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AIRBORNE ICING TANKER



AIRBORNE ICING TANKER SPRAY ARRAY



26 Oct 1999

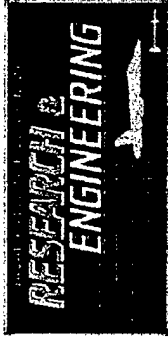
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AIT SYSTEM REQUIREMENTS

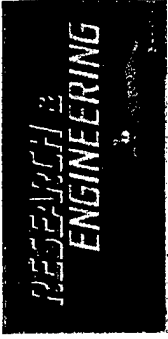
LWC, MVD DEFINED BY FAR PART 25 (next chart)
CLOUD SIZE 8 FT DIA. (MIN.)
SLD 0.1 TO 0.5 LWC, 50 TO 500 microns

SUBSYSTEM REQUIREMENTS

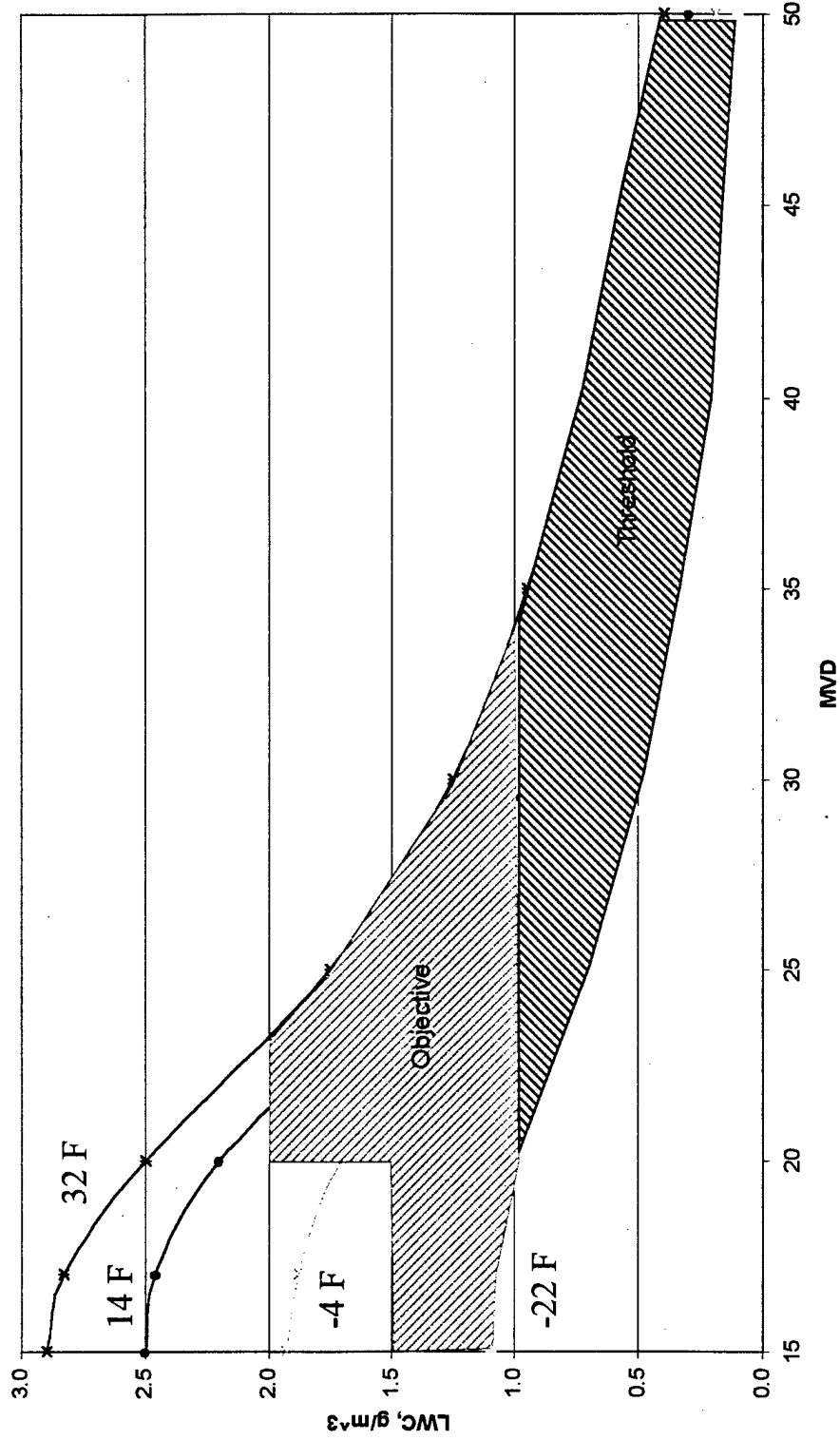
WATER:
FLOW RATE 33 gpm for 8 ft dia cloud with LWC = 2
 52 gpm for 10 ft dia cloud
AIR:
PRESSURE 58 psig at engine - (A/C ducts + boom + array)
FLOW RATE up to 105 lb/min, up to 6 scfm per nozzle



