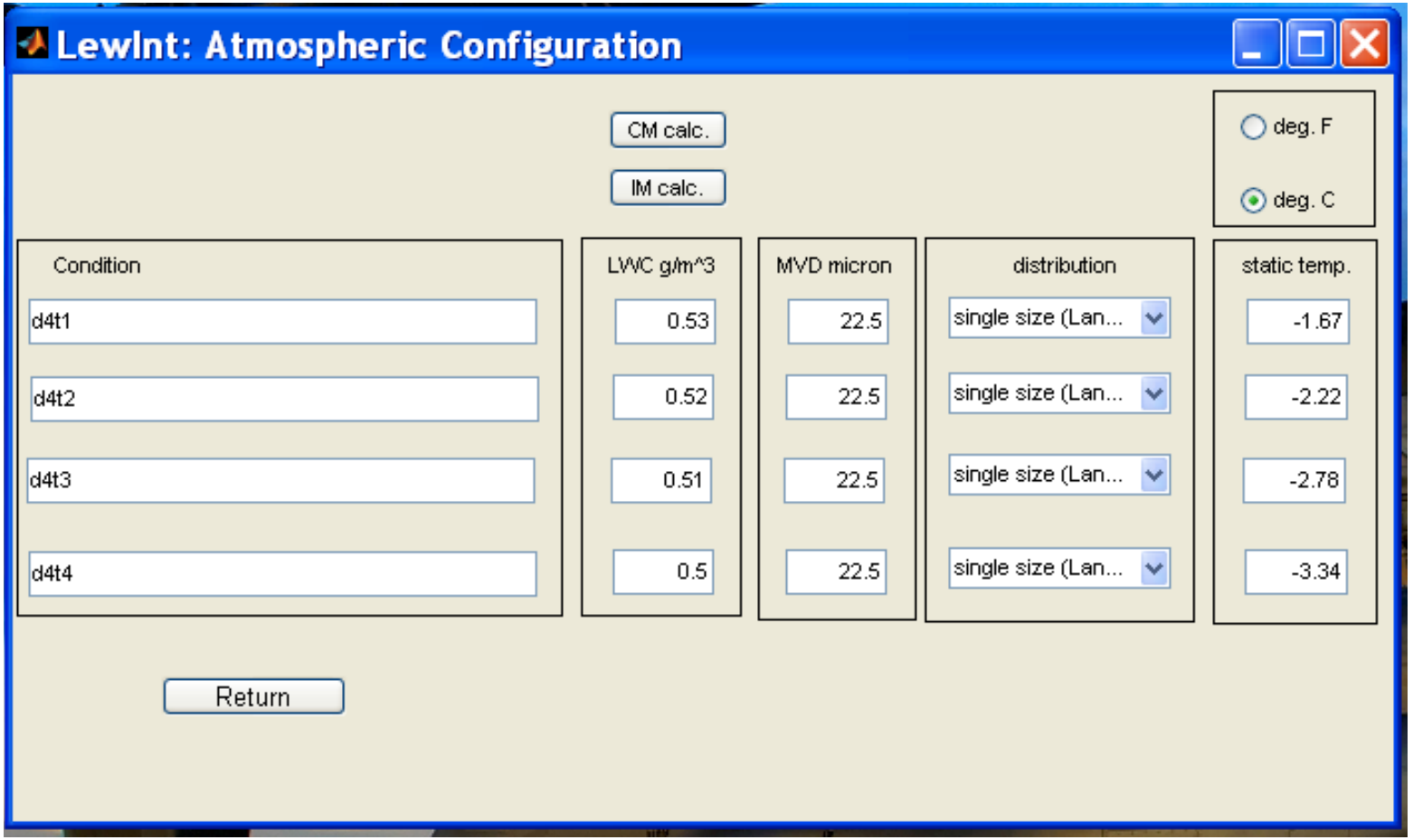
Vary Temp/LWC with Selected Critical Drop Size



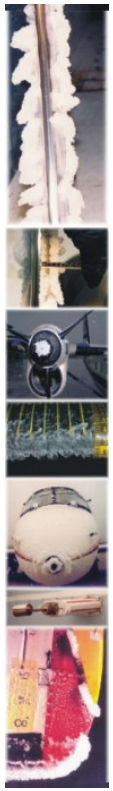
- 22.5 micron MVD selected
- Vary temperature by 1 deg F
- LWC corresponding to Appendix C CM limit

