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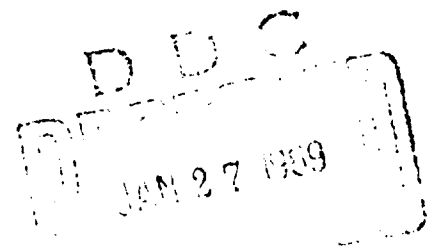
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TECHNICAL REPORT AFRPL-TR-68-141

STUDY OF LONG TERM EFFECTS OF HIGH
ENERGY PROPELLANTS ON FINE MICRONIC
STAINLESS STEEL WIRE CLOTH USED IN
SURFACE TENSION DEVICES

AIR FORCE CONTRACT F04611-68-C-0064
WESTERN FILTER COMPANY, INCORPORATED
CHATSWORTH, CALIFORNIA



AD-846 571

FINAL REPORT

STUDY OF LONG TERM EFFECTS OF HIGH ENERGY
PROPELLANTS ON FINE MICRONIC STAINLESS STEEL
WIRE CLOTH USED IN SURFACE TENSION DEVICES

Western Filter Company
Gardena, California

TECHNICAL REPORT AFRPL-TR-68-141
JULY 1968

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AIR FORCE ROCKET PROPULSION LABORATORY
DIRECTOR OF LABORATORIES
EDWARDS, CALIFORNIA
AIR FORCE SYSTEMS COMMAND, UNITED STATES AIR FORCE

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FOREWORD

This report, a one-volume document, is provided at the end of Contract F04611-68-C-0064, Study of Storability of Metal Screens.

This program, a one-man month effort over a three-month period, conducted for the Air Force Rocket Propulsion Laboratory, Edwards, California, beginning 1 April 1968 and completed on 1 July 1968, was performed by Western Filter Company, Gardena, California. Chief contributors to the program are named below:

Air Force Contract Monitor

Lt. R. B. Mears, RPRPT

Western Filter Company

L. J. DiPeri

K. H. Brown

The Western Filter Company Reference number for this document is S. O. 8332.

This technical report has been reviewed and is approved.

2nd Lt. R. B. Mears
USAF/RPRPT
Air Force Rocket Propulsion Laboratory
Edwards, California

ABSTRACT

→ This report covers the results of an effort involving a three months period to retrieve information on the compatibility of wire cloth filters with rocket propellants. The same types of wire cloth used in filters is also used in surface force orientation devices in missile systems undergoing low gravity environment.

During this study 96 filters were found that are considered good candidates for useful information. Each of these filters were found as part of an installation or as a separate unit. Most of the filters were still installed in live systems with propellants and performing their designated function. Six of the filter elements have been borrowed, visually inspected and photographed. Data sheets on all 96 units have been prepared and are included in this report. Time histories for the specimens range from 7-1/2 years to 3 months. Fluids were IRFNA, N_2O_4 , UDMH, N_2H_4 , NMH, H_2O_2 , ClF_3 , liquid chlorine, liquid hydrogen, liquid oxygen, and mixture of fluorine and oxygen. ()

It is concluded from the case histories established that valuable evidence of the storability of screens can be acquired by such investigation.

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INTRODUCTION

Advances in the art of applying surface tension technology to the management of liquid gas interfaces in Space Propulsion Systems and Tactical Weapons and other related activities has raised questions as to the long term effects of high energy propellants on fine micronic wire cloth from which surface tension devices are made.

A materials storability program is underway at the Edwards Air Force Base Rocket Propulsion Laboratory and in years to come, valid empirical storability data will be acquired.

In the interim, a means of gathering compatability data on wire cloth, is to research records of wire cloth filters that have been made for use with these propellants, to trace their whereabouts and examine those that have been in extended use for effects of propellants on the wire cloth.

This report summarizes the results of an effort covering a three month period to collect data that would provide evidence of the storability of stainless steel wire cloth in high energy propellants. In retrieving data for this contract, four major test facilities were visited: TRW Test Site, San Juan Capistrano; Wyle Laboratories, Norco Facility; Rocketdyne, Santa Susana Facility; and Marquardt Corporation, Magic Mountain Test Site.

Five filter manufacturers are represented by twenty-three case histories established which represent ninety-six filters; Capitol Westward Filter Company, Paramount, Calif.; Microporous Filter Company, Anaheim, Calif.; Flowatics Company, Sacramento, Calif.; and Western Filter Company, Gardena, Calif. Although the contract called for a review of Western Filter records to determine candidate filters, it was realized that it would be more effective to go into the field where there was a good chance of finding some candidates and determine vital design data. In following this procedure, several filters were uncovered that were not manufactured by Western Filter. However, since they were excellent examples for data, they have been documented and the resultant data is enclosed in this report. Unfortunately, design data is not always included due to the prohibitive length of time allowed by the contract.

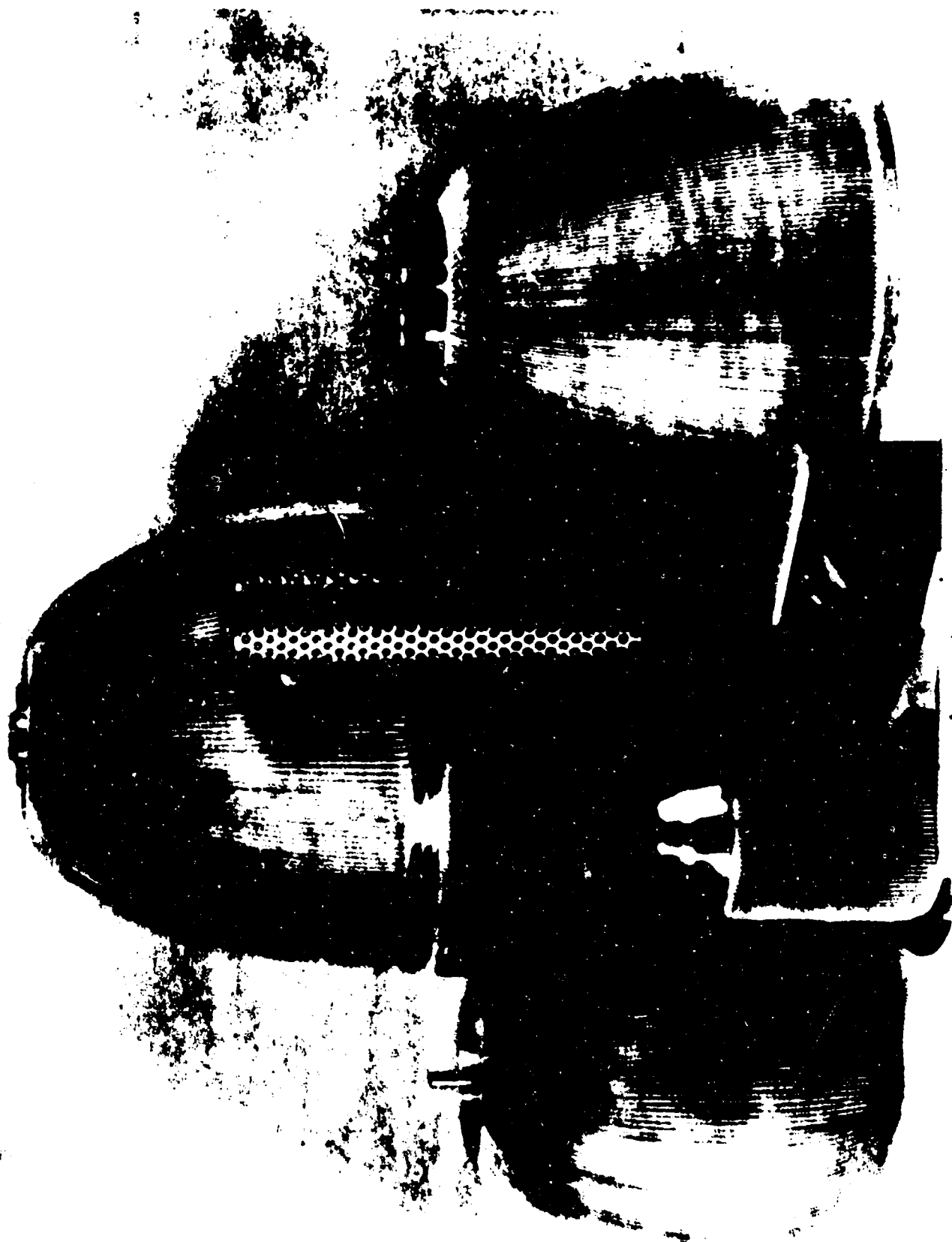


FIGURE 1
PAGE 10

Section 2

CASE HISTORIES AND DESCRIPTIONS

This section contains information and data retrieved during accomplishment of the study. Included are data sheets, photo reduced drawings of the filter assembly and filter element, and where possible, photographs of the general and specific areas where the filter units are located. Because of limited access to the various test sites, photographs could not be taken of all units observed. In most cases, supervisory personnel reviewed their files for photos taken of the area which contained a view of the filter.

In instances where filters were considered good candidates but were not Western Filter units, it was not possible to get copies of the drawings of the units. Consequently, in the time allotted for this program, an attempt was made to gather as much information as available. In some instances, photos of the units were available.

Photographs showing the surroundings indicate the environmental conditions, such as vibration from close proximity of engine tests, sunlight exposure causing hot day cycling conditions as well as outdoor cold day conditions. Also, an indication is given showing the ease or difficulty entailed in removing a sample element for further evaluation.

The following data is a summary of the number of filter units in each case history established.

<u>Company</u>	<u>Case History No.</u>	<u>Number of Filter Units</u>
Wyle - - - - -	1	4
	2	4
	3	4
	4	4
TRW - - - - -	5	12
	6	1
	7	6
	8	6
	9	8
	10	2
	11	2
	12	2
	13	2
	14	1
	15	2
	16	1
ROCKETDYNE - - - - -	17	1
	18	1
	19	1
	20	1
NASA - - - - -	21	25
DOUGLAS- - - - -	22	1
MARQUARDT- - - - -	23	5
	Total	96

Section 2.1

WYLE CASE HISTORIES

DESCRIPTION- CASE HISTORY #1

Filter Assembly P/N 1-1-10005 is a Y-Type configuration. The entire assembly is manufactured from stainless steel and Heli-arc welded in construction. This unit has 4-inch, 150 lb., ASA inlet and outlet flanges. A feature of this configuration is that the filter element can be removed without having to remove the filter case from the line. By removing the end cap and spider assembly, the element will slip out for cleaning or replacement. The pleated element is 304 stainless steel, Heli-arc welded and has in excess of 400 square inches of screen.

There are four filter units in this case history. The units have been in use at Wyle Laboratories, Norco Facility, for seven years. They have been functioning exposed to direct sunlight and weather. Flow rates have been to 250 GPM using both UDMH and N_2O_4 alternately. The elements have been cleaned many times.

Figures 2 through 10 relate information to the four candidate units in this case history. We have visually inspected the filter element shown and screen shows no detrimental effect from long term service.

The element in Figure 8 had the outer shroud removed. The shroud was similar to the inner shroud shown. A polka dot pattern of discoloration is in evidence on the screen. This matches the outer support holes and is believed to be a deposit caused by the higher concentration of fluid flow through this area.

To satisfy this theory, one-half of the unit was cleaned in an electro polishing bath. The polka dot pattern diminished in this area as a result of the cleaning. The upper half of the element remains as found, for a basis of comparison. See Figure 9. A close-up view of the element showing the area as found and the area cleaned is shown in Figure 10. In observing the cleaned area, there appeared to be no deleterious effects on the wire cloth from prolonged exposure to the propellants.

BASIC DATA FORMLONG TERM COMPATABILITY

PART NUMBER: _____ PN/1-1-10005

MANUFACTURER: _____ Western Filter

USER: _____ Wyle Labs. Norco, California

LIQUID: _____ UDMH and N_2O_4

ESTIMATE SERVICE TIME: _____ 7 years intermittent

USE, DUTY CYCLE: _____ continuous except for
occasional cleaning

CONDITION: _____ Good, shows no evidence of
deterioration or collapsing.

SCREEN MATERIAL: _____ 304L Cres steel Dutch Twill Cloth.

TEMPERATURE: _____ $+28^{\circ}$ to $150^{\circ}F$

SERVICE SPECIFICATION: _____ 4 inch Pipe-inlet & outlet flange.
(see fig. 2)

HISTORY: _____

REPLACEMENT COST: _____ \$400.00 for element (approx.)

FLOW RATE: _____ Flow Rate approx. 250 gpm

PRESSURE DROP: _____

OPERATING PRESSURE: _____

MICRON RATING: _____

OTHER: _____ Unit located outside in direct
sunlight.
Cognizant Supervisor August
Ferrira.
Screen collapsed due to
accidental reverse flow.
 N_2O_4 with high water content
(30%) have been in contact
with element.

