WL-TR-92-3053

SUBSONIC AERODYNAMIC RESEARCH LABORATORY

WRIGHT LABORATORY

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EXPERIMENTAL ENGINEERING BRANCH
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WRIGHT PATTERSON AIR FORCE BASE, OHIO 45433-6553

AUGUST 1992

Interim Report for Period JuLy 1983 - May 1992

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This technical report has been reviewed and is approved for publication.

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Stanley R Palmere

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13. ABSTRACT *(Maximum 200 words)*
In July of 1983 Air Force Systems Command (AFSC) approved construction of the Subsonic Aerodynamic Research Laboratory (SARL). the SARL is designed to provide a low turbulence flow(<0.05%) for flow visualization and precision measurements. The test section walls are 80% optical quality plexiglass. The large viewing area lends the facility to flow measurement by laser velocimetry, a nonintrusive flow measurement technique. A computer system is available for force and pressure data. The octagonal test section is 7'w X 10'h making it possible to test large models at high angles-of-attack. The SARL is designed for efficient low cost operation. The flow conditioning section of the tunnel contains both screens and honeycomb material. The facility was designed to operate up to Mach 0.6. A natural frequency problem with the drive system presently limits top speed to Mach 0.5. The SARL construction project is somewhat unique, being an in-house effort not requiring an MCP. A significant cost savings was realized because several major components needed for the SARL, were available from other unused facilities. The fan was obtained from NASA Langley Research Center. The 20,000 hp drive system was supplied by Wright-Patterson AFB.

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Standard Form 298 (Rev 2-89)
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TABLE OF CONTENTS: PAGE

1. Introduction

In July 1983 Air Force Systems Command (AFSC) approved construction of the Subsonic Aerodynamic Research Laboratory (SARL). The SARL is designed to provide a low turbulence flow (< 0.05%) for flow visualization and precision measurements. The test section walls are 80% optical quality plexiglass. The large viewing area lends the facility to flow measurement by laser velocimetry (LV). LV is a nonintrusive flow measurement technique. A computer system is available for force and pressure data. The octagonal test section is 7 feet wide by 10 feet high making it possible to test large models, similar to those tested at AEDC, at high angles of attack. The SARL is designed for efficient, low-cost operation. The flow conditioning section of the tunnel contains both screens and honeycomb material. The facility was designed to operate up to M 0.6. A natural frequency problem with the drive system presently limits top speed to M 0.5.

The SARL construction project is somewhat unique, being an in-house effort not requiring an MCP. Because the project was done in-house the project engineer could interact very closely with the prime and subcontractors. The interaction allowed government personnel to implement minor changes or clarifications in the construction procedure quickly, and often at no additional cost to the government. When an interference or fit problem was discovered, changes were implemented quickly. Therefore, parts did not need to be removed, modified and reinstalled. The parts were simply modified and then installed saving expense and delay of completion time. The largest savings was due to the amount of equipment needed for the SARL, that was available from other unused facilities. The fan was obtained from NASA Langley Research center. The available equipment used in constructing the SARL is listed below. The cost of new replacement equipment is listed for each item on-hand demonstrating over a 14 million dollar savings on the total project cost.

20,000 hp motor	1,000,000
Motor speed control	1,900,000
Buildings for the facility	8,000,000
Auxiliary air & vacuum equipment	2,292,000
NASA LARC fan	1,000,000
Total Savings	$14,192,000

2. Chronology of personnel's contributions to the design and development

The following contains a list by discipline, of the people who worked on the facility. Maurice Cain was the project engineer from 1982 until his retirement in 1988. Tom Presdorf was the project engineer from 1988 until 1992.

I. WL/FIMN:

A. Mechanical:

Werner Kachel was responsible for much of the early planning. He retired in 1984.

Alan Blore completed a stress analysis on the wooden instrumentation platforms. He assisted in the design and installation of the high pressure air system.

Maurice Cain and Wiley Wells (mechanical group leader) rounded up used equipment, had the equipment installed, wrote and supervised contracts for most of the facility construction, and did planning. Cain worked on operating procedures, safety coordination, speed control, drive system balancing, coordination of all work, and numerous other things. Wells retired in 1988.

Mark Maurice did most of the coordination with the shops to get the fan refurbished.

Perie Pitts wrote and followed the task contract to purchase the test section windows. He designed window handling devices and monitored the window fabrication and installation. He designed the smoke probe positioning device located immediately North of the test section. He designed and had built a smoke generator. The original generator used ammonia and sulfur dioxide which produced a dense stream. Unfortunately the stream produced a white residue on the model which interfered with the laser light sheet. Fortunately this attempt indicated the flying wing smoke probe (using the same chemicals) built by X-Aero would not have worked in the facility. The X-Aero probe was demonstrated at the dedication ceremony and before this test had been considered as a permanent system for the facility. The smoke probe was redesigned to use a Canadian designed smoke generator which uses light mineral oil.

Tom Presdorf completed detail designs and had built several parts of the SARL including the railing on the overhead crane, the railing on the contraction, the honeycomb section, the high loss screen section, a screen washing device, a lifting device for the test/model support sections and the model catcher (the design concept was formulated by Bunker, Grove, Presdorf and Tighe). The team received an AF invention award for the model catcher design. A patent request has been submitted for the screen washing device. He was in charge of preparing the facility for the dedication ceremony. He and Cain worked with Balco during the system balancing. Presdorf identified a natural frequency problem with the drive system, working with Balco, (Cain had suspected it) and obtained contractor support to isolate the problem. He obtained further contractor support to calculate a solution to the problem. He contracted to have the drive shaft straightened and a flexible coupling installed. He reviewed the exhaust deflector design rendering technical guidance. He was intimately involved in reviewing the model support design, and assisted in solving the model support rough pitch motion problem. Presdorf reviewed all the mechanical work done after 1988 and coordinated work efforts. He is presently working with Micro-Craft to design a high pressure air system for the model support.

Captain Bill Cipolla worked on the design of the test section door hydraulic actuator. Micro-Craft did a detail design and installed the system. He organized the project files and created an index for them (this was badly needed). He calculated the masses of many of the drive train components. The masses were used to complete a rotational analysis of the system. He has been managing the Experimental Engineering Branch's hazardous materials and safety issues since March 1991.

B. Electrical:

Stan Palmere was involved in the electrical planning. He became Tom Presdorf's group leader in 1989 when the mechanical and electrical groups were combined into the Facility Engineering group.

Norm Koon designed most of the high power systems in the facility, developed the PC control system (controls the subsystems, oiling cooling ect.) and is planning an upgrade to the speed control system.

Bob Corbin (technician) was involved with the early planning of the facility. He was the only person with experience running the 20,000 hp motor and the drive system. He installed a lot of the high power and control wiring. Using all the existing equipment (motor generator sets, 20,000 hp motor) would have been nearly impossible without him. He was in charge of reconditioning the 20,000 hp motor inn place. He retired in 1990.

Harold Day was group leader of the Facility Engineering technicians from 1983 until 1990. In 1990 he became a lead technician and has worked on several of the mechanical systems and is familiar with all the electrical systems. He is the lead facility operator. He worked on reconditioning the 20,000 hp motor.

Ray Wertz and Bob Reynolds installed the non welded hydraulic piping for the model support, the entire hydraulic system that operates the test section door and the oiling system for the drive fan and motor. They removed and reinstalled the fan blades when they were shortened.

Larry Dillion worked on reconditioning the motor, most of the facility wiring, removing the fan blades and reconditioning the 20,000hp motor.

Rick Gillium worked on much of the facility wiring, removing the fan blades, and reconditioning the 20,000 hp motor. He is a facility operator and became group leader of the Facility Engineering technicians group in 1990.

C. Electronics:

Glen Williams worked on the data systems interfacing them into the computer. This was a major effort.

Hank Baust worked on the model support computer control and hydraulic system. He was also involved in correcting the rough pitch problem in the model support hydraulic system.

Ray Raber (technician) completed most of the electronic instrumentation calibration, wiring, taking and analyzing data etc. Ray did an excellent job.

D. Mechanical Instrumentation Group:

Don Rutkowski was the project engineer on the model support until retiring in 1991. Don wrote the initial bid request for the model support, followed the project through countless meetings and continued the contract.

Dick Heck designed the facility pressure system with Matt Wagner. He designed the calibration system and had it built. He solved the model support pitch motion vibration problem and closed out the model support work unit.

Joe Martin (technician) worked on or assisted with a variety of the facility systems and model build up.

Larry Rieker and Dave Horton assisted in aligning the model support and the disassembly and repair of the yaw system. They did most of the build-up of the models tested in the facility. The have also worked on calibrating the model support and associated balances.

Mike Burns and Mark Geis completed several drawings on various SARL components including stiffening the North end of the diffuser and the over-all facility lay-out. Mark worked on the model support system, and designed a platform extending from the access section to the contraction. The platform particularly facilitates work done above the test section such as LV etc.

E. Aero-Optic Instrumentation:

George Seibert consulted on the design of the test section, especially the windows, to assure that laser velocimetry (LV) work would be functional and convenient in the facility.

Charlie Tyler designed and had an expandable cover built over the SARL test section to protect workers from laser light when the LV system was being used.

F. On site Contractors-Technology/Scientific Services Inc. (T/SSI):

Gary Clinehens (technician) worked on several systems. Specifically he assisted in the design and calibration of the facility pressure system. He completed most of the installation.

Jim Freed (supervisor) offered a lot of guidance during the design and check-out of the model support hydraulic system.

Gino Welcelean and Mike Jones completed a great deal of design and drafting including the honey-comb section and the high loss screen section.

Dick Huber completed the design of a lifting device for the test section/model support section. He is working on an overall view of the facility.

Franz Huber was a senior engineer who consulted on most of the aerodynamic design parameters of the facility. He is specifically responsible for the shape of the contraction. He retired in 1989.

2. WL/FIMM:

A. Airframe Aerodynamics:

Thomas Tighe this section is listed by year.

1983- present, He was a member of the SARL steering committee and as such was involved in many discussions and decisions that the group made as an entity.

1983- He suggested dropping the plan for building a control room "out in space" next to the tunnel, and instead using an existing room (present control room site) with an additional room as a "user" room. He laid out the concept and placement of all racks, computers, and stations.

1983- 1990 - He pushed for the use of dead-weight testers for on-line calibration of pressure transducers in the SARL circuit. He worked with Heck, Wagner, et al. on instrumentation choices and requirements of data channels.

1985- He identified a problem with the design of the original model catcher and headed a team to redesign the catcher more appropriately. Team received an Air Force Design award.

1985- He identified the need for a good design of the model support system. He worked with a team (Jim Grove, Bob Guyton) on a concept design, identifying requirements and off-the-shelf components to use with existing designs to achieve proper support goals for the SARL.

1985- He identified the design and placement of a tunnel fan rake measuring system to monitor fan performance.

1985- 1987- He pushed for the installation of weather stations for SARL.

1985- 1986- Through analysis he identified a basic flaw in the use of the old NASA fan, limiting tunnel speed to 0.3 Mach number. He worked with NASA Lewis design program to redesign inlet guide vanes for the fan resulting in achieving stated tunnel speed range. Redesign was started in 1987.

1986- He put the design requirements (loads, accuracies, movements) into the SOW for the model support contract. Followed through the contract as a member of a team overseeing the support work. (Rutkowski was the project manager.)

1986-1990- He put together, documented and updated the SARL shakedown plan including instrumentation choices and procedures for Maurice Cain. He designed and documented the calibration plan along with special instrumentation choices and procedures. The work involved designing instrumentation pieces suitable for the project.

1986- 1987- He was a member with Maurice Cain and Harold Day of the safety committee putting together the first safety permit and operating procedures for the facility.

1987- 1988- He worked on a new inlet design for SARL with input from consultant Franz Huber. The design included a choice of honeycomb, framing, screens, and building face treatment. This work opened the realistic operating window for the facility due to local winds. Work documented in AIAA paper; AIAA-88-4672 "Subsonic Wind Tunnel Design for Low Turbulence and Flow Visualization Capabilities."

1987- 1990- He documented and updated regularly the SARL instrumentation on the complete circuit. Identified the parameters and names to use in SARL data reduction. Provided to programmers the reduction procedures and calculations to be used, along with data presentation requirements.

1988- He defined the contours of the support blade cross section and the head to blade shaping to Fluidyne on the support contract, based on Euler code work performed by Dr. Don Kinsey of FIMM.

1988- He conducted tuft studies and an acoustic study of the test section. Results indicated vibration problems existed in the facility Contacted University of Cincinnati who's rough analysis confirmed vibration was present in the structure. The work was documented in AIAA paper; AIAA-90-0285 "SARL Noise Measurements,". He contacted Kop-Flex about installing a flexible coupling in the drive system. He contacted the Navy at Crane Ind. about straightening the drive shaft and recommended a new balancing of the tunnel drive system. Results of the contacts were the purchase of a coupling, straightening of the drive shaft, and rebalancing of the system.

1989- He designed a deflector for the tunnel to complete the facility. Deflector and previous vibration work quieted the tunnel 15- 20dB.

1990- 1991- He conducted calibration studies on the tunnel. Updated data reduction equations, and procedures were implemented.

1991- He wrote the programing for the model support positioning, and tare procedures(programing was with the aid of Glen Williams).

3. The following Appendices A-G

Appendix A

Annual Technology Managment Review Records

TECHNOLOGY MANAGEMENT REVIEW RECORD

1. [ ] 6.1 [X] 6.2 [ ] 6.3 [ ] 6.4

2. [X] IN-HOUSE [ ] EXTRAMURAL

3. CONTRACTOR/CONTRACT NO.

4. WORK UNIT NO.
24041318

5. START DATE
10 March 1982

6. TPO NO.
4

7. TITLE
Subsonic Aerodynamic Research Facility

8. WORK UNIT MONITOR
W. C. Wells

9. AFWAL/SYMBOL
AFWAL/FIMN

10. PRESENTER COMMENTS

M. R. Cain is the presenter. Technical performance is adequate for this task. Funding is considered marginal, mostly because the fiscal year requirements make it difficult to be sure funds are available when needed. The cost of the program to date has been comenserate with the accomplishments. Progress is about three months behind the schedule due to an unforeseen need for some of the required approvals. The 2750ABW procurement has been very cooperative on this project. The MASIS records are current, complete and accurate. Present manning levels are adequate at this time. Schedules for checkout testing of the SARL have been prepared. There are no problems with logistics or

11. LAST TMR DATE
13 May 1982

12 DATE OF LAST ADMINISTRATIVE REVIEW *(AFSC Form 311)*

13. ASSESSMENT AREAS/STATUS *Refer to Basic Regulation

E - EXCELLENT S - SATISFACTORY M - MARGINAL U - UNSATISFACTORY N - NOT APPLICABLE

CHECK	TABLE	*RULE	E	S	M	U	N	CHECK	TABLE	*RULE	E	S	M	U	N
a. Technical Performance	2	2		x				j. Functional Disciplines	3	7		x			
b. Funding Analysis	2	3&4			x			k. Technology Transfer	3	8					x
c. Cost vs. Accomplishment	2	5		x				l. Relevance	2	1		x			
d. Progress vs. Schedule	2	6		x				m. Key Decisions	3	1		x			
e. Contracting	3	2	x					n. System Support	3	6					x
f. Records				x				o.							
g. Manning	2	7&8		x				p.							
h. Testing	3	3		x				q.							
i. Logistics	3	4&5		x				r.							

~~14. REVIEWER COMMENTS~~ con't from block 10.
functional disciplines. The program is still relevant to the needs of the Air Force.

15 FOLLOW UP ACTION REQUIRED [ ] YES [ ] NO

a. BY WHOM

b. TYPE OF ACTION

REVIEWER/POSITION/SYMBOL

DATE
Dec 82

SIGNATURE

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TE. .NOLOGY MANAGEMENT REVIEW . CORD

1. [ ] 6.1 [ ] 6.3 [ ] 6.2 [ ] 6.4	2. [ ] IN-HOUSE [ ] EXTRAMURAL	3. CONTRACTOR/CONTRACT NO.

4. WORK UNIT NO. Task 2404-13	5. START DATE Oct 1977	6. TPO NO. 4

7. TITLE
AERODYNAMIC GROUND TEST TECHNOLOGY

8. WORK UNIT MONITOR Joseph M. Hample	9. AFWAL/SYMBOL AFWAL/FIMN

10. PRESENTER COMMENTS

The following listed work units were reviewed during May 1983. All were found to be satisfactory. 2404-13-03, 2404-13-06, 2404-13-07, 2404-13-18, 2404-13-19, 2404-13-21. Work unit 2404-13-07 has become very large. A new Work Unit has been initiated to cover the work being done in the aero-optics technology area. The number for this Work Unit is 2404-13-21.

11. LAST TMR DATE Dec 82	12 DATE OF LAST ADMINISTRATIVE REVIEW *(AFSC Form 311)*

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CHECK	E	S	M	U	N	CHECK	E	S	M	U	N
a. Technical Performance		X				j. Functional Disciplines		X			
b. Funding Analysis		X				k. Technology Transfer		X			
c. Cost vs. Accomplishment		X				l. Relevance		X			
d. Progress vs. Schedule		X				m. Intelligence Information					X
e. Contracting		X				n.					
f. Records		X				o.					
g. Manning		X				p.					
h. Testing		X				q.					
i. Logistics					X	r.					

14. REVIEWER COMMENTS

15. FOLLOW UP ACTION REQUIRED [ ] YES [ ] NO

a. BY WHOM	b. TYPE OF ACTION

REVIEWER/POSITION/SYMBOL	DATE	SIGNATURE
JOSEPH M. HAMPLE, Chief, Experimental Engineering Branch, AFWAL/FIMN	May 83	Joseph M. Hample

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TECHNOLOGY MANAGEMENT REVIEW RECORD

X EXTRAMURAL

4 WORK UNIT NO	5 START DATE	6 TPO NO.
24041318		

7 TITLE

Subsonic Aerodynamic Research Laboratory

8 WORK UNIT MONITOR	9. AFWAL/SYMBOL
M. R. Cain	FIMN

10 PRESENTER COMMENTS A contract was awarded for the drive system speed increaser. Contractor redesign of the test section was completed. Demolition of the portion of the former 10' wind tunnel tube within Bldg 25C was completed. Work continued on fan rehabilitation at engineering shops. Contracts were awarded for Phase I construction and the Bldg 25C north balcony and motor foundation were demolished under one of the contracts. Structural portions of the temporary model support were fabricated by engineering shops. Work was started on a contract effort contraction section redesign to reduce stresses in some areas.

11 LAST TMR DATE	12 DATE OF LAST ADMINISTRATIVE REVIEW (AFSC Form 311)
13 May 83	

13. ASSESSMENT AREAS STATUS *Refer to Basic Regulation

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CHECK	TABLE	*RULE	E	S	M	U	N	CHECK	TABLE	*RULE	E	S	M	U	N
a. Technical Performance	2	2		X				j. Functional Disciplines	3	7		X			
b. Funding Analysis	2	3&4		X				k. Technology Transfer	3	8					X
c. Cost vs. Accomplishment	2	5		X				l. Relevance	2	1		X			
d. Progress vs. Schedule	2	6		X				m. Key Decisions	3	1		X			
e. Contracting	3	2		X				n. System Support	3	6		X			
f. Records				X				o.							
g. Manning	2	7&8		X				p.							
h. Testing	3	3		X				q.							
i. Logistics	3	4&5		X				r.							

14. REVIEWER COMMENTS

15 FOLLOW UP ACTION REQUIRED YES NO

a. BY WHOM b. TYPE OF ACTION

REVIEWER POSITION SYMBOL	DATE	SIGNATURE
[illegible]	Feb 84	Joseph M Hampl[illegible]

AFWAL FORM 22

TECHNOLOGY MANAGEMENT REVIEW RECORD

1. ☐ 6.1 ☐ 6.3 ☐ 6.2 ☐ 6.4

2. ☒ IN-HOUSE ☐ EXTRAMURAL

3. CONTRACTOR/CONTRACT NO.

4. WORK UNIT NO.
24041318

5. START DATE

6. TPO NO.

7. TITLE
Subsonic Aerodynamic Research Laboratory

8. WORK UNIT MONITOR
M. R. Cain

9. AFWAL/SYMBOL
FIMN

10. PRESENTER COMMENTS Engineering for the drive train and an LV system was done on a PWI contract. A smoke research tunnel was started and made a separate work unit. Under Phase I construction contracts a fan tower was completed, the screen section was completed and shipped, contraction sections were nearly completed, bricks were removed from Bldg 25C south wall and tunnel shell components downstream of the model support section were installed. A contract was awarded for Phase II construction and resulted in a motor tower being 60% complete, power cable tray installation started and many miscellaneous steel items fabricated by a subcontractor. Fan rework and a filter house were nearly completed. The speed increaser progressed to final gear grinding.

11. LAST TMR DATE
Feb 84

12. DATE OF LAST ADMINISTRATIVE REVIEW *(AFSC Form 311)*

13. ASSESSMENT AREAS/STATUS

E – EXCELLENT S – SATISFACTORY M – MARGINAL U – UNSATISFACTORY N – NOT APPLICABLE

CHECK	TABLE (REFER TO AFSCR 80-25)	RULE (REFER TO AFSCR 80-25)	E	S	M	U	N	CHECK	TABLE (REFER TO AFSCR 80-25)	RULE (REFER TO AFSCR 80-25)	E	S	M	U	N
a. Technical Performance	2	2		X				j. Functional Disciplines	3	7		X			
b. Funding Analysis	2	3&4		X				k. Technology Transfer	3	4					X
c. Cost vs. Accomplishment	2	5		X				l. Relevance	2	1		X			
d. Progress vs. Schedule	2	6		X				m. Key Decisions	3	1		X			
e. Contracting	3	2		X				n. System Support	3	6		X			
f. Records				X				o.							
g. Manning	2	7&8		X				p.							
h. Testing	3	3		X				q.							
i. Logistics	3	4&5		X				r.							

14. REVIEWER COMMENTS

Continue with activity –

15 FOLLOW UP ACTION REQUIRED ☐ YES ☒ NO

a. BY WHOM

b. TYPE OF ACTION

REVIEWER/POSITION/SYMBOL
JOSEPH M. HAMPLE, Chief
Experimental Engineering Branch, AFWAL/FIMN

DATE
4/1/85

SIGNATURE
Joseph M Hample

AFWAL FORM NOV 83 22 PREVIOUS EDITION WILL BE USED

TECHNOLOGY MANAGEMENT REVIEW RECORD

1. ☐ 6.1 ☐ 6.3 ☒ 6.2 ☐ OTHER	2. ☒ IN-HOUSE ☐ EXTRAMURAL	3. CONTRACTOR/CONTRACT NO.

4. WORK UNIT NO.	5. START DATE	6a. TPO NO.	6b. MAJOR THRUST
24041318	Mar 82		MMC

7. TITLE
SARL

8. WORK UNIT MONITOR	9. AFWAL/SYMBOL
Maurice R. Cain	AFWAL/FIMN

10. PRESENTER COMMENTS

All parts of the contraction section have been set in place and are ready for welding. The screen section is being set in place. The speed increaser and motor stator have been set on the completed motor tower. Brick and windows have been removed from the north end of B25C and inflatable fairings designed. Test section, power cables and fan have been installed. A motor filter house has been fabricated. Contract changes for instrument platforms, air conditioner installation and miscellaneous work have been signed..

11. LAST TMR DATE	12. DATE OF LAST ADMINISTRATIVE REVIEW (AF Form 2519 (AFWAL Overprint))
1 Apr 85	11 Oct 84

13. ASSESSMENT AREA/STATUS

E - EXCELLENT S - SATISFACTORY M - MARGINAL U - UNSATISFACTORY N - NOT APPLICABLE (see reverse side)

ASSESSMENT AREA	E	S	M	U	N	ASSESSMENT AREA	E	S	M	U	N
a. Technical Performance		X				m. Relevance		X			
b. Funding Analysis		X				n. Key Decisions		X			
c. Cost vs Accomplishment		X				o. System Support		X			
d. Progress vs Schedule		X				p. System Safety		X			
e. Contracting		X				q. Environmental Protection		X			
f. Records		X				r. Product Assurance		X			
g. Manning		X				s. Life Cycle/Design to Cost		X			
h. Testing		X				t. Contract Security		X			
i. Logistics		X									
j. Meteorology		X									
k. Data Management		X									
l. Technology Transfer		X									

14. REVIEWER COMMENTS

15. FOLLOW UP ACTION REQUIRED ☐ YES ☒ NO

a. BY WHOM

b. TYPE OF ACTION

REVIEWER/POSITION/SYMBOL	DATE	SIGNATURE
ALFRED C. DRAPER Asst for Research & Technology Aeromechanics Division	25 Sept 85	Alfred C. Draper

AFSC FORM MAR 85 2722 REPLACES AFWAL FORM 22, AUG 84, WHICH IS OBSOLETE.

TECHNOLOGY MANAGEMENT REVIEW RECORD

1. ☐ 6.1 ☐ 6.3 ☒ 6.2 ☐ OTHER	2. ☒ IN-HOUSE ☐ EXTRAMURAL	3. CONTRACTOR/CONTRACT NO.

4. WORK UNIT NO	5. START DATE	6a. TPO NO.	6b. MAJOR THRUST
24041318	031082		

7. TITLE
Subsonic Aerodynamic Research Laboratory

8. WORK UNIT MONITOR	9. AFWAL/SYMBOL
M. R. Cain	AFWAL/FIMN

10. PRESENTER COMMENTS

Item C and D are marked marginal because of several contract changes which have resulted in extended completion dates and more cost. Since the last TMR the schedule has been extended to 1 Jul 86 from 1 Jul 85 at a cost of approximately $230,000. There were seven contract amendments. The work unit is being extended at this time to March 1987. Items G and K are marked marginal because there is not enough manpower for documentation and filing work which is being necessarily delayed. More engineers have been added from FIMM to help on concept designs remaining. It is not known at this time if further engineering support is required.

11. LAST TMR DATE	12. DATE OF LAST ADMINISTRATIVE REVIEW (AF Form 2519 (AFWAL Overprint))
25 Sep 85	11 Oct 84

13. ASSESSMENT AREA/STATUS

E - EXCELLENT S - SATISFACTORY M - MARGINAL U - UNSATISFACTORY N - NOT APPLICABLE (see reverse side)

ASSESSMENT AREA	E	S	M	U	N	ASSESSMENT AREA	E	S	M	U	N
a. Technical Performance		X				m. Relevance		X			
b. Funding Analysis		X				n. Key Decisions		X			
c. Cost vs Accomplishment			X			o. System Support		X			
d. Progress vs Schedule			X			p. System Safety		X			
e. Contracting		X				q. Environmental Protection		X			
f. Records		X				r. Product Assurance		X			
g. Manning			X			s. Life Cycle/Design to Cost		X			
h. Testing		X				t. Contract Security		X			
i. Logistics		X									
j. Meteorology		X									
k. Data Management			X								
l. Technology Transfer					X						

14. REVIEWER COMMENTS

1. I support the action to extend this WU to Mar 87.

2. Recommend using overtime to impact the manpower shortages. Further we will look into the possibility of reassigning, one of the on-site contractors from the Clark compressor installation to the SARL installation.

15. FOLLOW UP ACTION REQUIRED ☒ YES ☐ NO

a. BY WHOM Project Manager FIMNC TM/TSSI QAE

b. TYPE OF ACTION

REVIEWER/POSITION/SYMBOL	DATE	SIGNATURE
JOSEPH M. HAMPLE, AFWAL/FIMN	15Apr86	Joseph M Hample

AFSC FORM MAR 85 2722 REPLACES AFWAL FORM 22, AUG 84, WHICH IS OBSOLETE.

TECHNOLOGY MANAGEMENT REVIEW RECORD

1. ☐ 6.1 ☐ 6.3 ☒ 6.2 ☐ OTHER	2. ☐ IN-HOUSE ☐ EXTRAMURAL	3. CONTRACTOR/CONTRACT NO.

4. WORK UNIT NO.	5. START DATE	6a. TPO NO.	6b. MAJOR THRUST
24041318	031082		

7 TITLE
SUBSONIC AERODYNAMIC RESEARCH LABORATORY

8 WORK UNIT MONITOR	9. AFWAL/SYMBOL
M. R. Cain	AFWAL/FIMN

10 PRESENTER COMMENTS

Items d and g are marginal because rework necessary on some parts of the tunnel, and problems incountered with the physical amount of work needed to be done by small amounts of manpower, technical and labor, resulted in schedule slippage of 3-1/2 months. Part of slippage was due to contracted effort being extended at no cost (≈ 1-1/2 months). Item h is behind schedule due to smoke generator mishap resulting in new unit being built. This slowed testing until September 1986.

11. LAST TMR DATE	12. DATE OF LAST ADMINISTRATIVE REVIEW (AF Form 2519 (AFWAL Overprint))
15 Apr 86	

13. ASSESSMENT AREA/STATUS

E - EXCELLENT S - SATISFACTORY M - MARGINAL U - UNSATISFACTORY N - NOT APPLICABLE (see reverse side)

ASSESSMENT AREA	E	S	M	U	N	ASSESSMENT AREA	E	S	M	U	N
a. Technical Performance		X				m. Relevance		X			
b. Funding Analysis		X				n. Key Decisions		X			
c. Cost vs Accomplishment		X				o. System Support		X			
d. Progress vs. Schedule			X			p. System Safety		X			
e. Contracting		X				q. Environmental Protection		X			
f. Records		X				r. Product Assurance		X			
g. Manning			X			s. Life Cycle/Design to Cost		X			
h. Testing			X			t. Contract Security		X			
i. Logistics		X									
j. Meteorology		X									
k. Data Management		X									
l. Technology Transfer					X						

14 REVIEWER COMMENTS

The smoke work is being done under another work unit in FIMM.

We need a schedule that can be used to define what are critical paths are and to define all elements of work. This was started but the final product has not emerged yet.

15 FOLLOW UP ACTION REQUIRED ☑ YES ☐ NO

Complete the work element definition and layout a schedule by 15 Oct 1986.

a. BY WHOM M. Cain b. TYPE OF ACTION

REVIEWER/POSITION/SYMBOL	DATE	SIGNATURE
Melvin Buck AFWAL/FIMN	June 86	Melvin Buck

AFSC FORM MAR 85 2722 REPLACES AFWAL FORM 22, AUG 84, WHICH IS OBSOLETE

TECHNOLOGY MANAGEMENT REVIEW RECORD

1. ☐ 6.1 ☐ 6.3 ☒ 6.2 ☐ OTHER	2. ☒ IN-HOUSE ☐ EXTRAMURAL	3. CONTRACTOR/CONTRACT NO.

4. WORK UNIT NO.	5. START DATE	6a. TPO NO.	6b. MAJOR THRUST
24041318	031082		

7 TITLE
Subsonic Aerodynamic Research Laboratory

8 WORK UNIT MONITOR
M. R. Cain

9. AFWAL/SYMBOL
AFWAL/FIMN

10 PRESENTER COMMENTS The fan was reworked by deleting first stage rotor and installing new inlet guide vanes. Two construction contracts are in being for entry treatment. One is in the initial, off-site, work stage and the other extended for convenience of the gov't. Plans are to remove the entry door and install sheet metal fairings in its place. This work plus lube systems and control systems work in progress, should permit the achievement of a reasonable fan speed. The completion date has been extended till Mar 88.

11 LAST TMR DATE
Jun 86

12. DATE OF LAST ADMINISTRATIVE REVIEW *(AF Form 2519 (AFWAL Overprint))*
30 Apr 86

13. ASSESSMENT AREA/STATUS

E - EXCELLENT S - SATISFACTORY M - MARGINAL U - UNSATISFACTORY N - NOT APPLICABLE *(see reverse side)*

ASSESSMENT AREA	E	S	M	U	N	ASSESSMENT AREA	E	S	M	U	N
a Technical Performance		X				m. Relevance		X			
b Funding Analysis		X				n. Key Decisions		X			
c Cost vs Accomplishment		X				o System Support		X			
d. Progress vs Schedule			X			p. System Safety		X			
e. Contracting		X				q. Environmental Protection		X			
f Records		X				r. Product Assurance		X			
g. Manning		X				s. Life Cycle/Design to Cost		X			
h Testing		X				t. Contract Security		X			
i. Logistics		X									
j. Meteorology		X									
k Data Management		X									
l Technology Transfer					X						

14. REVIEWER COMMENTS
Review Overall "SARL" Program to assure no major unanticipated problems exist.

15 FOLLOW UP ACTION REQUIRED ☒ YES ☐ NO

a BY WHOM W.W.

b TYPE OF ACTION

REVIEWER/POSITION/SYMBOL	DATE	SIGNATURE
Draper Asst for R&T FIM	25 Sept 87	Alfred C. Draper

AFSC FORM MAR 85 2722 REPLACES AFWAL FORM 22, AUG 84, WHICH IS OBSOLETE.

SUBSONIC AERODYNAMIC RESEARCH FACILITY (SARL)

PROBLEM/NEED

The Flight Dynamics Laboratory has long recognized the need for a large, low speed, in-house, flow visualization capability. Such a facility needs to provide good flight simulation and outstanding flow visualization so that it can be used as a research tool. The facility should not only permit the researcher to see the flow but also to obtain the standard pressure and force measurements. Such a facility is needed to provide experimental verification for computational fluid dynamics analyses.

DESCRIPTION

The SARL is a unique facility, in that it was designed from the very beginning as flow visualization wind tunnel. The 7-foot wide by ten-foot high test section is 55 percent window to permit 360 degree line-of-sight access to the model. The configuration was chosen to permit high angle-of-attack testing associated with modern high performance aircraft. The facility has a forty-six foot by fifty foot inlet, giving a 35:1 contraction ratio. Honeycomb and screens are installed in the inlet before the contraction to reduce turbulence in the air passing through the test section to less than 0.05 percent. The SARL is designed for test section velocities of up to Mach 0.6. Construction of the SARL, except for some of the inlet fairing, was completed in Fy87, clearing the way for dedication of the SARL later in the calendar year. Shakedown of the facility has already started with problem-free operation of the drive motor and gearbox. Low speed fan operation has also been accomplished with no serious problems. High-speed checkout of the fan is expected during mid-1988. Calibration will begin immediately thereafter.

PAYOFF

With the SARL in full operation, the Air Force will have an in-house test capability which will utilize laser-velocimetry and smoke lines to visualize complex flow patterns. The more usual wind tunnel data, such as pressure distributions and force measurements can also be taken. These measurements will permit validation of computational fluid dynamics codes as well as testing of advanced, highly manueverable vehicles at high angles of attack.

TECHNOLOGY MANAGEMENT REVIEW RECORD

1. ☐ 6.1 ☐ 6.3 ☒ 6.2 ☐ OTHER	2. ☒ IN-HOUSE ☐ EXTRAMURAL	3. CONTRACTOR/CONTRACT NO.

4. WORK UNIT NO.	5. START DATE	6a. TPO NO.	6b. MAJOR THRUST
24041318	10 Mar 82		

7. TITLE
Subsonic Aerodynamic Research Laboratory

8. WORK UNIT MONITOR	9. AFWAL/SYMBOL
Tom A. Presdorf	FIMN

10. PRESENTER COMMENTS
Plans are to construct an exhaust elbow to direct airflow and noise up and away from occupied space. Excessive noise levels are presently being generated by the tunnel. Acoustical studies are started to determine the best solution to the problem. Calibration has started and will be on-going during the coming months. Final fan balancing is nearing completion. Parts are being purchased for the permanent model support. Leaks in the access section doors have been sealed. The temporary model support fairings have been replaced with stronger ones. The Kramer speed control system has been modified to produce more accurate speed control. Construction of the entire tunnel shell and circuit has been completed.

11. LAST TMR DATE	12. DATE OF LAST ADMINISTRATIVE REVIEW *(AF Form 2519 (AFWAL Overprint))*
May 88	Jun 88

13. ASSESSMENT AREA/STATUS

E - EXCELLENT S - SATISFACTORY M - MARGINAL U - UNSATISFACTORY N - NOT APPLICABLE *(see reverse side)*

ASSESSMENT AREA	E	S	M	U	N	ASSESSMENT AREA	E	S	M	U	N
a. Technical Performance		X				m. Relevance		X			
b. Funding Analysis		X				n. Key Decisions		X			
c. Cost vs Accomplishment		X				o. System Support		X			
d. Progress vs. Schedule			X			p. System Safety		X			
e. Contracting		X				q. Environmental Protection		X			
f. Records			X			r. Product Assurance		X			
g. Manning			X			s. Life Cycle/Design to Cost		X			
h. Testing		X				t. Contract Security		X			
i. Logistics		X									
j. Meteorology		X									
k. Data Management		X									
l. Technology Transfer		X									

14. REVIEWER COMMENTS

- Continue to work with [illegible] & his [illegible] to resolve problems identified (Vibration, Acoustics, etc)
- Based on Analysis [illegible], [illegible] & [illegible] develop a "get well plan" ASAP.

15. FOLLOW UP ACTION REQUIRED ☐ YES ☐ NO

a. BY WHOM Presdorf / [illegible]

b. TYPE OF ACTION

REVIEWER/POSITION/SYMBOL	DATE	SIGNATURE
[illegible] Asst for R&D	7 Sept 88	[signature]

AFSC FORM MAR 85 2722 REPLACES AFWAL FORM 22, AUG 84, WHICH IS OBSOLETE.

TECHNOLOGY MANAGEMENT REVIEW RECORD

1. ☐ 6.1 ☐ 6.3 ☒ 6.2 ☐ OTHER	2. ☒ IN-HOUSE ☐ EXTRAMURAL	3. CONTRACTOR/CONTRACT NO.

4. WORK UNIT NO. 24041318	5. START DATE 031082	6a. TPO NO.	6b. MAJOR THRUST

7. TITLE
SUBSONIC AERODYNAMIC RESEARCH LABORATORY (SARL)

8. WORK UNIT MONITOR Maurice R. Cain	9. AFWAL/SYMBOL AFWAL/FIMN

10. PRESENTER COMMENTS The fan blades have been reworked to increase the tip clearance but have not been installed. The drive train, without blades, has been balanced to commercial standards for the speed range. The blades will be installed and the fan balanced at full speed when other condition permit. The entry door has been removed and a contract is in being for fairings at the door location. Progress on existing contracts for fairings and high loss screen is back on a suitable schedule after delays for door removal. The facility computer has been installed and programs are being readied for tunnel calibration, expected to begin in July. The work unit has been extended to Mar 89.

11. LAST TMR DATE	12. DATE OF LAST ADMINISTRATIVE REVIEW (AF Form 2519 (AFWAL Overprint))

13. ASSESSMENT AREA/STATUS

E - EXCELLENT S - SATISFACTORY M - MARGINAL U - UNSATISFACTORY N - NOT APPLICABLE (see reverse side)

ASSESSMENT AREA	E	S	M	U	N	ASSESSMENT AREA	E	S	M	U	N
a. Technical Performance		X				m. Relevance		X			
b. Funding Analysis		X				n. Key Decisions		X			
c. Cost vs Accomplishment		X				o. System Support		X			
d. Progress vs Schedule			X			p. System Safety		X			
e. Contracting		X				q. Environmental Protection		X			
f. Records		X				r. Product Assurance		X			
g. Manning		X				s. Life Cycle/Design to Cost		X			
h. Testing		X				t. Contract Security		X			
i. Logistics		X									
j. Meteorology		X									
k. Data Management		X									
l. Technology Transfer					X						

14. REVIEWER COMMENTS

- Need to close out this WU and generate a new one wrt FIMM. (when tunnel attains full speed and front end work completed).

15. FOLLOW UP ACTION REQUIRED ☐ YES ☒ NO

a. BY WHOM	b. TYPE OF ACTION

REVIEWER/POSITION/SYMBOL	DATE	SIGNATURE
Thomas M. Weeks Chief, FIMN	19 Apr 87	[signature]

AFSC FORM MAR 85 2722 REPLACES AFWAL FORM 22, AUG 84, WHICH IS OBSOLETE

TECHNOLOGY MANAGEMENT REVIEW RECORD

1. ☐ 6.1 ☐ 6.3 ☑ 6.2 ☐ OTHER	2. ☑ IN-HOUSE ☐ EXTRAMURAL	3. CONTRACTOR/CONTRACT NO.

4. WORK UNIT NO.	5. START DATE	6a. TPO NO.	6b. MAJOR THRUST
24041318	10 Mar 82		

7. TITLE: Subsonic Aerodynamic Research Laboratory

8. WORK UNIT MONITOR: Tom A. Presdorf

9. AFWAL/SYMBOL: FIMN

10. PRESENTER COMMENTS

11. LAST TMR DATE: May 88

12. DATE OF LAST ADMINISTRATIVE REVIEW (*AF Form 2519 (AFWAL Overprint)*): Jun 88

13. ASSESSMENT AREA/STATUS

E - EXCELLENT S - SATISFACTORY M - MARGINAL U - UNSATISFACTORY N - NOT APPLICABLE (*see reverse side*)

ASSESSMENT AREA	E	S	M	U	N	ASSESSMENT AREA	E	S	M	U	N
a. Technical Performance		X				m. Relevance		X			
b. Funding Analysis		X				n. Key Decisions		X			
c. Cost vs Accomplishment		X				o. System Support		X			
d. Progress vs. Schedule			X			p. System Safety		X			
e. Contracting		X				q. Environmental Protection		X			
f. Records			X			r. Product Assurance		X			
g. Manning			X			s. Life Cycle/Design to Cost		X			
h. Testing		X				t. Contract Security		X			
i. Logistics		X									
j. Meteorology		X									
k. Data Management		X									
l. Technology Transfer		X									

14. REVIEWER COMMENTS

· Actively develop continuing interest and awareness of the SARL capability within FDL and potential users including Majcoms

15. FOLLOW UP ACTION REQUIRED ☐ YES ☑ NO

a. BY WHOM b. TYPE OF ACTION

REVIEWER/POSITION/SYMBOL	DATE	SIGNATURE
Thomas M. Weeks Chief Exp. Branch WRDC/FIMN	7 Jun 89	T M Weeks

AFSC FORM MAR 85 2722 REPLACES AFWAL FORM 22, AUG 84, WHICH IS OBSOLETE.

TECHNOLOGY MANAGEMENT REVIEW RECORD

1 ☐ 6.1 ☐ 6.3 ☒ 6.2 ☐ OTHER	2 ☒ IN-HOUSE ☐ EXTRAMURAL	3. CONTRACTOR/CONTRACT NO.

4. WORK UNIT NO.	5. START DATE	6a. TPO NO.	6b. MAJOR THRUST
24041318	8203		

7. TITLE
SUBSONIC AERODYNAMIC RESEARCH LABORATORY

8. WORK UNIT MONITOR	9. AFWAL/SYMBOL
T. Presdorf	WRDC/FIMN

10. PRESENTER COMMENTS
The drive shaft will be straightened and installed with a flexible coupling. Model support installation will be completed. The tunnel will be brought on-line at a reduced maximum speed until the foundations are stiffened. The north end of the tunnel will be stiffened. The model support will be installed and brought on line. The drive system will be aligned. An exhaust deflector will be designed for the facility.

11. LAST TMR DATE	12. DATE OF LAST ADMINISTRATIVE REVIEW *(AF Form 2519 (AFWAL Overprint))*

13. ASSESSMENT AREA/STATUS

E - EXCELLENT S - SATISFACTORY M - MARGINAL U - UNSATISFACTORY N - NOT APPLICABLE *(see reverse side)*

ASSESSMENT AREA	E	S	M	U	N	ASSESSMENT AREA	E	S	M	U	N
a. Technical Performance		X				m. Relevance		X			
b. Funding Analysis		X				n. Key Decisions		X			
c. Cost vs Accomplishment		X				o. System Support		X			
d. Progress vs. Schedule			X			p. System Safety		X			
e. Contracting		X				q. Environmental Protection		X			
f. Records			X			r. Product Assurance		X			
g. Manning			X			s. Life Cycle/Design to Cost		X			
h. Testing		X				t. Contract Security		X			
i. Logistics		X									
j. Meteorology		X									
k. Data Management		X									
l. Technology Transfer		X									

14. REVIEWER COMMENTS
Press on with Plan to assure flow quality as briefed
Continue to work agressively the SARL activities Committee.

15. FOLLOW UP ACTION REQUIRED ☒ YES ☐ NO

a. BY WHOM The Team b. TYPE OF ACTION as above

REVIEWER/POSITION/SYMBOL	DATE	SIGNATURE
Draper Melvin Buck	14 Aug 89	Alfred C. Draper Melvin L. Buck

AFSC FORM MAR 85 2722 REPLACES AFWAL FORM 22, AUG 84, WHICH IS OBSOLETE.

PROGRESS: 8-14-89

The entry section of the tunnel has been completed. Railings have been installed on the contraction. The backup DC motor lift pumps have been installed. Installation of the model support has started. The gearbox has been enclosed by a structure. Sverdrup has completed an analysis showing the fan system has an axial motion at 12.9 hertz (774 rpm) and a lateral motion at 15.5 hertz (930 rpm). Sverdrup also defined the modifications necessary to change the natural frequency of the system. The motor is presently limited to 400 rpm (465 max speed). The tunnel expansion joint has been replaced with a better material. The tunnel expansion joint has been replaced with a better material.

PLANS FOR THE NEXT FY ACTIVITY:

The model support will be installed and checked out. Calibration will be completed. The North end of the diffuser will be stiffened. The drive shaft will be removed and reworked. A flexible coupling will be installed at the gearbox. The alignment of the entire drive system will be checked. Testing will begin in the facility. An exhaust deflector will be designed for the facility.

