

# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-55

SHEET 1  
6-19-57

REV. 8  
PTC

## MOLYBDENUM STRIP

V-127(3)  
V-143  
V-146  
V-174  
V-187  
V-204  
V-240

1.0 GENERAL

- 1.1 This specification covers molybdenum strip manufactured by the sinter process for use as flat stampings, rolled cylinders, or furnace elements.  
1.2 Material purchased to this spec. must be slit in the direction of final rolling.

2.0 CHEMICAL COMPOSITION

- 2.1 The material shall be of high purity and shall contain molybdenum content of 99.8 per cent minimum.

3.0 DIMENSIONS

- 3.1 The material shall be uniform in width and thickness throughout its length.  
3.2 The material shall conform to the following tolerances:

3.2.1 Thickness Tolerances:

PLUS & MINUS, INCHES			
THICKNESS	WIDTHS UP TO 6"	WIDTHS 6 to 11	WIDTHS 11 to 16
.005	.0005	--	--
.006	.0005	--	--
.007	.0006	.0007	.0008
.008	.0008	.0009	.001
.009	.0008	.0009	.001
.010	.0008	.0009	.001
Over .010-.015 incl.	.0008	.0009	.001
Over .015-.020 incl.	.001	.0012	.0015
Over .020-.030 incl.	.0015	.0025	.003
Over .030-.070 incl.	.003	.0035	.004
Over .070	5%	6%	7%

Thickness tolerances are based on measurements taken 3/8 inch in from edge of rolled sheet 1 inch or more wide, and at any place on the sheet when less than 1 inch wide.

3.2.2 Width Tolerances:

\*POC57-6376

\* INDICATES REVISION



# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-55

SHEET 2  
5-1-57

REV 4  
PTC

## MOLYBDENUM STRIP

V-127(3)  
V-143  
V-146  
V-174  
V-187  
V-204  
V-240

PLUS & MINUS, INCHES					
THICKNESS	WIDTHS UP TO 2"	WIDTHS 2 to 4	WIDTHS 4 to 7	WIDTHS 7 to 11	WIDTHS 11 to 16
.005	.007	.010	.012	.015	.020
.006	.007	.010	.012	.015	.020
.007	.007	.010	.012	.015	.020
.008	.007	.010	.012	.015	.020
.009	.007	.010	.012	.015	.020
.010	.009	.012	.015	.020	.025
Over .010-.015 incl.	.009	.012	.015	.020	.025
Over .015-.020 incl.	.010	.012	.015	.020	.025
Over .020-.030 incl.	.015	.018	.020	.025	.030
Over .030-.070 incl.	.032	.035	.040	.050	.060
Over .070	.040	.050	.060	.070	.080

3.2.3 The length tolerance for cut pieces shall be plus or minus 1/64 inch. For strip furnished in multiples of the part length, the tolerance on the total length of the strip shall be plus 1/32 inch, minus 0 for multiples of 4 and under and plus 1/8 minus 0 for multiples of more than four. (See Item 6.1).

### 4.0 PHYSICAL PROPERTIES

4.1 Each strip shall be marked in the direction of final rolling using Magic Marker, Speedry Products, Inc., and the colors assigned to the particular vendor of the material. (Color assignments can be obtained from the Purchasing Dept.)

4.1.1 Bend Test: Strip and sheet shall take a bend of 180 degrees around a radius equal to the thickness of the material without fracture of the outside of the bent portion. It shall withstand this bend both parallel and 45 degrees to the sides. At a 45 degree angle to the edge the material shall withstand a bend of 90 degrees over a radius to its thickness and a return bend to approximate straightness without sharp fracture.

### 5.0 SURFACE CONDITION

5.1 The material shall have a bright clean surface with a gray metallic lustre.  
5.2 Each length of material shall have a uniform finish, shall be commercially flat and free from cracks, seams, slivers, burrs, and laminations.

\*POC57-6240

\* INDICATES REVISION



# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-55

SHEET 3  
12-26-56

REV. 3  
PTC

## MOLYBDENUM STRIP

V-127(3)  
V-143  
V-146  
V-174  
V-187  
V-204  
V-240

### 6.0 FORM OF UNIT

- 6.1 The length of material required to make the radio tube part shall be given on the Purchase Order and the material shall be supplied in multiples of the length required for the part.
- 6.2 Flat strip and sheet shall have a minimum length of 10 inches.
- 6.3 Coiled Stock.
  - 6.3.1 When supplied in coils, the maximum weight of material per coil shall be 10 pounds and the minimum weight 5 pounds. (For vacuum furnace heating element use, no piece shall be less than 10 feet.)
  - 6.3.2 Coils shall have a minimum inside diameter of 10 inches.
  - 6.3.3 No coil shall contain more than one continuous length of material.
  - 6.3.4 Coils shall be tied at least 4 places and bundles in at least 2 places with cord. Metallic binders are not to be used.

### 7.0 IDENTIFICATION

- 7.1 Each coil or package of material shall be marked with the following information:
  - 7.1.1 Name of material.
  - 7.1.2 Lot and type number.
  - 7.1.3 Physical dimensions.
  - 7.1.4 Name of vendor.
- 7.2 Each shipping unit or packing list contained in the unit shall supply the following information.
  - 7.2.1 Purchase Order Number
  - 7.2.2 Raytheon Manufacturing Company's Purchase Specification Number
  - 7.2.3 Date of packaging.
  - 7.2.4 Weights, gross and tare.

CORRECTION

\* INDICATES REVISION





# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R 5-55

SHEET 4L  
12-26-56

REV. 2  
PTC

## MOLYBDENUM STRIP

V-127(3)  
V-143  
V-146  
V-174  
V-187  
V-204  
V-240

### 8.0 PACKING

- 8.1 Individual coils shall be wrapped in clean paper and packed in wooden boxes with adequate protection against damage to coils.
- 8.2 Bundles of flat strip or sheet stock shall be wrapped in paper and shall have maximum weight of 15 pounds per bundle. The bundles of strip or sheet shall be packed in wooden boxes with adequate protection against damage or contamination during shipment.
- 8.3 No shipping unit shall exceed 40 pounds.

