

ADMIRALTY SURFACE WEAPONS ESTABLISHMENT

Specification AD/CV6180

Issue 1 Dated 18th September 1967.

To be read in conjunction with K1001,

K1005, K1006 and MIL-E-IE and

MIL-I-5422E. Paragraph numbers in
reference column refer to MIL-E-IE
unless otherwise statedSECURITYSpecificationValve

Unclassified

Unclassified

PROTOTYPE: M5316

DESCRIPTION: Travelling Wave signal amplifier for operation from 4.0 to 7.5 GHz

CATHODE: Indirectly heated

ENVELOPE: Packaged in a periodic permanent magnet focussing system

CONNECTIONS & DIMENSIONS: See Drawing Page 8

WEIGHT: 5.5 lb. max.

NOMINAL R.F. INPUT & OUTPUT IMPEDANCE: 50 ohms

MOUNTING POSITION: Any

COOLING: Free Convection

NATO STOCK NO. 5960-99-037-4622

Parameter	Ef	If	Ec1	Ic1	Ec2	Ic2	Ec3	Ic3	Ec4	Ic4
Unit:	V	A	Vdc	uAdc	Vdc	uAdc	Vdc	uAdc	Vdc	uAdc

ABSOLUTE MAXIMUMRATINGS (Note 1)

Maximum:	6.6	---	0	50	100	50	200	50	400	50
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Minimum:	6.0	---	-250	---	---	---	---	---	---	---
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TEST CONDITION:

(1)	0	0	0	0	0	0	0	0	0	0
-----	---	---	---	---	---	---	---	---	---	---

(2)	6.3	---	Note 2,3	---	Note 2,3	---	Note 2,3	---	Note 2,3	---
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Parameter:	Ec5	Ic5	Ew	Iw	Eb	Ib	Ik	Pi(rf)	Amb.Temp.	tk	If
Unit:	Vdc	uadc	Vdc	mAdc	Vdc	mAdc	mAdc	dBm	Deg.C	sec	(surge) A

ABSOLUTE MAXIMUMRATINGS (Note 1)

Maximum:	650	50	950	1.0	Ew+ 250	1.5	1.5	30	100	---	1.5
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Minimum:	---	---	550	---	Ew	---	---	---	-65	60	---
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TEST CONDITION:

(1)	0	0	0	0	0	0	0	as reqd	---	0	0
-----	---	---	---	---	---	---	---	---------	-----	---	---

(2)	Note 2,3	---	Note 2,3	---	Note 2,3,4	---	Note 33	as reqd	---	Note 33	---
			4,5.								

Requirements or tests:

General

Marking - Notes 2, 9 & K.1001, Section 4.

Dimensions - Per Outline Drawing

Preparation for Delivery - Note 31.

TEST	METHOD OR PARA.	REQUIREMENT OR TEST	CONDITIONS	SYMBOL	LIMITS		UNITS
					MIN.	MAX.	
		<u>QUALIFICATION INSPECTION</u> (Qualification Approval).					
1.	---	Humidity - Temperature	Test Condition (1) Note 11.	-	-	-	-
2.	---	Container Drop	Note 6, 16	-	-	-	-
3.	---	Shock	Test Condition (2) Note 16,17	-	-	-	-
		<u>QUALITY CONFORMANCE</u> <u>INSPECTION, Part 1 (100%)</u>	After 48 hours Holding Period				
4.	E-50.2	Post Holding Period Tests					
4.1	---	Grid Current	Test Condition (2)	Ic1	-10	+20	uAdc
				Ic2	-10	+20	uAdc
				Ic3	-10	+20	uAdc
				Ic4	-10	+20	uAdc
				Ic5	-10	+20	uAdc
4.2	---	Helix Current	Test Condition (2)	Iw	-10	100	uAdc
4.3	E-1301	Heater Current	Test Condition (1) Ef = 6.3	If	0.19	0.26	A
4.4	---	Cathode Current	Test Condition (2)	Ik	0.4	1.5	mA
4.5	---	Collector Current	Test Condition (2)	Ib	0.3	1.5	mA
4.6	---	Noise Figure	Test Condition (2) Note 10, 18, 20, 35	NF	Note 35	35	
4.7	---	Gain	Test Condition (2) Note 10, 18, 21. F=F1;F2;F3;F4.	Gss	35	45	dB
4.8	---	Frequency Gain Variation	Test Condition (2) Note 19,21	ΔGss	-	5	dB
4.9	---	Saturation Power Output	Test Condition (2) Note 10, 18, 22. F=F1;F2;F3;F4.		7	18	dBm
4.10	---	Power Gain	Test Condition (2) Note 10, 18, 23. F=F1;F2;F3;F4.	Gp	Note 24	-	-
4.11	---	Input Match	Test Condition (2) Note 26.	VSWR	-	2.5	ratio
4.12	---	Output Match	Test Condition (2) Note 26.	VSWR	-	2.5	ratio
4.13	---	Stability	Test Condition (2), No rf input Note 32		No oscillations		