Marginal Items.

d. Progress has been marginal because a variety of problems have surfaced. The natural frequency of the fan motor towers has been measured and calculated. There is a rotational natural frequency at 440 motor rpm. The model support schedule has been delayed slightly due to the complexity of the project.

f. The records are slightly backlogged but are nearly current.

g. There has been marginal monitoring of the work done and minimal planning of future work because of undermanning. Hopefully as the project nears completion it will require less time and the problem will be self-correcting.

[TOM.NOTES.REVIEW]tmr.89

FROM: FIMN (Tom Presdorf/57244) 8- -1989

Subject: Response to division level TMR

TO: FIMN (Stan Palmere/56032)

1. The flow quality of the SARL is presently compromised by noise and vibration. The noise problem is being reviewed by Ralph Shimmovits and Tom Tighe. They initially are investigating other facilities to study various techniques of noise control. After completing theIr investigation a noise suppression system will be designed. Estimated completion time for the noise suppression is 1.5 - 2 years. The noise problem may not be completely solvable. When operating at low speed, vibration will not cause a problem. The solution to the VIBRATION problem is to stiffen the fan tower. Stiffening requires digging up the foundations, increasing the size of the foundations and stiffening the above-ground structure.

2. The SARL committee will meet as required to suggest new solutions to the complicated problems that may arise.

Tom A Presdorf

Tom A Presdorf, Mechanical Engineer
Experimental Engineering Branch
Aeromechanics Division

[TOM.NOTES.REVIEW]tmrdiv.ans89

TECHNOLOGY MANAGEMENT REVIEW RECORD

1. ☐ 6.1 ☐ 6.3 ☒ 6.2 ☐ OTHER

2. ☒ IN-HOUSE ☐ EXTRAMURAL

3. CONTRACTOR/CONTRACT NO.

4. WORK UNIT NO. 24041318

5. START DATE 8203

6a. TPO NO.

6b. MAJOR THRUST

7. TITLE SUBSONIC AERODYNAMIC RESEARCH LABORATORY

8. WORK UNIT MONITOR T. Presdorf

9. AFWAL/SYMBOL WRDC/FIMN

10. PRESENTER COMMENTS

(SEE ATTACHED)

11. LAST TMR DATE

12. DATE OF LAST ADMINISTRATIVE REVIEW *(AF Form 2519 (AFWAL Overprint))*

13. ASSESSMENT AREA/STATUS

E - EXCELLENT S - SATISFACTORY M - MARGINAL U - UNSATISFACTORY N - NOT APPLICABLE *(see reverse side)*

ASSESSMENT AREA	E	S	M	U	N	ASSESSMENT AREA	E	S	M	U	N
a. Technical Performance		X				m. Relevance		X			
b. Funding Analysis		X				n. Key Decisions		X			
c. Cost vs Accomplishment		X				o. System Support		X			
d. Progress vs. Schedule			X			p. System Safety		X			
e. Contracting		X				q. Environmental Protection		X			
f. Records		X				r. Product Assurance		X			
g. Manning			X			s. Life Cycle/Design to Cost		X			
h. Testing		X				t. Contract Security		X			
i. Logistics		X									
j. Meteorology		X									
k. Data Management		X									
l. Technology Transfer		X									

14. REVIEWER COMMENTS

maintain a current detailed SARL schedule

prepare to provide a detailed SARL briefing at the division TMR.

15. FOLLOW UP ACTION REQUIRED ☒ YES ☐ NO

BY WHOM Presdorf

b. TYPE OF ACTION Schedule

REVIEWER/POSITION/SYMBOL	DATE	SIGNATURE
Thomas M. Weeks Chief FIMN	12 Feb 90	[signature]

AFSC FORM MAR 85 2722 REPLACES AFWAL FORM 22, AUG 84, WHICH IS OBSOLETE.

PROGRESS: 2-12-90

Installation of the permanent model support is about 90% complete. The model support hydraulic system has been installed. Additional platforms have been built to provide access to the model support and instrumentation systems. The north end of the diffuser has been stiffened. The alignment of the drive system was checked and is within tolerance. A flexible coupling has been built and installed at the gear box end of the main drive shaft. The exhaust deflector is approximately 90% complete.

PLANS FOR THE NEXT FY ACTIVITY:

The model support will be checked out and begin operation. Calibration of the model support and the facility will be completed. The first scheduled test is a joint effort with the Canadians. Long term goals are to install powered lift and moving ground plane capability in the facility.

Marginal Items.

d. Progress has been marginal because a variety of problems have surfaced which is common during the final stages of a project. Due to complexity the model support has suffered several delays. Presently completion of the the model support is delayed due to a cleaning requirement for the hydraulic piping that was not anticipated. Completion of the exhaust deflector is later than expected due to an optimistic schedule and probably more due to snow and inclement weather.

g. There has been marginal monitoring of the work done and minimal planning of future work because of undermanning. Hopefully as the project nears completion it will require less management time and the problem will be self-correcting.

[TOM.NOTES.REVIEW]tmr.90

TECHNOLOGY MANAGEMENT REVIEW RECORD

1. ☐ 6.1 ☐ 6.3 ☒ 6.2 ☐ OTHER

2. ☒ IN-HOUSE ☐ EXTRAMURAL

3. CONTRACTOR/CONTRACT NO.

4. WORK UNIT NO.: 24041318

5. START DATE: 8203

6a. TPO NO.

6b. MAJOR THRUST

7. TITLE: SUBSONIC AERODYNAMIC RESEARCH LABORATORY

8. WORK UNIT MONITOR: T. Presdorf

9. AFWAL/SYMBOL: WRDC/FIMN

10. PRESENTER COMMENTS

(See attached)

11. LAST TMR DATE: Feb 90

12. DATE OF LAST ADMINISTRATIVE REVIEW *(AF Form 2519 (AFWAL Overprint))*

13. ASSESSMENT AREA/STATUS

E - EXCELLENT S - SATISFACTORY M - MARGINAL U - UNSATISFACTORY N - NOT APPLICABLE *(see reverse side)*

ASSESSMENT AREA	E	S	M	U	N	ASSESSMENT AREA	E	S	M	U	N
a. Technical Performance		X				m. Relevance		X			
b. Funding Analysis		X				n. Key Decisions		X			
c. Cost vs Accomplishment		X				o. System Support		X			
d. Progress vs. Schedule			X			p. System Safety		X			
e. Contracting		X				q. Environmental Protection		X			
f. Records		X				r. Product Assurance		X			
g. Manning			X			s. Life Cycle/Design to Cost		X			
h. Testing		X				t. Contract Security		X			
i. Logistics		X									
j. Meteorology		X									
k. Data Management		X									
l. Technology Transfer		X									

14. REVIEWER COMMENTS

Reviewed Previously (Just Recently)

15. FOLLOW UP ACTION REQUIRED ☒ YES ☐ NO

a. BY WHOM: Tom Presdorf

b. TYPE OF ACTION

REVIEWER/POSITION/SYMBOL

DATE: 11 May 90

SIGNATURE: [illegible]

AFSC FORM 2722 REPLACES AFWAL FORM [illegible]

PROGRESS: 5-11-90

Installation of the permanent model support is about 90% complete. The model support hydraulic system has been installed. Additional platforms have been built to provide access to the model support and instrumentation systems. The north end of the diffuser has been stiffened. The alignment of the drive system was checked and is within tolerance. A flexible coupling has been built and installed at the gear box end of the main drive shaft. The exhaust deflector is approximately 90% complete. The mechanical parts of the hydraulic test section door actuator have been installed.

PLANS FOR THE NEXT FY ACTIVITY:

The model support will be checked out and begin operation. Calibration of the model support and the facility will be completed. The first scheduled test is a joint effort with the Canadians. Long term goals are to install powered lift and moving ground plane capability in the facility.

Marginal Items.

d. Progress has been marginal because a variety of problems have surfaced which is common during the final stages of a project. Due to complexity the model support has suffered several delays. Presently completion of the the model support is delayed due to problem with the yaw roll head that was not anticipated.

g. Necessary structural engineering work has not been completed. There has been marginal monitoring of the work done and minimal planning of future work because of undermanning. Hopefully as the project nears completion it will require less management time and the problem will be self-correcting.

[TOM.NOTES.REVIEW]tmr.90a

TECHNOLOGY MANAGEMENT REVIEW RECORD

1. ☐ 6.1 ☐ 6.3 ☐ 6.2 ☐ OTHER
2. ☐ IN-HOUSE ☐ EXTRAMURAL
3. CONTRACTOR/CONTRACT NO.

4. WORK UNIT NO. 24041318
5. START DATE 8203
6a. TPO NO.
6b. MAJOR THRUST

7. TITLE SUBSONIC AERODYNAMIC RESEARCH LABORATORY

8. WORK UNIT MONITOR Tom A. Presdorf
9. AFWAL/SYMBOL WL/FIMN

10. PRESENTER COMMENTS

11. LAST TMR DATE May 90
12. DATE OF LAST ADMINISTRATIVE REVIEW *(AF Form 2519 (AFWAL Overprint))*

13. ASSESSMENT AREA/STATUS

E - EXCELLENT S - SATISFACTORY M - MARGINAL U - UNSATISFACTORY N - NOT APPLICABLE *(see reverse side)*

ASSESSMENT AREA	E	S	M	U	N	ASSESSMENT AREA	E	S	M	U	N
a. Technical Performance			X			m. Relevance		X			
b. Funding Analysis			X			n. Key Decisions		X			
c. Cost vs Accomplishment		X				o. System Support		X			
d. Progress vs. Schedule			X			p. System Safety		X			
e. Contracting		X				q. Environmental Protection		X			
f. Records		X				r. Product Assurance			X		
g. Manning			X			s. Life Cycle/Design to Cost		X			
h. Testing		X				t. Contract Security		X			
i. Logistics		X									
j. Meteorology		X									
k. Data Management		X									
l. Technology Transfer		X									

14. REVIEWER COMMENTS

What is FIMK plan to close out this work unit? What will constitute completion? Be ready to address this at the division TMR.

15. FOLLOW UP ACTION REQUIRED ☐ YES ☐ NO

BY WHOM

b. TYPE OF ACTION

REVIEWER/POSITION/SYMBOL
THOMAS M. WEEKS, Chief
Experimental Engineering Branch
WL/FIMN

DATE 91

SIGNATURE

AFSC FORM MAR 85 2722 REPLACES AFWAL FORM 22, AUG 84, WHICH IS OBSOLETE

The following comments pertain to block 13 AFSC form 2722 work unit no. 24041318 SARL.

a. The model support pitch hydraulic system has been a major hurdle in the completion of the model support system. Fluidyne Engineering Corp. (FEC) has been only marginally effective in solving the problems.

b. Funding delays have drawn out the completion time of the project. If FEC had more money available they would have sent a second man on site to correct the model support problems. Delay of funding has cost numerous lost government man hours trying to obtain the needed funding. Much of the documentation has not been received making check out and trouble shooting of the model support very difficult for government personnel and wasting man hours.

d. Progress has been slow because the model support is complex and for the reasons listed in b.

g. Manning will improve as the model support and the overall facility nears completion. But at times there have been to many projects and a shortage of people.

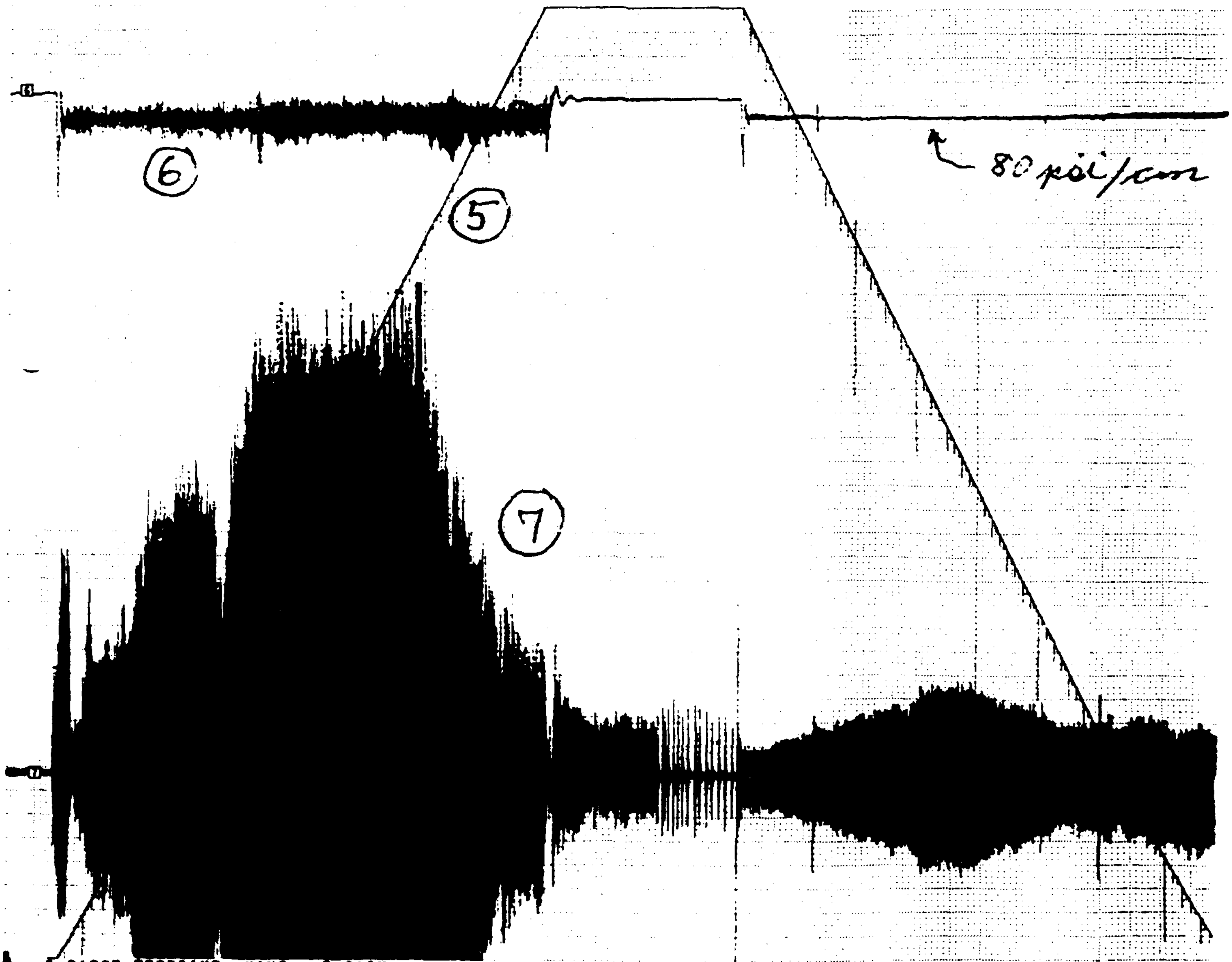
r. The long term reliability of the model support is presently unknown. The the speed control set condition is better understood. The SARL drive motor speed is controlled by the motor generator set located in bldg 24a. The DC exciters that control the motor generator set speed are over 40 years old. Parts of the exciters fail on occasion. To date all failures have been repairable. If a major part fails and cannot be replaced the facility will be down until the DC exciters are replaced. The speed control set will most likely become less and less reliable with age and run time and more likely to have a major failure.

NOTE: The two attached charts show the pitch system vibration before and after modification by Dick Heck and Tom Presdorf. Line 7 shows the dramatic reduction in vibrational amplitude. The two charts use the same scale.

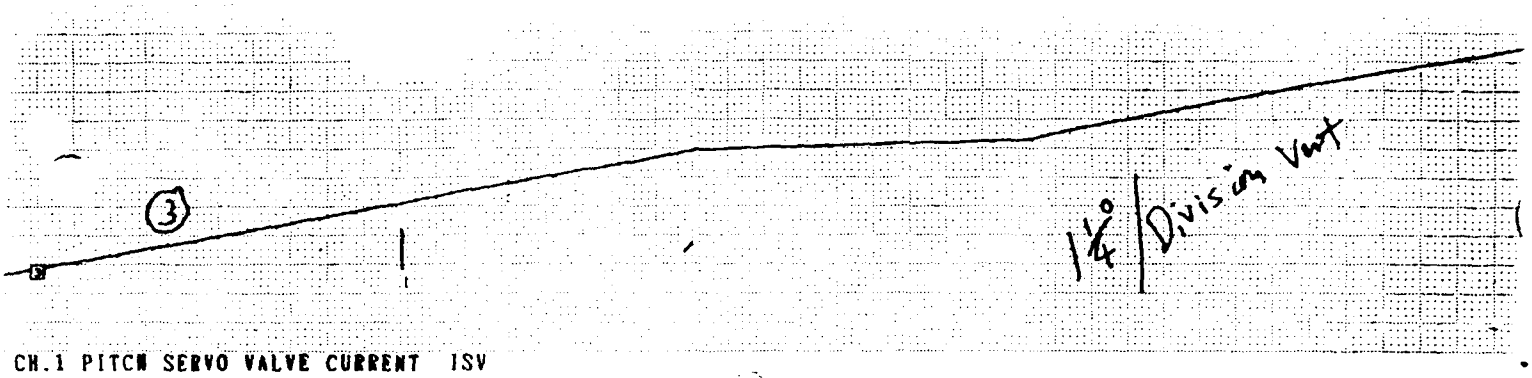
[tom.notes.review]tmr.91

CH.1 PITCH SERVO VALVE CURRENT ISV

CH.3 PITCH POSITION OUTPUT VOUT21

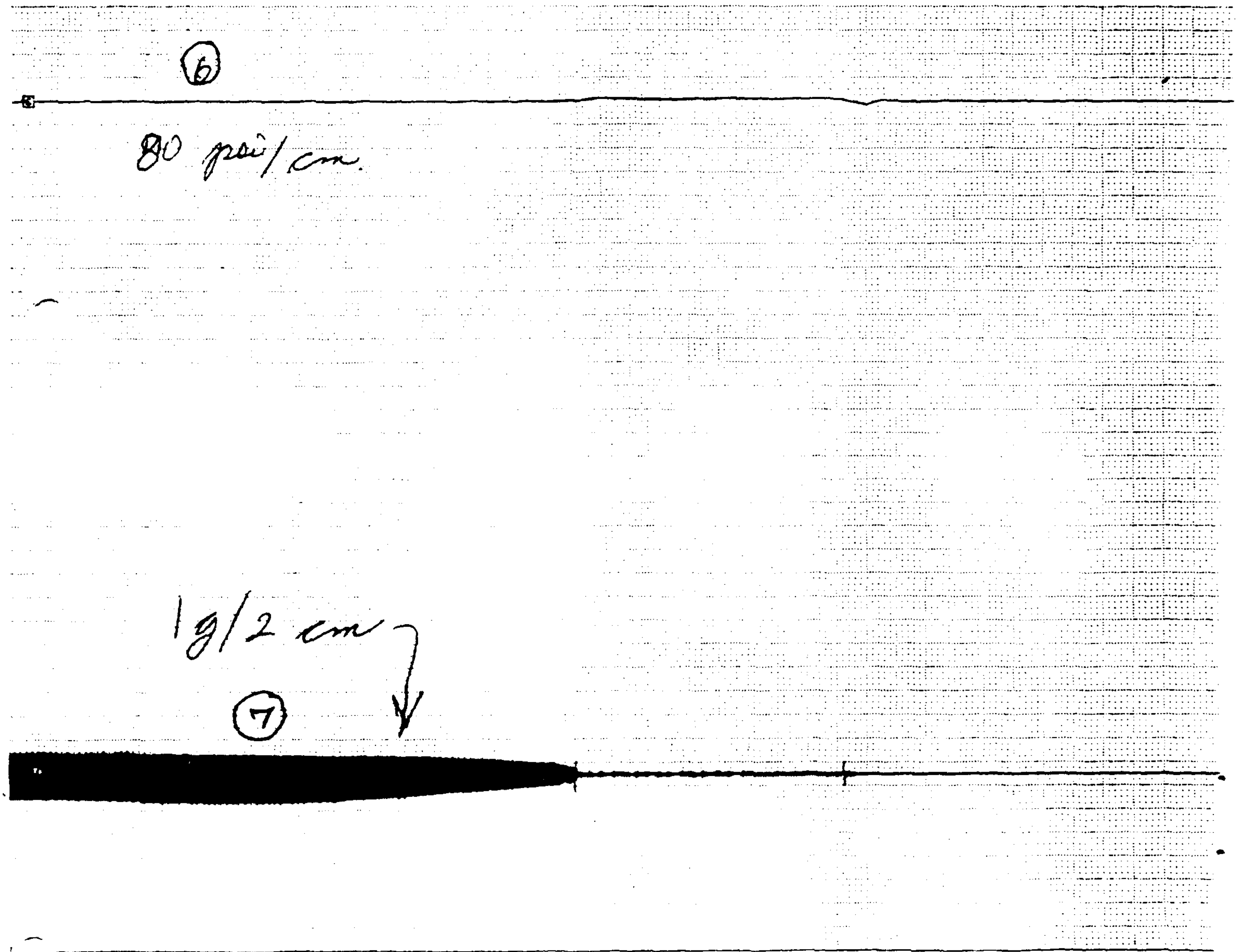


CH.5 PITCH SETPOINT VIN7 .5 GAIN
6 PRESSURE TRANSDUCER
CH.7 ACCELERATION OF PITCH CYLINDER



CH.1 PITCH SERVO VALVE CURRENT ISV

CH.3 PITCH POSITION OUTPUT VOUT21



5 PITCH SETPOINT VIN7 .5 GAIN
CH.6 PRESSURE TRANSDUCER
CH.7 ACCELERATION OF PITCH CYLINDER

1321

Appendix B

Facility Sketches

3-10-92

Sketches of five different parts of the facility have been scanned into HP Paint Brush software. The following is a short description of the sketches. The sketches will provide general information about the Facility and can be imported into some word processing software. Contact FIMN/57244 for access to the floppy disks containing the files.

1. AEROLIN.TIF - The aerodynamic lines of the facility are shown in this sketches including the cross sectional areas of various parts of the facility.

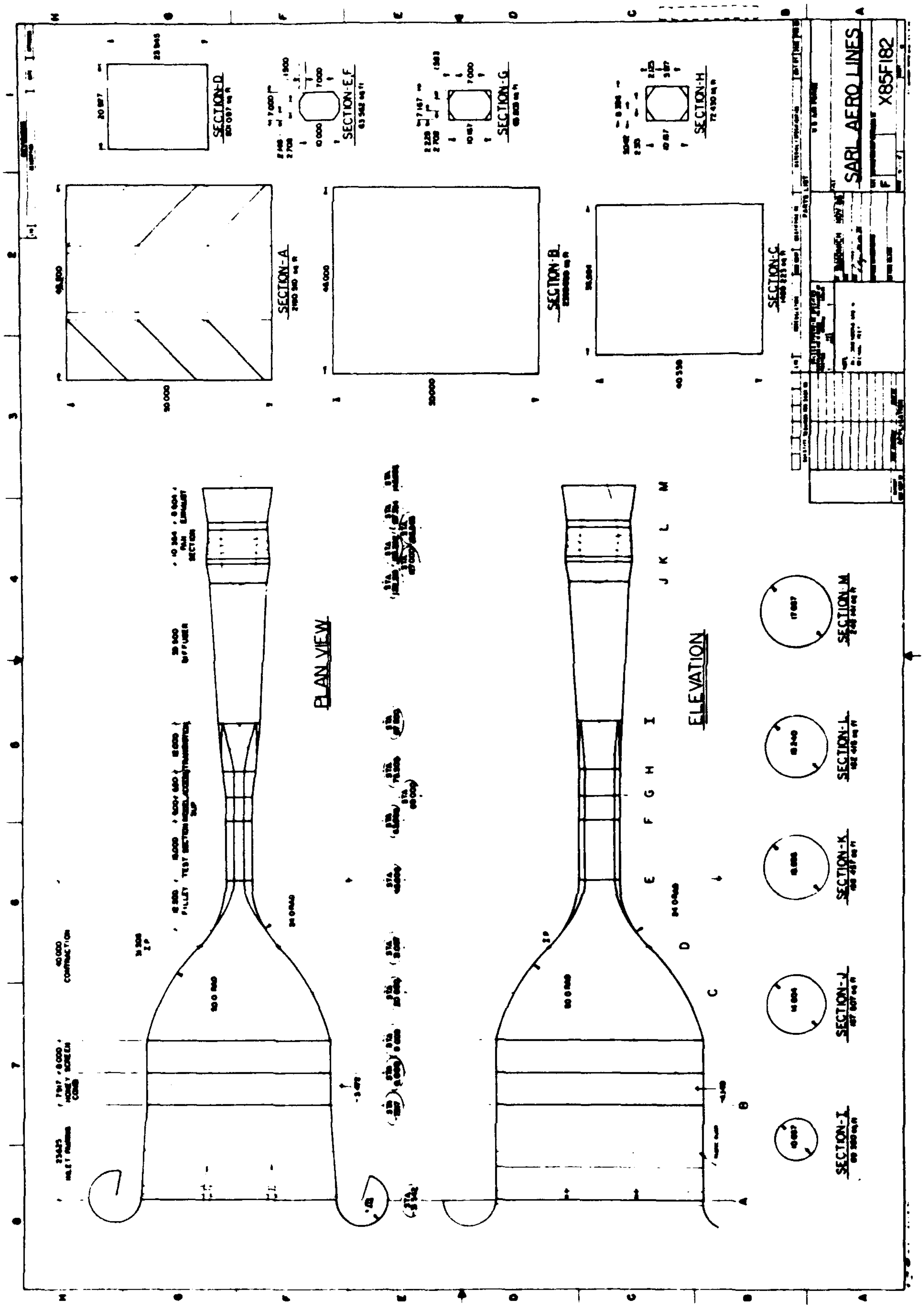
2. FACOVER.TIF - The sketch is an isometric overall of the facility looking from a South West over head position. The drive system support towers and building outline are shown.

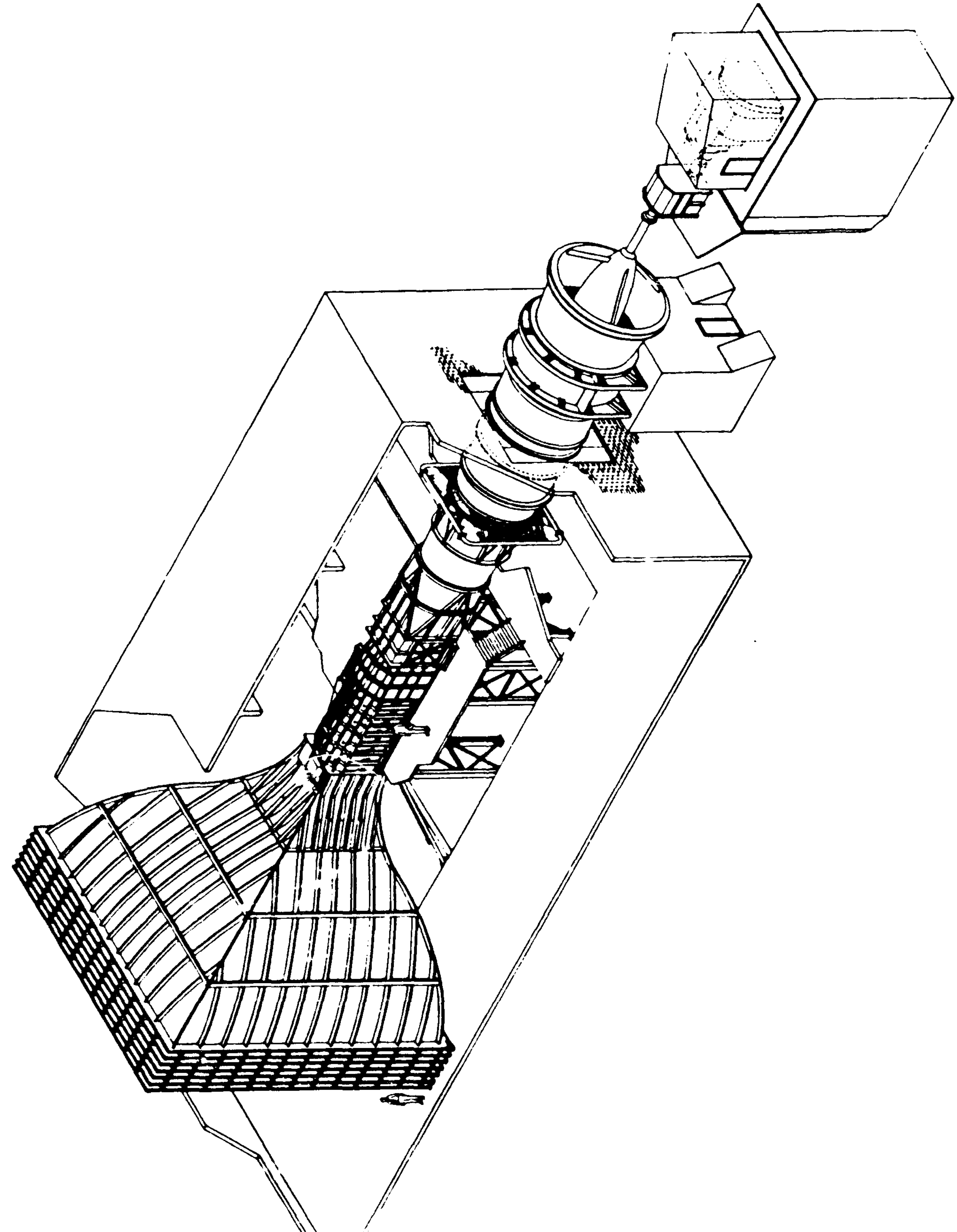
3. MODELS.TIF - The sketch shows the complete model support independent of the facility except for the bottom of the test section flow surface.

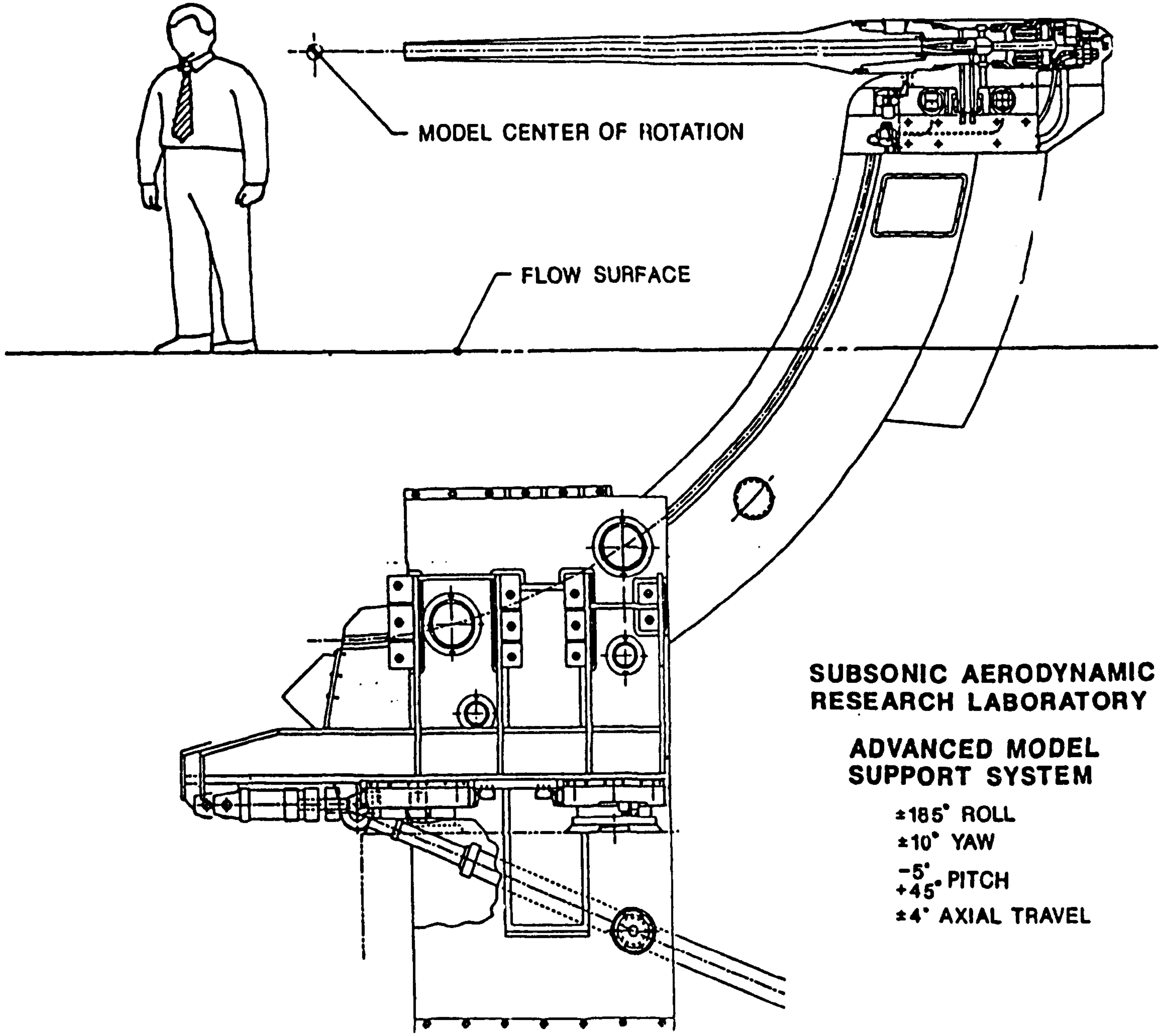
4. TESTCUT.TIF - In the sketch a cut through the test section shows the exact shape of the test section.

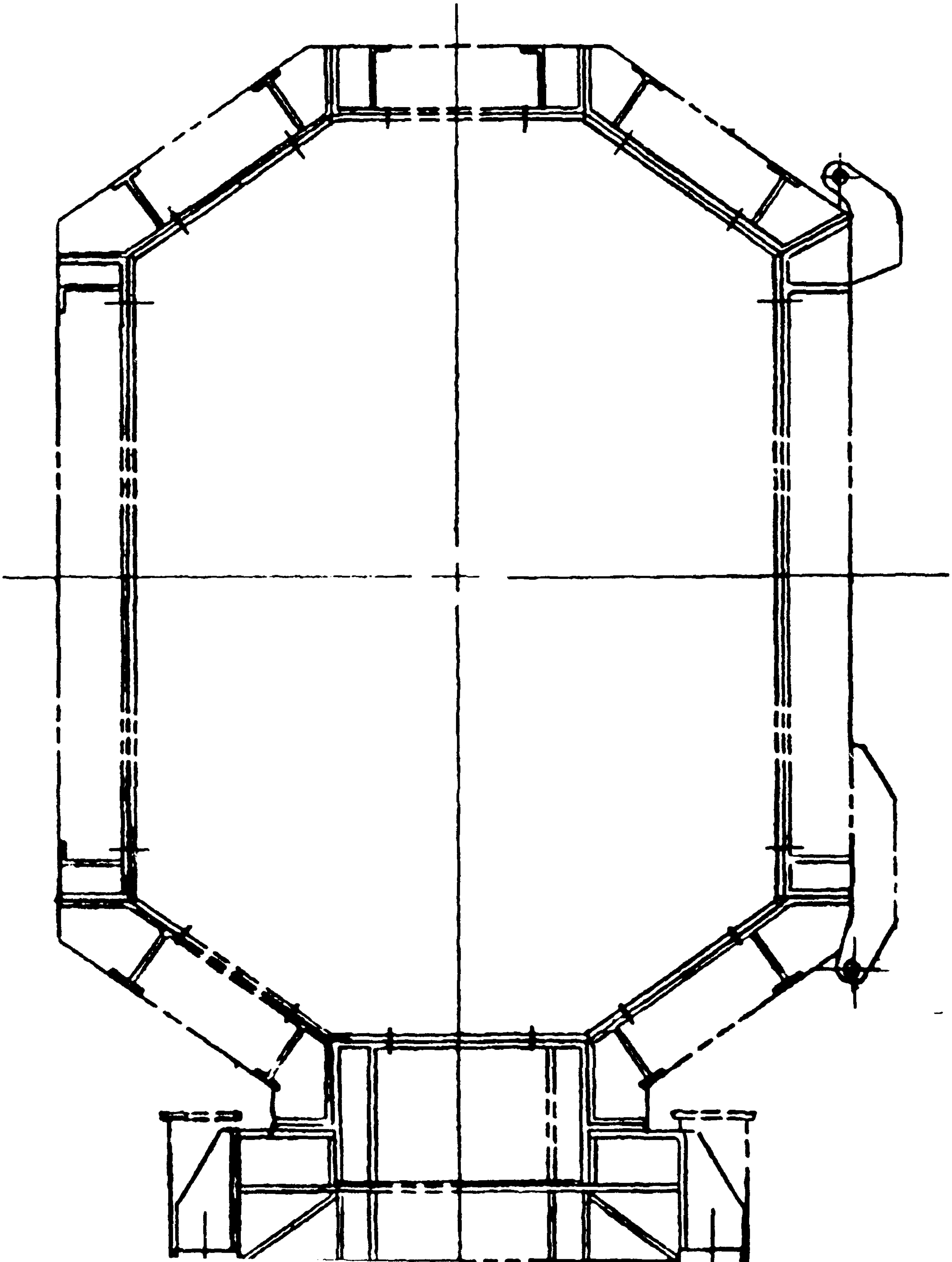
5. TESTSEC.tif - The sketch shows part of the facility from slightly North of the test section to slightly south of the access section.

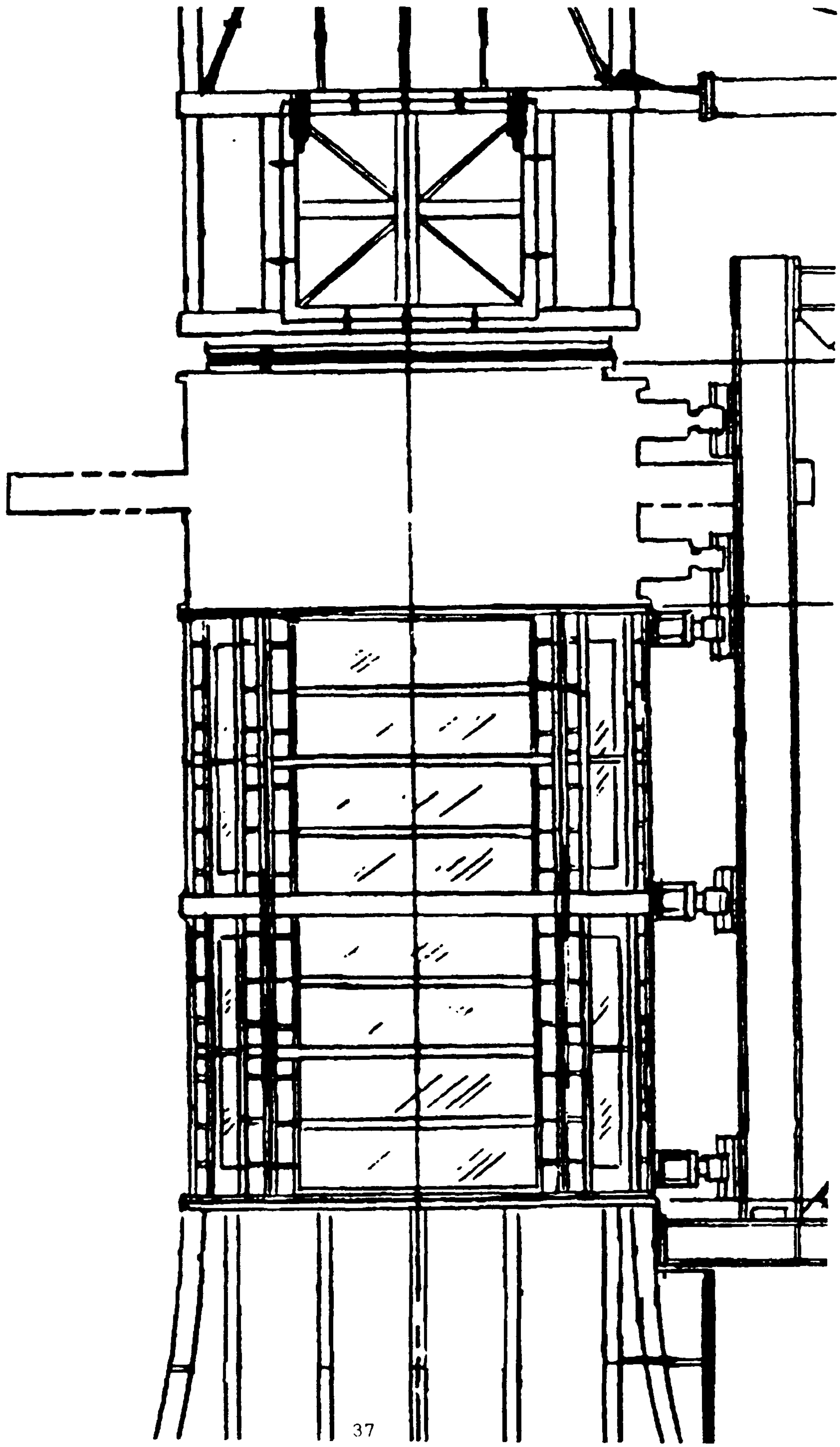
[TOM.NOTES.COMPUTER]SARL.SCAN


SARL AERO LINES
X85F182
SECTION-A
SECTION-B
SECTION-C
SECTION-D
SECTION-E,F
SECTION-G
SECTION-H
PLAN VIEW
ELEVATION
SECTION-I
SECTION-J
SECTION-K
SECTION-L
SECTION-M




MODEL CENTER OF ROTATION
FLOW SURFACE
SUBSONIC AERODYNAMIC RESEARCH LABORATORY
ADVANCED MODEL SUPPORT SYSTEM
±185° ROLL
±10° YAW
−5° +45° PITCH
±4" AXIAL TRAVEL





Appendix C

SARL Contracts

SARL CONTRACTS

SARL[CSARL]Contr.lst   Updated 3-19-92

No	DATE	CONTRACTOR	CONTRACT No. AND MOD.	COST	DESCRIPTION	S & T Folder	Project Engineer
1	Sep79	Univ.of Notre Dame	F33615-79-C-3034	69,486.	Smoke Tunnel Criteria (Info retired-res rpts avail)	None	Wells
2	Feb81	Univ.of Notre Dame	F33615-81-K-3008	54,615.	Contraction Study (Info retired-res rpts avail)	None	Wells
3	Aug81	FluiDyne Engr.	F33615-81-C-3014	192,800.	Smoke Tunnel Design (Info retired-res rpts avail)	None	Wells
4	May82	Univ. of Dayton	Task Order 82-13	8,000.00	Inlet shape studies (Huber)	1	Wells
5	May82	Beta Industries	PWI-82-N-001	22,305.80	Remove/ship NASA LaRC fan estab dwg list & SOW	2/2A	Wells
6	Oct82	Beta Industries	PWI-82-N-004	147,278.39	Remove/ship NASA LaRC fan LARC fan removal and shipment (22,372. unaccounted),(S&T in folder for PWI-82-N-001)	2/2A	Wells
7	Oct82	Beta Ind. (Huber)	PWI-82-N-009	70,188.22	Inlet analysis (Huber)	3/3A	Wells
8	Jan83	Bowser-Morner	F33601-83-F-0006 WP 1012-2	1,730.00	Soil tests	4	Simpson/ Wells
9	Mar83	Beta Industries	PWI 83-N-014	1,892.	Move LWTComponents For SARL (S&T file not reqd)	None	Wells
10	Jun83	Orbit Movers & Erect.	F33601-83-C0151	57,400.00	10 ft WT fan section removal	5	Wells
11	Jun83	Beta/FluiDyne Beta/FluiDyne	PWI 83-N-019 PWI 83-N-019,Mod 1	64,202.90 3,226.10	Test section redesign Mod 1 to test section redesign (reloc window mtng screws) (S&T in basic folder)	6/6A	Cain
12	Jun83	Beta Industries	PWI 83-N-011	0.00	Louver Design Not used-listed for completeness	7	Wells
13	Aug83	Philadelphia Gear	F33601-83-C0175	150,390.00	Speed increaser	8/8A	Webb/Cain
14	Sep83	Butt & Head	F33601-83-C-0261	856,600.00	Contraction Section, B25C	9	Wells

15	Sep83	Beta Ind.(Huber)	PWI-82-009A	18,191.	Smoke studies (Huber)	3A	Webb/Pitt
16	Oct83	Industrial Cont.	F33601-84-C0003	315,969.	Fan tower, downstream tube comp Construct/install fan tower, transition section, diffuser, fan section	10/10A	Wells
17	Dec83	Beta Ind./FluiDyne	PWI 84-N-026	33,123.40	Structural Analysis, con set dwgs Re-eval of upstream components, provide consistent set of dwgs (Basic=15,865.20 Mod=17,258.20)	11/11A	Webb
18	Jan84	Industrial Maint Serv	F33601-84-C0055	7,250.	Remove 10 Ft WT corner support (S&T file not reqd)	12	Wells
19	Mar84	Beta/Huber	PRS-PWI-84-N-031	26,085.40	Protype SARL Smoke Injector (can't find contr.)(Basic,Mar84=23,385.40: Mod,Sep84=2,700.00)	13	Webb/Pitt
19A				33,000.00	GFE cable tray, wiring labor, outside		Koon/Cain
19B				3,317.00	GFE cable tray, wiring labor, inside		Koon/Cain
20	Mar84	Fred B. DeBra Co.	AF 332	4710.	Closing the B25C-East wall opening	None	Wells
21	Mar84	Beta Ind./FluiDyne	PWI 84-N-030	153,140.05	LV Rings Positioning System	14/14A-B	Cain
22	May84	Beta/Sverdrup	PWI-84-N-028	71,109.	Drive train/motor cover Spec, dwgs for dr. trn. assy, motor cover	15/15A-C	Wells
23	Jun84	Ind. Contractors	F33601-84-C0003, Amend 4	438.	20Ft WT support removal	10B	Wells
24	Sep84	Butt & Head	F33601-84-C-0315	1,242,328.	Motor tower, Test section Construct/install motor tower, test section, model support section, fan lift platform and drive train mechanical, power cable tray and 20K HP power cables, fan lube system, motor & gearbox lube sys. (outside B25D), motor cover, 50K CFM blower and duct	16/16A-b	Cain/Well
25	Sep84	Butt & Head	F33601-83-C0261, Chg.1	55,245.67	Mod. Upstream Contraction	9A	Wells
26	Oct84	4950/AMF	2404 NC 02	18,913.02	Filter Housing Fabrication	17	Martsolf
27	Dec84	UES/Huber	UES-Task Proposal-85-2 of Cont.F33615-83-C-3000	25,981.00	Development of SARL Smoke System (can't find contract)($20,436.00 in 85 and $55445.00 in 86)	18	Webb/Pitts
28	May85	Beta/ESI	PWI 85-N-041	12,865.78	Inflatable fairings design	19/19A	Cain