\* All technical **inquiries** regarding this specification to be addressed to Raytheon Mfg. Co. Power Tube Division, Attention: Engineering Purchasing Liason Agent, c/o Purchasing Dept. Foundry Ave, Waltham 54, Mass.

\* Denotes Revisions

This Specification was originally derived from the following equivalents:  
Power Tube Division M.P. 10048 Receiving Tube Division M.P. 1287.

CORRECTION

\* INDICATES REVISION





# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R 5-27

SHEET 1  
7-22-46

REV. 3  
PT

## COPPER (OFHC) ROD

V-108  
V-124  
V-158  
V-183  
V-198  
V-208  
V-209  
V-210  
V-213  
V-218

### 1.0 GENERAL:

1.1 A certified copy of analysis from the mill fabricating the OFHC copper wire, bar, cakes, and billets shall precede or accompany each copper shipment and shall be sent to the Metallurgical Laboratory of the Raytheon Manufacturing Company. In lieu of this, a certificate shall be sent to the effect that the shipment was fabricated from billets of OFHC Copper, certified grade.

### 2.0 COMPOSITION:

#### \*2.1 Chemical Analysis

2.1.1 Certified OFHC copper shall have a copper content of 99.96 per cent, silver being counted as copper.

2.1.2 Impurities shall not exceed the following limits:

Phosphorus	0.0003%
Sulphur	0.0040%
Zinc	0.0003%
Oxygen	Nil

#### 2.2 Oxide Content

2.2.1 Micro-section shall show no evidence of embrittlement or "gassing" at a magnification of 75 diameters after heating at 875°C plus or minus 25°C for 30 minutes in commercial hydrogen and cooling in the same atmosphere

2.2.2 Samples not heated in hydrogen shall be free from cuprous oxide as determined by a microscopic examination at a magnification of 200 diameters.

2.2.3 All copper stock must conform with A.S.T.M. designation B170-42T, section 6 (a) and (b).

#### 2.3 Defects and Inclusions

2.3.1 All copper rod shall be clean, bright, free from excessive oxidation, scale porosity, slivers, seams, laps, segregations, pipes, and foreign inclusions.

\* INDICATES REVISION



# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R 5-27

SHEET 2  
8-5-47

REV. 4  
PT.

## COPPER (OFHC) ROD AND BAR

V-108  
V-124  
V-158  
V-183  
V-198  
V-208  
V-209  
V-210  
V-213  
V-218

### 2.4 Micro-Structure

- 2.4.1 The grain structure shall be homogeneous throughout any given section and shall show no evidence of excessive localized grain growth or "running away of the grain."
- 2.4.2 There shall be no evidence of intercrystalline separation.
- \*2.4.3 The average grain size, taken in a section transverse to the direction of rolling or drawing and tensile strength and elongation shall conform to the following:

Rod, Diameter inches Bar, Thickness inches	Average Grain Diameter in millimeters		Tensile Strength psi minimum		Elongation minimum per cent in 2 inches	
	minimum	maximum	Rod	Bar	Rod	Bar
Up to 0.040	0.015	0.035	45,000	40,000		12
0.041 to 0.125	0.025	0.050	45,000	40,000		12
0.126 to 0.250	0.030	0.080	45,000	40,000		12
0.251 to 0.500	0.030	0.090	40,000	40,000	10	12
0.501 to 1.000	0.035	0.100	40,000	40,000	12	12
1.001 to 1.500	0.035	0.100	38,000	35,000	15	15
1.501 to 2.000	0.035	0.100	35,000	35,000	15	15
2.001 and over	0.035	0.100	35,000	32,000	15	20

### 2.5 Desired Processing

- 2.5.1 Round Rod: Material shall be hot rolled, pickled, surface shaved, and cold drawn.
- 2.5.2 Rectangular Rod: Material shall be hot rolled, overhauled on all sides, and cold rolled or drawn.

\* INDICATES REVISION



# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R 5-27

SHEET 3  
1-4-56

REV. 2  
PT. 1

## COPPER (OFHC) ROD

V-108  
V-124  
V-158  
V-183  
V-198  
V-208  
V-209  
V-210  
V-213  
V-218

### 3.0 DIMENSIONS

3.1 Rod shall conform to the tolerances on the following tables unless otherwise specified on the individual purchase order.

#### \* 3.1.1 Diameter tolerances for rods.

Diameter or distance between parallel Surfaces, inches	Tolerances, plus and minus, inches	
	Rounds	Hexagonal Octagonal
Up to 0.150, incl.	0.0013	0.0025
Over 0.150 to 0.500, incl.	0.0015	0.003
Over 0.500 to 1.00, incl.	0.002	0.004
Over 1.00 to 2.50, incl.	0.0025	0.005
Over 2.50	0.15 per cent 0.30 per cent	

#### 3.1.2 Thickness tolerances for rectangular and square bars.

Thickness, inches	Over 0.090 to 0.150, incl.	Over 0.150 to 0.500, incl.	Over 0.500 to 1.00, incl.	Over 1.00 to 2.00, incl.	Over 2.00 to 4.00, incl.	Over 4.00 to 8.00, incl.
		0.0015	0.002	0.0025	0.0025	0.003

#### Tolerances plus and minus inches.

Over 0.090 to 0.150, incl.	0.0015	0.002	0.0025	0.0025	0.003	0.0035
Over 0.150 to 0.500, incl.	0.0025	0.0025	0.003	0.0035	0.0035	0.004
Over 0.500 to 1.00, incl.			0.0035	0.004	0.0045	0.005
Over 2.00 to 4.00 incl.				0.0045	0.005	0.006
					0.30%	

#### 3.1.3 Width tolerances for rectangular bars.

Width, inches	Tolerances plus and minus inches
Up to 0.500, incl.	0.0035
Over 0.500 to 1.00, incl.	0.005
Over 1.00 to 2.00 incl	0.006
Over 2.00	0.30 per cent