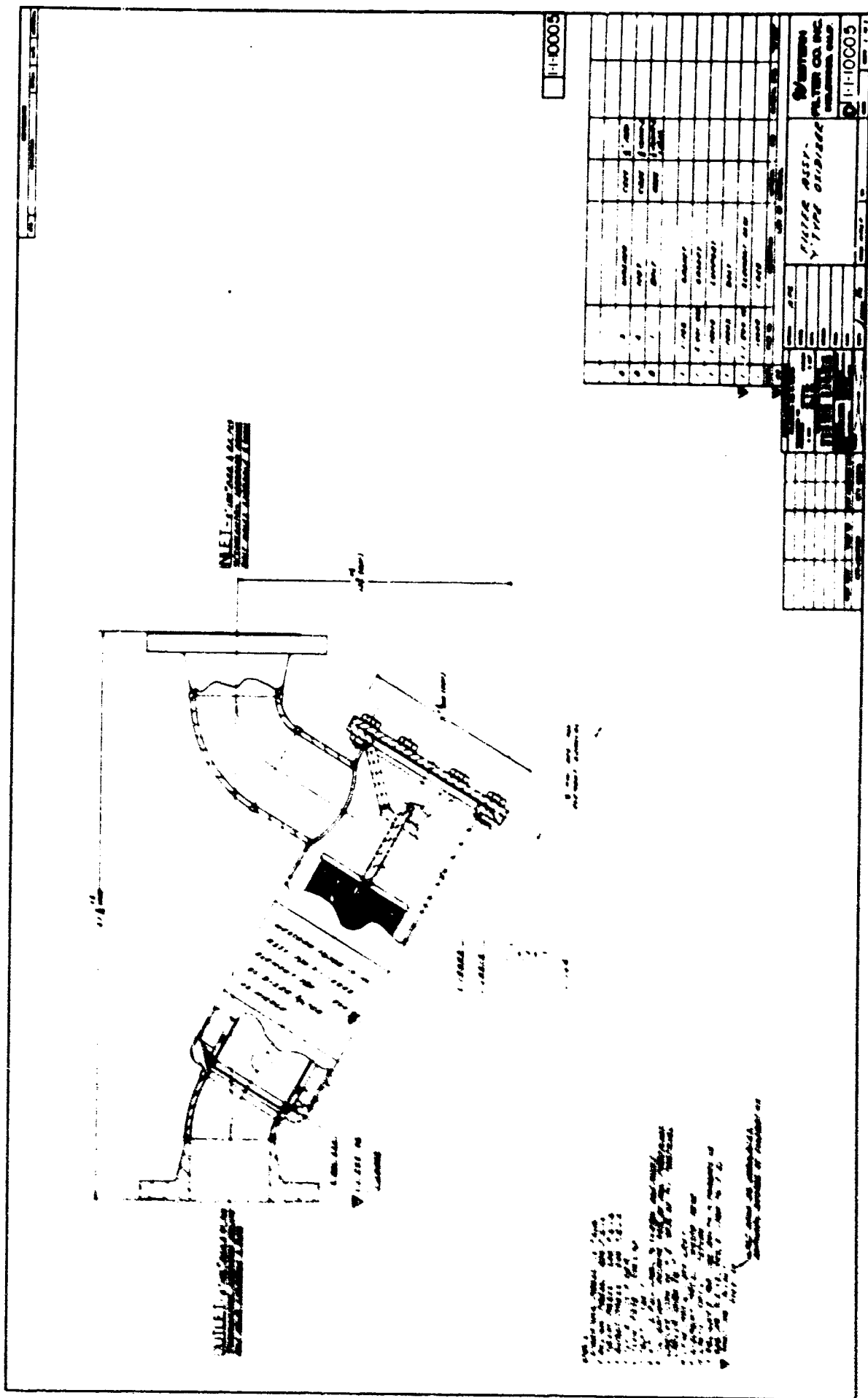




FIGURE 1
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FIGURE 5
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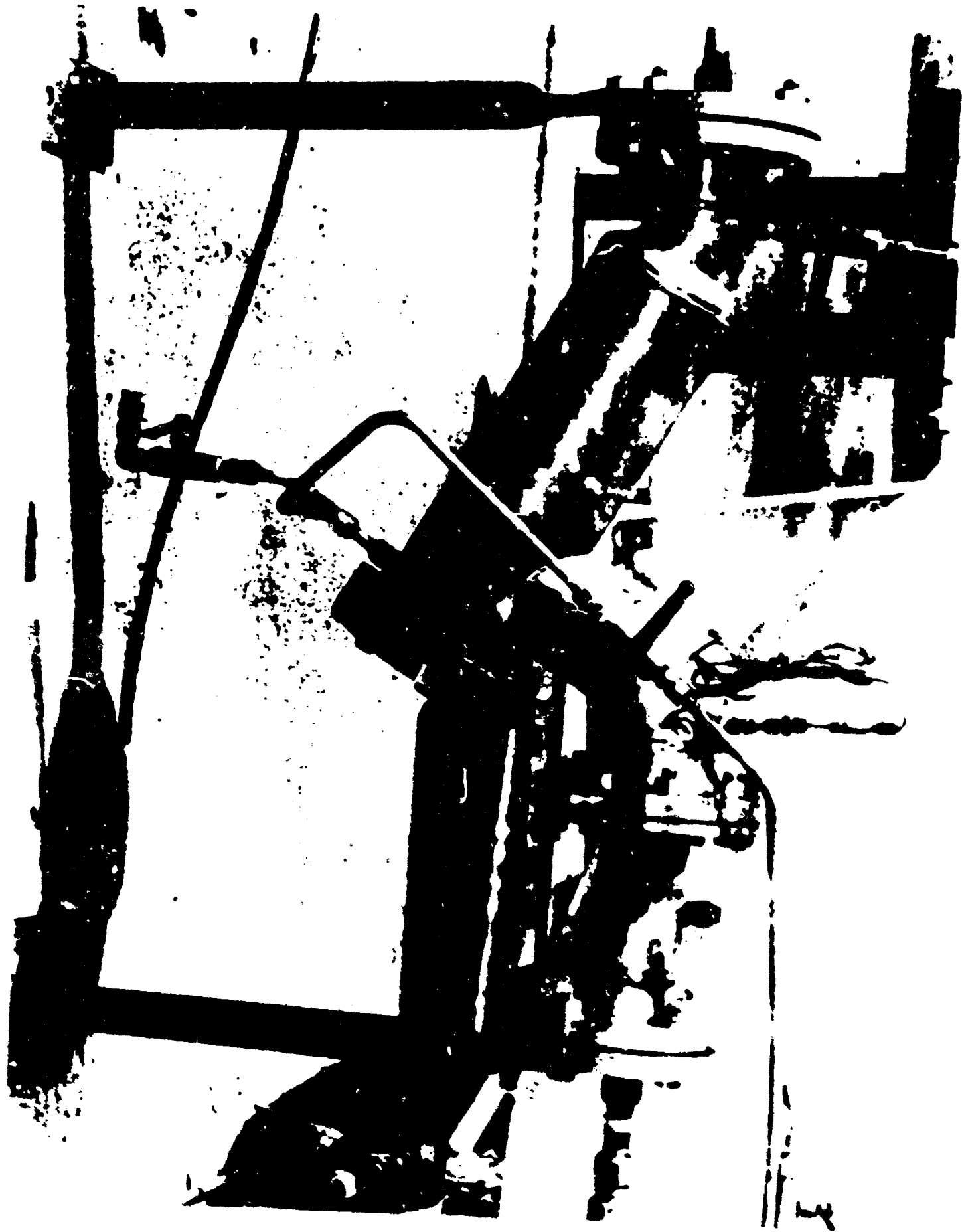


FIGURE 6
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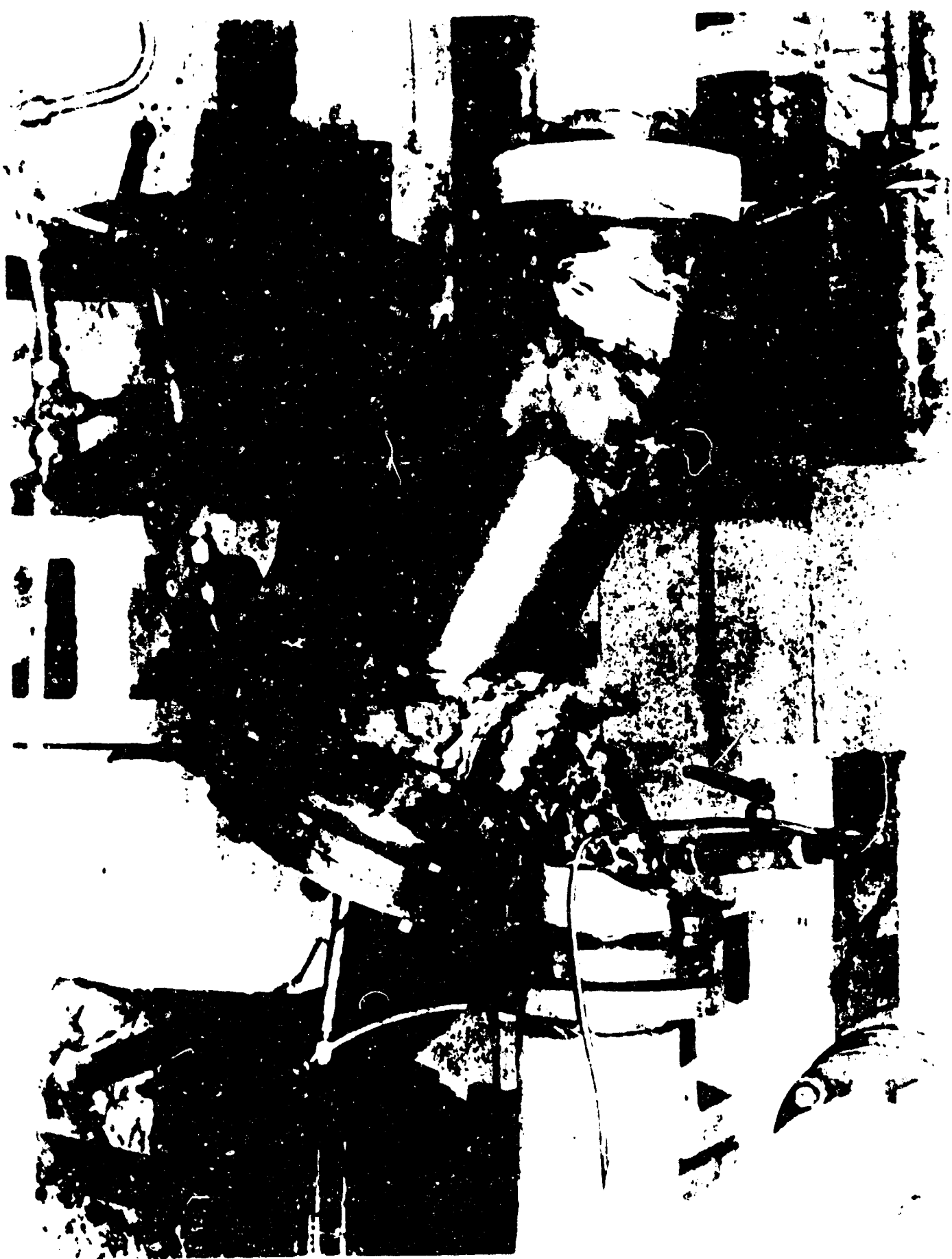


FIGURE
PAGE 11



FIGURE 8
PAGE 22



FIGURE 9
PAGE 23



FIGURE 10
PAGE 24

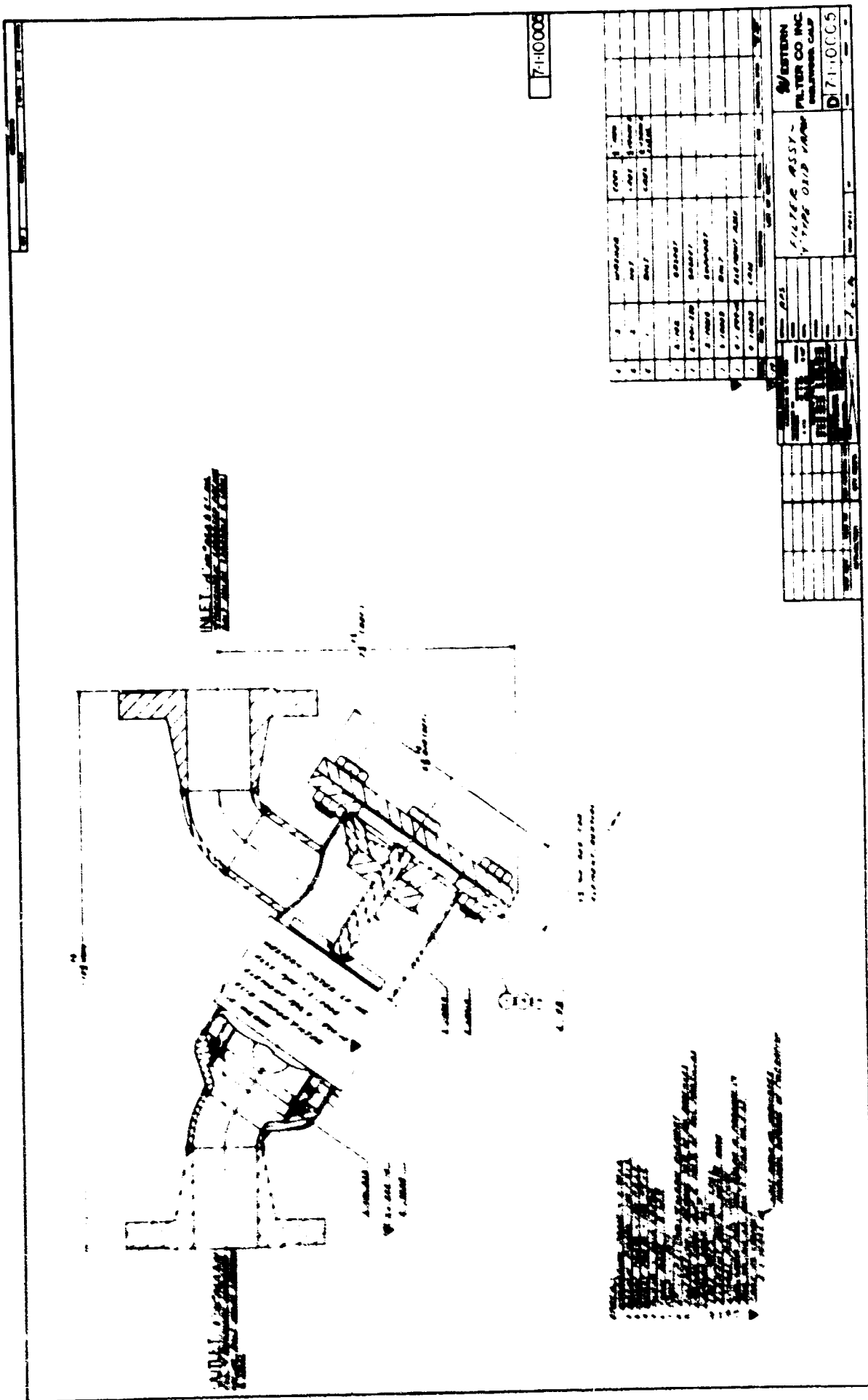
DESCRIPTION - CASE HISTORY #2

P/N 4-1-10005 Filter assembly is very similar to P/N 1-1-10005 except for the size of inlet-outlet flanges and flow rates. This unit is constructed from stainless steel and is Heli-arc welded. It has the same design features as the 1-1-10005. P/N 4-1-10005 has been in service at Wyle Labs for the past seven (7) years - it is located in the direct sunlight and has been used with UDMH and N_2O_4 . The unit has been in continuous service except for occasional cleaning. The filter element appeared to be in very good condition.

The Field Technician interviewed for this data, Mr. August Ferrira, was considered qualified since he has been employed by Wyle in the specific test area for eight years.

BASIC DATA FORM**CONTRACT NO. P04611-68-C0064****LONG TERM COMPATABILITY**

PART NUMBER: _____ 4-1-10005 Element P/N 2-1-54440
MANUFACTURER: _____ Western Filter Company
USER: _____ Wyle Lab-Norco Facility
LIQUID: _____ UDMH and N₂O₄
ESTIMATE SERVICE TIME: _____ 7 years
USE, DUTY CYCLE _____ Continuous except for occasional
cleaning
CONDITION: _____ Good
SCREEN MATERIAL: _____ 304L Cres Dutch Twilled
TEMPERATURE: _____ +28° to 150°F.
SERVICE SPECIFICATION: _____ 3" pipe flange Y type
HISTORY: _____
REPLACEMENT COST: _____ \$800.00 (approx.)
FLOW RATE: _____ 60 gpm
PRESSURE DROP: _____ 5 PSI max Clean element
OPERATING PRESSURE: _____ 60 PSI Design Press 200 PSI
MICRON RATING: _____ 40 microns (nominal)
OTHER: _____ Unit in direct sunlight



DESCRIPTION - CASE HISTORY #3

Filter Assembly P/N 28-1-16510 is manufactured from stainless steel and is an inline configuration. The element is a serviceable, permanent-type filter, with element easily removed for cleaning or replacement.

The element, although relatively small in size (about 2 inches long) has approximately 12 square inches of screen. The Filter Element is manufactured from 304 stainless steel and is Heli-arc welded. Another feature of the element is that the support tube is an integral part of the element assembly.

BASIC DATA FORMCONTRACT NO. F04611-68-C-0064**LONG TERM COMPATABILITY**

PART NUMBER: _____ 28-1-16510 Series
MANUFACTURER: _____ Western Filter Co.
USER: _____ Wyle Labs. Norco Facility
LIQUID: _____ N₂O₄ and UDMH
ESTIMATE SERVICE TIME: _____ 4 years
USE, DUTY CYCLE: _____ Continuous except for occasional cleaning
CONDITION: _____ Good
SCREEN MATERIAL: _____ 304 Dutch Twilled
TEMPERATURE: _____ Ambient
SERVICE SPECIFICATION: _____ Inline
HISTORY: _____
REPLACEMENT COST: _____ Less than \$100.00
FLOW RATE: _____ 4 to 5 GPM
PRESSURE DROP: _____
OPERATING PRESSURE: _____ Design 4500 PSI
MICRON RATING: _____ 5 Micron Nominal 10 Absolute
OTHER: _____ Inline, 1" filter configuration.

DESCRIPTION - CASE HISTORY #4

Filter Assembly P/N 6-1-16520 and Filter Element P/N 14-1-544.

This unit has been in service for 7-1/2 years at Wyle Laboratories, Norco Test Facility. The fluids used with this system have been UDMH and N_2O_4 . The operating pressure is 150 PSI flow rate 200 GPM. The 40 micron nominal filter element has a clean pressure drop below 5 PSI. The assembly is constructed of 100% stainless steel.

The filter element is manufactured of 304 stainless steel, Dutch Twilled wire cloth and is 100% Heli-arc welded. The filter assembly is installed in an enclosure and is exposed to partial sunlight and weather. Close visual inspection of the element shows no evidence of screen deterioration.

LONG TERM COMPATABILITY

PART NUMBER: _____ Filter Assembly 6-1-16520
Filter Element P/N 14-1-544

MANUFACTURER: _____ Western Filter Company

USER: _____ Wyle Laboratories

LIQUID: _____ UDMH & N₂O₄ - 4 ea. unit
total of 8 units

ESTIMATE SERVICE TIME: _____ 7-1/2 years

USE, DUTY CYCLE _____ Continuous except for
occasional cleaning

CONDITION: _____ Good

SCREEN MATERIAL: _____ 304 stainless steel Dutch
Twilled cloth

TEMPERATURE: _____ Ambient

SERVICE SPECIFICATION: _____ Inline 4-inch flanges

HISTORY: _____

REPLACEMENT COST: _____ \$800.00 (approx.)

FLOW RATE: _____ 200 GPM

PRESSURE DROP: _____ 5 PSI

OPERATING PRESSURE: _____ 150 PSI

MICRON RATING: _____ 40 micron (nominal)

OTHER: _____ Partial sunlight exposure.



Section 2.2

TRW CASE HISTORIES

DESCRIPTION - CASE HISTORY #5

Capitol Westward Filter Assembly P/N 2524-4 has been in use in the vertical engine test stand system at TRW, San Juan Capistrano Test Site. There are 6 fuel and 6 oxidizer units at this location. According to personnel in charge, the units are performing well and have been in use for the past three years.

Photographs are included, showing test stand installation.