29	Jul85	Butt Contruction	PR-F33601-84-C-0315, Amend 1	142,513.00	Modify contract requirements for GB/motor lube sys., construct/install instrument platforms, intercom and instrument cable trays, auxiliary drive cover.	16C	Cain/Wells
30	Jul85	Butt Consruction	PR-F33601-84-C0315, Amend 2	4,495.00	Remove 16 in. pipe, remove tray support in loft, remove part of south 10 ft WT corner support	16C	Cain/Wells
31	Jul85	Butt Construction	PR-F33601-84-C0315, Amend 3	510.00	Relocate tray support, locate new support in loft	16C	Cain/Wells
32	Jul85	Butt Construction	PR-F33601-84-C0315, Amend 4	3,045.00	Furnish fan lube system temperature controller, construct 4 additional cable tray supports	16C	Cain/Wells
33	Jul85	Butt Construction	PR-F33601-84-C0315, Amend 5	10,000.00	Repair GFE, additional work on fan assembly due to errors in govt dwgs	16D	Cain/Wells
34	Jul85	Butt Construction	PR-F33601-84-C0315, Amend 6	47,121.00	Air condition control room, insulate GB/motor lube lines	16D	Cain/Wells
35	JUL85	TSSI	(support contract)	114,643.21	Purchase requests for pressure system hardware	20	Heck/ Wagner
36	Nov85	Beta Ind	PWI 85-N-004	135,874.00	Roll-up entry door	21/21A-B	Cain
36a	Sep86	Beta Ind	PWI-85-N-004,Mod 1	38,240.00	Roll-up entry door	D 45	Cain
36b	Mar87	Beta Ind	PWI 85-N-004,Mod 2	5,291.00	Roll-up entry door	D 45	Cain
36c	May87	Beta Ind	PWI 85-N-004,Mod 2	1,270.88	Roll-up entry door	D 45	Cain
36d	Jan 88	Beta Ind	PWI 88-N-037	1,270.88	Roll-up entry door	D 45	Cain
37	Nov85	Beta Ind Beta Ind	PWI 85-N-005 PWI 85-N-005,Mod 1	179,547.52 6,818.38	Window Panes/Frames (Pitts has S&T) Mod to provide window handling	22 22	Webb/Pitt Pitts
38	Nov85	Industrial Contr.	PR-F33601-84-C-0003, Chg 1	2708.40	Modify fan section hatch cover	10B	Wells
39	Nov85	Butt Construction	PR-F33601-83-C-0261, Chg 2	6,085.00	Install pres. taps)	9A	Wells
40	Dec85	Beta Industries	PWI 85-N-010	40,028.50	Fab/install model catcher/hatch	2340	Presdorf
41	Dec85	Butt Construction	PR-F33601-84-C-0315, chg 7	26,897.70	Crane access, clean parts, pipe support, strainers, remove curb @ model lift platform, drive shaft	16E	Cain/Well

removal

42	Jan86	Butt Construction	F33601-86-B-0075	395,000.00	Construction of inlet flow comp SARL	D62	Presdorf
43	Apr86	Beta Industries	PWI-86-N-008 PWI-86-N-008A1	56,172.78 34,429.76	SARL Fan section Instr Assy & Inst Fan	D41	Wagner
44	Jan86	Beta Industries	PWI-86-N-009	8,450.57 6,830.64	Access Floor-TS, Case II Access Floor-TS, Case III	25 25	Rutkowski Rutkowski
45	Mar86	Beta Industries	PWI-86-N-014 (dropped)	1,892.00	Mobile Platform	26	Wells
46	Sep86	Butt Construction	F33601-86-c0302	596,962.00	Inlet Flow Treatment:Honeycomb, bldg. face beam mods, south sheet metal fairings.	27	Presdorf
46a	Aug86	Butt Construction	PR FDAFFD6028M001-1	201,962.00	Inlet flow treatment mod	D 44	Presdorf
47	Jul86	Beta Ind	PWI-86-N-022	4,811.28	Install Stator Colars	D 64	Presdorf
48	Nov86	Butt Const	PR FDAFF0635 6M001	428,000.00	High-loss screen section, north sheetmetal fairings	D 50	Presdorf
49	Dec87	Beta	PWI-86-N-022al	5,016.58	Revto #46 remove upstream stator blades, take measurements, install safty net	D 64	Presdorf
50	Mar87	Beta	PWI-86-N-022-2	8,396.70	Rev to # 46 remove upstream fan blades	D 64	Presdorf
51	Jul87	Beta	PWI-87-N-028	20,346.56	Remove downstream blad box pins and install inlet guide vanes	D 48	Cain/Pres
52	Jul87	Butt Construction	F33601-86-C0302-2	4,026.00	Rev to # 45 install perimeter rivets and fair with sealant	D 44	Presdorf
53	Aug87	Beta	PWI-87-N-032 PWI-87-N-033		Not Used Install fabric close out around SARL screen section		Presdorf
54	Nov87	Butt Construction	F33601-87-C0200	- 150,000.00	Delete sheet metal fairing	D 62	Presdorf
55	Jan88	Beta	PWI-87-N-037	10,467.56	Remove existing roll up door	D 44	Presdorf
56	Feb88	Beta	PWI-88-N-040	58,816.78	Install N. sheet metal close out	D 53	Presdorf
57	Mar88	Beta	PWI-88-N-033	1,905.76	Rev to # 51 install additional anchors	D 44	Presdorf
58	Aug88	Beta/A&A Steel	PWI-88-N-043	26,245.66	Fabricate & install ladder & railings		Presdorf
59	Nov88	Ind Millright Serv	PR FDAFFD8105M001	16,209.00	Construct gearbox cover	D 61	Presdorf

60	Jan89	Microcraft	PWI-N-89-009	11,039.86	Design hydraulic test section door actuator	D 54	Presdorf
61	Jan89	Micro Craft/Sverdrup	PWI-N-89-008	13,418.90	Modal analysis of drive system	D 67	Presdorf
62	Apr89	Micro Craft/Sverdrup	PWI-N-89-008 Addition of #54	7,348.24	Rotational modal analysis of drive system	D	Presdorf
63	Jun89	Micro Craft	PWI-N-89*009 Addition of #53	12,333.69	Construct hydraulic door actuator	D 54	Presdorf
64	Jun89	Micro Caraft	PWI M-89-016	58,638.16	Design exhaust deflector	D 73	Tighe
64a	Sep89	Micro Craft	PWI M-89-016-1	30,000,00	Design exhaust deflector	D 73	Tighe
64b	Oct89	Micro Craft	PWI M-89-016-2	30,000,00	Fabrication of exhaust deflector	D 73	Tighe
64a	Nov89	Micro Craft	PWI M-89-016-3	6,583.13	Fabrication ofexhaust deflector	D 73	Tighe
64a	Jan89	Micro Craft	PWI M-89-016-4	3,910,20	Fabrication of exhaust deflector	D 73	Tighe
65	Oct89	TSSI	PO 178-46-421	25,241.00	Hydraulic power for model support	D 66a	Presdorf
66	Jan90	TSSI	PWI 69006-094	4,601.00	Cleaning of model supp hydr piping	D 66a	Presdorf
67	Feb09	TSSI	PWI 69006-090	3,200.00	Balance drive fan	D 88	Presdorf
68	Aug91	TSSI	PWI 69006	3,744.00	Purchass fans for bldg cooling	E 17	Presdorf
69	91	TSSI	PO 178-76	22,825.02	Dynamic analysis of model supp	D 85	Heck
70	Jul91	TSSI	PO 178-86-238	2,487.00	Polish 20,000 hp motor shaft	D 81	Presdorf
71	Oct91	Micro Craft	PWI N-92-061	15,000.00	Design high pressure air system	D 86	Presdorf
72	Jan92	Micro Craft	PWI N-92-061 a	271,125.00	Complete design hi press air system	D86 D	Predorf

Total SARL contracts = $6,744,777.03

Appendix D

SARL Proposal

The Subsonic Aerodynamic Research Laboratory (SARL)
A New 10 X 7 Foot Low-Turbulence Facility
For Flow Visualization

Wiley C. Wells

John C. Beachler

Air Force Wright Aeronautical Laboratories

Wright-Patterson Air Force Base, Ohio

Introduction:

Flow visualization has historically played a key role in the understanding of fluid flow phenomena. Smoke-tunnels, water tables and water tunnels have all helped experimentalists to understand their measurements and analysts to formulate mathematical models from the earliest days of fluid dynamics research (Figure 1). In many cases complex mechanisms such as flow separation, flow field interactions, boundary layer transition and vorticity can still only be physically understood with the aid of experimental flow visualization techniques (Figure 2). Such physical understanding is a necessary prerequisite for mathematical modeling.

Traditionally, aerodynamic flow visualization test facilities have been limited in scale to "laboratory size" (i.e., less than 2 Ft diameter) test flows, due to the technical difficulties and attendant costs of producing the low-turbulence flow and flow visualization techniques (Such as well defined "smoke" streamlines and associated photo recording arts) which are required for success. This has resulted in subscale tests with poor geometrical representation of complex models and physical fluid mechanical structure where size greatly hampers both observation and quantitative measurements. This results in a self-defeating situation, since the complex flow problems of most interest (i.e. separation, interference, vorticity, etc.) are often viscous time-dependent phenomena which require sufficient size for good model geometry and flow field definition for meaningful study.

This lack of sufficient scale for detailed fluid mechanics investigations in flow visualization facilities is particularly frustrating with the recent developments in computer speed and storage capacity which permit solution of the three-dimensional Navier-Stokes equations for fairly complex viscous time-dependent flows. Particularly useful computational aerodynamic methods have been developed in both the subsonic and supersonic flow regimes which portend the capability for many very important future applications if experimental verification and better flow modeling aids become available (Figure 3).

The Subsonic Aerodynamic Research Laboratory (SARL), currently being developed at Wright Patterson AFB by the Flight Dynamics Laboratory is an effort to contribute to this need by extending existing small scale technologies to a facility of sufficient size and flow quality for meaningful simulation, detailed quantification and flow visualization in the subsonic flow regime.

Facility Program:

Several major factors have combined to make the SARL development both urgent and practical at this time.

The developing computational aerodynamics capability in the subsonic regime is currently constrained by lack of good experimental tools for correlation and flow field modeling validation. Although Schlieren photography and interferometry are very helpful in defining supersonic flows (Figure 4), existing hot wire anemometry, laser velocimetry and conventional pressure data are very difficult to translate into good descriptions for analytical models of complex subsonic flow fields.

In addition to these computational requirements, many new high performance aircraft concepts incorporate close-coupled conventional or canarded control surfaces, vortex leading-edge flaps, propulsive maneuvering and STOL capability (Figures 5 and 6). These designs involve complex interactive flow fields, high angle of attack flow separation, vortex-flow field interactions, jet-flow field interactions and ground effects which can only be understood through extensive ground testing with good flow visualization. Since most of these studies again involve viscous time-dependent phenomena, good geometrical representation and flow visualization which produce measurable structure in high quality test flows is required for useful technology development.

In response to this need, a recent research study sponsored by Flight Dynamics Laboratory at The University of Notre Dame[1] has successfully demonstrated technology for good smoke flow visualization at Mach numbers up to 1.4. This effort included development of high-contraction-ratio inlet contours and flow conditioning devices (i.e., honeycomb and screens) which produced axial turbulence intensities of about .1% entering the test section. This permitted good smoke stream flow visualization from low subsonic speeds to M=1.2 in a 5-inch-square test section induction wind tunnel (Figure 7). Although these Notre Dame studies were subscale, the excellent high speed results achieved by holding turbulence levels to a minimum indicated that good smoke-stream flow could be maintained over the long distances required for a large scale facility at subsonic speeds if similarly low turbulence levels were maintained.

The high cost of developing a useful size facility led to consideration of modifying and using as much existing equipment as possible. Several motors used in previous facilities at Wright-Patterson were examined and it was decided that an existing 20,000 H.P.motor and Modified Kramer speed control system could be coupled to a surplus fan from the decommissioned Langley 8 Ft Atmospheric Wind Tunnel to drive an induction type tunnel with a 35:1 inlet contraction ratio and 7x10 Ft test section at speeds up to M=.6.

Thus, the SARL was born and designed around the use of existing surplus or decommissioned equipment to meet the aerodynamicist's need for a subsonic flow visualization facility in a scale and speed sufficient for meaningful studies (Figure 8).

SARL Design:

Since the SARL is intended for flow visualization testing, the test section viewing area was to be maximized. It was decided that as many windows as possible should be installed in the walls and test section corners for maximum flow visualization. Then a contract for the detail design of the basic tunnel components was awarded to FluiDyne Engineering Corporation of Minneapolis, Minnesota.

The test section size was picked because many models exist for this size tunnel and because there are several tunnels of this size. This commonality makes data and model exchange more direct and therefore improves its value. Unlike most 7x10 tunnels, which are wider than they are high, the SARL is higher than it is wide. This was done because considerable STOL and high angle of attack-low aspect ratio configuration testing is anticipated.

The in-draft configuration was chosen to make the introduction of smoke lines easier, to eliminate the return leg with its losses, turbulence generation and extra cost, and to permit the use of a large contraction. The large contraction ratio was chosen to reduce turbulence. A larger ratio was desired, but was considered impractical from both location and construction considerations.

Inlet

The University of Notre Dame has been active in smoke facilities for flow visualization for many years. The FDL, to take advantage of that knowledge, sponsored an effort to develop criteria for inlets of high contraction. Their investigation showed that inlet sections designed based on matched cubic contours would give adquate flow characteristics to sustain smoke streams.(1) Fluidyne used this approach in the design effort. We later hired a consultant, Franz J. A. Huber, who recommended a matched circular-arc contour. For a subsonic tunnel, he believes the circular-arc contour has several advantages compared to the cubic. The most significant is that it can be made much shorter, 45 feet compared to 57. It has a smaller volume and therefore the smoke filaments have a shorter residence time. The curvature approaching the test section is more gentle (Figure 9).

Since the flow will enter the contraction through a multiple screen package, the screen outlet velocity is expected to be essentially uniform with no boundary layer at the wall. Huber therefore recommended an initial wall slope of about 16 degrees to achieve an immediate flow area reduction and a more gentle curvature in the concave portion without a long duct length.

An inlet height of 50 feet is the largest that can be fitted into the building selected for the site. For ease of construction, the inlet has a rectangular cross-section with corner fillets added to the inside of the inlet near the test section. The inlet width is the maximum possible while still remaining symmetrical about the tunnel vertical centerline. The width is 46 feet, giving an area ratio of 36.2 to 1.

The design specifications required an evaluation of steel, wood and fiberglass as materials for the inlet. Because of the tight tolerances needed at the downstream end and the fabrication costs, steel was selected.

It was recognized from the start that screens would be needed to reduce turbulence. Reference 1 indicates that eleven screens would be best for the high speed application. After much discussion and review of available material, the honeycomb, screen mesh and construction methods used in the Langley 8 Ft Transonic Pressure Tunnel (Rererences 3 and 4) were chosen for the SARL. The design would accommodate eleven screens but only six would be built and installed initially. For aerodynamic and structural reasons, a 30-mesh screen of 0.0065 inch wire was chosen. The honeycomb section was included in the design but will not be built unless a need is demonstrated during calibration of the tunnel.

The final inlet design therefore has a 46x50 foot intake with six screens leading to a contraction section with a matched, circular-arc contour with corner fillets in the downstream end.

Test Section

As stated earlier the test section was to have the maximum possible viewing area. In addition, it was desired that all the windows be of one size. As designed there are 28 windows, each 18 inches wide by 72 inches high. These windows comprise 56 percent of the test section surface area. One side of the test section will be removeable to permit easy access. The cross section is 10Ft high by 7Ft wide with windowed corners perpendicular to a corner-plane through the tunnel centerline to minimize wall interference for high angle-of-attack testing and to maximize flow visualization. The test section is 15 Ft long, giving an L/D of 1.5 times its height.

Model Support Section

The Model Support Section was designed in-house. This section was not included in the design contract because model support criteria had not been established. It had been decided to design a very simple support initially and then design and build an advanced model support later. For their design of the model support section-diffuser interface, FluiDyne was told to allow 6 feet between the test section and the diffuser and to consider the model support section as having the same internal cross-section as the test section. An isolation joint was included between the model support section and the diffuser. This joint is to prevent transmission of wall-borne vibrations from the diffuser. FluiDyne designed a junction that would permit the model support section to slip a few inches inside the diffuser to permit clearance for removing the test section. This meant there was an internal, downstream-facing step. This step was considered aerodynamically undesirable, so when the model support section was designed, the walls were made to diverge slightly so the downstream end matches the diffuser inlet. There is a 2 inch gap between the model support section and the diffuser. On the inside the gap is covered with flush-mounted sheet metal fastened only to the model support section. On the outside the gap is spanned by an elastomeric, pressure-carrying seal.

The temporary model support will be fabricated of steel channel welded to the inside of the model support section. It will have a manually-set pitch capability from - 7.50 to + 22.5°. It is designed to support a 250 pound model. Design loads are 3000 pounds normal, 1000 pounds axial, and 1000 pounds side force. Wood fairing will be used to achieve an aerodynamically smooth shape. The strut will also support calibration probes at eleven equally spaced vertical positions spanning the height of the test section.

Diffuser

The diffuser has three sections: the access, transition, and expansion cone. The access section has an octagonal cross-section with the top and bottom parallel but with the sides diverging. It is built as a rectangle with the corner fillets added. The corner fillets are 0.125 inch sheet metal backed with plastic foam. The access section has a 6 foot high by 5 foot wide door in the flat portion on each side. These doors provide the direct access to the model support and test sections. In the transition section the shape is changed from rectangular to round and the corner fillets taper out. The cone initially expands with a gentle 3.25 degree half-angle to prevent flow separation. The last 4.5 feet of the cone has a half-angle of 8.82 degrees. The upstream end of the fan nacelle protrudes into this expanded cone to a point 5.5 Ft upstream of the diffuser exit.

Drive

At NASA Langley Research Center a fan was found in a wind tunnel that was last used in 1952. From the size and operating envelope of the Langley Tunnel, the size of the fan, and power of the drive motor, it was determined that the fan would be suitable for the SARL. At Langley the fan was driven from the upstream end while in the SARL the motor is downstream. The fan has 36 blades in two rows of 18 blades each. The two rotors are keyed to a common shaft. It was found that these symmetrical rotors could be reversed on the shaft and that the formerly downstream bearing and retainer will support the reversed loads. The fan can, therefore, be driven from the downstream end.

A new housing was designed. The design of the nacelle and its supporting struts has been modified for the SARL installation. The support rods between the shaft bearing housings and the fan shell are in the stator blades. There are 17 each pre-rotation and straightening stator blades. An exhaust diffuser section with an 8 degree half angle extends 10 feet downstream from the straightening stators.

The fan rotor blades are made of fiberglass-reinforced epoxy. Each blade is fastened with a single pin into a blade box. The blade boxes are fastened to the rotors with three pins each. Except for the pins the blades are isolated from the boxes by an elastomeric pad, so the blade mount responds as a pure pin joint.

The fan drive shaft used at Langley will be used in the SARL. To keep the back pressure and turbulence at a minimum, it was decided that no intermediate shaft bearing would be used. The shaft is therefore unsupported between the fan and the speed increaser.

The speed increaser is mounted on the motor base. From the end of the exhaust section to the face of the motor base is one exit diameter, 212 inches. The maximum exit velocity will be about 90 miles per hour. To reduce the exhaust blockage, the face of the motor base is narrow and rounded. From the nose the base gradually widens to the width required for the motor. To help keep the nose narrow and to lower the motor base height, the 2:1 speed increaser will have the output shaft above the input shaft.

The motor is a 20,000 horsepower unit that was available in the Flight Dynamics Laboratory. An existing Modified Kramer speed-control will be used to vary the motor speed from zero to its maximum 465 RPM. A shelter will be built over the motor which will be outside. The shelter will be as low and as narrow as it can be without interferring with the motor operation.

Summary:

The requirement for continued development of computational aerodynamic methods as well as fluid mechanic and configuration technologies in the subsonic regime has placed great emphasis on the ability to visualize complex aerodynamic flows. Although Schlieren and Interferometry are available for defining the compressible flow regime above M=.85, only a few small scale wind tunnels can produce good flow visualization in the subsonic incompressible speed range where many of the problems of interest occur.

The Subsonic Aerodynamic Research Laboratory (SARL) is being developed by AFWAL/Flight Dynamics Laboratory to provide a flow visualization capability of sufficient size and flow quality for meaningful studies in the M=0 to 0.6 range. The SARL is a high inlet-contraction-ratio induction type facility. Incorporating an All glass" (56%)

test section, ground plane and both auxiliary suction and blowing capability to obtain maximum visualization and flexibility for aerodynamic and propulsion integration technology research. Continued research in "Smoke" stream, laser anemometer/interferometer and holographic technology will be an integral part of the Laboratory activity.

The SARL's 7x10Ft high quality M=.6 test flow will represent a unique step forward in bringing urgently needed flow visualization capability from the very small scale to a size and speed suitable for realistic development of fluid mechanics technology and applied research studies.

REFERENCES:

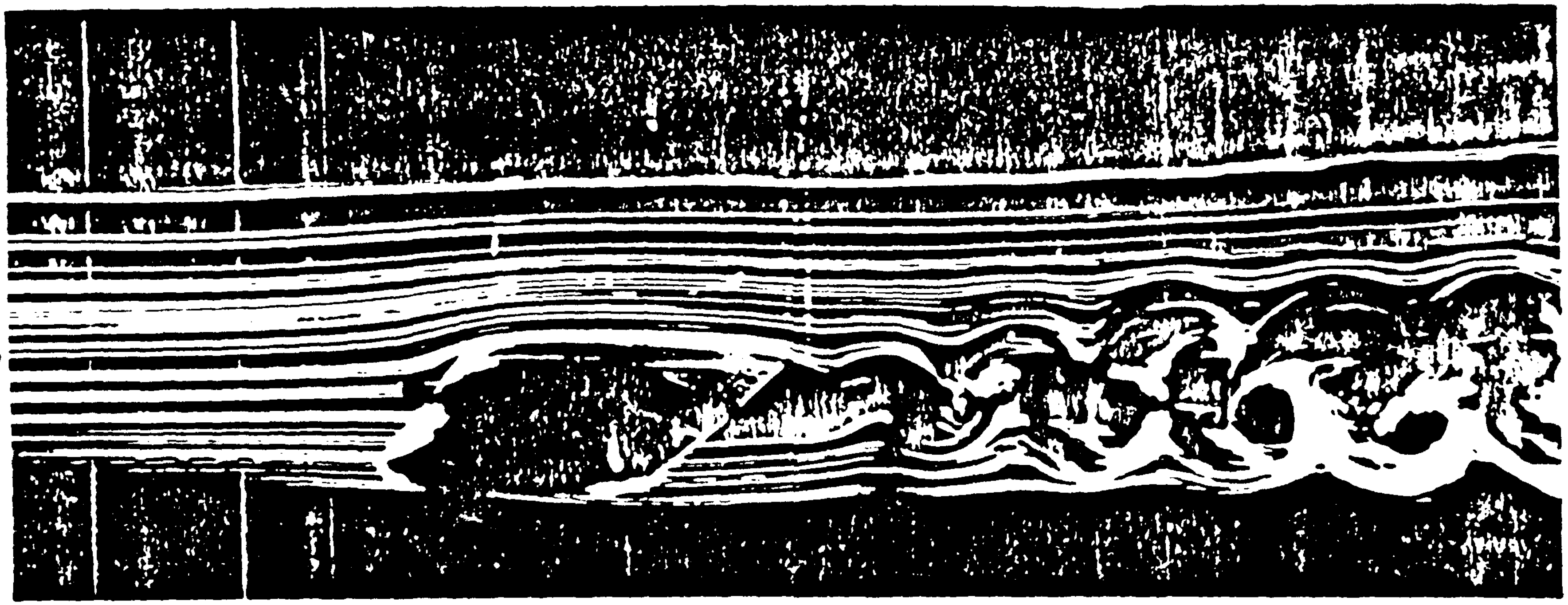
1. Batill, S.M., Nelson, R.C. and Mueller, T..J., "High Speed Smoke Flow Visualization," AFWAL-TR-81-3002, 1981.

2. Morel, T., "Comprehensive Design of Axisymmetric Wind Tunnel Contractions," Journal of Fluids Engineering, ASME Transactions, pp.225-233, June 1975.

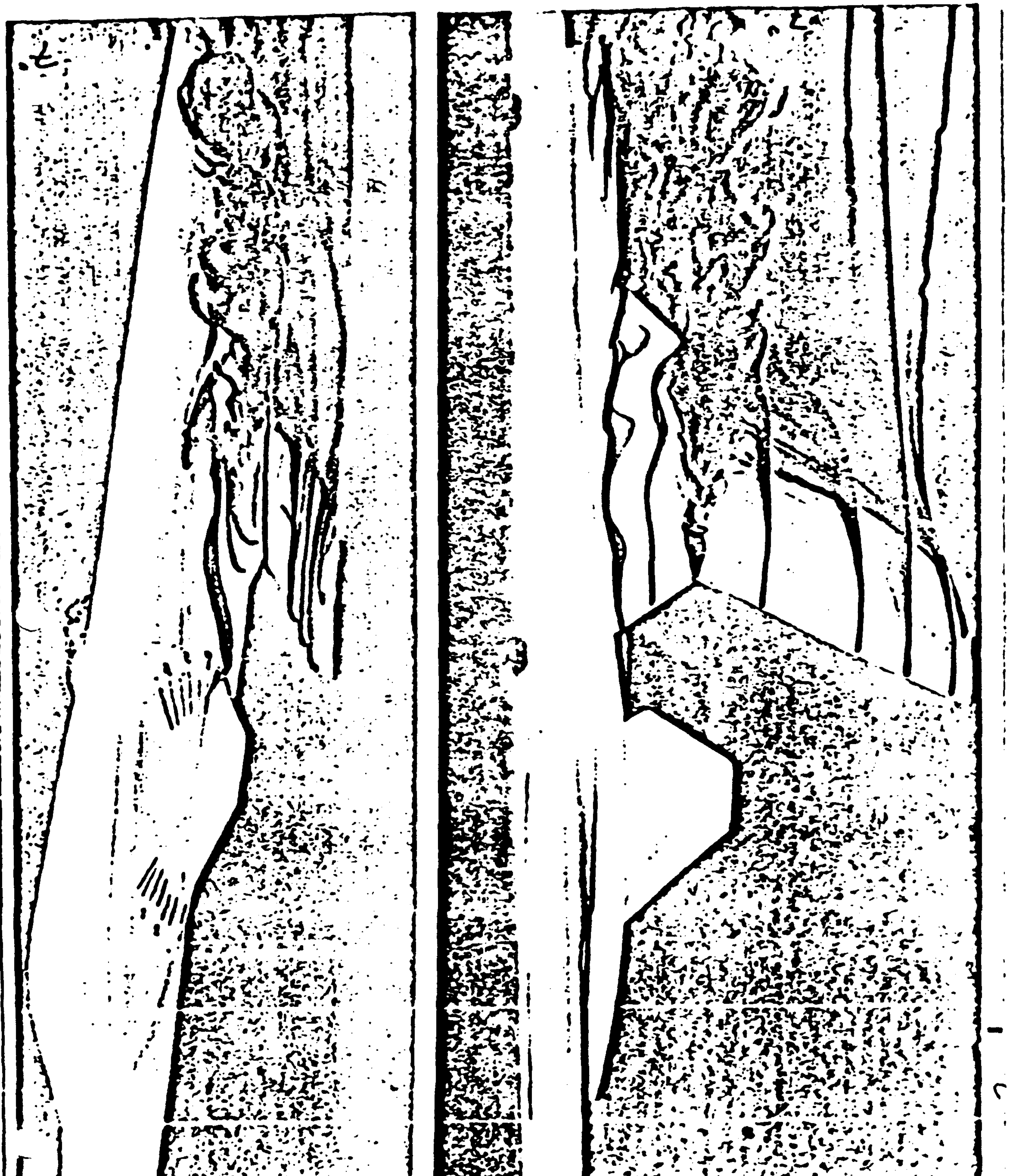
3. Harvey, W.D., NASA 8 Ft TPT, Private Communication, January 1983.

4. McKinney, M.D. and Schieman, J., "Evaluation of Turbulence Reduction Devices For The Langley 8 Foot Transonic Pressure Tunnel," NASA TM 81792, June 1981.

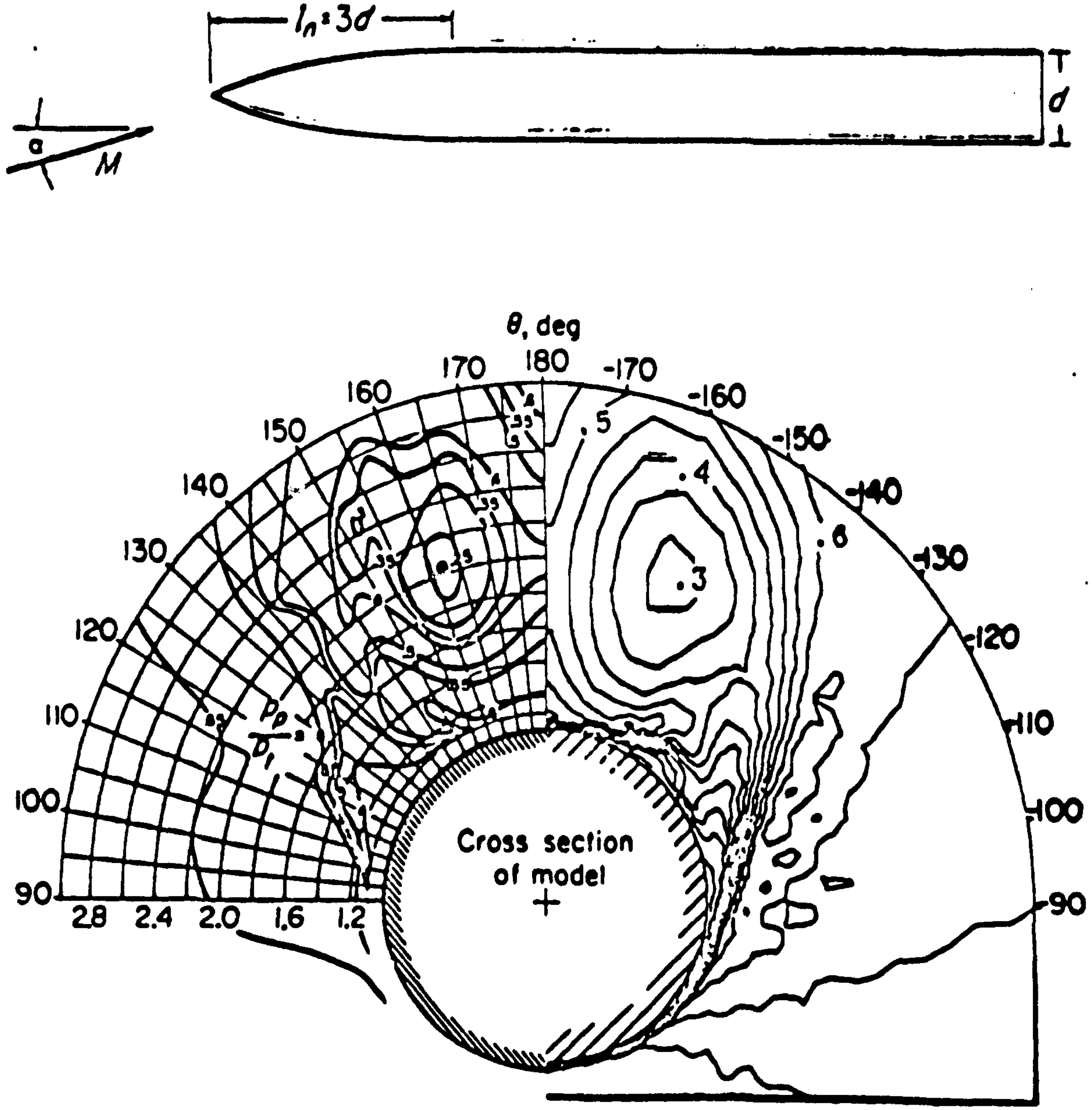
WAKE / TURBULENCE RESEARCH



(VERY LOW SPEED SMOKE FLOW)



FLOW FIELD OVER MISSILE AT ANGLE OF ATTACK



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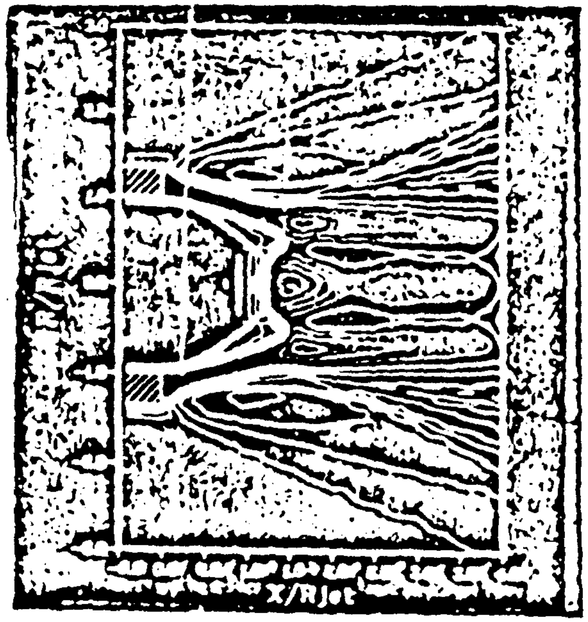

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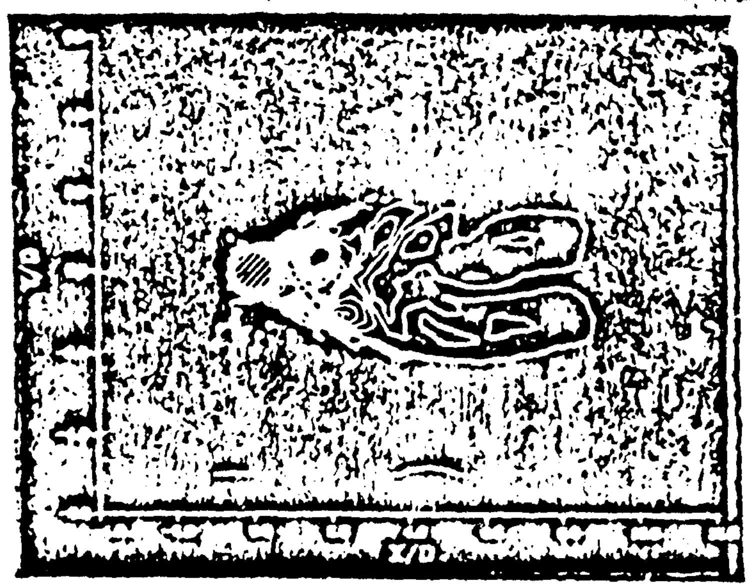

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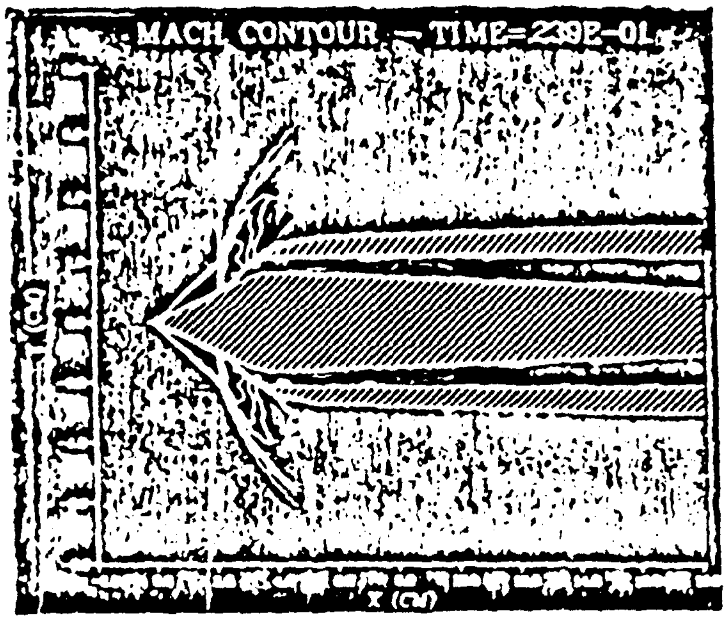
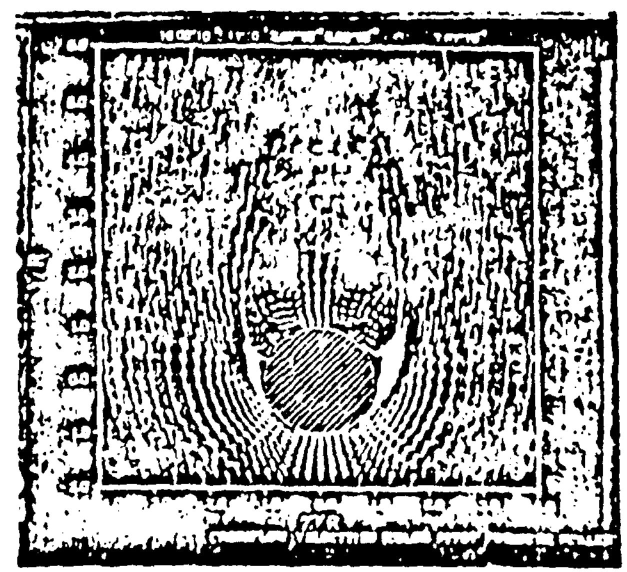


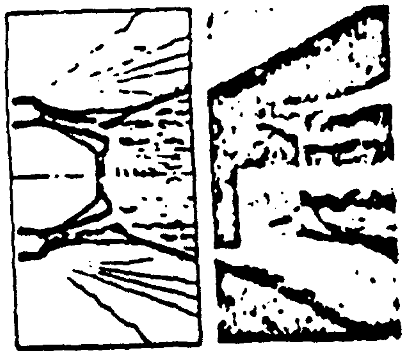
INLET BUZZ



MISSILE AT INCIDENCE

COMPUTATIONAL NOZZLE SOLUTIONS

(COMPUTED MACH NUMBER CONTOURS VS SCHLIEREN PHOTOGRAPHS)



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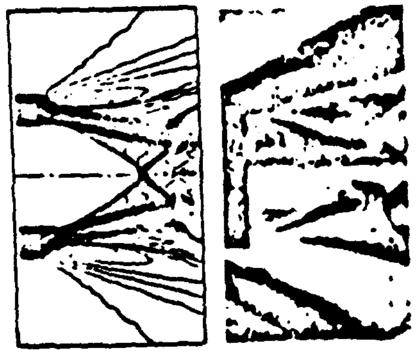

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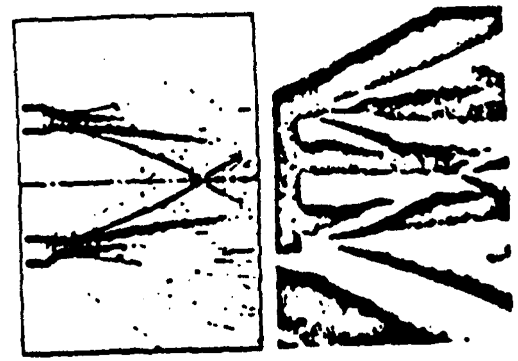

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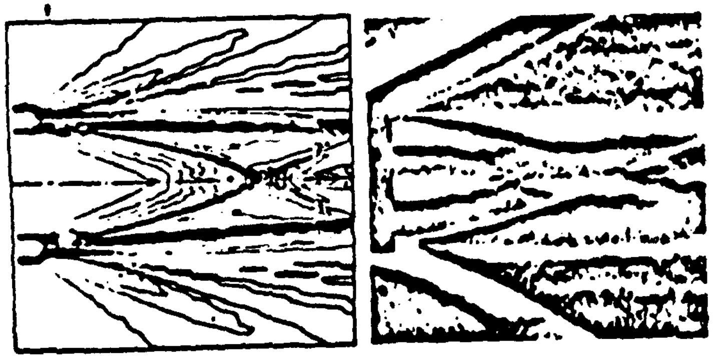

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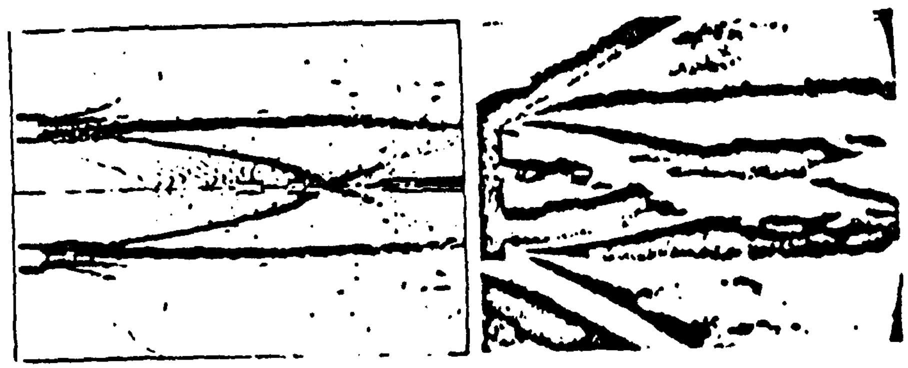

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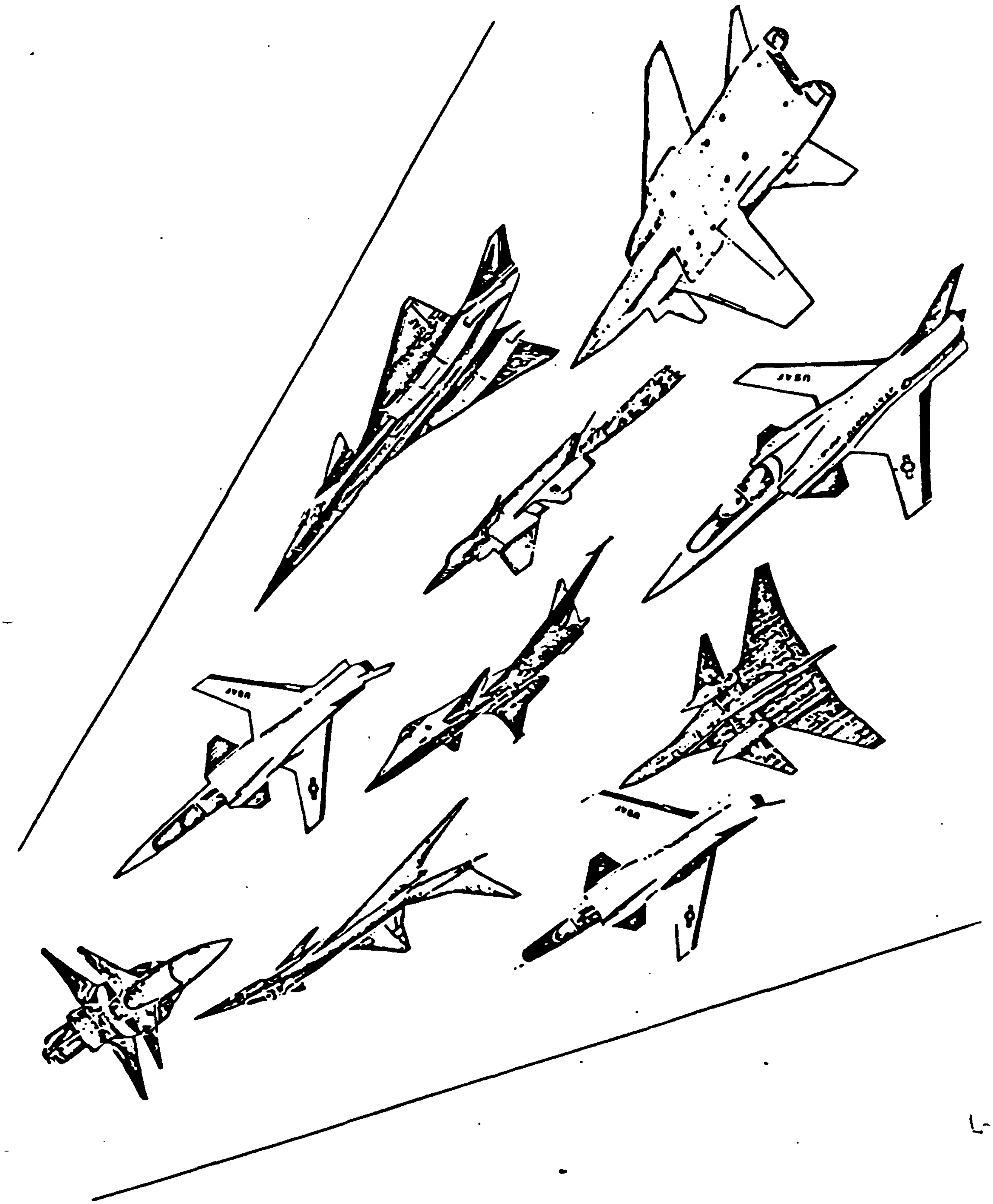
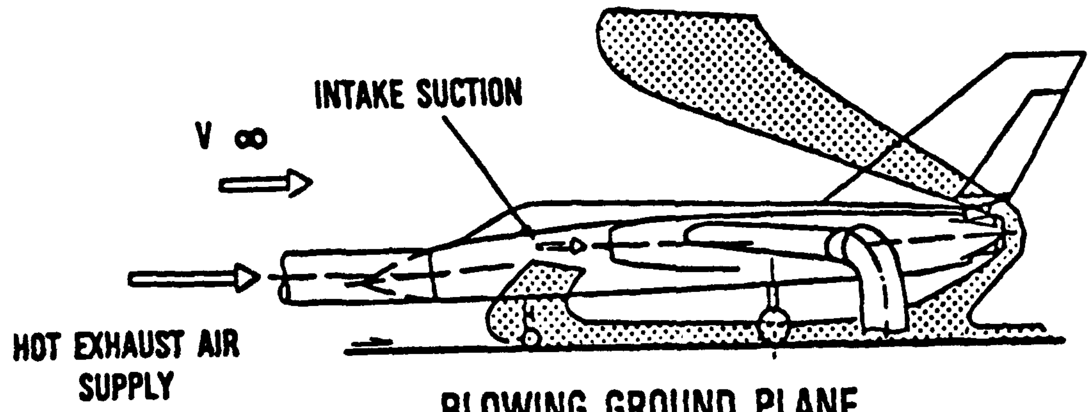