55-6836

\* INDICATES REVISION





# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-27

SHEET 4L  
7-22-46

REV. 3  
PT

## COPPER (OFHC) ROD

V-108  
V-124  
V-158  
V-183  
V-198  
V-208  
V-209  
V-210  
V-213  
V-218

### 3.1.4 Straightness tolerances

	Maximum curvature (depth of arc), inch	Portion of total length in which depth of arc is measured, inches
Drawn rods	1/2	120
Drawn bars and shapes	1/2	72

3.1.5 Rods shall be supplied in lengths of 8 to 12 feet, unless otherwise specified in the purchase order.

### 4.0 IDENTIFICATION:

4.1 Each container of the material shall be marked with the following identification.

- 4.1.1 Certified OFHC copper rod
- 4.1.2 Physical dimensions
- 4.1.3 Vendor's name
- 4.1.4 Gross, net, and tare weights
- 4.1.5 Raytheon Manufacturing Company's purchase specification number
- 4.1.6 Purchase order number
- \*4.1.7 Date of packaging

### 5.0 PACKAGING:

5.1 Bundles of rod shall be fastened by means of cord, copper alloy or copper binding only.

5.2 Rod shall be shipped in closed wooden boxes. Maximum weight shall be 200 pounds each box up to 1 inch diameter and 500 pounds each box for larger diameter rod.

5.3 Inside of containers shall be clean and free from dust and dirt. No dusty or linty material shall be used as packing.

All technical inquiries regarding this specification to be addressed to Raytheon Mfg. Co., Power Tube Division, Attention: Engineering Purchasing Liaison Agent, c/o Purchasing Dept. Foundry Ave., Waltham, Mass.

Note 1 Specific data concerning temper required must appear on each Purchase Order.

This specification was originally derived from the following equivalent  
Power Tube Division M.P 10024C  
POC 51-8202 \*

\* INDICATES REVISION

Retype



# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-24

SHEET 1  
2/7/53

REV. 14  
PT

## COPPER (OFHC) STRIP, RIBBON, SHEET AND BAR (All Tempers except Deep Dwg.)

V-108  
V-118(3)  
V-124  
V-158  
V-183  
V-198  
V-208  
V-209  
V-210  
V-213  
V-218  
V-222  
V-223  
V-225

### 1.0 GENERAL:

- 1.1 A certified copy of analysis from the mill fabricating the OFHC Copper Wire, bar, cakes, and billets shall precede or accompany each copper shipment and shall be sent to the Metallurgical Laboratory of the Raytheon Mfg. Co. In lieu of this, a certificate shall be sent to the effect that shipment was fabricated from billets of OFHC Copper, certified grade.

### 2.0 COMPOSITION:

#### 2.1 Chemical Analysis

2.1.1 Certified OFHC Copper shall have a copper content of 99.96 per cent, silver being counted as copper.

2.1.2 Impurities shall not exceed the following limits:

Phosphorus	0.0003%
Sulphur	0.0040%
Zinc	0.0003%
Oxygen	Nil

#### 2.2 Oxide Content

2.2.1 Micro-section shall show no evidence of embrittlement or "gassing" at a magnification of 75 diameters after heating at 875°C plus or minus 25°C for 30 minutes in commercial hydrogen and cooling in the same atmosphere.

2.2.2 Samples not heated in hydrogen shall be free from cuprous oxide as determined by a microscopic examination at a magnification of 200 diameters.

#### 2.3 Defects and Inclusions

2.3.1 All copper strip, ribbon, and sheet shall be clean, bright, free from excessive oxidation, scale, porosity, slivers, excessive preferred orientation and foreign inclusions.

POC 53-8039

\* INDICATES REVISION





# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-24

SHEET 2  
2/7/53

REV. 3  
PT

## COPPER (OFHC) STRIP, RIBBON, SHEET AND BAR (All Tempers except Deep Dwg.)

V-108  
V-118(3)  
V-121  
V-158  
V-183  
V-198  
  
V-208  
V-209  
V-210  
V-213  
V-218  
V-222  
V-223  
V-225

### 2.4 Micro-structure

- 2.4.1 The grain structure shall be homogeneous throughout any given section and shall show no evidence of excessive localized grain growth.
- 2.4.2 The grain should be approximately equiaxed in a section perpendicular to the direction in which the copper has been rolled or drawn.
- \*2.4.3 The average grain size, taken in a section-transverse to the direction of rolling or drawing, shall conform to the following:

Thickness, inches	Average grain diameter in millimeters	
	minimum	maximum
0.005 to 0.015	0.015	0.035
0.015 to 0.093	0.025	0.050
0.093 and above	0.035	0.070

### 2.5 Desired Processing

- 2.5.1 Material to be hot rolled, overhauled both sides, and cold rolled.

### 3.0 BEND TEST REQUIREMENTS ARE AS FOLLOWS:

#### 3.1

Size	Approximate number of bends
.005	35
.010	30
.015	30
.020	25
.032	20
.0625	10
.093	7

- 3.2 The copper having been fired in accordance with Section 2.2.1, the bend tests shall be conducted as follows:

POC 53-8039

\* INDICATES REVISION





# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-24

SHEET 3 REV. 2  
 2/7/53 PT

## COPPER (OFHC) STRIP RIBBON SHEET AND BAR (All Tempers except Deep Dwg.)

V-108  
 V-118(3)  
 V-124  
 V-158  
 V-183  
 V-198  
 V-208  
 V-209  
 V-210  
 V-213  
 V-218  
 V-222  
 V-223  
 V-225

- 3.3 The specimen shall be clamped between jaws with edges having a radius 2.5 times the diameter of the specimen.
- 3.4 It shall then be bent by hand over one edge of the jaws through an angle of 90 degrees and then returned to its original position. This constitutes one bend. It shall then be bent in the reverse direction through 90 degrees and returned to its original position. This constitutes a second bend. Each successive bend shall be made in the opposite direction from the previous bend.
- 3.5 The surface of the fractured sample shall be clean, bright, and appear as a smear under a stereoscopic microscope at 9 to 27 magnifications.

### 4.0 DIMENSIONS

4.1 Dimensional tolerances shall be as shown on the following tables, unless otherwise specified on the individual purchase order.