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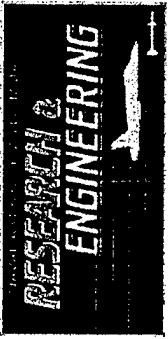


AIT CLOUD PHYSICS





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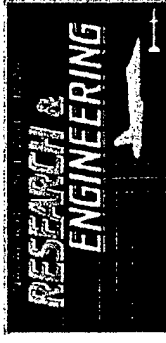


ARRAY DESIGN CONSTRAINTS

- AIR SUPPLY
 - ENGINE BLEED AIR, 9TH STAGE, 58 PSIG AT STRUT
- DRAG
 - CANNOT EXCEED EXISTING SPRAY BOOM LIMITS
 - USE OF AIRFOILS TO MINIMIZE
- WEIGHT
 - CANNOT EXCEED EXISTING SPRAY BOOM LIMITS
 - LIMITS SIZE OF NEW ARRAY, COMBINED WITH DRAG
- MAINTENANCE
 - ACCESS TO PLUMBING, REMOVEABLE NOZZLES



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ARRAY DESIGN PLAN

FY99

- NARROW NOZZLE CHOICES, # OF NOZZLES, ARRAY CONCEPT, INTERNAL PLUMBING, DRAG PREDICTION, AERO LOADS, MANUFACTURING SELECTION, EXTERNAL LIMITS