PROPULSION INTEGRATION RESEARCH

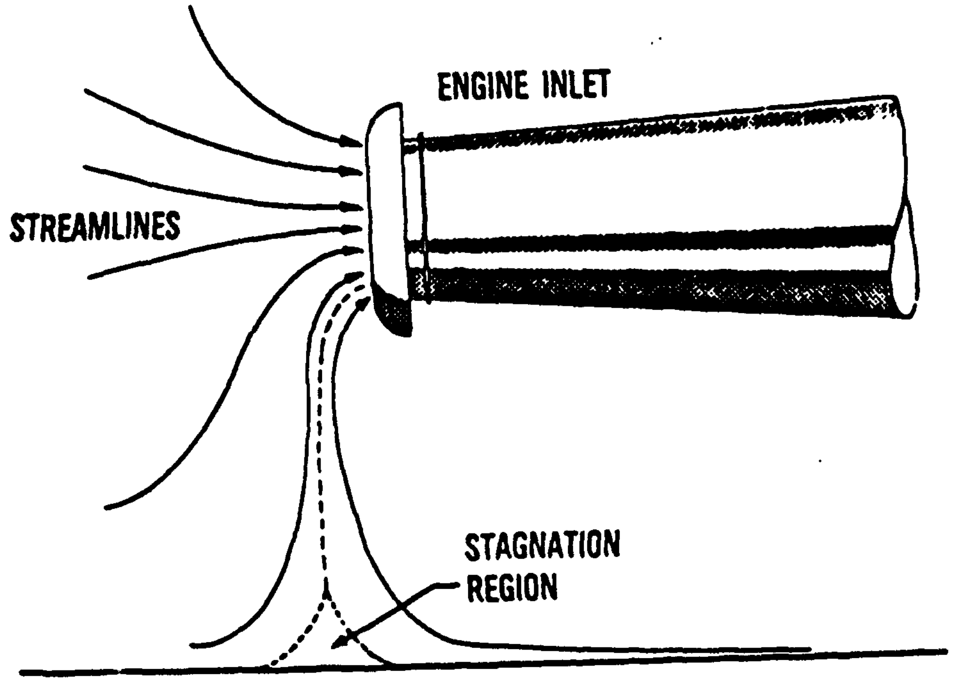


- VACUUM & HIGH PRESSURE AIR
- FLOW FIELD MEASUREMENT & VISUALIZATION
- GROUND EFFECTS TESTING
- METHODS DEVELOPMENT AND VALIDATION

6a

LOW SPEED PROPULSION INTEGRATION

(STOL / FOD)



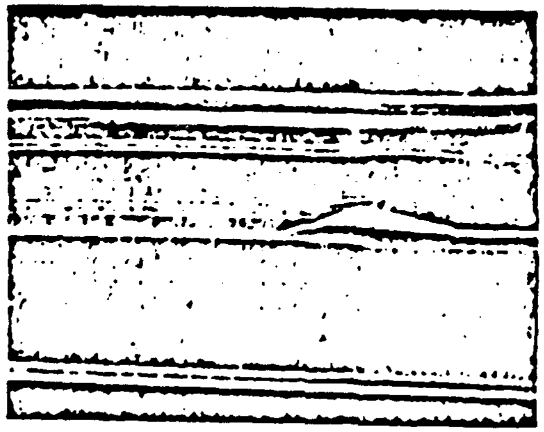
- DEVELOP ANALYSIS AND TEST TECHNIQUES

G

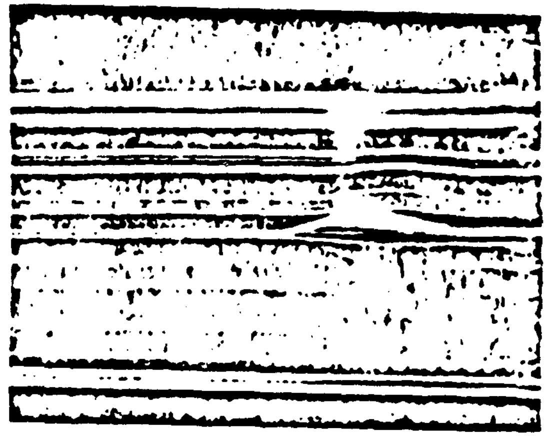
66

UNIVERSITY of NOTRE DAME
PILOT SMOKE TUNNEL
Top Lighted Mach No. 1.4

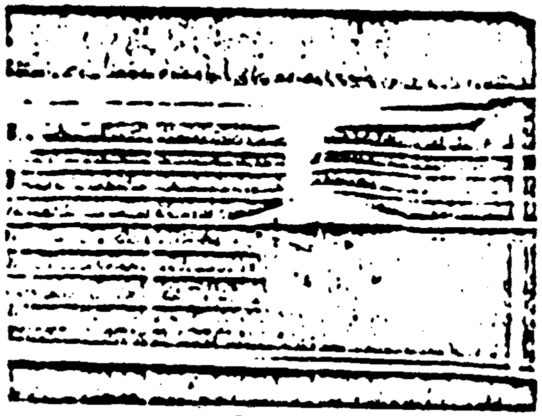
0 SCREEN



1 SCREEN



3 SCREENS



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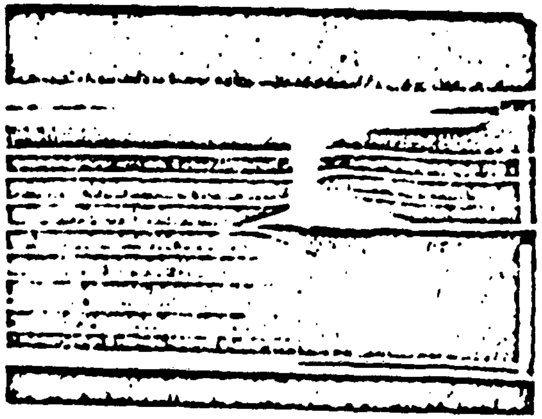

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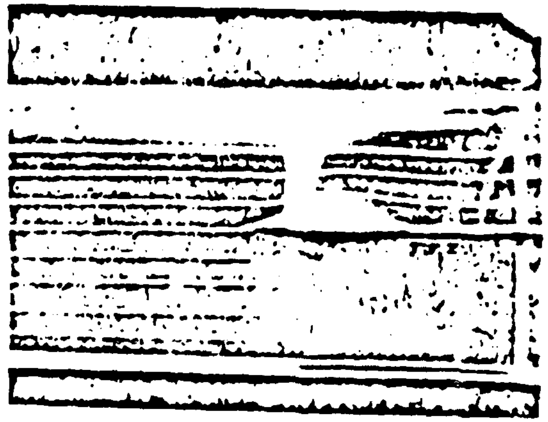
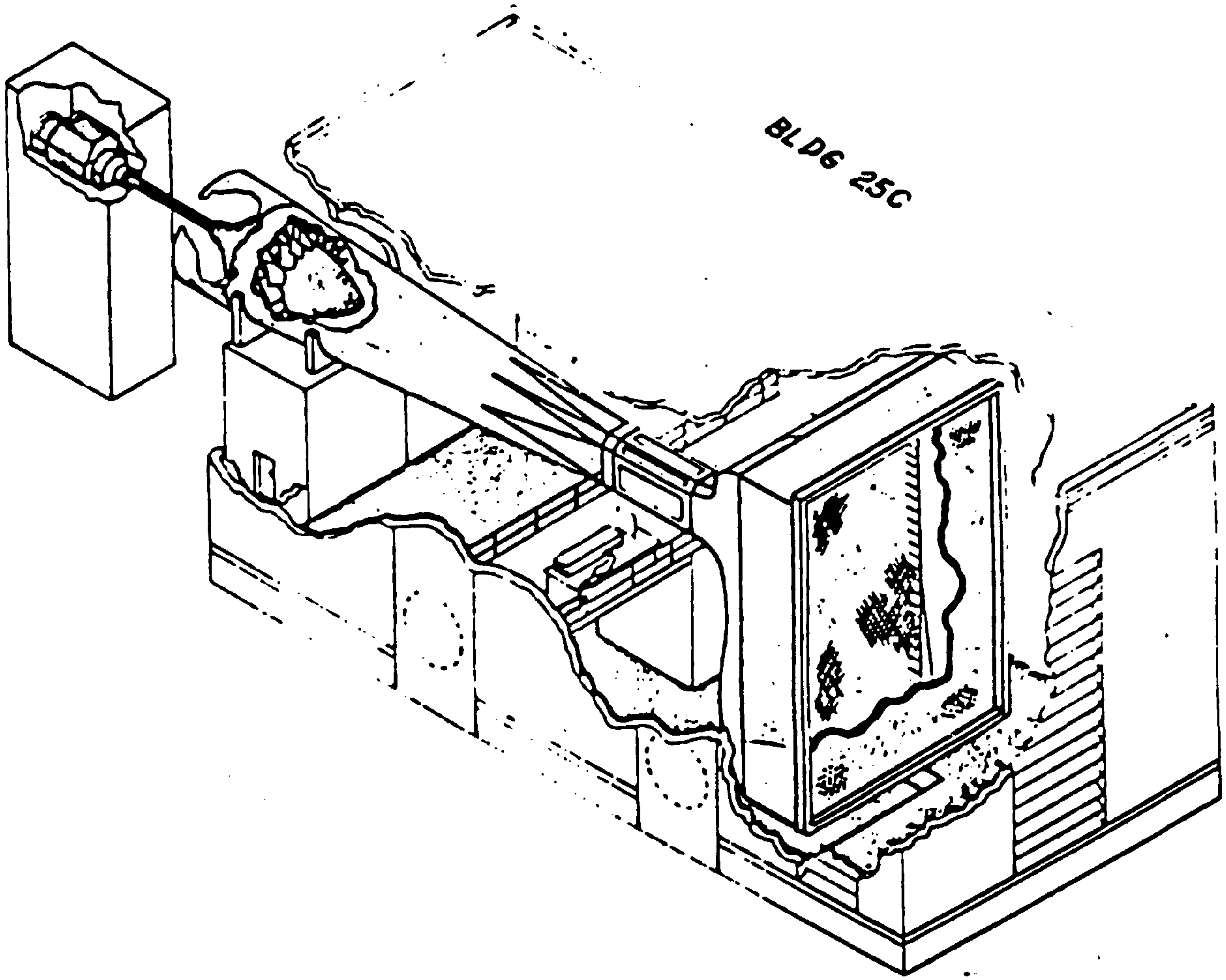


14 SCREENS

7

SUBSONIC AERODYNAMIC RESEARCH LABORATORY



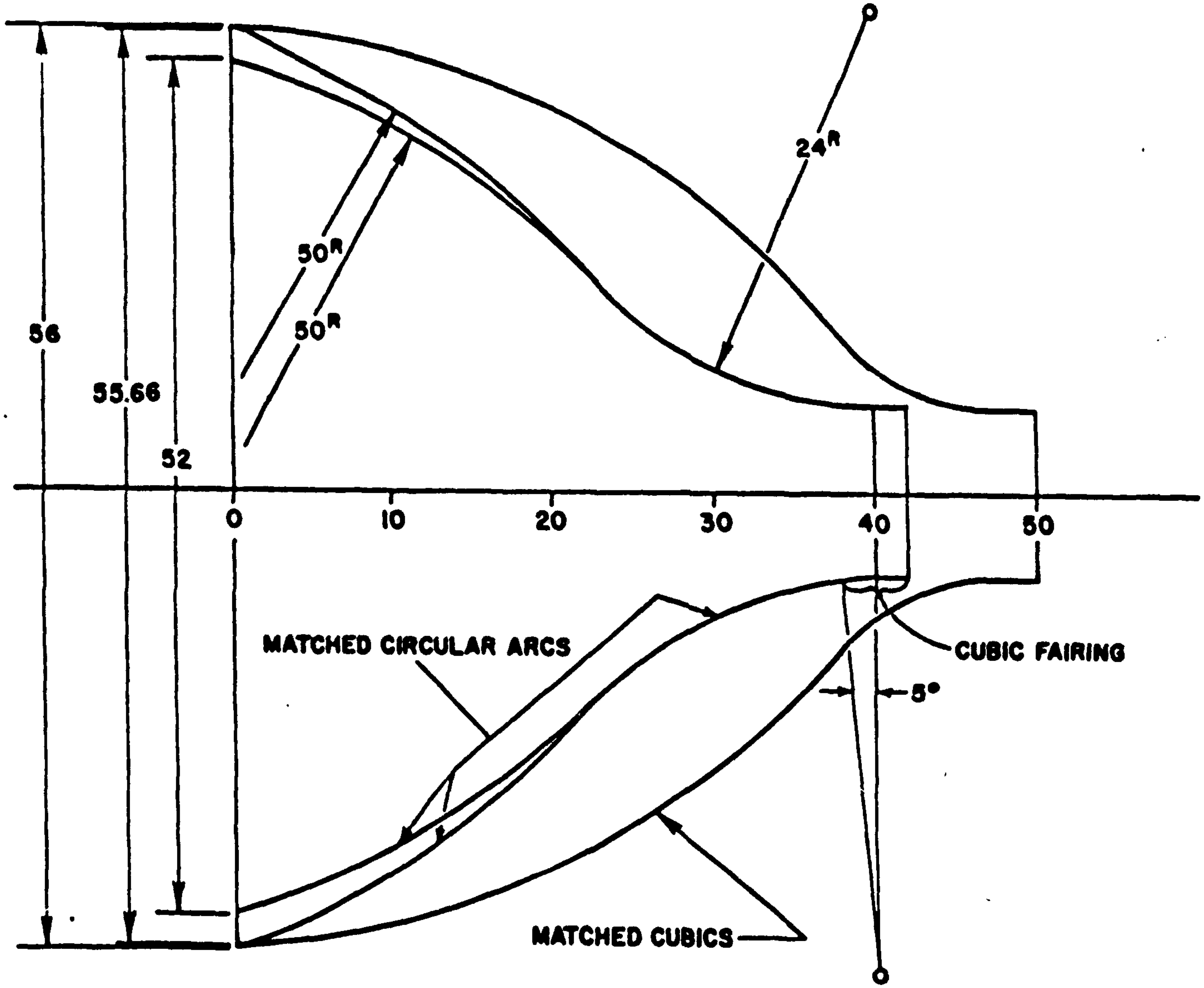


FIGURE 9 CONTRACTION DUCT CONTOURS, ENTRANCE AT SAME STATION

Appendix E

Honeycomb Report

STRUCTURAL AND AERODYNAMIC TESTING OF

HONEYCOMB FOR WIND TUNNEL TESTING

Tom A. Presdorf

1987

Air Force Wright Aeronautical Laboratories

Wright-Patterson Air Force Base, Ohio

ABSTRACT

Two focal points of modern wind tunnel design are low turbulence in the test section and a large amount of visual area. Both features are incorporated in the SARL design. Low turbulence results in high test accuracy. High visibility in the test section allows optical flow measurements to be taken easily. Honeycomb material appears to be the best method to reduce turbulence in a tunnel effectively and with low pressure losses. Therefore wind tunnels with high velocity in the flow conditioning section would operate with less power using one honeycomb section, rather than several screens to achieve the same turbulence reduction. Honeycomb design data available was for compression along the honeycomb cell length for a bonded or nonbonded configuration, neither of which were applicable to open cell unsupported use. Structural design data for the honeycomb section was obtained from material testing and supplemented by calculation.

FOREWORD

The data herein is part of the the design of the Subsonic Aerodynamic Research Laboratory (SARL). The SARL is expected to begin operation in 1989. It is located at Wright-Patterson Air Force Base (WPAFB) OH 45433. The SARL is designed to have less than 0.05% turbulence in the test section. The work is an element to in-house Work Unit Number 24041318 titled "Develop Subsonic Aerodynamic Research Laboratory" under Task Number 240413. The actual testing of the honeycomb material was done by Eugene Welcelean of Technical Scientific Services Inc. (TSSI). The testing was done over a period of approximately four weeks. The graphs were plotted by the AFWAL/FIMN Vax computer.

The author wishes to thank Maurice Cain, SARL Project Engineer, for guidance in testing configuration. The author wishes to thank the AFWAL technicians and lab workers for the use of stands, gages, break table etc..., and several TSSI personnel for their assistance.

INTRODUCTION

In July of 1983 Air Force Systems Command (AFSC) approved construction of the Subsonic Aerodynamic Research Laboratory (SARL). The SARL is designed to provide a low turbulence flow (< 0.05%) for flow visualization and flow measurements taken by laser velocimetry. The octagonal test section cross section is 7'w X 10'h making it possible to test large models at high angles of attack. The SARL is designed for efficient low cost operation.

The flow conditioning section of the tunnel contains both screens and honeycomb material. This report contains structural test data for several different honeycomb configurations. It also compares screens and honeycomb used for flow conditioning. The aerodynamic data is supplied by Mr. Franz J. Huber.

The SARL construction project is some what unique, by being an in-house effort. Because the project was done in-house, the project engineer could interact very closely with the construction contractors. The interaction allowed government personnel to implement minor changes or clarifications in the construction procedure quickly, and often at no additional cost to the government. When an interference or fit problem was discovered changes were implemented quickly. Therefore parts did not need to be removed, modified and reinstalled. The parts were simply modified and then installed saving expense and delay of completion time. The largest savings was due to the amount of equipment needed for the SARL that was available from other, unused facilities. The available equipment used in constructing the SARL is listed below. The cost of new replacement equipment is listed for each on hand item demonstrating over a 14 million dollar savings on the total project cost. The fan was obtained from Langely Research Center.

20,000 hp motor	$1,000,000
Motor speed control	1,900,000
Building for control room, motor and inlet.	8,000,000
Auxiliary air, vacuum	2,292,000
LaRC fan	1,000,000
Total Savings	14,192,000

TABLE OF CONTENTS

SECTION I
DESCRIPTION OF FACILITY

The flow conditioning section of the tunnel is discussed in limited detail; other sections are discussed in general terms. The tunnel shape is shown in Figures 1 and 2.

1. FLOW CONDITIONING SECTION

The SARL is an open circuit in-draft wind tunnel. (Ref 6) Air flow is from North to South. Prevailing winds are from the Southwest. The air stream is conditioned by several screens and a honeycomb section. Screens reduce longitudinal components of flow disturbances. Honeycomb reduces nearly all lateral components of flow disturbances and slightly reduces the longitudinal component. A screen with a large wire diameter (for strength) is used at the 48 ft wide x 50 ft high entrance of the tunnel to stabilize the airflow slightly and keep out insects and rodents. Next, two high loss screens in a special section stabilize the air stream before it enters the honeycomb section. The main screen section located downstream of the honeycomb presently contains 6 screens and is capable of containing 11 screens. Final turbulence reduction is accomplished in the main screen section and the contraction. The contraction ratio is 36 to 1. Contraction begins immediately after the screen section. The shape is a 50 ft internal radius matched to a 24 ft external radius. The 24 ft radius also connects to the test section and transitions to an octagonal shape. Most of the tunnel components requiring service or maintenance are located inside the weather seal around the screen section.

2. TEST SECTION

The 10 ft high x 7 ft wide x 15 ft long octagonal test section contains windows on all sides; Laser velocimetry and flow visualization are focal points of this tunnel's testing capability. The windows allow 360° viewing of the models and are required to have extremely flat and parallel surfaces. Minor distortions in the window surface distort the laser beam, making laser velocimetry measurements impossible.

The maximum model weight is 500 lbs. The proposed model support will be capable of -5 to 90 degree pitch, +180 degrees roll and $\pm$10 degrees yaw. A temporary model support with limited, manually positioned pitch is presently installed for tunnel shakedown.

3. TUNNEL STRUCTURE

The access section will allow the model support to be serviced. The access section connects to the transition section where the tunnel changes from octagonal to round. The round diffuser section is 53 feet long and expands from 10.5 to 14.6 feet in diameter.

4. DRIVE SYSTEM

Power is supplied by a 20,000 hp, variable speed, electric motor connected to a two to one speed increasing gearbox. The drive fan is 15.5 feet in diameter and has stator guide vanes upstream and downstream to improve efficiency. At maximum speed (900 fan RPM), air velocity in the test section will be Mach 0.6.

SECTION II
HONEYCOMB MATERIAL

Honeycomb material (Fig 3) is being more widely used in industry as materials become scarce and increasingly expensive. Honeycomb materials have been used for several years by the aircraft industry for low weight and high strength properties.

1. AVAILABLE HONEYCOMB STRUCTURAL DESIGN DATA

Floors, walls, and light weight platforms are common construction applications of honeycomb material. The honeycomb is sandwiched between two rigid pieces of material. Modern aircraft construction commonly utilizes honeycomb sandwich construction. Aircraft floors are constructed with honeycomb resulting in light weight and high strength. Design data for standard honeycomb construction is available in Ref 1.

A honeycomb sandwich panel has characteristics similar to an I beam in bending. Making two metal plates 2 times as thick and 3% heavier using honeycomb in the center to space them apart increases the relative strength over 700% (Ref 1 and Fig 4). The honeycomb sandwich panel is stronger in torsion than an I beam because it has a wide web section. When designing with honeycomb panels, concentrated loads must not exceed the crush strength of the honeycomb. Using sandwich panels for scaffolding provides workers with a strong, light-weight platform.

2. HONEYCOMB USED FOR AIR FLOW APPLICATIONS AND IN WIND TUNNELS

As a flow straightening or turbulence reducing medium, the honeycomb panel must be held by the panel edges. A plate bonded to honeycomb used for flow straightening is parallel with individual cell walls, while a sandwich panel has the end plates bonded perpendicular to the cell walls.

An aerodynamic industrial application using honeycomb is constructing turning vanes in heating and air conditioning ductwork. In large ducts honeycomb is used as turning vanes to reduce pressure loss in the air flow system by guiding the air around elbows. The honeycomb is held in a frame that sandwiches the edge of the honeycomb around its perimeter to retain it. Unfortunately the type of frame used to retain honeycomb in ductwork would cause excessive flow disturbance around the frame edges in a wind tunnel. Since any irregularity causes turbulence, for the SARL honeycomb panels the frames were constructed as thin as possible. To reduce the amount of framework, the honeycomb panels were constructed as large as possible. Using honeycomb for flow straightening in a wind tunnel was not a procedure with which the manufacturers were familiar.

Different frame configurations were tested in the smoke channel to reduce the wake size off the frame. The metal plates used were 0.10 in thick in the center between two 0.05 in thick plates.

Assembled symetrically (Fig 11A) the wake from the thinner plates added to that from the center plate. The wake produced by the symetric configuration was unacceptable. Grinding the plates to a 7° angle (Fig 11B and 12) produced an acceptable turbulence level. Unfortunately grinding the amount of plates required for the SARL would be very expensive. The sharpened plates would also make servicing the section dangerous. The arrangement in (Fig [illegible]) was used in the SARL honeycomb section. The asymmetry will not form an additive wake and the blunt metal edges are not dangerous (Ref 4). Time did not permit testing on the final frame configuration to be completed.

Honeycomb material reduces turbulence as follows. Turbulence passing through the honeycomb material, having a much larger scale than the honeycomb cell width essentially loses its lateral velocity components. The longitudinal velocity variations are reduced due to the pressure drop, approximately by the factor $1/\ 1+C_p$; this equation also applies to screens. To achieve a high flow smoothing effectiveness the honeycomb cell length-to-width ratio (L/D) needs to be equal to or greater than 8 (Ref 3). Air flowing through honeycomb having an L/D greater than 8 becomes nearly parabolic before exiting the honeycomb cells. The SARL honeycomb has an L/D of 13.3.

Low velocity air in the SARL flow conditioning section flowing through the honeycomb cells develops a nearly parabolic velocity profile in each cell. Air flowing through a screen also develops a similar velocity profile across its mesh openings. The large velocity gradients in the flow exiting from honeycomb cells and from screen openings decay rapidly to a uniform flow due to strong viscous stresses. A discontinuity such as a framework causes turbulence.

SECTION III
MECHANICAL TESTING

The samples of honeycomb material tested were 1/8 in cell, 0.002 in foil, 1 in x 24 in x 24 in and 3/8 in cell, 0.002 in foil, 3 in x 36 in x 36 in. The sample of 3/8 in cell material was bent, pulled and compressed to obtain design data. The 1/8 in cell honeycomb was tested simply supported and with 4 sides rigidly mounted. The data was needed to design a honeycomb section 46 ft wide by 50 ft high. Part of the data in graphic form are shown in graphs 1-7.

Simple support tests were run first using both the 1/8 in and 3/8 in cell honeycomb panels. The tension and compression tests were completed using the 3/8 in honeycomb panel only. The compression tests were run with three sides of the test piece against a fixed boundary. The boundaries were to simulate the full size honeycomb panels against a solid base and against a boundary on each side. In actual use, the honeycomb will have similar boundaries. Each panel will attempt to deform sideways in a similar manner. Therefore the panels located side by side will act as if they were against a solid wall. The outer panels are against such a solid wall. A cantilever test was run to determine the flexibility of the nonbonded honeycomb. The 3/8 in and 1/8 in cell honeycomb were tested as a bonded flat plate. The differences in characteristics between nonbonded and bonded honeycomb are similar to changing from a fishing rod to a steel bar.

In the first test the honeycomb was nonbonded and simply supported (Fig 5). The panels exhibited more strength when part of the cell walls were perpendicular to the supports. Tested in the stronger direction 1/8 in cell honeycomb panels were much stronger than 3/8 in honeycomb even allowing for the differences in span and thickness.

The equations below calculate the deflection of simply supported solid beams.

<u>1/8 in honeycomb</u>

24 in x 24 in x 1 in; 21 in span

$I = bh^3/12 = 24(1)^3/12 = 2 \text{ in}^4$

$y(max) = PL^3/48EI = P(21)^3/48E2$

$= 96.4P/E$

<u>3/8 in honeycomb</u>

36 in x 36 in x 3 in; 34 in span

$I = 36(3)^3/12 = 81 \text{ in}^4$

$y(max) = P(34)^3/48E81$

$= 10.1P/E$

The honeycombs deflection characteristics were assumed to be similar to solid deflection characteristics. The calculations show 10.1/96.4=0.105. The 3/8 in honeycomb panel should deflect only 10.5% as much as the 1/8 in honeycomb. Twelve lbs caused the 3/8 in honeycomb to deflect 2.05 in. The same weight caused the 1/8 in honeycomb to deflect only 0.23 in. Apparently the 1/8 in honeycombs higher test strength is caused by its higher material density. The 1/8 in honeycomb deformed in a rather unusual manner which is displayed in Fig 5.

When one cell wall was parallel to the supports both test pieces were weaker. The 1/8 in honeycomb was weaker than the 3/8 in honeycomb in this orientation. The data is shown in Table 1. Why the 1/8 in cell characteristics changed more in the second orientation than the 3/8 in cell characteristics is unknown. After completion of the simple support tests the 3/8 in honeycomb was cut into different size pieces.

The tension and compression tests were completed using only the 3/8 in honeycomb. For the tension test the honeycomb was bonded to a steel plate. The steel plate was clamped to a support structure (Fig 5). Weight was applied to the honeycomb by inserting several bars through the honeycomb cells. The bars distributed the weight across the honeycomb cells by penetrating plates on each side of the honeycomb. The test weights were suspended from the side plates (Fig 6). In all tests where more than one measurement for each data point was made, an average value was used. In tension the honeycomb strength was similar with or across the cells. When compressed with no side boundaries the honeycomb had strength similar to that demonstrated in the nonbonded tension test. In free compression the honeycomb was slightly stronger when the load was applied perpendicular to the straight cell wall. Compression was of more concern than tension. The foil buckles under excessive compression, which did happen during testing and is shown in Fig 7. In tension tests as expected cell wall buckling was not a problem. Fig 8 shows the standard test arrangement for doing compression tests. Note the resulting data is in the units (in/ft)/(lb/ft). For example if a test panel is 24 in high and deflected 1 in, the deflection is 0.5 in/ft. If a 6 in wide test piece weighted with 10 lbs deflects 1 in. it would require 20 lbs or (20 lbs/ft) to achieve the same deflection on a 1 ft wide section. Normalizing the force and deflection measurements allows force and deflection to be calculated for any size honeycomb panel easily. The calculations assume different size honeycomb panels deflect proportional to their size when loaded. The larger panels tested did deflect proportionally less than the smaller panels. Therefore, a design based on this assumption gives a safe answer.

Honeycomb tested in a cantilevered configuration (Fig 9) was very flexible. Below are calculations to equate the characteristics of a uniform beam in both simple support and the cantilever configuration and the corresponding test data.

Configuration (Load into page)			Deflection, In	Load, lb	Span (L) In
Simple	1	x		1.0	6	34
support	2		x	1.85	6	34
Cantilever	1	x		0.38	20	19.8
	2		x	2.34	4	19.3

(L_c cantilevered, L_s simply supported) length
(y_c cantilevered, y_s simply supported) deflection

$L_s/L_c = 34/19.8 = 1.72$ $\qquad y_s = PL_s^3/48EI = P(L_c\ 1.72)^3/48EI$

$y_c = PL_c^3/3EI$ $\qquad = PL_c^3/9.41EI$

The table above assumes a 6 in wide strip of the simply supported material will deflect in proportion to its partial width of the 36 in piece tested. (36 in/6 in = 6 equal sections of honeycomb) (12 lbs total load/6 pieces = 2 lbs/piece causing 2 in deflection). Assuming the deflection is linear, a 1 lb load will cause a 1 in deflection when one honeycomb cell wall is perpendicular to the support. Similarly when one cell wall was parallel to the support 1 lb caused 1.85 in of deflection. The same material loaded the same amount in the cantilevered configuration should deflect (by calculation) 9.41/3=3.1 times as much as the simply supported beam. The measured deflection difference from above is (0.38/20)/(1/6)=0.114 and (2.34/4)/(1.85/6)=1.85 i.e. varying widely from the expected value based on uniform beam theory. Apparently due to the interaction of cell walls or because of the side walls guiding the deflection, the honeycomb does not deflect in the same way a solid object would.

Honeycomb was also tested as a flat plate, simulating wind loads parallel to the cell walls. Honeycomb was bonded to steel plates. The plates were fastened to the wooden frame with screws (Fig 10). In actual use the metal bands adhered to the honeycomb will be fastened to another sheet metal band or to the tension bands. The tensioned bands are designed to support the individual honeycomb panels (Fig 11). The 1/8 in and 3/8 in cell honeycomb were both tested. Unfortunately the 3/8 in cell honeycomb yielded during the point in honeycomb point and distributed load results are compared using solid plate theory (Ref 2). Q - lb/ft^2; B - length of side, in; T - thickness, in; Y - deflection, in; W - lb.

Distributed load	Concentrated load
$y_D = \cdot\alpha QB^4/ET$	$y_C = \beta\ WB^2/ET$
$y_D = 0.0138QB^4/ET$	$y_C = 0.0611WB^2/ET$

$$y_D/y_C = 0.0138QB^4/0.0611WB^2$$

For $W=QB^2$

$$y_D/y_C = 0.0138/0.0611 = 0.226 \text{ theoretical}$$

Loaded to the same total weight the distributed load will cause 22.6% as much deflection as a concentrated load applied to a solid plate. The test results indicated the following when loaded at 30 lb total load (Graph 6 and 7).

test results: $y_D/y_C = 0.0024/0.0086 = 0.28$

The ratio of distributed to concentrated load deflection agrees well with solid plate theory.

SECTION IV
HONEYCOMB TESTING IN THE SMOKE CHANNEL

The SARL Smoke Flow Research Channel (SSFRC) was constructed in 1984 (Ref 5). This facility was designed to duplicate the centerline flow entering the SARL contraction section. The shape of the SSFRC is a 2 ft wide constant cross section octagon. A smoke filament was used for flow visualization and to test the flow smoothing performance of honeycomb and screens. The octagonal sections are 8 ft long and removable, allowing turbulence measurements to be made and smoke filaments to be viewed at various distances from the screens. A large radius inlet lip was used to help prevent flow separation of the inducted room air. Recessed in the inlet, where the flow is parallel, the honeycomb and the screens were installed. The 3/8 in hexagonal cell honeycomb is 3 in deep. Up to 12 screens of 30 x 30 wires/inch, 0.0065 in diameter wire, can be located in the air stream. The screen frames provide 8 in spacing between screens. Because the honeycomb, the screens, screen spacing, and the flow velocity through them are identical to those in the SARL, the flow through this duct will closely duplicate the airflow in the SARL from the inlet through the contraction section. A grid of 3 in mesh and 3/4 in diameter rods can be attached to the inlet lip to generate turbulence of known scale and intensity so that the turbulence damping effectiveness of the screens and honeycomb can be measured.

The 8 ft long test section, used for turbulence measurements and viewing a smoke filament, started 24 ft downstream of the last screen. However, the test section can be moved upstream by rearranging or removing some of the 8 ft sections to permit measuring the turbulence and viewing the diffusion of the smoke at various distances from the screens.

High intensity lighting aids viewing the smoke filament through windows in the test section. Hot-wire and pitot-static probes provide quantitative air flow data. The movable hot wire probe was also positioned 12 in behind the last screen to provide data at that location. A transition from the test section leads to the 6 bladed fan which can generate a maximum 20 ft/second duct velocity. In the SARL at test section Mach 0.6 the velocity at the screens is 15 ft/second. The test section is isolated from fan vibrations by a rubber joint. Because of the shape of the building containing the smoke channel, a large ceiling fan above the channel fan section can generate an axial flow velocity of about 5 ft/second ahead of the channel inlet. Then, the 15 ft/sec velocity in the channel generates a 3.7 ft diameter stream tube approaching the inlet which converges and accelerates inside the channel. The stream tube flow has less tendency for flow separation at the inlet than the three dimensional inlet flow that establishes itself in a large still air surrounding.

The constant velocity airflow past the SARL smoke rake, when placed in front of the honeycomb, was duplicated by placing the smoke tube and strut inside the channel ahead of the honeycomb. The effect of the turbulence trailing from the smoke tube and strut on the smoke filament was studied by observing the filaments persistence.

Using the smoke channel the present tunnel configuration was developed; i.e. an inlet screen, two high loss screens, honeycomb and 6 screens. The initial research (Ref 5) demonstrated the neccessity of honeycomb to maintain a smoke line. Later studies discovered that, especially in cross winds, screens in front of the honeycomb substantially reduce turbulence (Ref 4). It appears that if the velocity profile is very uneven entering the honeycomb, it does not become uniform while passing through the honeycomb. Placing screens in front of the honeycomb substantially reduced the turbulence.

SECTION V

HONEYCOMB PANEL SIZE DETERMINATION

Ideally the SARL honeycomb section should contain one very large panel of unbroken honeycomb. Unfortunately constructing a honeycomb panel this large is not possible for three reasons: (1) the honeycomb could not support its own weight; (2) A 46 ft wide x 50 ft high panel of honeycomb could not be transported; and (3) the maximum size panel the manufacturer can produce is 8 ft x 8 ft. Aluminum honeycomb was used because it has a much lower cost than stainless steel.

Aluminum honeycomb is produced by stacking adhesive coated aluminum. The adhesive is at specific locations on the honeycomb. The stacked foil looks like a solid bar of aluminum. After the adhesive is setup the honeycomb is pulled or expanded by a large machine. The capacity of the expansion equipment limits the panels size. The expansion process is not accurate. Therefore the material is expanded larger than the minimum required dimensions, then trimmed to size by a large bandsaw. The maximum finished dimension for a honeycomb panel is 8 ft x 8 ft up to 10 in thick.
Seamless honeycomb sections can be made using stainless steel honeycomb. It can be welded together. The honeycomb material is crimped into 2 sides of a rectangle. The corners are then welded to the next part. Unfortunately, the finished stainless steel (rectangular cell) honeycomb was more expensive than the SARL construction budget allowed.

The expected forces exerted on the SARL honeycomb are W_s = 0.3 lb/ft^2 normal force and 0.5 lb/ft^2 side force. The equations to relate stesses in different size honeycomb panels to each other are shown below.

	Overall Size	Panel Depth (D)	Foil Thickness (T)	Cell Width (C)
SARL Honeycomb Panel	8'x 8'	5"	0.004	0.375
Test Honeycomb Panel	2'x 2'	3"	0.002	0.375

Subscripts: (T - test; S - SARL)

Force (F), lbs

Weight (W), lbs/ft^2

Area (A), ft^2

$F_t/F_s = 1/2\ (D_t/D_s)^2\ (T_t/T_s)\ (C_s/C_t)$

$F_t = 1/2F_s\ (D_t/D_s)^2\ (T_t/T_s)\ (C_s/C_t)$

$F_s = W_s\ A_s$

$F_t = 1/2\ (0.3\text{lb/ft}^2)\ (8\text{ft})^2\ (3/5)^2\ (0.002/0.004)\ (0.375/0.375)$ (Ref 3)

$= 1.93$ lb

The test honeycomb panel yielded when a 70 lb point load was applied. The calculated equivalent load 1.93 lb/70 x 100 = 2.76% of the tested yield strength of the honeycomb panel. The deflection at this loading is calculated below (Ref 3).

F_t - point load on the test piece;

W_s - distributed load on the SARL honeycomb;

L - length;

$X_t = 0.022$ in deflection at $F_t = 30$ lb

$X_s = 1/4\ (X_t)\ (W_s/F_t)\ (L_s/L_t)\ (D_t/D_s)^3\ (T_t/T_s)\ (C_s/C_t)$

$= 1/4\ (0.022)\ (.3/30)\ (8/2)\ (3/5)^3\ (0.002/0.004)\ (0.375/0.375)$

$= 0.0061$ inches

The deflection caused by wind loading is inconsequential. The SARL honeycomb deflection due to its own weight has not been measured, but the panels are exstremely rigid. The SARL honeycomb weighs 2.25 lb/ft^2 of surface area. A 1 ft wide x 50 ft high section weighs 113 lbs. The panels near the top will be suspended, and panels near the bottom will be under compression. The SARL honeycomb is 66% wider and the foil is 100% thicker than the test honeycomb. Since doubling the thickness increases the moment of inertia 8 times because it is a cubic term, the SARL honeycomb should be 8 X 1.66 = 13.3 times as strong as the test honeycomb. Deflection characteristics of the two honeycombs are assumed similiar. The average verticle load will be 1/2 the maximum or 57 lb/ft. The SARL honeycomb cells are oriented with one cell wall perpendicular to the verticle bands because this was the most rigid simple support orientation of the test piece. This orientation transfers the axial load to the 50 ft high metal bands in the SARL.

Unbonded honeycomb had a compression constant of 0.017 in/ft/lb/ft and a tension constant of 0.012 in/ft/lb/ft. 0.012/0.017 x 100 = 70.1% as much deflection in tension as compression. The bonded compression deflection constant is 0.0031 in/ft/lb/ft. Assuming the bonded tension and compression constants vary at the same rate as the unbonded constants .701 x 0.0031 in/ft/lb/ft = .0022 in/ft/lb/ft will be the bonded tension constant. Using the weight of the honeycomb and the tension and compression constants, the honeycomb neutral point will be calculated. Using the neutral point location the maximum deflection can be found.

The deflection constants for the SARL honeycomb will equal the test deflection constants divided by 13.3, because of dimensional differences of the foil and cell thicknesses compared to the test honeycomb.

compression = 0.00023 in/ft/lb/ft

tension = 0.00017 in/ft/lb/ft

Average weight of 50ft high honeycomb 57 lb/ft

X section of honeycomb in compression

Y section of honeycomb in tension

$$X + Y = 50\text{ft}$$

$$0.00023X = 0.00017Y$$

$$0.00023X = 0.00017(50-X)$$

$$X = 21.3\text{ft}$$

$$Y = 50-23 = 28.7\text{ ft}$$

Maximum deflection in the honeycomb is at the neutral point and equals (21.3 ft) (0.00023 in/ft/lb/ft) (57 lb/ft) = .28 inches.

The small deflection is nearly unnoticeable when compared to the total size of the installation. The deflection of the honeycomb installed in the SARL was nearly zero. Side force was considered insignificant because it is a smaller force than the weight of the honeycomb.

SECTION VI
CONCLUSIONS

Honeycomb material is an excellent turbulence reducing medium. Based on experimentation completed in the SSFRC (Ref 4 and 5) in tunnels with high velocity air flow in the stilling chamber, honeycomb has a much lower pressure drop than screens for a similiar reduction in turbulence. In addition, honeycomb removes nearly all lateral turbulence components. This is especially important in tunnels with high contraction ratios. As the airstream flows through the contraction lateral vortices are accelerated while axial pulsations and vortices tend to dampen out. Screens tend to dampen out the axial component not the lateral. Therefore, honeycomb is even more effective than screens in reducing turbulence in high contraction ratio wind tunnels. The actual effectiveness of the flow conditioning system including the honeycomb will be studied in the SARL.

HONEYCOMB DEFLECTION CHARACTERISTICS
All Distances in Inches

Simple Support

Panel Size	Span	Cell Size	Thickness	Cell Orientation Load into Page	Max. Wt.	Deflection
24 x 24	21	1/3			20	[illegible]
24 x 24	21	1/3	1		4	[illegible]
36 x 36	34	3/3	3		12	[illegible]
36 x 36	34	3/8	3		5	[illegible]

Compression Bounded (3/3 x 3 x .002)in foil

Test Size	Deflection in/ft/#ft Cell Orientation	Deflection in/ft/#ft Cell Orientation
4.5W x 10.7H		0.0024
6W x 6H	0.0042	0.0077
12W x 12H	0.0039	0.0024
12W x 24H	0.0022	0.0020
24W x 12H	0.0032	
24W x 24H	0.0013	0.0022
Average Value	0.0013	0.0026
		0.0072 not averaged in

Tension Unbounded

6W x 12H	0.012	0.012

Compression Unbounded

12W x 12H	0.017	0.013

Cantilevered Span

6W x 24H (3 3/4)	2.34 in/#	1.37 in/#

References

1. Hexcell Mechanical Properties of Hexcell Honeycomb Materials [illegible] revision.

2. Roark, R.J. and Yound W.C., "Formulas for Stress and Strain", Fifth Edition, McGraw-Hill Book Company, 1975.

3. Huber, F.J.A., Aero Consultant, Beta, Inc., Private Communication, through-out 1987 and 1988.

4. Tighe T. "SARL Inlet Design Modification" Presented at SATA Meeting, [illegible]

5. Beachler, J.D., "Smoke Flow Research", Presentation at SATA Meeting, [illegible]

6. Wells, W.C. and Beachler, J.D., "The Subsonic Aerodynamic Research Laboratory (SARL) a new 7 x 10 Foot Low-Turbulence Facility for Flow Visualization". Presentation at SATA Meeting, Texas A&M University, April 1982.

