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

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

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

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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 Co., Gardena, California

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 speciments 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 fluorine, 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.

CONTENTS

Section

ILLUSTRATIONS

ILLUSTRATIONS (con't)

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.; Flowmatics 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 deisgn 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.

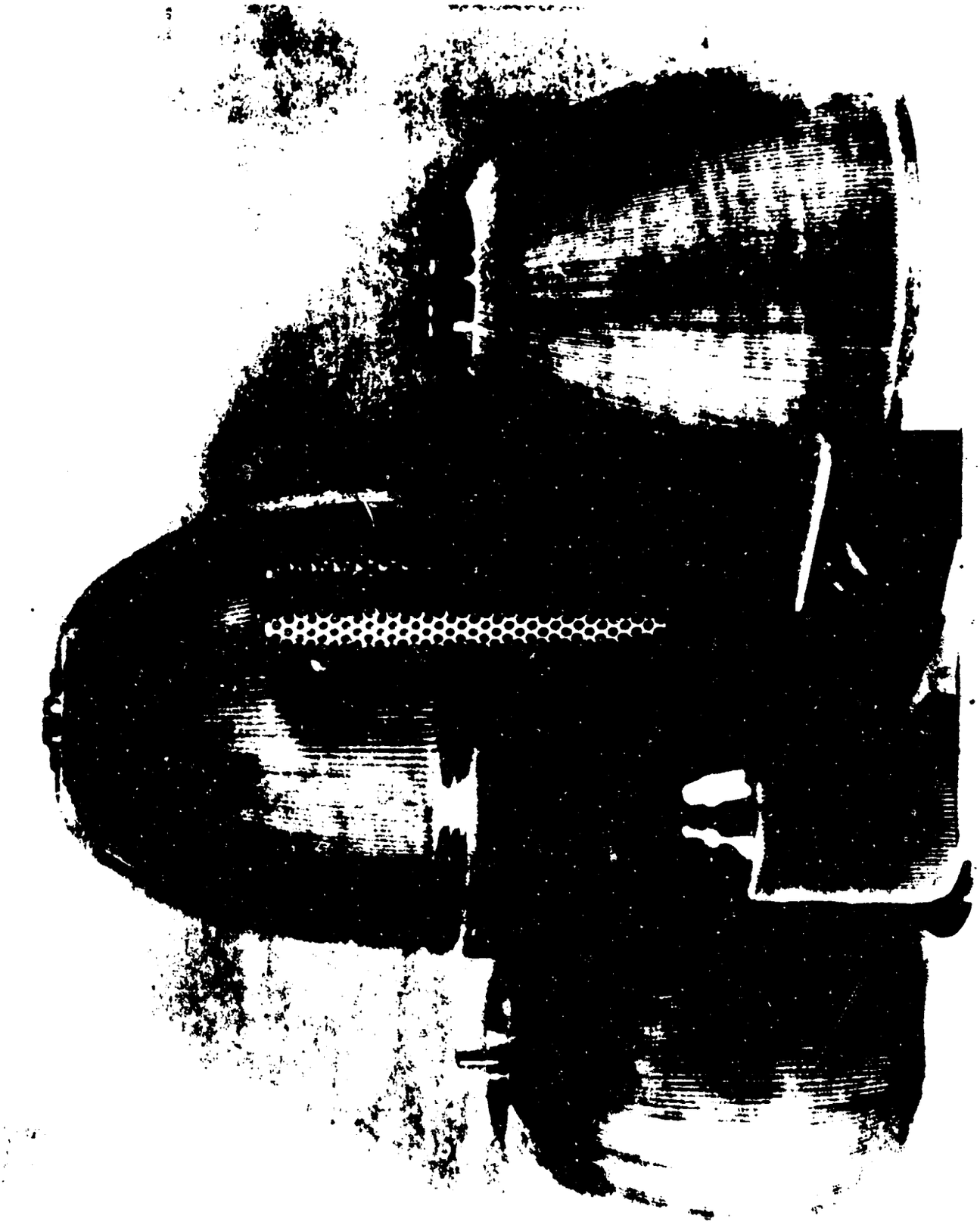

FIGURE 1
PAGE 10

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.

Company	Case History No.	Number of Filter Units
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 dettimental 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 FORM

LONG 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° to 150°F

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

HISTORY:

REPLACEMENT COST: $400.00 for element (approx.)

FLOW RATE: Flow Rate pprox. 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.

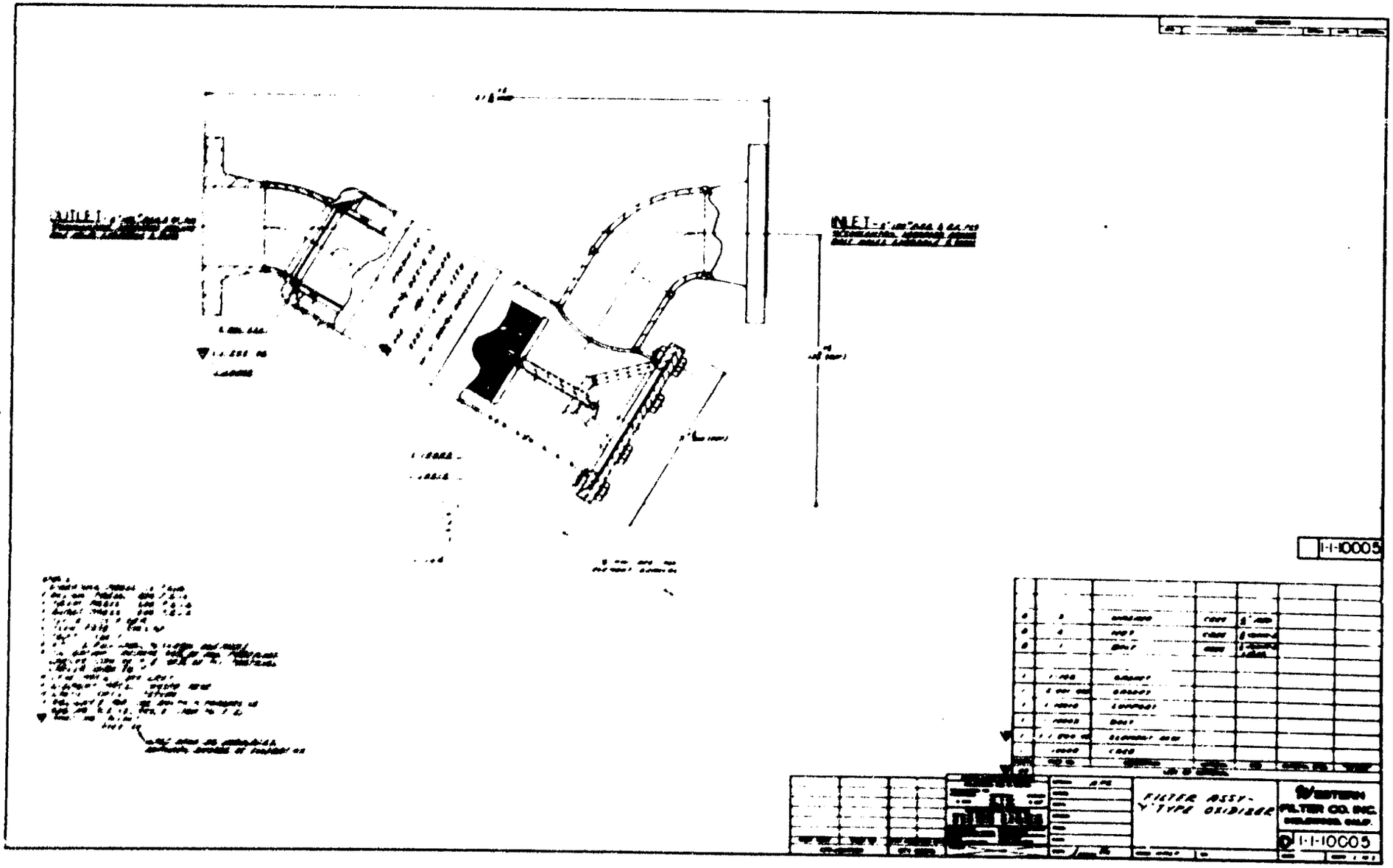

FIGURE 2
PAGE 16

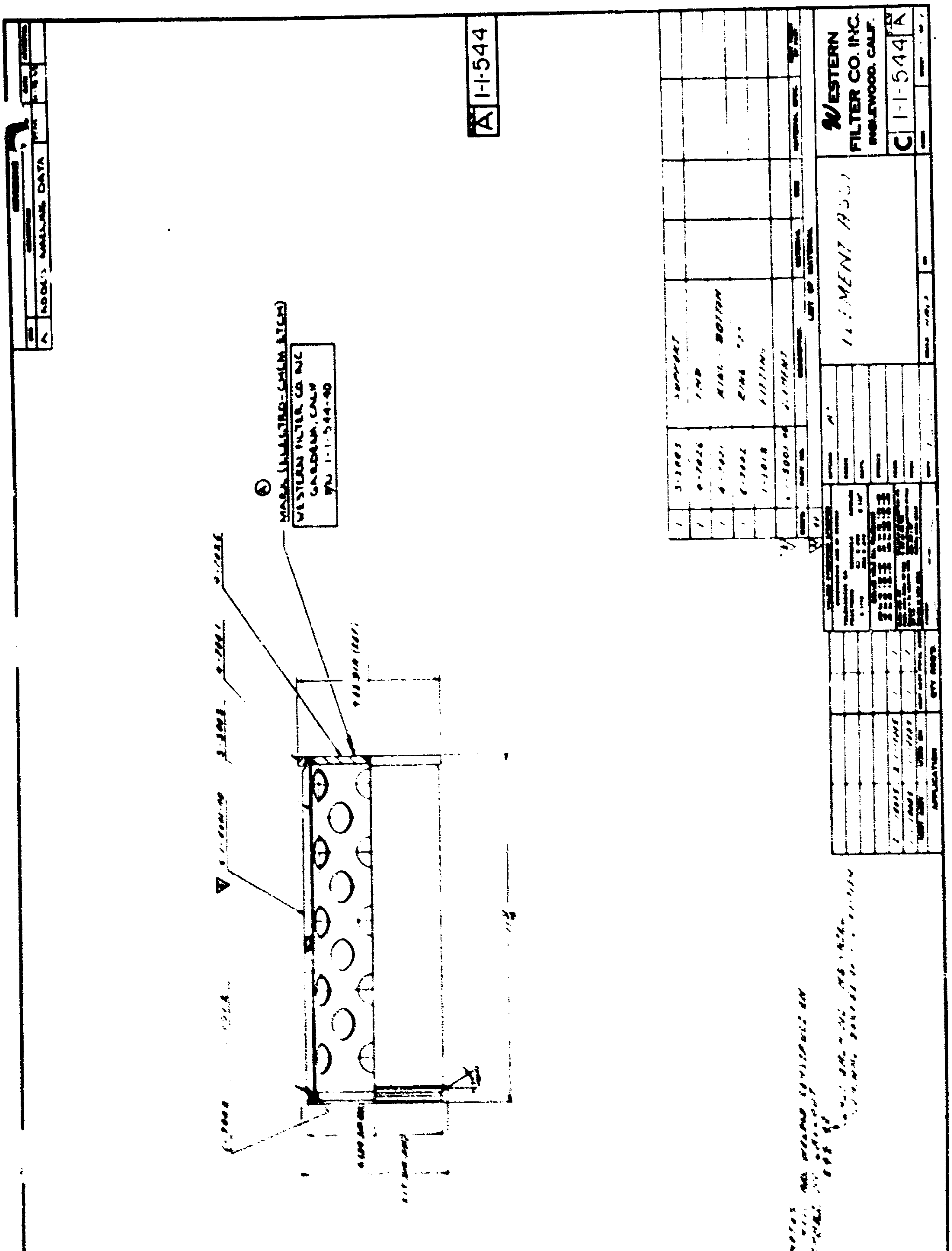
1-1-544
MARK (ELECTRO-CHEM ETCH)
WESTERN FILTER CO INC
GARDENA, CALIF
P/N 1-1-544-40
ELEMENT ASSY
WESTERN
FILTER CO. INC.
INGLEWOOD, CALIF.
C 1-1-544 A

