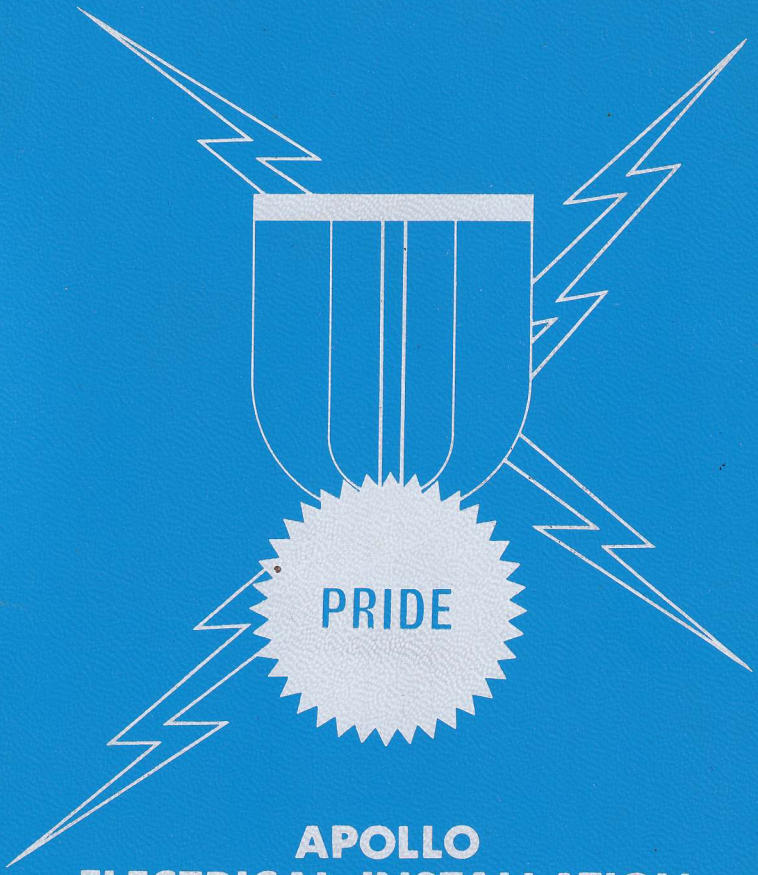
NORTH AMERICAN AVIATION, INC.
SPACE DIVISION



APOLLO
ELECTRICAL INSTALLATION
MANUAL

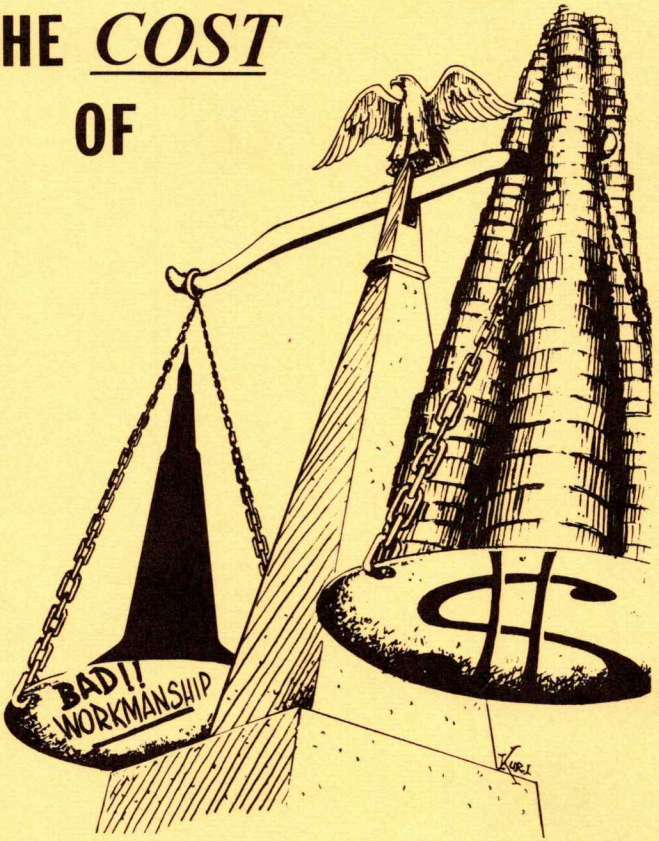
APOLLO ELECTRICAL INSTALLATION MANUAL

COPY NO. 0966

NORTH AMERICAN AVIATION, INC.
SPACE DIVISION

CONTENTS

THE *COST* OF



IMPROPER WORKMANSHIP *CANNOT* BE MEASURED

I INTRODUCTION

INTRODUCTION

This is the Space Age. Missiles span the oceans and continents in minutes. Manned Spacecraft and satellites orbiting the earth and other planets are but the start in man's adventures in the infinite void of space. Soon man will make his first venture into Deep Space and to the Moon. As he gains the ability to master the environment of space, he will seek to explore such places as Mars, Venus, and some day the remote stars and planets.

New techniques are continually being developed to meet the needs of this new age. These in turn are the cause of a multitude of new standards, requirements, facts, figures, and methods all of which are of vital importance to anyone associated with Apollo Manufacturing, of North American Aviation, Inc., Space Division.

The following provides directions and instructions in the various methods of preparation and installation which are accepted for Electrical and Electronic Fabrication at the Space Division. These directions are to be used with, but shall not supersede the requirements in official documentation.

The information contained here-in is to be treated as Company official, and shall not be distributed, used or disclosed in whole or in part for any purpose other than for reference information required in performance of a contract with North American Aviation Inc.

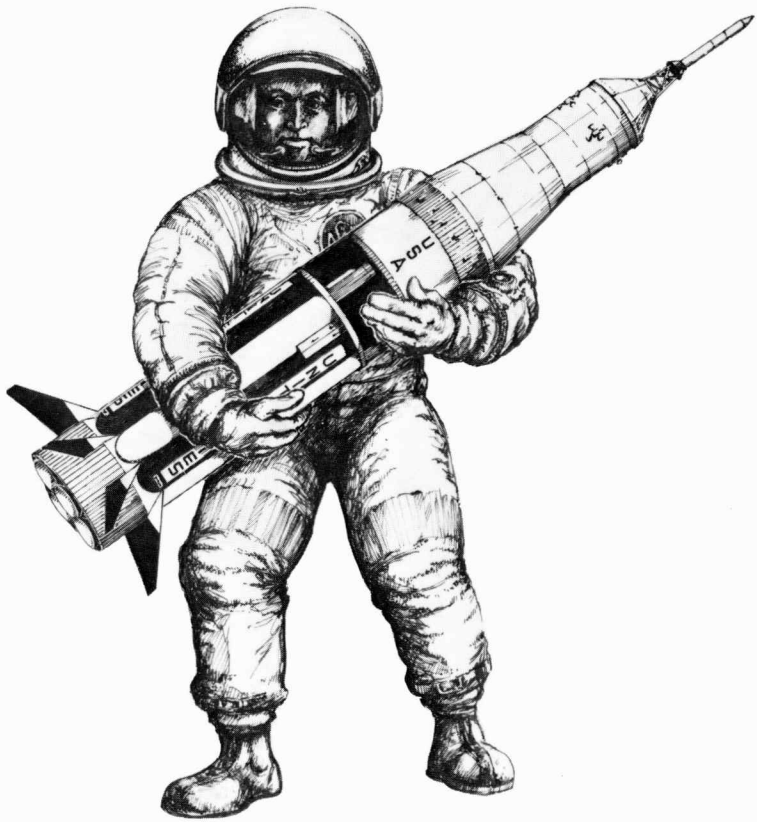
Controlled copies of the Apollo Electrical Installation Manual, may be obtained by addressing an Internal Letter signed by Supervision to: General Supervisor, D/667, 41-AB96.

Approved: Paul Greenhaw, Director
Apollo Manufacturing

Approved: L.B. Gray, Director
Apollo Quality & Reliability Assurance

Approved: R.L. Kurtz
Manager
Apollo CSM Electrical Systems

THE ASTRONAUTS HAVE A *ROUND TRIP* TICKET TO THE MOON!



HAVE *YOU* DONE YOUR SHARE TO INSURE A *SUCCESSFUL* FLIGHT ?

RULES FOR USE

1. Upper case letters will be used for all abbreviations.
2. Periods will be used only to avoid misinterpretation of an abbreviation. Example: ANT. - Antenna (Abbreviation spells out another word).
3. Abbreviations of word combinations shall be used as such and shall not be separated for use singly. Combination of single abbreviations is authorized as required.
4. Listed abbreviations shall be used only when their meanings are unquestionably clear. When in doubt, spell it out.

GENERAL TERMS

A

Absolute	ABS
Acceptable Quality Level	AQL
Acceptance Data Package	ADP
Access Panel	AP
Actuating	ACTG
Actuator	ACTR
AC Volts	ACV
Adapter	ADPT
Adapter Booster	AB
Adhesive	ADH
Adjust	ADJ
Advance	ADV
Advance parts release	APR
Aft Compartment	A/C
Aft Equipment Bay	AEB
Aft Heat Shield	AHS
Alignment	ALIGN.
Allowance	ALLOW.
All Systems	AS.
All Systems Test	AST
Alternate	ALT
Ammeter	AM
Ampere	AMP
Amplifier	AMPL
Analyzer	ANAL
Anode	A.
Antenna	ANT.
Apparatus	APP
Apollo Development	AD
Apollo Engineering	AE
Apollo Mission Simulator	AMS
Apollo Project Office	APO
Apollo Qualification	AQ
Apollo Reliability Engineering	ARE.
Apollo Requirements Manual	ARM.
Apollo Systems Integration	ASI
Apollo Systems Manual	ASM
Apollo Test & Operations	ATO
Apollo Test Requirements	ATR
Approved Parts List	APL
Approved Source List	ASL
Arrangement	ARR
Assemble	ASSEM
Assembly	ASSY
Assembly and Checkout	A&CO
Assembly-Components Parts List	ACPL
Attach	ATT
Attenuator	ATTEN
Authorize	AUTH
Automated Wire List	AWL
Automatic	AUTO.
Auxiliary	AUX
Average	AVG

B

Back Pressure	BP
Back to back	B TO B
Battery (Electrical)	BAT.
Bench Maintenance Equipment	BME
Bio-Med, Instr, Scien, & Crew equip	BISC
Black	BLK
Block	BLK
Blower	BLO
Blue	BLU
Blueprint	BP or B/P
Board	BD
Bonding	BOND.
Bracket	BRKT
Brown	BRN
Bulkhead	BHD
Bushing	BUSH.
Buzzer	BUZ
Bypass	BYP

C

Cable	CA
Cable Interconnect Diagram	CID
Cadium	CAD.
Calibrate	CAL
Capacitance	C
Capacitor	CAP.
Cathode	C
Center Section	CS
Centigrade	C
Change	CHG
Change Verification Record	CVR
Check	CHK
Checkout	C/O
Circuit	CKT
Circuit Breaker	CB
Clearance	CL
Clockwise	CW
Coaxial	COAX
Coding	COD.
Color Code	CC
Command Module	CM
Command Module Electrical Power System	CEPS
Command & Service Module	CSM
Communication	COMM
Communication System	CS
Compartment	COMPT
Complete	COMPL
Conductor	COND
Confidential	CONF
Connector	CONN.