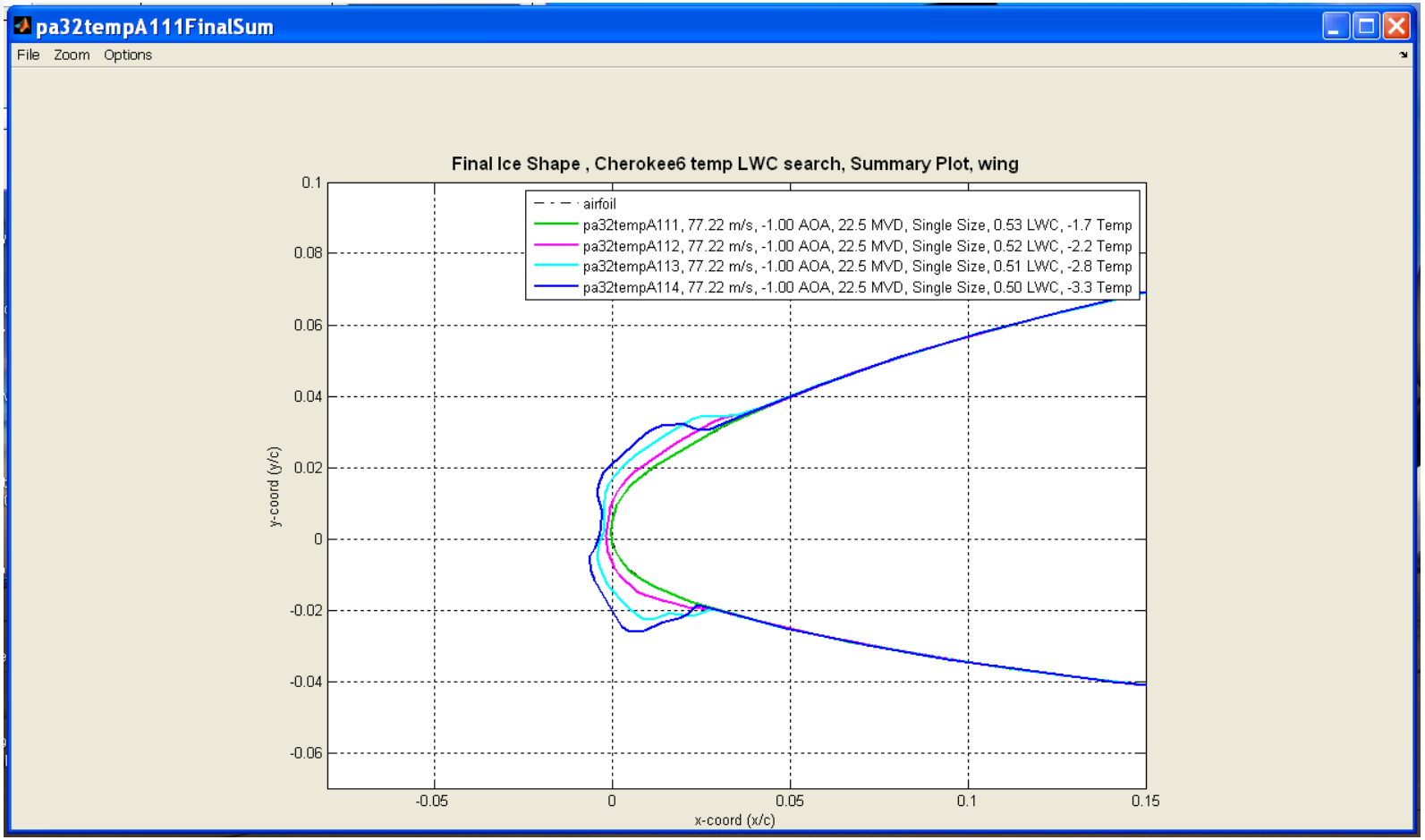
Atmospheric Conditions – Temp/LWC Search