FIGURE 3

FIGURE 5
PAGE 1

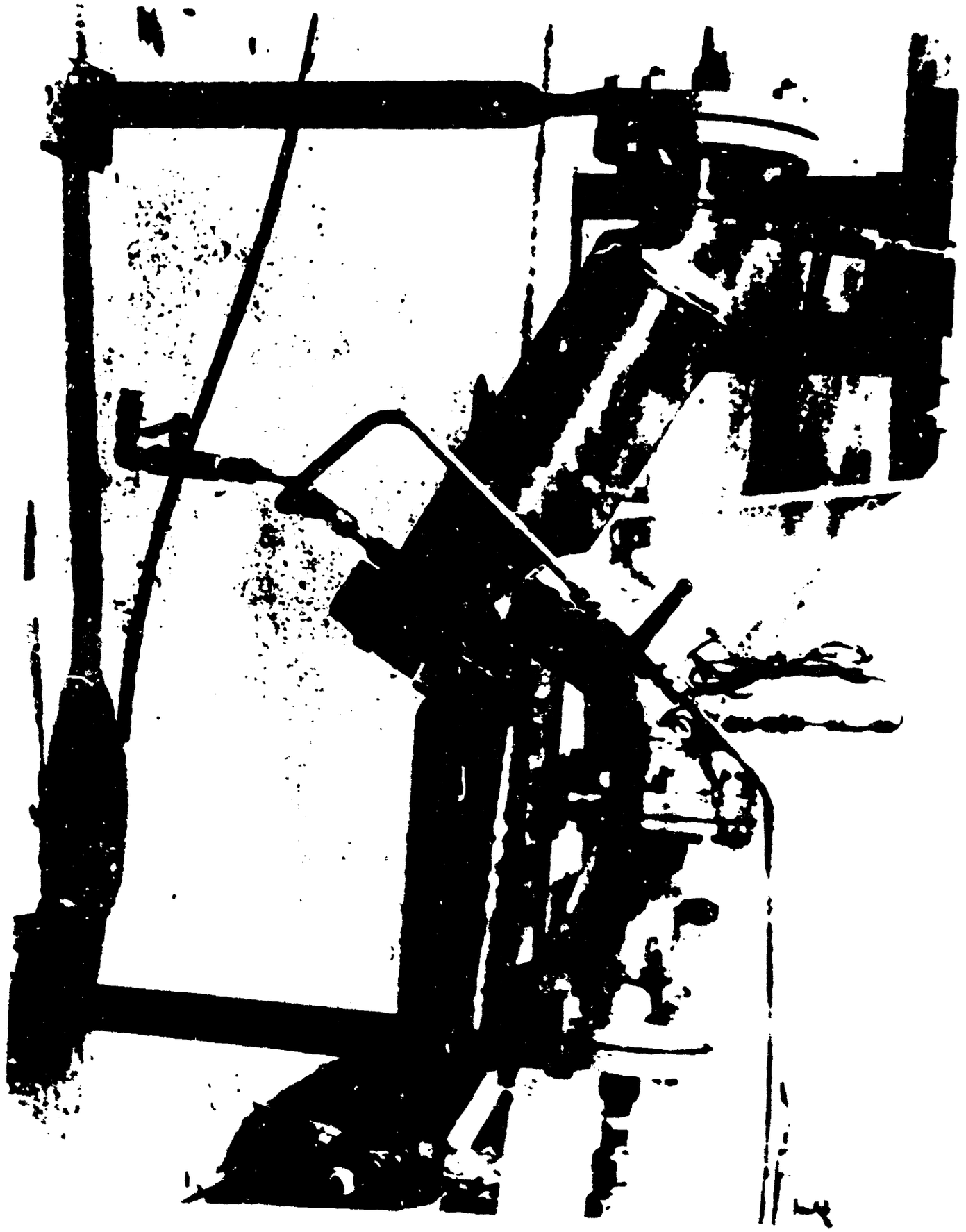

FIGURE 6
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FIGURE
PAGE

FIGURE 8
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FIGURE 9
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FIGURE 10
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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. F04611-68-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 N_2O_4
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

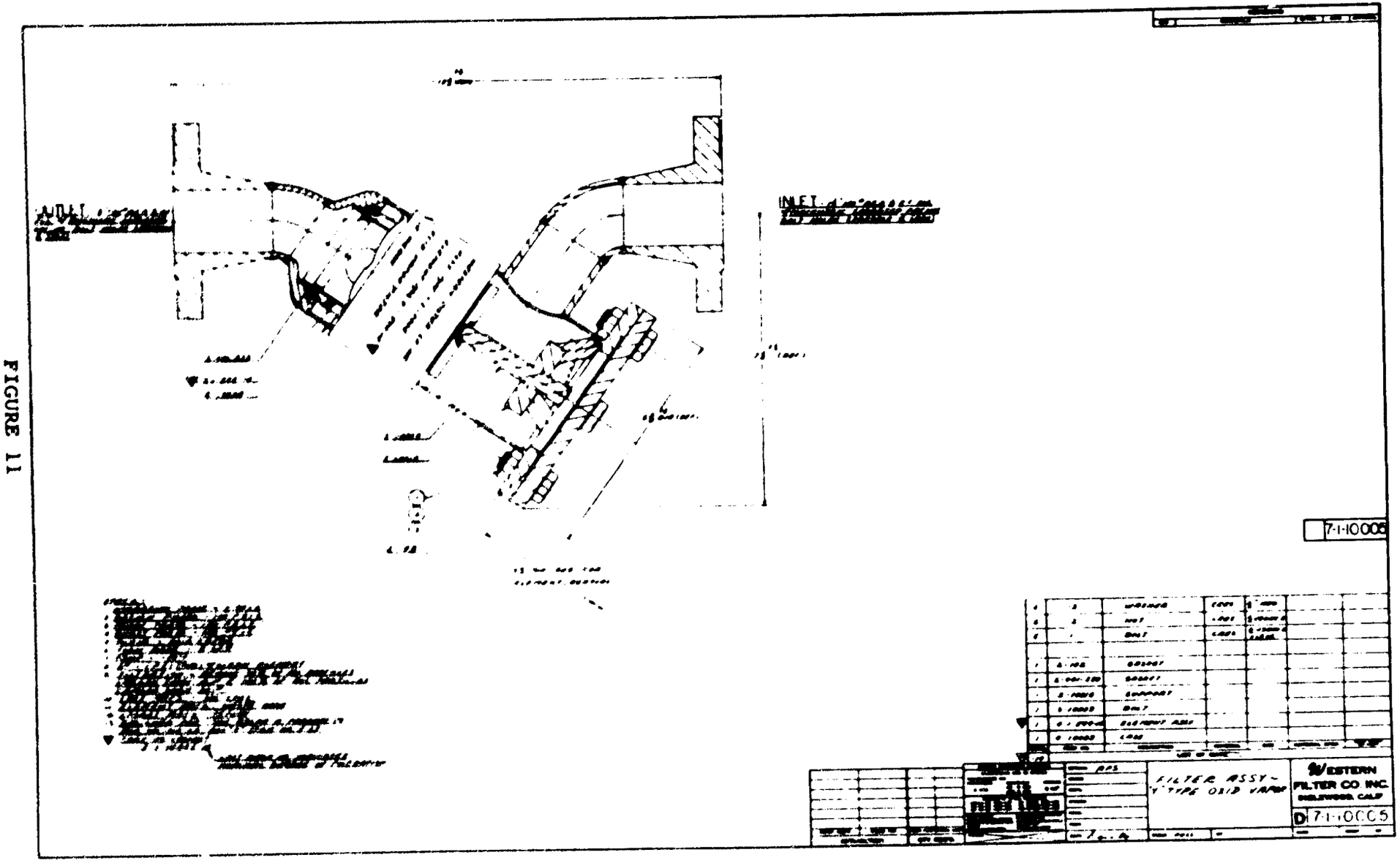

FIGURE 11
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DESCRIPTION - CASE HISTORY #3

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 FORM CONTRACT NO. F04611-68-C-0064

LONG TERM COMPATABILITY

PART NUMBER: 28-1-16510 Series

MANUFACTURER: Western Filter Co.

USER: Wyle Labs. Norco Facility

LIQUID: N_2O_4 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 Micron Absolute

OTHER: Inline, cartridge filter configuration.

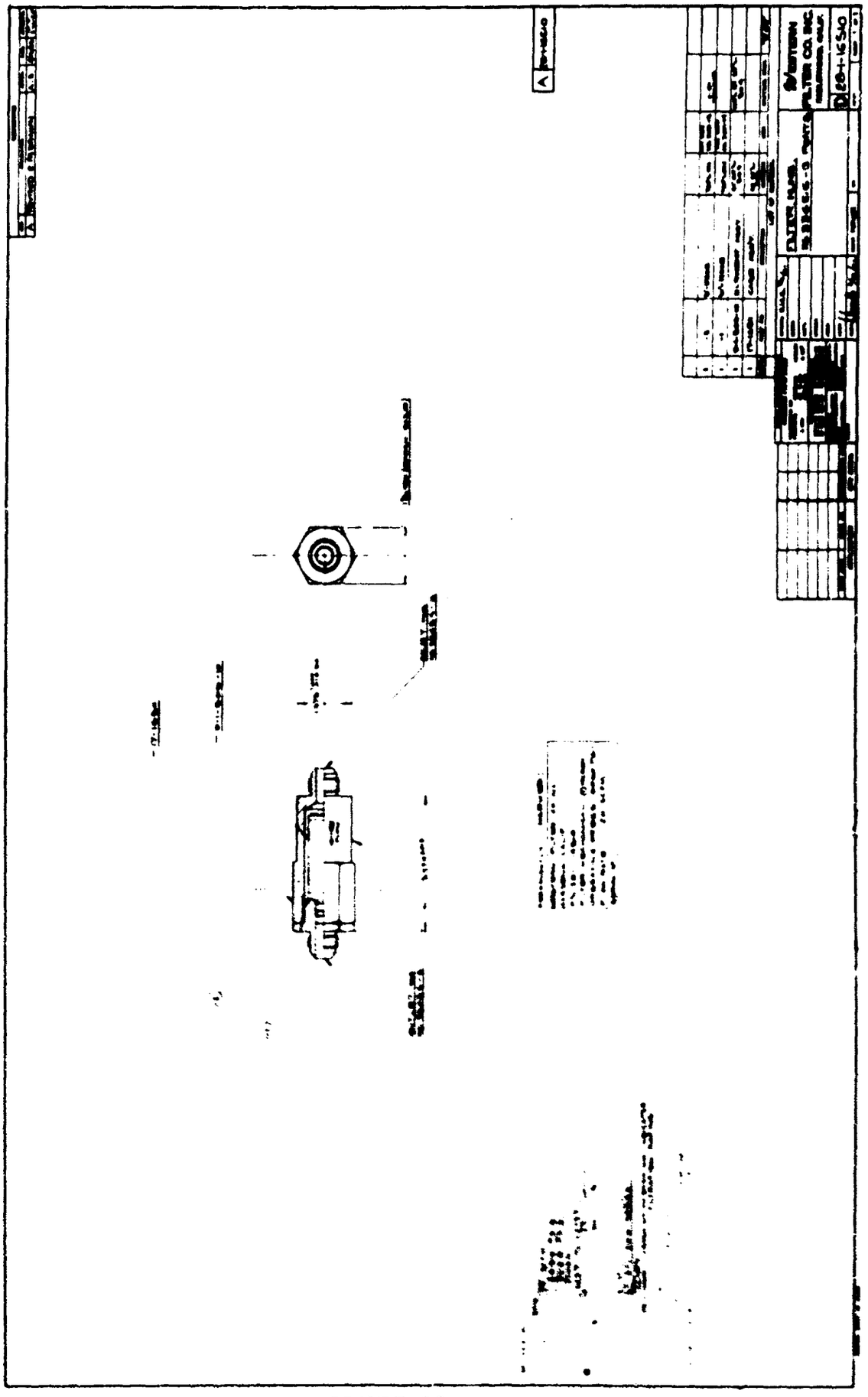

FIGURE 12
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DESCRIPTION - CASE HISTORY #4

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 & N_2O_4 - 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.