The filter assembly is the pot-type configuration with 3-inch inlet and outlet flanges. The flow rate is 120 GPM and operating pressure is 600 PSI through a 10 micron filter. The filter element P/N 6469 is Heli-arc welded 304 stainless steel Dutch Twilled wire cloth. A feature of this unit is that the element can be removed for cleaning or servicing without breaking the lines.

Figures 15 through 19 are photographs showing the locating of the filter assemblies and the surrounding environment. Figure 19 shows the test stand. Figure 16 shows a closer view of the test stand with the filter assemblies in view. Figures 17 and 18 are close-up views of the test stand with filters off to the side. Figure 19 is a close-up of the large filter units installation.

BASIC DATA FORMCONTRACT NO. **F04611-68-C0064****LONG TERM COMPATABILITY**

PART NUMBER: _____ 2524-4 Element P/N 6469
MANUFACTURER: _____ Capitol Westward
USER: _____ TRW
LIQUID: _____ Aerozine & N₂O₄
ESTIMATE SERVICE TIME: _____ 3 years
USE, DUTY CYCLE: _____ over 50%
CONDITION: _____ Good
SCREEN MATERIAL: _____ 304
TEMPERATURE: _____ Ambient
SERVICE SPECIFICATION: _____ Pot type configuration 3" flange
HISTORY: _____
REPLACEMENT COST: _____ \$1500.00 each (estimated)
FLOW RATE: _____ 120 gpm
PRESSURE DROP: _____ unknown
OPERATING PRESSURE: _____ 600 PSI
MICRON RATING: _____ 10 micron (nominal)
OTHER: _____

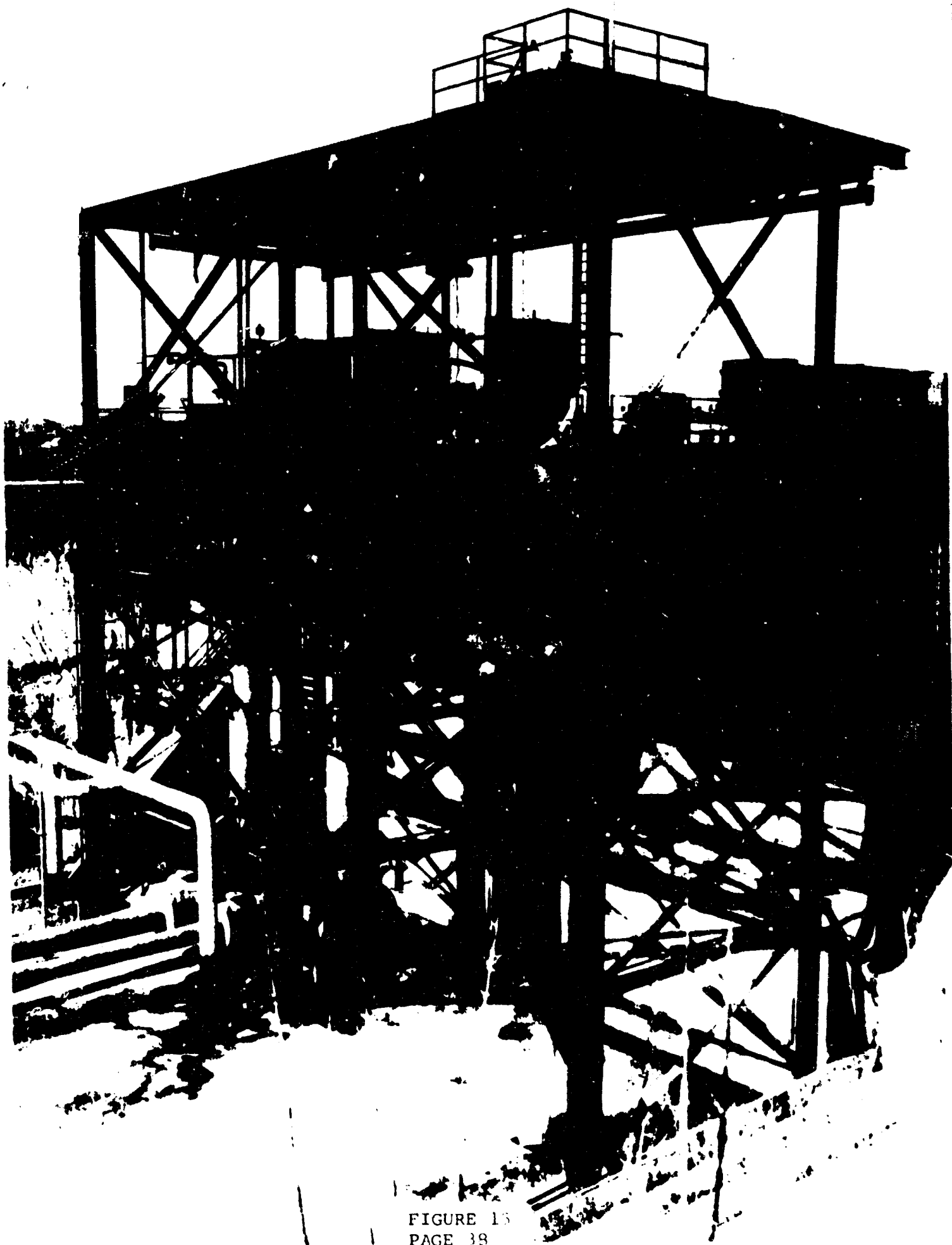


FIGURE 15
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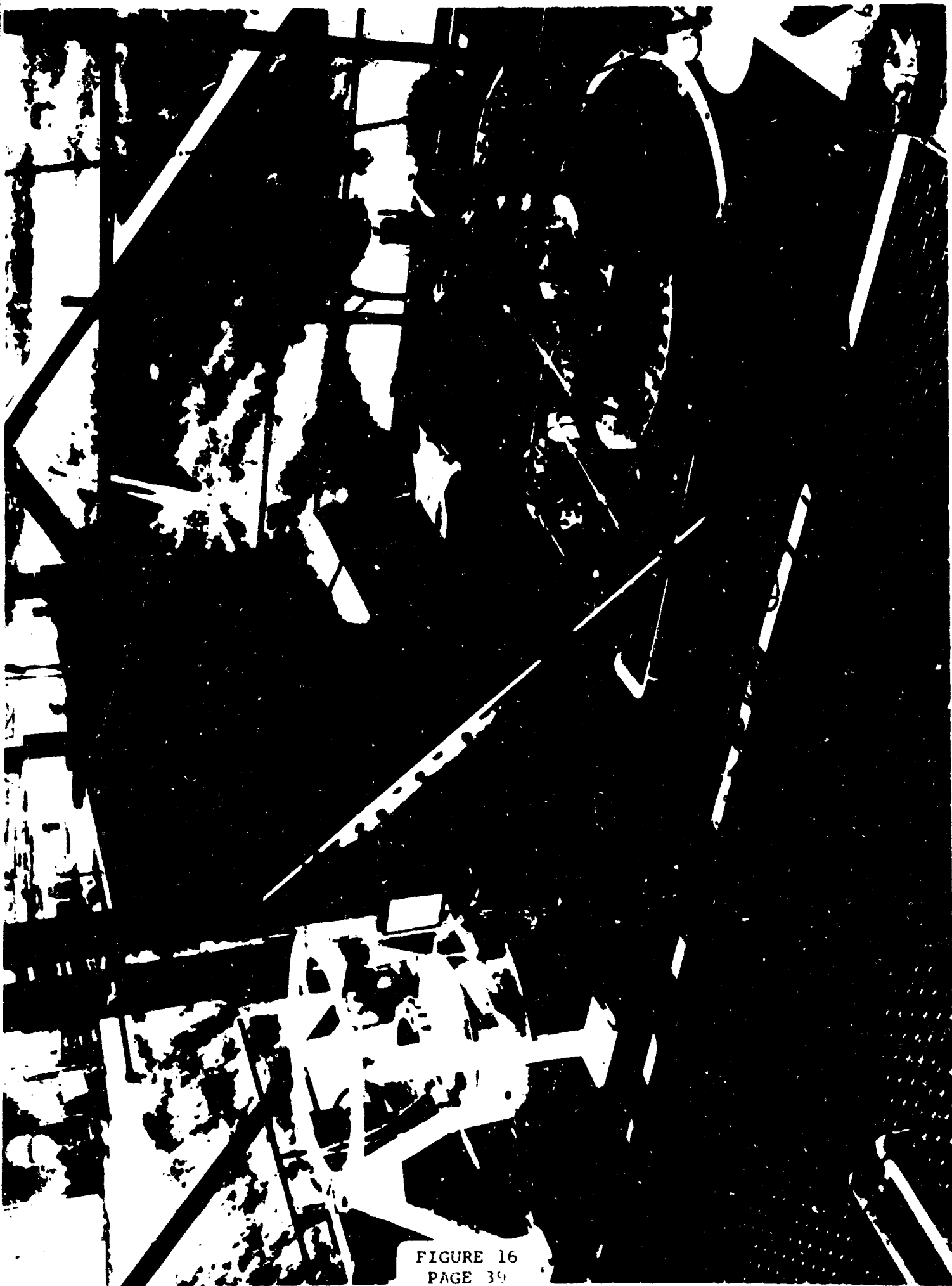
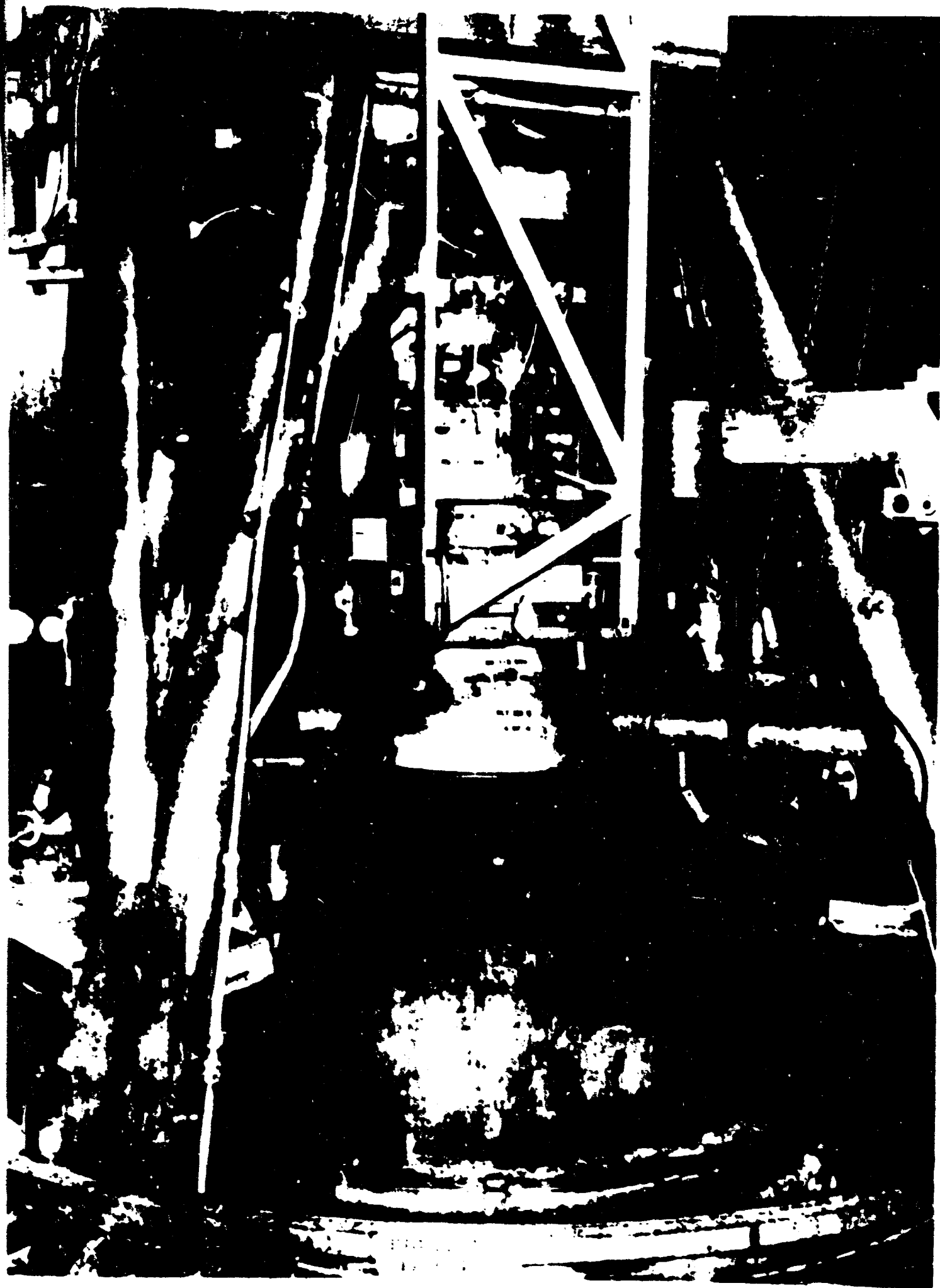
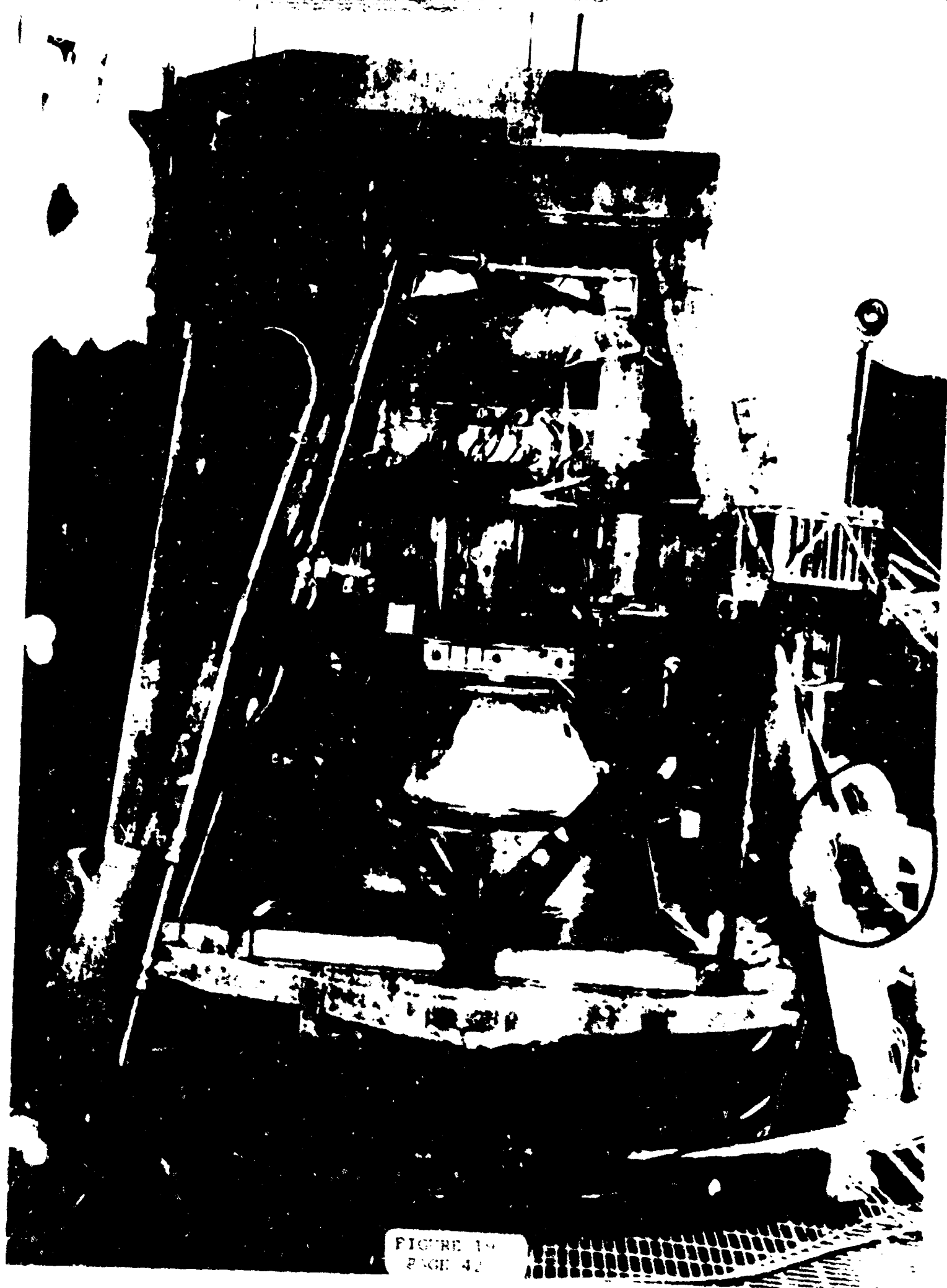


FIGURE 16
PAGE 39



FIGURE 17
PAGE 40





DESCRIPTION - CASE HISTORY #6

Filter assembly P/N 10270 was designed and manufactured by Capitol Westward for use in CLF₃ and was installed at TRW Test Systems, San Juan Capistrano, in the HEPS (High Energy Propellant Stand) area.