FY00

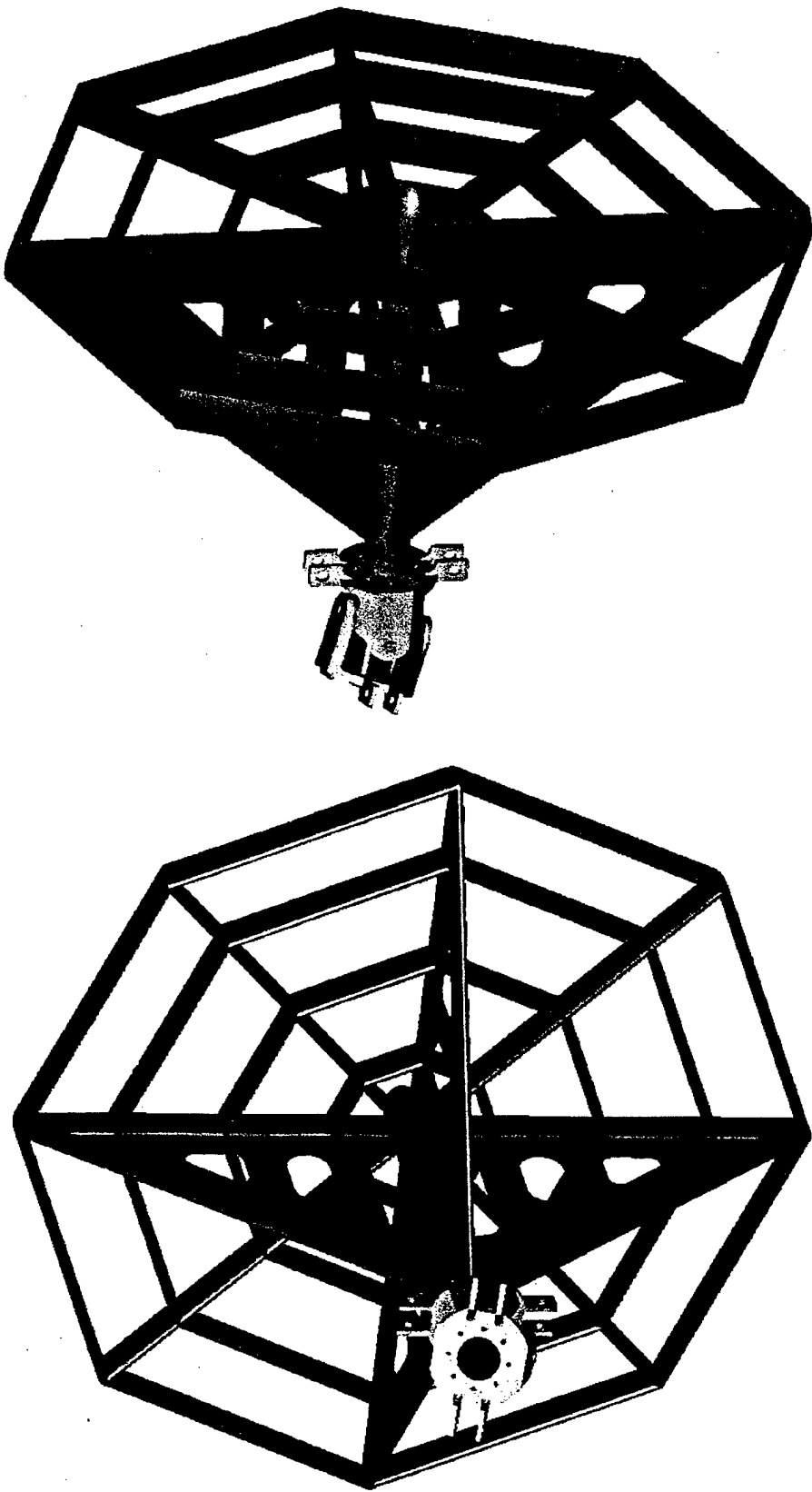
- SELECT NOZZLE, CONDUCT DRAG CFD ANALYSIS, HEAT TRANSFER CALC, DROPLET DISPERSION CFD, HYDRAULIC ANALYSIS, SCALE MODEL TESTING, DETAIL DESIGN ARRAY, ENGR DRAWINGS