#### 4.1.1 Thickness tolerances

Thickness, inches	Thickness Tolerances, plus and minus inches					
	Strip			Sheet		
	Width 8 in and under	Width Over 8 to 12 in. incl.	Width Over 12 to 14 in. incl.	Width Over 14 to 20 in. incl.	Width Over 20 to 28 in. incl.	Width Over 28 to 36 in. incl.
0.004 and under	0.0003	0.0006	0.0006			
Over 0.004 to 0.006 incl.	0.0004	0.0008	0.0008	0.0013		
Over 0.006 to 0.009, incl.	0.0006	0.0010	0.0010	0.0015		
Over 0.009 to 0.013, incl.	0.0008	0.0013	0.0013	0.0018	0.0025	0.003
Over 0.013 to 0.017, incl.	0.0010	0.0015	0.0015	0.002	0.0025	0.003
Over 0.017 to 0.021, incl.	0.0013	0.0018	0.0018	0.002	0.003	0.0035
Over 0.021 to 0.026, incl.	0.0015	0.002	0.002	0.0025	0.003	0.0035
Over 0.026 to 0.037, incl.	0.002	0.002	0.002	0.0025	0.0035	0.004
Over 0.037 to 0.050, incl.	0.002	0.0025	0.0025	0.003	0.004	0.005
Over 0.050 to 0.073, incl.	0.0025	0.003	0.003	0.0035	0.005	0.006
Over 0.073 to 0.130, incl.	0.003	0.0035	0.0035	0.004	0.006	0.007
Over 0.130 to 0.187, incl.	0.0035	0.004	0.004	0.0045	0.007	0.008

POC 53-8039

\* INDICATES REVISION



# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-24

SHEET 14  
2/7/53

REV. 2  
PT

## COPPER (OFHC)

### STRIP RIBBON SHEET AND BAR (All Tempers except Deep Dwg.)

V-108  
V-118(3)  
V-124  
V-158  
V-183  
V-198  
V-208  
V-209  
V-210  
V-213  
V-218  
V-222  
V-223  
V-225

Thickness, inches	Thickness tolerances, plus and minus, inches					
	Bars			Plates		
	Width 8 in. and under	Width over 8 to 12 in., incl.	Width over 12 to 14 in., incl.	Width over 14 to 20 in., incl.	Width over 20 to 28 in., incl.	Width over 28 to 36 in., incl.
Over 0.188 to 0.205, incl.	0.0035	0.004	0.004	0.0045	0.007	0.008
Over 0.205 to 0.300, incl.	0.004	0.0045	0.0045	0.005	0.009	0.010
Over 0.300 to 0.500, Incl.	0.0045	0.005	0.005	0.006	0.012	0.013
Over 0.500 to 0.750, incl.	0.0055	0.007	0.007	0.009	0.015	0.017
Over 0.750 to 1.00, incl.	0.007	0.009	0.009	0.011	0.018	0.021

#### 4.1.2 Width tolerances for slit metal and metal with rolled edges.

Width, inches	Width tolerances, plus and minus, inches	
	0.004 to 0.032 inches incl. in Thickness	Over 0.032 to 0.188 inches incl. in Thickness
2 and under	0.005	0.010
Over 2 to 8, incl.	0.008	0.013
Over 8 to 20, incl.	1/64	1/64

#### 4.1.3 Width tolerances for square sheared metal. (All lengths up to 120 inches, inclusive)

Width, inches	Width tolerances, plus and minus, inches		
	1/16 inch and under in Thickness	Over 1/16 to 1/8 inch incl. Thickness	Over 1/8 inch inch in Thickness
20 and under	1/32	3/64	1/16
Over 20 to 36, incl.	3/64	3/64	1/16
Over 36 to 120, incl.	1/16	1/16	1/16

POC 53-8039

\* INDICATES REVISION





# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-24

SHEET 5  
10-23-56

REV. 7  
PT

## COPPER (OFHC) STRIP, RIBBON, SHEET AND BAR (All Tempers except Deep Dwg.)

V-108  
V-118(3)  
V-124  
V-158  
V-183  
V-198  
V-208  
V-209  
V-210  
V-213  
V-218  
V-222  
V-223  
V-225

### 4.1.4 Width tolerances for sawed metal.

Width, inches	Width tolerances, plus and minus, inches		
	For lengths up to 10 ft., incl.		For lengths over 10 feet
	1-1/2 inches and under in Thickness	Over 1-1/2 inches in Thickness	All Thicknesses
up to 12, incl.	1/32	1/16	1/16
Over 12 to 120, incl.	1/16	1/16	1/16

### 4.1.5 Flatness tolerances

Thickness	Width of Metal				
	Up to 1 1/2"	over 1 1/2"-3" incl.	over 3-6" incl.	over 6-12" incl.	over 12-24" incl.
.010-.020 incl.	.0020	.0025	.0025	.003	.006
.020-.032 incl.	.0025	.003	.004	.006	.012
.032-.063 incl.	.003	.0045	.006	.010	.020
.063-.125 incl.	.004	.007	.010	.015	.030
over .125	.008	.0115	.015	.020	.040

The flatness figures given apply to the central portion of the width of the strip disregarding the designation of 1/4" in from the edges on either edge. This 1/4" is taken to allow the slight deformation at the edge of the strips resulting from the shearing operation.

The flatness tolerance figures given refer to the deviation from flatness per foot of length.

### 5.0 PHYSICAL PROPERTIES:

5.1 Temper requirements: The copper shall be ordered to one of the following temper designations and shall meet the hardness limits given below for material .012 inch. thick and over.

\*POC 56-6703

\* INDICATES REVISION





# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-24

SHEET 6  
3-4-57

REV. 8  
PT

## COPPER (OFHC) STRIP, RIBBON, SHEET AND BAR (All Tempers except Deep Dwg.)

(Cont'd)

TEMPER	TENSILE STRENGTH (p.s.i.)	ROCKWELL HARDNESS	SUPERFICIAL 30T	
			MIN.	MAX.
LIGHT COLD ROLLED	32,000 - 40,000	F46 - F82	-	49
1/2 HARD	37,000 - 46,000	F77 - F89	43	57
HARD	43,000 - 52,000	F86 - F93	54	62

5.2 The temper supplied shall be as indicated on the individual purchase order.

### 6.0 MECHANICAL CONDITION:

#### 6.1 Coiled Ribbon and Strip

6.1.1 The ribbon or strip shall be free from ragged edges and substantially free from burrs with no burrs larger than 0.002 inch.