Contract Change Authorization	CCA
Control	CONT
Control Panel	CP
Control Number on SCD (SD)	ME.
Coordinate	COORD
Copper	COP.
Corrosion-Resistant	CRE
Counterclockwise	CCW
Crew Compartment	C/C
Crew Compartment Heat Shield	CCHS
Current	CUR.
Cutoff	CO
Cycles Per Second	CPS

D

DC Volts	DCV
Delta	Δ
Design Change Authorization	DCA
Design Engineering Inspection	DEI
Design Manual	DM
Diagram	DIAG
Diameter	DIA
Dimension	DIM.
Diode	DIO
Direct Current	DC
Disassembly	DISASSY
Disconnect	DISC.
Displays and Controls	D&C
Distribution	DISTR
DIT-MCO, automatic C/O equip	DIT-MCO
Does Not Apply	DNA
Document	DOC.
Double Pole	DP
Double Pole, Double Throw	DPDT
Double Pole, Single Throw	DPST
Double Throw	DT
Down	DN
Drafting Room Manual	DRM
Drawing	DWG
Drawing List	DL
Duplicate	DUP

E

Earth Landing Subsystem	ELS
Electric	ELEC
Electrical Power Distribution System	EPDS
Electrical Power Subsystem	EPS
Electronics	ELECTRO.
Electronic Control Assembly	ECA
Electronic Data Processing	EDP
Emergency Detection Subsystem	EDS
End Item	E/I
Engineering	ENGR
Engineering Change Proposal	ECP
Engineering Configuration Control	ECC
Engineering Control Drawing	ECD
Engineering Development Laboratory	EDL
Engineering Order	EO
Engineering Order Purchase Request	EOPR
Engineering Project Authorization	EPA
Environmental Control System	ECS
Equipment	EQUIP.
Equivalent	EQUIV
Escape Tower	ET
Estimate	EST
Estimated Plan of Action	EPA
Environmental Control Subsystem	ECS
Exterior	EXT

F

Fabricate	FAB
Fabrication, Assembly, and Inspection Record	FAIR.
Face of Drawing	F/D
Facing	FCG
Fahrenheit	F
Final	FNL
Fitting	FTG
Flameproof	FP
Flange	FLG
Flathead	FHD
Flight Director Attitude Indicator	FDAI
Forward	FWD
Forward Compartment	F/C
Forward Equipment Bay	FEB
Forward Heat Shield	FHS
Four-Conducter	4/C
Four-Pole	4P
Frequency	FREQ
Frequency Meter	FRM
Frequency Modulation	FM
Front	FR
Front View	FV
Fuel Cell	F/C

G

Gage	GA
General Electric	GE
General Order	GO
Generator	GEN
Guidance & Control	G&C
Guidance & Navigation	G&N
Glycol	GLY
Government	GOVT
Government Furnished	GF
Government Furnished Equipment	GFE
Government Furnished Property	GFP
Government Property	GP
Gray	GY
Green	GRN
Grommet	GROM
Ground	GRD
Ground Support Equipment	GSE

H

Hardware	HDW
Harness	HARN
Harness Assembly	H/A
Heater	HTR
Heat Resisting	HR
Heat Shield	H/S
High Frequency	HF
High Voltage	HV
Horizontal	HOR
Horizontal Center Line	HCL
Horizontal Reference Line	HRL
Hotwire	HW
House Spacecraft	HS/C

I

Identification	IDENT
Incorporated	INC
Indicator	IND
Inflammable	INFL
Information	INFO
Inspection	INSP

Installation	INSTL
Instrumentation	INST
Insulate	INS
Interdivision Change Proposal	IDCP
Interdivisional Change Schedule	IDCS
Interdivisional Operations	IDO
Interdivisional Support Request	IDSR
Inter-Division Work Authorization	IDWA
Interface	I/F
Interface Control Document	ICD
Interior	INT
Internal Letter	IL
Item Change Analysis	ICA

J

Jack	J
Job Improvement Request	JIR
Job Order	JO
Junction	JCT
Junction Box	JB

K

Kennedy Space Center	KSC
Keyway	KWY

L

Laboratory	LAB
Launch Escape	LE
Launch Escape Subsystem	LES
Launch Escape Tower	LET.
Launch Vehicle	LV
Liquid Oxygen	LOX
List of Material	L/M
Lockwasher	LWASH
Logistics	LOG.
Lower	LWR
Lower Equipment Bay	LEB
Low Voltage	LV
Lunar Module	LM
Lunar Orbital Rendevous	LOR

M

Main Display Console	MDC
Maintenance	MAINT
Manual	MAN.
Manned Spacecraft Center	MSC
Master Change Record	MCR
Master Switch	MS
Material	MATL
Material Review	MR
Maximum	MAX.
Maximum Torque	MT
Measure	MEAS
Mechanical	MECH
Meter	M
Minimum	MIN
Miscellaneous	MISC
Mississippi Test Facility	MTF
Mockup	MU
Modification	MOD
Mount	MT

N

National Aeronautics and Space Administration	NASA
National Aircraft Standards	NAS
Next Assembly	NA
No Connection	NC
Nomenclature	NOM
Normal	NOR.
Normally Closed	NC
Normally Open	NO
Not Applicable	N/A
Not To Scale	NTS
Number	NO.
Nut Plate	NTPL

O

Object	OBJ
Ohmmeter	OHM.
Operating	OPER
Operating Manual	O/M
Operational Checkout Procedure	OCP
Orange	ORN
Oscillator	OSC
Outside diameter	OD
Outside radius	OR.
Oxygen	OXY

P

Package	PKG
Panel	PNL
Part Number	PN
Permanent	PERM
Phase	PH
Plan of Action	POA
Plug	PL
Plyboard	P/B
Position	POS
Potentiometer	POT.
Power	PWR
Power Amplifier	PA
Pressure	PRESS.
Production	PROD.
Process Specification (Space Division)	MA
Procurement Specification (Space Division)	MC
Programming Document	P/D
Programming or Program	PROG
Pulse Code Modulation	PCM
Purchase Order	PO
Purple	PR

Q

Quad Door	Q/DOOR
Quality	QUAL
Quality Assurance	QA
Quality Assurance Engineering	QAE
Quality Assurance Division	QAD
Quality Assurance Laboratory	QAL
Quality Assurance Manual	QAM
Quality Assurance Source List	QASL

Quality Control	QC
Quality Control Specification	MT
Quality and Reliability Assurance	Q/RA
Quality Engineering	QE
Quantity	QTY

R

Radar	RDR
Radio	RAD
Radio Frequency	RF
Radius	RAD or R
Rate of Change	RC
Reaction Control Command Module	R/CCM
Reaction Control Service Module	R/CSM
Reaction Control System	RCS
Receptacle	RECP
Red	RED
Request for contact investigation	RCI
Request for Drawing Change	RDC
Request for Engineering Change Proposal	RECP
Research/Development	R/D
Resistor	RES
Release	REL
Reverse	REV.
Rework After Completion	RAC
Rheostat	RHEO
Rotary	ROT.
Rough	RGH

S

Schedule	SCH
Schedule Change Board	SCB
Schematic	SCHEM
Sequential Events Control Subsystem	SECS
Serial	SER
Series Relay	SRE
Service Module	SM
Service Module Quads	SMQ
Service Propulsion Subsystem	SPS
S D Process Specification	MA
S D Procurement Specification	MC
Silver	SIL
Single Conductor	1/C
Single Contact	SC
Single Pole	SP
Single Throw	ST
Sleeve	SLV
Socket	SOC
Solenoid	SOL
Spacecraft	S/C
Spacecraft Adapter	S/A
Spacecraft Lem Adapter	SLA
Spacer	SPR
Space Suit Assembly	SSA
Spare	SP
Specification	SPEC
Specification Control Drawing (ME at Space Division)	SCD
Specification Change Notice	SCN
Stabilization & Control Subsystem	SCS
Standard	STD
Support Work Authorization	SWA
Switch	SW
Symbol	SYM
System	SYS
System Assembly Mockup	SAM.
Systems Assembly Support	SAS
Systems Integration	SI
Systems Measuring Devices	SMD
Special Test Equip	STE

T

Technical Information Center	TIC.
Temperature	TEMP
Terminal	TERM.
Terminal Board	TB
Test and Inspection Record	TAIR
Test Preparation Sheet	TPS
Three Conductor	3/C
Time Delay	T/D
Toggle	TGL
Torque	TOR
Tool Request	TR
Transformer	TRANS
Transistor	TSTR
Transponder	XPNDR
Travel Expense Report	TER
Twisted	TW
Two-Conductor	2/C
Typical	TYP

U

Umbilical	UMB
Under Voltage	UV

V

Vehicle	VEH
Violet	VIO
Volt	V
Voltage Requlator	VR
Voltage Relay	VR
Voltammeter	VA
Voltampere	VA
Voltmeter	VM
Volt Ohm Milliammeter	VOM
Volts AC	VAC
Volts DC	VDC
Volume	VOL

W

White	WHT
Work Transfer Request	WTR

X

X-Ray	XR

Y

Yellow	YEL

This section contains data relative to the basic nature of the operational Command and Service Module spacecraft systems. The words defined in this Glossary or technical vocabulary apply particularly to the work of Apollo electrical fabrication. They are not intended to include the basic concepts of electronics.

BISC -"Bio-Medical, Instrumentation, Scientific, and Crew" Equipment is that equipment furnished by NASA for use with engineering models, prototypes, spacecraft mockups, and deliverable spacecraft to provide life support aids and to transmit and record measurement data.

BME - An area established for the "Bench Maintenance of Equipment" used in the spacecraft. This area has the capability of the check out and repair of malfunctioning equipment such as Black Boxes, Panels, and/or Electronic Equipment.

CASL - The "Component Assembly Sequence Library" is an automated list of the most commonly used connectors and terminal boards with a permanently assigned line number to which has been added the type (crimp or solder), number of pins, tooling, contact and sealing plug numbers, clocking, and the pin sequence for wire installation.

COMM - The "Telecommunication System" provides for voice, television, telemetry, tracking & ranging data communication between the spacecraft and ground support stations, the crew extra-vehicular activity and portable life support systems and intercommunication of the crew in the spacecraft.

DELTA - An "Established Period Of Time" after the initial release of engineering information which allows Engineering and/or Manufacturing to accumulate design changes and treat these as a package in lieu of individual changes.

DIT-MCO - A "Programming and Operations" function established to accomplish an automatic continuity, insulation resistance and high potential test.

ECS - The "Environmental Control System" provides a controlled environment for three astronauts in the Apollo spacecraft during missions of up to fourteen days duration.

EDS - The "Emergency Detection System" is designed to detect and display emergency conditions of the launch vehicle and also provides automatic abort initiation under certain conditions.

ELS - The "Earth Landing System" is designed to provide a safe landing for the astronauts and Command Module following an abort or a normal re-entry from an orbital or lunar mission.

EPS - The "Electrical Power System" generates, controls, conditions and distributes the electrical power required for the various spacecraft systems.

FAIR - The "Fabrication, Assembly, & Inspection Record " is a system utilized to perform production control functions, establish and maintain traceability, provide records of completion, inspection and acceptance of manufactured items, and provides detailed information about the specific operations and processes used in producing these items.

G&N - The "Guidance & Navigation" system is a semi-automatic system, directed and operated by the flight crew, which performs two basic functions: inertial guidance and optical navigation.

IDWA - The "Inter-Divisional Work Authorization" is a system by which Space Division obtains products and services of other Company divisions to: 1. take advantage of their special products, facilities, and capabilities. 2. reduce work flow time and alleviate peak work loads.

LES - The "Launch Escape System" provides the Command Module with immediate abort capabilities from the launch pad, or away from the path of the launch vehicle in the event of an abort shortly after launch.

MCR - The "Master Change Record" is an Engineering issued document to authorize engineering or change proposal effort. Upon authorization and approval of an MCR, Engineering prepares and releases E.O.'s, drawings, and specifications.

MDC - The "Main Display Console" consists of the group of panel assemblies upon which are located the controls and displays for most of the spacecraft systems, permitting the astronauts to adequately monitor and control the functions of the various spacecraft systems.

RCI - The "Request for Contact Investigation" is initiated describing a problem condition when it has been determined that a manufacturing problem exists, and then forwarded to Shop Contact to investigate it and take appropriate action.

RCS - The "Reaction Control System" provides the spacecraft with the capability to accomplish normal, and/or emergency attitude maneuvers, and operate in response to either automatic or manual control signals.

RDC - The "Request for Drawing Change" is a formal means of conveying to the responsible Engineering groups drawing change information for approval and incorporation on the drawing.

SCD - The "Specification Control Drawing" is a document used to assign control numbers to supplier or subcontractor products procured, enabling the control of the characteristics of these products to be ensured.