FY01

- FABRICATE ARRAY, FULL SCALE GROUND TESTS

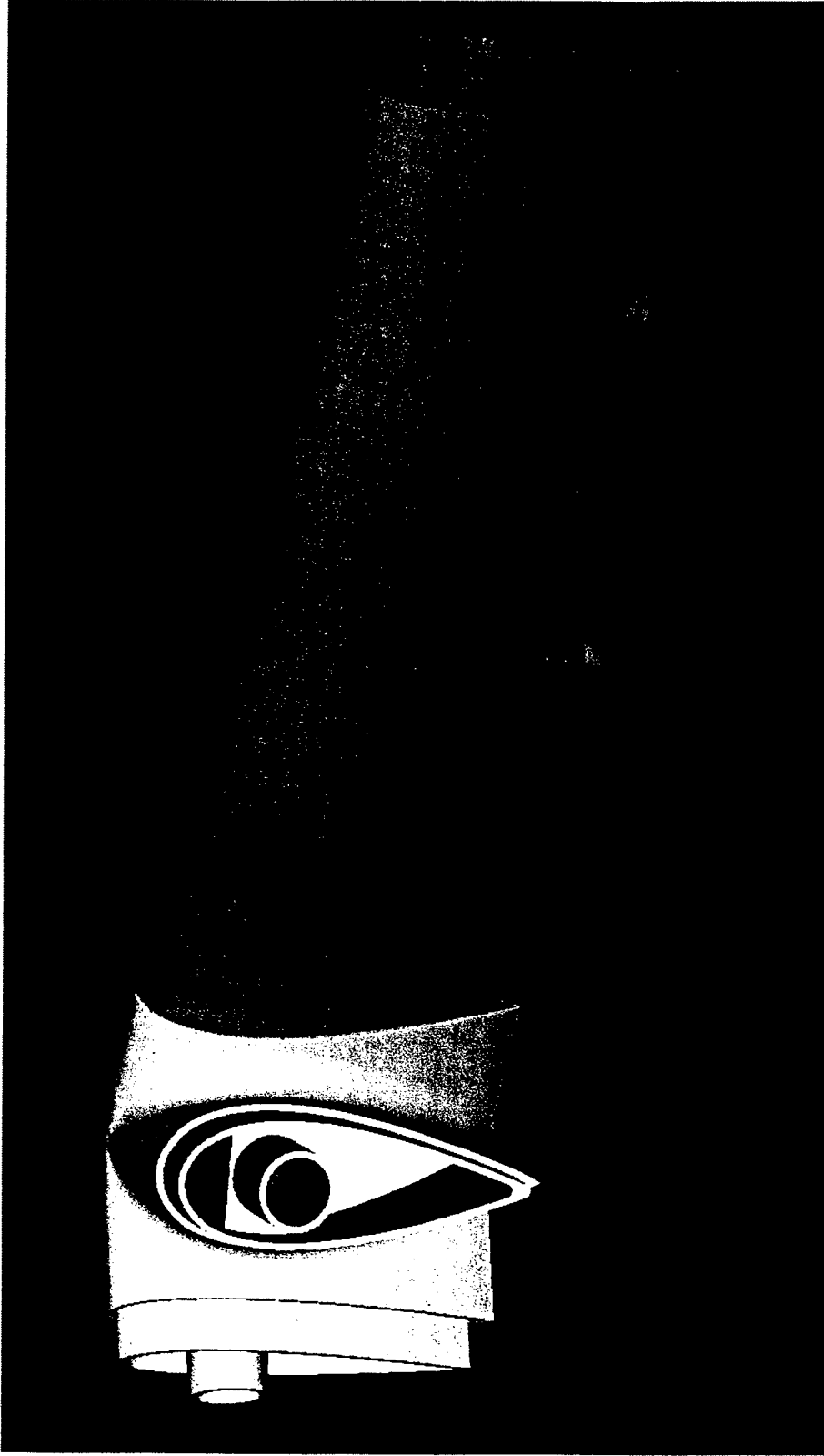


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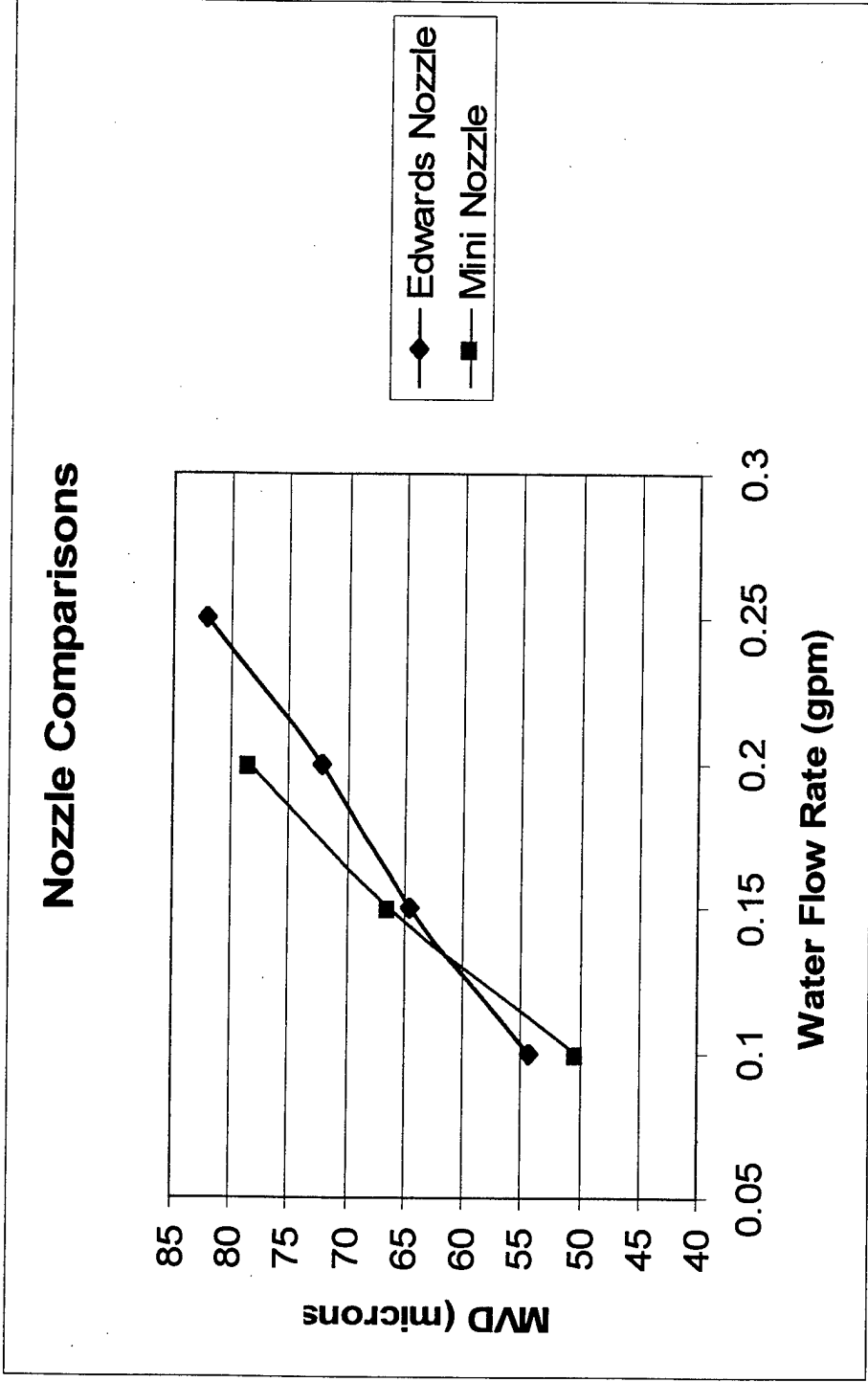
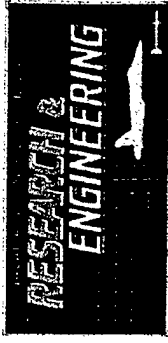


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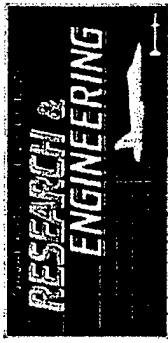
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Testing w/ 45 psi air, PDPA at 3 ft standoff, 10 runs at each point
 Edwards: Spray Systems Nozzle 1/4J 60100-140-1110SS
 Mini: Spray Systems Nozzle 1/8PAJSS 140-6-37-70 (no fluid cap)