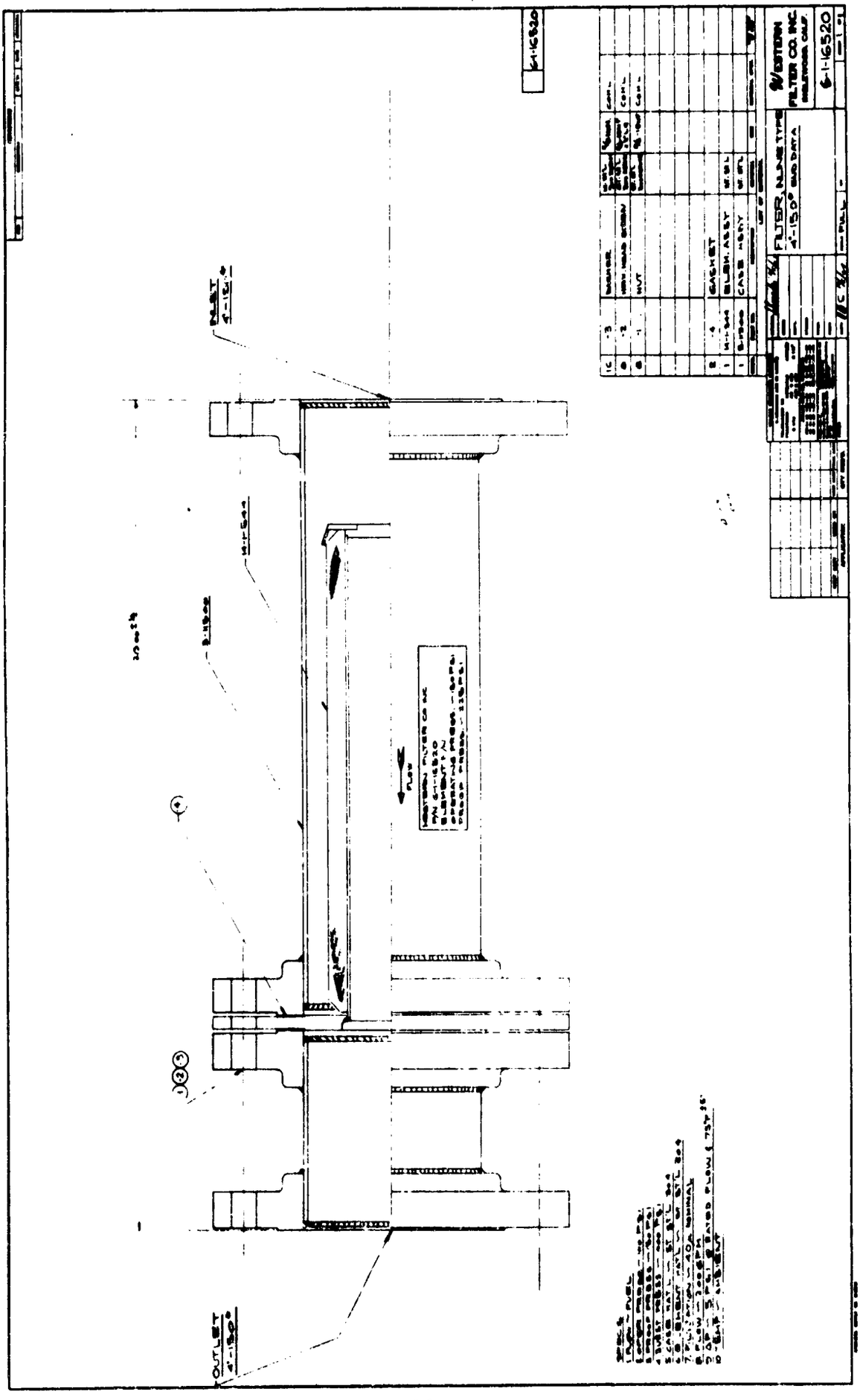

FIGURE 13
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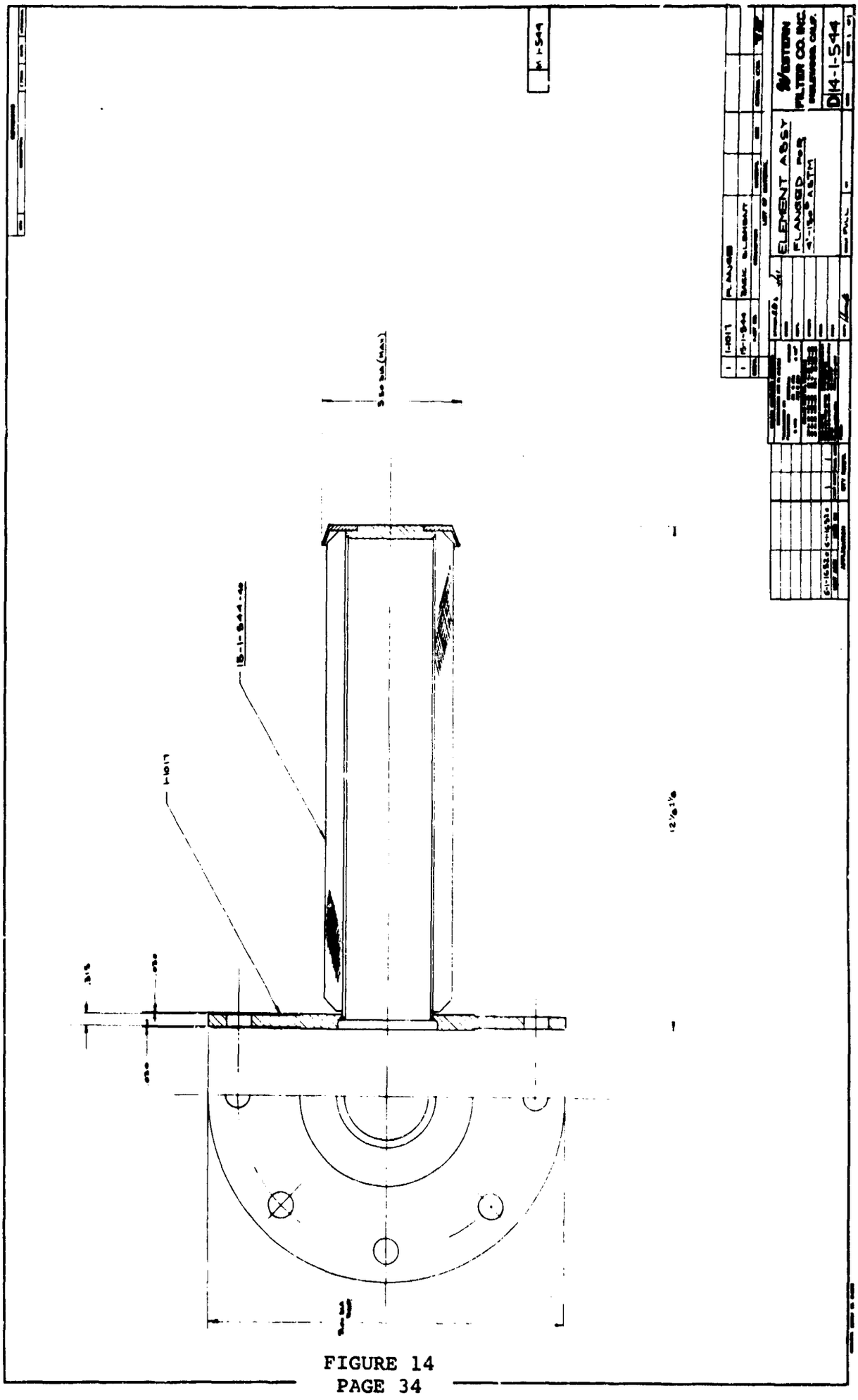

FIGURE 14
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Section 2.2 TRW CASE HISTORIES

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 FORM CONTRACT NO. F04611-68-C0064

LONG TERM COMPATABILITY

PART NUMBER: 2524-4 Element P/N 6469

MANUFACTURER: Capitol Westward

USER: TRW

LIQUID: Aerozine & N_2O_4

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:

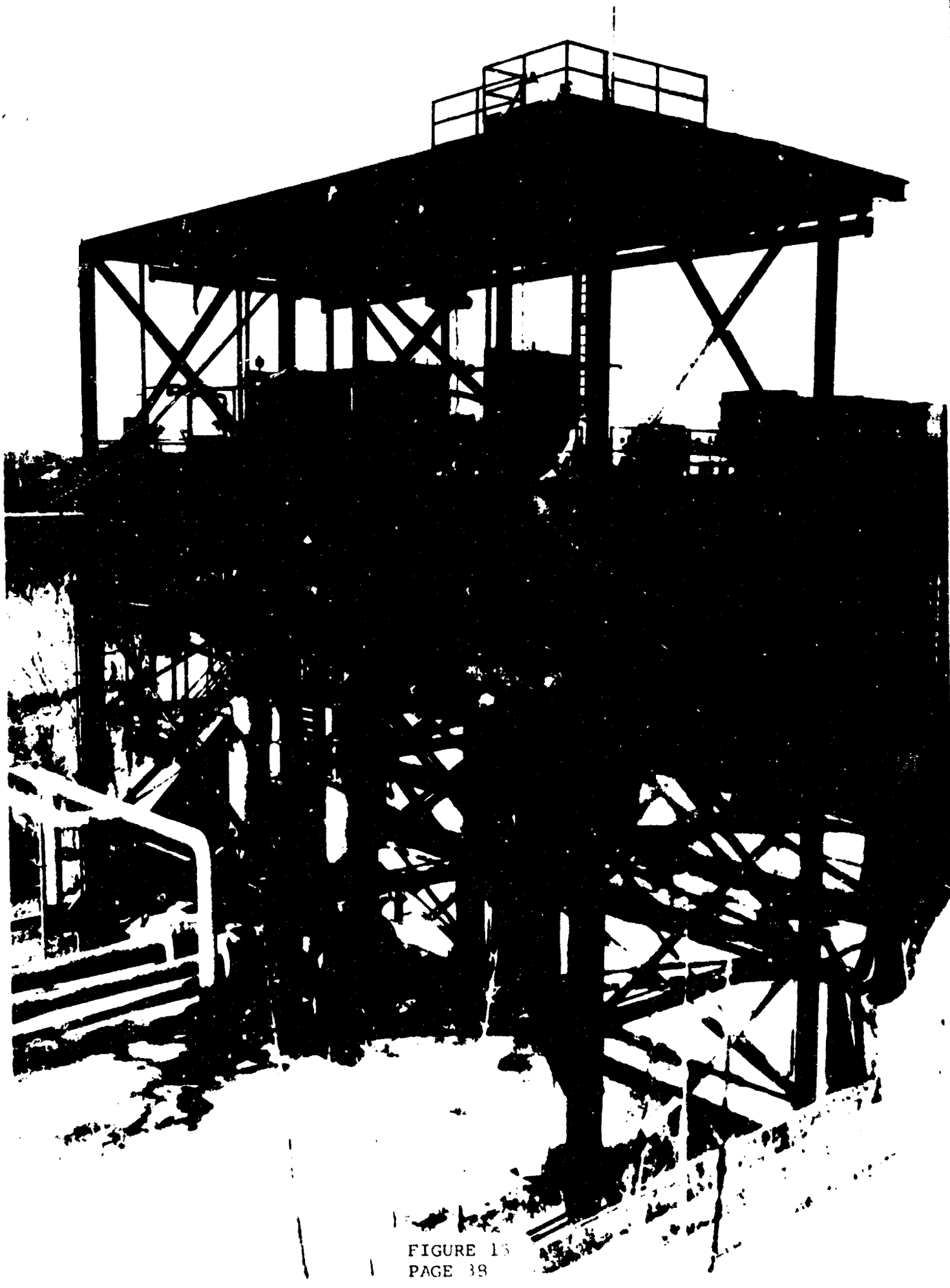

FIGURE 15
PAGE 38

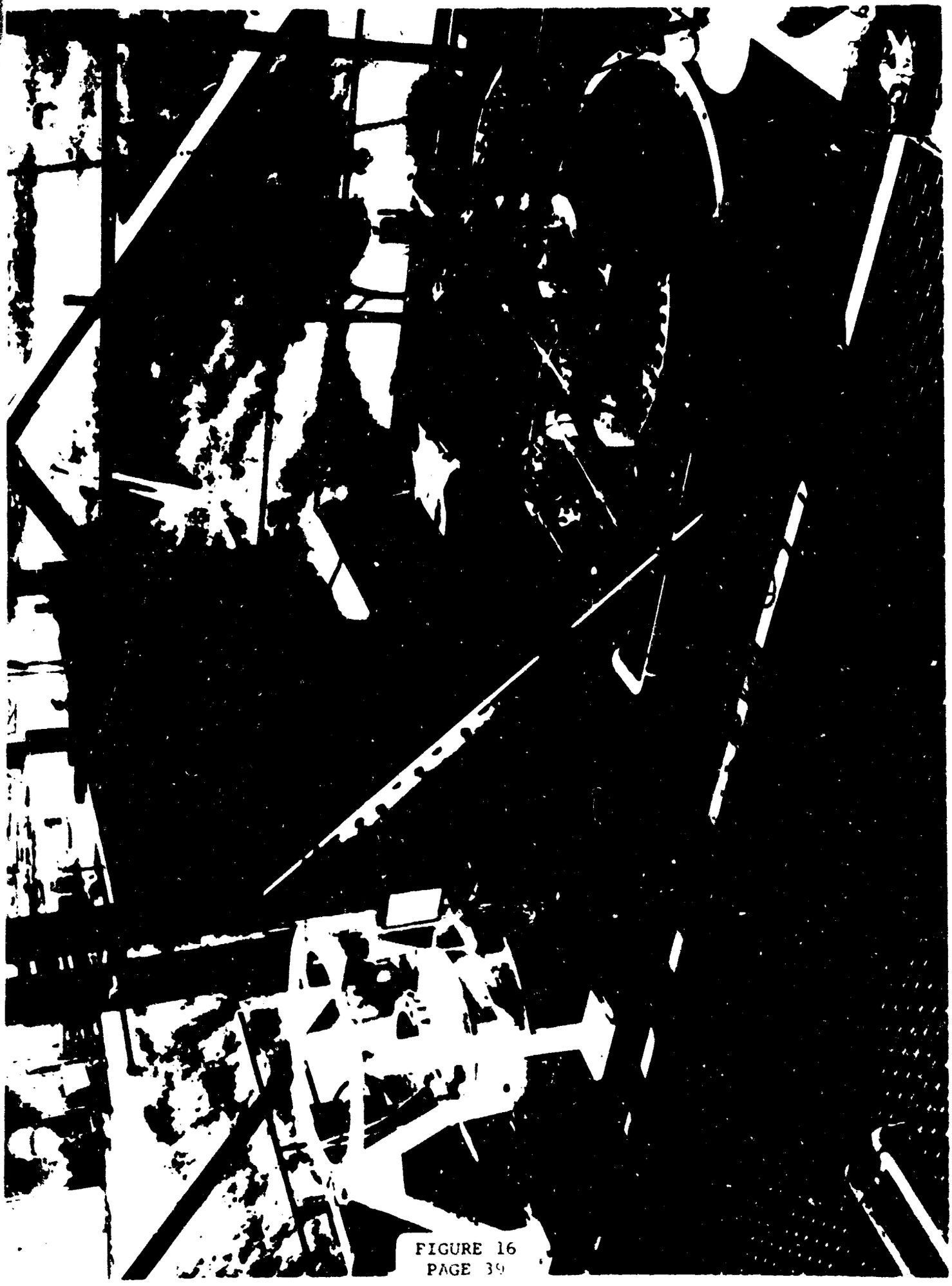

FIGURE 16
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FIGURE 17
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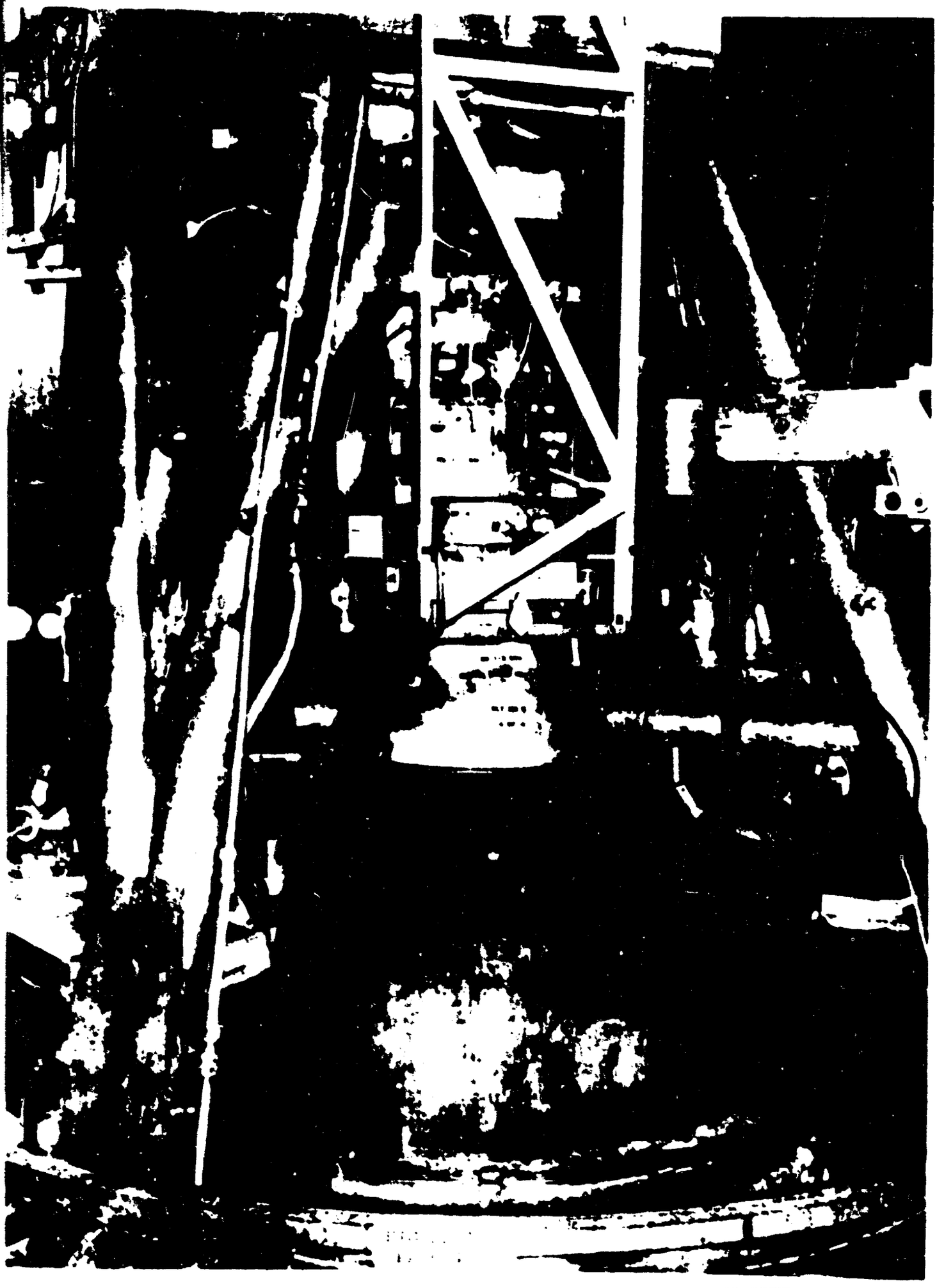

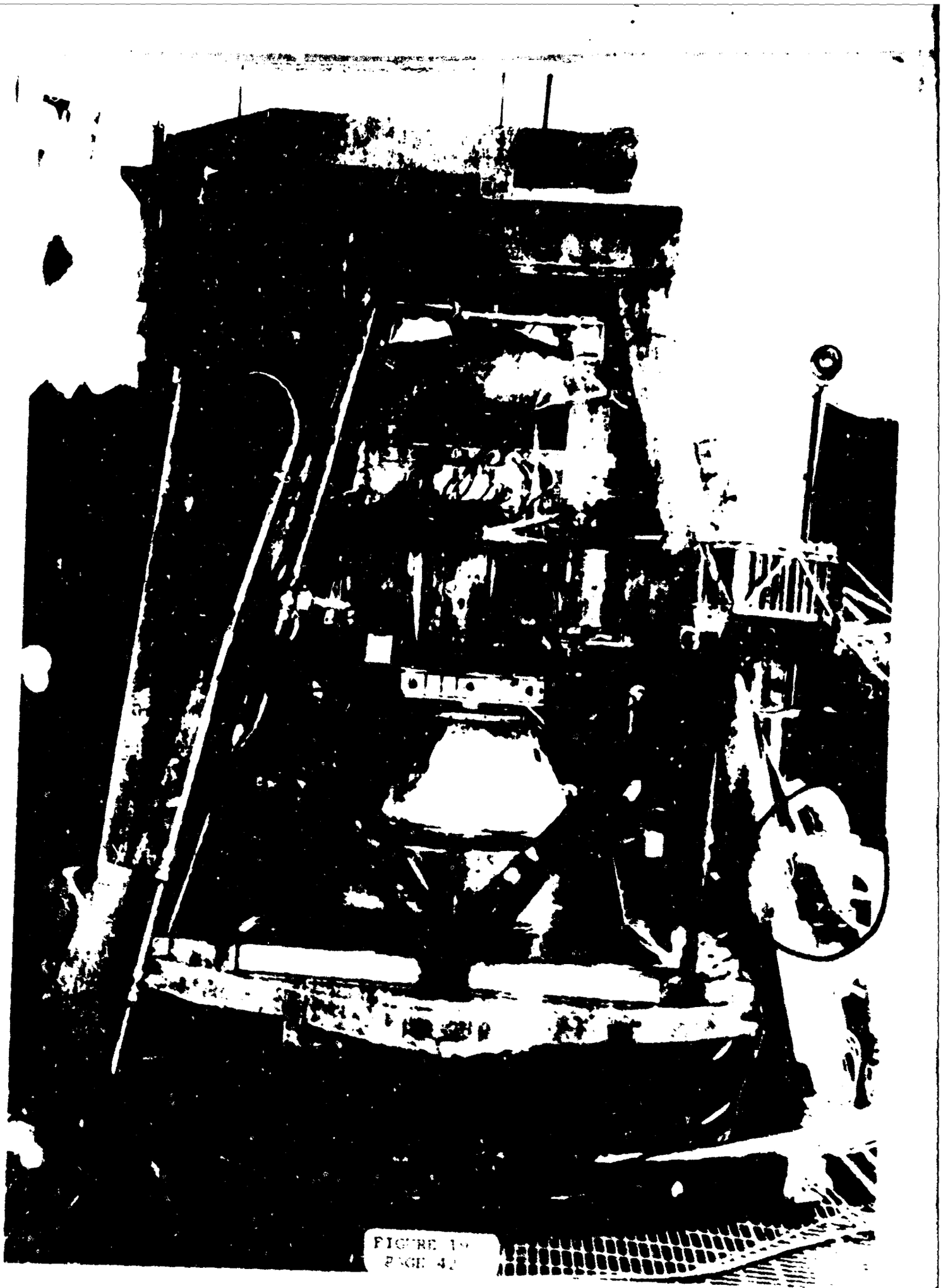

FIGURE 19
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DESCRIPTION - CASE HISTORY #6

Filter assembly P/N 10270 was designed and manufactured by Capitol Westward for use in CLF_3 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: CLF_3 (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 33656-16)

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

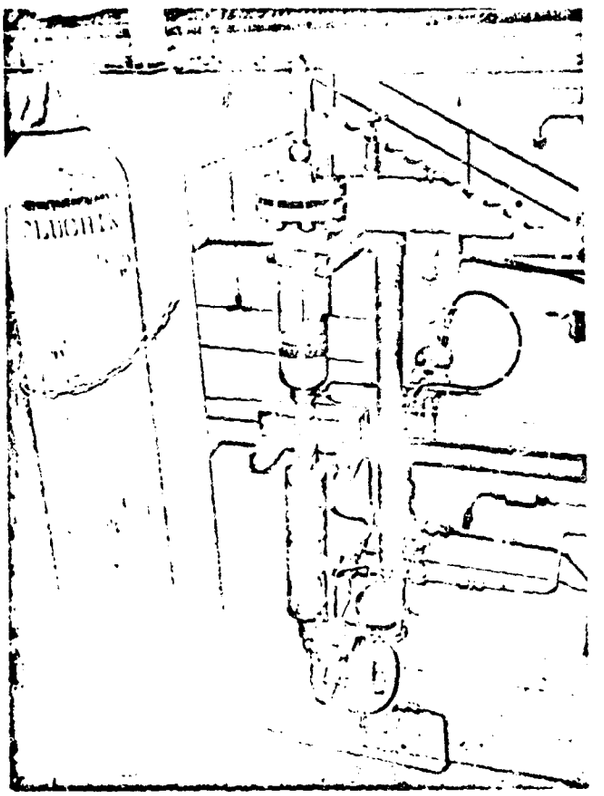

FIGURE 20
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DESCRIPTION - CASE HISTORIES 7, 8, 9 and 10

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 FORM CONTRACT NO. F04611-68-C0064

LONG TERM COMPATABILITY

PART NUMBER:	28-1-16510
MANUFACTURER:	Western Filter
USER:	TRW
LIQUID:	N_2O_4 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 FORM CONTRACT NO. F04611-68-C-0064

LONG TERM COMPATABILITY

PART NUMBER: 28-1-16510-10

MANUFACTURER: Western Filter Company

USER: TRW Systems

LIQUID: MMH - N_2H_4

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 FORM CONTRACT 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 FORM CONTRACT NO. F04611-68-C0064

LONG TERM COMPATABILITY

PART NUMBER:	28-1-16520-10
MANUFACTURER:	Western Filter Company
USER:	TRW
LIQUID:	MMH, N_2H_4
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 micron

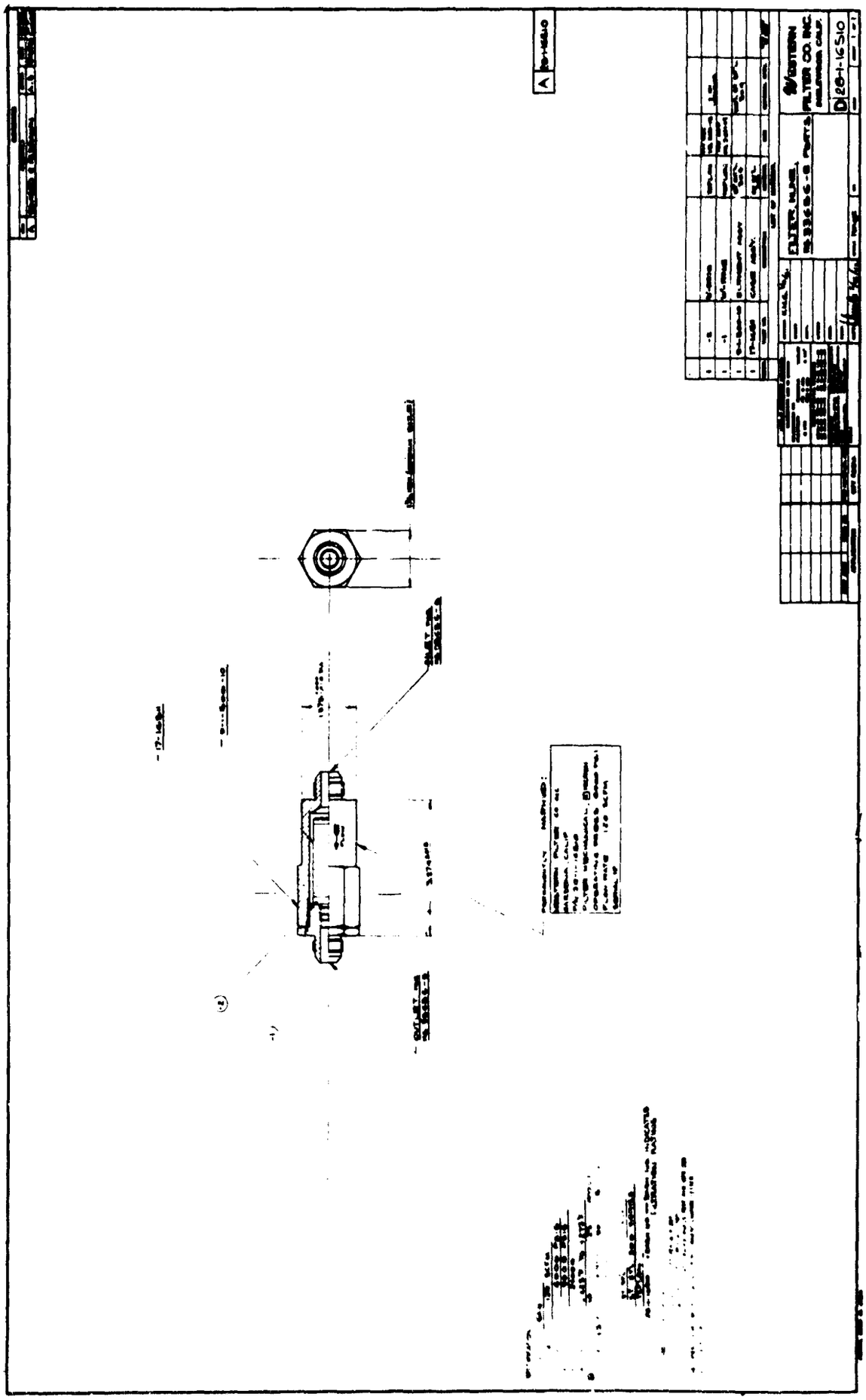

FIGURE 21
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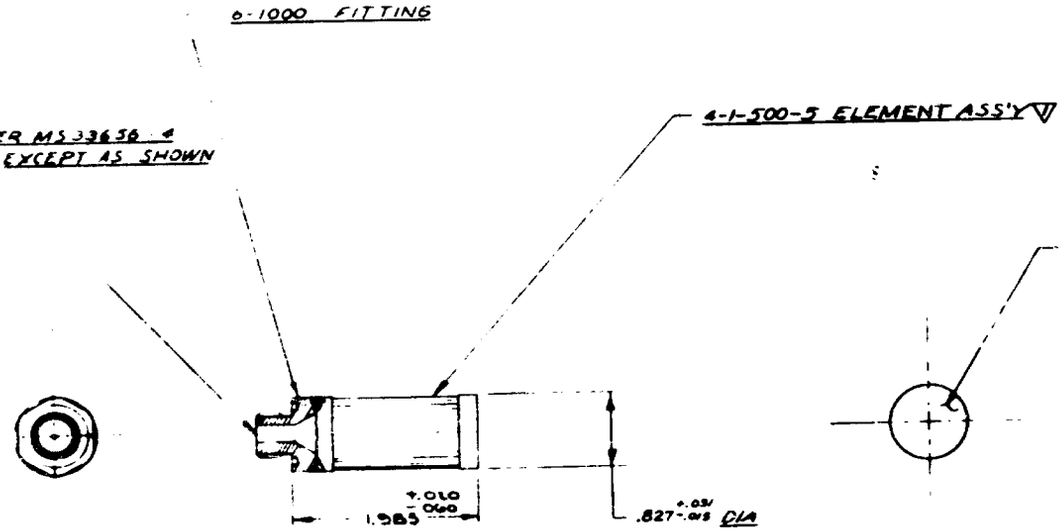
REVISIONS				
LTR	DESCRIPTION		DATE	APPROVED
A	2.24 WAS 2.37		2-12-63	
B	ADDED NOTE # 1	HNS	4-4-63	HNS
C	ADDED NOTE # 2			
D	1.983 +.010 -.060 WAS 2.000/1.970	PM	7-26-64	