SCS - The "Stabilization & Control System" provides either automatic or manual operated control and monitoring of the spacecraft attitude, and rate control of the thrust vector of the service propulsion engine.

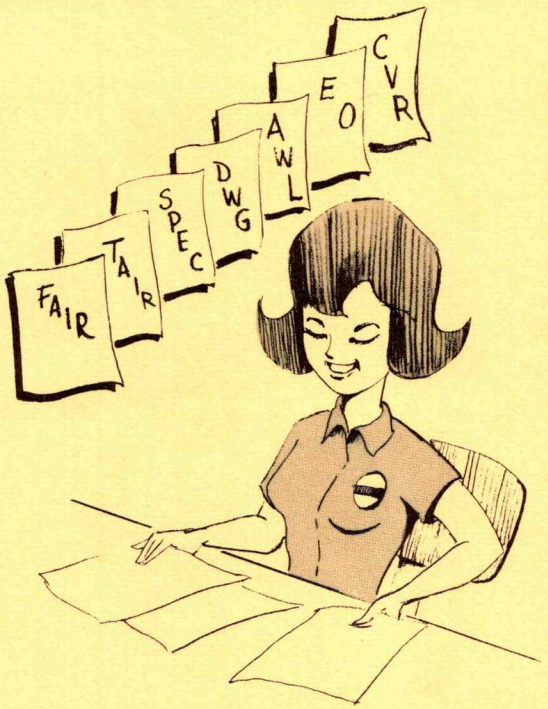
SPS - The "Service Propulsion System" provides the thrust required for large changes in spacecraft velocity after booster separation, such as providing for the insertion and ejection of a lunar orbit.

STE - "Special Test Equipment" is used to verify the required satisfactory functional performance or to isolate areas of malfunction of the end item system and/or its components during Manufacturing and Inspection.

TAIR - The "Test And Inspection Record" is a system of control and inspection documentation used by "Test & Operations" to record the progressive status of testing and inspection effort.

UMB - The "Umbilical" is the electrical cable and hardline assembly utilized to connect and make functional the various systems which are dependent upon one another in both the Command and Service Modules.

RELEASED INFORMATION



is the *ONLY* way!

II APPROVED SOURCES

DRAWING NUMBERING
APOLLO ESCAPE SYSTEM, COMMAND MODULE, & SERVICE MODULE
BLOCK II

88XXXX
MODIFICATION KIT

000024
FINISH SPECIFICATION VEHICLE

89XXXX
KIT DRAWING

000048
FINISH SPECIFICATION GSE

FIRST 2 DIGITS OF GROUP NUMBER IS FUNCTION NUMBER.

EXAMPLE: XXX-30 XXXX
GROUP NUMBER
FUNCTION NUMBER
AREA NUMBER

000002
GENERAL

01XXXX
WIND TUNNEL MODELS

03XXXX
HANDBOOK DRAWINGS

▲ 34XXXX
TANKS INSTALLATION

▲ 35XXXX
COMMAND-SERVICE MODULE UMBILICAL INSTALLATION

▲ 36XXXX
MICRO-METEOROID SHIELD INSTALLATION

▲ 37XXXX
INSULATION INSTALLATION COMPLETE

▲ 38XXXX
HEAT SHIELD INSTALLATION

▲ 39XXXX
BAY I EQUIPMENT INSTALLATION

▲ 20XXXX
SYSTEMS INSTALLATION COMPLETE

30XXXX
BODY GROUP INSTALLATION

- 31XXXX FAIRING (FWD)
- 32XXXX BASIC STRUCTURE
- 33XXXX EQUIPMENT SUPPORT STRUCTURE

40XXXX
POWER SYSTEMS

- 41XXXX ENGINE INSTALLATION
- 42XXXX ELECTRICAL WIRING ALL SYSTEMS
- 43XXXX ENGINE CONTROL
- 44XXXX ELECTRICAL INSTALLATION
- 45XXXX ELECTRICAL POWER SYSTEM
- 46XXXX PROPELLANT PRESSURIZATION SYSTEM
- 47XXXX PROPELLANT OXIDIZER SYSTEM
- 48XXXX FUEL SYSTEM

50XXXX
VEHICLE MECHANISMS

- 51XXXX INSTRUMENT INSTALLATION
- 52XXXX ATTITUDE CONTROL EQUIPMENT
- ● 53XXXX CREW FURNISHINGS
- 54XXXX ELECTRO-MECHANICAL EQUIPMENT
- 55XXXX MISCELLANEOUS MECHANISMS
- 56XXXX LAUNCH EQUIPMENT
- ● 57XXXX EARTH LANDING SYSTEM
- ● 58X0XX HYDRAULIC EQUIPMENT
- 58X5XX PNEUMATIC EQUIPMENT
- 59XXXX PYROTECHNIC EQUIPMENT

60XXXX
LIFE SUPPORT SYSTEMS

- 61XXXX ENVIRONMENTAL CONTROL
- 62XXXX BIO-INSTRUMENTATION
- 63XXXX FOOD & WASTE SYSTEM

70XXXX
ELECTRONIC CONTROL SYSTEM

- 71XXXX COMMUNICATION SYSTEMS
- 72XXXX NAVIGATION EQUIPMENT
- 73XXXX STABILIZATION EQUIPMENT
- 74XXXX RADAR EQUIPMENT
- 75XXXY INSTRUMENTATION
- 76XXXX ELECTRONIC DISPLAY EQUIPMENT
- 77XXXX ELECTRONIC DISPLAY EQUIPMENT
- 79XXXX MISCELLANEOUS EQUIPMENT

80XXXX
GROUND SUPPORT & CONTROL EQUIPMENT COMPLETE

- 81XXXX HANDLING EQUIPMENT
- 82XXXX AUXILIARY EQUIPMENT
- 83XXXX FLIGHT TEST EQUIPMENT
- 84XXXX SERVICE EQUIPMENT
- 85XXXX CHECKOUT EQUIPMENT
- 86XXXX TRAINING EQUIPMENT
- 87XXXX GLOBAL OPERATIONS SUPPORT EQUIPMENT

AREA	(XXX-XX1XXX) THIRD DIGIT OF GROUP NUMBER (1)
XX0XXX	(1)
XX1XXX	BAY I
XX2XXX	BAY II
XX3XXX	BAY III
XX4XXX	BAY IV
XX5XXX	BAY V
XX6XXX	BAY VI
XX7XXX	CENTRAL SECTION
XX8XXX	FORWARD BULKHEAD AREA
XX9XXX	AFT BULKHEAD AREA
XX0XXX	
XX1XXX	CREW BAY
XX2XXX	RH EQUIP BAY
XX4XXX	LOWER EQUIP BAY
XX5XXX	UPPER EQUIP BAY
XX6XXX	FORWARD COMPT
XX7XXX	AFT COMPT

THIS CHART IS ONLY APPLICABLE IN CONJUNCTION WITH PROJECT DESIGNATION NUMBERS 35, 36 AND 37

NOTE: (1) THE "AREA" OR THIRD DIGIT OF THE GROUP NUMBER MAY BE "0" WHEN AREA DESIGNATION IS NOT DESIRED OR REQUIRED, OR WHEN TWO OR MORE AREAS ARE INVOLVED. IN GSE THE AREA CODE IS NOT APPLICABLE.

● = DRAWINGS UNIQUE TO THE ESCAPE SYSTEM AND COMMAND MODULE

▲ = DRAWINGS UNIQUE TO THE SERVICE MODULE

UNCODED = DRAWINGS APPLICABLE TO ALL THREE AREAS (C/M, S/M & ESCAPE SYSTEM)

ENGINEERING DRAWINGS

Engineering Drawings document and transmit design data to Manufacturing, Inspection, and other concerned organizations. There are four basic types of drawings.

1. Detail Drawings - A Detail Drawing represents a single part and shall specify all dimensions, material, and information required for its manufacture, either directly on the drawing or by reference.

2. Assembly Drawings - An Assembly Drawing shows two or more parts that are put together to make an assembly. Detail parts are often shown on Assembly Drawings to eliminate the extra drawings for each part. Subassemblies are also listed by dash numbers.

3. Installation Drawings - An Installation Drawing shows the information that is needed to locate and install parts and assemblies in their final location.

4. Automated Wire List (AWL) - The AWL provides the wire requirements for fabrication of Cables, Harnesses, Modification Kits, and the Electrical/Electronic fabrication of Black Boxes and Panels.

   The AWL contains the following pages:
   - TITLE Page No. 1
   - TABLE of CONTENTS Page No. 1.1
   - GENERAL NOTES Page No. 1.2
   - PICTORIAL DRAWING Page No. 1.2.1
   - APPLICATION (USAGE) DATA Page No. 1.3
   - REVISION RECORD Page No. 1.4
   - LIST OF MATERIALS Page No. 1.5 thru
   - WIRE LIST Page No. 2 thru

WIRE LIST

1. Pages are numbered consecutively, starting with page No. 2.

2. "FROM REFERENCE DESIGNATOR" column lists the reference part or component item number that the wire comes "FROM".

3. "TERMINAL" column contains the terminal number or letter of the part where the wire is attached. Terminals identified 1F, 2F, etc., indicate ferrules associated with the part. 1E, 2E, etc., indicate splices associated with the part. An Asterisk (*) in this column indicates the wire is stowed at the part location. A dash (-) preceding the terminal letter indicates the letter is lower case.

4. "SHIELD BOND" column shows the ferrule number 1F, 2F, etc., to which the shield of a shielded cable is connected. FLT denotes floating shield.

5. "CABLE DESCRIPTION" column identifies and describes wires common to a multi-conductor cable.

6. "WIRE NUMBER" column contains the numbers assigned to the individual wires.

7. Information in ( ) parenthesis indicates Mating Item.

8. "COLOR" column lists, in abbreviated form, the color or color codes of the wire insulation.

9. "REMARKS" column indicates the Circuit Function.

10. "TO REFERENCE DESIGNATOR" column lists the reference part or component item number that the wire goes "TO".

11. "TERMINAL"column contains the same information as noted in 3.

12. "EMC"code column indicates the grouping of the wires into specific groups in reference to their electro-magnetic compatibility.

13. "ROUTING"column indicates the routing of the wires in the harness.

14. "REVISION"column lists the latest change letter made for each line entry.

15. "PARTS END FIT"column indicates the associated parts, components or hardware used on the "FROM" end of the wire.

16. "WIRE TYPE"column refers to the type of wire as described in the List of Materials.

17. "NUMBER REQUIRED"column indicates the quantity of items required.

18. "WIRE LENGTH"column indicates the length of wire in inches.

19. "GENERAL NOTES"column refers to the number of the note or the letter on the GENERAL NOTES page.

20. "PART NUMBER" column contains the actual part number of the "FROM ITEM".

6V31 CODE IDENT. NO. C3953 PART DESCRIPTION HARNESS LIST OF MATL.