TEST	METHOD OR PARA.	REQUIREMENT OR TEST	CONDITIONS	SYMBOL	LIMITS		UNITS
					MIN.	MAX.	
		<u>QUALITY CONFORMANCE INSPECTION, Part 3.</u>					
5	---	Magnetic Shielding	Test Condition (2), Note 7,8	-	-	-	-
6	---	Temperature	Test Condition (2) Note 10, 12, 13, 29. F=F1;F2;F3;F4.	-	-	-	-
7	---	Vibration	Test Condition (2) Note 7, 14, 15, 16.	-	-	-	-
8	---	Insertion Loss	Test Condition (1) Note 7, 25.	L	55	-	dB
9		Life Test	Test Condition (2) Note 10, 27, 28, 29, 30 F=F1;F2;F3;F4.	t	1000	-	hours
10		Life Test End Points	Test Condition (2) Note 10. F=F1;F2;F3;F4.	-		Note 30	-

NOTES

Note 1: The absolute maximum ratings define the upper limits of electrical inputs which may be applied to the tube without danger of permanent damage. (MIL-E-I, Para 6.5). The electrical input ratings necessary to provide the required tube performance are specified elsewhere.

Note 2: The tube operating voltages and currents shall be listed on a label affixed to the tube. The voltages shall fall within the following limits:

<u>Element</u>	<u>Minimum Voltage</u>	<u>Maximum Voltage</u>
Heater	6.24	6.36
Grid 1	-50	5
Grid 2	5	50
Grid 3	5	120
Grid 4	5	200
Grid 5	100	500 450
Helix	650	950
Collector	Ew+5	Ew+210

Ampl. 2

All voltages are measured with respect to cathode.

NOTES (Cont'd)

Note 3: In order to maintain the specified performance over the specified temperature range, the following power supply requirements must be met:

<u>Element</u>	<u>Installation Accuracy ($\pm\%$)</u>	<u>Stability ($\pm\%$) (Long term variation)</u>	<u>Ripple</u> (volts pk to pk) (Short term variation)
Heater	1.0	1.0	
Grid 1	0.15	1.0	0.020
Grid 2	-	1.0	0.020
Grid 3	0.15	1.0	0.020
Grid 4	0.15	1.0	0.050
Grid 5	0.15	1.0	0.050
Helix	0.15	0.25	0.050
Collector	0.15	5.0	10.0

(a) Installation accuracy is set on accuracy at 20°C.

(b) Stability includes power supply variations from all causes including temperature.

Note 4: Tube may be operated with any one of the following elements at capsule potential:

Cathode
Helix
Collector

Note 5: The symbols and abbreviations used are defined in MIL-E-1E, except as follows:

Iw	Helix Current
Ew	Helix Voltage
GHz	10^9 Hz
Gss	Small Signal Gain
Gp	Power Gain
L	Insertion Loss
dBm	dB relative to 1 milliwatt

Note 6: The tube shall be packed in its regular shipping container and the packaged tube subjected to the drop tests specified in K.1005. There shall be no mechanical damage following the drop tests.

Note 7: These tests shall be performed on one tube every 6 months when the tube is in continuous production or one tube per 100 tubes, whichever comes sooner. In the event of a failure, corrective action shall be taken by the manufacturer and the Approval Authority informed.

NOTES (Cont'd.)