6.1.2 The material shall be free from kinks and bends other than natural curvature due to final coiling.

\*57-6112  
\*INDICATES REVISION



# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-24

SHEET 7  
2/7/53

REV. 6  
PT.

## COPPER (OFHC) STRIP RIBBON SHEET AND BAR (All Tempers except Deep Dwg.)

(3) V-108  
V-118  
V-124  
V-158  
V-183  
V-198  
V-208  
V-209  
V-210  
V-213  
V-218  
V-222  
V-223  
V-225

6.1.3 Ripple should be kept to the absolute minimum.

### 6.2 Flat Stock

6.2.1 The stock shall lie flat with no appreciable spring-up from a flat surface.

### 6.3 Straightness tolerances (applicable to any longitudinal surface or edge of material supplied in nominal flat straight lengths and to any longitudinal edge of material supplied in rolls).

6.3.1 Bars, flat wire and strip, with rolled (not previously slit) or drawn edges.

When furnished in straight lengths, in rolls or on bucks.  $1/2$ " maximum curvature (depth of arc) in any 6 foot portion of the total length.

## 7.0 FORM OF UNIT:

7.1 Unless otherwise specified on the Purchase order, the material shall be supplied in flat lengths no greater than 10 feet in length. At least 75% by weight shall be the length specified. 25% by weight may be shorter, but no piece shall be less than 50% of the length specified.

7.2 When so specified on the Purchase order, the material shall be supplied in rolls and shall conform to the following:

7.2.1 Strip or ribbon 0.020 inch in thickness and under shall be supplied in rolls with an inside diameter of approximately 1-1/2 to 2 inches and an outside diameter not to exceed 12 inches.

7.2.2 Strip exceeding 0.020 inch in thickness shall be supplied in rolls with a minimum inside diameter of 8 inches.

7.2.3 The outer ends of each roll shall be securely fastened.

7.2.4 Rolls shall be tied only with cord, copper alloy or copper binding.

7.2.5 No roll shall exceed 65 pounds in weight.

## 8.0 IDENTIFICATION:

8.1 Each shipping container shall be marked with the following information:

\* INDICATES REVISION



# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-24

SHEET 8L  
2/7/53

REV. 4  
PT

## COPPER (OFHC) STRIP, RIBBON, SHEET AND BAR (All Tempers except Deep Dwg.)

- (3) V-108
- V-118
- V-124
- V-158
- V-183
- V-198
- V-208
- V-209
- V-210
- V-213
- V-218
- V-222
- V-223
- V-225

- 8.1.1 Name of material
- 8.1.2 Physical dimensions
- 8.1.3 Weight
- 8.1.4 Name of Vendor

8.2 Each shipping unit or packing list contained in the unit shall supply the following information:

- 8.2.1 Purchase Order number
- 8.2.2 Raytheon Manufacturing Company's Purchase Specification number.
- 8.2.3 Gross and tare weights
- 8.2.4 Date of packaging

### 9.0 PACKING

- 9.1 Rolls shall be shipped in closed wooden boxes, with cardboard between the rolls, to protect the edges of one roll from being damaged by the edges of another roll. No box of rolls shall exceed 450 pounds in weight.
- 9.2 Flat stock shall be shipped in closed wooden boxes. No box of flat stock shall exceed 200 pounds in weight.
- 9.3 No dusty or linty material shall be used as padding.
- 9.4 Inside of container shall be clean and free from dust and dirt.

All technical inquiries regarding this specification to be addressed to Raytheon Mfg. Co., Power Tube Division, Attention: Engineering Purchasing Liason Agent, c/o Purchasing Dept., Foundry Ave., Waltham 54, Mass.

This specification was originally derived from the following equivalent: Power Tube Division M.P. 10024-G.

POC 53-8039

\* INDICATES REVISION





# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-3

SHEET 1 REV. 3  
5-13-58

## BRASS PLATE, SHEET, STRIP, & ROLLED BAR

V-102  
V-108  
V-118 (3)  
V-124  
V-126  
V-138  
V-139  
V-158  
V-161  
V-170  
V-172  
V-183  
V-198  
V-208  
V-209  
V-210  
V-213

### 1.0 GENERAL:

1.1 This specification is similar to ASTM Designation B36-56, Brass Plate, Sheet, Strip, Rolled Bar, Alloy #6 or Alloy #8, except for sections 4.1, 5.2, 8.0, and 9.0.

### 2.0 CHEMICAL COMPOSITION:

2.1 The requirements of this specification shall be considered satisfied if the material meets either of the following chemical compositions.

	ALLOY #6		ALLOY #8	
	Minimum %	Maximum %	Minimum %	Maximum %
Copper	68.5	71.5	64.0	68.5
Lead	--	0.07	--	0.15
Iron	--	0.05	--	0.05
Zinc	Remainder		Remainder	

### 3.0 PHYSICAL PROPERTIES:

3.1 Temper shall be supplied as shown on Purchase Order.

Temper	Normal Reduction B&S Gage	Approx. % Reduction
Deep Drawing	--	--
Quarter Hard	1	10.9
Half Hard	2	20.7
Three Quarters Hard	3	29.4
Hard	4	37.1
Extra Hard	6	50.0
Spring	8	60.5
Extra Spring	10	68.7

POC58-6159

\* INDICATES REVISION



# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-3

SHEET 2  
5-13-58

REV. 3

## BRASS PLATE , SHEET, STRIP, & ROLLED BAR

### 3.2 Tensile Strength and Rockwell Hardness

Alloy #6	Tensile Strength, Psi		Rockwell Hardness Subject to confirmation by Tensile Tests			
			B Scale		Superficial 30-T	
Rolled Temper	Min.	Max.	Min.	Max.	Min.	Max.
Quarter Hard	49,000	59,000	40	65	43	60
Half Hard	57,000	67,000	60	77	56	68
Three Quarter Hard	64,000	74,000	72	82	65	72
Hard	71,000	81,000	79	86	70	74
Extra Hard	83,000	92,000	85	91	74	77
Spring	91,000	100,000	89	93	76	78
Extra Spring	95,000	104,000	91	95	77	79