D 9-1-500

FEDERAL SUPPLY CODE FOR MFGR 13520

FIGURE 22
PAGE 52

	1	6-1000	FITTING	SF. ST'L 304			
▽	1	4-1-500-5	ELEMENT ASS'Y	SF. ST'L 304			
▽	-5	PART NO.	DESCRIPTION	MATERIAL	SIZE	MATERIAL SPEC.	NO. REQ'D

LIST OF MATERIAL

18157	18157	1	1
55-1-16510	55-1-16510	1	1
18019	18019	1	1
28-1-16510	28-1-16510	1	1
26-1-16510	26-1-16510	1	1
NEXT ASSY APPLICATION	USED ON	NEXT ASSY FINAL ASSY QTY REQ'D.	

DESIGN STRESS ANALYSIS WF 195

OPTIONAL B.K. Rankin
ORIGIN Schmaltz
CHK'D
CHK'D
PROD
PROP
DATE 1-15-65.

ELEMENT ASS'Y ▽

SCALE FULL WT.

WESTERN FILTER CO. INC.
GARDENA, CALIF.

C 9-1-500 D

SIZE 13520 SHEET 1 OF 1

2 ELEMENT WELDED PER MIL-W-8611
▽ PART NO CALLOUT
9-1-500-5, 10, 25, 40, 100
LAST DIGIT INDICATES NOMINAL FILTRATION RATING

NOTES: UNLESS OTHERWISE SPECIFIED

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:	N_2O_4, 50/50, Hydrazine N_2H_4 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.)

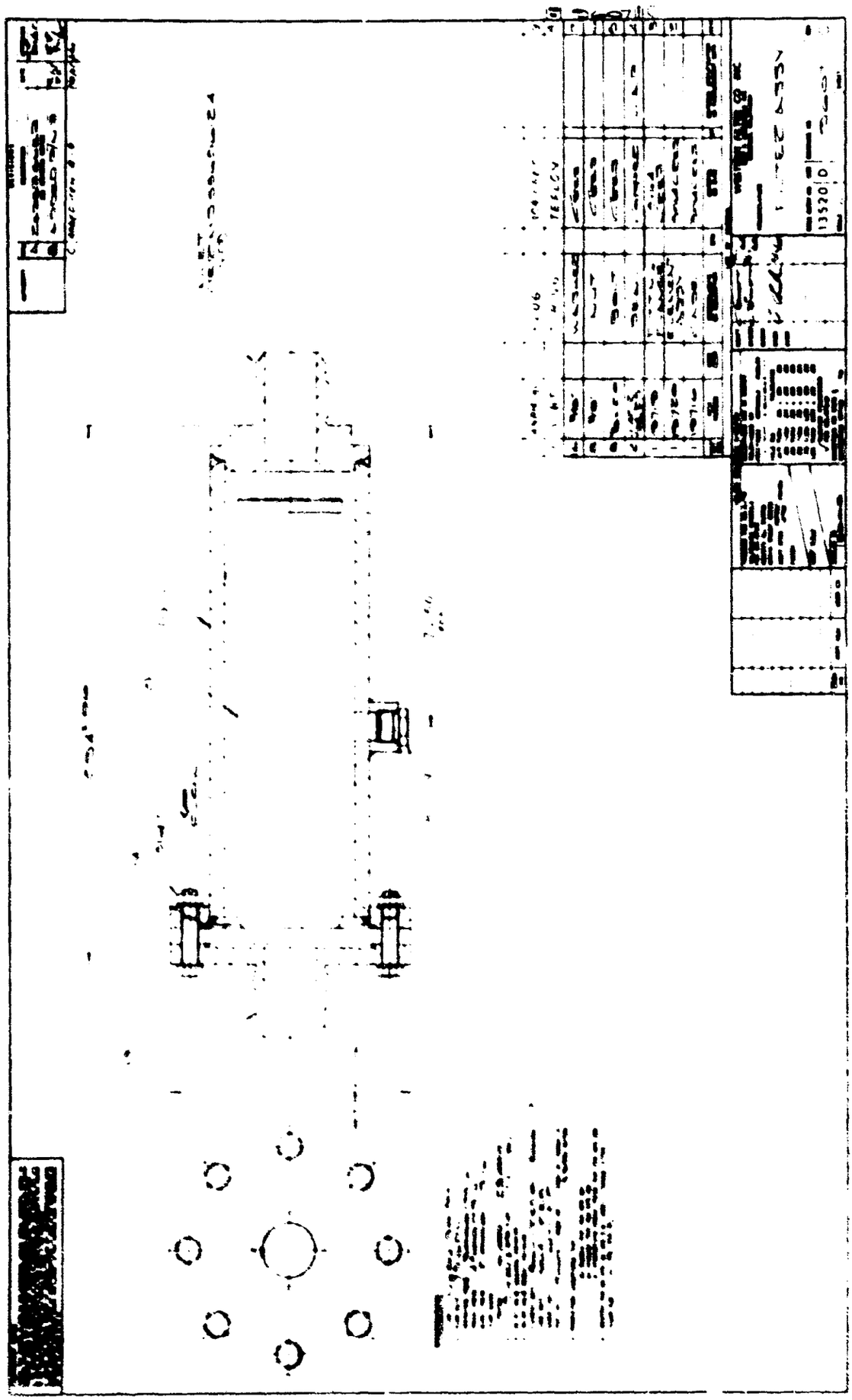
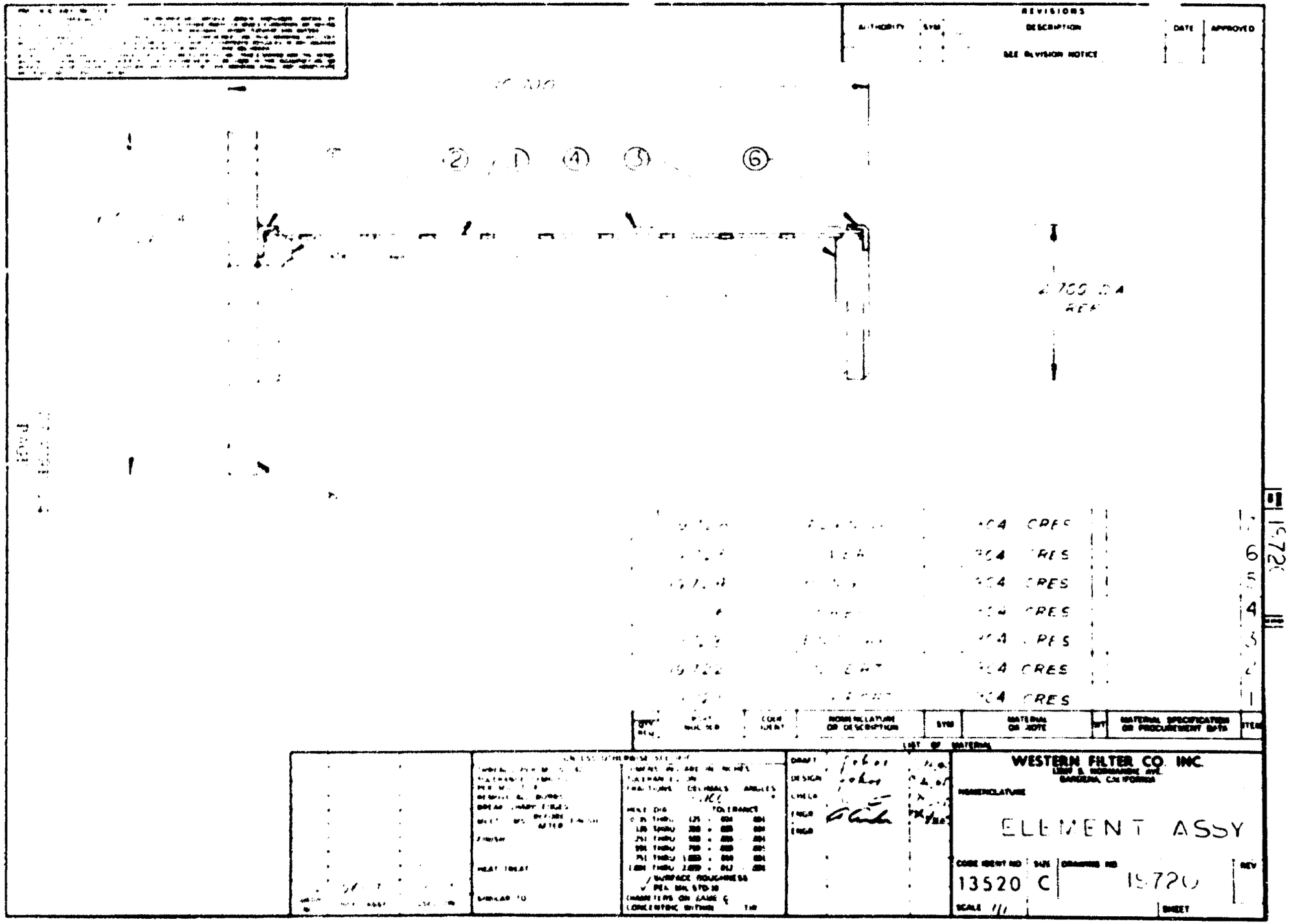


FIGURE 23
PAGE


REVISIONS
DESCRIPTION
DATE
APPROVED
SEE REVISION NOTICE
2
1
4
3
6
.700 DIA
REF
.004 CRES
.004 CRES
.004 CRES
.004 CRES
.004 CRES
.004 CRES
.004 CRES
QTY REQ
NOMENCLATURE OR DESCRIPTION
SYM
MATERIAL OR NOTE
MATERIAL SPECIFICATION OR PROCUREMENT DATA
ITEM
LIST OF MATERIAL
WESTERN FILTER CO. INC.
SANTA BARBARA, CALIFORNIA
NOMENCLATURE
ELEMENT ASSY
CODE IDENT NO
13520
SIZE
C
DRAWING NO
19720
REV
SCALE
SHEET

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.