The filter assembly, an inline configuration, has MS 33656-16 ports at each end. The filter element, P/N 5561, is Heli-arc welded using 304 stainless steel wire cloth.

The first element used in this system, when taken out and cleaned, reacted and burned up because of over temperature in passivation. It was then replaced with a new element which has remained in service for 1-1/2 years unharmed.

The enclosed photograph shows the inline filter assembly installed in a vertical position. See Figure 20.

BASIC DATA FORM**CONTRACT NO. F04611-68-C0064****LONG TERM COMPATABILITY**

PART NUMBER: _____ 10270 Element P/N 5561
MANUFACTURER: _____ Capitol Westward
USER: _____ TRW
LIQUID: _____ CLF₃ (CTF)
ESTIMATE SERVICE TIME: _____ 1 1/2 years
USE, DUTY CYCLE _____ 95%
CONDITION: _____ Good *See Below
SCREEN MATERIAL: _____ 304
TEMPERATURE: _____ Ambient
SERVICE SPECIFICATION: _____ Inline 275 PSI oper.
HISTORY: _____ Heli-arc welded
REPLACEMENT COST: _____
FLOW RATE: _____
PRESSURE DROP: _____ Unknown
OPERATING PRESSURE: _____
MICRON RATING: _____
OTHER: _____ 1" line size (MS 31656-16)

*Element burned up because of hot passivation, caused it to react; replaced and remained in service unharmed 1-1/2 years.

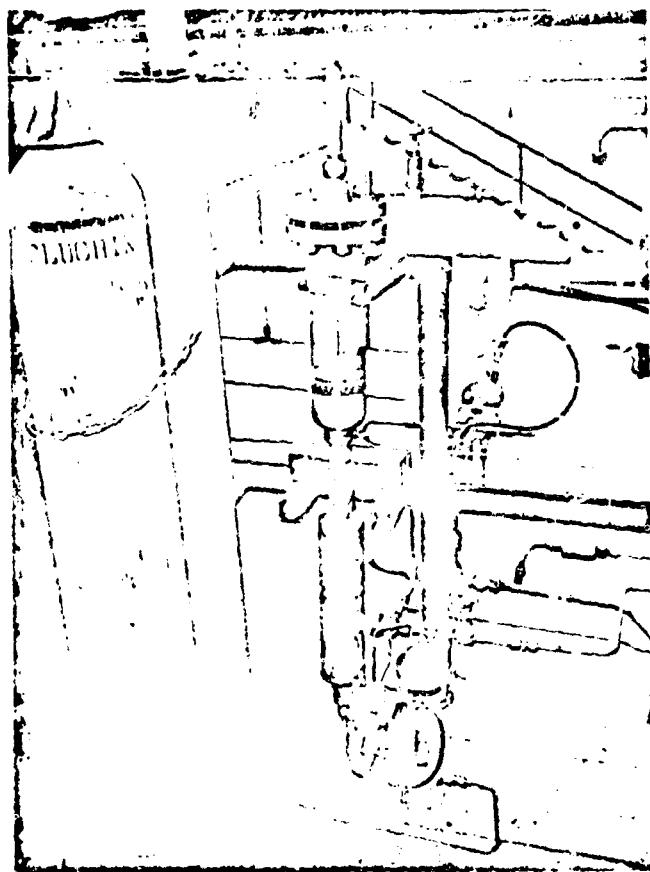


FIGURE 20
PAGE 45

DESCRIPTION - CASE HISTORIES 7, 8, 9 and 10

The following data covers case histories 7, 8, 9 and 10. The data gathered pertains to in service information concerning Western Filter assembly 28-1-16510. The assembly is an in-line configuration which incorporates a recleanable element designed for easy removal and servicing.

The element, although relatively small in size (about 2 inches in length) has approximately 12 square inches effective screen area. It is manufactured from 304 stainless steel and is 100% heliarc welded. The support tube is an integral part of the element assembly.

BASIC DATA FORMCONTRACT NO. **F04611-68-C0064****LONG TERM COMPATABILITY**

PART NUMBER: _____ 28-1-16510
MANUFACTURER: _____ Western Filter
USER: _____ TRW
LIQUID: _____ N₂O₄ 50/50 Hydrazine
ESTIMATE SERVICE TIME: _____ 3 1/2 years
USE, DUTY CYCLE _____ 90%
CONDITION: _____ Good
SCREEN MATERIAL: _____ 304
TEMPERATURE: _____ Ambient
SERVICE SPECIFICATION: _____ MS33656-8 Ports, Inline
HISTORY: _____
REPLACEMENT COST: _____ Less than \$100.00
FLOW RATE: _____
PRESSURE DROP: _____
OPERATING PRESSURE: _____
MICRON RATING: _____
OTHER: _____ Inline
Design. Press. 4500
Cleaned 25 to 30 times

BASIC DATA FORMCONTRACT NO. F04611-68-C-0064LONG TERM COMPATABILITY

PART NUMBER: _____ 28-1-16510-10
MANUFACTURER: _____ Western Filter Company
USER: _____ TRW Systems
LIQUID: _____ MMH - N₂H₄
ESTIMATE SERVICE TIME: _____ 3 1/2 years
USE, DUTY CYCLE _____ 90%
CONDITION: _____ Good
SCREEN MATERIAL: _____ 304 stainless steel
TEMPERATURE: _____ Ambient
SERVICE SPECIFICATION: _____ MS 33656-8 Ports Inline
HISTORY: _____
REPLACEMENT COST: _____ Less than \$100.00
FLOW RATE: _____ 4 GPM
PRESSURE DROP: _____
OPERATING PRESSURE: _____ Designed for 4500 PSI
MICRON RATING: _____ 10 nominal 15 absolute
OTHER: _____

BASIC DATA FORMCONTRACT NO. **F04611-68-C0064****LONG TERM COMPATABILITY**

PART NUMBER: _____ 28-1-16510-10
MANUFACTURER: _____ Western Filter Company
USER: _____ TRW
LIQUID: _____ 50/50 Aerozine
ESTIMATE SERVICE TIME: _____ 3 years
USE, DUTY CYCLE _____ 6 months continuous
CONDITION: _____ Good
SCREEN MATERIAL: _____ 304
TEMPERATURE: _____ Ambient
SERVICE SPECIFICATION: _____ MS33656-8 Ports, Inline
HISTORY: _____
REPLACEMENT COST: _____ Less than \$100.00
FLOW RATE: _____
PRESSURE DROP: _____
OPERATING PRESSURE: _____
MICRON RATING: _____ 10 micron
OTHER: _____ 600 PSI operating

BASIC DATA FORMCONTRACT NO. F04611-68-C0064LONG TERM COMPATABILITY

PART NUMBER: _____ 28-1-16520-10
MANUFACTURER: _____ Western Filter Company
USER: _____ TRW
LIQUID: _____ MMH, N₂H₄
ESTIMATE SERVICE TIME: _____ 3 1/2 years
USE, DUTY CYCLE: _____ 90%
CONDITION: _____ Good
SCREEN MATERIAL: _____ 304
TEMPERATURE: _____ Ambient
SERVICE SPECIFICATION: _____ MS33656-8 Ports, Inline
HISTORY: _____
REPLACEMENT COST: _____ Less than \$100.00
FLOW RATE: _____
PRESSURE DROP: _____
OPERATING PRESSURE: _____
MICRON RATING: _____
OTHER: _____ Design Press. 4500
10 micror.

DESCRIPTION - CASE HISTORY #10

Filter assembly P/N 19607 was designed for use in N_2O_4 and 50/50 Hydrazine. The unit is an inline configuration, stainless steel, and heli-arc welded in construction. The end fittings are MS 33656-24 in size. The length is approximately 13 inches. The filter assembly has a flanged connection on the outlet side of the filter and has a drain port on the side.

Western Filter Company designed the sealing portion utilizing a copper gasket, which is considered good for compatibility.

The stainless steel element has approximately 300 square inches of effective screen filtering area.

The filter was designed to flow 75 GPM. but for the past two years it has seen flow rates of 40 GPM, with an operating pressure of 3000 PSI and a pressure drop of less than 5 PSI using the above liquids.

LONG TERM COMPATABILITY

PART NUMBER: _____ 19607 Element P/N 19720

MANUFACTURER: _____ Western Filter Company

USER: _____ TRW

LIQUID: _____ N₂O₄, 50/50, Hydrazine
N₂H₄ MMH

ESTIMATE SERVICE TIME: _____ 2 years

USE, DUTY CYCLE: _____ 90%

CONDITION: _____ Good

SCREEN MATERIAL: _____ 304 Dutch Twilled

TEMPERATURE: _____ Ambient

SERVICE SPECIFICATION: _____ Inline 1 1/2 line size

HISTORY: _____

REPLACEMENT COST: _____ \$1000.00 (approx.)

FLOW RATE: _____ Design 75 gpm actual 40 gpm

PRESSURE DROP: _____ 5 PSI at Rated flow

OPERATING PRESSURE: _____ 3000 PSI

MICRON RATING: _____ 10 micron (nominal)

OTHER: _____ 300 in.² of screen area (approx.)

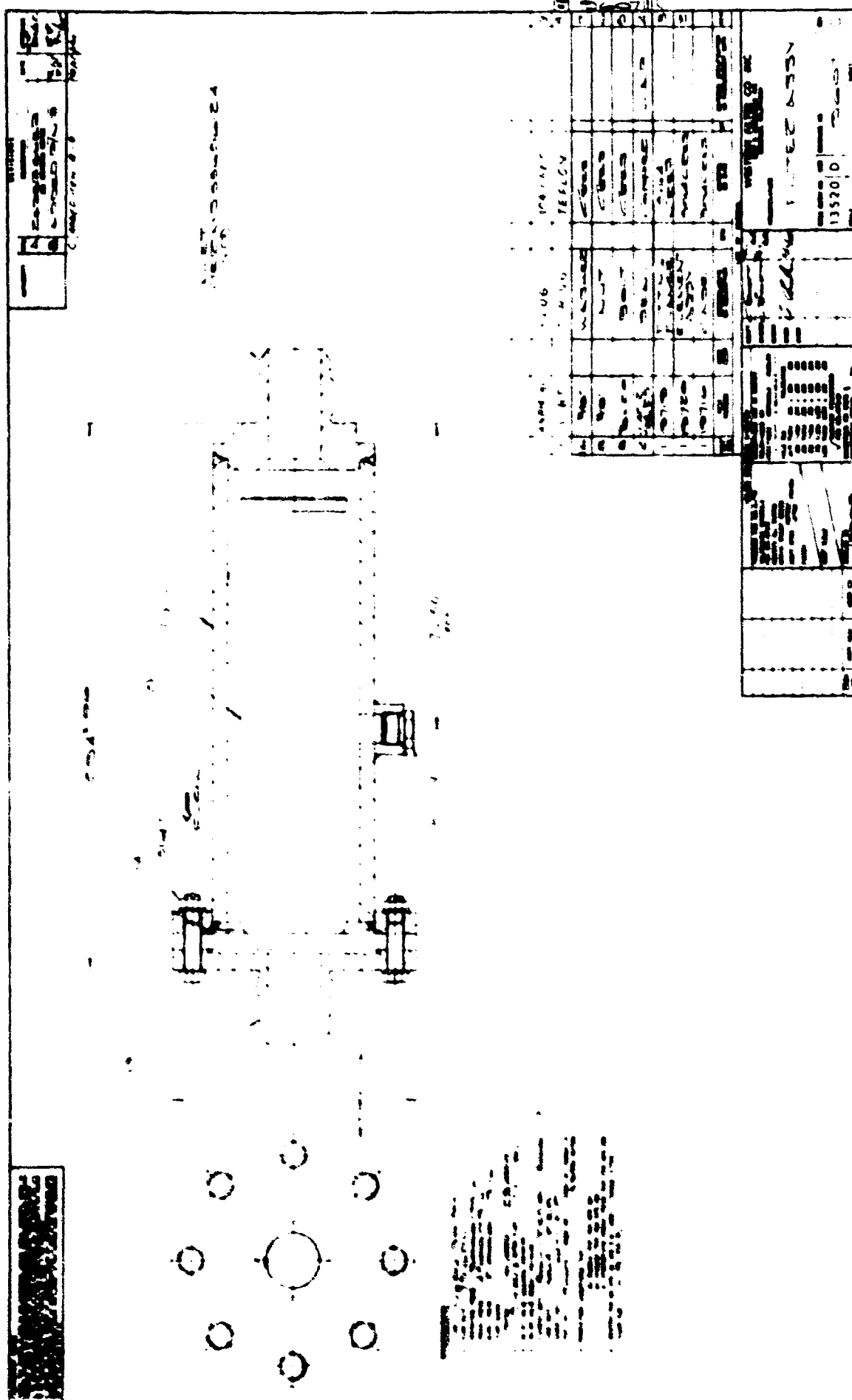


FIGURE 23
PAGE 1

01 1972

REVISIONS		DATE	APPROVED
NO.	DESCRIPTION		
1	SEE ALUMINUM NOTICE		
2			
3			
4			
5			
6			

2700 SA
REF

QTY	UNIT	DESCRIPTION	DATE	BY	REMARKS
1	EA	CRFC			
1	EA	RES			
1	EA	RES			
1	EA	RES			
1	EA	RES			
1	EA	RES			
1	EA	RES			

WESTERN FILTER CO. INC.
1000 A
BANDON, CA 94002

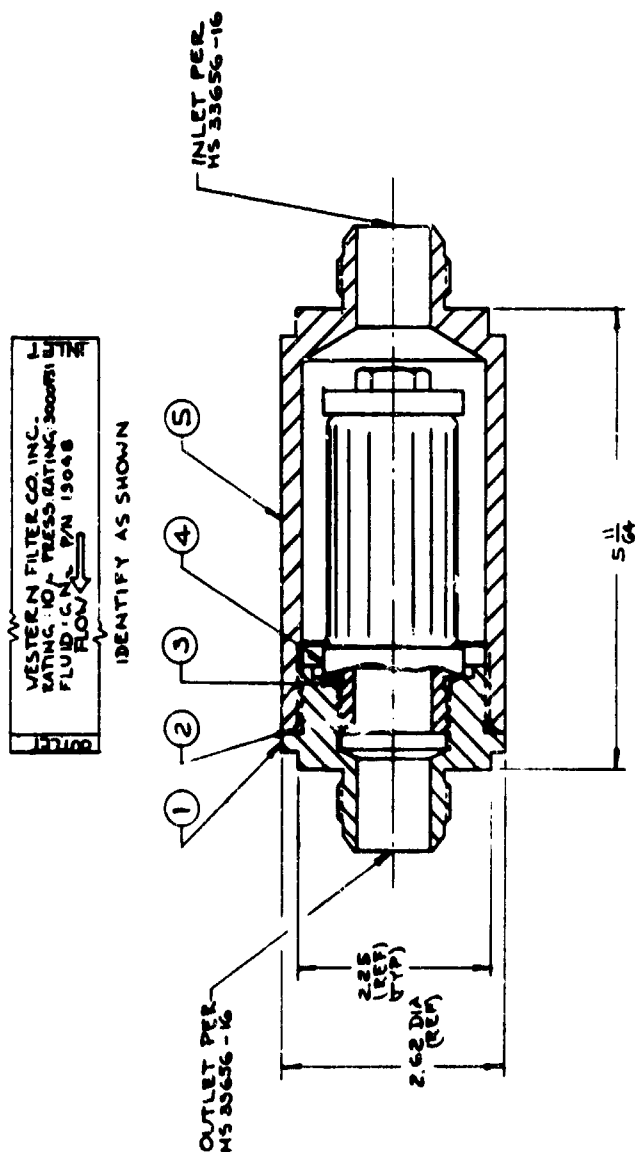
ELLEMENT ASSY

CASE NO. 13520 C
DATE 1972
SCALE 1/1

DESCRIPTION - CASE HISTORY #11

Filter assembly P/N 19048 is an inline configuration made of stainless steel with MS 33656-16 end fittings. The design pressure is 3000 PSI. The assembly has been in service for two years in N_2O_4 at ambient temperatures. The construction features are similar to P/N 28-1-16510 filter assembly previously described. Although it has not seen continuous dynamic service, it has been in the fluid continuously, except for cleaning; the element has been cleaned 10 times.