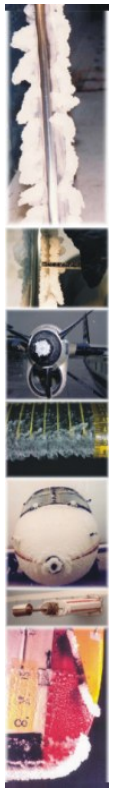


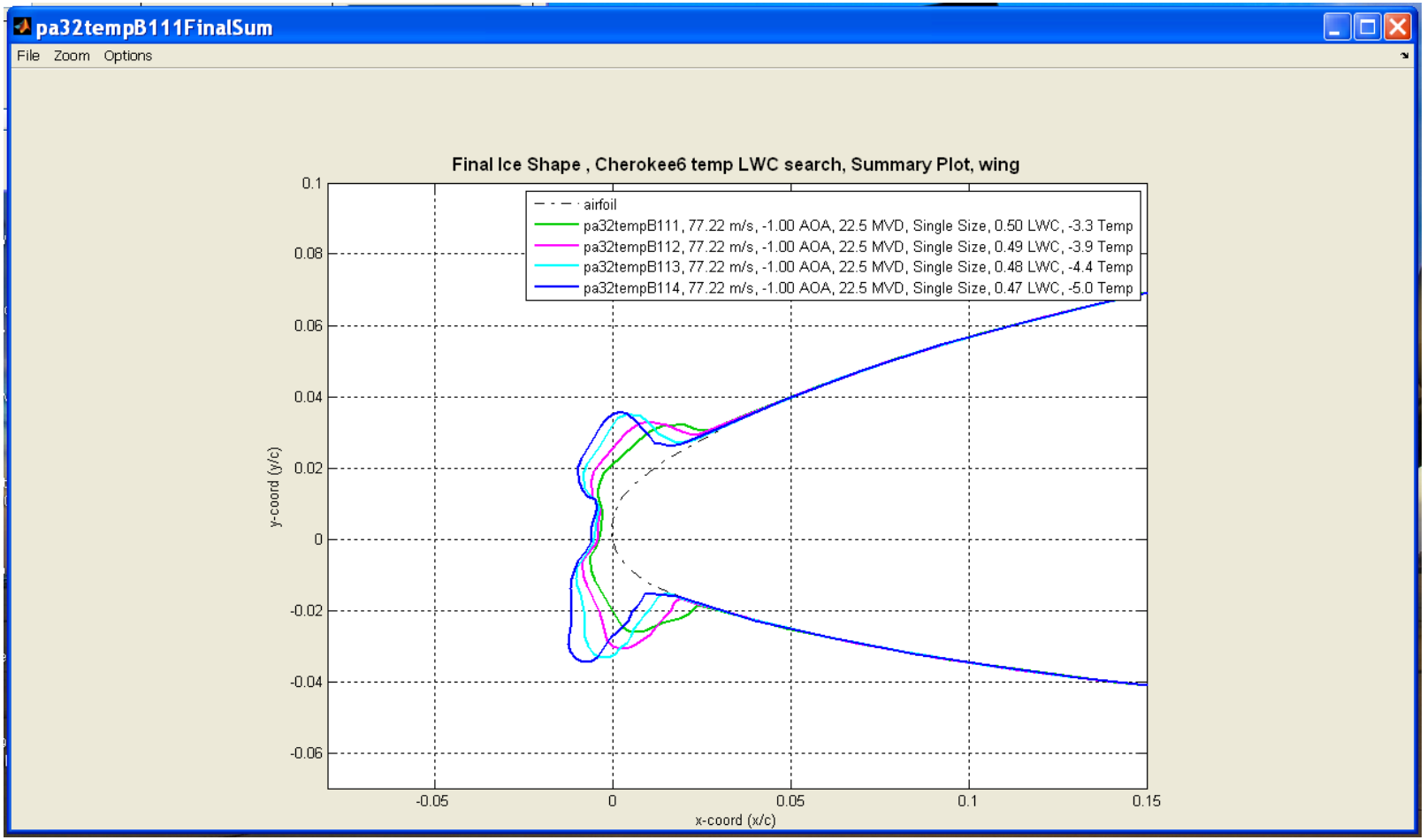
Plot Temp Search A



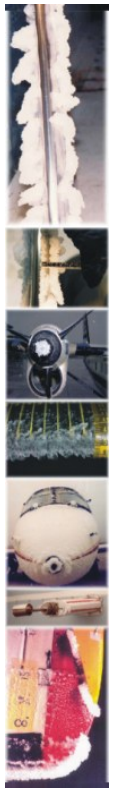


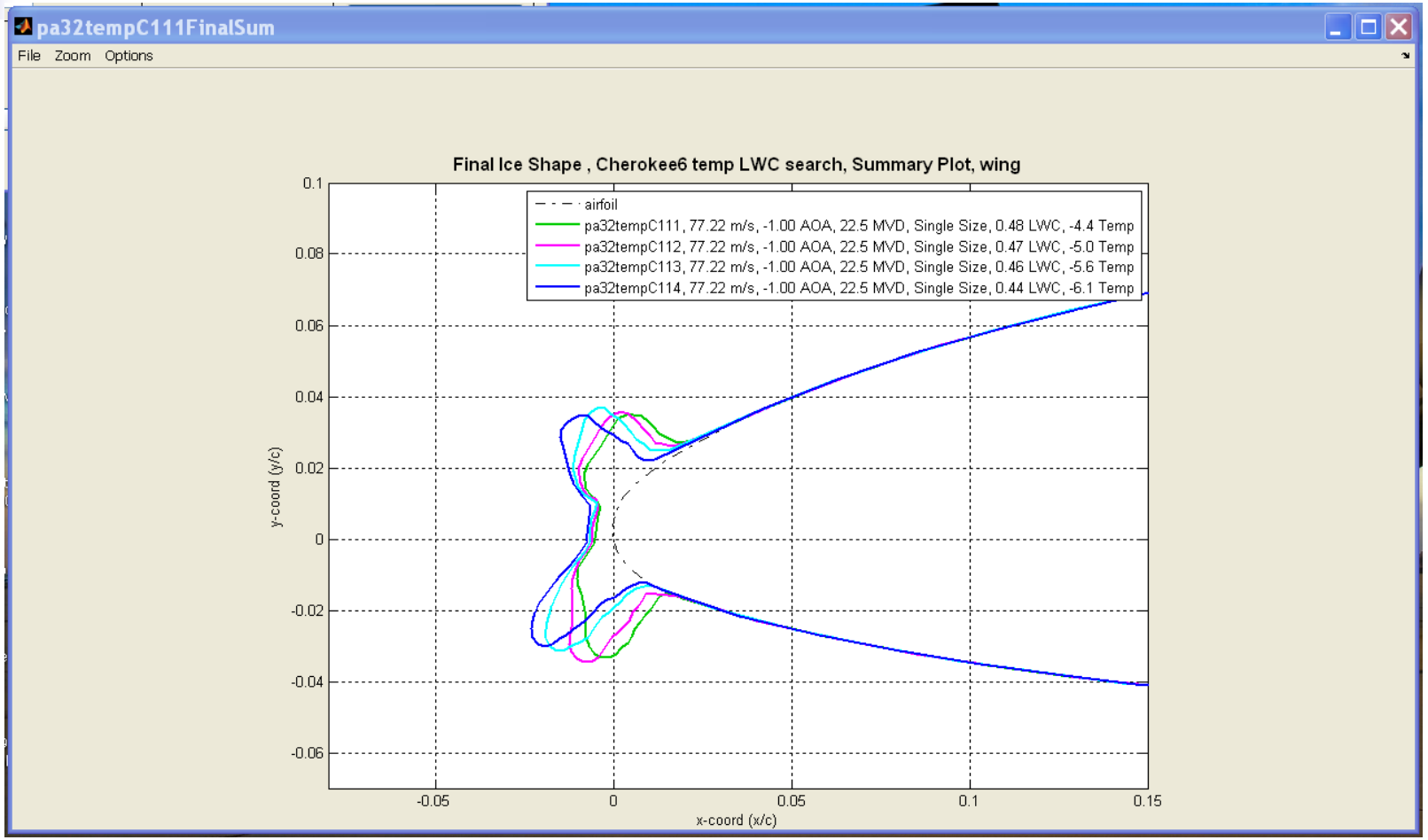