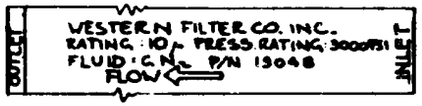
LONG TERM COMPATABILITY

PART NUMBER:	19048-10 Element 19138-10
MANUFACTURER:	Western Filter Company
USER:	TRW
LIQUID:	N_2O_4
ESTIMATE SERVICE TIME:	2 years
USE, DUTY CYCLE	50% (estimated)
CONDITION:	Good
SCREEN MATERIAL:	304
TEMPERATURE:	Ambient
SERVICE SPECIFICATION:	
HISTORY:	
REPLACEMENT COST:	
FLOW RATE:	
PRESSURE DROP:	
OPERATING PRESSURE:	
MICRON RATING:	
OTHER:	1" line size clean 10 times 3000 PSI

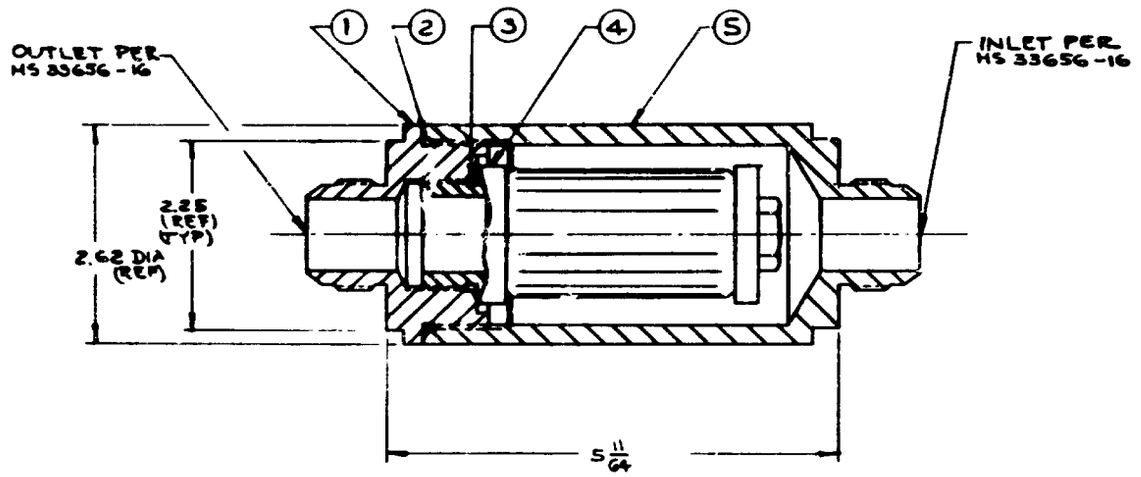
PROPRIETARY NOTICE

REVISIONS

AUTHORITY	ZONE	DESCRIPTION	DATE	APPROVED
		SEE HUMBER NOTICE		



IDENTIFY AS SHOWN



QTY REQ	PART NUMBER	CODE IDENT	NOMENCLATURE OR DESCRIPTION	SPEC	MATERIAL OR NOTE	MFR	MATERIAL SPECIFICATION OR MANUFACTURER'S DATA	ITEM
1	19149		FILTER HOUSING		CRES 304			5
1	19138-10		ELEMENT ASSY		CRES (REF)			4
1	NAS617-16		GASKET 'O' RING		BUNA N			3
1	NAS617-28		GASKET 'O' RING		BUNA N			2
1	19142		FITTING		CRES 304			1

LIST OF MATERIAL

DASH NO.	NEXT ASSY.	USED ON

UNLESS OTHERWISE SPECIFIED
THREADS PER MIL-S-7742
TOLERANCE SYMBOLS PER MIL-STD-8
REMOVE ALL BURRS
BREAK SHARP EDGES
MEET DIMS BEFORE AFTER FINISH
FINISH
HEAT TREAT
SIMILAR TO

DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ±.06 DECIMALS ±.03 ±.010 ANGLES ±
HOLE DIA TOLERANCE
.0135 THRU .125 + .004 — .000
.126 THRU .250 + .005 — .000
.251 THRU .500 + .005 — .000
.501 THRU .750 + .005 — .000
.751 THRU 1.000 + .007 — .000
1.001 THRU 2.000 + .012 — .000
✓ SURFACE ROUGHNESS PER MIL-STD-10
DIAMETERS ON SAME ℄ CONCENTRIC WITHIN TIR

DRAFT	A B	10-2-64
DESIGN	A B	12-2-64
CHECK		
ENGR		12-4-64
ENGR		

WESTERN FILTER CO. INC
SOUTH EL SEGUNDO AVE.
GARDENA, CALIFORNIA

NOMENCLATURE
FILTER ASSEMBLY INLINE, INCH TUBE 25μ ABSOLUTE.

CODE IDENT NO.	SIZE	DRAWING NO.	REV
13520	C	19048	

SCALE FULL SHEET 1

FIGURE 25
PAGE 59

PROPRIETARY NOTICE

REVISIONS			
AUTHORITY	SYM	DESCRIPTION	APPROVED
	A	ADDED GNT'S	
		SEE REVISION NOTICE	

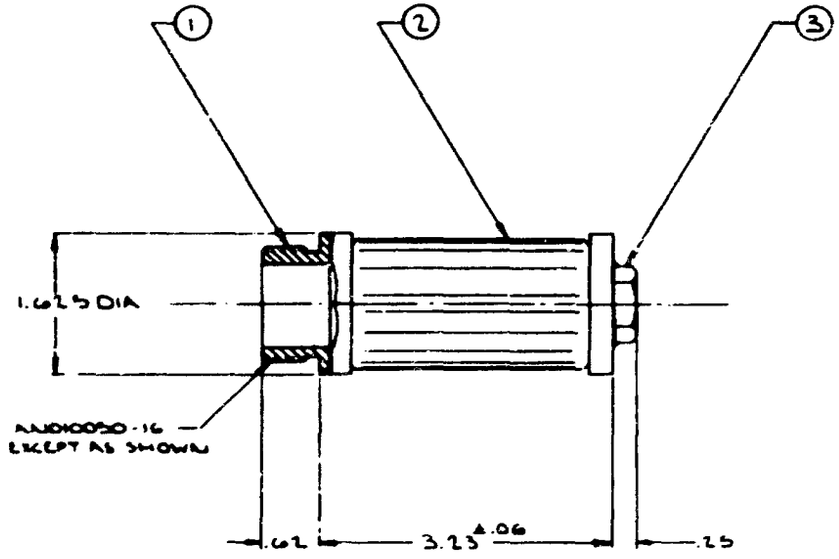


FIGURE 26
PAGE 60

NOTES

1. 19138
2. 5 15
3. MS 133
4. 6 ALLEN PER WFS 110 (FOR 19241 ASSY ONLY)

QTY REQ	PART NUMBER	CODE IDENT	NOMENCLATURE OR DESCRIPTION	SYM	MATERIAL OR NOTE	MFT	MATERIAL SPECIFICATION OR PROCUREMENT SOURCE	ITEM
1			TORQUING BLOCK		304 CRES			3
1	4-1-502		ELEMENT - BASIC		304 CRES			2
1	19139		ADAPTER		304 CRES			1

LIST OF MATERIAL

DASH NO.	NEXT ASSY.	USED ON
4	19241	19241
1	19002	19002

UNLESS OTHERWISE SPECIFIED
THREADS PER MIL-S-7742
TOLERANCE SYMBOLS PER MIL-STD-8
REMOVE ALL BURRS
BREAK SHARP EDGES
MEET DIMS BEFORE AFTER FINISH
FINISH PASSIVATE PER WFS 210
HEAT TREAT
SIMILAR TO

DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ±.06 DECIMALS ±.05 ANGLES ±0°30'

HOLE DIA	TOLERANCE
.0135 THRU .125	+ .004 — .000
.126 THRU .250	+ .005 — .001
.251 THRU .500	+ .005 — .001
.501 THRU .750	+ .005 — .001
.751 THRU 1.000	+ .010 — .001
1.001 THRU 2.000	+ .012 — .001

√ SURFACE ROUGHNESS PER MIL-STD-10
DIAMETERS ON SAME ℄ CONCENTRIC WITHIN .01 TIR

DRAFT		11-24-64
DESIGN		
CHECK		
ENGR		11-24-64
ENGR		

WESTERN FILTER CO. INC.
1307 S. NORMANDIE AVE.
GARDENA, CALIFORNIA

NOMENCLATURE
ELEMENT ASSY

CODE IDENT NO.	SIZE	DRAWING NO.	REV
13520	C	19138	A

SCALE 1/1 SHEET 1

19138 A

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.

LONG TERM COMPATABILITY

PART NUMBER:	Filter Assembly 10236-1 Element P/N 5484N
MANUFACTURER:	Capitol Westward
USER:	TRW Systems
LIQUID:	N_2O_4
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 obsolute). It is designed to operate at 3000 psi system pressure.

No assembly or detail drawings of this filter are available.

BASIC DATA FORM CONTRACT NO. F04611-68-C-0064

LONG 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 FORM CONTRACT 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

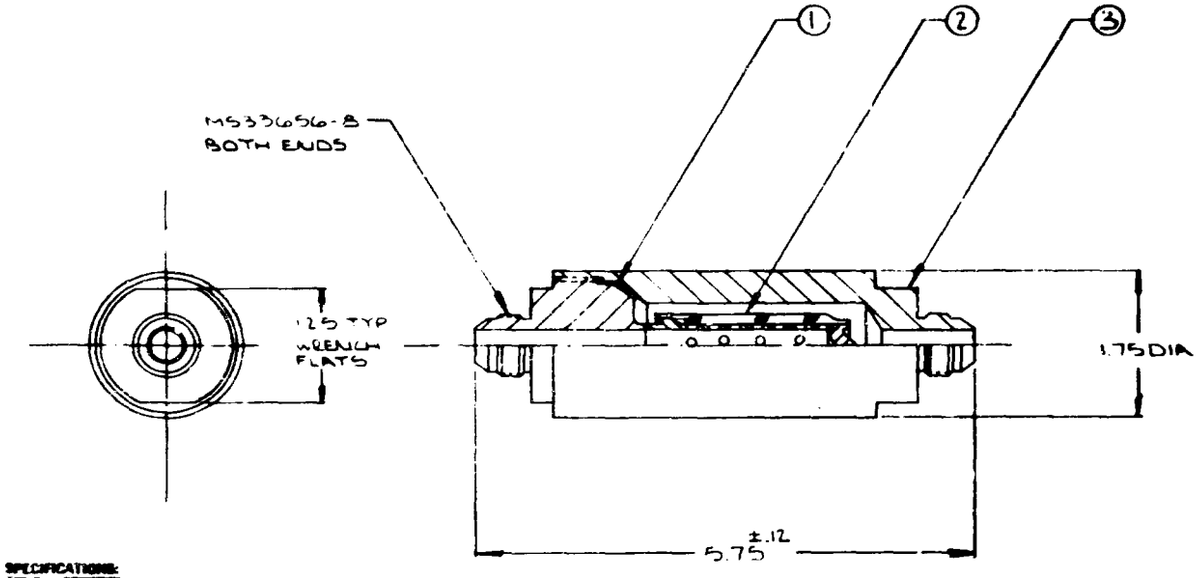
MICRON RATING: 10 micron (nominal

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, kthey 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.

PROPRIETARY NOTICE

REVISIONS				
AUTHORITY	ZONE	DESCRIPTION	DATE	APPROVED
		SEE REVISION RECORD		
	A	ADDED PIN TO ITEMS 1,2&3 IN	8/2/67	



SPECIFICATIONS:

1. FLUID — LIQUID FLUORINE OR COMPOUNDS
2. FLOW RATE — 1 #/SEC MAX
3. OPERATING PRESS — 1100 PSIG
4. PROOF PRESS — 1800 PSIG
5. BURST PRESS — 4800 PSIG
6. TEMP RANGE —
7. FILTRATION — SEE TABLE
8. ΔP — 10 PSI (MAX) @ RATED FLOW, TO °F. &
9. RELIEF VALVE CRACKING PRESSURE — —
10. RELIEF VALVE RESEAT PRESSURE — —
11. ELEMENT MATL — N-200 NICKEL AREA —
12. CASE MATL — N-200 NICKEL
13. GASKET MATL — COPPER
14. PART NO — 321060 + DASH NO. — DASH NO. INDICATES FILTRATION RATING
15. PRODUCTION ACCEPTANCE TEST —
    (b) BUBBLE TEST PER WFS 207
    (d) LEAKAGE TEST PER WFS 209
    (c) HYDROSTATIC PROOF PRESS TEST PER WFS 208
16. IDENTIFY PER MIL STD 130, WFC P/N CURRENT CHANGE LETTER
17. CLEAN PER WFS 185

FILTRATION	
NOMINAL	ABSOLUTE
2	10
5	15
10	25

QTY REQ	PART NUMBER	CODE IDENT	NOMENCLATURE OR DESCRIPTION	SYM	MATERIAL OR SIZE	MT	MATERIAL SPECIFICATION OR PROCUREMENT DATA	ITEM
1	321083		HOUSING		N-200 NICKEL			3
1	321082		ELEMENT ASSY		N-200 NICKEL			2
1	121088		SEAL		CAPPEL			1

LIST OF MATERIAL

DASH NO.	NEXT ASSY.	USED ON
—	FINAL	FINAL

UNLESS OTHERWISE SPECIFIED
THREADS PER MIL-S-7742
TOLERANCE SYMBOLS PER MIL-STD-8
REMOVE ALL BURRS
BREAK SHARP EDGES
MEET DIMS BEFORE FINISH / AFTER
FINISH
HEAT TREAT
SIMILAR TO
DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS DECIMALS ANGLES
HOLE DIA TOLERANCE
.0135 THRU .125 + .004 — .001
.126 THRU .250 + .005 — .001
.251 THRU .500 + .005 — .001
.501 THRU .750 + .005 — .001
.751 THRU 1.000 + .005 — .001
1.001 THRU 2.000 + .005 — .001
125 SURFACE ROUGHNESS PER MIL-STD-10
DIAMETERS ON SAME ℄ CONCENTRIC WITHIN .005 TIR

DRAFT		8-18-67
DESIGN		
CHECK		8-28-67
ENGR		8-28-67
ENGR		

WESTERN FILTER CO. INC.
1869 S. NORMANDIE AVE.
TORRANCE, CALIFORNIA

NOMENCLATURE: FILTER ASSY, INLINE, NICKEL

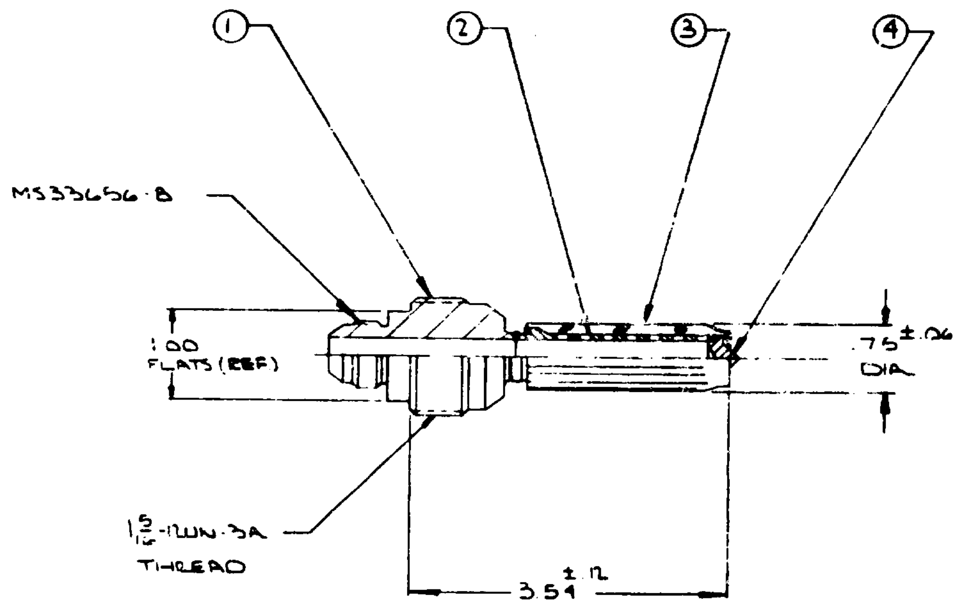
CODE IDENT NO.	SIZE	DRAWING NO.	REV
13520	C	321060	A