PROFESSIONAL SERVICE

[illegible]

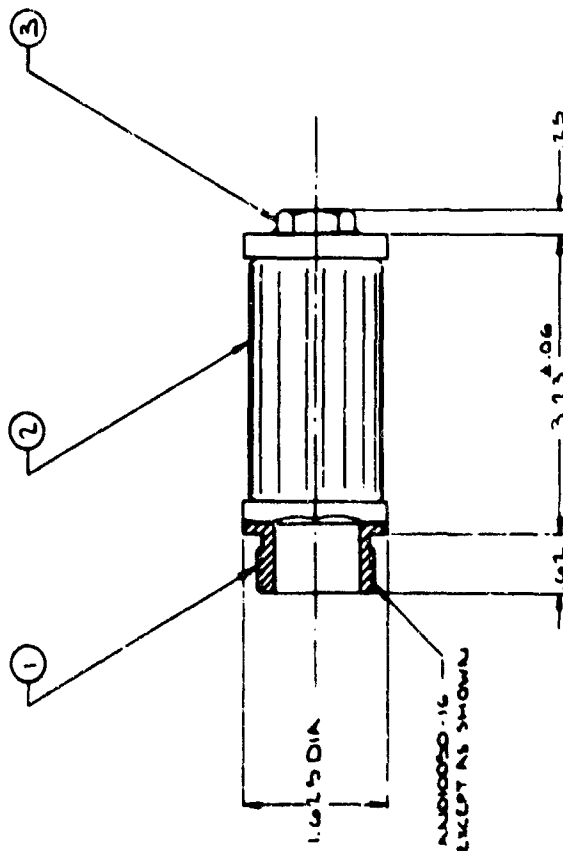


FIGURE 26
PAGE 60

1. WESTERN FILTER CO. INC.
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 100. 124-14

DESCRIPTION - CASE HISTORY #12

Filter assembly P/N 10236-1 was manufactured by Capitol Westward for TRW Test Systems of San Juan Capistrano for use in N_2O_4 .

The filter assembly was made from 100% stainless steel. The unit is a tee-type configuration which features ease of element removal for servicing without breaking the assembly from the line.

The filter is designed for 4500 PSI operating pressure. Design flow is 6 GPM of N_2O_4 through a MS 33656-8 line. Filtration is 5 micron nominal and a 15 absolute.

The element is manufactured from 304 stainless steel wire screen and is heli-arc welded. This unit has been in continuous service for one year. The element has been removed 25 times for cleaning.

BASIC DATA FORM**CONTRACT NO. F04611-68-C0064****LONG TERM COMPATABILITY**

PART NUMBER: _____ Filter Assembly 10236-1
Element P/N 5484N

MANUFACTURER: _____ Capitol Westward

USER: _____ TRW Systems

LIQUID: _____ N₂O₄

ESTIMATE SERVICE TIME: _____ 1 year

USE, DUTY CYCLE: _____ Continuous

CONDITION: _____ Good

SCREEN MATERIAL: _____ 304 Dutch Twilled

TEMPERATURE: _____ Ambient

SERVICE SPECIFICATION: _____ 1/2" Line Tee Type

HISTORY: _____

REPLACEMENT COST: _____ \$500.00 (estimated)

FLOW RATE: _____ 6 GPM

PRESSURE DROP: _____

OPERATING PRESSURE: _____ 4500 PSI

MICRON RATING: _____ 5 micron (nominal)

OTHER: _____ Cleaned 25 times

DESCRIPTION - CASE HISTORY #13

Filter assembly P/N SB4733 was manufactured by Flowmatics Company of Sacramento, California. The filters are the in-line configuration, made from 100% stainless steel, and have MS33656-24 ports. The units are two years old and are performing well in N_2O_4 and MMH propellants. The element is a heli-arc welded assembly made of stainless steel Dutch Twilled micronic cloth (10 micronic nominal, 25 absolute). It is designed to operate at 3000 psi system pressure.

No assembly or detail drawings of this filter are available.

BASIC DATA FORMCONTRACT NO. F04611-68-C-0064LONG TERM COMPATABILITY

PART NUMBER: _____ SB4733 Serial No. 5727
MANUFACTURER: _____ Flowmatics
USER: _____ TRW
LIQUID: _____ N_2O_4
ESTIMATE SERVICE TIME: _____ 2 years old
USE, DUTY CYCLE _____ 50%
CONDITION: _____ Good
SCREEN MATERIAL: _____ 304
TEMPERATURE: _____ Ambient
SERVICE SPECIFICATION: _____ Inline 1 1/2 lines size
HISTORY: _____
REPLACEMENT COST: _____
FLOW RATE: _____
PRESSURE DROP: _____
OPERATING PRESSURE: _____
MICRON RATING: _____
OTHER: _____ 3000 PSI operating press.

DESCRIPTION - CASE HISTORY #14

Nickel filter assembly P/N 321060 was designed for TRW Test Systems for use in Flox and liquid Fluorine. The assembly is made of nickle N-200 material. The unit is an inline configuration with MS 33656-8 end fittings.

The filter element P/N 321082 is also manufactured from nickle N-200 material, including the 10 micron Dutch Twilled wire cloth.

The element was designed in such a manner as to minimize the weld joints and reduce dirt entrapment areas. It is an integral part of the end fitting on the outlet side of the assembly. A copper seal was used for compatibility.

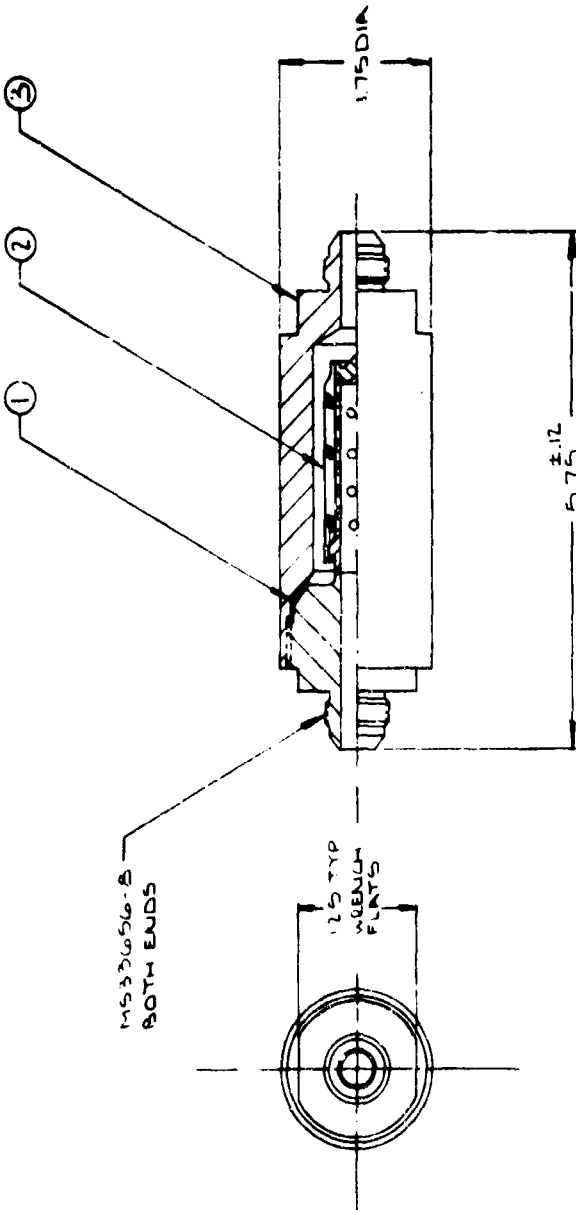
BASIC DATA FORMCONTRACT NO. **F04611-68-C-0064****LONG TERM COMPATABILITY**

PART NUMBER: _____ 321060 Element 321082
MANUFACTURER: _____ Western Filter Company
USER: _____ TRW
LIQUID: _____ Fluorine, Flox
ESTIMATE SERVICE TIME: _____ 6 months
USE, DUTY CYCLE _____ continuous, except for cleaning
CONDITION: _____ *See Note below
SCREEN MATERIAL: _____ Nickle N200
TEMPERATURE: _____ -320°F
SERVICE SPECIFICATION: _____ inline MS33656-8 fittings
HISTORY: _____
REPLACEMENT COST: _____ less than \$400.00
FLOW RATE: _____ 6 pm
PRESSURE DROP: _____ 5 PSI
OPERATING PRESSURE: _____ 1200-actual 1000 PSI
MICRON RATING: _____ 10 micron (nominal)
OTHER: _____

*500 lbs of fluorine was flowed thru the filter at the above flow rate. Element was taken out of system and cleaned, was then installed back into the system later when removed, was visually inspected. Very tiny pin line holes were observed. Investigation found that when the filter was first cleaned, water was left in the element. They thought they had blown all the water from the element, but did not - so it was then established the cause of the very tiny burn holes were attributed to the water.

321060 A

REVISIONS			
NO.	DESCRIPTION	DATE	BY
	SEE THE THIRD FLOOR		
1	RECORD PLAN TO REVISION 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100		



FILTRATION	
NOMINAL	ABSOLUTE
2	10
5	15
10	25

- SPECIFICATIONS:**
1. FLUID: LIQUID FLUORINE OR COMPOUND A
 2. FLOW RATE: 10 GPM MAX
 3. OPERATING PRESS: 1100 PSIG
 4. PACK PRESS: 1100 PSIG
 5. BUST PRESS: 1100 PSIG
 6. TEMP RANGE: 100°F TO 200°F
 7. FILTRATION: 2 MICRONS
 8. P. 10 PSI (MAX) @ 100°F TO 200°F
 9. RELIEF VALVE: CRACKING PRESSURE 1100 PSIG
 10. RELIEF VALVE: RESET PRESSURE 1100 PSIG
 11. ELEMENT MATL: N-200 NICKEL
 12. CASE MATL: N-200 NICKEL
 13. GASKET MATL: COPPER
 14. PART NO: 321060 - 1 (Housing) 321060 - 2 (Element) 321060 - 3 (Seal)
 15. PRODUCTION ACCEPTANCE TEST:
 - (a) 100% TEST PER MIL-STD-123
 - (b) 100% TEST PER MIL-STD-123
 - (c) 100% TEST PER MIL-STD-123
 16. IDENTIFY PER MIL-STD-123, INC. P/M CURRENT CHANGE LETTER
 17. CLEAN PER MIL-STD-123

QTY	PART NUMBER	DESCRIPTION	QTY	DATE	BY
1	321060	HOUSING	1	12-17	
1	321062	ELEMENT ASSY	1	12-17	
1	121060	SEAL	1	12-17	

WESTERN FILTER CO. INC.	
FILTER ASSY, INLINE, NICKEL	
CODE: 13520 C	REV: A
SCALE: 1:1	SHEET: 1 OF 1

FIGURE 27
PAGE 67

321082

PROPRIETARY NOTICE

*COMPETITIVE ARTICLE HEREIN ENCLOSED, OWING TO LIES ON OTHER PARTY TO WHOM FURNISHED OR RELAYED, DOES NOT MEASURE CUSTOMER TRUTHFUL AND ACCURATE. IS "GIVE IN COMPLIANCE AND THIS UNKNOWN SMALL NOT BE THE SAME" AND THIS CONTESTED BEING IN ANY MANNER BEING DELIVERED AND BEING DELIVERED. THE ABOVE INFORMATION IS NOT TO BE USED IN THE FUTURE AND BEING RELAYED TO THIS CUSTOMER THAT NOT CONSTITUTE

100

AUTHORITY	SYM
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REVISIONS	DESCRIPTION	SEE REVISION NOTICE

DATE	APPROVE

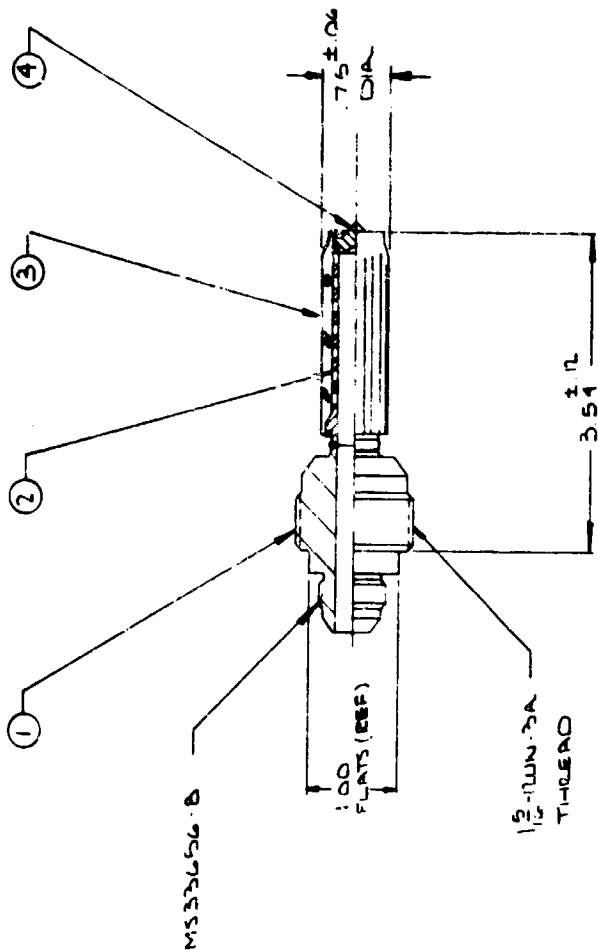


FIGURE 28
PAGE 68

NOTE

- 1 PART NO - 3110B1 + DATA NO - ~~0~~ DATA NO INDICATES
FILTRATION RATING
- 2 FILTRATION - AS ORDERED
- 3 PRODUCTION ACCEPTANCE TEST - BUBBLE TEST PER WFS 107
- 4 CLEAN PER WFS 195
- 5 IDENTIFY PER MIL STD 120 WFC PLY, CURRENT CHANGE LETTER

DASH NO.		NEXT ASSY	USED ON	SPECIFICATIONS		TOLERANCES ARE IN INCHES		UNLESS OTHERWISE SPECIFIED		DRAWING NO.		SIZE		DRAWING NO.		CODE IDENT NO.		NOMENCLATURE		WESTERN FILTER CO. INC.		MATERIAL & CERTIFICATION OF MATERIAL DATA	
1	221087	END CAP																					
1	221086	SCREEN ASSY																					
1	221085	SUPPORT																					
1	321084	FRONT FITTING																					

DRAFT		NOMENCLATURE		WESTERN FILTER CO. INC.		MATERIAL & CERTIFICATION OF MATERIAL DATA	
1	221087	END CAP					
1	221086	SCREEN ASSY					
1	221085	SUPPORT					
1	321084	FRONT FITTING					

DRAFT		NOMENCLATURE		WESTERN FILTER CO. INC.		MATERIAL & CERTIFICATION OF MATERIAL DATA	
1	221087	END CAP					
1	221086	SCREEN ASSY					
1	221085	SUPPORT					
1	321084	FRONT FITTING					

DRAFT		NOMENCLATURE		WESTERN FILTER CO. INC.		MATERIAL & CERTIFICATION OF MATERIAL DATA	
1	221087	END CAP					
1	221086	SCREEN ASSY					
1	221085	SUPPORT					
1	321084	FRONT FITTING					

DRAFT		NOMENCLATURE		WESTERN FILTER CO. INC.		MATERIAL & CERTIFICATION OF MATERIAL DATA	
1	221087	END CAP					
1	221086	SCREEN ASSY					
1	221085	SUPPORT					
1	321084	FRONT FITTING					

DRAFT		NOMENCLATURE		WESTERN FILTER CO. INC.		MATERIAL & CERTIFICATION OF MATERIAL DATA	
1	221087	END CAP					
1	221086	SCREEN ASSY					
1	221085	SUPPORT					
1	321084	FRONT FITTING					

DRAFT		NOMENCLATURE		WESTERN FILTER CO. INC.		MATERIAL & CERTIFICATION OF MATERIAL DATA	
1	221087	END CAP					
1	221086	SCREEN ASSY					
1	221085	SUPPORT					
1	321084	FRONT FITTING					

DRAFT		NOMENCLATURE		WESTERN FILTER CO. INC.		MATERIAL & CERTIFICATION OF MATERIAL DATA	
1	221087	END CAP					
1	221086	SCREEN ASSY					
1	221085	SUPPORT					
1	321084	FRONT FITTING					

DRAFT		NOMENCLATURE		WESTERN FILTER CO. INC.		MATERIAL & CERTIFICATION OF MATERIAL DATA	
1	221087	END CAP					
1	221086	SCREEN ASSY					
1	221085	SUPPORT					
1	321084	FRONT FITTING					

DRAFT		NOMENCLATURE		WESTERN FILTER CO. INC.		MATERIAL & CERTIFICATION OF MATERIAL DATA	
1	221087	END CAP					
1	221086	SCREEN ASSY					
1	221085	SUPPORT					
1	321084	FRONT FITTING					

DRAFT		NOMENCLATURE		WESTERN FILTER CO. INC.		MATERIAL & CERTIFICATION OF MATERIAL DATA	
1	221087	END CAP					
1	221086	SCREEN ASSY					
1	221085	SUPPORT					
1	321084	FRONT FITTING					

DRAFT		NOMENCLATURE		WESTERN FILTER CO. INC.		MATERIAL &	
-------	--	--------------	--	-------------------------	--	------------	--

DESCRIPTION - CASE HISTORY #15

Filter Assembly P/N 28-1-16510 is manufactured from stainless steel and is an inline configuration. The element is a serviceable, permanent-type filter with the element is easily removed for cleaning or replacement.