Alloy #8	Tensile Strength, Psi		Rockwell Hardness Subject to confirmation by Tensile Tests			
			B Scale		Superficial 30-T	
Rolled Temper	Min.	Max.	Min.	Max.	Min.	Max.
Quarter Hard	49,000	59,000	40	65	43	60
Half Hard	55,000	65,000	57	74	54	66
Three Quarter Hard	62,000	72,000	70	80	65	71
Hard	68,000	78,000	76	84	68	73
Extra Hard	79,000	89,000	83	89	73	76
Spring	86,000	95,000	87	92	75	78
Extra Spring	90,000	99,000	88	93	76	79

### 3.3 Grain Size Requirements for Deep Drawing Material.

Alloy	Grain Size, mm. (b)		Approx. Rockwell Hardness (a) Superficial 30-T	
	Min.	Max.	Min.	Max.
#6 and #8				
Deep Drawing	.015	.035	27	42

(a) Rockwell Hardness values apply as follows:

The 30-T scale applies to metal 0.015 inches in thickness and over.

(b) Although minimum grain size is not required, this material must be fully recrystallized.

3.4 All Deep Drawing material shall be free from "earring."

\* INDICATES REVISION

POC58-6159



V-102  
V-108  
V-118(3)  
V-124  
V-126  
V-138  
V-139  
V-158  
V-161  
V-170  
V-172  
V-183  
V-198  
V-208  
V-209  
V-210  
V-213



# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-3

SHEET 3 REV 4  
5-13-58

## BRASS PLATE, SHEET, STRIP, & ROLLED BAR

- V-102
- V-108
- V-118(3)
- V-124
- V-126
- V-138
- V-139
- V-158
- V-161
- V-170
- V-172
- V-183
- V-198
- V-208
- V-209
- V-210
- V-213

4.0 MECHANICAL CONDITION:

4.1 Straightness Tolerances, inches

Maximum Edgewise Curvature (depth of arc) in any 72 inch portion of the total length.

Width, inches	Slit Metal		Straightened or Edge-rolled Metal
	Shipped in rolls	Shipped Flat or in rolls	Shipped Flat, in rolls, or on bucks
Over 1/4 to 3/8 incl.	3	1-1/2	--
Over 3/8 to 1/2 incl.	2	1	1/2
Over 1/2 to 1 incl.	1-1/4	3/4	1/2
Over 1 to 2 incl.	3/4	5/8	1/2
Over 2 to 4 incl.	5/8	1/2	1/2
Over 4	1/2	1/2	1/2

4.2 Where flatness of closer tolerances than standard commercial practice is required, purchase orders must specify "specially flattened" stock. See Note 1.- last page.

Specially flattened stock supplied in straight lengths in thickness range of 1/8" to 3/16" inclusive, in width range 3" to 6" inclusive and in 3/4 hard or hard tempers, shall not deviate from flatness by more than .005" of any 3-1/2" length of material when measured in the central portion of the strip, disregarding 1/2" of width of either edge

5.0 SURFACE CONDITIONS

- 5.1 The material shall be free from external and internal defects within the confines of good workmanship.
- 5.2 The surface finish of deep drawing material shall be equal to or better than 32 microinches.

POC 58-6159

\* INDICATES REVISION





# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-3

SHEET 4  
5-13-58

REV. 5

## BRASS PLATE, SHEET, STRIP, & ROLLED BAR

6.0 DIMENSIONS:

6.1 Thickness Tolerances

Thickness, inches	Thickness Tolerances, plus and minus, inches			
	STRIP			
	8" and under in Width	Over 8" to 12" incl. in Width	Over 12" to 14" incl. in Width	Over 14" to 20" incl. in Width
0.004 and under	0.0003	0.0006	0.0006	---
Over 0.004 to 0.006, incl.	0.0004	0.0008	0.0008	0.0013
Over 0.006 to 0.009, incl.	0.0006	0.0010	0.0010	0.0015
Over 0.009 to 0.013, incl.	0.0008	0.0013	0.0013	0.0018
Over 0.013 to 0.017, incl.	0.0010	0.0015	0.0015	0.002
Over 0.017 to 0.021, incl.	0.0013	0.0018	0.0018	0.002
Over 0.021 to 0.026, incl.	0.0015	0.002	0.002	0.0025
Over 0.026 to 0.037, incl.	0.002	0.002	0.002	0.0025
Over 0.037 to 0.050, incl.	0.002	0.0025	0.0025	0.003
Over 0.050 to 0.073, incl.	0.0025	0.003	0.003	0.0035
Over 0.073 to 0.130, incl.	0.003	0.0035	0.0035	0.004
Over 0.130 to 0.188, incl.	0.0035	0.004	0.004	0.0045

POC58-6159

\* INDICATES REVISION



V-102  
V-108  
V-118(3)  
V-124  
V-126  
V-138  
V-139  
V-158  
V-161  
V-170  
V-172  
V-183  
V-198  
V-208  
V-210  
V-213  
V-209

# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-3

SHEET 5 REV. 0  
5-13-58

## BRASS PLATE, SHEET, STRIP, & ROLLED BAR

V-102  
V-108  
V-118 (3)  
V-124  
V-126  
V-138  
V-139  
V-158  
V-161  
V-170  
V-172  
V-183  
V-198  
V-208  
V-209  
V-210  
V-213