FROM REF. DES.	TERM	SHLD BOND	CABLE DESC.	WIRE NUMBER	CLR	REMARKS	PART NUMBER TO REF. DES.	TERM	EMC	CALLOUT DWG. ROUTING	REV	NO. REQD PARTS END FIT	WIRE TYPE	LGTH	GN EQ NT E S
②	③	④	⑤	⑥	⑦	⑧ ⑨	⑩	⑪	⑫	⑬		⑭	⑮	⑯ ⑰ ⑱	⑲
S000000															
J4	40F			JPR183		SHLD	J4	7E		0000	NC		203	12	
	1F			JPR249		SHLD	J4	2E		0000	NC		203	12	
	2E			JPR249		SHLD	J4	1F		0000	NC		203	12	
	2E			JPR250		SHLD	J4	2F		0000	NC		203	12	
	2E			JPR251		SHLD	J4	3F		0000	NC		203	12	
	2E			JPR252		SHLD	J4	4F		0000	NC		203	12	
	2E			JPR256		Q-BALL SIG SHLD TERMINATE	J4	7E		0000	NC		204	12	
	2F			JPR250		SHLD	J4	2E		0000	NC		203	12	
	3F			JPR251		SHLD	J4	2E		0000	NC		203	12	
	4F			JPR252		SHLD	J4	2E		0000	NC		203	12	
	5F			JPR253		SHLD	J4	7E		0000	NC		203	12	
	6E			JPR7540			J4	101		0000	NC		204	12	
	6E			JPR7541			J4	24F		0000	NC		203	12	
	6E			JPR7542			J4	25F		0000	NC		203	12	
	7E			JPR253		SHLD	J4	5F		0000	NC		203	12	
	7E			JPR256		Q-BALL SIG SHLD TERMINATE	J4	2E		0000	NC		204	12	
	7E			JPR4659		SHLD TERMINATE	J4	7		0000	NC		204	12	
	8F			JPR183		SHLD	J4	40F		0000	NC		203	12	
	8F			JPR4657		SHLD	J4	94		0000	NC		204	12	
J5	RECP.C/M-S/M UMBILICALIC09W1P905J					S01W5	ME414-0149-0014		Y	V37-426600	B	3935	1 REQD		
	1										NC				
	2	1F	2SH11	1WL747C20	YEL	S/M-ADAPT SEP	J41	61	HO	N7G4G-9G	A		350	330	EW
	3	1F	2SH11	1WL747C20	BLK	S/M-ADAPT SEP	J41	62	HO	N7G4G-9G	A		350	**	EW
	4	FLT	2SH13	M436Y20	YEL		A	*	HO	NC2UR	A		350	96	
	5	FLT	2SH14	M419Y20	YEL		A	*	HO	NC2UR	A		350	96	
	6	12F	2SH15	M387Y20	YEL		A	*	HO	NC2UR	A		350	96	
	7			JPR7589		SHLD	J5	12F	HO	0000	NC		204	12	
	8	2F	2SH7	1WL740D20	YEL	S/M DEADFACE	P269	A	HO	NC1R-AR	A		350	148	EW
	9	13F	2SH12	1WL741D20	YEL	S/M DEADFACE	P270	A	HO	NC1R-AR	A		350	149	EW
	10			JPR7204		SHLD TERMINATE	J5	1E		0000	NC		204	12	
	11										NC				
	12										NC				
	13										NC				
	14										NC				
	15										NC				
	16		2TW1	1L106C22	YEL	EXT LIGHT PWR SYS 1	P237	A	EQ	RNE-D	NC		217	179	
	17		2TW1	1L106C22	BLK	EXT LIGHTS SYS 1 NEUT	P237	B	EQ	RNE-D	NC		217	**	
	18		3TW6	1QR244C20	RED		J166	-S	HO	RNC-J	NC		222	146	
	19		3TW6	1QR244C20	YEL		J166	-U	HO	RNC-J	NC		222	**	
	20										NC				
	21										NC				
	22										NC				
	23	FLT	2SH13	M436Y20	BLK		A	*	HO	NC2UR	A		350	**	

APOLLO WIRE LIST DWG. NO. DATE REV. PAGE
S/M WIRE HARNESS ASSY S000000 V37-426600 23 JANUARY 1967 B 2

FIGURE 1

APPROVED SOURCES -ENGINEERING DRAWINGS	18 JUL 1967	
	DATE	DATE REVISED
	11	2.2.1
TITLE	SECTION	NUMBER

ENGINEERING ORDER

An Engineering Order (E.O.) is the only means by which Engineering releases requirements to Manufacturing. When approved by the responsible Engineering Supervision, the E.O. is an authorization to do one of the following:

1. Release new or revised drawings and specifications.
2. Release design revision (E.O.'s to be incorporated on the drawing at a later date).
3. Release instructions to Manufacturing other than changes.
4. Release requirements for test and/or development.
5. Release quotation request or purchase request.
6. Obsolete or re-release drawings and specifications.
7. Stop fabrication or procurement.
8. Supersede other previously released E.O.'s

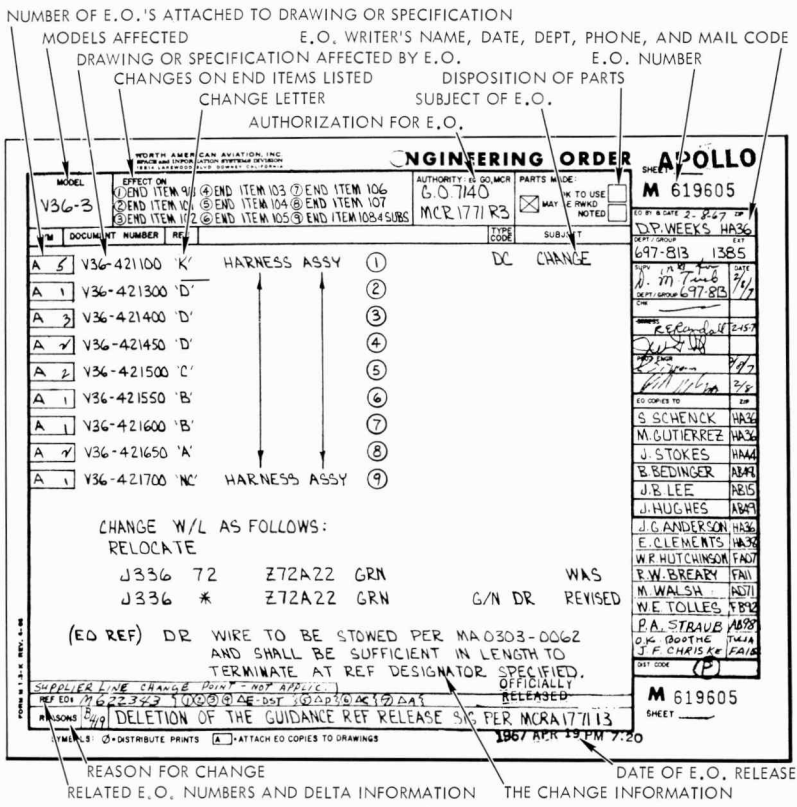


FIGURE 1

APPROVED SOURCES ENGINEERING ORDERS (E.O.)	18 JUL 1967	
	DATE	DATE REVISED
	11	2.3
TITLE	SECTION	NUMBER

ENGINEERING ORDER (Cont)

Machine E.O. - Major changes to a wire list are usually made by use of the computer. These are referred to as machine E.O.'s and use the same basic format as the wire list with the addition of the disposition, and action columns. Disposition 1 is work that must be accomplished, disposition 3 is a record change. The Action column describes the operation for each item, N = NEW, D = DELETE, R = REVISE, and W = WAS.
When an E.O. change is to be incorporated into an assembly, utilizing the DELTA (Δ) SYSTEM, the delta designation will be shown in the ref. E.O.'s block of the E.O. (i.e.: ΔA, ΔB, ΔC, etc.). The DELTA SYSTEM is an established method of incorporating several individual E.O. changes as a package unit in lieu of several separate changes.

PLANNING RESIDENT ORDER (PRO)

The PRO is an authorized and approved manufacturing document to supplement mandatory planning and to centralize points of specification documentation. PRO's meet all documentation and change control requirements but are not intended for use as inspection records and are secondary to engineering documentation. There are two types of PRO's :

1. Correlates and/or amplifies General Process Specifications and is controlled by M-XXXX numbers.

2. Correlates and/or amplifies specific Process Specifications and/or engineering drawings and is controlled by T7-XXXXXX numbers.

S&ID PARTS MANUAL

The S&ID Parts Manual (SPM) is the official medium by which pertinent design, part, and component data is disseminated to all engineering groups within S&ID. The manual is divided into subject codes based on function rather than part number order. In general all data and parts falling into a given category are grouped together to permit ease of location comparison, and selection. The pages include information concerning part numbers, detail data, part details, dimensions, characteristics, measurements, and tolerances.

The manual is divided into two sections as follows:

Volume 1, ELECTRICAL/ELECTRONIC MANUAL (EEM) - This volume contains information pertaining to electrical attachments, conductors, terminals, potting, electronic components, relays, lenses, motors, sub-assemblies, and other associated hardware.

Volume 2, MECHANICAL PARTS MANUAL (MPM) - This volume contains information concerning screws, bolts, nuts, washers, clamps, rivets, and other mechanical hardware.

Each volume contains a Numerical Index (subject 0001) and a Alphabetical Index (subject 0002).

PROCESS SPECIFICATIONS

Specifications are used to give detailed instructions to the shop. These instructions concern the manufacturing, installation, testing, and inspection of the component parts of a system or the complete system. The specifications have the same authority as Engineering Drawings (prints). If, however, the prints differ from the specifications, the prints should be followed.
The basic specifications used in electrical fabrication are listed below.

ASSEMBLY	MA0303-0067	SEALED TERMINAL STRIP ASSEMBLY, PROCEDURE FOR
BONDING	MA0106-003	BONDING WITH EPOXY-POLYIMIDE ADHESIVE, FOR NON-STRUCTURAL APPLICATIONS
BONDING	MA0110-029	SURFACE TREATMENT OF FLUOROCARBON WIRE INSULATION FOR IMPROVED ADHESION
BONDING	MA0613-002	ELECTRICAL BONDING REQUIREMENTS FOR APOLLO
CLEANING	MA0110-010	SOLVENT CLEANING METHODS INCLUDING LIST OF GENERAL CHEMICAL PROCESSING SPECIFICATIONS
CLEANING	MB0210-005	CLEANING AGENT 1, 1, 2-TRICHLORO-1, 2, 2-TRIFLUOROETHANE
CLEANING	MA0616-035	CLEAN PACKAGING REQUIREMENTS FOR APOLLO SPACECRAFT AND SUPPORT EQUIPMENT
COATING	MA0606-035	CONFORMAL COATING OF ELECTRICAL AND ELECTRONIC EQUIPMENT FOR HUMIDITY PROTECTION (APOLLO)
CODING	MA0303-0006	COLOR CODING OF ELECTRICAL CONNECTORS, PROCEDURE FOR
CODING	MA0305-0011	APOLLO CSM AND ASSOCIATED GSE WIRING REQUIREMENTS FOR ELECTROMAGNETIC COMPATIBILITY
CONNECTOR	MA0303-0009	CONNECTOR ELECTRICAL, CRIMP REMOVABLE CONTACT, RECTANGULAR, SCREW LOCK TYPE, ASSEMBLY OF
CONNECTOR	MA0303-0061	GENERAL PURPOSE AND RECTANGULAR CONNECTOR ASSEMBLIES, PROCEDURE FOR
CONNECTOR	MA0303-0098	CONNECTOR ASSEMBLIES, SUBMINIATURE, HIGH DENSITY, ASSEMBLY PROCEDURE FOR
CONNECTOR	MA0303-0099	GSE UMBILICAL AND SPECIAL PURPOSE CONNECTOR, ASSEMBLY, PROCEDURE FOR
CONNECTOR	MA0303-0118	COMMERCIAL TYPE ELECTRICAL CONNECTORS FOR APOLLO SPACE VEHICLES, ASSEMBLY PROCEDURE FOR
CONNECTOR	MA0305-0122	COAXIAL CONNECTORS, BLOCK II APOLLO SPACE VEHICLES, ASSEMBLY FOR
CONTAMINATION	MA0610-018	CONTAMINATION CONTROL - APOLLO SPACECRAFT AND ASSOCIATED EQUIPMENT