SCALE 1:1 SHEET 1 OF 1

321060 REV A

FIGURE 27
PAGE 67

REVISIONS				
AUTHORITY	SYM	DESCRIPTION	DATE	APPROVED
		SEE REVISION NOTICE		



NOTE

1. PART NO — 321082 + DASH NO ⟶ DASH NO INDICATES FILTRATION RATING
2. FILTRATION — AS ORDERED
3. PRODUCTION ACCEPTANCE TEST — BUBBLE TEST PER WFS 207
4. CLEAN PER WFS 195
5. IDENTIFY PER MIL-STD-130 WFC P/N, CURRENT CHANGE LETTER

QTY REQ	PART NUMBER	CODE IDENT	NOMENCLATURE OR DESCRIPTION	SYM	MATERIAL OR NOTE	WT	MATERIAL SPECIFICATION OR PROCUREMENT DATA	ITEM
1	221087		END CAP		N-200 NICKEL			4
1	221086		SCREEN ASSY		N-200 NICKEL			3
1	221085		SUPPORT		N-200 NICKEL			2
1	321084		FRONT FITTING		N-200 NICKEL			1

LIST OF MATERIAL

DASH NO.	NEXT ASSY	USED ON
–	321060	321060

UNLESS OTHERWISE SPECIFIED
THREADS PER MIL-S-7742
TOLERANCE SYMBOLS PER MIL-STD-8
REMOVE ALL BURRS
BREAK SHARP EDGES
MEET ... BEFORE / AFTER FINISH
FINISH
HEAT TREAT
SIMILAR TO

DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ± –; DECIMALS .XX ±.03, .XXX ±.010; ANGLES ±0°30'
HOLE DIA TOLERANCE
.0135 THRU .125 + .004 — .001
.126 THRU .250 + .005 — .001
.251 THRU .500 + .006 — .001
.501 THRU .750 + .008 — .001
.751 THRU 1.000 + .010 — .001
1.001 THRU 2.000 + .012 — .001
√ SURFACE ROUGHNESS PER MIL-STD-10
DIAMETERS ON SAME ℄ CONCENTRIC WITHIN .03 TIR

DRAFT	[signature]	8.2.67
DESIGN		
CHECK		
LAGR		
ENGR		

WESTERN FILTER CO. INC.
GARDENA, CALIFORNIA

NOMENCLATURE
ELEMENT ASSY

CODE IDENT NO.	SIZE	DRAWING NO	REV
13520	C	321082	

SCALE 1:1 SHEET 1 OF 1

321082

FIGURE 28

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 N_2H_2
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 HISTOKY #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 10/65SIB, #1EC65-11/10/65SIC

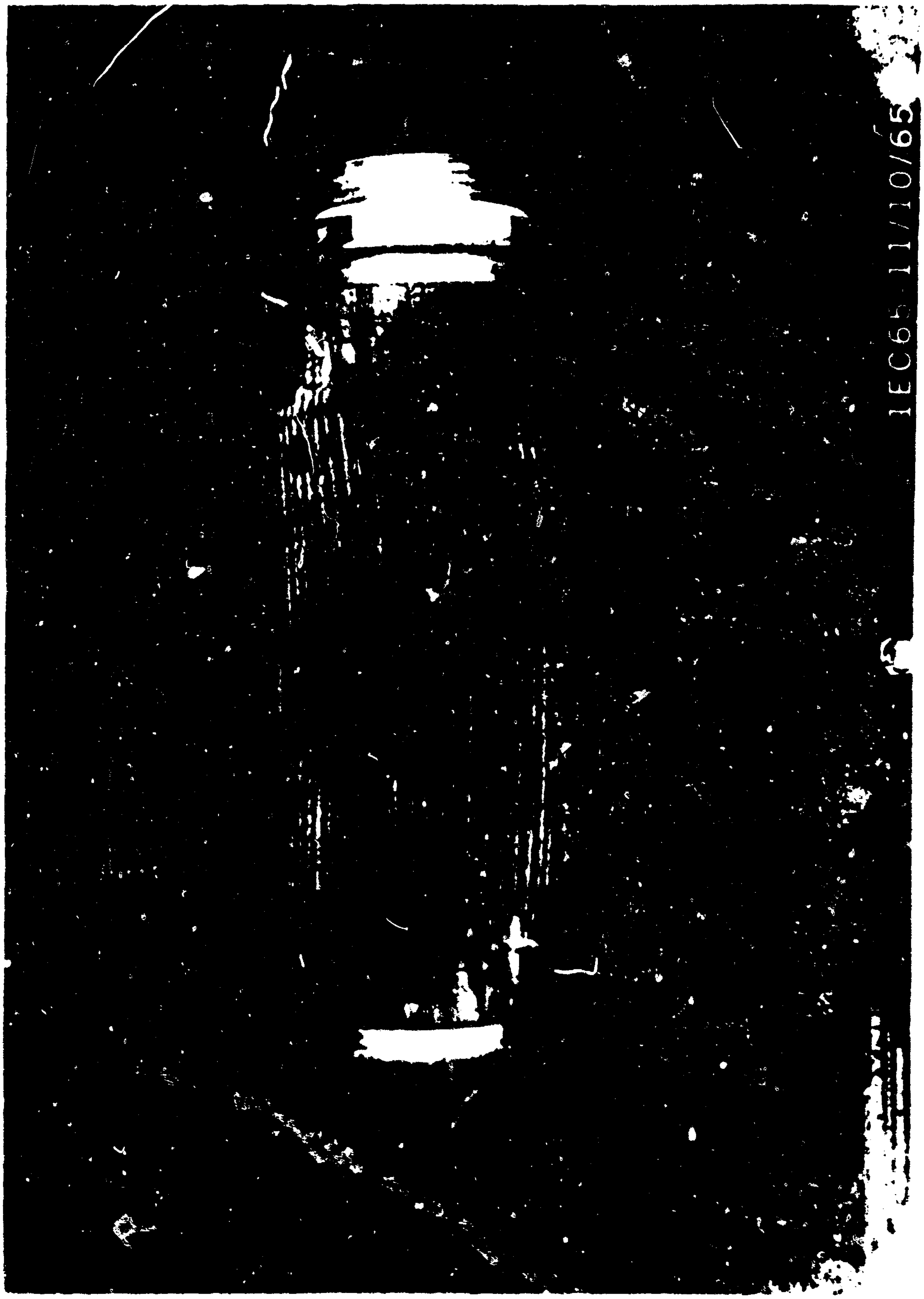


FIGURE 29
PAGE 76


0/65-SLB

11/10/65

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 micronic 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.

BASIC DATA FORM CONTRACT NO. F04611-68-C0064

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.

LONG TERM COMPATABILITY

PART NUMBER:	19470
MANUFACTURER:	Western Filter Company
USER:	Rocketdyne
LIQUID:	NTO, 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

NASA

FIGURE 32
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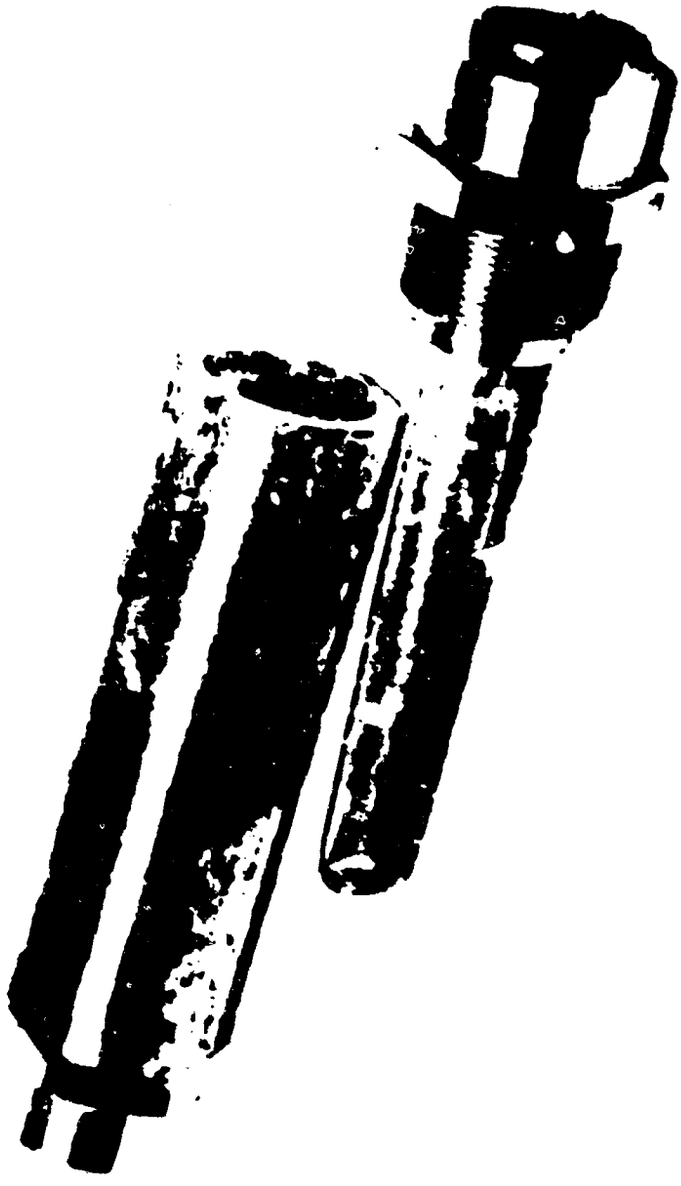

FIGURE 33
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FIGURE 34
PAGE 90

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 cooperative 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. F04611-68-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 fluorine-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)

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.

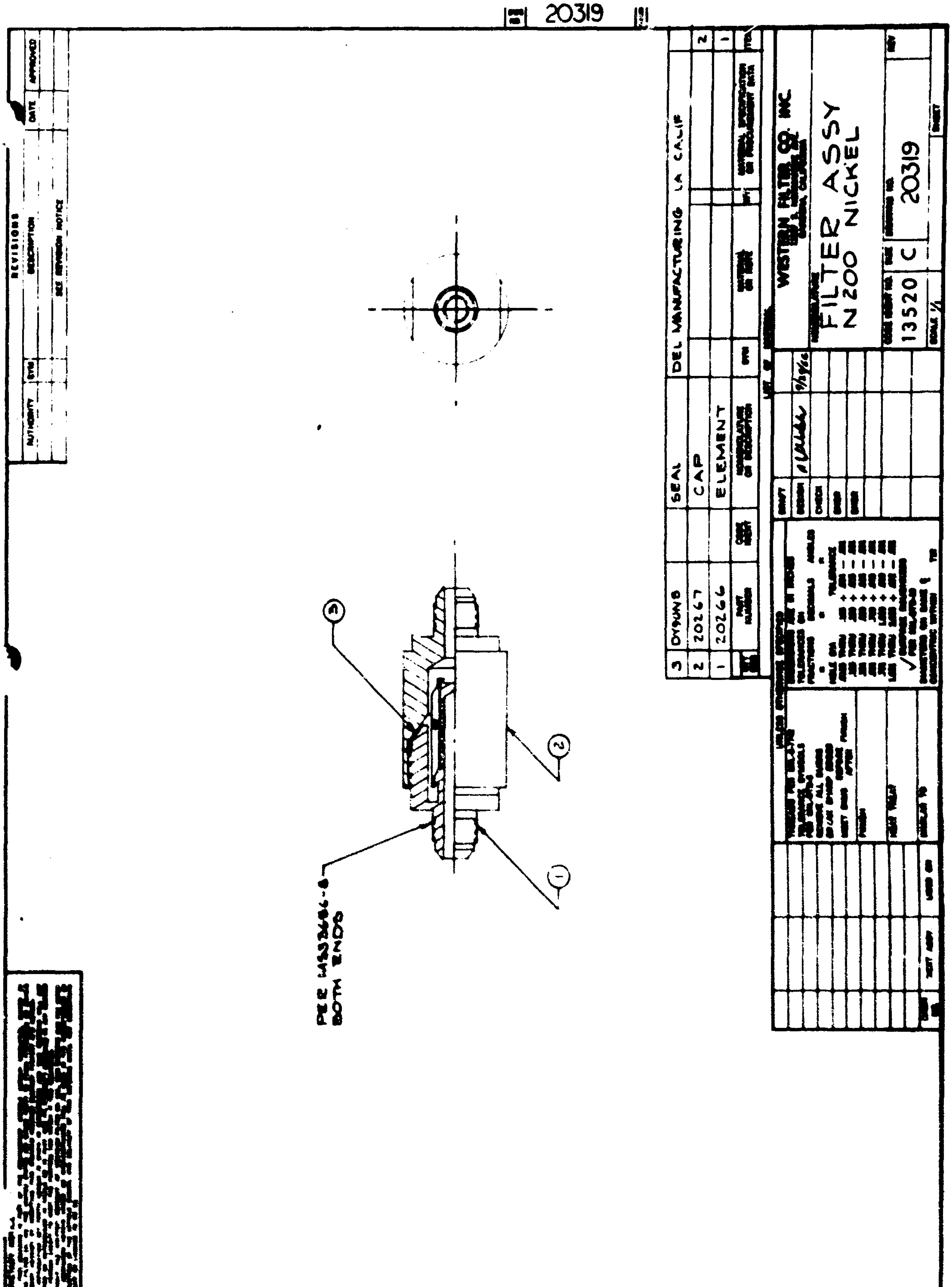
The test unit is assembled and then cooled in a Dewar to -320°F (see Figure 2).