Thickness, inches	Thickness Tolerances, plus and minus, inches			
	SHEET			
	Over 20 to 28" incl. in Width	Over 28 to 36" incl. in Width	Over 36 to 48" incl. in Width	Over 48 to 60" incl. in Width
0.004 and under	---	---	---	---
Over 0.004 to 0.006, incl.	---	---	---	---
Over 0.006 to 0.009, incl.	---	---	---	---
Over 0.009 to 0.013, incl.	0.0025	0.003	0.0035	0.004
Over 0.013 to 0.017, incl.	0.0025	0.003	0.0035	0.0045
Over 0.017 to 0.021, incl.	0.003	0.0035	0.004	0.005
Over 0.021 to 0.026, incl.	0.003	0.0035	0.004	0.005
Over 0.026 to 0.037, incl.	0.0035	0.004	0.005	0.006
Over 0.037 to 0.050, incl.	0.004	0.005	0.006	0.007
Over 0.050 to 0.073, incl.	0.005	0.006	0.007	0.008
Over 0.073 to 0.130, incl.	0.006	0.007	0.008	0.010
Over 0.130 to 0.188, incl.	0.007	0.008	0.010	0.012
	PLATE			
Over 0.188 to 0.205, incl.	0.007	0.008	0.010	0.012
Over 0.205 to 0.300, incl.	0.009	0.010	0.012	0.014
Over 0.300 to 0.500, incl.	0.012	0.013	0.015	0.018
Over 0.500 to 0.750, incl.	0.015	0.017	0.019	0.023
Over 0.750 to 1.00, incl.	0.018	0.021	0.024	0.029
Over 1.00 to 1.50, incl.	0.022	0.025	0.029	0.036
Over 1.50 to 2.00, incl.	0.026	0.030	0.036	0.044
	ROLLED BAR		PLATE	
	8" and under in Width	Over 8 to 12" incl. in Width	Over 12 to 14" incl. in Width	Over 14 to 20" incl. in Width
Over 0.188 to 0.205, incl.	0.0035	0.004	0.004	0.0045
Over 0.205 to 0.300, incl.	0.004	0.0045	0.0045	0.005
Over 0.300 to 0.500, incl.	0.0045	0.005	0.005	0.006
Over 0.500 to 0.750, incl.	0.0055	0.007	0.007	0.009
Over 0.750 to 1.00, incl.	0.007	0.009	0.009	0.011
Over 1.00 to 1.50, incl.	0.022	0.022	0.022	0.022
Over 1.50 to 2.00, incl.	0.026	0.026	0.026	0.026

\* INDICATES REVISION

POC58-6159





# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-3

SHEET 6 REV. 0  
5-13-58

## BRASS PLATE, SHEET, STRIP, & ROLLED BAR

### 6.2 Width Tolerances for Slit Metal and Slit Metal With Rolled Edges.

Width, inches	Width Tolerances, Plus and Minus, inches			
	For Thickness 0.004 to 0.032", incl.	For Thick. over 0.032 to 0.125", incl.	For Thick. Over 0.125 to 0.188", incl.	For Thick. over 0.188 to 0.500", incl.
2 and under	0.005	0.010	0.012	0.015
Over 2 to 8, incl.	0.008	0.013	0.015	0.015
Over 8 to 20, incl.	1/64	1/64	1/64	1/32

### 7.0 FORM OF UNIT AND PACKING:

- 7.1 Strip shall be shipped in rolls or flat as ordered.
- 7.2 Rolls shall be of 8 inch minimum inner diameter. The outer ends of each roll shall not be more than one continuous length of strip per roll.
- 7.3 Rolls up to 3-1/2 inches wide shall not exceed 75 pounds in weight.
- 7.4 Rolls over 3-1/2 inches wide shall not exceed 100 pounds in weight.
- 7.5 Flat stock shall be furnished in not less than 8 or more than 12 foot lengths.
- 7.6 Rolls shall be shipped flat in closed wooden boxes with cardboard between coils to protect their edges.
- 7.7 Flat stock shall be shipped in closed wooden boxes.
- 7.8 The packing shall be adequate to protect the material from contamination and physical damage during shipment.

### 8.0 IDENTIFICATION:

- 8.1 Each shipping container shall be marked with the following information:
- 8.1.1 Name of material and Alloy number.
  - 8.1.2 Physical dimensions.
  - 8.1.3 Weight.
  - 8.1.4 Temper
  - 8.1.5 Name of Vendor.
- 8.2 Each shipping unit or packing list contained in the unit shall supply the following information:

\* INDICATES REVISION POC58-6159



V-102  
V-108  
V-118(3)  
V-124  
V-126  
V-138  
V-139  
V-158  
V-161  
V-170  
V-172  
V-183  
V-198  
V-208  
V-209  
V-210  
V-213



# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-3

SHEET 7L REV. 0  
5-13-58

## BRASS PLATE, SHEET, STRIP, & ROLLED BAR

V-102  
V-108  
V-118(3)  
V-124  
V-126  
V-138  
V-139  
V-158  
V-161  
V-170  
V-172  
V-183  
V-198  
V-208  
V-209  
V-210  
V-213

- 8.2.1 Purchase Order Number.
- 8.2.2 Raytheon Manufacturing Company's Purchase Specification Number.
- 8.2.3 Gross and tare weights.
- 8.2.4 Date of packaging.

NOTE 1: Specific data concerning temper required or patent leveling if required must appear on each Purchase Order.

All technical inquiries regarding this specification to be addressed to Raytheon Mfg. Co., Power Tube Division, Attention: Engineering Purchasing Liaison Agent, c/o Purchasing Dept., Foundry Ave., Waltham 54, Mass.

This Specification was originally derived from the following equivalent:  
Power Tube Division M.F. 10064.

POC58-6159

\* INDICATES REVISION



# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-1

SHEET 1  
5-14-58

REV. 5

## BRASS TUBING (FREE CUTTING)

### 1.0 GENERAL:

1.1 This specification is similar to ASTM Designation B135-55 Brass Tubes, Alloy #4 (Free Cutting), except for sections 4.2, 4.3, 4.4, 5.2, 6.2, 7.0, & 8.0.

### 2.0 CHEMICAL COMPOSITION:

2.1 The brass shall conform to the following chemical requirements.

	PERCENT	
	Minimum	Maximum
Copper	65.0	68.0
Lead	1.30	2.00
Iron		0.07
Zinc	Remainder	

### 3.0 PHYSICAL PROPERTIES:

3.1 Drawn tempers are specified in terms of tensile strength and Rockwell Hardness as prescribed in the following table:

TEMPER	OUTSIDE DIAM. IN.	WALL THICKNESS IN.	TENSILE STRENGTH P.S.I.	ROCKWELL B HARDNESS
Drawn (general purpose)	all	all	54,000 Min.	55 min.
Hard Drawn	Up to 1, incl.	0.020 to 0.120 incl.	66,000 Min.	75 min.
	Over 1 to 2, incl.	0.035 to 0.180 incl.	66,000 Min.	75 min.
	Over 2 to 4, incl.	0.060 to 0.250 incl.	66,000 Min.	75 min.