The element, although relatively small in size, about 2 inches long, has approximately 12 square inches of screen area. The Filter Element is manufactured from 304 stainless steel and is all heli-arc welded. Another feature of the element is that the support tube is an integral part of the element assembly.

BASIC DATA FORM

CONTRACT NO. F04611-68C0064

LONG TERM COMPATABILITY

PART NUMBER: _____ 28-1-16520-10
MANUFACTURER: _____ Western Filter Company
USER: _____ TRW
LIQUID: _____ MMH N₂H₂
ESTIMATE SERVICE TIME: _____ 3 1/2 years
USE, DUTY CYCLE _____ 90%
CONDITION: _____ Good
SCREEN MATERIAL: _____ 304
TEMPERATURE: _____ Ambient
SERVICE SPECIFICATION: _____
HISTORY: _____
REPLACEMENT COST: _____ less than \$100.00
FLOW RATE: _____
PRESSURE DROP: _____
OPERATING PRESSURE: _____
MICRON RATING: _____
OTHER: _____ inline
Design Press. 4500
10 micron

DESCRIPTION - CASE HISTORY #16

P/N S6-19310 is a standard Filter Element which incorporates a seal manufactured by Western Filter Company.

The Filter Seal is a truncated cone-shaped seal attached to a cylindrical wrap-around stainless steel wire cloth filter. Installation is accomplished by disconnecting any MS 33656 fitting, inserting the Filter Seal, and reconnecting the fitting. It is 100% Heli-arc welded construction. This Filter Seal has been in Flox for the past three months, operating at 1000 PSI and at a flow rate of 0.15 lbs. per second with a temperature of 320° F. Filtration is 74 micron nominal, 100 micron absolute. Examination of the filter showed the wire cloth screen to be in good condition.

BASIC DATA FORM**CONTRACT NO. F04611-68-C0064****LONG TERM COMPATABILITY**

PART NUMBER: _____ S6 19310
MANUFACTURER: _____ Western Filter Company
USER: _____ TRW
LIQUID: _____ Flox 80% Fluorine 20% Lox
ESTIMATE SERVICE TIME: _____ 3 months
USE, DUTY CYCLE _____ 95%
CONDITION: _____ Good
SCREEN MATERIAL: _____ 304
TEMPERATURE: _____ -320°F
SERVICE SPECIFICATION: _____ Filter Seal.
HISTORY: _____
REPLACEMENT COST: _____ Less than \$20.00
FLOW RATE: _____ 0.15 lbs. per sec.
PRESSURE DROP: _____
OPERATING PRESSURE: _____ 1000 PSI
MICRON RATING: _____ 74 Nominal
OTHER: _____ NASA Program
Floyd Robinette Proj. Eng.

Section 2.3

ROCKETDYNE CASE HISTORIES

DESCRIPTION - CASE HISTORY #17

Filter element P/N 0086-1 was designed and manufactured by Capitol Westward for Rocketdyne for use in IRFNA. The Filter element is 304 stainless steel Dutch Twilled wire cloth. The element is pleated and heli-arc welded, mesh is 40 micron nominal. The assembly has been in IRFNA for approximately one year.

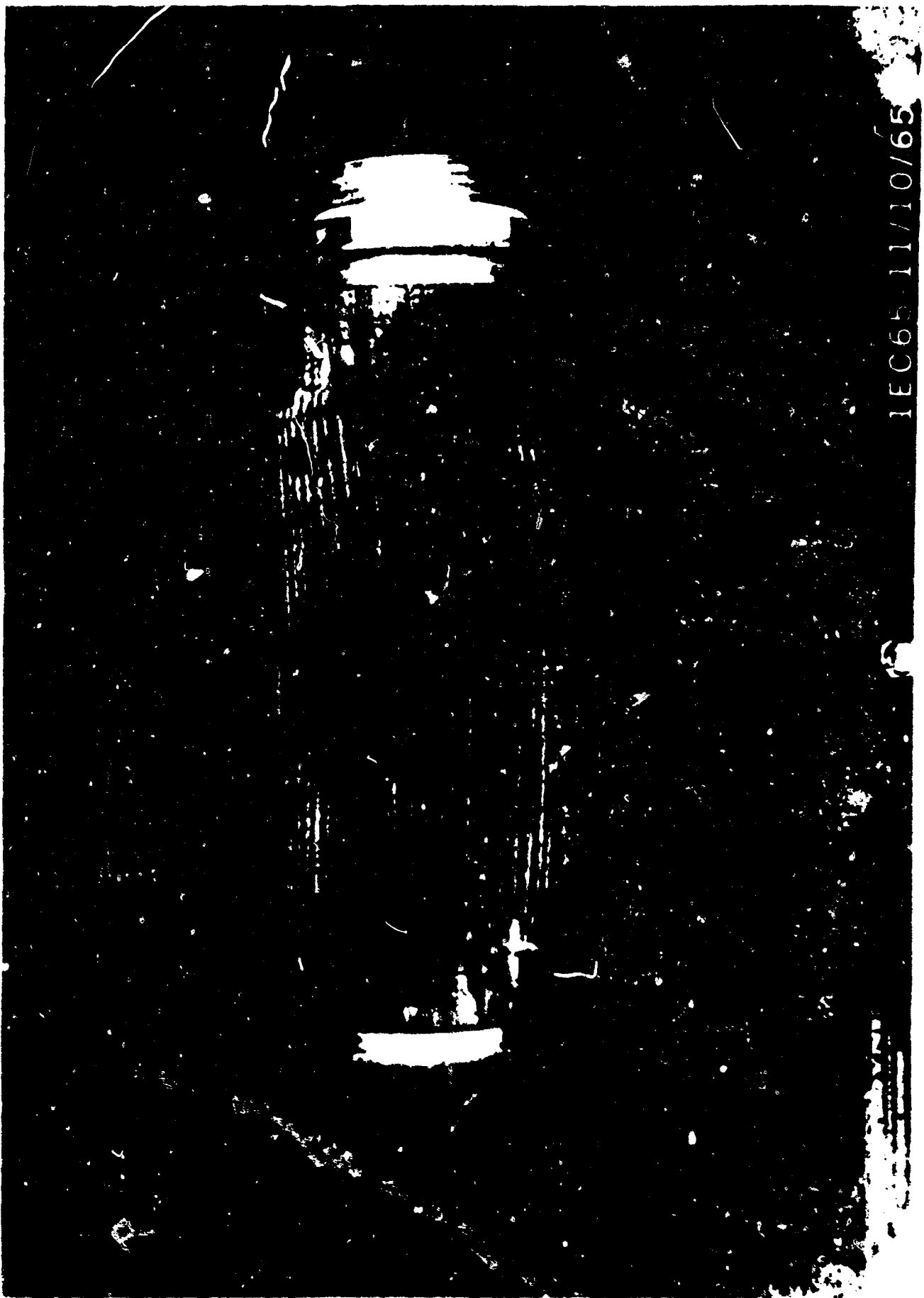
It is apparent that there was a severe compatibility problem. The photograph shows the wire screen deteriorated. See Figures 36, 37 and 38.

During the life of the filter, the element was taken out of the assembly and then cleaned and flushed repeatedly. The element was dried out with dry gas and flushed with water (contaminated well water).

LONG TERM COMPATABILITY

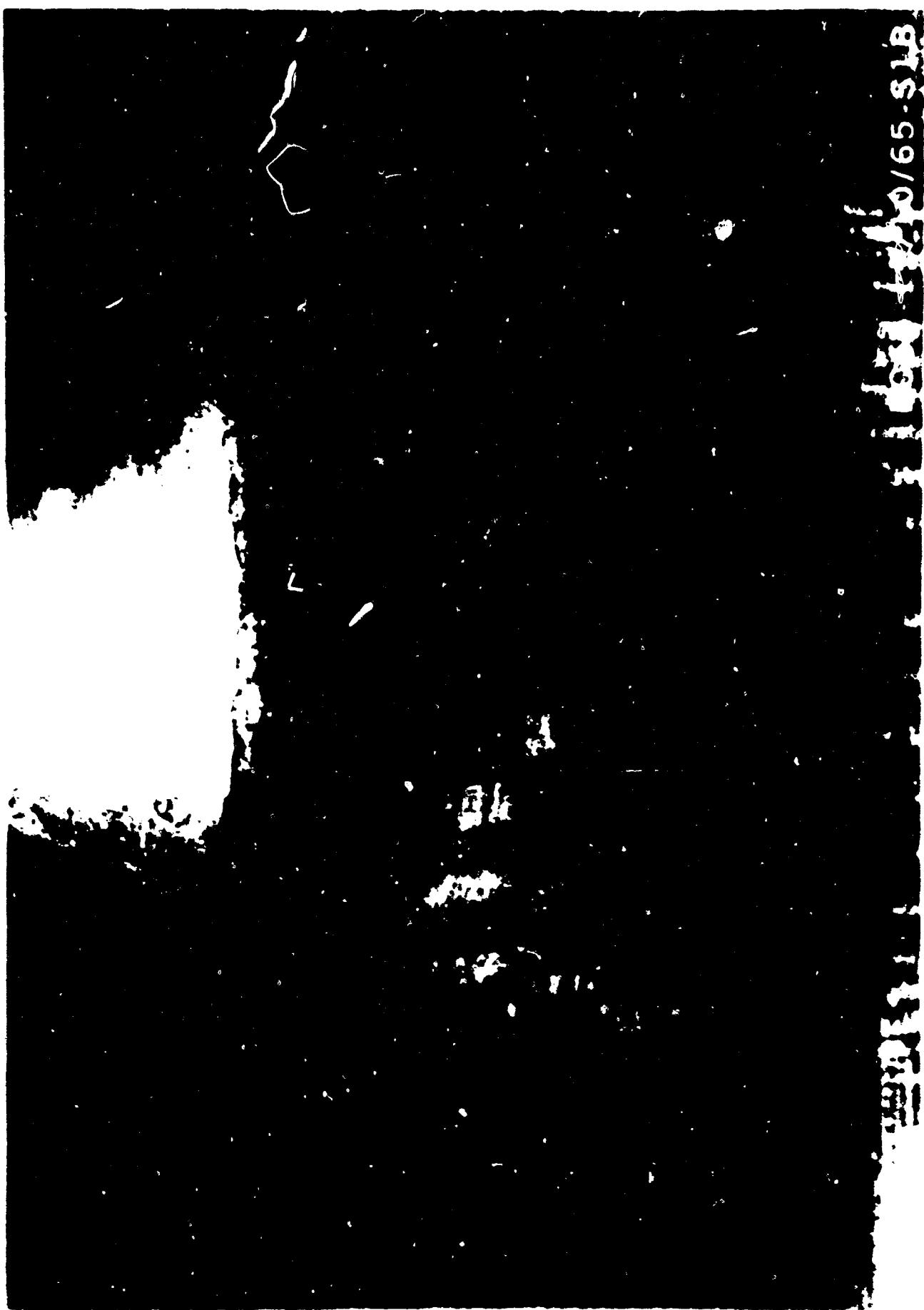
PART NUMBER: _____ Filter Element 0086-1
MANUFACTURER: _____ Capitol Westward
USER: _____ Rocketdyne
LIQUID: _____ IRFNA
ESTIMATE SERVICE TIME: _____ Designed 10/63
photographed 11/10/65
USE, DUTY CYCLE _____ static continuous in solution
CONDITION: _____ Significant deterioration
SCREEN MATERIAL: _____ Stainless Steel
TEMPERATURE: _____ Ambient
SERVICE SPECIFICATION: _____ Element Only
HISTORY: _____
REPLACEMENT COST: _____ Unknown
FLOW RATE: _____
PRESSURE DROP: _____
OPERATING PRESSURE: _____
MICRON RATING: _____ 40 nominal
OTHER: _____ cleaned and flushed many times,
dried out with dry gas, flushed
out with contaminated water.

Photographs of the units are:
Rocketdyne Photo #1EC65 -11/10/65SIA
#1EC65-11 10/65SIE, #1EC65-11/10/
65SIC



1EC65 11/10/65

FIGURE 20
PAGE 70



0/65-SLB



5/11/10/65 1A

DESCRIPTION - CASE HISTORY #18

Filter element P/N 412G was manufactured by Microporous Filter Company, Anaheim, California. The filter is 100% stainless steel, heli-arc welded from 304 stainless steel, 2 micron Dutch Twilled wire cloth.

The filter has been in service for four years in the following propellants: 50/50 Hydrazine, NTO, IRFNA, UDMH. There is evidence that a filter in contact with a multitude of propellants is exposed to more difficult environmental requirements than when in contact with only one propellant. The filter has been used in the Ground Support Equipment for the Gemini program.

The time span of this study did not allow retrieval of the design details. However, the element is pleated stainless steel screen and similar to Western Filter Company filter P/N 9-1-500 specifications for which are included in this report.

LONG TERM COMPATABILITY

PART NUMBER: _____ P/N 412G
MANUFACTURER: _____ Microporous
OTHER: _____ Rocketdyne
LIQUID: _____ 50/50 Hydrazine, NTO*
ESTIMATE SERVICE TIME: _____ 4 years
USE, DUTY CYCLE _____
CONDITION: _____ Fair
SCREEN MATERIAL: _____
SERVICE SPECIFICATION: _____
TEMPERATURE: _____
HISTORY: _____
REPLACEMENT COST: _____ Unknown
FLOW RATE: _____ 12 GPM
PRESSURE DROP: _____
OPERATING PRESSURE: _____ 3000 PSI
MICRON RATING: _____ 2 micron (nominal)
OTHER: _____

*IRFNA, UDMH - All of these
liquids have been in contact
with screen

DESCRIPTION - CASE HISTORY #19

Filter assembly P/N 160064 was manufactured by Microporous filter Company of Anaheim, California.

The filter assembly is an inline configuration designed for 3000 PSI operating pressure. Rocketdyne has been using this filter in Hydrazine for the past year. It has seen continuous service except for occasional cleaning. The filter housing has MS 33656-6 ports.

The filter element is heli-arc welded and has a 2 micron nominal 10 micron absolute filtration rating. Fluid temperatures were from +30° F to 140° F. Comments from the Rocketdyne personnel indicate the stainless steel screen is in good condition.

BASIC DATA FORM**CONTRACT NO. F04611-68-C0064****LONG TERM COMPATABILITY**

PART NUMBER: _____ 160064
MANUFACTURER: _____ Microporous
USER: _____ Rocketdyne
LIQUID: _____ Hydrozine
ESTIMATE SERVICE TIME: _____ 1 Year
USE, DUTY CYCLE _____ In and out for cleaning
CONDITION: _____ Good
SCREEN MATERIAL: _____ 304 stainless steel
TEMPERATURE: _____ +30°F to 140°F.
SERVICE SPECIFICATION: _____ Inline
HISTORY: _____
REPLACEMENT COST: _____ Unknown
FLOW RATE: _____
PRESSURE DROP: _____
OPERATING PRESSURE: _____ 3000 psi
MICRON RATING: _____ 2 micron (nominal)
OTHER: _____ 3/8 line size
4 1/2 " long

DESCRIPTION - CASE HISTORY #20

Filter assembly P/N 19470 was designed and manufactured by Western Filter Company.

The filter assembly is an inline configuration with AN 10050-8 ports. The unit has been used at the Rocketdyne Santa Susana Test facilities for two years. The filter has been in the following liquids: NTO, IRFNA, Hydrazine. The filter assembly is 7.25 inches long and 1.750 inches in diameter. The housing was designed for an operating pressure of 3000 PSI.

The filter element P/N 4-1-501 is manufactured from 304 stainless steel and 100% heli-arc welded. It has approximately 50 square inches of wire cloth. The filter element has been in continuous service except for occasional cleaning. Inspection indicates the wire cloth to be in good condition.