Plot Temp Search B



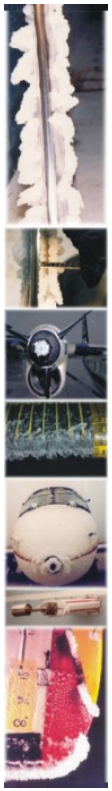


Plot Temp Search C



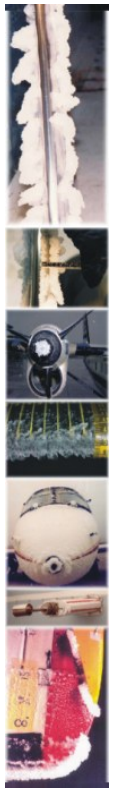


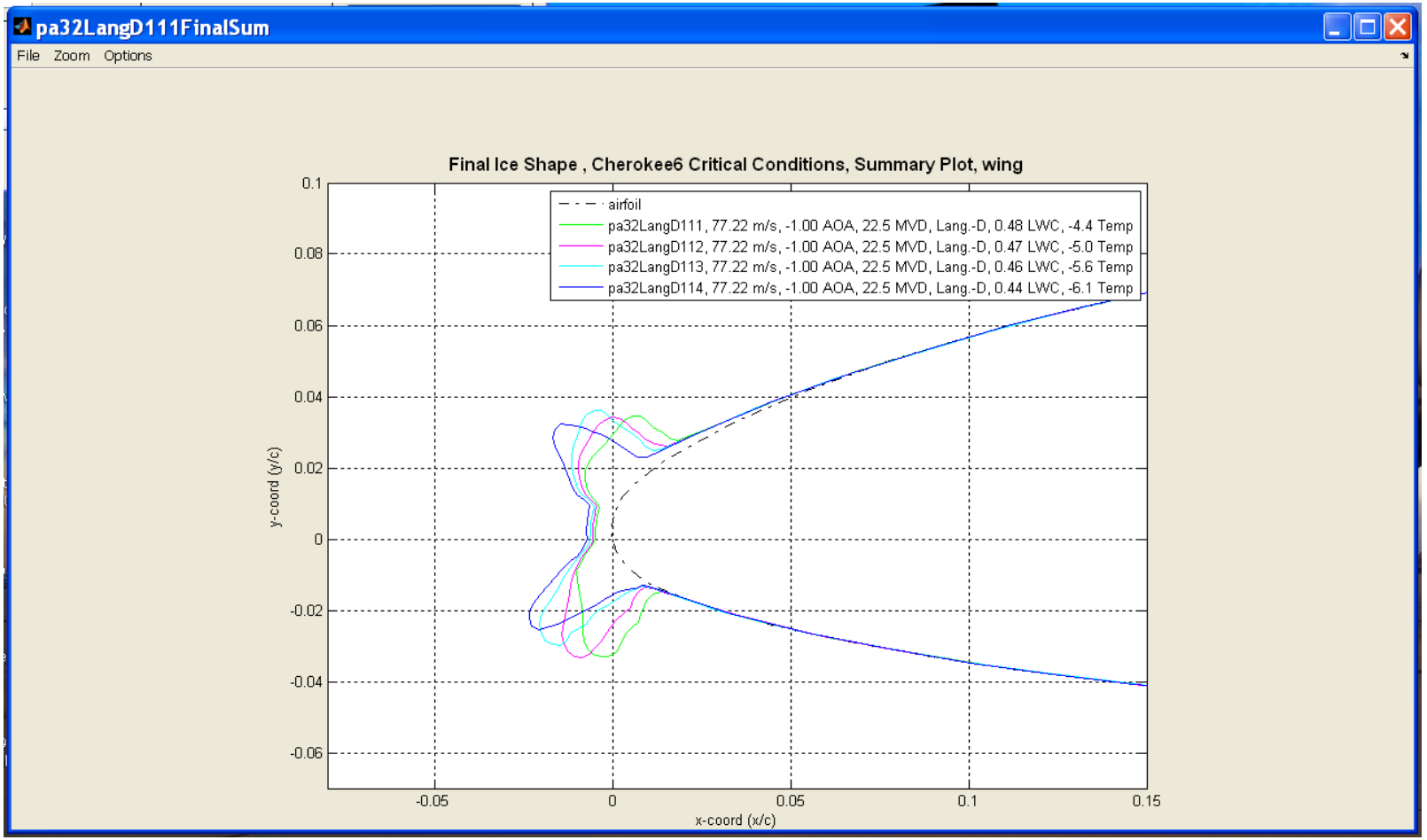
Critical Condition Selected



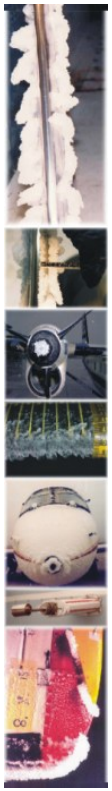
- 22.5 micron MVD
- Either 23 or 22 deg F
- LWC corresponding to 0.47 or 0.46 g/m^3
- Run Langmuir-D varying temp and LWC.