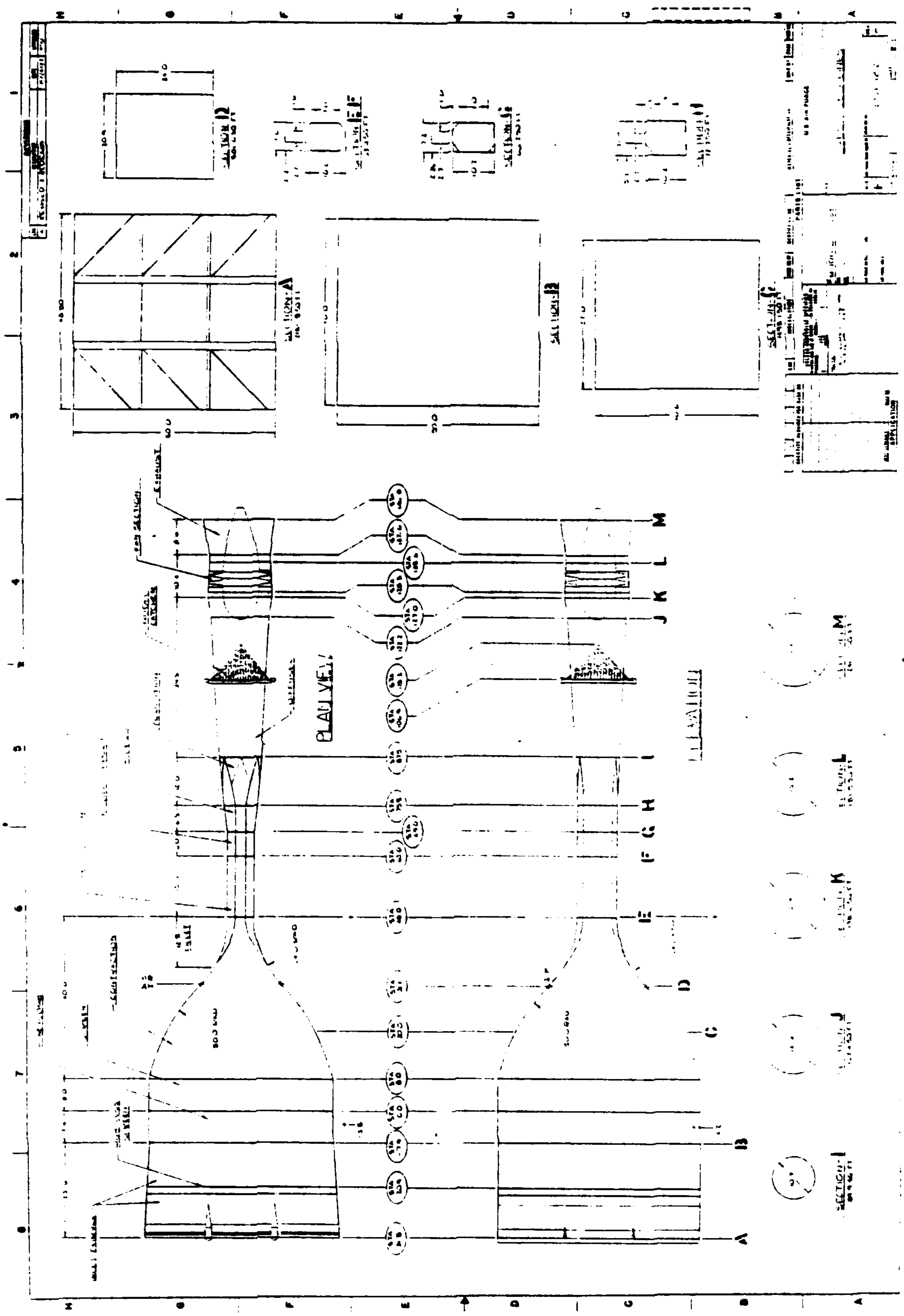
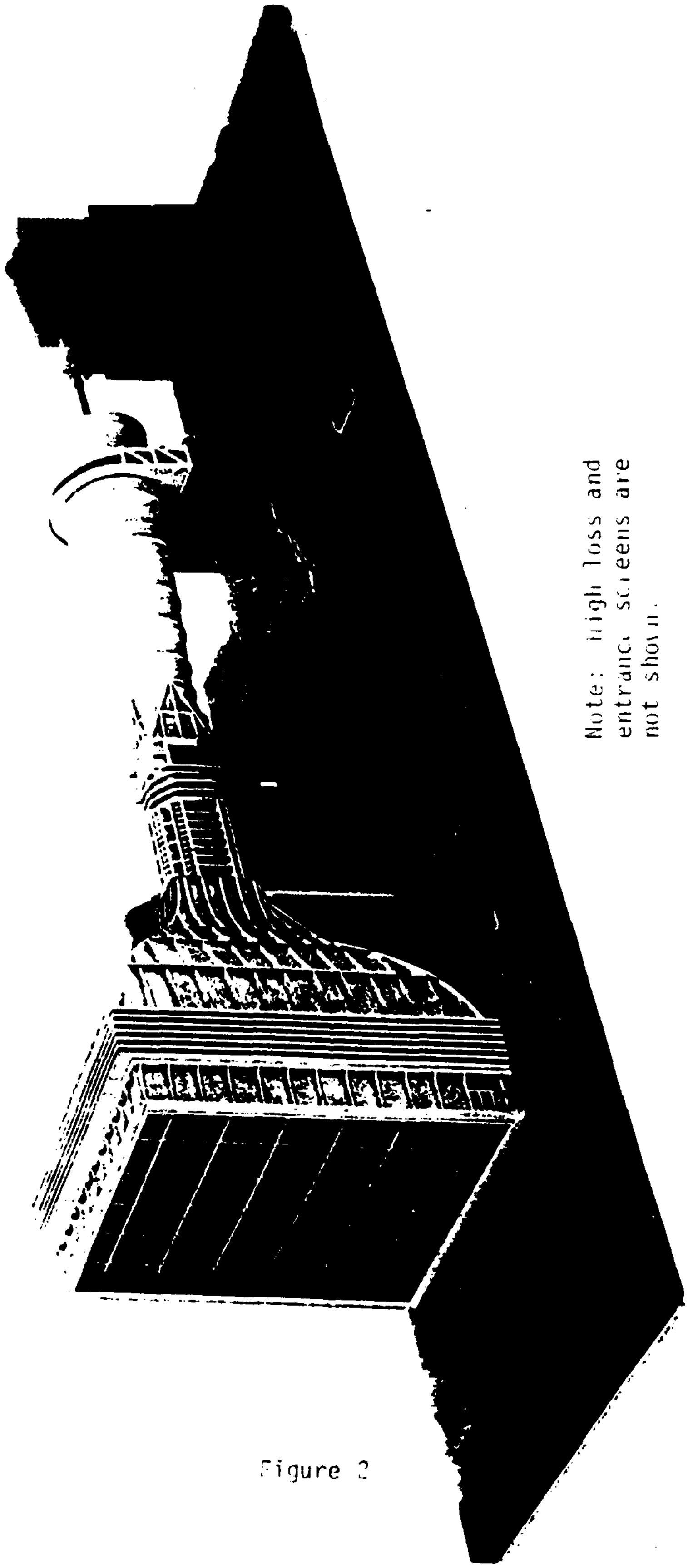
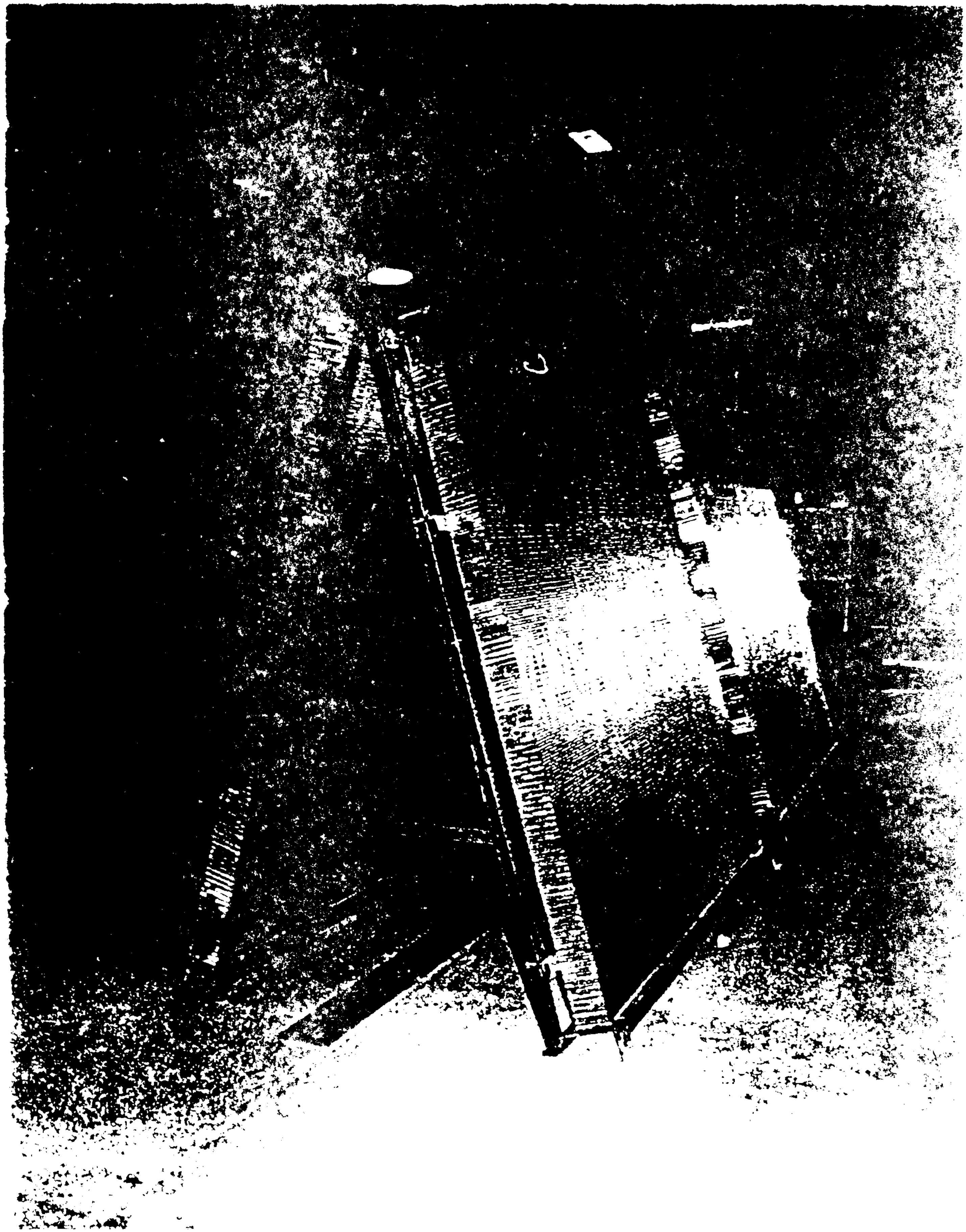


Figure 1

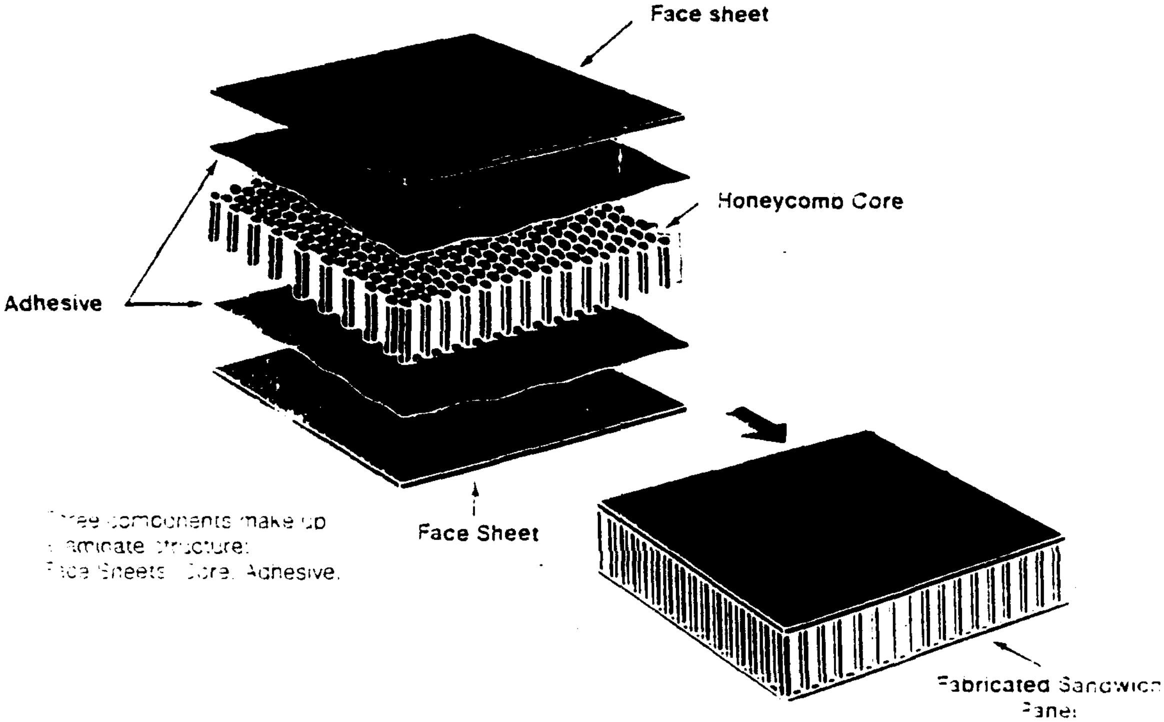


Note: High loss and entrance screens are not shown.

Figure 2



Honeycomb Sandwich Construction



Honeycomb stiffens and strengthens a structure without materially increasing its weight

Relative Stiffness	100	700	3,700
Relative Strength	100	350	925
Relative Weight	100	103	106

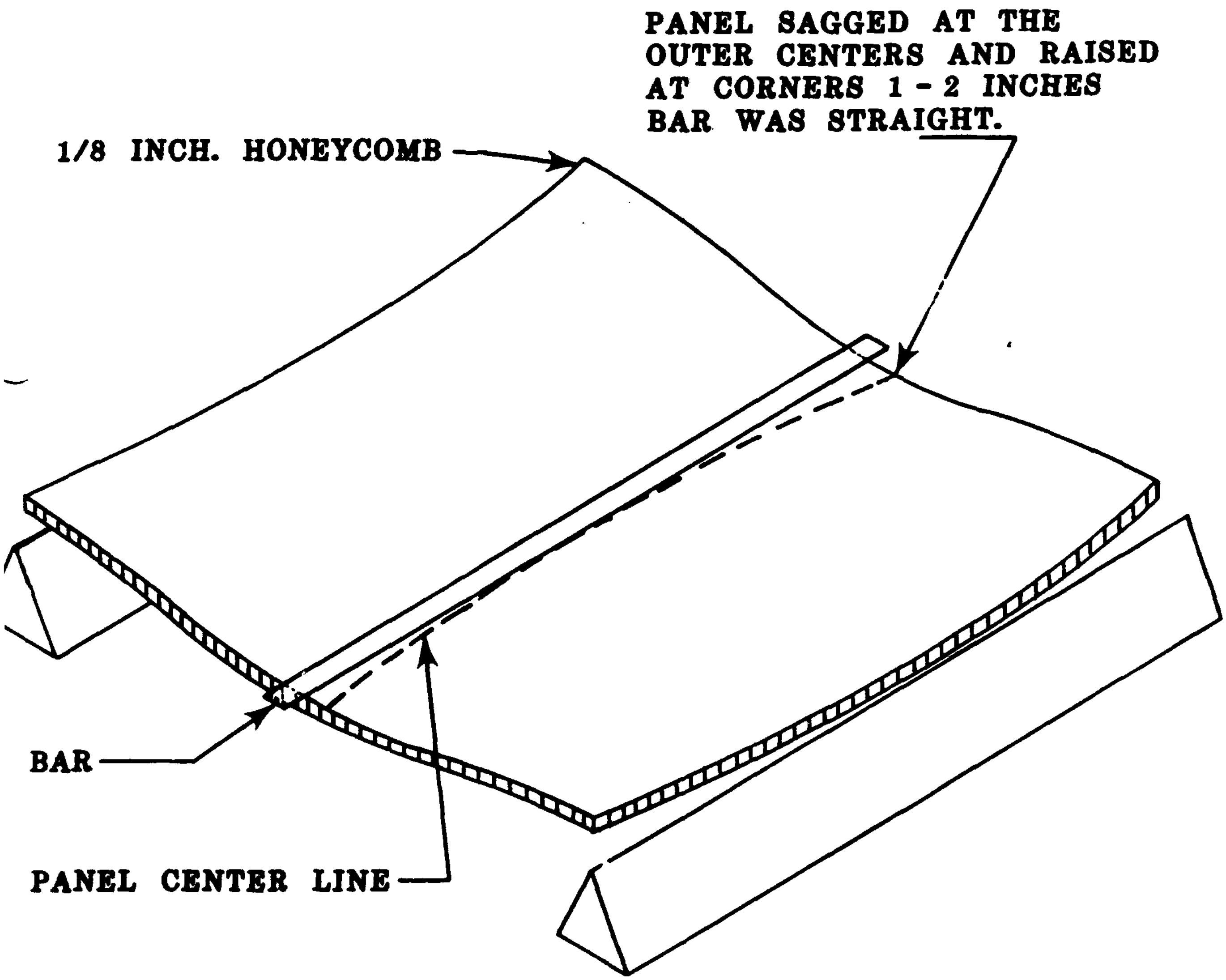
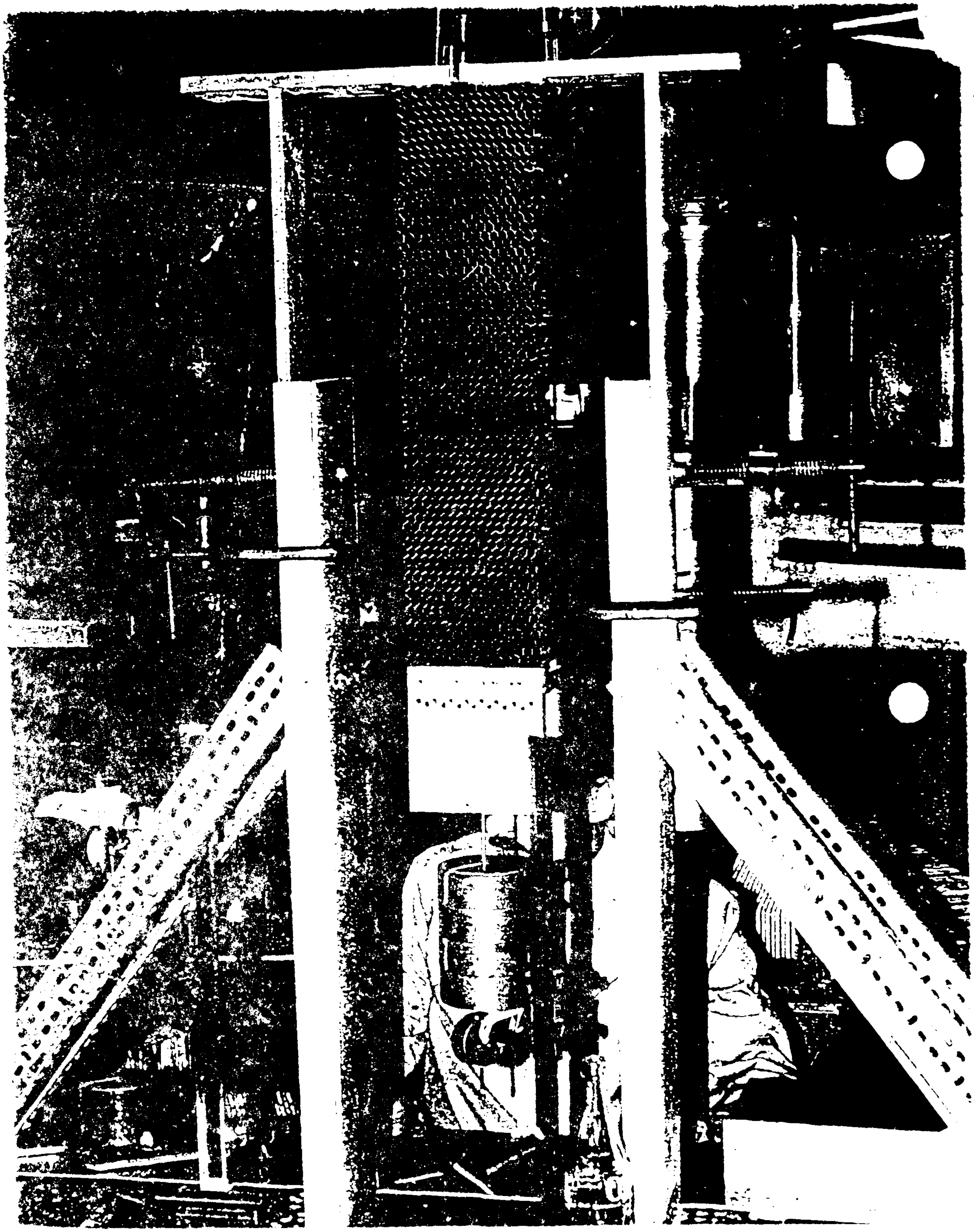

PANEL SAGGED AT THE OUTER CENTERS AND RAISED AT CORNERS 1 - 2 INCHES BAR WAS STRAIGHT.
1/8 INCH. HONEYCOMB
BAR
PANEL CENTER LINE

Figure 5



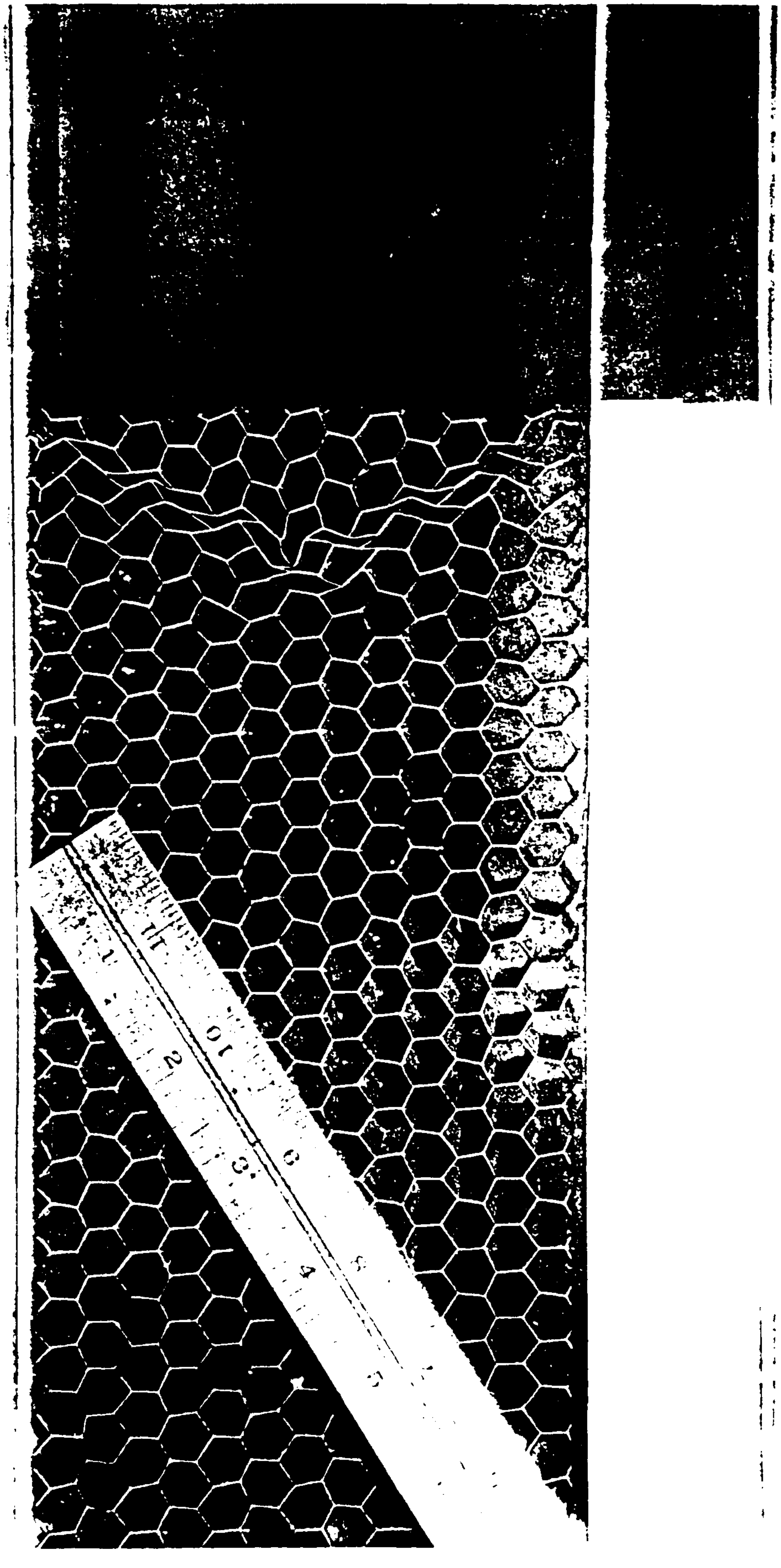


Figure 8

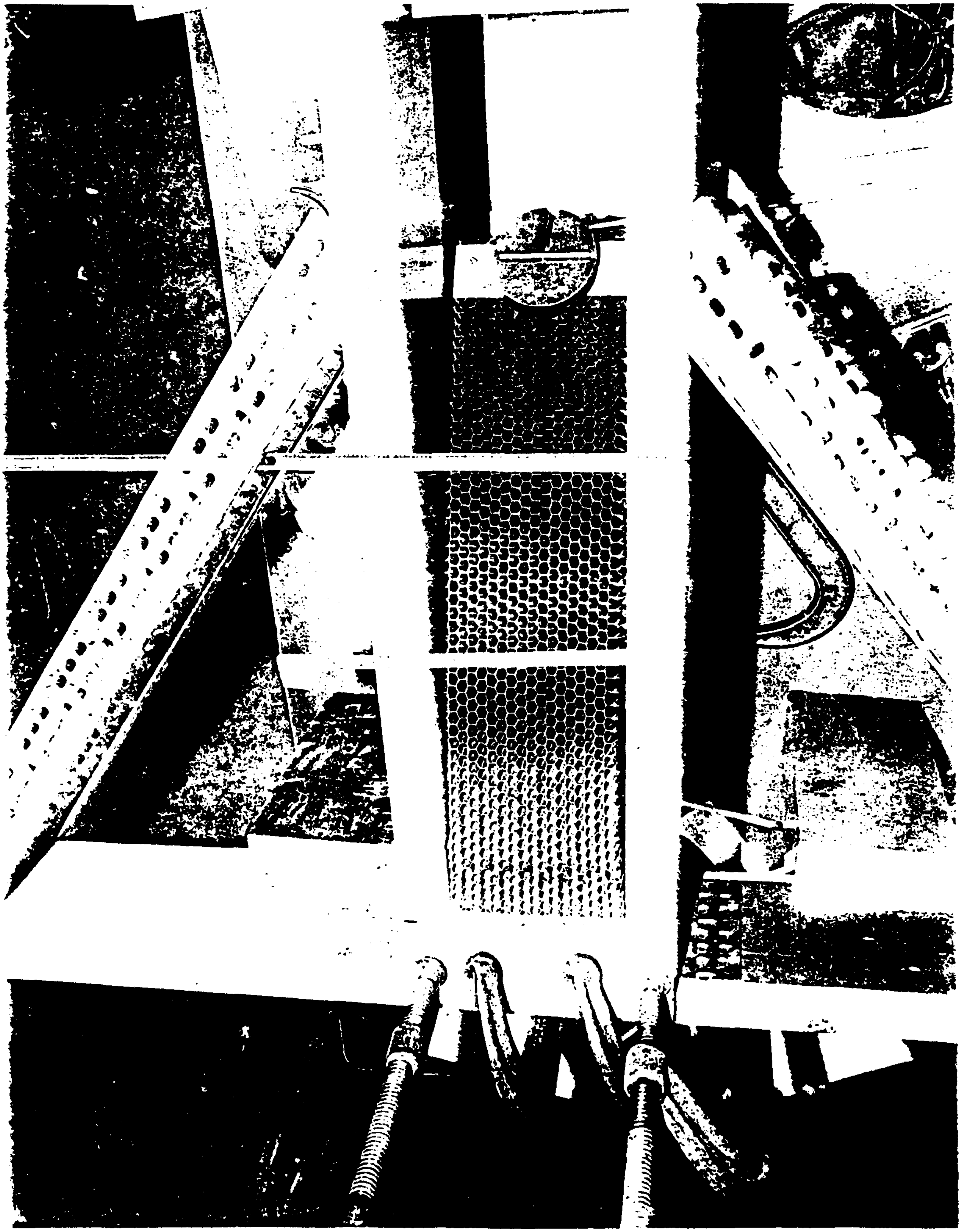
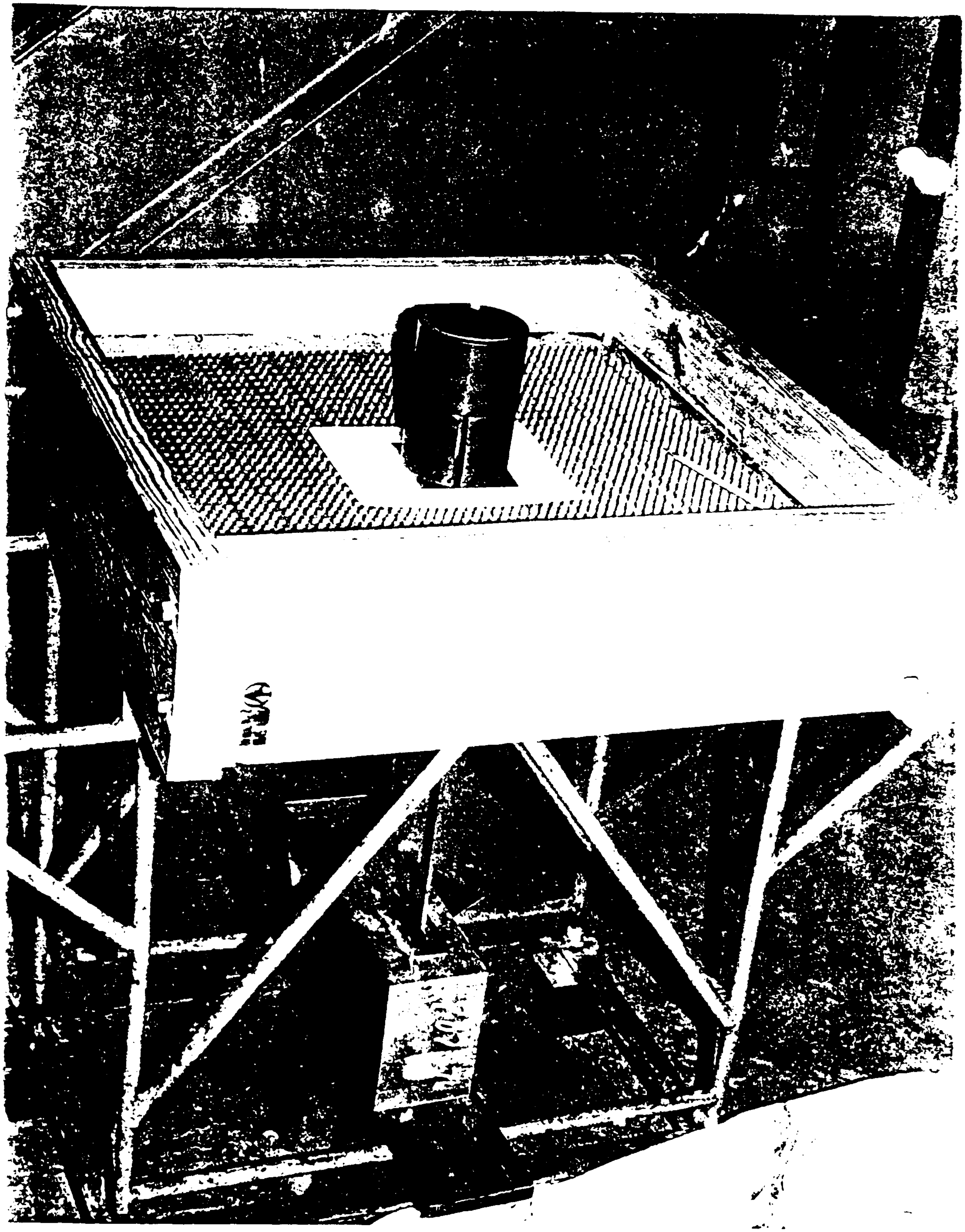
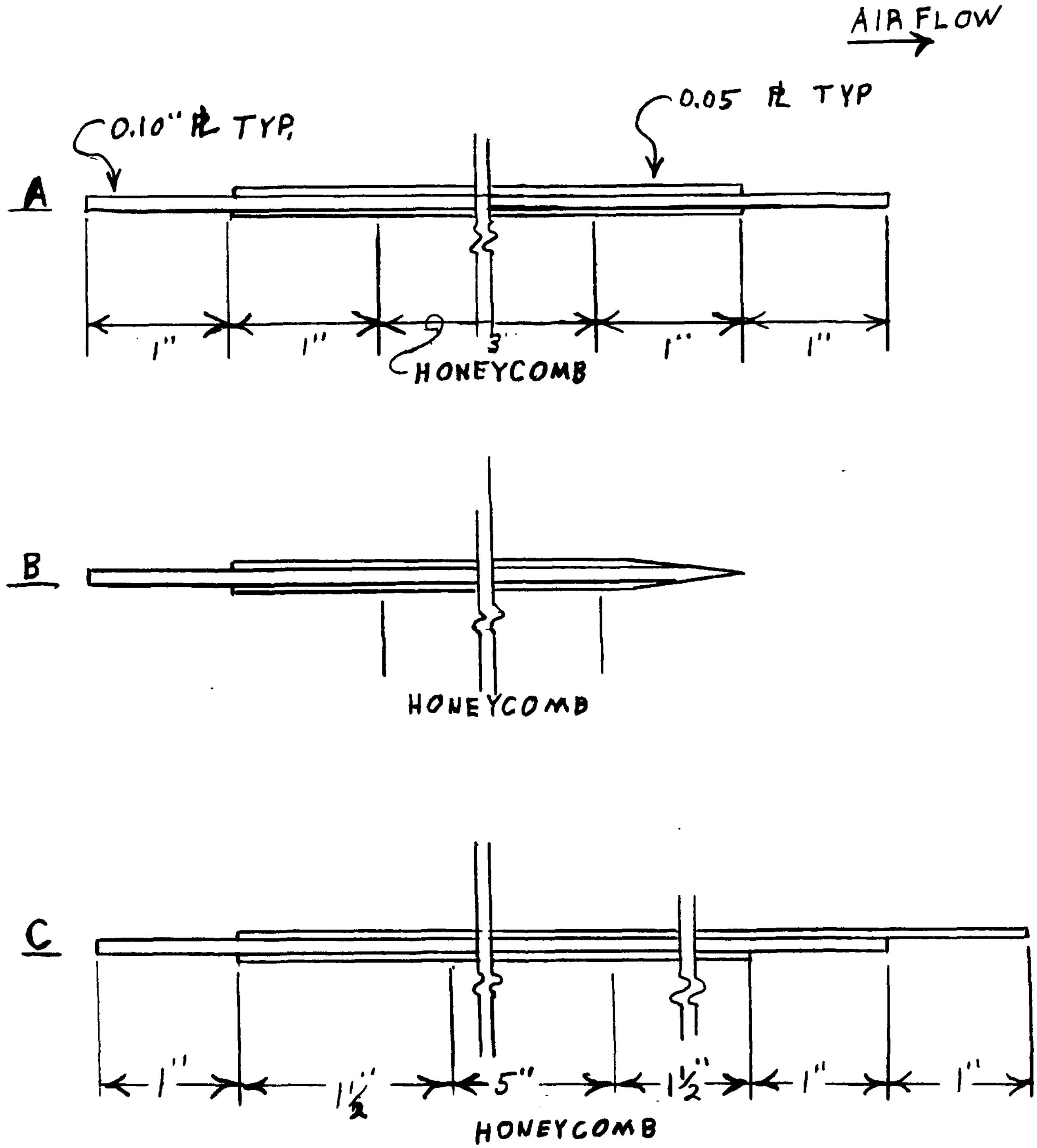


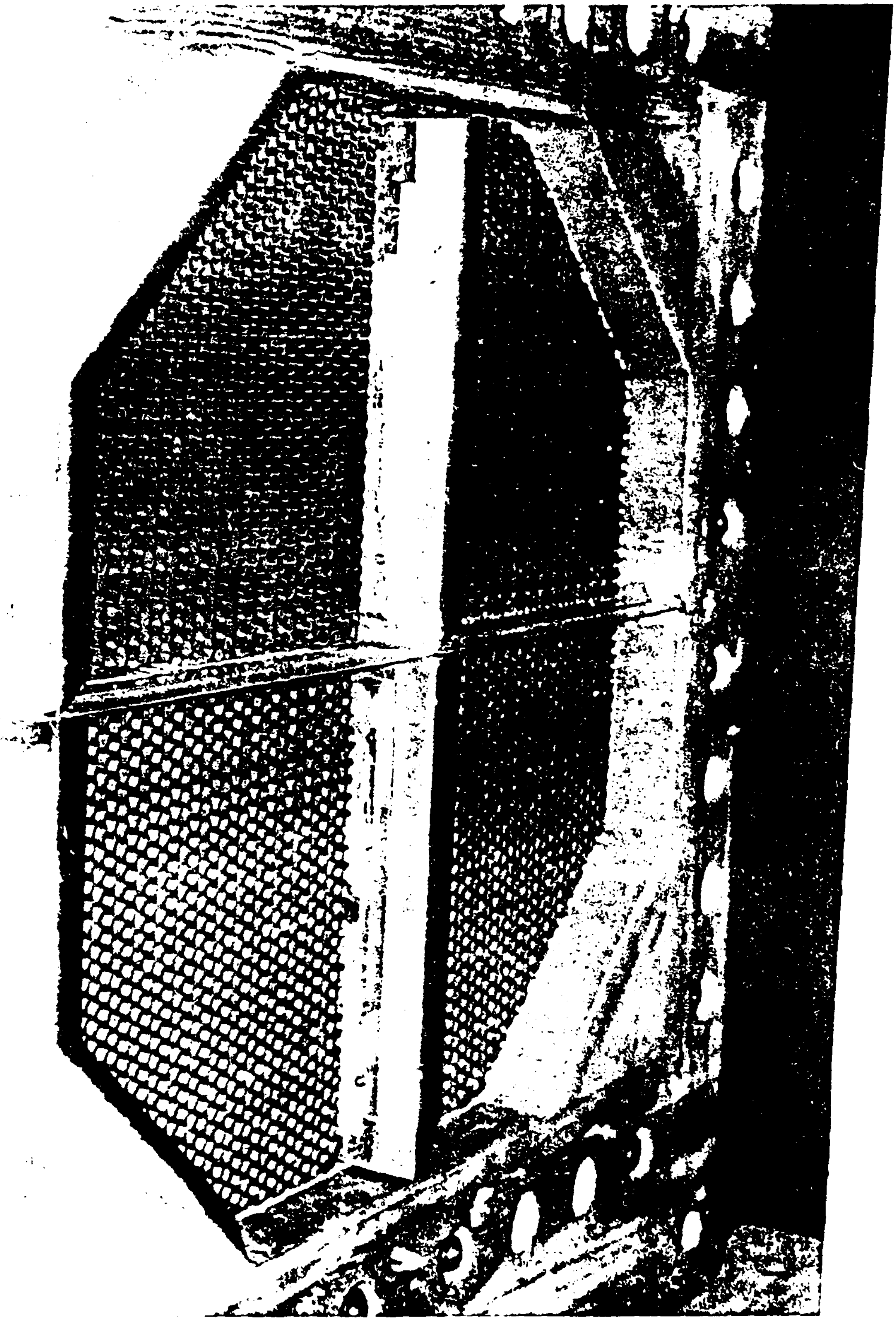
Figure 9

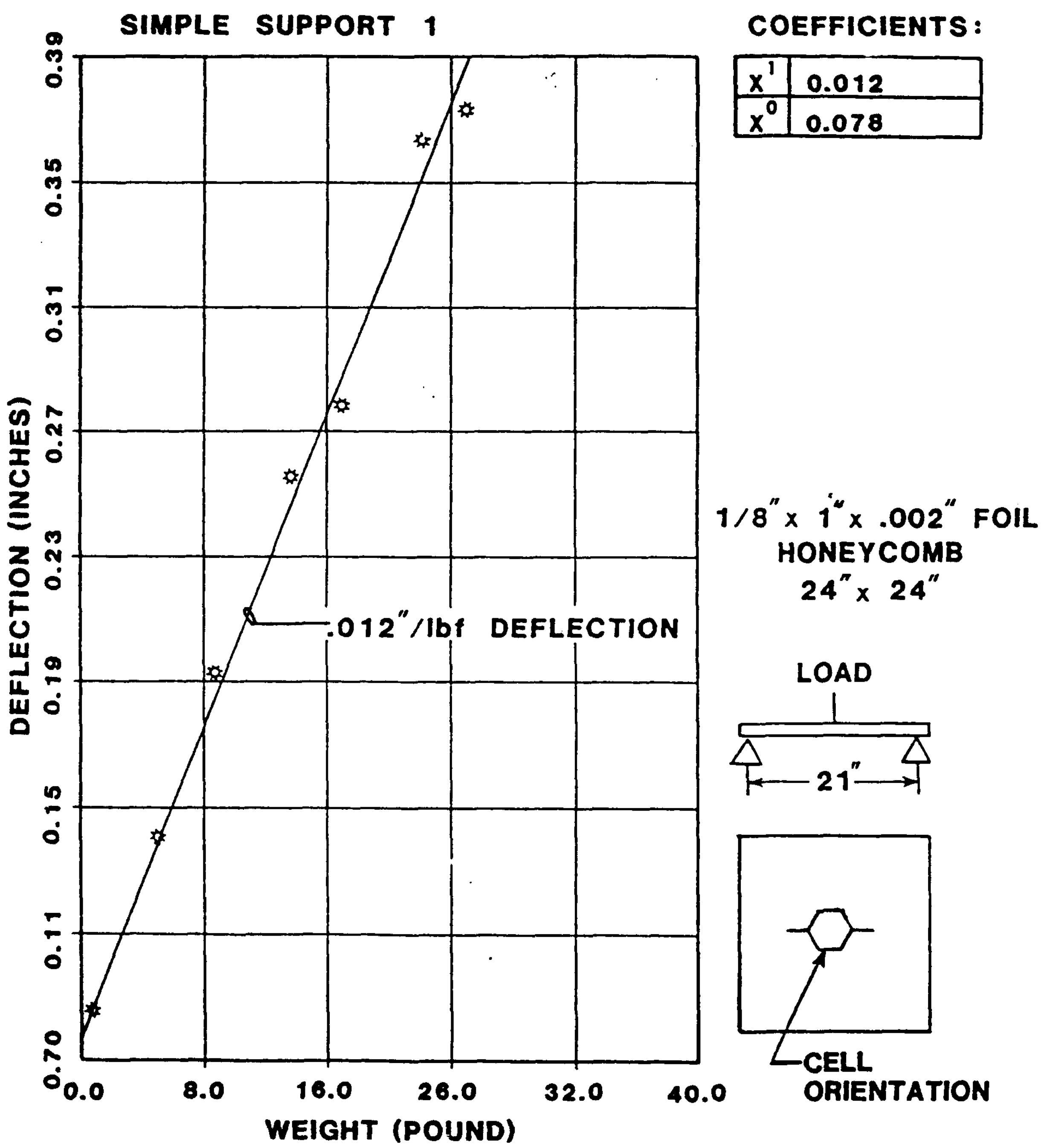




C. HAS BEEN INSTALLED IN THE SARL

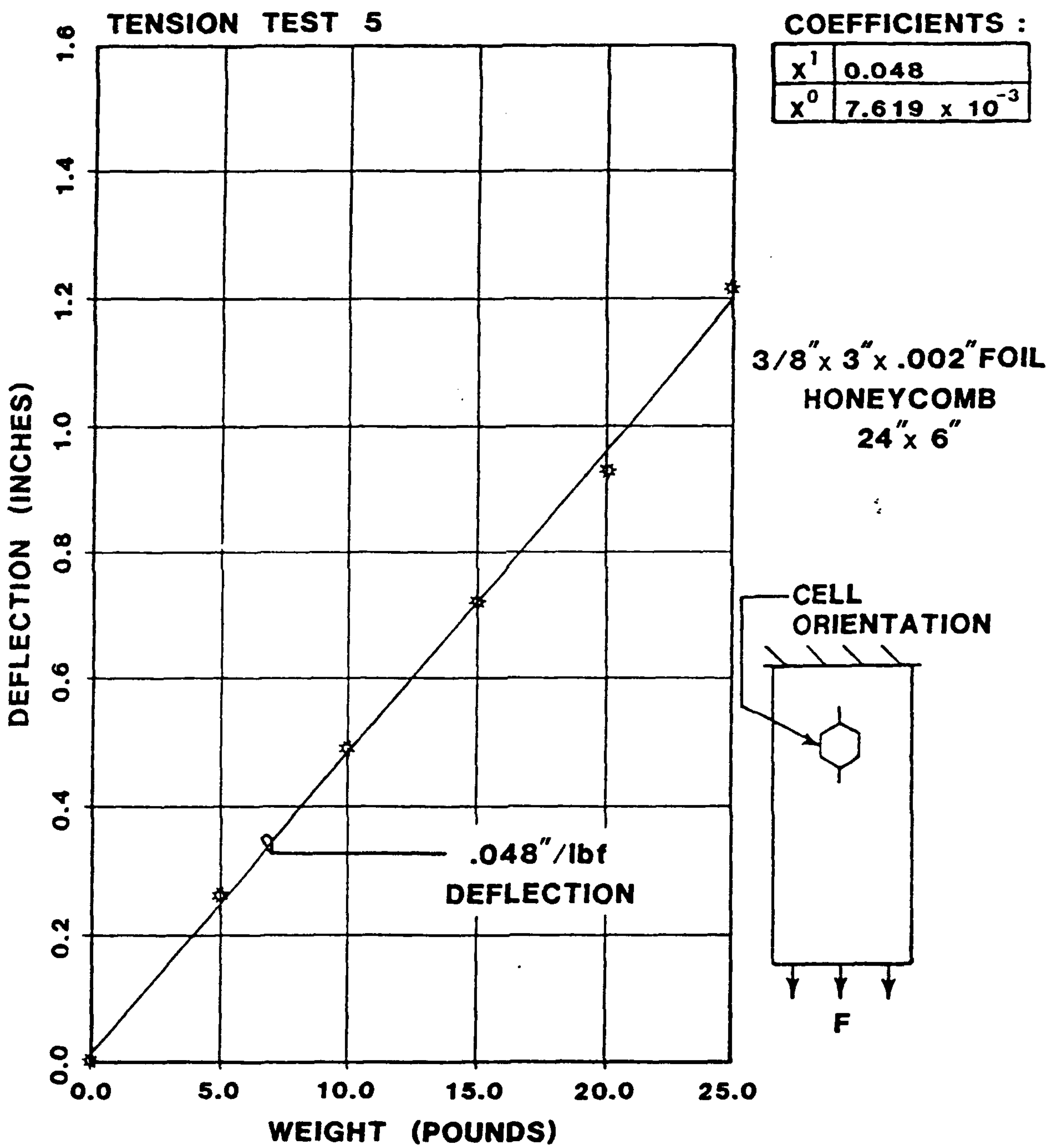
FIG 11



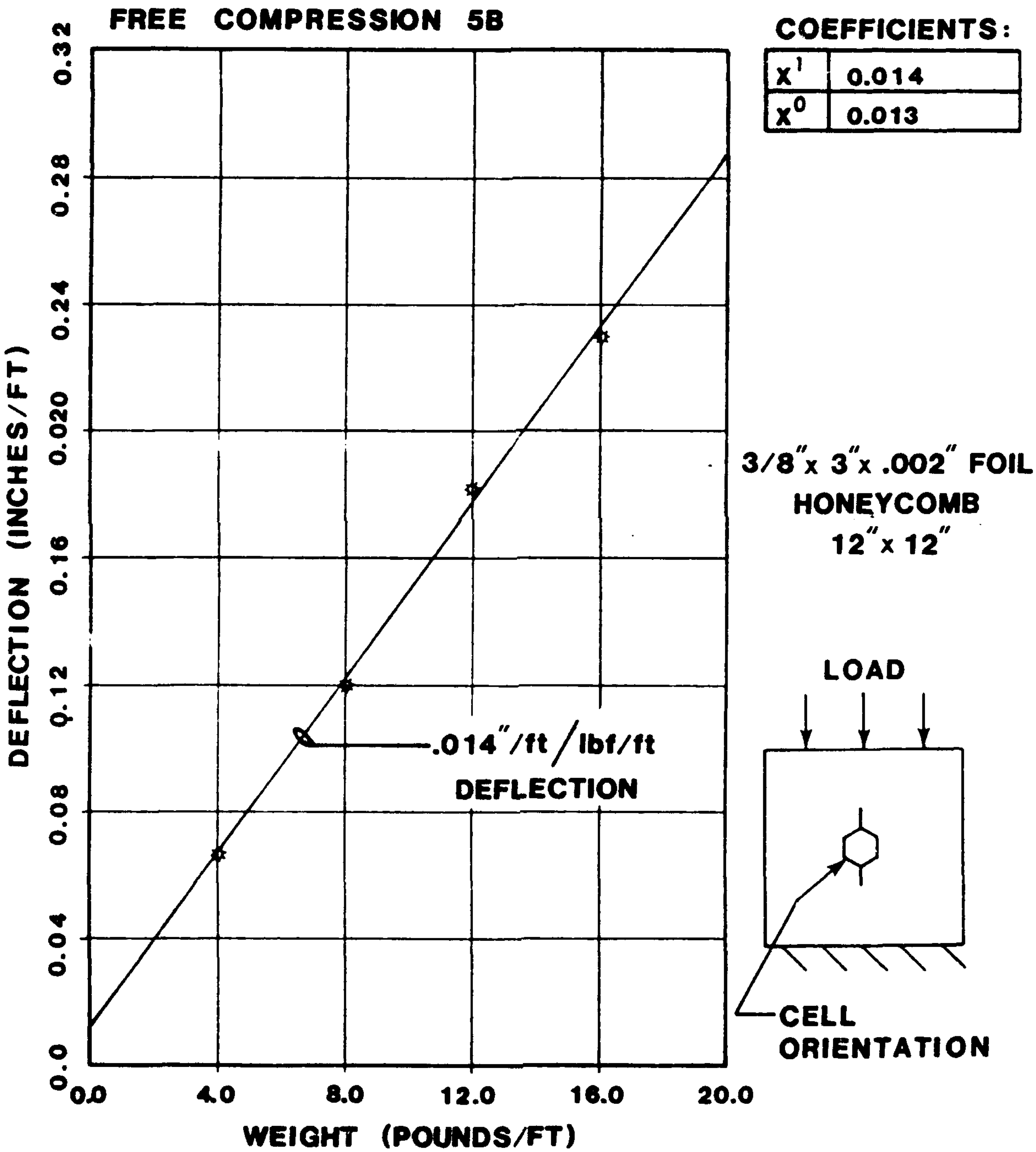


SIMPLE SUPPORT 1
COEFFICIENTS:
X^1 0.012
X^0 0.078
DEFLECTION (INCHES)
0.70
0.11
0.15
0.19
0.23
0.27
0.31
0.35
0.39
.012"/lbf DEFLECTION
0.0
8.0
16.0
26.0
32.0
40.0
WEIGHT (POUND)
1/8" x 1" x .002" FOIL
HONEYCOMB
24" x 24"
LOAD
21"
CELL
ORIENTATION