COMPONENTS	MA0113-002	ELECTRONIC COMPONENTS AND HARDWARE, MOUNTING OF, GENERAL SPECIFICATION FOR
CONTINUITY	MA0201-3075	ELECTRICAL SYSTEMS CONTINUITY AND INSULATION RESISTANCE TEST, APOLLO SPACECRAFT, PROCEDURE FOR
CRIMP	MSC-ASPO-C3C	CRIMPING OF ELECTRICAL CONNECTIONS, REQUIREMENTS FOR (NASA)
FABRICATION	MA0303-0060	FABRICATION OF ELECTRICAL WIRE HARNESS FOR APOLLO SPACE VEHICLES
HANDLING	MA0117-001	HANDLING OF FLAMMABLE AND DANGEROUS LIQUIDS AND CHEMICALS
IDENTIFICATION	MA0303-0065	IDENTIFICATION OF ELECTRICAL WIRE, CABLES AND CONNECTORS.
INSTALLATION	MA0101-005	INSTALLATION OF THREADED AND COLLARED FASTENERS
INSTALLATION	MA0303-0095	ELECTRICAL WIRE HARNESSES AND COAXIAL CABLES FOR APOLLO SPACE VEHICLES, INSTALLATION OF
INSTALLATION	MA0303-0112	ELECTRICAL WIRE HARNESS AND COMPONENTS FOR DISPLAY AND CONTROL PANELS, INSTALLATION OF
POTTING	MA0106-036	GENERAL PURPOSE MECHANICAL POTTING AND SEALING FOR SERVICE AT TEMPERATURES BETWEEN -225F AND 600F
POTTING	MA0106-072	ELECTRICAL CONNECTOR POTTING FOR SERVICE AT TEMPERATURE BETWEEN -160F AND 600F
PROTECTION	MA0616-003	INTRA/INTERPLANT PARTS PROTECTION REQUIREMENTS FOR THE APOLLO PROGRAM
SLEEVING	MB0150-025	SLEEVING, ELECTRICAL, INSULATING, HEAT SHRINKABLE, TEFLON
SOLDERING	NPC-200-4	QUALITY REQUIREMENTS FOR HAND SOLDERING OF ELECTRICAL CONNECTIONS (NASA)
STOWAGE	MA0303-0062	STOWAGE OF ELECTRICAL WIRES, CABLES AND CONNECTORS FOR APOLLO SPACE VEHICLES
TERMINATIONS	MA0303-0063	INSTALLATION OF CRIMP TERMINATIONS FOR APOLLO SPACE VEHICLES
TERMINATIONS	MA0303-0064	TERMINATION OF SHIELDED CABLE FOR APOLLO SPACE VEHICLES

OPERATIONAL CHECKOUT PROCEDURE (OCP)

OCP's provide a detailed step-by-step method of accomplishing a specific test. OCP's are designed to direct all tasks required during a specific test and includes all equipment requirements, pre-test setup, test sequences, data requirements, and post test activity in ATO.

OCP's are prepared by Spacecraft and Ground Systems Engineers. Changes to the OCP must be requested on a REQUEST FOR OCP CHANGE FORM. Deviations from the OCP must be requested on an OCP DEVIATION SHEET. For further detail refer to SECTION III DOCUMENTATION.

ACCEPTANCE TEST PROCEDURE (ATP)

ATP's are the manufacturing departments equivalent of ATO'S OPERATIONAL CHECKOUT PROCEDURE. The basic difference is in the title only, which is to avoid conflict of documentation between the two departments.

TEST PREPARATION SHEETS (TPS)

TPS's are used to authorize the start of work, or testing, on a Spacecraft or GSE. During the ATO test and checkout phase, it provides planned directions and permanent records of activities and operations performed on the spacecraft.

FABRICATION, ASSEMBLY, and INSPECTION RECORD (FAIR)

The FAIR system is a written order to the shop which directs the manufacture of parts. The individual sheets which make up a FAIR book are referred to as FAIR TICKETS. Each of the different types and their uses are described below.

1. SALMON - (Control Ticket) Routes parts through manufacturing and inspection to final stores.
2. GREEN - (Bench Order) Remains with parts during manufacturing. It outlines initial work as well as rework required and records time expended on the job.
3. YELLOW - (Material Requisition) Authorizes withdrawal of material from stock. Used by accounting for material cost control and then filed.
4. GRAY - (Material Traveler) Routes controlled parts from the warehouse to using dept. May be retained or destroyed by using dept.
5. RED - (Schedule Location) Filed in responsible shop department, used as cross reference in locating the salmon copy.
6. ORCHID - (Production Record) Retained in planning open order files until the completed salmon is returned. The Orchid copy is then destroyed.
7. BLUE - (Reference Copy) Furnished to stockrooms or others as required for information.
8. SALMON - (Production Order) This ticket supplements the control ticket for complex detail parts and assemblies. It provides the detailed sequence for manufacturing, inspection, and traceability.

FAIR (cont)

The FAIR book consists of any or all of the M71-K series forms as shown below by color and form number. Refer to SECTION III, DOCUMENTATION section of this Manual for detail of FAIR.

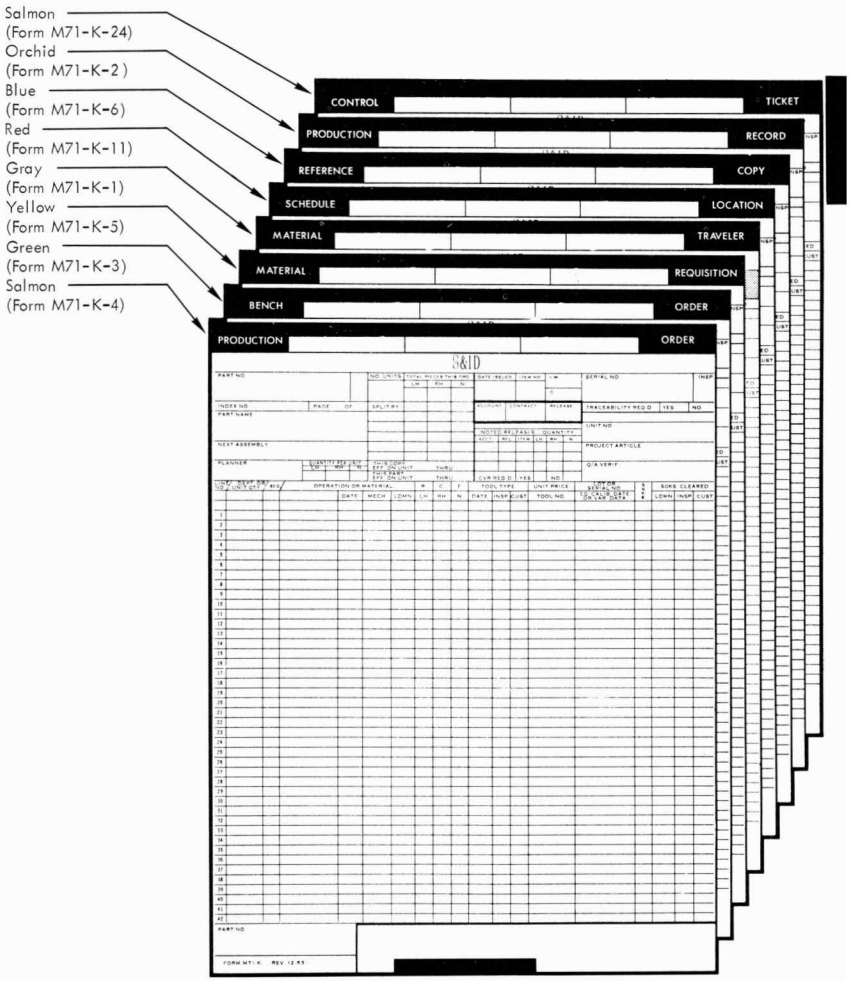


FIGURE I

APPROVED SOURCES FAIR BOOK	18 JUL 1967	
	DATE	DATE REVISED
	11	2.5.1
TITLE	SECTION	NUMBER

TEST AND INSPECTION RECORDS

Test and Inspection Record(TAIR)books are permanent inspection records maintained after the manufacturing completion date for each applicable end item and miscellaneous piece of support equipment delivered to test and operation sites. TAIR books record the progressive status of testing and inspection effort.

A TAIR book contains the definition, authorization, recording inspection and sign-off verification of work accomplished and will include acceptance programs, test and operation procedures for the on-site, off-site test facilities.

MANUFACTURING ASSEMBLY SPECIFICATION

The Manufacturing Assembly Specification (MAS) is a set of (1) Quality Engineering Accepted (2) detailed, (3) sequenced and (4) release controlled manufacturing instructions.

These instructions are used for the assembly and hookup of a wire harness, cable, panel, black box, and or modification kit.

The information for the Assembly Specification is obtained from released engineering prints, Automated Wire Lists, and process specifications.

The Assembly Specification is identified by the drawing assembly number or the planning assembly number, and is coordinated with the FAIR ticket.

The Manufacturing Assembly Specifications are used as the inspection criteria.

The Assembly Specification pages are listed below. The arrangement may not be in the order listed. Pages marked with an asterisk (*) may not be found in all specifications.

TITLE PAGE
RELEASING E.O.
SURVEYS
*ALPHA NUMERICAL ITEM LIST
*CONFIGURATION RECORD
TABLE OF CONTENTS
SYSTEM ASSEMBLY SUPPORT APPROVAL
E.O., DISPOSITION, AND EFFECTIVITY
LIST OF MATERIAL
TOOLING REQUIREMENTS
SEQUENCE OF OPERATIONS
*APPLICABLE INSPECTION REQUIREMENTS (REF. I.T.I)
*DETAIL REQUIREMENTS
*GENERAL NOTES
*EXPLANATION OF ABBREVIATIONS
*INDEX OF CONNECTORS
OPERATIONS

REQUIRED

complete *YOUR* effort

sign off and sell!

III DOCUMENTATION

A. FABRICATION, ASSEMBLY AND INSPECTION RECORD (FAIR)

1. The FAIR system is used at the Space Division to perform production control functions, establish and maintain traceability, to provide records of completion, inspection, and acceptance of manufactured items, and provide detailed information about the specific operations and processes used in producing these items.

2. FAIR BOOK (Major Assemblies and Systems Installation) The FAIR BOOK is a collection of documents in book form used to document operations, configuration, traceability, processing, completion, and acceptance of assemblies or installations. See Approved Sources section of this manual for the various forms used for record purposes.

FAIR

FABRICATION, ASSEMBLY & INSPECTION RECORD

ASSEMBLY NAME		ASSEMBLY NO.
INSTRUMENTATION INST. R.C.S. ENG. TEMP.		V36-XXXXX
DEPT. NO.	CONTRACT	MODEL
661-2	7137	V36-3
UNIT NO.		SERIAL NO.
1		06362- AAE1496
ACCOUNT	ITEM	RELEASE
3001		123

NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

FORM 844-F NEW 10-62

1. PAGE ADDITIONS & REMOVALS | 2. SHORTAGES | 3. OPERATIONS | 4. SQUAWKS | 5. SERIALIZATION
6. PART REMOVALS | 7. DMDs | 8. MISCELLANEOUS

FIGURE 1

DOCUMENTATION-FABRICATION, ASSEMBLY & INSPECTION RECORD (FAIR)	18 JUL 1967	
	DATE	DATE REVISED
	III	3.1
TITLE	SECTION	NUMBER

FORM 999-A-7 REV 4-67

Contents of book are as follows:

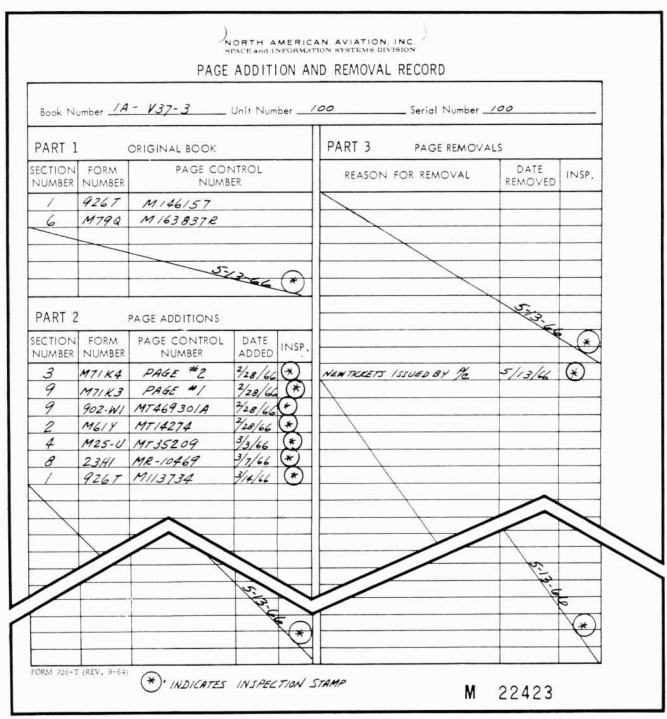
a. Page addition and removal record (Form 926-T)
b. Shortage report (Form M61-Y)
c. Operation (Production Order) (Form M71-K-4)
d. Variable data sheet (Form M71-K-4)
e. Squawk sheet (Form M-25-U)
f. Installed equipment serialization record (Form 917-B)
g. Part removal record (Form M79-Q)
h. Material review disposition (Form 23H-1)

a. PAGE ADDITION AND REMOVAL RECORD

PURPOSE: To maintain a record of the pages of the FAIR book. Each page is identified by:

Section number
Form number
Page control number

Technical Integration makes all entries in PART 1. Inspection makes all entries in PARTS 2 & 3.