Plot Langmuir-D Critical Condition Runs



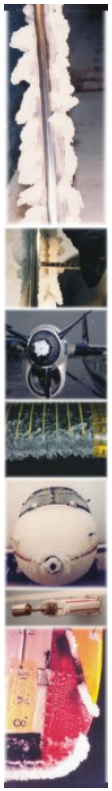


Current State



- Full release V1.04 available (current 2021)
- Next release includes;
  - Restricting more thermal configuration flags based on what can or should be run together.
  - Energy balance plotting.
- LewInt/LEWICE training class available on request.
  - Customized material based on active programs of customer can be developed.

Current State



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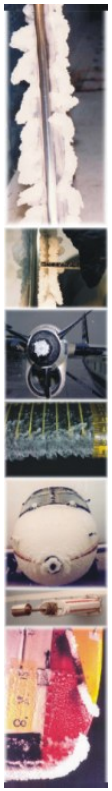
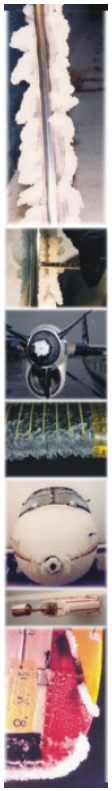
  - Customized material based on active programs of customer can be developed.

Licenses



- Licenses are node locked to a particular computer, can be moved to a new computer on request.
- Licenses are permanent and include one year of updates and technical support.
- Try before you buy. Software can be installed and used without limit for two weeks.

Training & Consulting



- Customized on-site training available.
- Training instructors include Icing DER.
- Certification and analysis consulting by DER experienced in icing analysis utilizing LEWICE.

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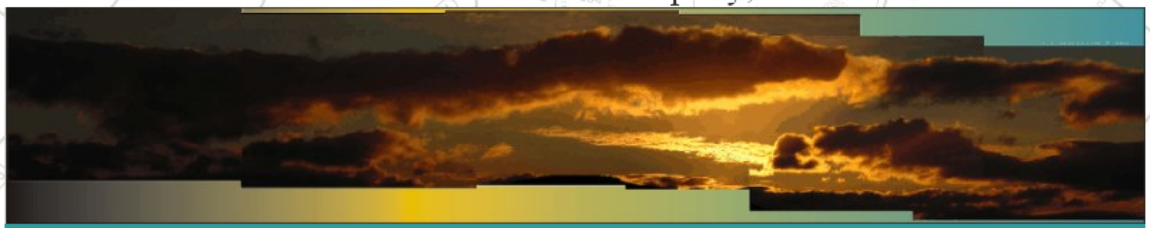


Updated 03/14/2009

LewInt integrates the ice accretion code LEWICE (version 3.2.2) with American Kestrel's user interface, icing analysis tools, and automated plotting. LEWICE 3.2.2 is a validated ice accretion code developed by NASA Glenn Research Center. LewInt (including LEWICE) is distributed both within the US and internationally under non-exclusive license with NASA Glen Research Center. LewInt is available to individuals, educational institutions and businesses worldwide.

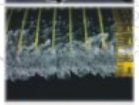
Just a note, there is not an educational version of the software at this time. I expect the sales volume to be too low to allow an educational discount.

Alpha 0.9.4 release:

A new Alpha release is available. This one license key issues. You can purchase via a PO and check. In the future payment by credit card will be accepted and keys generated automatically. You can download the latest version here.

Alpha 0.9.3 release:

A new Alpha release is available. This one includes the previous changes but extends the license for another 15 days while I work out issues with key generation and payment.



Alpha 0.9.1 release:

I think the execution speed is better, I have added the SLD (splashing flag), added some tool tips to the run page (tell me if you like them), and added the ability to save MatlabTM fig files for later editing in MatlabTM. The instructions to install are still the same. The installer will not install the MCR library again if it is already installed.

Purchase:

Currently only checks or wire transfers are accepted for payment. Send email to LEWINT@AmericanKestrelCo.com for purchasing information. Current pricing is $1500 USD for the first license and for a limited period a second license can be obtained for an additional $500 USD.

Installation:

Download the self expanding file containing the LewInt release. Extract the files into a temporary directory. You will need to execute two installer files. The first LewintAlpha_install.exe installs both the interface and the Matlab libraries required for the interface. Then execute LewIntExample.msi to install some example files. You are

Done