- Note 8: The tube under test shall be mounted parallel with, and at a distance not greater than 3" between centres from another CV6180, on a steel plate which is 18" square by $\frac{1}{2}$ " thick. The tube under test shall operate within the limits specified for each test listed under Quality Conformance Inspection Part 1. (Tests 4.1 through 4.13)
- Note 9: A label shall be fixed to the body of each tube. The label shall be indelibly marked "Magnetised Materials".
- Note 10: The test frequencies F_n are defined as follows:

<u>Designation</u>	<u>Frequency (GHz)</u>
F1	4.0
F2	5.0
F3	6.0
F4	7.5

- Note 11: Follow procedure of MIL-T-5422E.

- Note 12: The results of all performance measurements shall be recorded. These measurements shall be of the Grid and Helix currents, Gain, Saturation Power Output and Noise Figure as specified in Quality Conformance Part 1. The Temperature test shall be performed as follows:

Affix a temperature indicating device to the capsule outside diameter at a point approximately bisecting the tube length,

<u>Step</u>	<u>Condition</u>	<u>Time at Indicated Capsule Temperature Prior to measurements</u>	<u>Measurements</u>
1	Room ambient temp. Normal test rig outside chamber	-	Required Record ambient temp.
2	Room temp. as in Step 1 but with tube in chamber	-	Required
3	Adjust chamber to -10°C	40 minutes	Required
4	" " " -62°C	1 Hour	Not required
5	" " " 45°C	2 Hours 10 Min.	Required
6	" " " 70°C	30 Minutes	Required
7	" " " 90°C	25 Minutes	Required
8	Room ambient temp. Normal test rig outside chamber	1 Hour 25 Min.	Required Record ambient temp.

- Note 13: Where measured, the performance at the operating temperatures shall be compared with the performance at Step 2 (Note 12) and the differences shall not exceed the following limits:

<u>Performance</u>	<u>Limits</u>
Gain	± 3 dB
Saturation Power Output	± 1.5 dB
Noise Figure	± 2 dB

The grid and helix currents shall not exceed the following limits:

Grid Currents	As specified in test 4.1.
Max. Helix Current	150 uA d.c. for steps 3 and 5 in Note 12 350 uA d.c. for steps 6 and 7 in Note 12

There shall be no change greater than Measurement Error (Note 34) in performance between Steps 1 and 8 (Note 12). In the event of a failure the Approval Authority shall be informed immediately.

NOTES (Cont'd.)

- Note 14: Measure gain using a swept frequency technique. Gain variation due to resonances during the test shall be less than 0.5 dB at any frequency between 4.0 and 7.5 GHz.
- Note 15: The tube shall be vibrated in three mutually perpendicular directions successively, one of which shall be the major axis.
- (a) Resonance search: 5 to 55 Hz at ± 0.010 " amplitude, 1 Hz steps, 15 secs each. Record resonant frequencies.
 - (b) 5 to 15 Hz at ± 0.030 " amplitude, 1 Hz steps; 2 minutes/step
16 to 25 Hz at ± 0.020 " amplitude, 1 Hz steps, 2 minutes/step
26 to 55 Hz at ± 0.010 " amplitude, 1 Hz steps, 2 minutes/step
Record resonant frequencies.
 - (c) 2 hours at resonances.
- Note 16: Before and after this test, perform Quality Conformance Inspection tests 4.6, 4.7 and 4.9. There shall be no change greater than the limits of Measurement Error (Note 34).
- Note 17: Following the procedure of MIL-T-5422E subject the operating tube, with no rf input and at the prevailing room temperature, to 18 impact shocks of 30G and a time duration of 11 ± 1 ms. Three impact shocks shall be applied in each direction to the tube in each of three mutually perpendicular axes.
- Note 18: At the discretion of the manufacturer, a swept frequency signal source may be employed and the performance recorded continuously over the frequency band.
- Note 19: Frequency Gain Variation shall be measured using a swept frequency source over the operating band.
- Note 20: Noise mounts of A.I.L. manufacture having part nos. 07049, 07050 shall be assumed to have a relative excess noise temperature of 15.3 dB.
- Note 21: Gain tests shall be performed with input power adjusted to give an output power level of 1 milliwatt.
- Note 22: The Saturation Power Output test shall be performed as follows:
At each frequency, increase the power input until the first power output peak is reached, measure the power output at this value of power input.
- Note 23: Power Gain is defined as the gain measured with the input power adjusted to give the power output obtained using the setting procedure specified in Note 22.
- Note 24: Power Gain shall be not less than the value of $G_{ss} - 8$ dB.
- Note 25: The Insertion Loss shall be measured across the frequency band using a swept frequency technique.
- Note 26: The VSWR at the relevant connector shall be measured across the frequency band using a swept frequency technique, the other connector being terminated in a matched load.
- Note 27: The tube selected for this test shall have passed the acceptance tests (Quality Conformance Inspection, Part 1), or have the approval of the Inspecting Officer.
- Note 28: Before the life tests and at 50, 100, 200, 500 and 1000 hours, the electrode currents, the gain, saturated power output and noise figure shall be measured.