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

PAGE ADDITION AND REMOVAL RECORD

Book Number IA - V37-3 Unit Number 100 Serial Number 100

PART 1 ORIGINAL BOOK

SECTION NUMBER	FORM NUMBER	PAGE CONTROL NUMBER
1	926T	M146157
6	M79Q	M163837E

5-12-66 (*)

PART 2 PAGE ADDITIONS

SECTION NUMBER	FORM NUMBER	PAGE CONTROL NUMBER	DATE ADDED	INSP.
3	M71K4	PAGE #2	3/28/66	(*)
9	M71K3	PAGE #1	3/28/66	(*)
9	902-W1	MT469301A	3/28/66	(*)
2	M61Y	MT14274	3/29/66	(*)
4	M25-U	MT35209	3/3/66	(*)
8	2341	MR-10469	3/7/66	(*)
1	926T	M113734	3/16/66	(*)

5-12-66 (*)

PART 3 PAGE REMOVALS

REASON FOR REMOVAL	DATE REMOVED	INSP.
	5-13-66	(*)
NEW TICKETS ISSUED BY Pic	5/13/66	(*)

5-13-66 (*)

FORM 926-T (REV. 9-64)

(*) INDICATES INSPECTION STAMP

M 22423

FIGURE 2

DOCUMENTATION-FAIR BOOK-ADDITION AND REMOVAL	18 JUL 1967	
	DATE	DATE REVISED
	III	3.1.1
TITLE	SECTION	NUMBER

b. SHORTAGE REPORT

The Shortage Report (Form M61-Y) is a serialized four part form used to record and transmit documentation related to actual and/or held-up shortages when items are transferred between departments, facilities, or to storage. Individual copies are distributed as follows:

WHITE - Accompanies part or assembly.
PINK - Included in closed-out sign-off book.
BLUE - To CVR Planning.
HARD COPY - Remains in inspection of originating department.

NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

SHORTAGE REPORT

☒ ELECTRICAL PAGE 1 OF 1

☒ MECHANICAL DATE 6-12-67

DEPT. OF ORIGIN	TRANSFERRED TO	UNIT NO.	CONTRACT NO.	SERIAL NO.	L.H.	R.H.	UPPER	LOWER
659	662	S/C 101	7137	06362 AAF6349	Neutral (Traceability yes N/A V36-753261)			

ASSEMBLY NAME	ASSEMBLY NUMBER
Panel #001	V36-761011

SHORTAGES ACTUAL	HELD UP	INSP. VERIF.	QUANT.	PART NUMBER	PART NAME & REMARKS	CLOSURE DATE	MECH.	L.B.	INSP.
		xxx	6-12-67		No Shortages or held up Items				
					Ok to transfer to Next Assy.				
					Insp-xxx				
						6-12-67			xxx

FORM NO. M61-Y, REV. 7/64

M 307571 S

FIGURE 3

DOCUMENTATION-FAIR BOOK-SHORTAGES	18 JUL 1967	
	DATE	DATE REVISED
	III	3.1.2
TITLE	SECTION	NUMBER

FORM 999-A-7 REV 4-67

c. OPERATIONS

This is the "WORKING" section of the FAIR book. It provides the required assembly/installation and inspection instructions to personnel in the shop relative to:

- Operational sequences
- Tooling information
- Cost accumulation
- Inspection acceptance records

S&ID

- PART NO: V36-XXXXXX
- NO. UNITS: 1
- TOTAL PIECES THIS ORD: LH / RH / N
- DATE ISSUED / ITEM NO
- I.W. 2240 / C 2225
- SERIAL NO: 06362 AAE 1496
- INDEX NO / PAGE OF / SPLIT BY
- ACCOUNT: 3001 CONTRACT: 7137 RELEASE: 123
- TRACEABILITY REQ'D: YES / NO
- PART NAME: INSTRUMENTATION INST. R.C.S. ENG. TEMP.
- UNIT NO.
- NOTED RELEASES / QUANTITY: ACCT / REL / ITEM / LH / RH / N
- NEXT ASSEMBLY: V36-XXXXXX V36-3
- PROJECT ARTICLE: A-V V36-3 -102
- PLANNER: R. ALVAREZ
- QUANTITY PER UNIT: LH / RH / N
- THIS COPY EFF. ON UNIT THRU
- THIS PART EFF. ON UNIT THRU
- CVR REQ'D: YES / NO
- Q/A VERIF: [signature]

LINE NO.	DEPT. OR UNIT QTY	SEQ	OPERATION OR MATERIAL	DATE	MECH	LDMN	R (LH)	C (RH)	E (N)	TOOL TYPE (DATE)	INSP	CUST	UNIT PRICE (TOOL NO)	LOT OR SERIAL NO (EQ CALIB DATE OR VAR DATA)	SQKS	SQKS CLEARED LDMN	INSP	CUS
1		X	INSTALL ELECTRICAL WIRING PER MA0303-0095															
2			(CERTIFIED OPER. REQ'D.)															
3		X	INSTALL SENSOR PER MA0107-002															
4																		
5	6-19-67																	
6																		
7	661-2	1	O.K. TO LOCATE AND INSTALL SENSOR SPT 123XXX															
8																		
9			RECORD S/N										S/N					
10																		
11	147		INSP.															
12																		
13	661-2	2	INSTALL (SPECIAL SKILL REQ'D.).															
14																		
15	147		INSP.															
16																		
17	661-2	3	PREPARE WIRES FOR CRIMPING.															
18																		
19		4	MECH.															
20																		
21		5	CRIMP AND RECORD TOOL AND S/N															
22																		
23	147		INSP.															
24																		
25	661-2	6	INSTALL CRIMP PIN.															
26																		
27	147		INSP.															
28																		
29	661-1	7	PERFORM FUNCTIONAL TEST (MA0201-3075).															
30			(SPECIAL SKILL REQ'D.)															
31			INSP. PER ITI 236															
32																		
33	147		INSP.															
34																		
35	NASA		INSP.															
36																		
37	661-1	8	PROTECT PER MA0116-013 (PF-17)															
38																		
39	147		INSP.															
40																		
41	41-661																	
42																		

PART NO: V36-XXXXXX

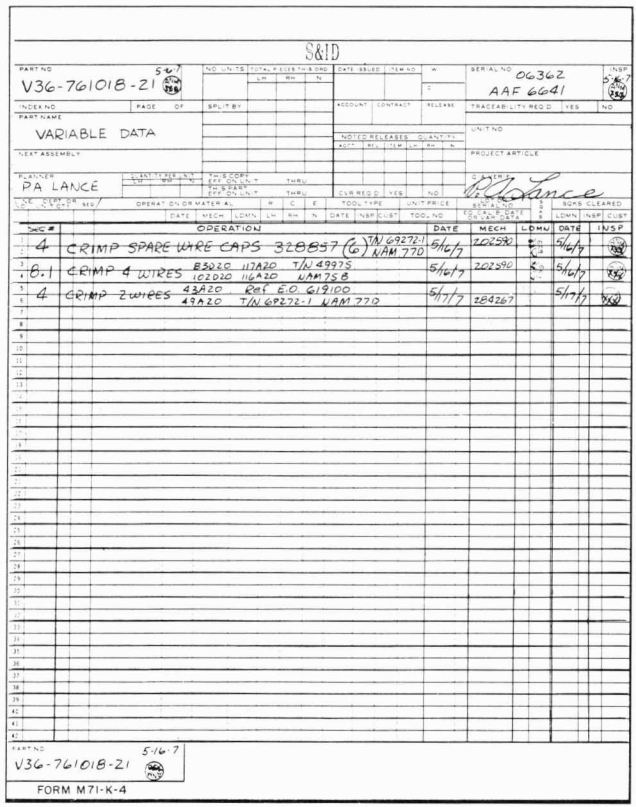
FORM M71-K-4

FIGURE 4

Upon completion of an operation the mechanic must enter his personal NAA identification number after the operations point in the FAIR book. The manufacturing leadman determines that the work is properly completed, stamps the appropriate column of the FAIR book and submits to Quality Assurance for acceptance.

c. OPERATIONS (Cont)

A "VARIABLE DATA SHEET" should be used to record operations called out in a sequence when the entire sequence can't be completed. All work you perform should be documented on the variable data sheet. If it completes a sequence in the FAIR book, the sequence should be submitted to Quality Assurance.



S&D

PART NO V36-761018-21 5-16-7

SERIAL NO 06362 AAF 6641

INSP 5-16-7

INDEX NO PAGE OF SPLIT BY

PART NAME VARIABLE DATA

NEXT ASSEMBLY

PLANNER PA LANCE

SEQ #	OPERATION	DATE	MECH	LOMN	DATE	INSP
4	CRIMP SPARE WIRE CAPS 328857 (6) T/N 69272-1 WAM 770	5/16/7	202590		5/16/7	
6.1	CRIMP 4 WIRES B3A20 117A20 T/N 49975 102D20 116A20 WAM 758	5/16/7	202590		5/16/7	
4	CRIMP 2 WIRES 43A20 Ref E.O. 619100 49A20 T/N 69272-1 WAM 770	5/17/7	284267		5/17/7	

PART NO V36-761018-21 5-16-7

FORM M71-K-4

FIGURE 5

DOCUMENTATION-FAIR BOOK-OPERATIONS	18 JUL 1967	
	DATE	DATE REVISED
	III	3.1.4
TITLE	SECTION	NUMBER

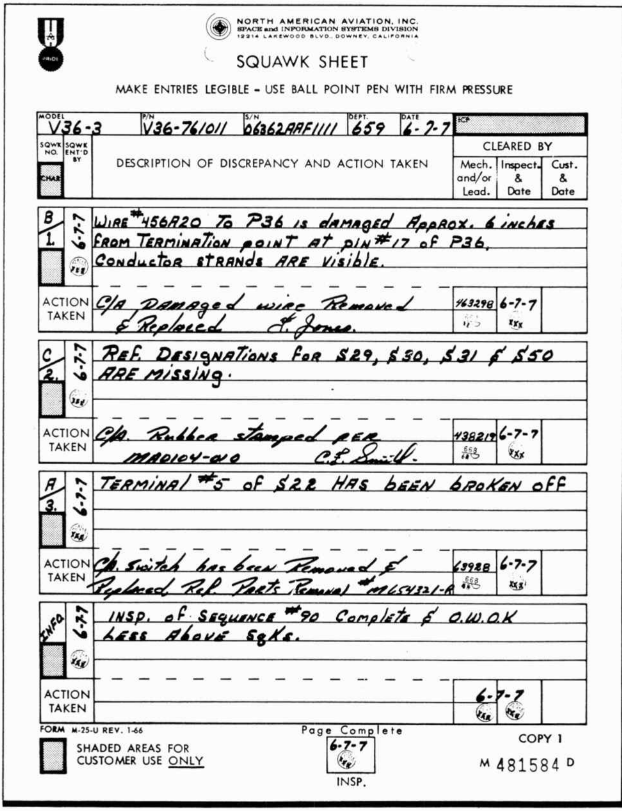
d. SQUAWK SHEET

A Squawk Sheet provides a permanent progressive record of inspection squawks and corrective action.