3.2 Temper shall be as indicated on Purchase Order.

3.3 Hard Drawn tubes shall be cold drawn to a reduction of area of more than 25 per cent.

3.4 All tubing shall be stress relief annealed.

3.5 The lead phase of this material shall be evenly distributed.

POC 58-6159

\* INDICATES REVISION





# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-1

SHEET 2  
5-14-58

REV. 4

## BRASS TUBING (FREE CUTTING)

V-102  
V-108  
V-118(3)  
V-124  
V-126  
V-138  
V-139  
V-158  
V-161  
V-170  
V-172  
V-183  
V-188  
V-198  
V-208  
V-209  
V-210  
V-213

4.0 MECHANICAL CONDITION:

4.1 The cut-off angle of the end of the tube may depart from square by not more than .010" for tubes 5/8" OD and under and by not more than .016" per inch of diameter for tubes over 5/8" OD.

4.2 Tubing shall be straight and free from kinks and bends.

5.0 SURFACE CONDITION:

5.1 The outside surface of the material shall be free from slivers and scale. Seams, cracks and other surface defects shall be within the confines of good workmanship.

5.2 Inside surface to be free from oxide, dirt, grease and drawn-in scale. Dents, splinters, seams, sharp projections, tool marks or flaws shall be within the confines of good workmanship.

6.0 DIMENSIONS:

6.1 Tubing shall not be less than 7 nor more than 14 feet in length unless otherwise specified.

6.2 Tolerances in Wall Thickness, Plus and Minus, inches.

POC58-6159

\* INDICATES REVISION





# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-1

SHEET 3  
5-14-58

REV. 5

## BRASS TUBING (FREE CUTTING)

V-102  
V-108  
V-118(3)  
V-124  
V-126  
V-138  
V-139  
V-158  
V-161  
V-170  
V-172  
V-183  
V-188  
V-198  
V-208  
V-209  
V-210  
V-213

Stubs' Gage	WALL THICKNESS		OUTSIDE DIAMETER, INCHES				
	Inch	Over 1/8" to 5/8" incl.	Over 5/8" to 1" incl.	Over 1" to 2" incl.	Over 2" to 4" incl.	Over 4" to 7" incl.	
00 and over	0.380 and over	---	---	5%	5%	6%	
Nos. 2 to 00, excl.	0.284 to 0.380 excl.	---	0.011	0.012	0.014	0.016	
Nos. 5 to 2 excl.	0.220 to 0.284 excl.	---	0.009	0.010	0.012	0.014	
Nos. 8 to 5 excl.	0.165 to 0.220 excl.	0.007	0.0075	0.008	0.010	0.012	
Nos. 11 to 8 excl.	0.120 to 0.165 excl.	0.005	0.006	0.006	0.008	0.010	
Nos. 14 to 11 excl.	0.083 to 0.120 excl.	0.004	0.005	0.005	0.007	0.009	
Nos. 17 to 14 excl.	0.058 to 0.083 excl.	0.0035	0.004	0.004	0.006	0.008	
Nos. 20 to 17 excl.	0.035 to 0.058 excl.	0.003	0.0035	0.0035	0.005	0.007	
Nos. 23 to 20 excl.	0.025 to 0.035 excl.	0.0025	0.0025	0.003	0.004	---	
Nos. 26 to 23 excl.	0.018 to 0.025 excl.	0.002	0.002	0.0025	---	---	
Under 26	Under 0.018	0.001	0.0015	0.002	---	---	

POC58-6159

\* INDICATES REVISION



# MATERIAL PURCHASING SPECIFICATION

RAYTHEON MFG. CO.

R5-1

SHEET 4L  
5-14-58

REV. 1

## BRASS TUBING (FREE CUTTING)

### 6.3 Tolerances in Average Diameter, Plus and Minus, Inches

Specified Diameter, Inch.	Diameter to which Tolerance Applies	Tol. Plus & Minus In.
Over 1/8 to 5/8 incl.	Inside or Outside	0.002
Over 5/8 to 1 incl.	Inside or Outside	0.0025
Over 1 to 2 incl.	Inside or Outside	0.003
Over 2 to 3 incl.	Inside or Outside	0.004
Over 3 to 4 incl.	Inside or Outside	0.005
Over 4 to 5 incl.	Inside or Outside	0.006

6.4 **Out-of-roundness:** For drawn unannealed tubes in straight lengths, neither the major nor minor diameter shall vary more than 1 per cent from the specified diameter.

### 7.0 FORM OF UNIT AND PACKING:

7.1 The packing shall be adequate to protect the material from contamination and physical damage during shipment.

7.2 Bundles of tubing shall be shipped in closed wooden boxes.

### 8.0 IDENTIFICATION:

8.1 Each shipping container shall be marked with the following information:

- 8.1.1 Name of material.
- 8.1.2 Physical dimensions.
- 8.1.3 Weight.
- 8.1.4 Name of vendor.

8.2 Each shipping unit or packing list contained in the unit shall supply the following information:

- 8.2.1 Purchase Order number.
- 8.2.2 Raytheon Manufacturing Company's Purchase Specification number.
- 8.2.3 Gross and tare weights.
- 8.2.4 Date of packaging.

All technical inquiries regarding this specification to be addressed to Raytheon Mfg. Co., Power Tube Division, Attention: Engineering Purchasing Liaison Agent, c/o Purchasing Dept., Foundry Ave., Waltham 54, Mass.

This specification was originally derived from the following equivalent:  
Power Tube Division M.P. 10066.



V-102  
V-108  
V-118(3)  
V-124  
V-126  
V-138  
V-139  
V-158  
V-161  
V-170  
V-172  
V-183  
V-188  
V-198  
V-208  
V-209  
V-210  
V-213