BASIC DATA FORM**CONTRACT NO. F04611-68-C-0064****LONG TERM COMPATABILITY**

PART NUMBER: _____ 19470
MANUFACTURER: _____ Western Filter Company
USER: _____ Rocketdyne
LIQUID: _____ NFO, IRFNA, Hydrazines
ESTIMATE SERVICE TIME: _____ 2 years
USE, DUTY CYCLE _____ Continual except for
cleaning
CONDITION: _____ Good
SCREEN MATERIAL: _____ 304 stainless steel
TEMPERATURE: _____ Ambient
SERVICE SPECIFICATION: _____ Inline
HISTORY: _____
REPLACEMENT COST: _____ less than \$150.00
FLOW RATE: _____
PRESSURE DROP: _____
OPERATING PRESSURE: _____ 3000 PSI
MICRON RATING: _____ 10 micron
OTHER: _____

Section 1.4 NASA FLIGHT TEST CENTER CASE HISTORIES

DESCRIPTION - CASE HISTORY #21

P/N 106586 is a stainless steel filter used in the Hydrogen Peroxide test servicing cart for the X-15 aircraft. The manufacturer is Western Filter Company.

The Filter Element is made of stainless steel in its entirety for compatibility with Hydrogen Peroxide. The filters are eight years old and have been in a 90% Peroxide solution continuously except when removed for cleaning. The element is about 8 inches in length and approximately 1-1/4 inches in diameter. The filter element is resistance welded using 304 stainless steel Dutch Twilled wire screening. According to the NASA personnel, the filter element has been performing well. Close inspection indicates no detrimental effects on the screen. The Filter Assembly has female threaded end fittings. The unit, a 10 micron filter, operates at 25 PSI with a flow rate of 4 to 5 GPM.

The Supervisor of Vehicle Maintenance, Mr. John Russell, was interviewed for this data. He is considered to be well qualified to comment since he has been with NASA at this facility approximately fifteen years.

Figures 40, 41, and 42 show the location of the unit and its subassemblies.

BASIC DATA FORM**CONTRACT NO. F04611-68-C0064****LONG TERM COMPATABILITY**

PART NUMBER: _____ Filter Assembly 106586
Filter Element P/N 106310-10

MANUFACTURER: _____ Western Filter Company

USER: _____ NASA

LIQUID: _____ Hydrogen Peroxide

ESTIMATE SERVICE TIME: _____ 8 years

USE, DUTY CYCLE _____ Continuous except cleaning

CONDITION: _____ Good

SCREEN MATERIAL: _____ 304 stainless steel

TEMPERATURE: _____ Ambient

SERVICE SPECIFICATION: _____ Inline 1/2 inch

HISTORY: _____

REPLACEMENT COST: _____ less than \$350.00

FLOW RATE: _____ 5 GPM

PRESSURE DROP: _____ Low

OPERATING PRESSURE: _____ 25 psi

MICRON RATING: _____ 10 micron (nominal)

OTHER: _____ Used in X-15 GSE (Ground Support Equipment) test cart to aircraft

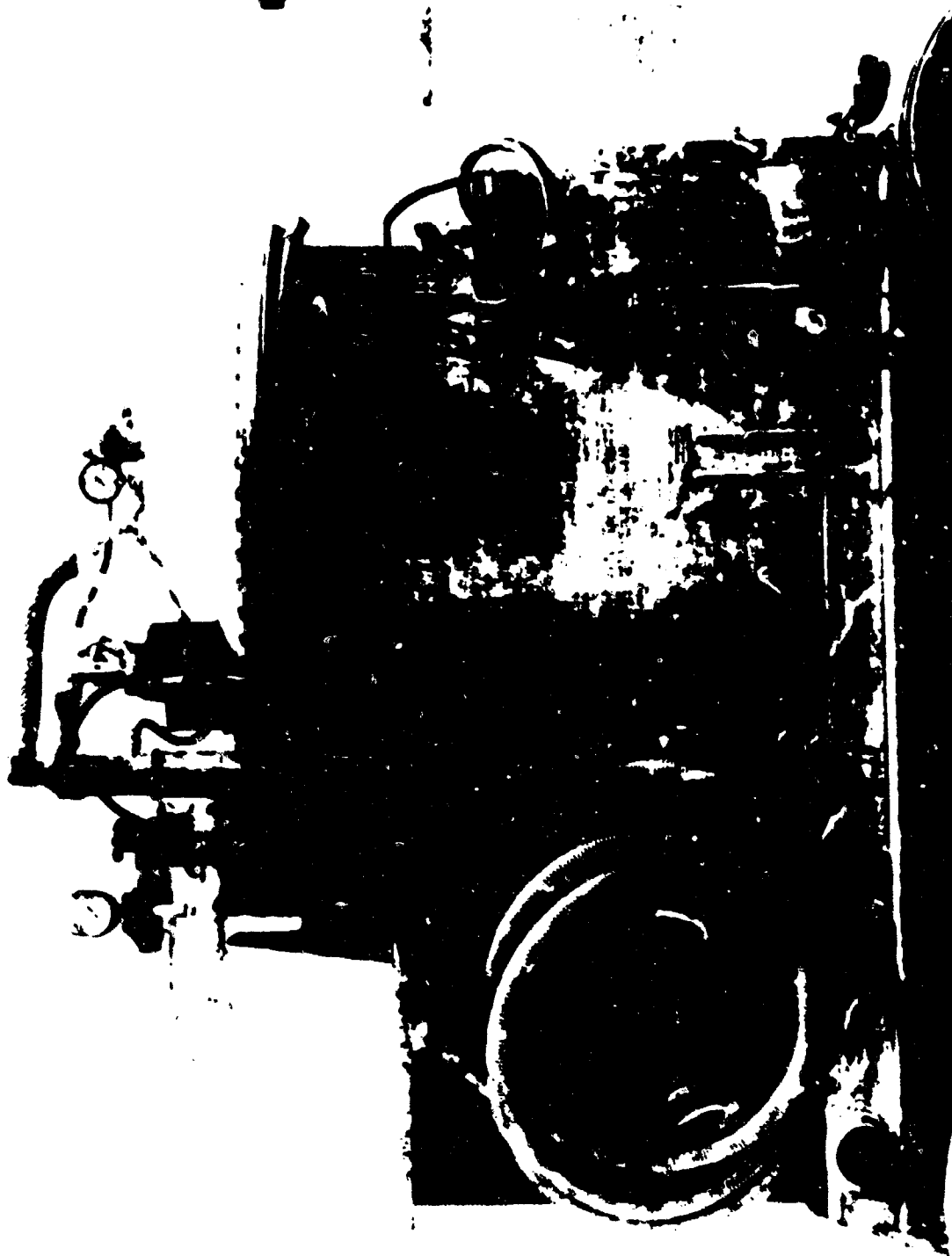
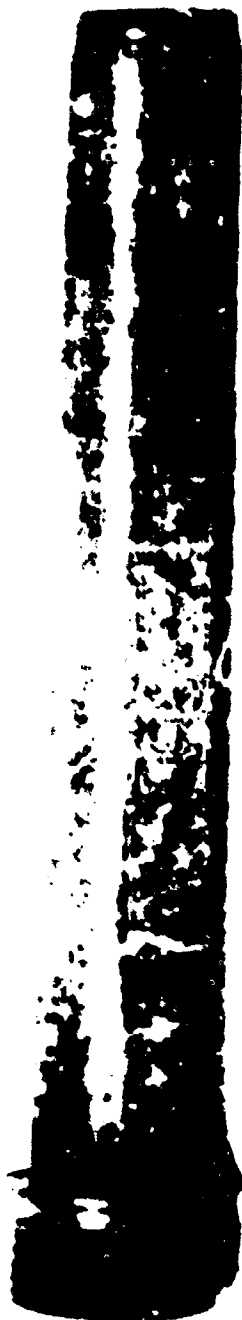


FIGURE 32
PAGE 89



FIGURE 33
PAGE 89

N. 4
E-17038



High Research Center
Berkeley, California

FIGURE 34
PAGE 90

Section 2.5

DOUGLAS CASE HISTORIES

DESCRIPTION - CASE HISTORY #22

The fabrication of Western Filter Company filter assembly P/N 321060 was to demonstrate the superior compatibility of nickel as a filter media for use with Fluorine. Because of the desire to reduce the number of unknowns the unit was made of all nickel and a nickel seal was used. The compatibility of the nickel element was demonstrated, as is evidenced by the data provided by the Douglas Company. However, some **assembly** and **disassembly** difficulty was encountered due to the galling of similar materials.

Although the unit was designed to perform a function of a filter, the Douglas Company desired to conduct a bubble point test with a surface tension device in liquid Fluorine. A co-operative effort was established for Western Filter to provide Douglas a nickel surface tension device for the bubble point test and Douglas would conduct a compatibility test on the filter assembly. The filter element was used as the surface tension device for the bubble point test (see Figure 46) and then tested as a filter (see Figure 45)

BASIC DATA FORM**CONTRACT NO. P04611-68-C-0064****LONG TERM COMPATABILITY**

PART NUMBER: _____ 321060

MANUFACTURER: _____ Western Filter Company

USER: _____ Douglas & Western Filter Co.

LIQUID: _____ LF_2

ESTIMATE SERVICE TIME: _____

USE, DUTY CYCLE _____

CONDITION: _____

SCREEN MATERIAL: _____ Nickel

TEMPERATURE: _____

SERVICE SPECIFICATION: _____

HISTORY: _____ See test data sheet and Douglas
letter #A-830-BBFO-356

REPLACEMENT COST: _____

FLOW RATE: _____

PRESSURE DROP: _____

OPERATING PRESSURE: _____

MICRON RATING: _____ 10 micron. (nominal)

OTHER: _____



DOUGLAS

MISSILE & SPACE SYSTEMS DIVISION

3000 OCEAN PARK BOULEVARD SANTA MONICA CALIFORNIA

July 25, 1967
A-830-BBPO-356

Mr. Leonard J. DiPeri
Chief Engineer & Director of Advanced Technology
Western Filter Company, Inc.
13527 S. Normandie Avenue
Gardena, California

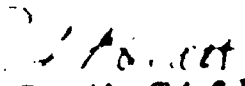
Dear Mr. DiPeri:

I am happy to enclose a copy of the laboratory report containing the test data and results obtained with your ten micron Western nickel filter assembly N22 in flowing LF_2 . The tests included helium gas breakthrough pressures across the filter for LOX and LF_2 , compatibility with flowing LF_2 , and the filtering capability for solid HF. The Western nickel filter was fluoxine-compatible under the test conditions employed.

Any questions and comments which you may have concerning these data will be welcomed. We are pleased to cooperate in this way in obtaining R&D information of mutual interest. Your cooperation and patience are most certainly appreciated.

Very truly yours,

Douglas Aircraft Company


P. L. Klevatt, Chief Engineer
Advance Propulsion Department
Research and Development

WEC:bw
Encl. noted (U)

DOUGLAS AIRCRAFT COMPANY INC. CORPORATE OFFICES SANTA MONICA CALIFORNIA

DESCRIPTION OF COMPATIBILITY TEST SET-UP P/N 20319

The test apparatus used is illustrated in Figure 46, consists of a Kovar-Pyrex adapter made from a Kovar-Pyrex glass metal seal, 1.25" OD.

The end of the 4" tube was bent 90° and reduced to 1/4" OD glass tube 6 inches long.

The adapter was connected with an AN fitting to the downstream side of the Western Filterassembly by flaring the Kovar tube end. The upstream side of the filter is connected to a 1/2" line. Gaseous helium is introduced on the upstream side and measured by a Heise precision pressure gauge. The downstream pressure gage was a compound vacuum pressure type.

The filter test assembly was fluorine cleaned by vapor degreased in Freon and baked dry (vacuum) for 24 hours at 105°C.

The test unit is assembled and then cooled in a Dewar to -320°F (see Figure 2).

LF is condensed from scrubbed GF_2 into the test unit. A slow GHe sweep on the downstream side² of the test unit is turned on and passes out through a disposal line.

The upstream side of the test unit is pressurized with GHe. The GHe pressure is reduced until gas bubbling stops and the pressure is again recorded. The differences between these two pressures is reported as the gas breakthrough pressure (see Table 1).

The level of LF_2 during GHe pressurization was above the 6" sight level.

After the test, the LF_2 was disposed, the filter was removed and examined for significant corrosion attack. None was observed.

REVISIONS					
AUTHORITY	SYS	DESCRIPTION	DATE	APPROVED	
SEE REVISION NOTICE					

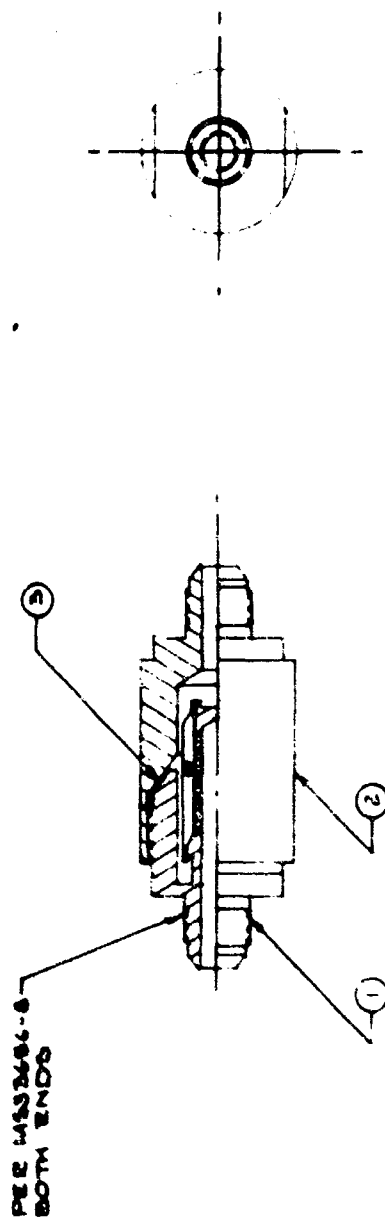
[illegible][illegible]

FIGURE 35
PAGE 96

2-2-67 Wesley F. 16
After second test with
LF2



FIGURE 36
PAGE 97

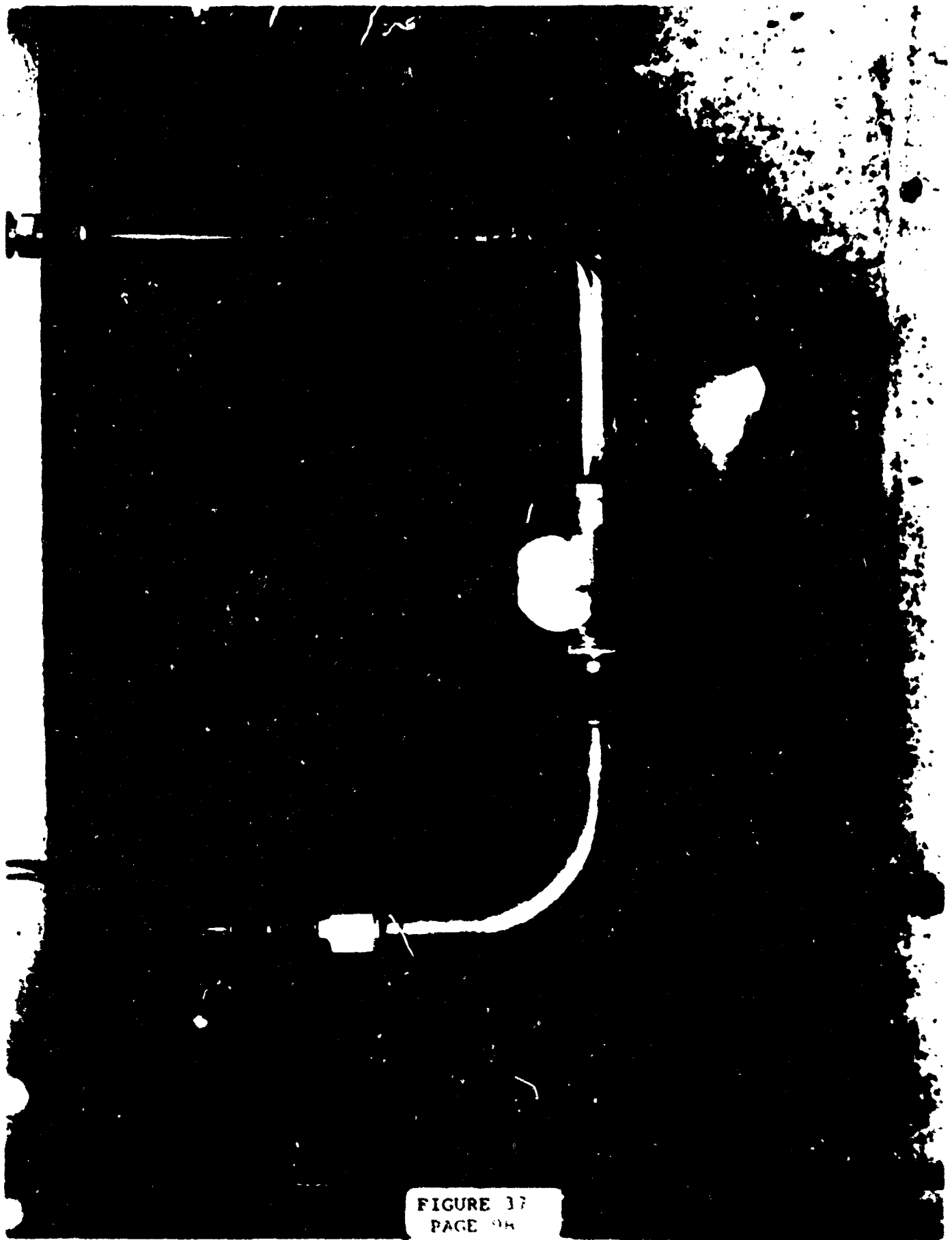


FIGURE 17
PAGE 96

Section 2.6

MARQUARDT CASE HISTORIES

DESCRIPTION - CASE HISTORY #23

Filter Assembly P/N 28-1-16510 is manufactured from 304 stainless steel. It is an inline configuration. The element P/N 9-1-500-5 is a serviceable, permanent-type filter easily removed for cleaning or replacement.