Graph 1

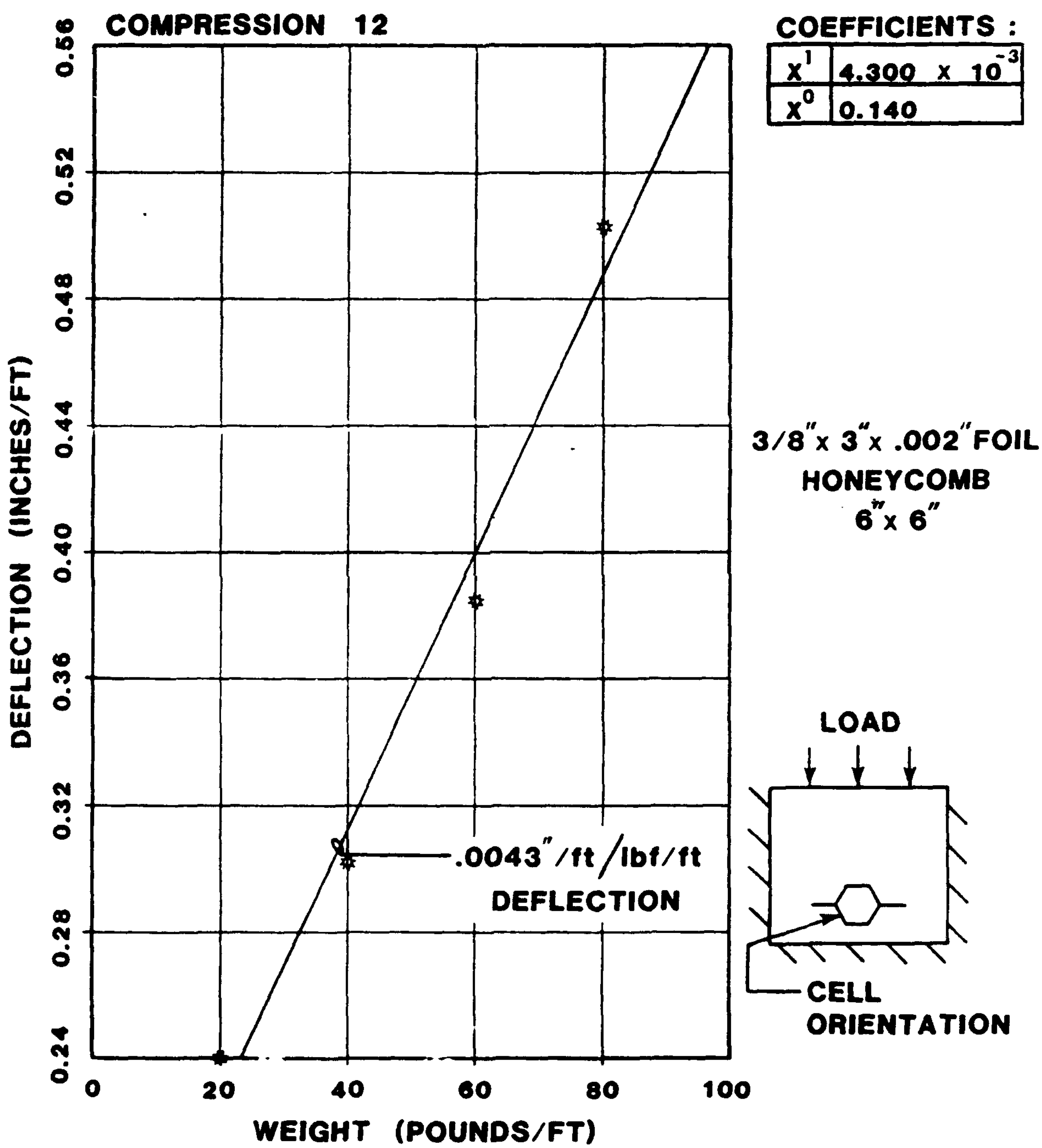

TENSION TEST 5
COEFFICIENTS :
X1 0.048
X0 7.619 x 10-3
3/8"x 3"x .002"FOIL
HONEYCOMB
24"x 6"
CELL
ORIENTATION
F
.048"/lbf
DEFLECTION
DEFLECTION (INCHES)
WEIGHT (POUNDS)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
0.0
5.0
10.0
15.0
20.0
25.0

Graph 2

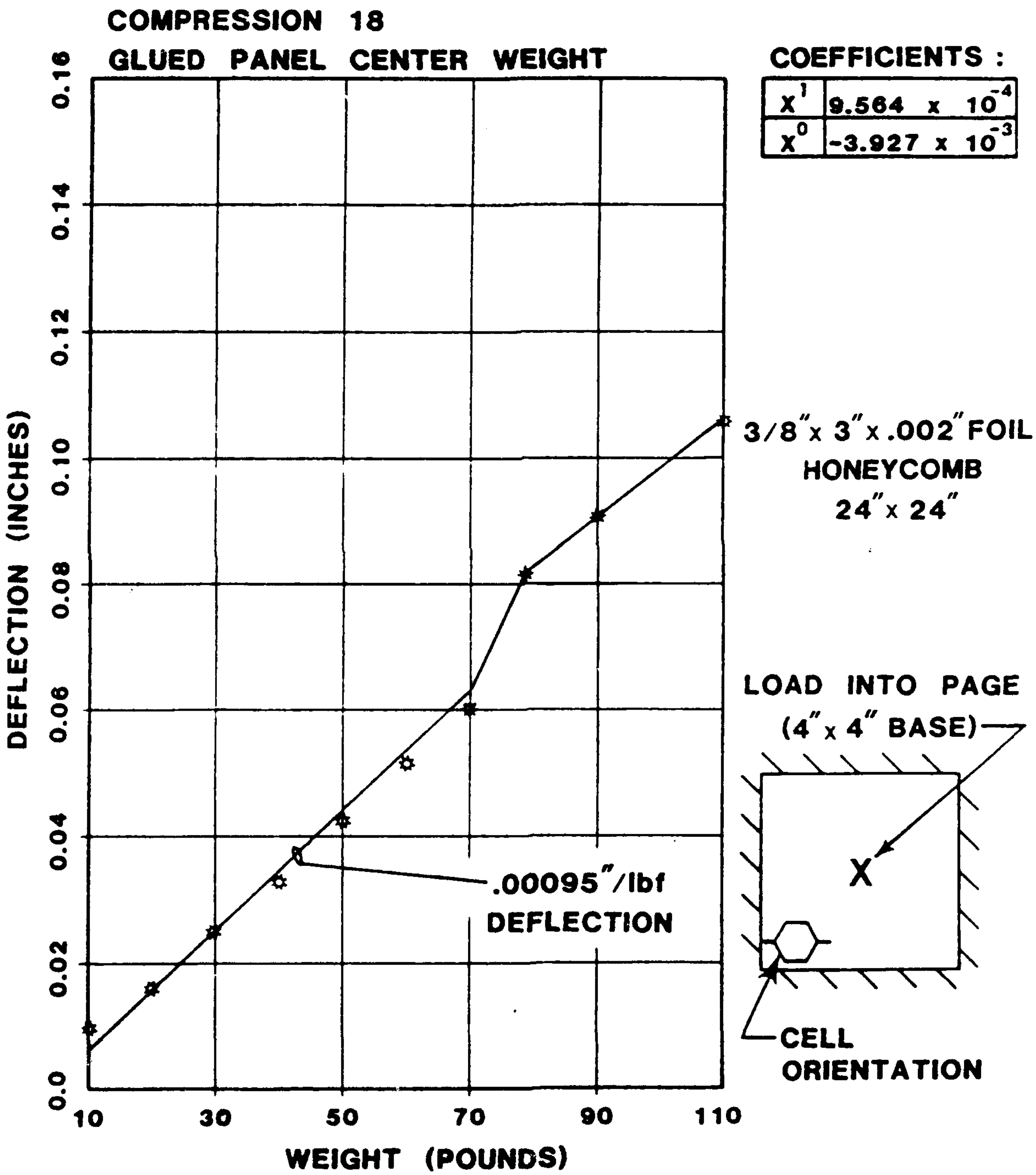


FREE COMPRESSION 5B
COEFFICIENTS:
X1 0.014
X0 0.013
DEFLECTION (INCHES/FT)
0.0
0.04
0.08
0.12
0.16
0.020
0.24
0.28
0.32
0.0
4.0
8.0
12.0
16.0
20.0
WEIGHT (POUNDS/FT)
.014"/ft / lbf/ft
DEFLECTION
3/8"x 3"x .002" FOIL
HONEYCOMB
12"x 12"
LOAD
CELL
ORIENTATION

Graph 3

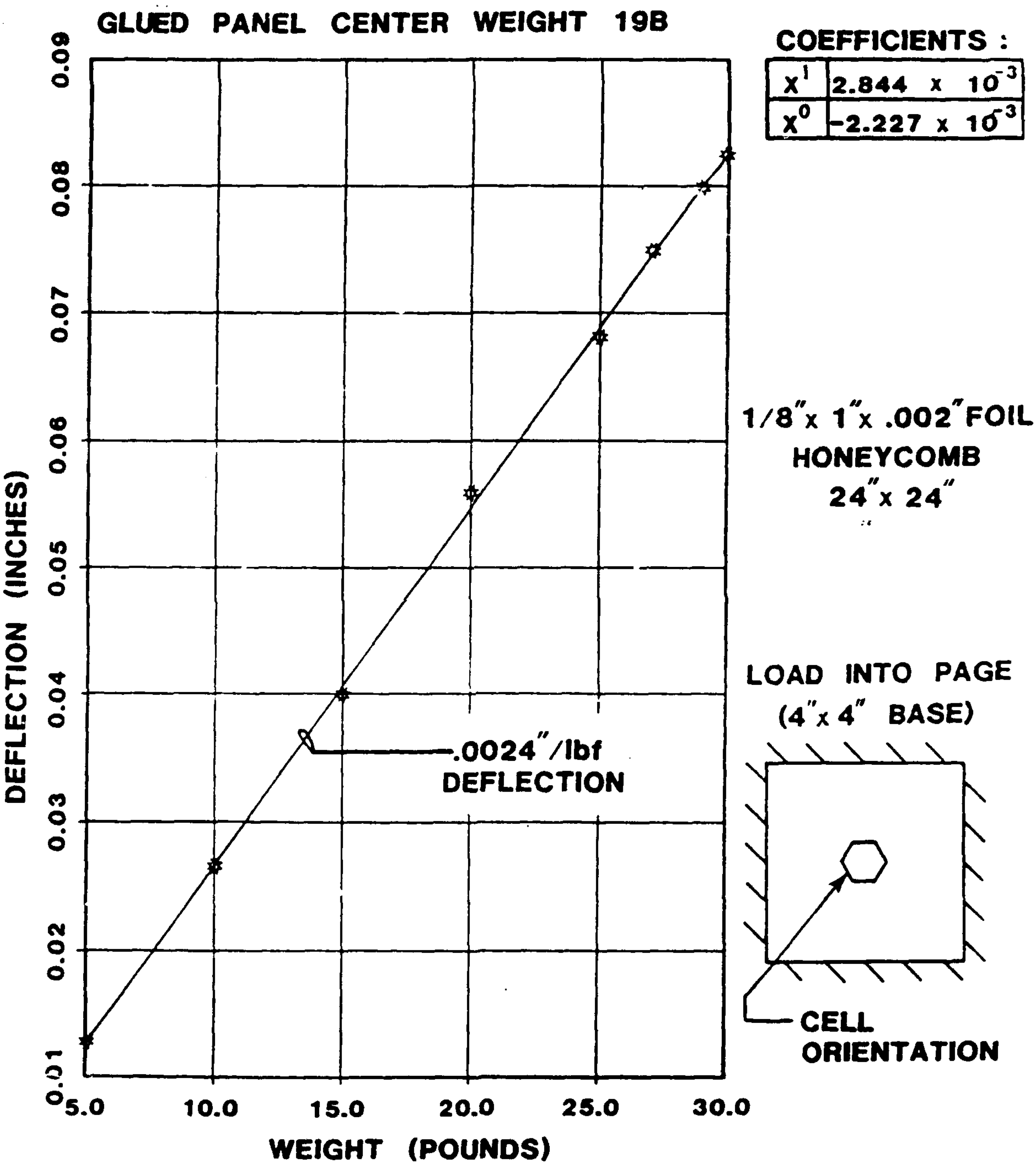

COMPRESSION 12
COEFFICIENTS :
X1 4.300 X 10-3
X0 0.140
3/8" x 3" x .002" FOIL
HONEYCOMB
6" x 6"
LOAD
CELL
ORIENTATION
.0043"/ft/lbf/ft
DEFLECTION
DEFLECTION (INCHES/FT)
0.24
0.28
0.32
0.36
0.40
0.44
0.48
0.52
0.56
0
20
40
60
80
100
WEIGHT (POUNDS/FT)

Graph 4



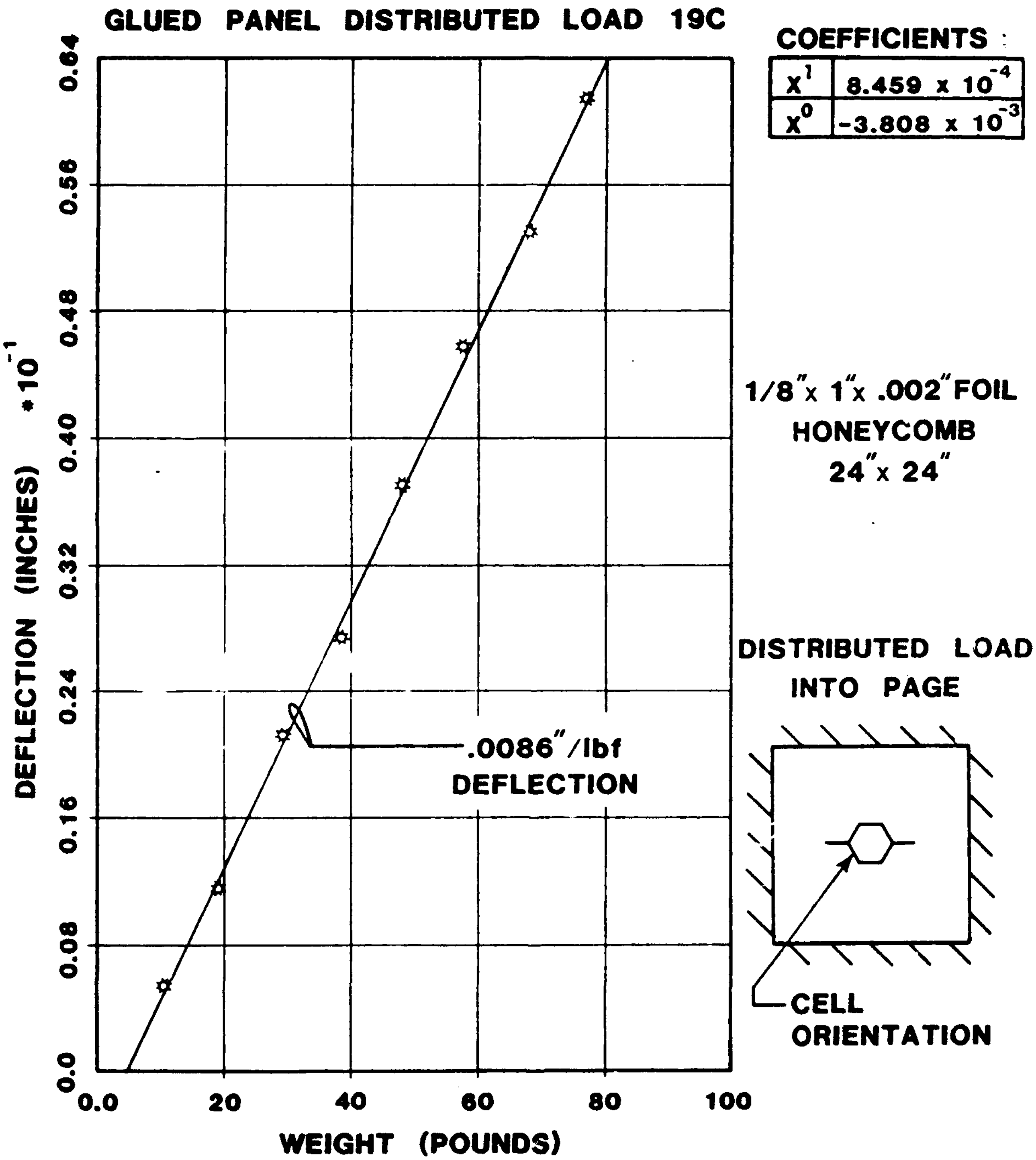
COMPRESSION 18
GLUED PANEL CENTER WEIGHT
COEFFICIENTS :
X^1 9.564×10^{-4}
X^0 -3.927×10^{-3}
DEFLECTION (INCHES)
0.0
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
10
30
50
70
90
110
WEIGHT (POUNDS)
.00095"/lbf
DEFLECTION
3/8" x 3" x .002" FOIL
HONEYCOMB
24" x 24"
LOAD INTO PAGE
(4" x 4" BASE)
X
CELL
ORIENTATION

Graph 5



GLUED PANEL CENTER WEIGHT 19B
COEFFICIENTS :
X1 2.844 x 10-3
X0 -2.227 x 10-3
DEFLECTION (INCHES)
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
5.0
10.0
15.0
20.0
25.0
30.0
WEIGHT (POUNDS)
.0024"/lbf DEFLECTION
1/8"x 1"x .002"FOIL HONEYCOMB 24"x 24"
LOAD INTO PAGE (4"x 4" BASE)
CELL ORIENTATION

Graph 6


GLUED PANEL DISTRIBUTED LOAD 19C
COEFFICIENTS :
x^1 | 8.459×10^{-4}
x^0 | -3.808×10^{-3}
1/8"x 1"x .002" FOIL
HONEYCOMB
24"x 24"
DISTRIBUTED LOAD
INTO PAGE
CELL
ORIENTATION
.0086"/lbf
DEFLECTION
DEFLECTION (INCHES) $*10^{-1}$
0.0
0.08
0.16
0.24
0.32
0.40
0.48
0.56
0.64
0.0
20
40
60
80
100
WEIGHT (POUNDS)

Graph 7

Appendix F

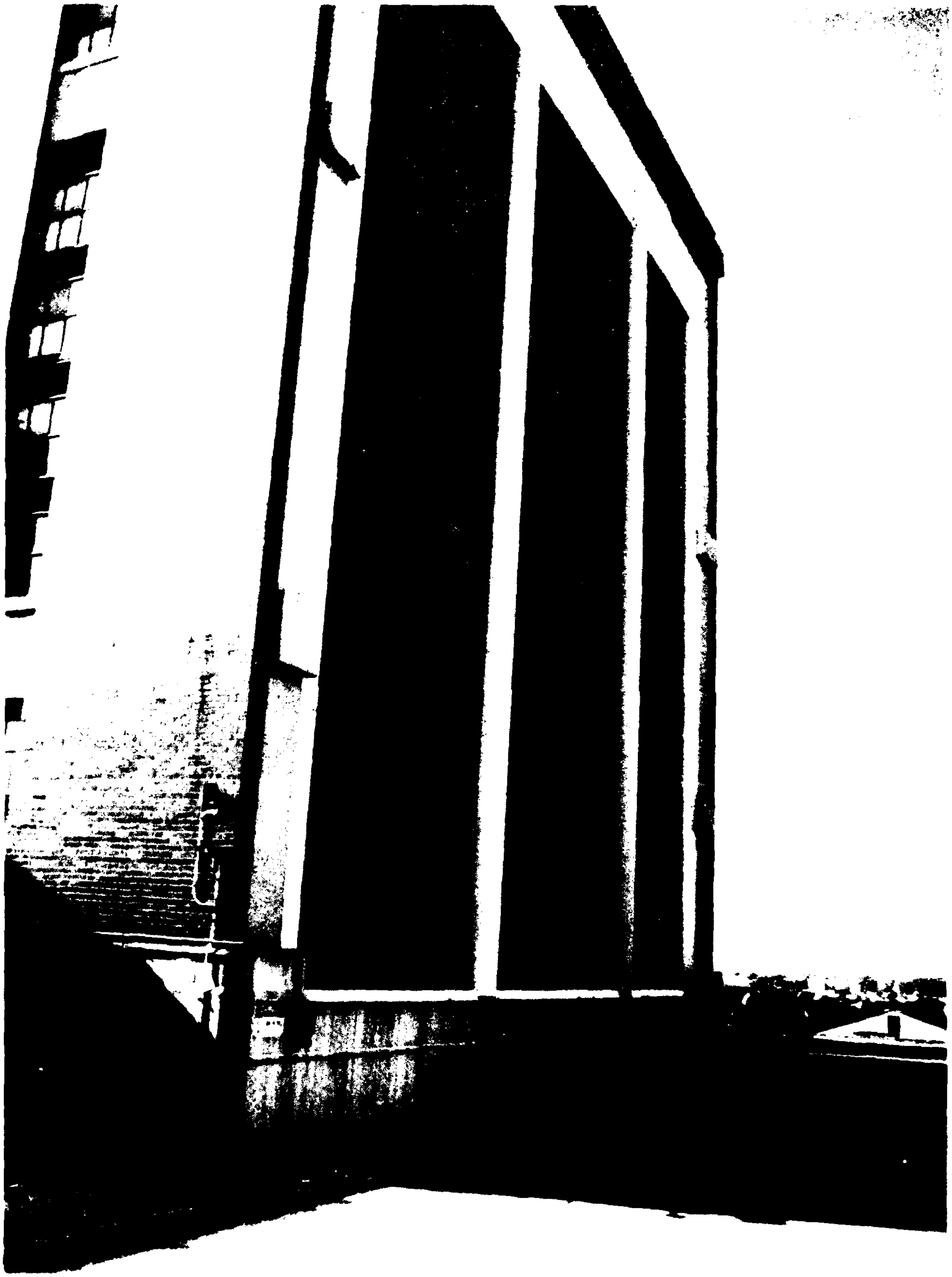
Photographs

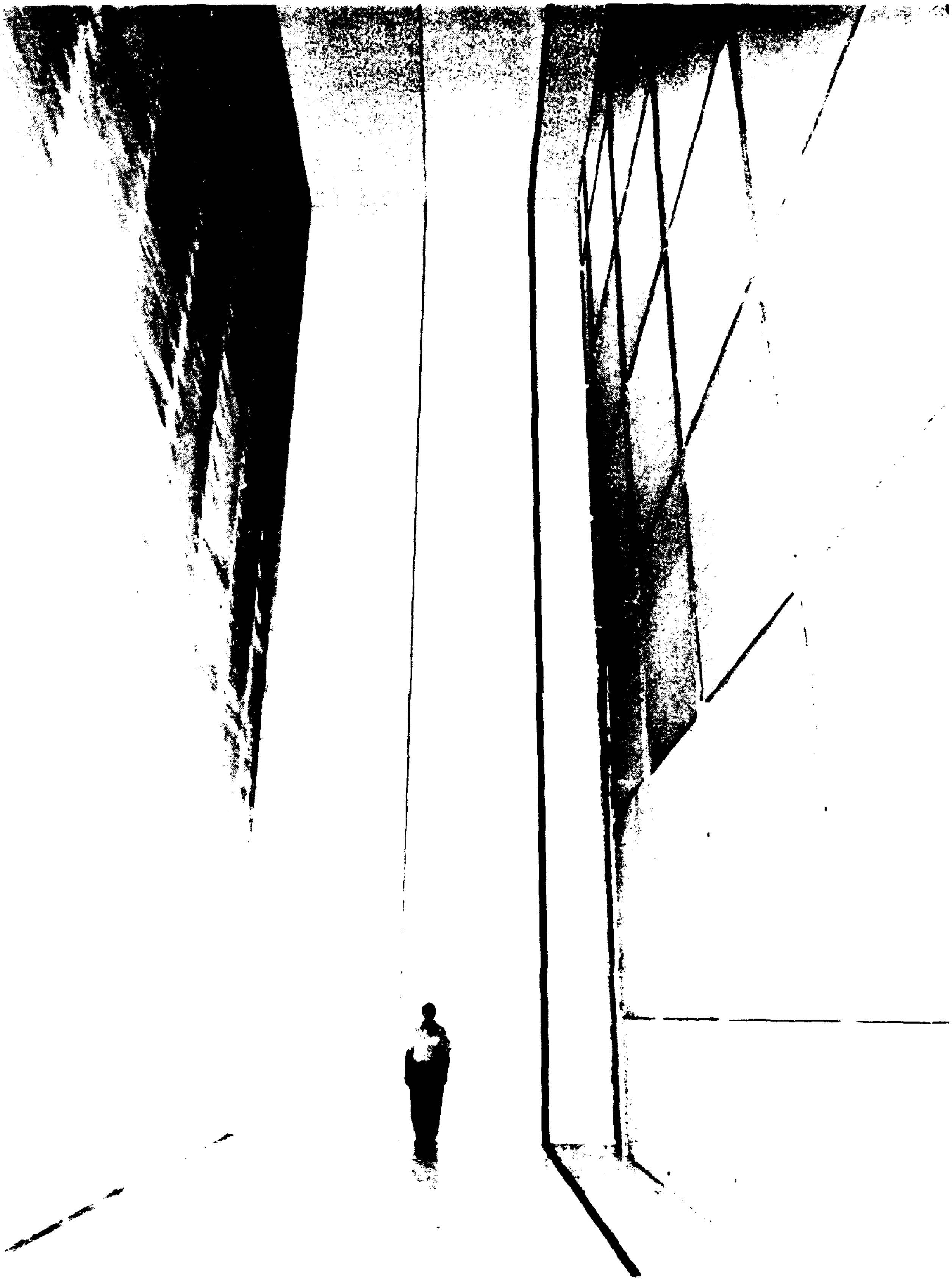
THE FOLLOWING IS A LIST OF PHOTOGRAPHIC RECORDS OF THE SARL: Started 6-22-90
(NEGATIVES & PROOF SHEETS) [TOM.FILES]PHOTO.FILE Updated on 3-26-92

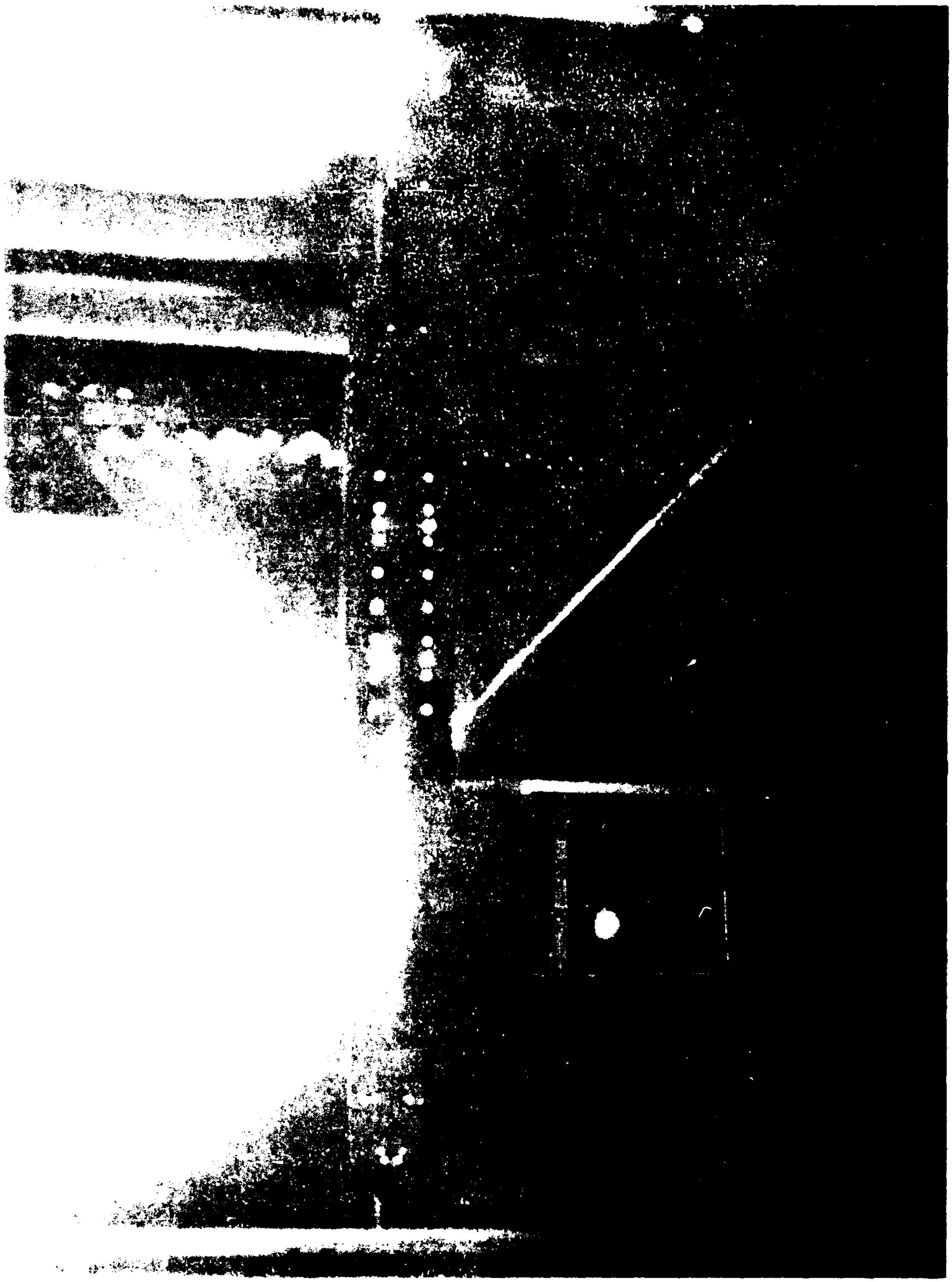
NOTE: Photo charge # V*FIM1, * indicates the last digit of the year,
Tech photo phone # 52585

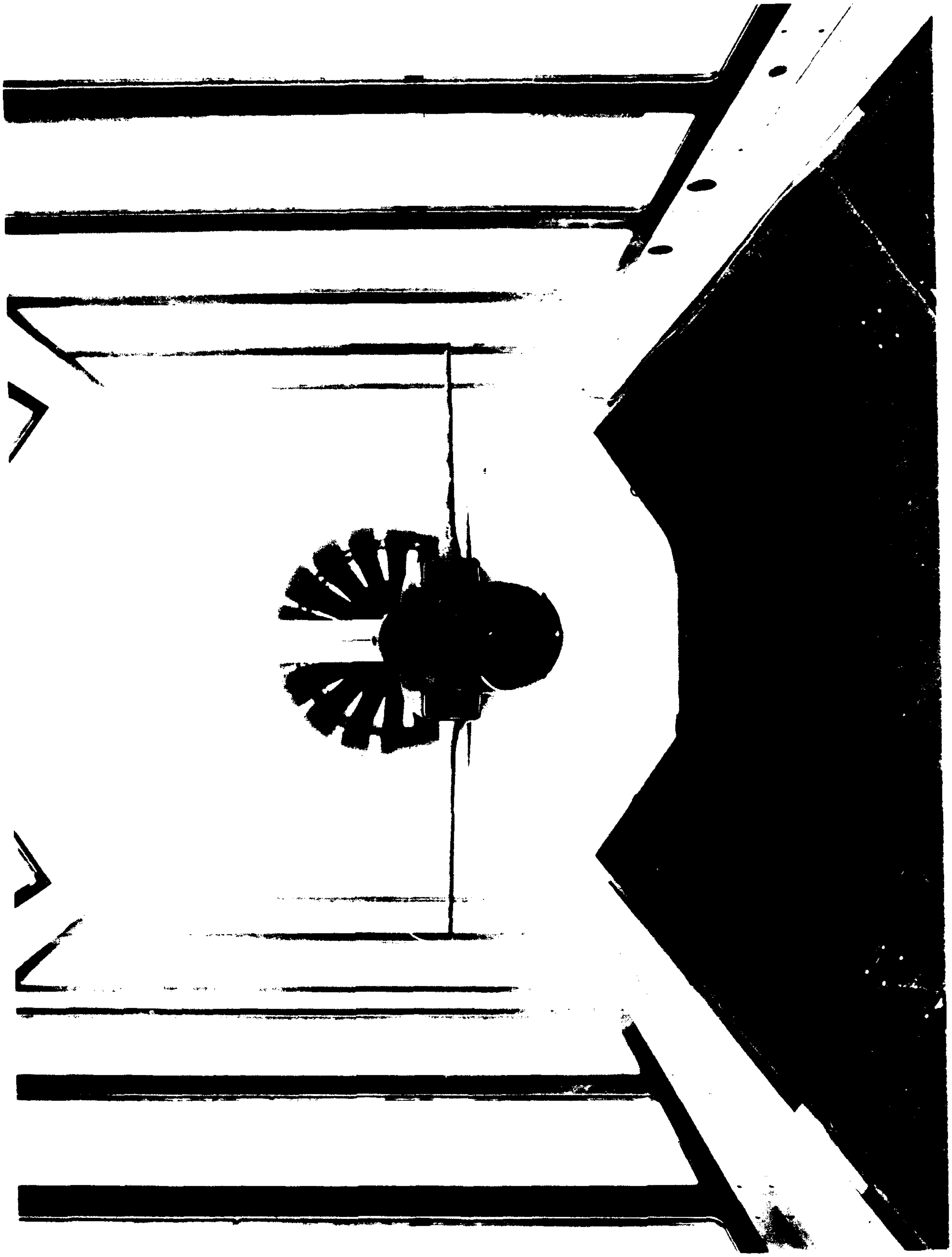
FILE #	TECH PH #	DATE	DESCRIPTION
-12		82	Install diffuser
-11		82	Install diffuser & smoke channel
-10		82	Install diffuser inside and outside the building
-9		82	Install diffuser & aerial complex shot
-8		82	Install diffuser and fan shaft
-7	70906	82	Install diffuser
-6	70964	82	Renovate bldg25c floor, install diffuser
-5	2540?	-	Smoke channel molds (no negatives)
-4	70460	85	Smoke channel
-3	10016	86	Smoke channel
-2	21278	88	N. end of SARL, Instl of high loss screens
-1	21529	88	N. end of SARL, TGF cooling coil
0	1870	83	SARL blade boxes
1	4996	88	SARL temp model support fairing failure
2	22667	87	SARL dedication displays
3	22661	87	SARL dedication displays
3a	22662	87	SARL dedication displays
4	22663	87	SARL dedication displays
5	22656	87	SARL dedication displays
6	22655	87	SARL dedication displays
7	9000	87	SARL dedication displays
8	9001	87	SARL dedication displays
9	9002	87	SARL dedication displays
10	9003	87	SARL dedication ceremony
11	42198	87	SARL dedication ceremony
12	42197	87	SARL dedication ceremony
13	8196	87	SARL dedication ceremony
14	9004	87	Philip P. Antonatos Plaque
15	9005	87	SARL dedication displays
16	9006	87	SARL dedication displays
17	9007	87	SARL dedication displays
18	9008	87	SARL dedication displays
19	9009	87	SARL dedication displays
20	9010	87	SARL dedication displays
21	9011	87	SARL dedication displays
22	9012	87	SARL dedication displays
23	9013	87	SARL dedication displays
24	9014	87	SARL dedication displays
25	9016	Fall 89	N. end of facility, Model support shutters
26	23291	Sum 89	SARL early model support
27	7841	fall 89	Model support, Drive shaft removal
28&29	5558	89	N. end of bldg, Control room, Screens & honeycomb
30	1227	87	X-29 in sarl test section
31	1228	87	X-29 in sarl test section
32		Fall 89	Model support
33		Fall 89	Model support, Control room, Shaft instl
34		Spr 90	Model support head removal, Control room, MG s
35		Spr 90	Model support head removal, Deflector, MG s
36		Spr 90	Model support head removal, SR 71 landing
37		Sum 90	Failed starting reactor
38		Spr 90	Test section door actuator, model supp, cal rake

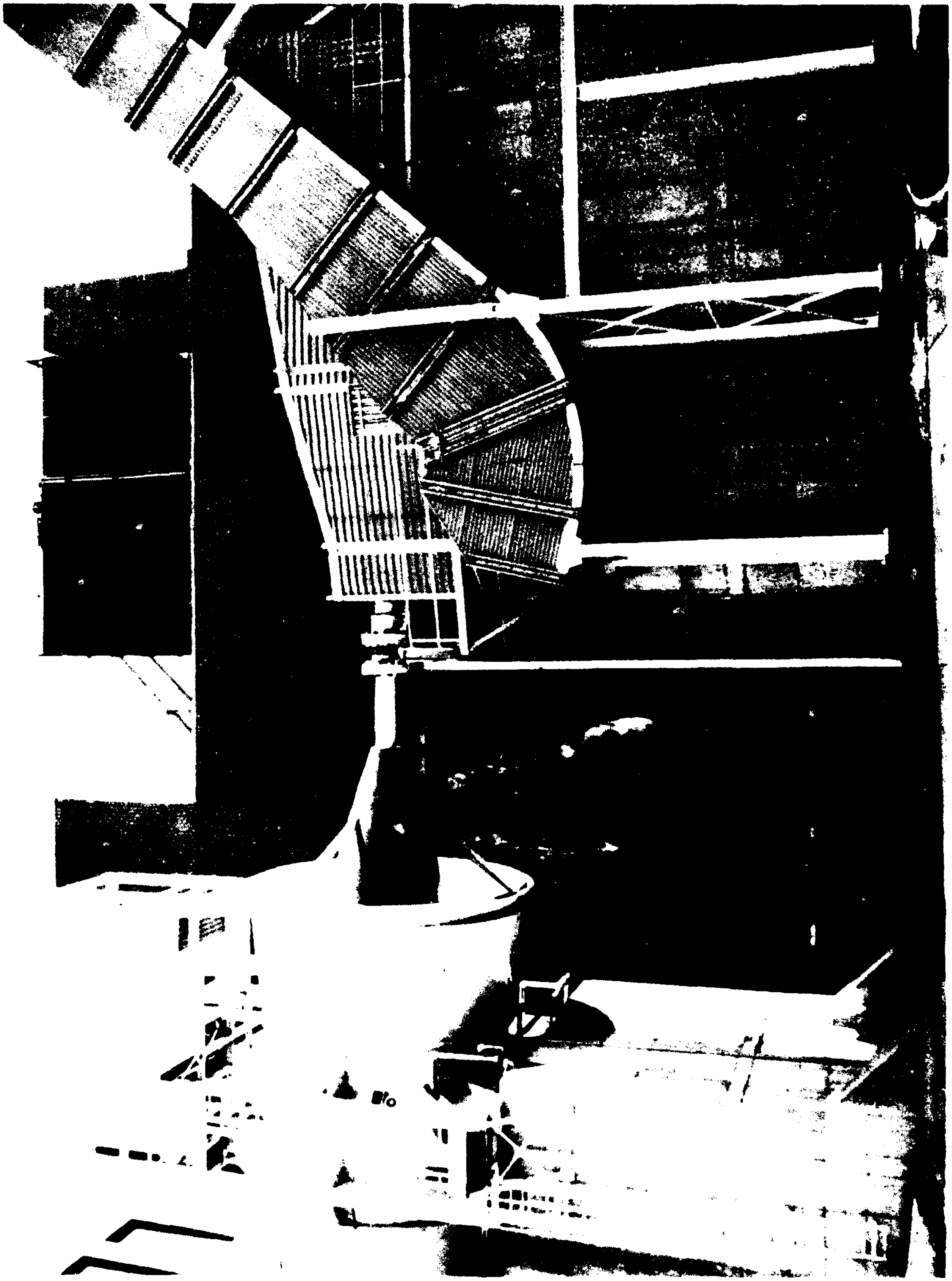
39	8719	Fal 90	Calibration rake, test section door actuator
40		Win 90	Model support, Exhaust deflector
41		Dec 90	Various SAR1 photos (general)

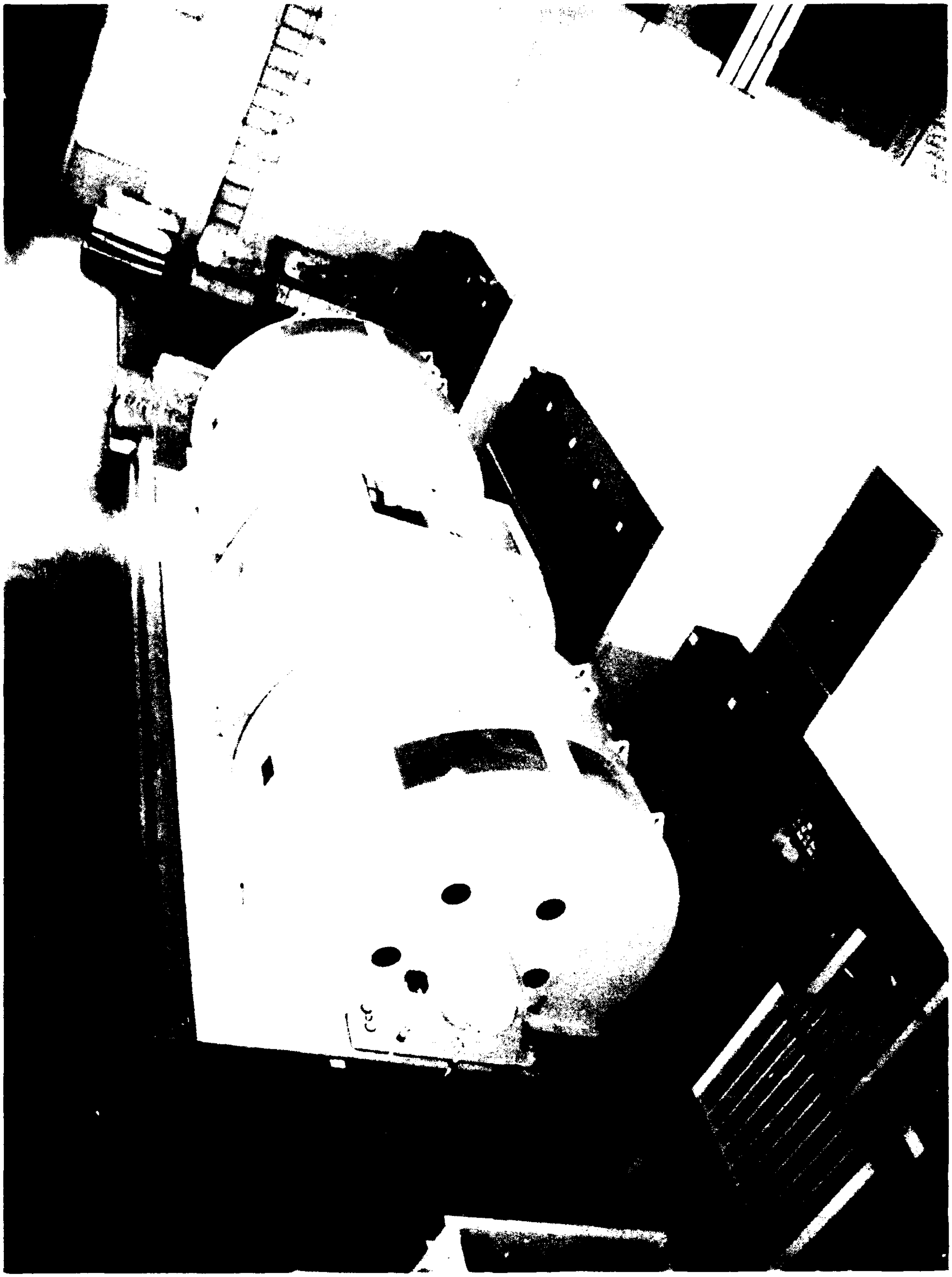












Appendix B

List of Drawings

MEMO FOR THE RECORD

01 JUL 1988

SUBJECT: Facility Drawings

The attached list of drawings will not be retired at the close-out of this effort due to importance.