Upon discovery of a discrepancy Inspection enters it on the squawk sheet. Mechanic and Leadman resolving squawk must sign-off the action taken. Present to Inspection and Customer for concurrence.

There are four categories of squawks:
A = Critical
B = Major
C = Minor
P = Paperwork

Extreme CARE must be taken when performing rework operations.



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION
12214 LAKEWOOD BLVD., DOWNEY, CALIFORNIA

SQUAWK SHEET

MAKE ENTRIES LEGIBLE - USE BALL POINT PEN WITH FIRM PRESSURE

MODEL	P/N	S/N	DEPT.	DATE	ICP
V36-3	V36-761011	06362AAF1111	659	6-7-7	

SQWK NO. / CHAR	SQWK ENT'D BY	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY Mech. and/or Lead.	Inspect. & Date	Cust. & Date
B / 1.	6-7-7	WIRE #456A20 To P36 is damaged Approx. 6 inches FROM TERMINATION point at pin #17 of P36. Conductor strands ARE visible.			
ACTION TAKEN		C/A Damaged wire Removed & Replaced F. Jones.	463298	6-7-7	
C / 2.	6-7-7	Ref. Designations for S29, S30, S31 & S50 ARE missing.			
ACTION TAKEN		C/A. Rubber stamped per MA0104-010 C.E. Smith.	438219	6-7-7	
A / 3.	6-7-7	TERMINAL #5 of S22 HAS been broken off			
ACTION TAKEN		C/A. Switch has been Removed & Replaced Ref. Parts Removal #ML54321-R	69928	6-7-7	
INFO	6-7-7	INSP. of SEQUENCE #90 Complete & O.W. O.K Less Above SqKs.			
ACTION TAKEN			6-7-7	6-7-7	

FORM M-25-U REV. 1-66

SHADED AREAS FOR CUSTOMER USE ONLY

Page Complete 6-7-7 INSP.

COPY 1

M 481584 D

FIGURE 6

e. INSTALLED EQUIPMENT SERIALIZATION RECORD

The purpose of the Installed Equipment Serialization Record is to provide a complete traceability "tree" through a record of all serialized components at each Assembly/Installation level.

Upon completion of the Assembly/Installation remove the original from the FAIR book, and make a duplicate copy, identify it as a "duplicate" in the upper right hand corner and the words "Transferred to Recap" followed by an acceptance stamp and a date, on a diagonal line. File duplicate in the FAIR book being closed out.

The original shall accompany the hardware with the recap package for the next assembly FAIR book.

NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

M 211309

INSTALLED EQUIPMENT SERIALIZATION RECORD

END ITEM NAME C/M
END ITEM P/N V36-761003
END ITEM S/N ______

SYSTEM P/N C/22/2A203
SYSTEM NAME ENGINEER STA. MAIN DISPLAY

ASSEMBLY NAME PANEL 3 ASSY.
ASSEMBLY P/N V36-761013-21
ASSEMBLY S/N 06362-AAF8243

ITEM	ORIGINAL					NEW				NEW			
1. PART NAME / 2. PART NUMBER	LOT OR S/N	LOCATION LATEST E.O.	DWG. CHG.	DATE INSP	BOOK NO. / REMOVAL # / CODE	LOT OR S/N	DWG CHG LATEST E.O.	DATE INSP	REMOVAL SQK # / CODE	LOT OR S/N	DWG CHG LATEST E.O.	DATE INSP	REMOVAL SQK # / CODE
1. INDICATOR	097603	DS6		3/14/7									
2. ME432-0172-0012	212311			(XX)									
1. SWITCH	057757	S39		4/1/7	M79Q	057757		4/8/7					
2. ME452-0102-2219	012025			(XX)	M202717	012025		(XX)					
1. METER	097603	M1		3/14/7									
2. ME432-0170-0036	836104			(XX)									
1. CONNECTOR	022200	J4		12/26/6									
2. ME414-0132-0041	A39504			(XX)									
1.													
2.													
1.													
2.													
1.													
2.													
1.													
2.													
1.													
2.													
1.													
2.													
1.													
2.													
1.													
2.													

FORM 917-B REV 10-66 CODE: (Reason for Removal) P = PHYSICAL F = FUNCTIONAL C = CONFIGURATION

(XX) = INDICATES INSPECTION STAMP

FIGURE 7

f. PART REMOVAL RECORD

Provides a record of all parts removed from an assembly or installation, and reason for removal. Permits part to be reinstalled without planning action.

Manufacturing makes entries with Quality Controls concurrence.

DO NOT remove parts until properly completing the removal portion of the Part Removal Record and obtaining inspections OK to remove. Any part removed must be handled with the same delicate care as new parts require.

NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

PART REMOVAL RECORD

DEPARTMENT *66B* MODEL *V36-3* UNIT NO. *V36-761013-21 103* S/N *06362 AHFB243*

ITEM (1 PART NAME / 2 PART NUMBER)	SERIAL NO. ORIG.	SERIAL NO. NEW	OK TO REMOVE DATE	OK TO REMOVE CO. INSP.	OK TO REMOVE CUST. INSP.	REMOVED BY CO. MECH.	OK TO INSTALL DATE	OK TO INSTALL CO. MECH.	OK TO INSTALL CO. INSP.	INSTALLATION OK DATE	INSTALLATION OK CO. MECH.	INSTALLATION OK CO. INSP.	OPERATION OK DATE	OPERATION OK CO. MECH.	OPERATION OK CO. INSP.	OPERATION OK CUST. INSP.
1 TERM BLOCK TB3	03221XX 6609B	03221XX 6702C	5-3-7	(✓)	N/R	441 884	5-3-7	441 884	(xx)	5-4-7	441 884	(xx)	5-4-7	N/R	(xx)	N/R
2 MD417-0015-0107	REASON FOR REMOVAL & LOCATION	20 REMOVE DAMAGED GROMMET REF. SQK. #89														
1 ALL LUGS	NONE	NONE	5-5-7	(xx)	N/R	283 541	5-5-7	283 541	(xx)	5-5-7	283 541	(xx)	5-5-7	N/R	(xx)	N/R
2 322363	REASON FOR REMOVAL & LOCATION	TORQUED T/N TQ-1 NAM #14-5 LBS TO RESTACK LUGS PER SPEC. MA0303-0112 REF. SQK. #91 & #92														
1 CONN J9	022200A 39878	022200 AS3402	5-18-7	(xx)	N/R	441 884	5-18-7	283 541	(xx)	5-18-7	283 541	(xx)	5-18-7	N/R	(xx)	N/R
2 ME414-0149-0014	REASON FOR REMOVAL & LOCATION	REMOVE ALL WIRES TO WORK SQK. #106 PART NOT TO BE RE-INSTALLED REF. SQK. #2905-25-7 REPLACE CONN. PER SQK. #290														
1																
2	REASON FOR REMOVAL & LOCATION															
1																
2	REASON FOR REMOVAL & LOCATION															
1																
2	REASON FOR REMOVAL & LOCATION															
1																
2	REASON FOR REMOVAL & LOCATION															
1																
2	REASON FOR REMOVAL & LOCATION															
1																
2	REASON FOR REMOVAL & LOCATION															
1																
2	REASON FOR REMOVAL & LOCATION															

FORM M T9-Q REV 6-62

M 229353 **-R**

(xx) = INDICATES INSPECTION STAMP

FIGURE 8

g. DISCREPANT MATERIAL DISPOSITION (DMD)

Material Review Disposition (MRD) Form 23H-1 is presently in use.

A discrepant item is any material, part, or assembly which does not conform to all requirements of the engineering drawing and specification governing the item. When a discrepancy of this type occurs, and Inspection Supervision deems and MR is required, inspection immediately contacts Material Review for an analysis. If Material Review decides, (with Engineering and Customer concurrence) that the discrepancy is acceptable for use, or that it may be reworked, an MRD is initiated. The MRD contains all necessary rework instructions and all required inspection points.

A copy of the MRD is then inserted in the DMD section of the FAIR book. The required rework is then accomplished in accordance with the instructions on the MRD.

For the procedure used to initiate MRD's refer to Material Review System.

S/C 101

MR 225302

PAGE 1 OF 1

1 PART NO	2 PART NAME	3 COPIES TO	DEPT	NO.	4 DIVISION	5 MODEL - PROGRAM	6 GO	CONT	IDWA	7 SUPPLIER OR DEPT
V36-412103	WIRE HARNESS	MR	167	5	41	V36-3/APOLLO		7126		NAA/D1670
		D1670	670	2						

8 MATERIAL & PRESENT CONDITION: N/A

9 TRAVELER NO: N/A

10 WITHHOLDING DOC NO: M480438D

11 NO. OF PIECES	12 SERIAL/UNIT NO.	13 LOT/HEAT/BATCH NO.	14 % COMPLETE	15 RESTRICTED END USE	16 NEXT ASSY AFFECTED	17 ACCOUNT	18 SUB ACCOUNT	19	20	21	22
ONE	101	N/A	N/A	☐ YES ☒ NO	☐ YES ☒ NO	N/A	7122	CA43B/CODSI	T/L	N/A	670 NA4

23 DISCREPANCY

Occurred on Assembly

SQR#103 (2) WIRE INSULATION DAMAGE ON 3 TWISTED PAIR, NO CONDUCTOR DAMAGE & CONDUCTOR NOT EXPOSED.

WIRE NUMBER: 3N510A20 RED
3N510A20 BLK

LOCATION: X_c 43 - Y_c 55 - Z_c 8
ONE INCH ABOVE GIRTH SHELF

ROUTES: P343-34 — RED — J485-48
P343-36 — BLK — T848I-A3

* NOTE: PRIOR TO APPLYING HEAT, ADJACENT AREAS SHALL BE SHIELDED FROM HEAT APPLICATION

24 DISPOSITION

REPAIR PER STANDARD REPAIR EL 1.1 (REV'A') DATED 4-24-67

STEP 1- REMOVE WIRE FROM ONE TERMINATION POINT, IDENTIFY TERMINATION POINT WHERE REMOVED ____ INSP ____

STEP 2- USING THE THERMO-STRIPPER, REMOVE DAMAGED SECTION OF INSULATION. INSP ____

STEP 3- INSTALL MB0150-025, CLASS III, ELECT SLEEVING OVER STRIPPED AREA AS FOLLOWS:

(A) CUT A LENGTH TO PROVIDE A MINIMUM OF 3/8" OVERLAP BEYOND EACH SIDE OF STRIPPED AREA

(B) CLEAN CONDUCTOR WITH ISOPROPYL ALCOHOL. INSP ____

*(C) SLIP SLEEVE OVER END OF WIRE & CENTER OVER DAMAGED AREA, SHRINK IN PLACE IN ACCORDANCE WITH MA0303-0065. INSP ____

(D) RE-TERMINATE WIRE THAT WAS REMOVED. INSP ____

25 N/A

26 N/A

MATERIAL REVIEW APPROVAL

27 MR ENGINEER	DISP	DATE	28 ENGINEERING	DATE	29 CUSTOMER	DATE
J. Ratedy	STD-REP	5/4/67	K. K. Lee	5/4/67	[illegible] Harrison	5/4/67

30 C.A.R. INITIATED?	31 C.A.R. NO.	32 WRITTEN BY	33 DIV.	34 BLDG.	35 PHONE	36 DATE
☐ YES ☒ NO	N/A	J. A. Ratedy	41	290	4923.4	5/6/67

NORTH AMERICAN AVIATION, INC. MATERIAL REVIEW DISPOSITION

FIGURE 9

DOCUMENTATION - DESCREPANT MATERIAL DISPOSITION (DMD)	18 JUL 1967	
	DATE	DATE REVISED
	III	3.1.8
TITLE	SECTION	NUMBER

FORM 999-A-7 REV 4-67

B. TEST AND INSPECTION RECORD (TAIR)

1. The TAIR system is the control and inspection documentation system used by Test & Operations after manufacturing completion. Upon completion of test operations the TAIR book becomes a permanent Quality and Reliability Assurance historical record. All sections of the TAIR book are the same as the FAIR book except the operations.