Items 1, 2, 3, 4, and 5, Filter Element P/N 9-1-500-5 (see Figures 48 and 49) have been in continuous use at Marquardt Magic Mountain test facility for two years. These five filter elements have been in contact with Hydrazine and Nitrogen tetroxide. Items 1, 2, and 3 have been in Hydrazine; Items 4 and 5 have been in Nitrogen tetroxide. The five units were borrowed from Marquardt and brought to Western Filter for examination. A bubble point test was conducted on each unit. After the bubble point test, each filter element was submerged in isopropyl alcohol at +150°F and ultrasonically cleaned for 1 1/2 hours in a DeltaSonic Model DS850. The elements were rinsed with deionized water and dried in an oven.

The following data are the bubble point pressures in inches of water, before and after cleaning:

ITEM	BUBBLE POINT DESIGN REQUIREMENT (Min)	BUBBLE POINT AS RECEIVED	BUBBLE POINT AFTER CLEANING
1	16.5	22.00	18.00
2	16.5	21.00	19.00
3	16.5	23.00	20.0'
4	16.5	20.00	17.00
5	16.5	20.00	19.50

The condition of the filter elements is excellent.

LONG TERM COMPATABILITYITEM I

PART NUMBER: _____ Filter Assembly 28-1-16510
Filter Element P/N 9-1-500-5

MANUFACTURER: _____ Western Filter Company

USER: _____ Marquardt

LIQUID: _____ Hydrazine

ESTIMATE SERVICE TIME: _____ 2 years

USE, DUTY CYCLE _____ Continuous except for cleaning

CONDITION _____ Excellent

SCREEN MATERIAL: _____ 304 stainless steel Dutch Twilled

TEMPERATURE: _____ Ambient on fuel

SERVICE SPECIFICATION: _____ 1/2 inch inline

HISTORY: _____

REPLACEMENT COST: _____ less than \$100.00

FLOW RATE: _____ .21 lb per second

PRESSURE DROP: _____ 1/2 PSI

OPERATING PRESSURE: _____ 1000 PSI

MICRON RATING: _____ 5 micron nominal 15 absolute

OTHER: _____ Unit in direct sunlight
Temperatures vary from +100°F
during the heat of the day to
+17°F during the cool of the
night.

LONG TERM COMPATABILITYITEM 2

PART NUMBER: _____ Filter Assembly 28-1-16510
Filter Element 9-1-500

MANUFACTURER: _____ Western Filter Company

USER: _____ Marquardt

LIQUID _____ Hydrazine

ESTIMATE SERVICE TIME: _____ Unknown

USE, DUTY CYCLE _____ Continuous except cleaning

CONDITION: _____ Excellent

SCREEN MATERIAL: _____ 304 stainless steel Duth Twilled

TEMPERATURE: _____ Ambient

SERVICE SPECIFICATION: _____ 1/2 inch inline

HISTORY: _____

REPLACEMENT COST: _____ less than \$100.00

FLOW RATE: _____ .2 lb per second

PRESSURE DROP: _____ 1/2 PSI

OPERATING PRESSURE: _____ 1000 PSI

MICRON RATING: _____ 5 micron nominal 15 absolute

OTHER: _____ Unit in direct sunlight
Temperatures vary from +100°F
during the heat of the day to
+17°F during the cool of the
night

LONG TERM COMPATABILITYITEM 3

PART NUMBER: _____ Filter Assembly 28-1-16510
Filter Element 9-1-500-10

MANUFACTURER: _____ Western Filter Company

USER: _____ Marquardt

LIQUID: _____ Hydrazine

ESTIMATE SERVICE TIME: _____ 2 years

USE, DUTY CYCLE _____ Continuous except cleaning

CONDITION: _____ Excellent

SCREEN MATERIAL: _____ 304 stainless steel Dutch Twilled

TEMPERATURE: _____ Ambient

SERVICE SPECIFICATION: _____ 1/2 inch inline

HISTORY: _____

REPLACEMENT COST: _____ less than \$100.00

FLOW RATE: _____ .2 lb per second

PRESSURE DROP: _____ 1/2 psi

OPERATING PRESSURE: _____ 1000 psi

MICRON RATING: _____ 5 micron nominal 15 absolute

OTHER: _____ Unit in direct sunlight
Temperatures vary from +100°F
during the day to +1°F
during the cool of the night,

LONG TERM COMPATABILITYITEM IV

PART NUMBER: _____ Filter Assembly 28-1-16510
Filter Element 9-1-500-10

MANUFACTURER: _____ Western Filter Company

USER: _____ Marquardt

LIQUID: _____ Nitrogen tetroxide

ESTIMATE SERVICE TIME: _____ 1 year

USE, DUTY CYCLE _____ continuous except for cleaning

CONDITION: _____ excellent

SCREEN MATERIAL: _____ 304 stainless steel Dutch Twilled

TEMPERATURE: _____ +20°F to 160°F

SERVICE SPECIFICATION: _____ 1/2 inch inline

HISTORY: _____

REPLACEMENT COST: _____ less than \$100.00

FLOW RATE: _____ .3 lb per second

PRESSURE DROP: _____ 1/2 PSI

OPERATING PRESSURE: _____ 1000 PSI

MICRON RATING: _____ 5 micron nominal 15 micron absolute

OTHER: _____ Unit in direct sunlight
Temperatures vary from +100°F
during the heat of the day to
+17°F during the cool of the
night.

LONG TERM COMPATABILITY

ITEM V

PART NUMBER: _____ Filter Assembly 28-1-16510
 Filter Element 9-1-500

MANUFACTURER: _____ Western Filter Company

USER: _____ Marquardt

LIQUID: _____ Nitrogen te troxide

ESTIMATE SERVICE TIME: _____ 1 year

USE, DUTY CYCLE _____ Continuous except for cleaning

CONDITION: _____ Excellent

SCREEN MATERIAL: _____ 304 stainless steel Dutch Twilled

TEMPERATURE: _____ +20°F to +100°F

SERVICE SPECIFICATION: _____ 1/2 inch inline

HISTORY: _____

REPLACEMENT COST: _____ less than \$100.00

FLOW RATE: _____ .3 lbs per second

PRESSURE DROP: _____ 1/2 PSI

OPERATING PRESSURE: _____ 1000 PSI

MICRON RATING: _____ 5 micro nominal 15 absolute

OTHER: _____ Unit in direct sunlight
 Temperatures vary from +100°F
 during the heat of the day to
 +17°F during the cool of the
 night.

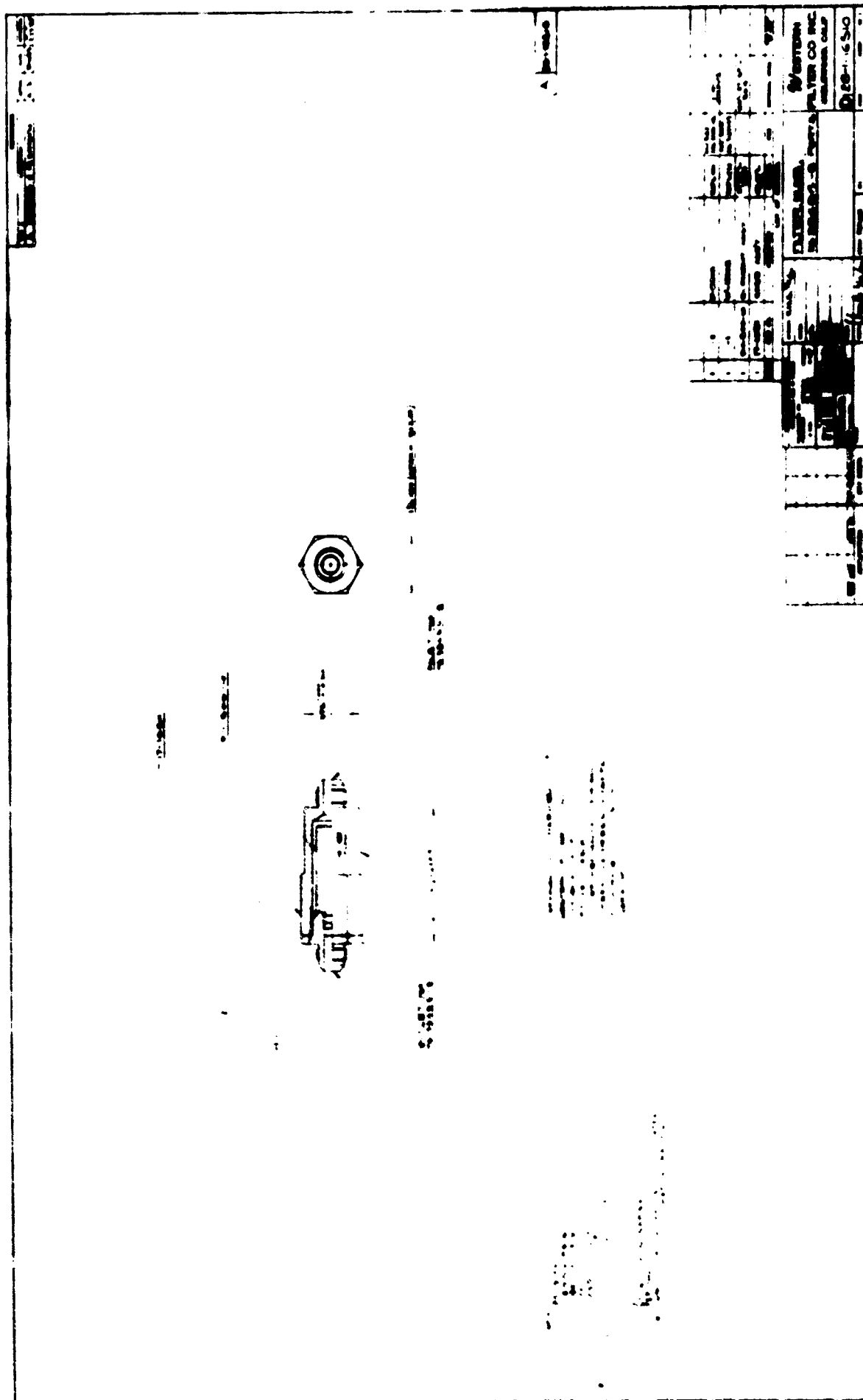


FIGURE 38
PAGE 100

0-10000 51771046

ASTORIA 5-005-7-0

62-117757-12022X
5-1810671W-226

PERMANENT MARK
WESTERN FILTER CO. INC.
P/N 9-1-500-V



D 9-1-500

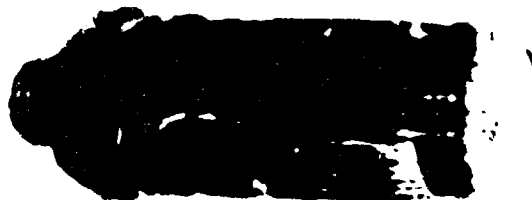
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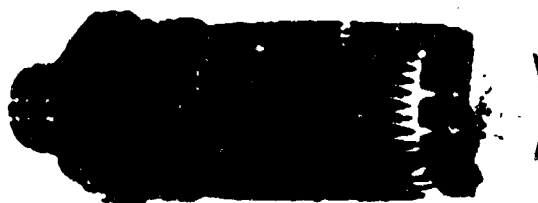
FIGURE 39
PAGE 107



1



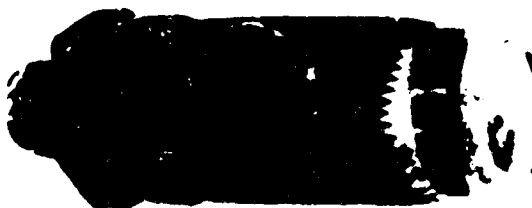
2



3



4



5

FIGURE 4
PAGE 100



2

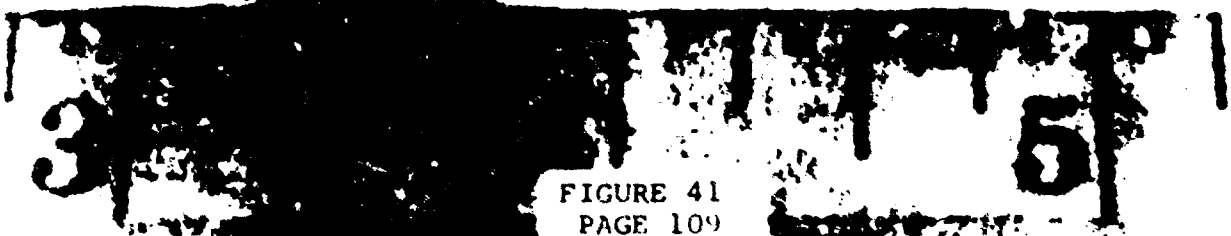


FIGURE 41
PAGE 109

Conclusions

Based on the similarity between micronic filter elements and surface force orientation devices and the 96 filter elements surveyed and inspected by Western Filter Company, the following may be concluded:

1. Micronic stainless steel devices are compatible with storable oxidizers and fuels when in contact with these propellants for long periods of time.
2. Long term storage of stainless steel screen devices in N_2O_4 , CLF_5 , CLF_3 , and amine fuels does not cause degradation in the surface tension characteristics of the devices.
3. Fine mesh screen devices must be thoroughly cleaned before being used with corrosive propellants in order to insure no deterioration of the device. The deterioration of the filter element reported in Case History #17 was due to improper cleaning which resulted in deterioration of the device when used in IRFNA.

RECOMMENDATIONS

- A It is recommended that the Rocket Propulsion Laboratory advise all Air Force Contractors and Government Agencies utilizing high energy propellant, or who have utilized such fluids in the past, to inventory installation of Filters in use, or on the active status, and to hold such hardware and records for future evaluation.
- B It is recommended that a Liaison team be established to visit those activities to review such filters or installation which would represent valuable candidate case histories.
- C It is recommended that the case histories be documented and the candidate units acquired.
- D It is recommended that an organization with capability to provide Testing Spectrographic Analysis and Documentation be given case histories and units acquired for analysis
- E It is recommended that results of recommendations A through D be disseminated in reports to the technical community.

UNCLASSIFIED

Security Classification

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Western Filter Company, Incorporated		UNCLASSIFIED
		25. GROUP
3. REPORT TITLE		
Study of Long Term Effects of High Energy Propellants on Fine Micronic Stainless Steel Wire Cloth Used in Surface Tension Devices		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)		
Final Draft		
5. AUTHOR(S) (Last name, first name, initial)		
6. REPORT DATE	74. TOTAL NO. OF PAGES	75. NO. OF REFS
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		AIR FORCE ROCKET PROPULSION LABORATORY
13. ABSTRACT		
Two operational surface tension experiment hardware units were delivered to AFRPL for orbital flight tests. The companion dielectrophoretic experiment effort was terminated during the early fabrication phase. This 22-month program was divided into two phases. The first phase, lasting seven months, provided experiment definition, analysis, predesign and test plans for both experiments. This report summarizes all work performed during Phase II concerning final design, fabrication, and successful ground testing of the surface tension experiment apparatus. For future reference, all design and fabrication work performed up to the termination date of 2 March 1967 is summarized for the dielectrophoretic experiment.		

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