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Back-ups

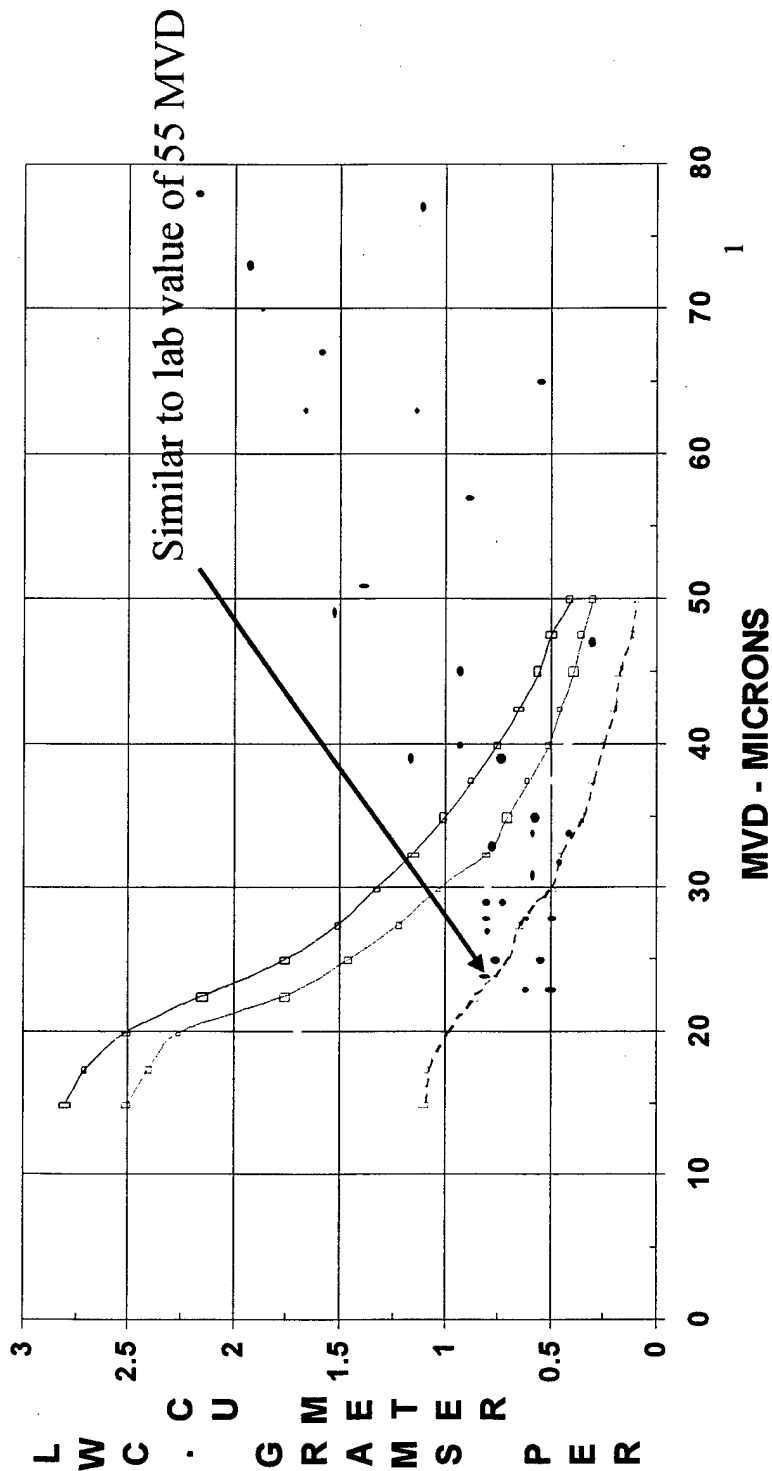


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INTERMITTENT MAXIMUM (CUMULIFORM CLOUDS)
 FAR PART 25 Vs ARTIFICIAL CONDITIONS
 LWC Vs MVD

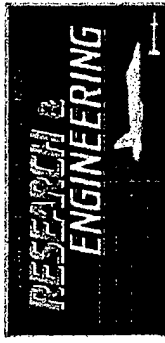
—□— +32 F —○— +14 F - - - - -4 F - - - - -22 F • Tanker Calibration



AIR FORCE KC-135A PAST TEST DATA



AIRBORNE ICING TANKER



SYSTEM REQUIREMENTS

System Capabilities and Characteristics	Thresholds	Objectives
Icing Cloud Liquid Water Content (LWC), Median Volumetric Diameter (MVD), and Temperature	those portions of FAR Part 25 Continuous and Intermittent Maximum conditions shown in Appendix A	threshold + those additional portions of FAR Part 25 Continuous & Intermittent Maximum conditions shown in Appendix A
Icing Cloud Size at 50 ft behind array	8 ft diameter	15 ft diameter
Supercooled Large Drop Liquid Water Content	0.10 to 0.50 gram per cubic meter	-
Supercooled Large Drop Diameter	50 to 500 microns	-
Supercooled Large Drop Distribution	N/A	IAW with Table 2 below
Supercooled Large Drop Temperature Range	0° to -15° Celsius	-
Supercooled Large Drop Cloud Size at 50 ft behind array	8 ft diameter	15 ft diameter
Rain Cloud Rainfall Rate	5.0 inches per hour	7.0 inches per hour
Rain Cloud Median Volumetric Drop Diameter	1 mm	2 mm
Rain Cloud Size at 50 to 75 ft behind array	5 ft	-