NOTES (Cont'd)

Note 29: This test shall be one tube per lot where lot size shall consist of 25 tubes or 1 month's production, whichever is the greater.

Note 30: The End of Life is defined as the time at which any of the following changes occur:-

Helix current exceeds the specified limits.
Grid current exceeds the specified limits.
Gain changes by more than 2 dB.
Sat Power Output changes by more than 2 dB.
Noise Figure changes by more than 1 dB.

In the event of a failure the Approval Authority shall be informed.

Note 31: Preservation, packaging and packing. Unless otherwise specified in the contract or order, preservation, packaging and packing shall be according to J.S. Specification K1005.

Note 32: With the tube input and output separately terminated in a short, the phase of the mismatch shall be varied by 360 electrical degrees and helix voltage swept plus and minus 2 per cent from its optimum value at a 50 to 400 cycle rate. The detected tube output shall be viewed as the vertical deflection on an oscilloscope and the helix voltage as the horizontal deflection. The sensitivity of the test circuit shall be that necessary to indicate the tube noise output. The onset of oscillation is observed as a discontinuity in the oscilloscope trace.

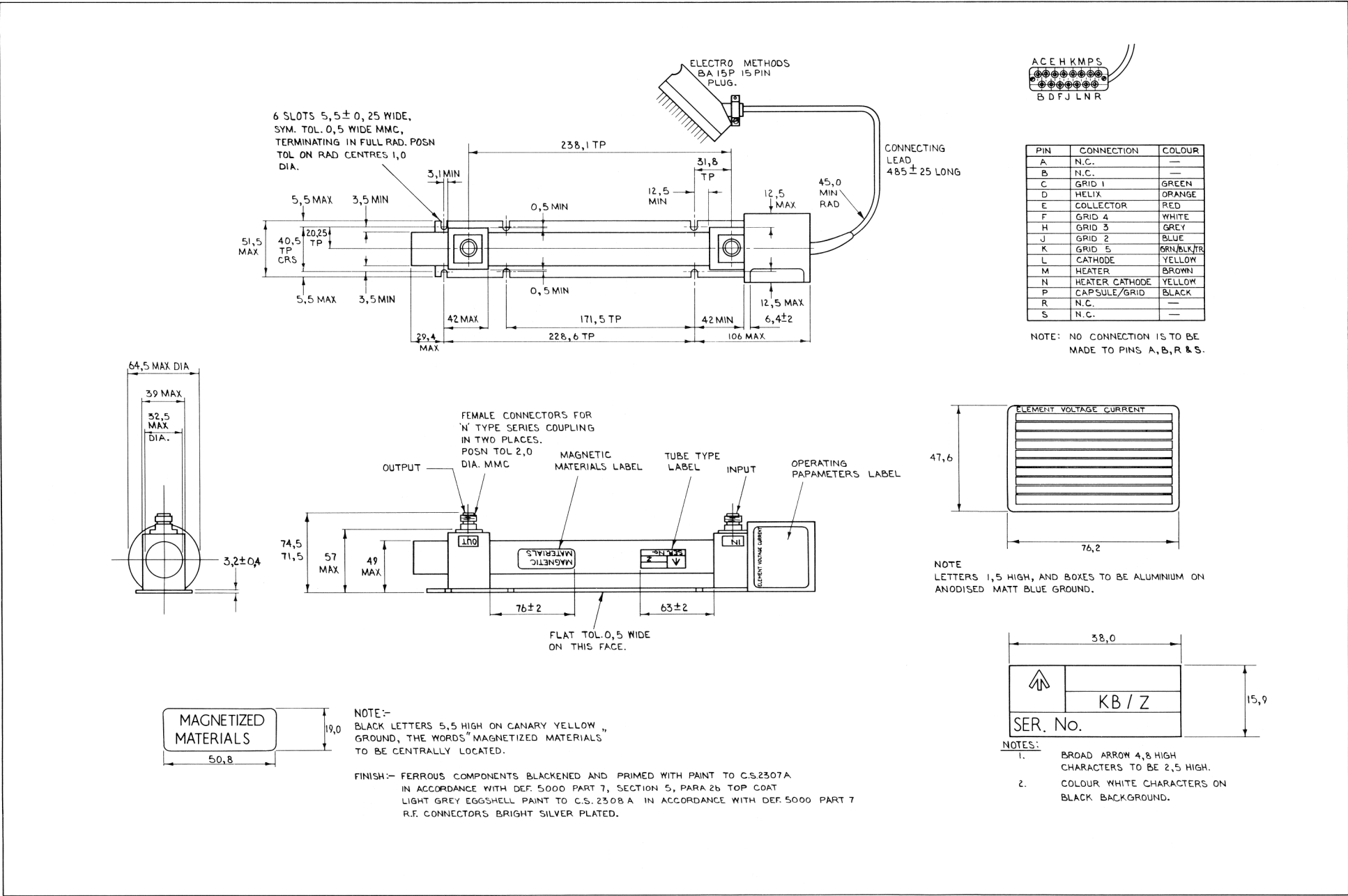
Note 33: Installation and alignment shall be as follows:-