Drawings will be used to modify and update the facility in upcoming years. They will also be used in daily operation to facilitate testing operations (inserting models).

Tom A. Presdorf

TOM A. PRESDORF, Mech Engr
Mechanical Systems Group
Experimental Engineering Branch

Jul/88

4	1	0	USAF/EJW	X83F042		Gearbox Specification	F1	
4	1	0	USAF/DJR	X83F102		Test Sect. Sidewall Access Concept	F1	
4	1	0	USAF/EJW	X83F232		L.V. Positioning Concept	F1	
13	1	0	USAF/EJW	X83J257		S.A.R.L. (layout-plan)	F1	
13	1	0	USAF/EJW	X83J258		S.A.R.L. (layout-elev)	F1	
5	1	0	USAF/EJW	X84F002		Motor Cover Design Proposal	F1	Not used
5	1	0	USAF/MAB	X84F006		(2 Sh) Proposed Entry Pairings	F1	
5	1	0	USAF/MSM	X84F010		Platform Concepts	F1	
5	1	0	USAF/EJW	X84F016		Removable Motor Cover Concept	F1	
5	1	0	USAF/EJW	X84C081		Proposed Lubrication System Mounting Configuration	F2	
5	1	0	USAF/EJW	X84F100		Level Floor Instrument Platform Concept	F2	
6	1	0	USAF/EJW	X85F149		Roll-up Door Configuration (2 Shts)	F1	
6	1	0	USAF/PJS	X85F152		Sarl Exhaust Elbow-47 Deg. Proposal	F1	
6	1	0	USAF/PJS	X85F182		Sarl Aero Lines	F1	
6	1	0	USAF/PJS	X86F039		SARL Hatch/Viewport Layout	F1	
7	2	0	FluiDyne	1305-020		Site Map and Drawing List	A1	
7	2	0	FluiDyne	1305-021	A	Aerodynamic Lines and Loads	A1	
12	2	0	FluiDyne	1305-022		Foundation Loads	A1	Obsolete
12	2	0	FluiDyne	1305-023		Overall Tunnel Assembly	1	Obsolete
7	2	0	FluiDyne	1305-024		Platform Concepts	A1	
12	2	0	FluiDyne	1305-025	B	Overall Contraction Assembly	B1	Obsolete
7	2	0	FluiDyne	1305-026	A	Honeycomb Shell	A1	Obsolete
7	2	0	FluiDyne	1305-027		Honeycomb Details	A1	Obsolete
12	2	0	FluiDyne	1305-028		Upstream Contraction (Weldment)	1	Obsolete
12	2	0	FluiDyne	1305-029		Upstream Contraction-Details	1	Obsolete
12	2	0	FluiDyne	1305-030		Upstream Contraction (Weldment)	1	Obsolete
12	2	0	FluiDyne	1305-031		Upstream Contraction - Details	1	Obsolete
7	2	1	FluiDyne	1305-032		Sidewall Hole Locations	B1	Obsolete
7	2	1	FluiDyne	1305-033		Sidewall Hole Locations	B1	Obsolete
7	2	1	FluiDyne	1305-035	A	Bottom Wall Hole Locations	B1	Obsolete
7	2	0	FluiDyne	1305-036		Overall Screen Assembly	1	Obsolete
7	2	0	FluiDyne	1305-037		Screen Assembly - Plan	1	Obsolete
7	2	1	FluiDyne	1305-038	A	Screen Assembly - Detail	B1	Obsolete
12	2	0	FluiDyne	1305-039		Screen Clamping Assembly	1	Obsolete
12	2	0	FluiDyne	1305-040		Clamp/Spring Details	1	Obsolete
7	2	1	FluiDyne	1305-041	A	Liner Panel Details	B1	Obsolete
7	2	1	FluiDyne	1305-042	A	Liner Panel Details - Bottom	B1	Obsolete
12	2	0	FluiDyne	1305-043		Downstream Contraction Assembly	1	Obsolete
12	2	0	FluiDyne	1305-044		Sidewall Weldment	1	Obsolete
12	2	0	FluiDyne	1305-045		Top Wall Weldment	1	Obsolete
12	2	0	FluiDyne	1305-046		Bottom Wall Weldment	1	Obsolete
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12	2	0	FluiDyne	1305-049		Support Frame Upstream Contr.	1	Obsolete
12	2	1	FluiDyne	1305-051		Support Frame Details	B1	Obsolete
12	2	1	FluiDyne	1305-052		Support Frame Details	B1	Obsolete
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12	2	0	FluiDyne	1305-054		Side Panel Assembly	1	Obsolete
12	2	0	FluiDyne	1305-055		Side Panel Weldment	1	Obsolete
12	2	0	FluiDyne	1305-056		Side Panel Weldment Details	1	Obsolete
12	2	0	FluiDyne	1305-057		Window Assembly	1	Obsolete
12	2	0	FluiDyne	1305-058		Window Details	1	Obsolete
12	2	0	FluiDyne	1305-059		Filler Plates	1	Obsolete
12	2	0	FluiDyne	1305-060		Corner Panel Assembly	1	Obsolete
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12	2	0	FluiDyne	1305-062		Filler Plates	1	Obsolete
12	2	0	FluiDyne	1305-063		Top Panel Assembly	1	Obsolete
12	2	0	FluiDyne	1305-064		Top Panel Weldment	1	Obsolete

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12	2	0	FluiDyne	1305-066		Bottom Panel Weldment	1	Obsolete
12	2	1	FluiDyne	1305-067		Support Leg Assembly	B1	Obsolete
12	2	1	FluiDyne	1305-068		Support Beam	B1	Obsolete
12	2	1	FluiDyne	1305-069		Support Details	B1	Obsolete
7	2	1	FluiDyne	1305-071		Upstream Diffuser Supp. Weldment	B1	
7	2	1	FluiDyne	1305-072		Diffuser Assembly	B1	
7	2	1	FluiDyne	1305-073		Access Door Weldment	B1	
7	2	1	FluiDyne	1305-074	A	Diffuser Shell - Weldmt	B1	
7	2	1	FluiDyne	1305-075	B	Diffuser Shell - Details	B1	
7	2	1	FluiDyne	1305-076		Diffuser Corner Fillet	B1	
7	2	0	FluiDyne	1305-077		Shaft Locking Ring	A1	
7	2	1	FluiDyne	1305-078	A	Fan Assembly	B1	
7	2	2	FluiDyne	1305-078	A	Fan Assembly	C1	On st B
7	2	2	FluiDyne	1305-079		Fan Assembly	C1	
7	2	0	FluiDyne	1305-080		Nacelle Nose Section	A1	Obsolete
7	2	0	FluiDyne	1305-081		Upstream Nacelle	A1	
7	2	0	FluiDyne	1305-082		Tension Bars-Details	A1	
7	2	2	FluiDyne	1305-083		Struts	C1	
7	2	0	FluiDyne	1305-084		Clamp Ring - Upstream	A1	
7	2	0	FluiDyne	1305-085		Clamp Ring - Downstream	A1	
7	2	1	FluiDyne	1305-086	A	Fan Shell Section (Weld'mt)	B1	
7	2	1	FluiDyne	1305-087	A	Fan Shell Section (Weld'mt)	B1	
7	2	1	FluiDyne	1305-088	A	Fan Shell Section (Details)	B1	
7	2	2	FluiDyne	1305-089	A	Support Spider Ass'y, Upstr'm	C1	
7	2	2	FluiDyne	1305-090	A	Support Spider Ass'y, D'nstrm	C1	
7	2	0	FluiDyne	1305-091		Downstream Nacelle	A1	
7	2	0	FluiDyne	1305-092	A	Lubrication System - Upstream	A1	
7	2	0	FluiDyne	1305-093	A	Lubrication System - D'stream	A1	
7	2	1	FluiDyne	1305-094	A	Fan Section Installation	B1	
7	2	2	FluiDyne	1305-094	A	Fan Section Installation	C1	
7	2	1	FluiDyne	1305-095		Exhaust Section	B1	
12	2	0	FluiDyne	1305-096		Drive Assembly	A1	Obsolete
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12	2	0	FluiDyne	1305-098		Auxiliary Drive Assembly	A1	Obsolete
7	2	0	FluiDyne	1305-099		Auxiliary Drive Base	A1	
0	2	0	FluiDyne	1305-704		Model Support Concept 1 (SARL)	A1	NoOrigina
0	2	0	FluiDyne	1305-705		Model Support Concept 2 (SARL)	A1	NoOrigina
99	3	0	USAF/BLW	X82D170		Test Cabin	1	
99	3	0	USAF/BLW	X82C171		Test Cabin Doors	1	
99	3	0	USAF/BLW	X82D172		Diffuser	1	
99	3	0	USAF/BLW	X82D269		Screen Spacer	1	
99	3	0	USAF/BLW	X82D270		Screen Fixture	1	
99	3	0	USAF/BLW	X82E271		Inlet (Matched Cubic)	1	
99	3	0	USAF/BLW	X82E272		Support Stand	1	
99	3	0	USAF/BLW	X82D273		Support Stand	1	
99	3	0	USAF/BLW	X82E274		Support Stand	1	
99	3	0	USAF/BLW	X82B275		Support Stand	1	
99	3	0	USAF/BLW	X82E276		Reducer	1	
99	3	0	USAF/BLW	X82E277		Inlet (Matched Circle)	1	
99	3	0	USAF/BLW	X82E278		Assembly-Pilot SARL	1	
99	3	0	USAF/BLW	X82B346		Steel Pin-Choke Actuator	1	
99	3	0	USAF/BLW	X82B347		Pos. Indicator Plate-Choke Actuator	1	
99	3	0	USAF/BLW	X82B348		Left Side Plate-Choke Actuator	1	
99	3	0	USAF/BLW	X82B349		Right Side Plate-Choke Actuator	1	
99	3	0	USAF/BLW	X82B350		Torque Shaft-Choke Actuator	1	
99	3	0	USAF/BLW	X82D351		Support Bracket-Choke Actuator	1	
99	3	0	USAF/BLW	X82D352		Sub Assembly-Choke Actuator	1	
99	3	0	USAF/BLW	X82D353		Support Bracket-Choke Actuator	1	

99	3	0	USAF/BLW	X82B354	Left Cover Plate-Choke Actuator	1	
99	3	0	USAF/BLW	X82B355	Right Cover Plate-Choke Actuator	1	
99	3	0	USAF/BLW	X82B360	Latch-Choke Actuator	1	
99	3	0	USAF/BLW	X82B364	Support Stand-Choke Actuator	1	
99	3	0	USAF/BLW	X82D368	Plan View-Choke Actuator	1	
99	3	0	USAF/BLW	X82C369	Flange Reducer-Choke Actuator	1	
99	3	0	USAF/BLW	X82D380	Assembly-Choke Actuator	1	
99	3	0	USAF/BLW	X83D003	"T" Seal Mold#1-18" Butterfly Valve	1	
99	3	0	USAF/BLW	X83D004	"T" Seal Mold#2-18" Butterfly Valve	1	
99	3	0	USAF/BLW	X83B005	"T" Seal Mold Adapter	1	
3	4	0	PGC	01080-0319	Layout	F1	
3	4	0	PGC	03080-0302	Dimension Sheet	F1	
3	4	0	PGC	07080-0111	Piping Schematic	F1	
3	4	0	PGC	07080-0112	Lubrication System Assembly	F1	
4	4	0	USAF/WCW	X82D356	Demolition Plan, Bldg 25c	F1	
4	4	0	USAF/WCW	X82D357	Termination Piping B25C Pit	F1	
4	4	0	USAF/WCW	X82D358	Closure-Vacuum Volume 50MW Facility	F1	
4	4	0	USAF/WCW	X82D359	Cover-Floor Openings B25C	F1	
4	4	0	USAF/EJW	X82D378	Relocation-Diesel MG Set B25C	F1	
99	4	0	Sverdrup	OP174-30/5	High Speed, Low Pressure, High Pressure, Low Temp Wind Tunnel	F2	
0	4	0	West'hse	13-A-3066	Outline, Motor No. 2, High Altitude Wind Tunnel	G2	
0	4	0	West'hse	14-A-3561	CW Motor-FR 14-93-54,Thrust Bearing Pedestal and Housing	G2	Photorepr
0	4	0	West'hse	14-A-3645	CW Motor-FR 14-93-54, Bedplate & Bridge	G2	Photorepr
0	4	0	West'hse	15-A-3326	Motor Bedplate and Column Sole Plate, Foundation Bolt Drilling	G2	Photorepr
0	4	0	West'hse	8-B-5846	CW Motor-FR 14-93-54, Column and Sole Plate	G2	Photorepr
0	4	0	West'hse	8-B-5917	CW Motor-FR 14-93-54, Bed Plate Covers	G2	Photorepr
1	5	0	LaRC	LAZ-1061	(NOTE: All LaRC drawings are on microfiche.)	I2	
1	5	0	LaRC	LAZ-1061	Sh.1 Propellor Blade Sleeve	I1	Obsolete
1	5	0	LaRC	LAZ-1061	Sh.2 Orifice	I1	Obsolete
1	5	0	LaRC	LAZ-1061	Sh.3 2" Lock Washer	I1	Obsolete
1	5	0	LaRC	LAZ-1061	Sh.4 Drift Key Screw Lock Clip	I1	
1	5	0	LaRC	LAZ-1061	Sh.5 1" Lock Washer	I1	
1	5	0	LaRC	LAZ-1061	Sh.6 Aux. Drive Thrust Washer	I1	
1	5	0	LaRC	LAZ-1061	Sh.7 Aux. Drive Shaft Collar	I1	
1	5	0	LaRC	LAZ-1061	Sh.8 Hub Plate Nut	I1	Obsolete
1	5	0	LaRC	LAZ-1061	Sh.10 Aux. Drive Stud Bolt	I1	
1	5	0	LaRC	LAZ-1061	Sh.11 Slip Ring Drive Brass Plug	I1	
1	5	0	LaRC	LAZ-1061	Sh.12 Packing Gland Washer	I1	
1	5	0	LaRC	LBZ-1062	Sh.1 Shaft Coupling Bolt	I1	
1	5	0	LaRC	LBZ-1062	Sh.2 Hub Plate Bolt #1	I1	Obsolete
1	5	0	LaRC	LBZ-1062	Sh.3 Hub Plate Bolt #2	I1	Obsolete
1	5	0	LaRC	LBZ-1062	Sh.4 Shaft Coupling Bolt Nut	I1	
1	5	0	LaRC	LBZ-1062	Sh.5 Aux. Drive Locking Cap	I1	
1	5	0	LaRC	LBZ-1062	Sh.6 Aux. Drive Lead Screw Nut	I1	
1	5	0	LaRC	LBZ-1062	Sh.7 Aux. Drive Table Stop	I1	
1	5	0	LaRC	LBZ-1062	Sh.8 Aux. Drive Mounting Block	I1	
1	5	0	LaRC	LBZ-1062	Sh.9 Aux. Drive Limit Switch Actuator	I2	
1	5	0	LaRC	LBZ-1062	Sh.10 Aux. Drive Limit Switch Mount	I1	
1	5	0	LaRC	LBZ-1062	Sh.11 Aux. Drive Guard Bracket	I1	
1	5	0	LaRC	LBZ-1062	Sh.12 Downstream Prop. Coordinates	I1	Obsolete

1	5	0	LaRC	LBZ-1062	Sh.13	Upstream Prop. Coordinates	I1	Obsolete
1	5	0	LaRC	LBZ-1062	Sh.14	Upstream Nacelle #2 Strut	I1	
1	5	0	LaRC	LBZ-1062	Sh.15	Hub Plate Bolt Setter	I1	Tool
1	5	0	LaRC	LBZ-1062	Sh.16	Hub Plate Bolt Puller	I1	Tool
1	5	0	LaRC	LBZ-1062	Sh.18	Packing Gland Nut	I1	
1	5	0	LaRC	LBZ-1062	Sh.19	Retaining Nut	I1	
1	5	0	LaRC	LBZ-1062	Sh.20	Drive Balance Weights	I1	
1	5	0	LaRC	LBZ-1062	Sh.21	Lube System	I1	
1	5	0	LaRC	LBZ-1062	Sh.22	Spider Support Springs	I1	
1	5	0	LaRC	LCZ-1063	Sh.1	Outer Hub Plate	I1	Obsolete
1	5	0	LaRC	LCZ-1063	Sh.2	Center Hub Plate	I1	Obsolete
1	5	0	LaRC	LCZ-1063	Sh.3	Upstream Hub Cone	I1	
1	5	0	LaRC	LCZ-1063	Sh.4	Intermediate Hub Cone	I1	
1	5	0	LaRC	LCZ-1063	Sh.5	Downstream Hub Cone	I1	
1	5	0	LaRC	LCZ-1063	Sh.6	Hub Cone Locking Cap	I1	
1	5	0	LaRC	LCZ-1063	Sh.7	Intermediate Bearing	I1	
1	5	0	LaRC	LCZ-1063	Sh.8	Tension Rod	I1	
1	5	0	LaRC	LCZ-1063	Sh.9	Spoke Alteration	I1	
1	5	0	LaRC	LCZ-1063	Sh.10	Drift Key	I1	Tool
1	5	0	LaRC	LCZ-1063	Sh.11	Straight Drift Key Drive	I1	Tool
1	5	0	LaRC	LCZ-1063	Sh.12	Tapered Drift Key Guide	I1	Tool
1	5	0	LaRC	LCZ-1063	Sh.13	Lock Key	I1	
1	5	0	LaRC	LCZ-1063	Sh.14	Lock Nut	I1	
1	5	0	LaRC	LCZ-1063	Sh.15	Spacer	I1	Tool
1	5	0	LaRC	LCZ-1063	Sh.16	End Bearing	I1	
1	5	0	LaRC	LCZ-1063	Sh.17	Inner Hub Plate	I1	Obsolete
1	5	0	LaRC	LCZ-1063	Sh.18	Hub Plate Cover	I1	Obsolete
1	5	0	LaRC	LCZ-1063	Sh.19	Oil Slinger	I1	
1	5	0	LaRC	LCZ-1063	Sh.20	Hollow Tension Rod	I1	
1	5	0	LaRC	LCZ-1063	Sh.21	Split Tension Rod Sleeve	I1	
1	5	0	LaRC	LCZ-1063	Sh.22	Aux. Drive Tabe Slide	I1	
1	5	0	LaRC	LCZ-1063	Sh.23	Aux. Drive Screw Shaft	I1	
1	5	0	LaRC	LCZ-1063	Sh.24	Inner Hub Plate	I1	Obsolete
1	5	0	LaRC	LCZ-1063	Sh.25	Slip Ring Drive Shaft	I1	
1	5	0	LaRC	LCZ-1063	Sh.26	Slip Ring Drive Bearing Housing Cover	I2	
1	5	0	LaRC	LCZ-1063	Sh.27	Slip Ring Drive Seal Plate	I1	
1	5	0	LaRC	LCZ-1063	Sh.28	Slip Ring Drive Adapter	I1	
1	5	0	LaRC	LCZ-1063	Sh.29	Upstream Nacelle #2 Nose Fairing	I2	
1	5	0	LaRC	LCZ-1063	Sh.30	Jacking Plate And Shaft	I1	
1	5	0	LaRC	LDZ-1064	Sh.1	Hub Shaft	I1	
1	5	0	LaRC	LDZ-1064	Sh.2	Propellor Hub	I1	
1	5	0	LaRC	LDZ-1064	Sh.3	Shaft Spool	I1	
1	5	0	LaRC	LDZ-1064	Sh.4	Shaft Coupling	I1	
1	5	0	LaRC	LDZ-1064	Sh.5	Gear	I1	
1	5	0	LaRC	LDZ-1064	Sh.6	Front Brng. Cap	I1	
1	5	0	LaRC	LDZ-1064	Sh.7	Bearing Cap	I1	
1	5	0	LaRC	LDZ-1064	Sh.8	Propellor Hub Forgings	I1	
1	5	0	LaRC	LDZ-1064	Sh.9	Bearing Housing Support	I1	
1	5	0	LaRC	LDZ-1064	Sh.10	Bearing Housing	I1	
1	5	0	LaRC	LDZ-1064	Sh.11	Alteration To Center Bearing	I1	Obsolete
1	5	0	LaRC	LDZ-1064	Sh.12	Door Alteration At Vent Tower	I1	Obsolete
1	5	0	LaRC	LDZ-1064	Sh.13	Drive Shaft Opening Alter-ations	I2	Obsolete
1	5	0	LaRC	LDZ-1064	Sh.14	Outer Ring And Propellor Pit	I1	Obsolete
1	5	0	LaRC	LDZ-1064	Sh.15	Aux. Drive Sliding Table	I1	
1	5	0	LaRC	LDZ-1064	Sh.16	Hub Shaft Forging	I1	
1	5	0	LaRC	LDZ-1064	Sh.18	Bearing Labrynth	I1	

1	5	0	LaRC	LDZ-1064	Sh.19 Turning Vane	I1	Obsolete
1	5	0	LaRC	LEZ-1065	Sh.1 Drive Shaft	I1	
1	5	0	LaRC	LEZ-1065	Sh.2 Counter Vane	I1	
1	5	0	LaRC	LEZ-1065	Sh.3 Pre-Rotation Vane	I1	
1	5	0	LaRC	LEZ-1065	Sh.4 Outer Ring	I1	Obsolete
1	5	0	LaRC	LEZ-1065	Sh.5 Nacelle Fairing Extension	I1	
1	5	0	LaRC	LEZ-1065	Sh.6 Alteration to nose ring	I1	
1	5	0	LaRC	LEZ-1065	Sh.7 Upstream Nacelle Tail Ring	I1	
1	5	0	LaRC	LEZ-1065	Sh.8 Aux. Drive Sub Assembly	I1	
1	5	0	LaRC	LEZ-1065	Sh.9 Aux. Drive Base	I1	
1	5	0	LaRC	LEZ-1065	Sh.10 Aux. Drive Guard	I1	
1	5	0	LaRC	LEZ-1065	Sh.11 Slip Ring Drive Sub Assembly	I1	
1	5	0	LaRC	LEZ-1065	Sh.12 Upstream Nacelle #2 Nose Section	I2	
1	5	0	LaRC	LEZ-1065	Sh.13 Upstream Nacelle #2 Spacer	I1	
1	5	0	LaRC	LEZ-1065	Sh.14 Upstream Nacelle #2 Shaft Tail Fairing	I2	
1	5	0	LaRC	LEZ-1065	Sh.15 Fan Alteration upstream Nacelle Intm. Ring-Section	I2	
1	5	0	LaRC	LXZ-1066	Sh.1 General Assembly	I1	
1	5	0	LaRC	LXZ-1066	Sh.2 Downstream Rotor Blade Detail	I1	Obsolete
1	5	0	LaRC	LXZ-1066	Sh.3 Upstream Rotor Blade Detail	I1	Obsolete
1	5	0	LaRC	LXZ-1066	Sh.4 Vent Bldg Monorail	I1	Obsolete
1	5	0	LaRC	LXZ-1066	Sh.5 Drive Section Monorail	I1	Obsolete
1	5	0	LaRC	LXZ-1066	Sh.6 Propellor Shaft Fairing	I1	Obsolete
1	5	0	LaRC	LXZ-1066	Sh.7 Lube System	I1	
1	5	0	LaRC	LXZ-1066	Sh.8 Propellor Shaft Fairing	I1	Obsolete
1	5	0	LaRC	LDZ-11522	Sh.1 Schematic Diagram	I1	
1	5	0	LaRC	LDZ-11522	Sh.2 Storage Tank	I1	
1	5	0	LaRC	LDZ-11522	Sh.3 Vacuum Tank	I1	
1	5	0	LaRC	LDZ-11522	Sh.4 Typical Mounting	I1	
1	5	0	LaRC	LDZ-11522	Sh.6 Drive Motor and Thrust Bearing Schematic	I2	
1	5	0	LaRC	LR-110105	Planform	I1	
1	5	0	LaRC	LR-110106	Blade Sections	I1	
1	5	0	LaRC	LC-110107	Fabric Layup	I	
1	5	0	LaRC	LD-110117	Blade Socket Base (Upstream)	I1	
1	5	0	LaRC	LC-110118	Base, Outer Beam (Upstream)	I1	
1	5	0	LaRC	LE-110116	Fairing (Upstream)	I1	
1	5	0	LaRC	LB-110121	Blade Sleeve (End)	I1	
1	5	0	LaRC	LB-110122	Blade Sleeve (Center)	I1	
1	5	0	LaRC	LBZ-13183	Sh.2 Base-Center Plate	I1	
1	5	0	LaRC	LBZ-13183	Sh.4 Base-Center Lug	I1	
1	5	0	LaRC	LBZ-13183	Sh.5 Base-End Lug	I1	
1	5	0	LaRC	LBZ-13183	Sh.6 Base-Side PLate (Downstream)	I1	
1	5	0	LaRC	LBZ-13183	Sh.7 Base-Inner Beam (Downstream)	I1	
1	5	0	LaRC	LC-110119	Base Side Plate (Upstream)	I1	
1	5	0	LaRC	LBZ-13359	Sh.3 Blade Socket Pin	I1	
1	5	0	LaRC	LB-110129	Blade attachment Pin	I1	
1	5	0	LaRC	LB-110130	Drawing And Parts List	I1	
1	5	0	LaRC	LDZ-6120	Sh.1 Lube System-Power And Control Schematic And Wiring Diagrams	I2	
1	5	0	LaRC	LDZ-6120	Sh.2 Lube System-Plot Plan,Conduit And Cable Schedule,Wiring and Interconnection Diagrams	I3	
1	5	0	LaRC	LE-15896	Fan Alteration-Downstream Nacelle, Intermediate Ring	I2	
1	5	0	LaRC	LX-15895	Sh.3 Fan Alteration-Pre Rotation Vanes-Sub Assembly	I2	

1	5	0	LaRC	LD-15897		Sh.5 Fan Alteration-Downstream Nacelle Strut	I2	
1	5	0	LaRC	D-5475		Propellor Drive-End Bearing Details	I1	
1	5	0	LaRC	LX-15895		Sh.2 Fan Alteration-Downstream Nacelle-Body Section	I2	
4	6	0	USAF/MSM	X83F075		Drive Gear Modification	F1	
4	6	0	USAF/MSM	X83F077		Nacelle Nose Section	I1	
5	6	3	USAF/SDM	X84F132		Cover For Aux. Drive Motor	H1	Obsolete
6	6	0	USAF/MMM	X85D010		Sarl Drive Shaft Assembly	I1	
6	6	0	USAF/EJW	X85F039		Upstream Sheet Metal Modification, Fan Section	I2	
6	6	0	USAF/EJW	X85F040		Downstream Sheet Metal Modification, Fan Section	I2	
0	6	0	USAF/MSM	X85F184		Stator Collars-SARL Fan	I1	
0	6	0	USAF/MEJ	X86F064		Proximity Probe Instl & Misc Details	I1	
6	18	0	USAF/EJW	X86F065		Joneycomb bonding fixture scheme	1	
0	6	0	USAF/MEJ	X86F066		Aux Drive Gear Tach Instl/Details	1	Obsolete
0	6	0	USAF/MRC	X86C100		Cover-Tach Probe, SARL Drive Train	1	
6	6	0	USAF/TAP	X87C007		SARL Upstream Blade Removal	1	
6	6	0	USAF/MAB	X87F015		Pattern-Stator Collars, Fan Section	I1	Obsolete
6	6	0	USAF/MAB	X87F016		Inlet Stator Blade, Fan Section	I1	
6	6	8	USAF/MAB	X87F017	A	Installation-Stator Blade, Fan Sect.	I1	
0	6	0	USAF/MEJ	X87F032		Stator Blade Collars Set-Up Fixture	I1	
4	7	0	USAF/EJW	X83F055	A	Support Frame, Downstream Contraction	F2	
4	7	0	USAF/EJW	X83F056		Support Frame, Downstream Contraction,Details	F2	
4	7	0	USAF/EJW	X83F028	A	Model Support Section Assy	F1	
4	7	0	USAF/EJW	X83F029	A	Model Support Section Weldment	F1	
4	7	0	USAF/EJW	X83F030	A	Model Support Section Details	F1	
4	7	0	USAF/EJW	X83F031	A	Model Support Section Details	F1	
4	7	1	USAF/EJW	X83F047		Corner Fillet Detail	B1	
4	7	1	USAF/EJW	X83F055		Support Frame	B1	
4	7	0	USAF/EJW	X83F056		Support Frame Detail	F1	
4	7	1	USAF/EJW	X83F090		Foundation Removal	B1	
4	7	1	USAF/EJW	X83F093		Fan Tower Plans and Elevation	B1	
4	7	1	USAF/EJW	X83F094		Fan Tower Reinforcing Details	B1	
4	7	1	USAF/EJW	X83F095		Site Work and Removals	B1	
0	7	0	USAF/EJW	X85D164		Downstream Contraction Filler Panel	1	
4	8	0	USAF/EJW	X83F063	A	Model Support Weldment	F1	
4	8	0	USAF/EJW	X83F071		Balance Calibration Assy.	F1	
4	8	0	USAF/EJW	X83F072		Balance Calibration Detail	F1	
4	8	0	USAF/EJW	X83F073	A	Fairing Side Covers	F1	Redrawn
4	8	0	USAF/EJW	X83F074	A	Fairing Nose Sections	F1	Redrawn
12	8	0	USAF/EJW	X83D076		Hole Template Nose Fairing	F1	Obsolete
4	8	0	USAF/EJW	X83D083		Sting, Temporary Model Support	F1	
4	8	0	USAF/EJW	X83F084	A	Temporary Model Support Assy & Installation	F2	
4	8	0	USAF/EJW	X83F086		Sting Positioning Assy	F1	
4	8	0	USAF/EJW	X83F087		Sting Positioning Detail	F1	
8	8	0	FluiDyne	1392-Cvr		xxxxxxx	1	
8	8	2	FluiDyne	1392-001		Test Section Assembly	C1	
8	8	2	FluiDyne	1392-002		Test Section Assembly Details	C1	
8	8	2	FluiDyne	1392-003		West Side Panel Assembly	C1	
8	8	2	FluiDyne	1392-004		West Side Panel Weldment	C1	
8	8	2	FluiDyne	1392-005		West Side Panel Weldment Details	C1	
8	8	2	FluiDyne	1392-006		Filler Plate Details, Sheet 1	C1	
8	8	2	FluiDyne	1392-007		East Side Panels and Door Assembly	C1	
8	8	2	FluiDyne	1392-008		East Sidewall Weldment	C1	

8	8	2	FluiDyne	1392-009		Door Weldment	C1	
8	8	2	FluiDyne	1392-010		Filler Plate Details, Sheet 2	C1	
8	8	2	FluiDyne	1392-011		Typical Corner Panel Assembly	C1	
8	8	2	FluiDyne	1392-012		Upper West Corner Panel Weldment	C1	
8	8	2	FluiDyne	1392-013		Upper East Corner Panel Weldment	C1	
8	8	2	FluiDyne	1392-014		Lower West Corner Panel Weldment	C1	
8	8	2	FluiDyne	1392-015		Lower East Corner Panel Weldment	C1	
8	8	2	FluiDyne	1392-016		Filler Plate Details, Sheet 3	C1	
8	8	2	FluiDyne	1392-017		Top Panel Assembly	C1	
8	8	2	FluiDyne	1392-018		Top Panel Weldment	C1	
8	8	2	FluiDyne	1392-019		Bottom Panel Assembly	C1	
8	8	2	FluiDyne	1392-020		Bottom Panel Weldment	C1	
8	8	2	FluiDyne	1392-021		Miscellaneous Part Details, Sh 1	C1	
8	8	2	FluiDyne	1392-022		Miscellaneous Part Details, Sh 2	C1	
8	8	6	FluiDyne	1392-023	B	Plastic Window Assembly	H1	
8	8	6	FluiDyne	1392-024	B	Plastic Window Details	H1	
8	8	6	FluiDyne	1392-025	A	Door Window Assembly	H1	
8	8	6	FluiDyne	1392-026	A	Door Window Details	H1	
8	8	0	FluiDyne	1392-027		Glass Window Assembly	1	
8	8	0	FluiDyne	1392-028		Glass Frame	1	
8	8	0	FluiDyne	1392-029		Window Details	1	
8	8	2	FluiDyne	1392-030		Support Leg Assembly	C1	
8	8	2	FluiDyne	1392-031		Support Beam	C1	
8	8	2	FluiDyne	1392-032		Support Details	C1	
8	8	0	FluiDyne	1392-033		Retractable Working Floor Concept	1	
8	8	0	FluiDyne	1392-034		Interlocking Floor Concept	1	
5	8	0	USAF/WCW	X84F101		Assembly, Window Test Box	F1	
5	8	0	USAF/WCW	X84F102		Test Frame, Window Test Box	F1	
5	8	0	USAF/WCW	X84F103		Box, Window Test Box	F1	
5	8	0	USAF/WCW	X84F104		Covers, Window Test Box	F1	
5	8	0	USAF/WCW	X84F1[illegible]		Plastic Window Details, Option 1	F1	
99	8	0	USAF/BLW	X84C237		Support And Traverse Bars- Dial Indicator Rig SARL Window Test Box	F2	Not Used
99	8	0	USAF/BLW	X84C238		Dial And Block Supports - Dial Indicator Rig SARL Window Test Box	F2	Not Used
99	8	0	USAF/BLW	X84C239		End Support Blocks - Dial Indicator Rig SARL Window Test Box	F2	Not Used
6	8	0	USAF/EJW	X85F155		Winch Mounting Plate & Sheave Plate	1	
0	8	0	USAF/EJW	X85F156		Winch & Sheave Assy	1	
3	8	6	Beta	SWH-505105-1		SARL Window Handles	F1	
6	8	0	USAF/EJW	X85F109		Dual Sheave Mounting Assy (2 Sheets)	F1	Obsolete
0	8	0	USAF/DJR	X85F053		Planks-Test Section Flooring & Test Section Access Flooring	2	
0	8	0	USAF/DJR	X85F059		Test Section Access Flooring Assy	1	
0	8	0	USAF/PJS	X85F070		Installation-Test Section Floor & Access Floor	2	
0	8	0	USAF/DJR	X85F157		Transport Cart-Test Sect Work Floor	1	
0	8	0	USAF/EJW	X86F019		Dual Sheave Mounting Assy (2 Sheets)	1	
0	8	0	USAF/MEJ	X86F029		Diffuser Access Platform, Assy/Instl	1	
0	8	0	USAF/MEJ	X86F075		Diffuser Access Steps	1	
0	8	0	USAF/MEJ	X86F083		Test Section Door Actuation Mod	1	
6	8	0	USAF/TAP	X87C006		Cable Restaint Assembly	1	
6	8	0	USAF/TAP	X86B136		Test Section Transition Fairings	1	
7	9	0	FluiDyne	1305-022	B	Foundation Loads	A1	RvB-StA?
7	9	1	FluiDyne	1305-023	C	Overall Tunnel Assembly	B1	Revised
7	9	1	FluiDyne	1305-025	B	Overall Contraction Assembly	B1	Redrawn
7	9	1	FluiDyne	1305-028	C	Upstream Contraction (Weldment)	B1	Redrawn
7	9	1	FluiDyne	1305-029	B	Upstream Contraction-Details	B1	Redrawn
7	9	1	FluiDyne	1305-030	B	Upstream Contraction (Weldment)	B1	Redrawn

7	9	1	FluiDyne	1305-031	B	Upstream Contraction - Details	B1	Redrawn
7	9	1	FluiDyne	1305-036	B	Overall Screen Assembly	B1	Revised
7	9	1	FluiDyne	1305-037	B	Screen Assembly - Plan	B1	Revised
7	9	1	FluiDyne	1305-039	B	Screen Clamping Assembly	B1	Revised
7	9	1	FluiDyne	1305-040	B	Clamp/Spring Details	B1	Revised
7	9	1	FluiDyne	1305-043	B	Downstream Contraction Assembly	B1	Revised
7	9	1	FluiDyne	1305-044	C	Sidewall Weldment	B1	Redrawn
7	9	1	FluiDyne	1305-045	B	Top Wall Weldment	B1	Redrawn
7	9	1	FluiDyne	1305-046	B	Bottom Wall Weldment	B1	Redrawn
7	9	1	FluiDyne	1305-047	B	Corner Tie Details	B1	Revised
6	9	0	USAF/TAP	X86F095		Handrail & Walkway Details Contraction Section SARL	2	
4	10	2	USAF/EJW	X83F028	B	Model Support Section Assy	C1	
4	10	2	USAF/EJW	X83F029	B	Model Support Section Subassembly	C1	
4	10	2	USAF/EJW	X83F030	B	Model Support Section Details	C1	
4	10	2	USAF/EJW	X83F031	A	Model Support Section Details	C1	
4	10	2	USAF/EJW	X83F096		Installation - Screen North Wall	C1	
4	10	0	USAF/EJW	X83F097		Arrangement SARL Control Room	F1	
4	10	0	USAF/EJW	X83D111		East Wall Closure Bldg. 25C	F1	
4	10	2	USAF/EJW	X83D112		South Wall Closure Instal. Bldg 25C	C1	
4	10	2	USAF/EJW	X83D113		South Wall Closure Det. Bldg 25C	C1	
4	10	0	USAF/EJW	X83F121		Platform & Hoist Assy-Fan	F1	
4	10	0	USAF/EJW	X83F122		Platform Weldment,Fan	F1	
4	10	0	USAF/EJW	X83F123		Hoist Weldment	F1	
4	10	0	USAF/EJW	X83F124		Hoist Sections & Details	F1	
4	10	0	USAF/EJW	X83F126		Ladder & Grating Details	F1	
4	10	2	USAF/EJW	X83F152		Floor Installation, Control Room	C1	
4	10	3	USAF/EJW	X83F152	A	Floor Installation, Control Room	C1	
4	10	0	USAF/EJW	X83F177		East Wall Enclosure Tempor.	F1	
4	10	0	USAF/EJW	X83F182		West Elevation Scavenging Bldg 25D	F1	
4	10	0	USAF/EJW	X83F183		Sections, Scavenging Bldg 25D	F1	
4	10	0	USAF/EJW	X83F184		East Elev., Scavenging Bldg 25D	F1	
4	10	2	USAF/EJW	X83F185		Motor Support Tower (6 Sheets)	C1	
4	10	2	USAF/EJW	X83F186	A	Control Room Bldg 25C Mod. Plan	C1	
4	10	0	USAF/EJW	X83F187		Pipe Modification Bldg 25D	F1	
4	10	2	USAF/EJW	X83F188		Cable Tray Installation	C1	
4	10	3	USAF/EJW	X83F188	A	Cable Tray Installation	C1	
4	10	2	USAF/EJW	X83F189		Cable Tray Installation	C1	
4	10	3	USAF/EJW	X83F189	B	Cable Tray Installation	C1	
4	10	2	USAF/EJW	X83F196	A	Fan and Piping Installation	C1	
4	10	2	USAF/EJW	X83F197	A	Fan and Piping Details	C1	
4	10	0	USAF/MSM	X83F206	A	Drive Assembly	F1	
12	10	0	USAF/EJW	X83F207		Fan Enclosure	1	Obsolete
12	10	0	USAF/EJW	X83F208		Filter Housing Weldment	1	Obsolete
12	10	0	USAF/EJW	X83F209		Closure Weldments	1	Obsolete
12	10	0	USAF/EJW	X83F210		Ceiling Weldment	1	Obsolete
4	10	2	USAF/EJW	X83F248		Cable Tray Support Details	C1	
4	10	2	USAF/EJW	X83F249		Cable Tray Support Details	C1	
4	10	2	USAF/EJW	X83F250		Cable Tray Support Details	C1	
5	10	2	USAF/EJW	X84F001		Cable Tray Support Details	C1	
5	10	2	USAF/EJW	X84F003		Cable Tray Support Details	C1	
5	10	2	USAF/EJW	X84F004		Cable Tray Installation	C1	
5	10	3	USAF/EJW	X84F004	C	Cable Tray Installation	1	
5	10	2	USAF/EJW	X84F007		Motor Tower Cable Tray Installation	C1	
5	10	3	USAF/EJW	X84F007	A	Motor Tower Cable Tray Installation	C1	
5	10	2	USAF/EJW	X84F009		Cable Tray Support Detail	C1	
5	10	2	USAF/EJW	X84F019		Motor Lub. System Piping Assy.	1	
5	10	3	USAF/EJW	X84F019	A	Motor Lub. System Piping Assy.	C1	
5	10	2	USAF/EJW	X84F031		Gearbox Lub. System Piping Assy.	C1	

5	10	2	USAF/EJW	X84F036		Top Weldment-Model Support Section	C1	
5	10	2	USAF/EJW	X84F037		Bottom Weldment-Model Support Section	C2	
5	10	2	USAF/EJW	X84F038		Side Weldment-Model Support Section	C1	
5	10	2	USAF/EJW	X84F043		Main Floor Closure, North End Of Bldg. 25C	C2	
5	10	2	USAF/EJW	X84F044		South Balcony Closure, Bldg. 25C	C1	
5	10	2	USAF/EJW	X84F063		Motor Buss Instl. and Electrical Hookup	C2	
5	10	2	USAF/EJW	X84F064		Motor Buss Instl. and Electrical Hookup, Sections & Details	C2	
5	10	2	USAF/EJW	X84FCOVER		Index	C1	Comments
5	10	2	USAF/EJW	X84F067	A	Pump Pit and Step Closure	C1	
6	10	3	USAF/SDM	X85F049		Motor Lube System-Addition of Oil Level Switch and Site glass	H2	Lub Mods
6	10	3	USAF/SDM	X85F050		Motor Lube System Schematic	H1	Lub Mods
3	10	3	ASD/DEP	84WA3289		Provide Cooling for Computer Room	C1	
6	10	4	USAF/PJS	X85D165		Gearbox Lubrication System Piping Support	F2	
9	11	0	FluiDyne	1432Cover		Index	1	
9	11	2	FluiDyne	1432-001		Modification to Support Frame,	C2	
9	11	2	FluiDyne	1432-002		Support Frame, Model Support Section	C1	
9	11	2	FluiDyne	1432-003		Support Frame Details, Sht. 1, Model Support Section	C2	
9	11	2	FluiDyne	1432-004		Support Frame Details, Sht. 2, Model Support Section	C2	
9	11	0	FluiDyne	1432-005		LVPS Support Structure Overall Assembly	G2	
9	11	0	FluiDyne	1432-006		Foundation & Building Modifications	G2	
9	11	0	FluiDyne	1432-007		LVPS Support Structure Concrete Pier	G1	
9	11	0	FluiDyne	1432-008		Foundation & Building Modification Details	G2	
9	11	0	FluiDyne	1432-009		LVPS Support Structure West Support Frame	G2	
9	11	0	FluiDyne	1432-010		LVPS Support Structure West Support Frame Details	G2	
9	11	0	FluiDyne	1432-011		LVPS Support Structure East Support Frame	G2	
9	11	0	FluiDyne	1432-012		Miscellaneous Support Structure Details	G2	
9	11	0	FluiDyne	1432-013		LVPS Support Structure Assembly	G1	
9	11	0	FluiDyne	1432-014		Upper East Support	G1	
9	11	0	FluiDyne	1432-015		Upper West Support	G1	
9	11	0	FluiDyne	1432-016		Lower East Support	G1	
9	11	0	FluiDyne	1432-017		Lower West Support	G1	
9	11	0	FluiDyne	1432-018		Lower West Support Details	G1	
9	11	0	FluiDyne	1432-019		Miscellaneous Support Structure Details	G2	
9	11	0	FluiDyne	1432-020		Laser Velocimeter Positioning System Locations	G2	
9	11	0	FluiDyne	1432-021		LVPS End Viewing Window Detail	G1	
9	11	0	FluiDyne	1432-022		LVPS and Structure Interface Details	G1	
9	11	0	FluiDyne	1432-023		Laser Velocimeter Positioning System Overall Assembly	G2	
9	11	0	FluiDyne	1432-024		Bridge Assembly	G1	
9	11	0	FluiDyne	1432-025		Bridge Assembly Details	G1	
9	11	0	FluiDyne	1432-026		Axial Drive Assembly	G1	
9	11	0	FluiDyne	1432-027		Axial Carriage/Tangential Drive Assembly	G2	