LF is condensed from scrubbed GF_2 into the test unit. A slow GHe sweep on the downstream side 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.


20319
DEL MANUFACTURING LA CALIF
SEAL
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WESTERN FILTER CO. INC
FILTER ASSY
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REVISIONS

FIGURE 35

FIGURE 36
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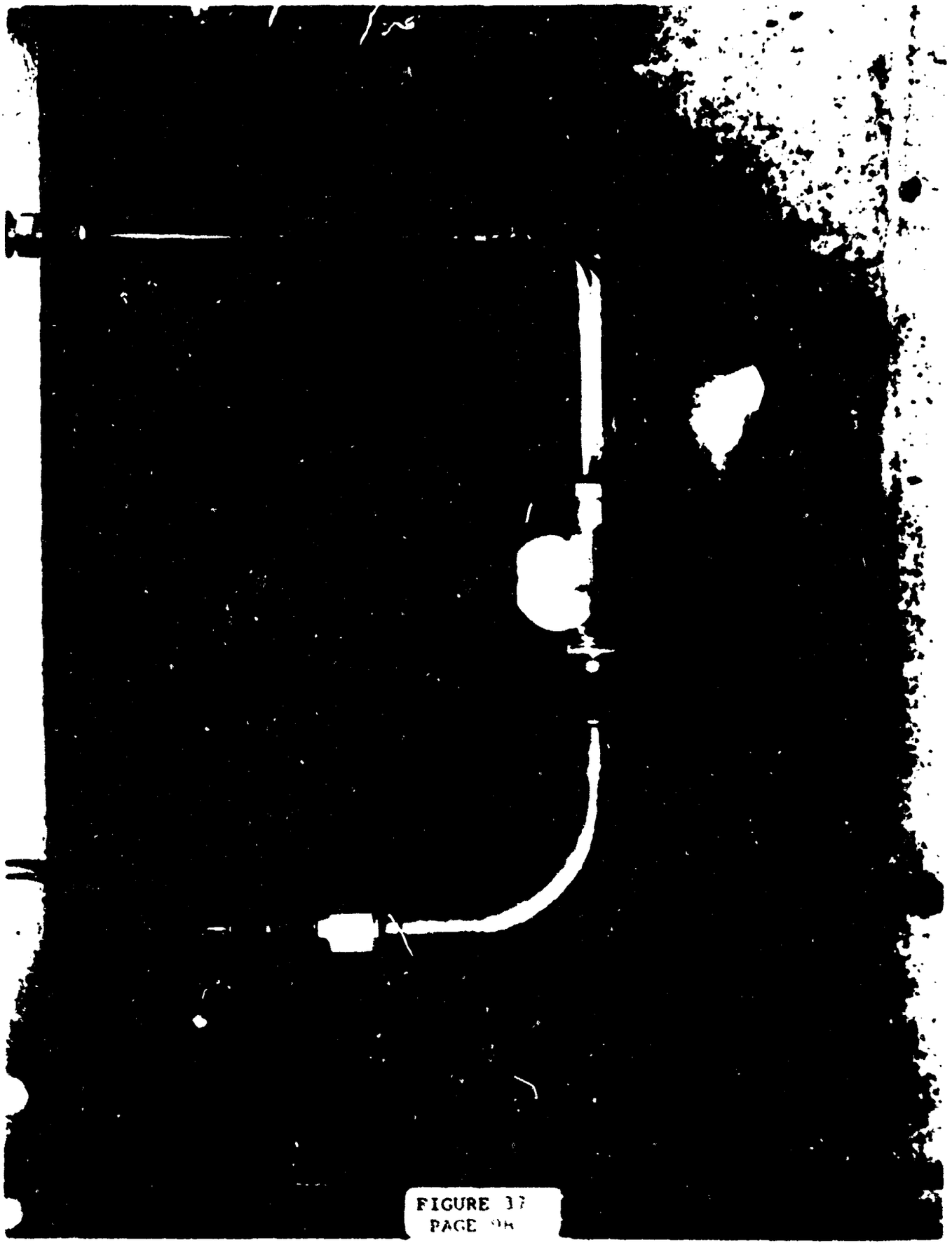

FIGURE 37
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Section 2.6 MARQUARDT CASE HISTORIES

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 COMPATABILITY

ITEM 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:	I/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 COMPATABILITY

ITEM 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 COMPATABILITY

ITEM 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.

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LONG TERM COMPATABILITY

ITEM 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.

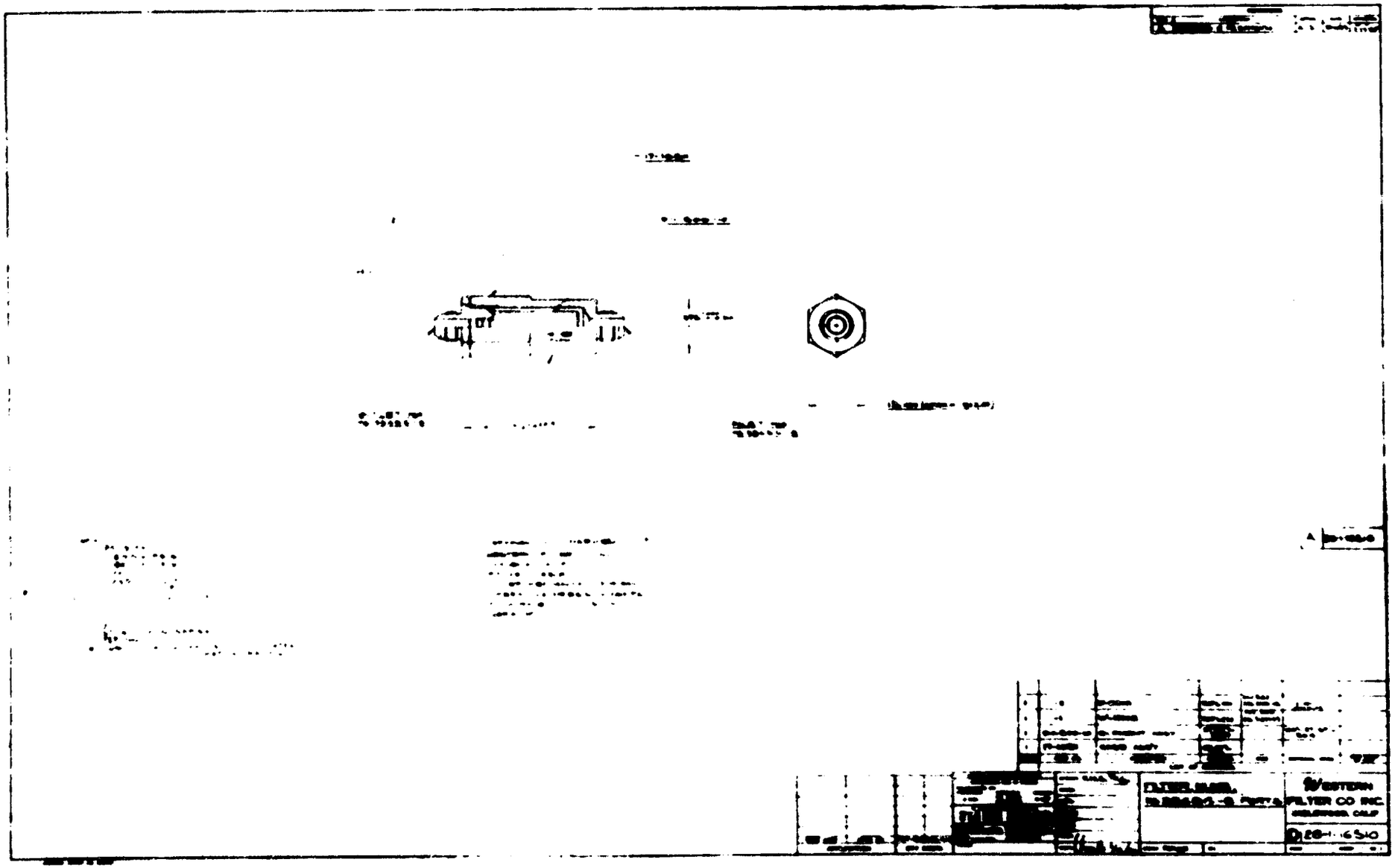

FIGURE
PAGE 1

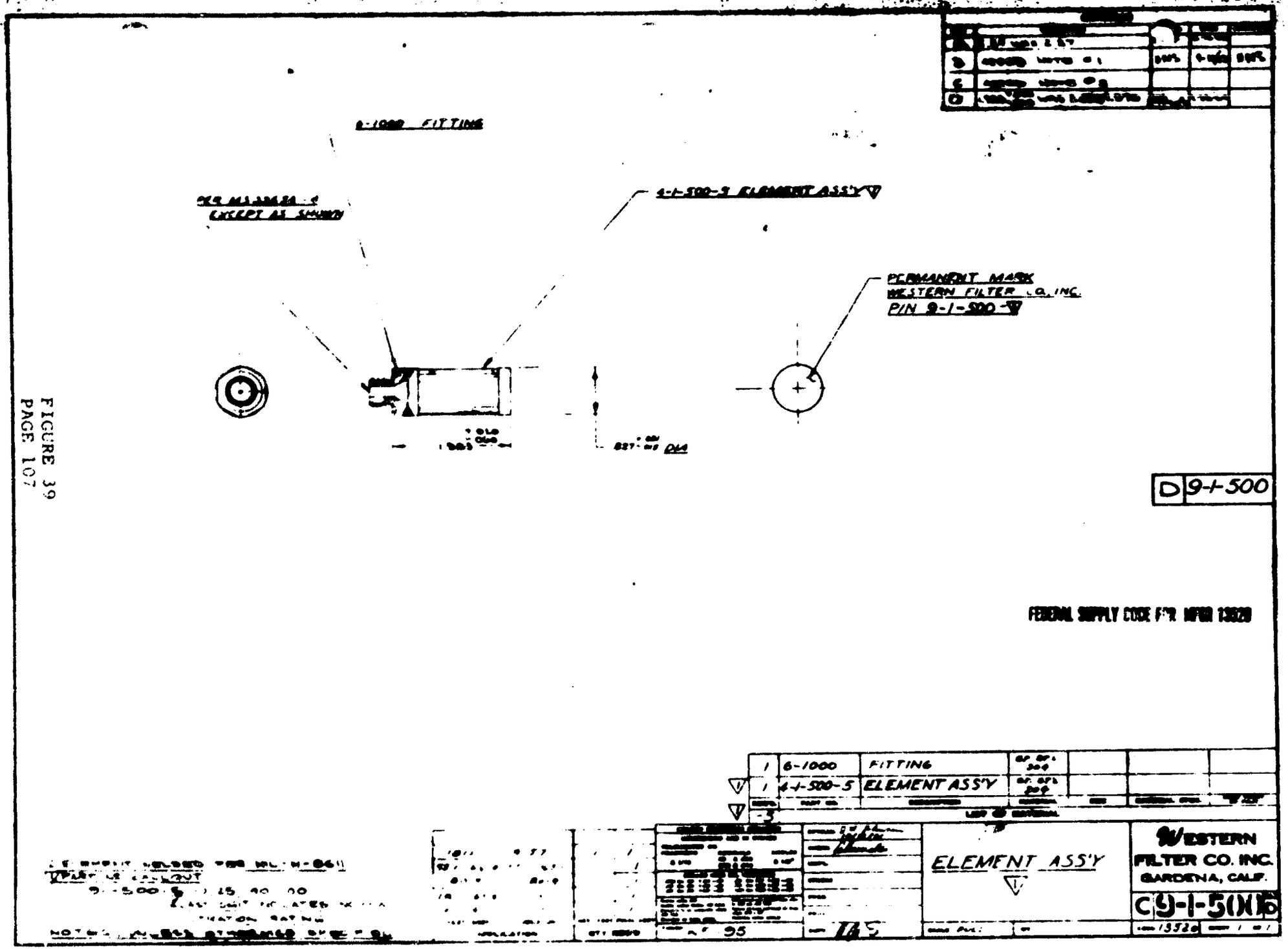

FIGURE 39
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FIGURE 4
PAGE 1 OF

FIGURE 41
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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

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)

Western Filter Company, Incorporated

2a. REPORT SECURITY CLASSIFICATION

UNCLASSIFIED

2b. GROUP

3. REPORT TITLE

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4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final Draft

5. AUTHOR(S) (Last name, first name, initial)

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	AFRPL-TR-68-141

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	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.

DD FORM 1 JAN 64 1473

UNCLASSIFIED

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Filter; Storability, Propellants, Surface Tension Devices, Ground Test, Test Stand, Compatibility, Corrosion						

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