- (a) Connect power supply and rf lines to the TWT
- (b) Apply rated heater voltage for a period of two minutes. The full rated heater voltage may be applied instantaneously.
- (c) Set grid 2 to zero volts, and set all other elements to voltages shown on the tube label.
- (d) Turn up the voltage on grid 2 until the collector current reaches the value shown on the tube label. Grid 2 voltage shall then be approximately that shown on the label. Collector current shall be set to an accuracy of 1%.
- (e) After initial installation and setting of voltages, subsequent turn-on procedure may be as follows:-
 1. Same as (b).
 2. All other voltages may then be immediately turned on to the preset values with the proviso that the grid 2 voltage is not achieved before the helix voltage.

Note 34: Measurement Error shall be defined as:-

Gain ± 1 dB
Sat. Power C/P ± 1 dB
Noise ± 0.5 dB

Note 35: The Noise Figure may fluctuate between maxima of 11 dB and 11.5 dB throughout the operating frequency range. The minimum total bandwidth over which the N.F. shall not exceed 11 dB is 3000 MHz; the maximum total bandwidth over which the N.F. may exceed 11 dB but not exceed 11.5 dB is 250 MHz.



OUTLINE DRAWING OF TUBE

DIMENSIONS IN mm
CV 6180/1/8

ELECTRONIC VALVE SPECIFICATION
SPECIFICATION AD/CV6180 DATED 18th SEPTEMBER, 1967

AMENDMENT No. 1

Page 2

Tests 4.6 Noise Figure and 4.7 Gain

Delete existing tests and substitute the following:-

TEST	METHOD OR PARA.	REQUIREMENT OR TEST	CONDITIONS	SYMBOL	LIMITS		UNITS
					MIN.	MAX.	
4.6	-	Noise Figure	Test Condition (2) Note 10, 18, 20	NF	See Note 35		
4.7	-	Gain	Test Condition (2) Note 10, 18, 21 F = F1; F2; F3; F4	Gss	35	45	dB

*JAGS
28/6/68*

March, 1968

TVC for ASWE

ELECTRONIC VALVE SPECIFICATION
SPECIFICATION AD/CV6180 ISSUE 1
DATED 18TH SEPTEMBER 1967

AMENDMENT 2

Page 2 Test 4.7 - Gain

Limits column:- amend the maximum value to 42 dB.

Page 3 Note 2

Amend the Grid5 maximum voltage to 450 Volts.

August, 1968.

TVC for ASWE

✓MS
20/8/68

ELECTRONIC VALVE SPECIFICATION

SPECIFICATION AD/CV 6180

ISSUE NO 1 DATED 18 SEPTEMBER 1967

AMENDMENT NO 4

OUTLINE DRAWING OF TUBE

FINISH - FIRST SENTENCE, AFTER "..... Section 5, Paragraph 2b".

ADD - , or commercial equivalent.

FINISH - SECOND SENTENCE, AFTER "..... DEF 5000, PART 7".

ADD - , or commercial equivalent.

SLR 23 FOR PSV2/P14481/76

October 1976