9	11	0	FluiDyne	1432-028		Tangential Carriage/Lateral Support Drive Assembly	G2	
9	11	0	FluiDyne	1432-029		Lateral Support & Drive Assembly	G1	
9	11	0	FluiDyne	1432-030		Lateral Carriage Assembly	G1	
9	11	0	FluiDyne	1432-031		Optics Table & Base Assembly	G1	
9	11	0	FluiDyne	1432-032		LVPS Lines & Leads Concept, Sheet 1	G1	
9	11	0	FluiDyne	1432-033		LVPS Lines & Leads Concept, Sheet 2	G1	
9	11	0	FluiDyne	1432-034		Demolition for West Support Structure Frame	G2	
13	11	0	USAF/EJW	X84E119		Proposed L.V.P.S. Support Location	G1	
5	11	0	USAF/MEJ	X86F084		L.V. Cooling Water Pipe Diag./instl. SARL	2	
3	12	2	Sverdrup	M-1		Demolition, Bldg 25D	C1	
3	12	2	Sverdrup	M-2		Fan Lubrication System, Schematic Diagram	C2	
3	12	3	Sverdrup	M-2	A	Fan Lubrication System, Schematic Diagram	H2	
3	12	2	Sverdrup	M-3		Fan Lubrication System, Plans, Sections and Details	C2	
3	12	3	Sverdrup	M-3	A	Fan Lubrication System, Plans, Sections and Details	H2	
3	12	2	Sverdrup	S1		Drive System, General Arrangement	C1	
3	12	3	Sverdrup	S1	A	Drive System, General Arrangement	C1	
3	12	2	Sverdrup	S2		Drive System, Fan Blade Access and Hoist Structure-Sh 1	C2	
3	12	2	Sverdrup	S3		Drive System, Fan Blade Access and Hoist Structure-Sh 2	C2	
3	12	2	Sverdrup	S4		Drive System, Fan Blade Access Platform Ladder	C2	
3	12	2	Sverdrup	S5		Drive System, Drive Motor Cover Details, Sh 1	C2	
3	12	2	Sverdrup	S6		Drive System, Drive Motor Cover Details, Sh 2	C2	
3	12	2	Sverdrup	S7		Drive System, Drive Train Assembly, Bedplate & Anchor Bolt Installation	C2	
3	12	2	Sverdrup	S8		Drive System, Drive Train Assembly, Drive Machinery Layout	C2	
3	12	2	Sverdrup	S9		Drive System, Drive Train Assembly, Sections and Details	C2	
3	12	2	Sverdrup	S10		Drive System, Fan Assembly, Sh 1	C1	
3	12	2	Sverdrup	S11		Drive System, Fan Assembly, Sh 2	C1	
12	12	0	Sverdrup	S12		Honeycomb Shell Details	F1	Obsolete
3	12	0	Sverdrup	S13		Tunnel Entry Fairing Concept	F1	
0	12	0	USAF/MEJ	X86F135		Motor Tower Cover Hatch-Mod	1	
0	12	0	USAF/MEJ	X86F137		Motor Tower Gearbox Housing & Face Frame Installation (4 Sheets)	B2	
0	12	0	USAF/MEJ	X86F141		Motor Tower Gearbox Housing Frame Assy (5 Sheets)	B2	
0	12	0	USAF/MEJ	X87F001		Motor Tower Housing-Face Frame Assy/ Details (5 Sheets)	B2	
0	12	0	USAF/MEJ	X87F109		Stringer Mod. & Additional Walkway Supports	B2	
6	12	11	USAF/MEJ	X86F137		Motor Tower Gearbox Housing & Face Frame Instl. (4 Shts)	L2	
6	12	11	USAF/MEJ	X86F141		Motor Tower Gearbox Housing Frame Ass'y (5 Shts)	L2	
6	12	11	USAF/MEJ	X87F001		Motor Tower Housing Face Frame ass'y/Dets. (5 Shts)	L2	
6	12	11	USAF/MEJ	X87F109		Motor Support Tower Additional	L3	

					Walkway Supports & Stringer Mod. (1 Sht)	
6	12	11	USAF/MEJ	X83F185	Motor Support Tower For SARL (1 Sht)	L1
99	13	0	USAF/BLW	X83D233	Inlet-2'x2' Test Duct	1
99	13	0	USAF/BLW	X83D234	Test Section-2'x2' Test Duct	1
99	13	0	USAF/BLW	X83D235	Duct-2'x2' Test Duct	1
99	13	0	USAF/BLW	X83D236	Fan Duct Adapter-2'x2' Test Duct	1
99	13	0	USAF/BLW	X83D237	Straightening Vanes-2'x2' Test Duct	1
99	13	0	USAF/BLW	X83D238	Turbulent Grid-2'x2' Test Duct	1
99	13	0	USAF/BLW	X83D239	Grid Duct-2'x2' Test Duct	1
99	13	0	USAF/BLW	X83D240	Screen Fixture-2'x2' Test Duct	1
99	13	0	USAF/BLW	X83D241	Screen Sup. Bracket-2'x2' Test Duct	1
99	13	0	USAF/BLW	X83D242	Flange Hole Details-2'x2' Test Duct	1
99	13	0	USAF/BLW	X83D243	Test Section Walls-2'x2' Test Duct	1
99	13	0	USAF/BLW	X83B244	Rod-2'x2' Test Duct	1
99	13	0	USAF/BLW	X83B245	Nut-2'x2' Test Duct	1
99	13	0	USAF/BLW	X83F246	Assembly-2'x2' Test Duct	1
99	13	0	USAF/BLW	X83D247	Spacers-2'x2' Test Duct	1
99	13	0	USAF/BLW	X84D082	Heater Element Channel/SFRC	1
99	13	0	USAF/BLW	X84D083	Lower Channel Smoke Generator SSFRC	1
99	13	0	USAF/BLW	X84D084	Upper Channel Smoke Generator SSFRC	1
99	13	0	USAF/BLW	X84B085	Modification To 2" Coupling, Smoke Generator SSFRC	2
99	13	0	USAF/BLW	X84B086	Modification To 1/2" Coupling, Smoke Generator SSFRC	2
99	13	0	USAF/BLW	X84B087	Modification to 2" Coupling	1
99	13	0	USAF/BLW	X84B088	Cover Plate Smoke Generator SSFRC	1
99	13	0	USAF/BLW	X84C089	Copper Heating Strip, Smoke Generator SSFRC	2
99	13	0	USAF/BLW	X84B090	Insulating Washer Smoke Generator	1
99	13	0	USAF/BLW	X84B091	Insulating Support Bushing, Smoke Generator SSFRC	2
99	13	0	USAF/BLW	X84D092	Generator Frame Weldment, Smoke Generator SSFRC	2
99	13	0	USAF/BLW	X84D093	Frame Weldment Smoke Generator	1
99	13	0	USAF/BLW	X84C094	Strip Heater Assembly, Smoke Generator SSFRC	2
99	13	0	USAF/BLW	X84D095	Smoke Generator Assembly SARL Smoke Flow Research Channel	2
99	13	0	USAF/EJW	X84F125	Smoke Flow Aparatus Assembly	1
99	13	0	USAF/EJW	X84D126	Smoke Flow Weldment	1
99	13	0	USAF/EJW	X84D127	Smoke Flow Stand Detail	1
99	13	0	USAF/EJW	X84D128	Smoke Flow Tube Detail	1
99	13	0	USAF/EJW	X84D129	Smoke Flow Fairing Assembly	1
99	13	0	USAF/EJW	X84D130	Vacuum Valve Mod & Support Detail	1
13	14	1	Arrow	D-PTRN 1&2	Dif.Shell Cone Pattern for Cone 1&2	D1
13	14	1	Arrow	D-PTRN 3&4	Cone Detail Exhaust & Diffuser End	D1
13	14	1	Arrow	D-1305075-1	Rectangular to Round Transition	D1
13	14	1	Arrow	D-1305075-2	Diffuser Field Joint Assy & Details	D1
13	14	1	Arrow	D-1305086-1	Fan Housing, Field Joint Splice	D1
13	14	1	Arrow	D-1305087-1	Fan Housing Patterns	D1
13	14	1	Arrow	D-62169-15	Cone Detail Fan Housing	D1
13	14	1	FluiDyne	1305071AR	Upstream Diffuser Support Weldment	D1
13	14	1	FluiDyne	1306072AR	Diffuser Assembly	D1
13	14	1	FluiDyne	1305073AR	Access Door Weldment	D1
13	14	1	FluiDyne	1305074AR	Diffuser Shell - Weldment	D1
13	14	1	FluiDyne	1305075AR	Diffuser Shell - Details	D1
13	14	1	FluiDyne	1305076AR	Diffuser Corner Fillet	D1

13	14	1	FluiDyne	1305078AR	Fan Assembly	D1
13	14	1	FluiDyne	1305086AR	Fan Shell Section (Weld'mt)	D1
13	14	1	FluiDyne	1305087AR	Fan Shell Section (Weld'mt)	D1
13	14	1	FluiDyne	1305088AR	Fan Shell Section (Details)	D1
13	14	1	FluiDyne	1305094AR	Fan Section - Installation	D1
13	14	1	FluiDyne	1305095AR	Exhaust Section	D1
13	14	1	Arrow	D-1305023-1	Spacer Detail Bottom of Screen Section	D2
13	14	1	Arrow	D-1305028-1	Stiffeners Sides-Papa & Mama	D1
13	14	1	Arrow	D-1305028-2	Stiffeners Sides-Baby Bear	D1
13	14	1	Arrow	D-1302028-3	Corner Flange Papa Bear Section	D1
13	14	1	Arrow	D-1305028-4	Corner Flange Mama Bear Section	D1
13	14	1	Arrow	D-1305028-5	Corner Flange Baby Bear Section	D1
13	14	1	Arrow	D-1305028-6	Cutting Detail WT 12X27.5#	D1
13	14	1	Arrow	D-1305028-7	Cutting Detail WT 10.5X22#	D1
13	14	1	Arrow	D-1305028-8	Top & Bottom PL's Baby Bear Section	D1
13	14	1	Arrow	D-1305028-9	Side PL's Baby Bear Section	D1
13	14	1	Arrow	D-1305028-10	Top & Bottom PL's Mama Bear Sec.	D1
13	14	1	Arrow	D-1305028-11	Side PL's Mama Bear Sec.	D1
13	14	1	Arrow	D-1305028-12	Top & Bottom PL's Papa Bear Sec.	D1
13	14	1	Arrow	D-1305028-13	Side PL's Papa Bear Sec.	D1
13	14	1	Arrow	D-1305028-14	Bottom Weldment Screen Section	D1
13	14	1	Arrow	D-1305028-15	Side Weldment Screen Section	D1
13	14	1	Arrow	D-1305028-16	Top Weldment Screen Section	D1
13	14	1	Arrow	D-1305028-17	Screen Section Stiffener (Papa Bear)	D1
13	14	1	Arrow	D-1305030-1	Stifeners-Papa & Mama Top & Bottom	D1
13	14	1	Arrow	D-1305030-2	Stiffener-Baby Bear Top & Bottom	D1
13	14	1	Arrow	D-1305043-1	Stiffener Details Side, Top, & Bottom Wall Downstream Contraction	D2
13	14	1	Arrow	D-1305043-2	Stiffener Details Bottom Wall Downstream Contraction	D2
13	14	1	Arrow	D-1305043-3	Side Wall PL Downstream Cont.	D1
13	14	1	Arrow	D-1305043-4	Top & Bottom Wall PL Downstream Contraction	D2
13	14	1	Arrow	D-1305043-5	End Flanges Downstream Contraction	D1
13	14	1	FluiDyne	1305-023AR	Overall Tunnel Asembly	D1
13	14	1	FluiDyne	1305-025AR	Overall Contraction Assembly	D1
13	14	1	FluiDyne	1305-028AR	Upstream Contraction (Weldment)	D1
13	14	1	FluiDyne	1305-029AR	Upstream Contraction - Details	D1
13	14	1	FluiDyne	1305-030AR	Upstream Contraction (Weldment)	D1
13	14	1	FluiDyne	1305-031AR	Upstream Contraction - Details	D1
13	14	1	FluiDyne	1305-032AR	Sidewall Hole Locations Upstream Contraction	D2
13	14	1	FluiDyne	1305-033AR	Sidewall Hole Locations Upstream Contraction	D2
13	14	1	FluiDyne	1305-034AR	Top Wall Hole Locations Upstream Contraction	D2
13	14	1	FluiDyne	1305-035AR	Bottom Wall Hole Locations Upstream Contraction	D2
13	14	1	FluiDyne	1305-041AR	Liner Panel Details Upstream Contraction	D2
13	14	1	FluiDyne	1305-042AR	Liner Panel Details - Bottom Upstream Contraction	D2
13	14	1	FluiDyne	1305-043AR	Downstream Contraction Assembly	D1
13	14	1	FluiDyne	1305-044AR	Side Wall Weldment Downstream Contraction	D2
13	14	1	FluiDyne	1305-045AR	Top Wall Weldment Downstream Contraction	D2
13	14	1	FluiDyne	1305-046AR	Bottom Wall Weldment Downstream	D2

						Contraction		
13	14	1	FluiDyne	1305-047AR		Corner Tie Details Downstream Contraction	D2	
13	14	1	FluiDyne	1305-049AR		Support Frame Upstream Contraction	D1	
13	14	1	USAF/EJW	X83F047AR		Corner Fillet Detail Downstream Contraction	D2	
13	14	1	USAF/EJW	X83F055AR		Support Frame, Downstream Contraction, Weld'mt	D2	
13	14	1	USAF/EJW	X83F056AR		Support Frame - Downstream Contraction - Details	D2	
5	4	0	USAF/EJW	X84F068		Fan Enclosure Assy., Bldg. 25D	F1	
5	4	0	USAF/EJW	X84F069		Filter Housing Weldment	F1	
5	4	0	USAF/EJW	X84F070		Filter Housing Weldment	F1	
5	4	0	USAF/EJW	X84F071		Closure Weldments	F1	
5	4	0	USAF/EJW	X84F072		Closure & Door Weldment	F1	
5	4	0	USAF/EJW	X84F074		Ceiling Support Details	F1	
5	4	3	USAF/EJW	X84F120	A	Lubrication Piping Assembly, Bldg. 25D	H2	
5	4	3	USAF/EJW	X84F121		Lubrication Piping Installation Detail Bldg 25D	H2	
5	15	0	USAF/WCW	X84F140		Assembly-Curtain North Wall, Bldg 25C	F2	Obsolete
5	15	0	USAF/WCW	X84F141		Sections-Curtain North Wall, Bldg 25C	F2	Obsolete
5	15	0	USAF/WCW	X84F142		Guides-Curtain North Wall Bldg 25C	F1	Obsolete
5	15	0	USAF/WCW	X84F143		Details-Curtain North Wall, Bldg 25C	F2	Obsolete
5	15	0	USAF/WCW	X84F144		Curtains North Wall Bldg 25C	F1	Obsolete
5	15	0	USAF/EJW	X85F014		Inflatable Fairing Configuration (3 sheets)	H2	Obsolete
6	15	0	USAF/EJW	X86F030		Pressure switch/gage assembly	1	Obsolete
5	15	0	USAF/SDM	X85F075		Bulkhead, Diffuser Section	F1	Obsolete
5	15	0	USAF/SDM	X85F124		Bulkhead, Contraction Section	F1	
12	15	0	ESI	1		Sarl Inflatable Fairing	H1	Obsolete
12	15	0	ESI	2		Sarl Inflatable Fairing	H1	Obsolete
12	15	0	ESI	3		Sarl Inflatable Fairing	H1	Obsolete
12	15	0	ESI	4		Sarl Inflatable Fairing	H1	Obsolete
12	15	0	ESI	5		Sarl Fairing Base Rings	H1	Obsolete
3	15	0	ESI	6		Sarl High Pressure Blowers	H1	Obsolete
3	15	0	ESI	7		Sarl Low Pressure Blower	H1	Obsolete
6	15	5	USAF/EJW	X85F136		Inflatable Fairing, Plan View	J1	Obsolete
6	15	5	USAF/EJW	X85F137		Inflatable Fairing, Top & West Side	J2	Obsolete
6	15	5	USAF/EJW	X85F138		Inflatable Fairing, East Side	J1	Obsolete
6	15	5	USAF/EJW	X85F139		Inflatable Fairing, Base Rings	J1	Obsolete
6	15	0	USAF/EJW	X85F140		Inflatable Fairing, Elevation	H1	Obsolete
0	15	7	BETA	505104-101		Sarl Door, Plan View	H1	
0	15	7	BETA	505104-102		Sarl Door, Elevation View	H1	
0	15	7	BETA	505104-103		Sarl Door, Elevation South	H1	
0	15	7	BETA	505104-104		Sarl Door, Plate Details, West Lower Bi-pod	H2	
0	15	7	BETA	505104-105		Sarl Door, Plate Details, East Lower Bi-pod	H2	
0	15	7	BETA	505104-106		Sarl Door, Joint Details, Main Lintel Details	H2	
0	15	7	BETA	505104-107		Sarl Door, Joint Details, Counter Weight Support	H2	
0	15	7	BETA	505104-108		Sarl Door, Joint Details, Horizontal	H1	
0	15	7	BETA	505104-109		Sarl Door, Joint Details, Vertical	H1	

0	15	7	BETA	505104-110		Sarl Door, Lintel Details	H1	
0	15	7	BETA	505104-111		Sarl Door, Joint Details, Upper Guide Rails	H2	
0	15	7	BETA	505104-112		Sarl Door, Face Plate Details	H1	
0	15	7	BETA	505104-113		Sarl Door, Guide Rail & Lover Plate Details	H2	
0	15	7	BETA	505104-114		Sarl Door, Face Plate Details, Short	H1	
0	15	7	BETA	505104-115		Safety Cage, Counter Weight, SARL Tunnel Door	H2	
0	15	7	BETA	505104-116		Counter Weight System, Assy and Detail, East Wall	H2	
0	15	7	Kuss	24110326		Space Requirement and Install. for D-2 Special Manual Inside Door Seals	H2	
0	15	7	Kuss	24090559		Counterbalance Install., Model D2	H1	
0	15	7	Kuss	24120024		Install.: Model D-2 Para Port Door	H1	
0	15	7	Kuss	24100103		Building Wiring, 460v, Mod D2 Para Port (contr file prnt -not updated)	2	no orig
5	15	5	USAF/EJW	X85F162		Fairing Brace Details, 2 sheets	J1	
5	15	5	USAF/EJW	X85F166		Fairing, Sheet Metal, Assembly, 5 Sheets	J2	
5	15	5	USAF/EJW	X85F167		Fairing, Sheet Metal, Views & Details, 3 Sheets	J2	
5	15	5	USAF/EJW	X85F168		Fairing, Close Out Frames & Support Beam	J2	
5	15	5	USAF/EJW	X85F192		Sheet Metal Fairing Panel Detail	J1	
5	15	5	USAF/EJW	X85F193		Bldg Mod, North End B25C, 2 sheets	J1	
6	15	5	USAF/EJW	X86F002		Sheet Metal Lower External Fairing	J1	
6	15	0	USAF/TAP	X86F003		Honeycomb Test Frame Assy/Details	1	
6	18	0	USAF/EJW	X86F013		Bottom door fairing assy	1	
6	15	5	USAF/EJW	X86F014		Honeycomb Shell Assembly, 2 Sheets	J1	
6	15	5	USAF/EJW	X86F015		Honeycomb Sections and Details, 5 Sheets	J2	
6	15	5	USAF/PJS	X86F016		Honeycomb Door Assy. & Instl	J1	
6	18	0	USAF/EJW	X86F019		Dual sheave mounting assy	1	
6	15	5	USAF/EJW	X86F020		Vertical Column Fairing Assy, 2 Shts	J1	
6	15	5	USAF/EJW	X86F024		Column & Support Fairing Instltn	J1	
6	18	0	USAF/MB	X86F025		Lamp attachment - camera - ASRL	1	
6	15	5	USAF/MEJ	X86F027		Screen Installation-North Wall B25C, 2 Sheets	J2	
6	15	5	USAF/EJW	X86F028		Inflatable Fairing Blower System Installation, 4 Sheets	J2	
6	18	0	USAF/MEJ	X86F029		Diffuser access platform assy/instl	1	
6	18	0	USAF/EJW	X86F030		pressure switch/gage asssy	1	
6	15	5	USAF/PJS	X86F036		Honeycomb Sections & Details	J1	
6	15	5	USAF/EJW	X86F038		Inflatable Fairing Instltn, 2 Sheets	J1	
6	15	5	USAF/EJW	X86F065		Honeycomb Bonding Fixture Scheme	J1	
6	15	9	USAF/MEJ	X86F091		High-Loss Screen Sect. Ass'y., 4 SH.	K1	
6	15	9	USAF/MEJ	X86F092		High-Loss Screen Sect. Frame Weldment, 5 SH.	K2	
6	15	9	USAF/MEJ	X86F096		Liner Panel Dets., High-Loss Screen Section, 4 SH.	K2	
6	15	9	USAF/MEJ	X86F097		High-Loss Screen Sect. Screen Clamping Assy,	K2	
6	15	9	USAF/MEJ	X86F098		High-Loss Screen Sect. Misc. Details	K1	
6	15	9	USAF/MEJ	X86F099	A	High-Loss Screen Sect. Ass'y-Instl. Dets., 2 SH.	K2	
6	15	9	USAF/MEJ	X86F104	A	Proposed Inlet Treatment Config. SARL	K2	
6	15	9	USAF/MEJ	X86F105		Fairing Brace Details (Modified)	K1	

6	15	9	USAF/MEJ	X86F106	A	Sheet Metal Fairing Assy (Modified), Sheets 1,3,4,5	K2	
6	15	9	USAF/MEJ	X86F106		Sheet Metal Fairing Assy (Modified), Sheet 2	K2	
6	15	9	USAF/MEJ	X86F107	A	Fairing, Sheet Metal Veiw and Details (Modified), 3 SH.	K2	
6	15	9	USAF/MEJ	X86F108		Fairing Close Out Frame & Support Beam (Modified)	K2	
6	15	9	USAF/MEJ	X86F109		Sheet Metal Fairing Panel Detail (Modified)	K2	
6	15	9	USAF/MEJ	X86F110		Screen Instl. North Wall BLDG. 25C (Modified), 2 SH.	K2	
6	15	0	USAF/MEJ	X86F111		SARL Tunnel Config.	K1	
6	15	10	USAF/MEJ	X87COVER		SARL Sht. Mtl. Fairing Access Sect.	K1	
6	15	10	USAF/MEJ	X87F079		Overall Plan View Fairing Access Sect. (4 sheets)	K2	
6	15	10	USAF/MEJ	X87F080		Flooring Struct. Instl./Dets. Sht. Mtl. Fairing Access Sect.	K2	
6	15	10	USAF/MEJ	X87F081		Upper Plan View Sht. Mtl. Fairing Access Sect.	K2	
6	15	10	USAF/MEJ	X87F082		Door Assy/Instl Sht. Mtl. Fairing Access Sect. (2 sheets)	K2	
6	15	10	USAF/MEJ	X87F083		Column Support Braces Sht. Mtl. Fairing Access Sect.	K2	
6	15	10	USAF/MEJ	X87F084		Decking Panel Details Sht. Mtl. Fairing Access Sect.	K2	
6	15	10	USAF/MEJ	X87F085		Demolition & Relocation- Roll-Up Door Sht. Mtl. Fairing Access Sect.	K2	
6	15	10	USAF/MEJ	X87F097		Overall plan view sht mtl fairing access sect. shts. 1 - 4	K2	
6	15	11	USAF/MEJ	X87FCOVER		Motor tower gearbox housing	L1	
6	15	11	USAF/MEJ			frame instl. sh. 1 - 4		
6	15	11	USAF/MEJ	X86F141		Motor tower gearbox housing frame ass'y sh. 1 - 5	L2	
6	15	11	USAF/MEJ	X87F001		Motor tower housing face frame ass'y /dets sh. 1 - 5	L2	
6	15	11	USAF/MEJ	X87F109		Motor support tower additional walkway supports & stringer mod.	L2	
6	15	11	USAF/MEJ	X83F185		Motor support tower for SARL	L1	
0	16	2	SOF-4961	#1		Diagonal	E1	Prnt only
0	16	2	SOF-4961	#001		Mod. to Support Frame Downstream Section	E2	Prnt only
0	16	2	SOF-4961	#002		Support Frame Model Support Section	E1	Prnt only
0	16	2	SOF-4961	#003		Support Frame Details SheetE1 Model Support Section	E2	Prnt only
0	16	2	SOF-4961	#004		Support Frame Details Sheet 2 Model Support Section	E2	Prnt only
0	16	2	SOF-4962	#AB1		Motor Support Tower	E1	Prnt only
0	16	2	SOF-4962	#1		Motor Support Tower	E1	Prnt only
0	16	2	SOF-4962	#2		Motor Support Tower	E1	Prnt only
0	16	2	SOF-4962	#3		Motor Support Tower	E1	Prnt only
0	16	2	SOF-4962	#4		Motor Support Tower	E1	Prnt only
0	16	2	SOF-4962	#5		Motor Support Tower	E1	Prnt only
0	16	2	SOF-4962	#6		Motor Support Tower	E1	Prnt only
0	16	2	SOF-4962	#7		Motor Support Tower	E1	Prnt only
0	16	2	SOF-4962	#10		Fan Blade Access Platform	E1	Prnt only
0	16	2	SOF-4962	#11		Fan Blade Access Platform	E1	Prnt only
0	16	2	SOF-4962	#12		Fan Blade Access Platform	E1	Prnt only
0	16	2	SOF-4962	#13		Fan Blade Access Platform	E1	Prnt only

0	16	2	SOF-4962 #14		Fan Blade Access Platform	E1	Prnt only
0	16	2	SOF-4962 #15		Fan Blade Access Platform	E1	Prnt only
0	16	2	SOF-4962 #16		Fan Blade Access Platform	E1	Prnt only
0	16	2	SOF-4962 #17		Fan Blade Access Platform	E1	Prnt only
0	16	2	SOF-4962 #18		Fan Blade Access Platform	E1	Prnt only
0	16	2	SOF-4962 #19		Fan Blade Access Platform	E1	Prnt only
0	16	2	SOF-4962 #20		Fan Blade Access Platform	E1	Prnt only
0	16	2	SOF-4962 #ES-2		Fan Blade Access Platform	E1	Prnt only
0	16	2	SOF-4962 #ES-3		Fan Blade Access Platform	E1	Prnt only
0	16	2	SOF-4962 #ES-4		Fan Blade Access Platform	E1	Prnt only
0	16	2	SOF-4962 #E-F185-3		Motor Support Tower	E1	Prnt only
0	16	2	SOF-4962 #E-F185-5		Motor Support Tower	E1	Prnt only
13	16	2	SOF-4963 #1		Drive Motor Cover	E1	Prnt only
13	16	2	SOF-4963 #1A		Drive Motor Cover	E1	Prnt only
13	16	2	SOF-4963 #1B		Drive Motor Cover	E1	Prnt only
13	16	2	SOF-4963 #1C		Drive Motor Cover	E1	Prnt only
13	16	2	SOF-4963 #2		Drive Motor Cover	E1	Prnt only
0	16	2	SOF-4964 #F001		Cable Tray Support Details	E1	Prnt only
0	16	2	SOF-4964 #F003		Cable Tray Support Details	E1	Prnt only
0	16	2	SOF-4964 #F009		Cable Tray Support Details	E1	Prnt only
0	16	2	SOF-4964 #F248		Cable Tray Support Details	E1	Prnt only
0	16	2	SOF-4964 #F249		Cable Tray Support Details	E1	Prnt only
0	16	2	SOF-4964 #F250		Cable Tray Support Details	E1	Prnt only
0	16	2	SOF-4965 #1		Fan & Piping Installation	E1	Prnt only
0	16	2	SOF-4965 #2		Fan & Piping Installation	E1	Prnt only
0	16	2	SOF-4965 #3		Fan & Piping Installation	E1	Prnt only
0	16	2	SOF-4965 #4		Fan & Piping Installation	E1	Prnt only
0	16	2	SOF-4965 F196 #E-1		Fan & Piping Installation	E1	Prnt only
0	16	2	SOF-4965 F197 #E-2		Fan & Piping Installation	E1	Prnt only
0	16	2	WHLG 85-3554 #1		Decking Layout	1	Prnt only
0	16	2	WHLG 85-3554 #2		Decking Layout	1	Prnt only
0	16	2	WHLG 85-3554 #3		Decking Layout	1	Prnt only
0	16	2	WHLG 85-3554 #4		Decking Layout	1	Prnt only
0	16	2	WHLG 85-3554 #5		Decking Layout	1	Prnt only
0	16	2	WHLG 85-3554 #6		Decking Layout	1	Prnt only
0	16	2	STL SER CO. 4773-1		Motor Support Tower	E1	Prnt only
13	16	2	BRN.CAMPB.CO. #1		Motor Support Tower Walkway	E1	Prnt only
0	16	2	Thern SD1311		Assy Drawing-489A3B,E18L Motion Savers (Note:SARL TS Door Winch)	E2	Prnt only
3	16	3	SOF-6657 #1		Cover-Aux. Drive Shaft	E1	
3	16	3	SOF-6657 #2		Data Cable Tray Routing	E1	
3	16	3	SOF-6657 #3		Data Cable Tray Routing	E1	
3	16	3	SOF-6657 #4		Data Cable Tray Routing	E1	
5	17	0	USAF/MJB X85F029		Model Catcher-SARL	1	Obsolete
5	17	0	USAF/MJB X85F030		Model Catcher Details - SARL	1	Obsolete
5	17	0	USAF/MJB X85F031		Model Catcher Details - SARL	1	Obsolete
5	17	0	USAF/MJB X85F032		Model Catcher Details - SARL	1	Obsolete
5	17	3	USAF/EJW X85F038		Cable Tray Support Details	H1	
5	17	3	USAF/EJW X85F039		Upstream sheet metal fairing mod	1	
5	17	3	USAF/EJW X85F040		Downstream sheet metal mod	1	
5	17	3	USAF/WRH X85F042		Instrumentation Platform Plan-SARL	H1	
5	17	3	USAF/WRH X85F043		West Inst. Platform - SARL	H1	
5	17	3	USAF/WRH X85F044		East Inst. Platform - SARL (2 Shts)	H1	
5	17	3	USAF/WRH X85F045		Lower Inst. Platform and Catwalk	H1	
5	17	3	USAF/WRH X85F046		Model Lift Area Platform- SARL	H1	
5	17	3	USAF/WRH X85F047		Inst. Platform Details - SARL	H1	
5	17	3	USAF/WRH X85F048		Details & WeldmentS-SARL (2 Sheets)	H1	
5	17	3	USAF/EJW X85F056	A	Data Cable Tray Routing - Bldg 25C (2 sheets)	H2	

5	17	3	USAF/WRH	X85F057		Inst.Platform Column Schedule	H1
5	17	3	USAF/SDM	X85F058		2" Instrumentation Conduit Run, Bldg 25C, SARL	H2
5	17	3	USAF/PS	X85F070		Installation - test section floor & access floor	2
5	17	0	USAF/MJB	X85F081		Hatch Door-Diffuser Section	H1
5	17	3	USAF/WRH	X85F083		Instrument Platforms-Section & Elevation	H2
5	17	3	USAF/WRH	X85F084		North Elevation, Inst. Platforms Elevations	H2
5	17	3	USAF/SDM	X85F087		Cable Tray Installation, Control Rooms	H2
5	17	3	USAF/EJW	X85F136		Inflatable fairing (plan view)	1
5	17	3	USAF/EJW	X85F137		Inflatable fairing top & W. side	1
5	17	3	USAF/EJW	X85F138		Inflatable fairing E. side	
5	17	3	USAF/EJW	X85F139		Inflatable fairing base rings	1
5	17	3	USAF/EJW	X85F140		Inflatable fairing elevation	1
5	17	3	USAF/EJW	X85F149		Roll up door configuration	1
5	17	3	USAF/EJW	X85F152		SARL exhaust elbow 47 deg proposal	1
5	17	3	USAF/EJW	X85F155		Winch mtg plate & sheave bracket	1
5	17	3	USAF/EJW	X85F156		Winch & sheave assy	1
5	17	3	USAF/EJW	X85F157		Transport cart test section work floor SARL	2
5	17	3	USAF/EJW	X85F164		Down stream contract filler pannnel	1
5	17	3	USAF/PS	X85F165		SARL/gear lube system pipe support	1
5	17	3	USAF/PS	X85F182		SARL aero lines	1
5	17	3	USAF/MM	X85F184		STator collars - SARL fan	1
3	17	3	USAF/RDH	S53C1161	B	Partition Addition-Soundproof Bldg 25D (Control Room)	H2
5	17	3	USAF/PJS	X85F191		SARL Model Catcher (3 Sheets)	H1
5	17	4	USAF/TAP	X85F153		60 Ton Crane Access Platform Inst.	F1
5	18	0	USAF/MEJ	X85F108		P.Ref Manifold and Transducer Module Assy's - Instl. (2 Sheets)	G2
5	18	0	USAF/MEJ	X85F109		Contraction Section Pressure Tap Instl. /Details (2 Sheets)	G2
5	18	0	USAF/MEJ	X85F112		P.Ref Manifold Supply and PSI System Rack- Assy/Instl (3 Sheets)	G2
5	18	0	USAF/MEJ	X85F113		P.Ref Manifold Supply and PSI System Rack- Details (2 Sheets)	G2
5	18	0	USAF/MEJ	X85F114		Test Section Pressure Taps and Probe Details/Instl. (4 Sheets)	G2
5	18	0	USAF/MEJ	X85F115		Model Support Pressure Taps Details and Instl	G2
5	18	0	USAF/MEJ	X85F116		Diffuser Sect Pressure Tap Details and Instl (2 Sheets)	G2
5	18	0	USAF/MEJ	X85F151		Probe at Sta. 11.2' Assy/Instl (2 Sheets)	G2
5	18	8	USAF/MEJ	X85F158		Fan Rakes and Pressure Taps Instl (4 Sheets)	G2
5	18	8	USAF/MEJ	X85F159		Fan Rakes Assy/Dets (2 Sheets)	G1
5	18	0	USAF/MEJ	X85F177		Bldg.25C Southwall Penetration	G1
5	18	0	USAF/MEJ	X85F179		Transducer Module Assy Vertical Configuration (2 Sheets)	G2
5	18	0	USAF/MEJ	X85F180		Transducer Module Assy Horizontal Configuration (2 Sheets)	G2
5	18	0	USAF/MEJ	X85F181		Transducer Module Assy Details (2 Sheets)	G2
5	18	0	USAF/MEJ	X85F185		Transducer Module Oven Box Assy	G1
5	18	0	USAF/MEJ	X85F186		Transducer Module Oven Box Details	G1

6	17	0	USAF/MSG	X86C005	Mounting Panel-Scanner Controls	1
6	17	0	USAF/MSG	X86C006	Mounting Enclosure-Scanner Controls	1
6	17	0	USAF/MSG	X86B007	Support Member-Scanner Controls	1
6	17	0	USAF/MSG	X86C008	Mtng Panel-Pan, Tilt, Zoom Controls	1
6	17	0	USAF/MSG	X86C009	Mtng Enclosure-Pan, Tilt, Zoom	1
6	17	0	USAF/MSG	X86C010	Support Member-Pan, Tilt, Zoom	1
6	17	0	USAF/MSG	X86C011	Assembly, Scanner Controls	1
6	17	0	USAF/MSG	X86C012	Assy, Pan Tilt, Zoom Controls	1
6	17	0	USAF/MSG	X86F013	Bottom door fairing assy	1
6	18	0	USAF/MEJ	X86F017	Pressure System Schematic	G1
6	17	0	USAF/MSG	X86F019	Dual sheave mounting assy	1
6	17	0	USAF/MSG	X86C021	Welding Assy, Pan, Tilt, Zoom Cntrls	1
6	17	0	USAF/MSG	X86C022	Welding Assy, Scanner Video Controls	1
6	18	0	USAF/MEJ	X86F031	398 Baratron Cover	1
6	18	0	USAF/MEJ	X86F037	Control Wiring Diagram	1
6	18	0	USAF/PS	X86F039	SARL hatch/viewports layout	1
6	17	0	USAF/LM	X86B073	Hatch Cover Bolt	1
6	18	0	USAF/MAU	X86F074	Power distribution bdlg 25c	1
6	18	0	USAF/MEJ	X86F075	Diffuser access steps - SARL	1
6	18	0	USAF/LM	X86D085	Schematic, Drive Train Dynamic Inst	1
6	17	0	USAF/MJB	X86F095	Handrail & Walkway Details	1
6	18	0	USAF/MRC	X86C100	Cover - tach probe SARL drive train	1
6	18	0	USAF/MEJ	X86F135	Motor tower cover hatch mod - SARL	1
6	18	0	USAF/TAP	X86B136	Test section transition fairings SARL	1
6	18	0	USAF/MEJ	X86F138	Emergency shut off switch assy / instl SARL	2
6	18	0	USAF/MEJ	X86F139	Emergency shut off switch details SARL	1
6	23	12	USAF/MEJ	X87F033	Test Section Door Hydraulics Inst	1
6	23	12	USAF/MEJ	X87F002	Mtr. twr. gearbox inst. covers	1
6	23	12	USAF/TAP	X87F006	SARL cable restraint assembly	1
6	23	12	USAF/TAP	X87F007	SARL upstream blade removal	1
6	23	12	USAF/MB	X87F015	Pattern - stator blade collars	1
6	23	12	USAF/MB	X87F016	Stator blades - fan section	1
6	23	12	USAF/MB	X87F017	Installation stator blades	1
6	23	12	USAF/MEJ	X87F021	Access ladder dets cont. & diffuser sect.	2
6	23	12	USAF/MEJ	X87F032	Stator blade collars - set up fixture	1
6	17	3	USAF/TAP	X870036	PIN PULLER (SARL FAN)	H1
6	23	12	USAF/EJW	X87F040	Fan lube system storage tank liquid level mod	2
6	23	12	USAF/EJW	X87F041	liquid level measuring assy	1
6	23	12	USAF/EJW	X87F042	Honeycomb hole sizer	1
6	23	12	USAF/EJW	X87F065	Temporary model support pivot arm assy & detail	2
6	23	12	USAF/EJW	X87F066	Temporary model support actuator support	2
6	23	12	USAF/EJW	X87F067	Temporary model support	1
6	23	12	USAF/EJW	X87D073	Model support concept # 3	1
6	23	12	USAF/DW	X87F091	Laddre & wiring diagrams - SARL test cabin door	2
6	23	12	USAF/EJW	X87D095	Model/sting adapter	1
6	23	12	USAF/TG	X87F103	Fan lube system-scheematic diagram	1
6	23	12	USAF/EJW	X87D104	Test section lower viewing glass protector	2
6	23	12	USAF/MEJ	X87F109	Stringer mod & additional walkway supports SARL	2
6	23	12	USAF/MEJ	X87F113	Fan lube oil storage tank mod. & heater instl.	2
6	23	12	USAF/MEJ	X88F001	Readout Gear Plate Instl 20,000 Hp	2

					Speed Control (2 Sheets)		
6	23	12	USAF/MEJ	X88F002	Readout Gear Plate Assy 20,000 Hp Speed Control	2	
6	23	12	USAF/MEJ	X88F003	Readout Gear Plate Misc Dets	1	
6	23	12	USAF/MEJ	X88F005	Oil Pump Replacement/Instl 2 GPM SARL (2 Sheets)	2	
6	23	12	USAF/MEJ	X88F006	D.C. Motor Instl. Oil Lift Pump 2 GPM (2 Sheets)	2	
6	23	12	USAF/MEJ	X88F007	Oil Pump MTG BRKT SARL	1	
6	23	12	USAF/MEJ	X88F009	Spacer Plate Det. D. C. Motor Instl	1	
6	23	12	USAF/MS	X88F010	Pin retainer-bulkhead-SARL	1	
6	23	12	USAF/MS	X88F011	Brake trigger-test section door assembly SARL	2	
6	23	12	USAF/MSG	X88F019	Calibration probe-five hole-SARL	1	
6	23	12	USAF/MSG	X88F020	Calibration probe-pitot static tube SARL	2	
6	23	12	USAF/MSG	X88F021	Static pressure wall pipe-SARL See dwg X88F041	2	Obsolete
6	23	12	USAF/EJW	X88F026	Calibration rake positioning collar	1	
6	23	12	USAF/EJW	X88F027	Calibration rake ass'ys/SARL	1	
6	23	12	USAF/MEJ	X88F030	Calibration rake dets SARL	1	
6	23	12	USAF/MEJ	X88F041	Static pressure wall pipe ass'ys /instls SARL	2	
6	23	12	USAF/EJW	X88F047	Instrumentation pod configuration	1	
6	23	12	USAF/MEJ	X88F048	Calibration rake positioning system overall layout	2	
6	23	12	USAF/MEJ	X88F049	Calibration rake positioning slide instl/dets	2	
6	23	12	USAF/MEJ	X88F050	Calibration rake positioning strut assy/dets	2	
6	24	13	MICR/MEJ	X89F010	Test section door, hydr, instl,(SARL)	1	
6	24	13	MICR/MEJ	X89F011	Test section door, hydr, det., (SARL)	1	
6	24	13	MICR/MEJ	X89F012	Test section door, hydr, sys, (SARL)	1	
6	24	13	MICR/MEJ	X89F013	Test section door, winch, demo,(SARL)	1	
6	23	12	KOP-FLEX	89 CC73824	No. 8.0 Type HD Flex-Half Coupling	1	
6	25	14	Micr/MEJ	X89F115639	SARL exhaust deflector, overall layout, instl.	2	
6	25	14	Micr/MEJ	X89F115640	SARL exhaust deflector, support structure, instl, det.	2	
6	25	14	Micr/MEJ	X89F115641	SARL exhaust deflector, misc. det., sliding door ass'y.	2	
6	25	14	Micr/MEJ	X89F115642	SARL exhaust deflector, concrete footer plan/det	2	
6	23	12	USAF/MB	X89F115673	SARL/stiffener addition to access	1	
6	23	12	USAF/MSG	X90D12971	Stings/long & short-3000# suspension system	2	
6	23	12	USAF/MSG	X90D12972	Support-scarf joint-3000# suspension system	2	
6	23	12	USAF/MSG	X90D12973	Adapter fairing-scarf jiont support- 3000# suspension system	2	
6	24	13	USAF/TB	X90F12980	Ladder diagram, SARL cabin door	1	
6	24	13	USAF/TB	X90F12981	Wiring diagram, SARL cabin door	1	
6	24	13	USAF/TB	X90F12982	Program listing SARL cabin door	1	
6	24	13	USAF/RDH	X90F12983	SARL test cabin door hydraulic system	1	
6	23	12	USAF/MSG	X90C12989	Spanner wrench-adapter fairing & jam nut-3000# suspen. sys.	2	
6	23	12	USAF/MSG	X90C12990	Misc. details/vortex model fuselage/ SARL	2	
6	26	12	USAF/RDH	X90D12991	Installation dwg SARL smoke pole	2	

					system	
6	26	12	USAF/RDH	X90E12992	Side plate assy, smoke pole-SARL	1
6	26	12	USAF/RDH	X90D12993	2" base plate-smoke pole-SARL	1
6	26	12	USAF/RDH	X90D12994	Details plate-smoke pole-SARL	1
6	26	12	USAF/RDH	X90E12995	Tunnel modification SARL	1
6	28	12	USAF/RDH	X91D93299	Installation SARL test cabin hoist	1
6	28	12	USAF/RDH	X91D93300	Assy SARL test cabin hoist	1
6	28	12	USAF/RDH	X91D93301	Boom outside SARL test cabin hiost	1
6	28	12	USAF/RDH	X91D93302	Assy inside SARL test cabin hoist	1
6	28	12	USAF/RDH	X91D93303	Veticle hinges tube SARL test cabin hoist	2
6	28	12	USAF/RDH	X91D93304	Hing half assy SARL test cabin hoist	2
6	28	12	USAF/RDH	X91D93305	Details - hinges SARL test cabin hoist	2
6	28	12	USAF/RDH	X91D93306	Assy/details - hinge SARL test cabin hoist	2
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