TAIR

TEST AND INSPECTION RECORD

BOOK NO. 1	
ASSEMBLY NAME INSTRUMENTATION INST. R.C.S. ENG. TEMP.	MODEL NO. V36-3
ASSEMBLY NO. V36-XXXXXX	SERIAL NO. 06362 - AAE 1496
UNIT NO. 1	LOCATION BLDG. #6

NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

FORM 961-C NEW 6-63

FIGURE 1

DOCUMENTATION-TEST AND INSPECTION RECORD (TAIR)	18 JUL 1967	
	DATE	DATE REVISED
	III	3.2
TITLE	SECTION	NUMBER

2. TEST PREPARATION SHEET (TPS)

The Operation section consists of Test Preparation Sheet (TPS), and rework tickets, which provide continuity of documentation for engineering configuration changes.

The purpose of a TPS is to delineate test sequences and related mandatory inspection points, and to provide accounting data. They are used to authorize tests per an Operational Checkout Procedure (OCP), authorize troubleshooting, or control removal and replacement of parts. Q&RA provides a separate TAIR book for each OCP.

CONFIGURATION CHANGE	
NON-CONFIGURATION CHANGE	X
TPS MODIFICATION	

NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

TEST PREPARATION SHEET

TPS NO. 814-053
S/C STA 2D | CAT. GSE | NO. 039
MOD. SHEET NO.
PAGE / OF / | DATE 6-19-7

PROGRAM	END ITEM NO.	SYSTEM NAME	INITIATOR	DEPT.
APOLLO	814-053	ECS/GSE	J.H. EARL	643
ASSY NAME W/G TRIM SET	ASSY. NO. 616-855157	ASSY. S/N 009	AUTH E.O. NO.	DATE REQD 6-19-7
TPS SHORT TITLE REMOVE TEMP CONTROL TRAY			PART WEIGHING REQUIRED	YES / NO X
REASON FOR WORK ITEM REQUIRED TO REPLACE FAILED			C.R. REQD.	YES / NO X
ITEM IN 814-053 CONSOLE AT STA 2B			TRACEABILITY CODE	

LINE	DESCRIPTION (Print or Type)	TECH	INSP. NAA	INSP. CUST
1	(1) REMOVE TEMP CONTROL TRAY AND	445 420	(*)	(*)
2	TRANSPORT TO STA 2B. VERIFY REMOVAL			
3	RECORD LEFT OPEN.			
4				
5	(2) RE-INSTALL TEMP CONTROL TRAY SAME		(*)	(*)
6	P/N. VERIFY FUNCTIONAL % PER TPS.			
7	VERIFY REMOVAL RECORD CLOSED.			
8				
9	(3) PERFORM ECS CHECKOUT PER		(*)	(*)
10	OCP-P-XXX-SCXXX			
11	SECTION 2			
12	SECTION 4			
13	SECTION 8			
14				
15				
16				
17				
18				
19				
20				

PART WEIGHED & RECORDED IF REQ'D. | FINAL ACCEPTANCE DATE

APPROVALS — REFER TO PROCEDURES FOR SPECIFIC APPROVALS

	SIGNATURE	DEPT.	DATE		SIGNATURE	DEPT.	DATE
1	John Doe	642	6-19-7	1	John Henry	Mgmt	6-20-7
2				2			
3	John Doe	642	6-19-7	3			
4				4			

FORM 999-K REV. 10-66 (*) INDICATES STAMP REQUIRED.

FIGURE 2

DOCUMENTATION-TAIR BOOK-TEST SEQUENCES	18 JUL 1967	
	DATE	DATE REVISED
	III	3.2.1
TITLE	SECTION	NUMBER

C. CHANGE VERIFICATION RECORD (CVR)

1. The CVR system is initiated after the initial release of engineering documents. It provides a permanent record, in book form, of design changes related to the specific deliverable item.

   CVR supplements the FAIR/TAIR documentation system & provides:

   1. A POSITIVE audit of the FAIR/TAIR system.
   2. A timely "ALERT" to all concerned personnel.
   3. A summary association of design change to specific part, assembly, etc. with end item orientation.

   The CVR book is initiated and maintained by Manufacturing Planning, and is identified to the FAIR book being supplemented.

   The CVR book should be located with the FAIR book.

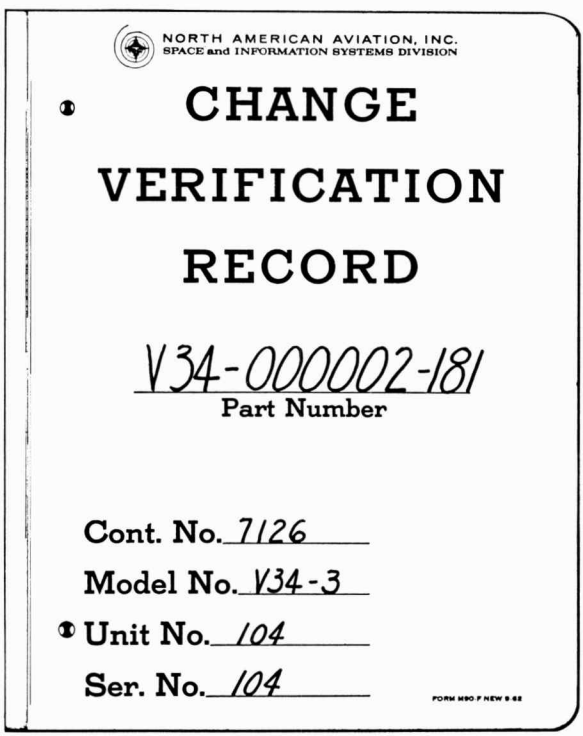


FIGURE 1

DOCUMENTATION-CHANGE VERIFICATION RECORD (CVR)	18 JUL 1967	
	DATE	DATE REVISED
	III	3.3
TITLE	SECTION	NUMBER

2. CVR BOOK

BOOK CONTAINS:

1. Change verification record (Form M81-C)
2. Page addition and removal record (Form M90-F-1).
3. CVR transfer sheet (Form M81-D).

3. CHANGE VERIFICATION RECORD

USE OF FORM:

1. E.O. number.
2. Drawing number if change is against a sub-assembly.
3. Drawing change letter if the drawing change was released by the noted E.O.
4. Brief description of the change.
5. Mechanic and Inspection verification.

Entries at 1 thru 4 are controlled by Manufacturing Planning, identified by stamp.

All E.O.'s shall be verified by mechanic and sold to inspection as work on assembly or installation progresses and changes are incorporated.

INSPECTION AUTHORIZATION FOR REMOVAL OF THIS SHEET FROM BOOK

CHANGE VERIFICATION RECORD

MOVING FORM

E.O. NUMBER (AND DWG. IF APPLICABLE)	DWG. CHG. LTR.	TYPE	CHG. POINT	DESCRIPTION OF CHANGE	ORIG. DEPT.	REMARKS (IN INK)	ENTRY DATE	MECH. DATE	INSP. SQ. REF.	INSP. STAMP
M465115 V36-759560	A	MCR NTD	NTD SEE EO	Release of 'A' CHG DRAWING	659	Ref EDM 210938	10-20	404368 6-20-67		XX
M465118 V36-759561	B	MCR NTD	NTD SEE EO	Release of 'B' CHG DWG	659		12-13	405437 6-20-67		XX

UNIT NO. 104 U/N 104 SECTION V36-310000 CONTRACT 7137 PAGE NO. PAGE NO. PAGE NO.

FORM M81-C REV 4-63 XX = INDICATES STAMP REQUIRED ENTRIES VOID IF NOT WRITTEN IN INK PAGE NO. PAGE NO. PAGE NO. 1

FIGURE 2

DOCUMENTATION-CVR BOOK-CHANGE RECORD	18 JUL 1967	
	DATE	DATE REVISED
	III	3.3.1
TITLE	SECTION	NUMBER

4. ADDITIONS & REMOVALS

Used to control the CVR book by maintaining a record of pages added or removed. All entries are made by Manufacturing Planning.

ADDITION AND REMOVAL RECORD

PAGES OF THIS CVR MAY BE ADDED OR REMOVED ONLY BY PLANNING CVR GROUP AND A RECORD OF ALL SUCH ADDITIONS AND REMOVALS WILL BE MADE ON THIS PAGE, PROPERLY VERIFIED BY PLANNING AND INSPECTION STAMPS AND DATE.

UNIT NO. #105 ASSEM NO. V36-759011-21 DATE 12-14-66

S/N AAG 3238 ORIG. PAGES 1 THRU 9

PLAN. STAMP	PAGE NUMBERS ADDED	INSP. STAMP	DATE	PLAN. STAMP	PAGE NUMBERS REMOVED	INSP. STAMP	DATE
(*)	V36-880000 PG. 1	(*)	12-14-6	(*)	V36-750000 PG. 2	(*)	12-20-66

FORM M90-P-1 (*) = INDICATES STAMP REQUIRED.

FIGURE 3

5. CVR TRANSFER SHEET

The CVR Transfer Sheet is used as a recap sheet to summerize E.O.'s NOT cleared at the time an assembly is closed out and transferred to the next assembly. Copy distribution is as follows:

YELLOW - To N/A CVR Book
PINK - To Technical Integration after yellow copy is mated in N/A.
GREEN - To CVR Planning to indicate assembly received at next using station.
BLUE - To CVR Planning to indicate assembly closed-out.
WHITE - Retained by originating department.

C.V.R. TRANSFER SHEET

TO: DEPT. 479 CVR GROUP, CONTRACT 7137 DATE 6-8-7

FROM DEPT. 659

SUBJECT: OPEN E.O.'S ON ASSEM. NO. V36-761011 UNIT NO. 101 S/N 06362 AAF1111

TRANSFERRED TO DEPT. NO. 662 FROM DEPT. NO. 659

PLEASE LIST NOTED E.O.'S ON ONE ADDITIONAL ASSEM. TO COMPLETE (10) UNIT VERIFICATION

E.O. NO.	PLANNING ACTION	E.O. NO.	PLANNING ACTION
M368681			
M372538			

6-8-7 6-8-7

John Henroy VERIFIED BY INSPECTION

Frank Jones REQST'D BY

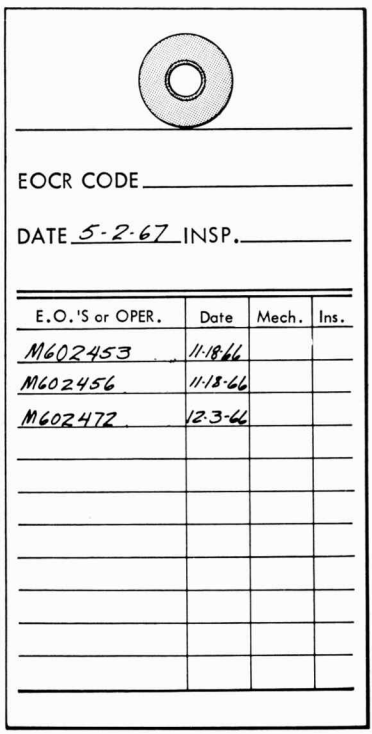
PHONE 4638

Form M81-D (Rev. 1-62) PLANNING CVR GROUP

FIGURE 4

D. PARTS STATUS AND IDENTIFICATION TAG

Commonly called the 902-W-1 tag. It is used in the CVR system as an attached & serialized part status record of a production detail or sub-assembly below the CVR level. The 902-W-1 reflects the incorporated E.O.'s effective against the part or sub-assembly at the time the FAIR control ticket was completed against the part.



BACK FRONT

FIGURE 1

A 902-W-1 tag is initiated to record EOCR's for an assembly affected by E.O.'s against it. All E.O.'s are recorded in the EOCR. Initial preparation of all 902-W-1 tags is the responsibility of Manufacturing.

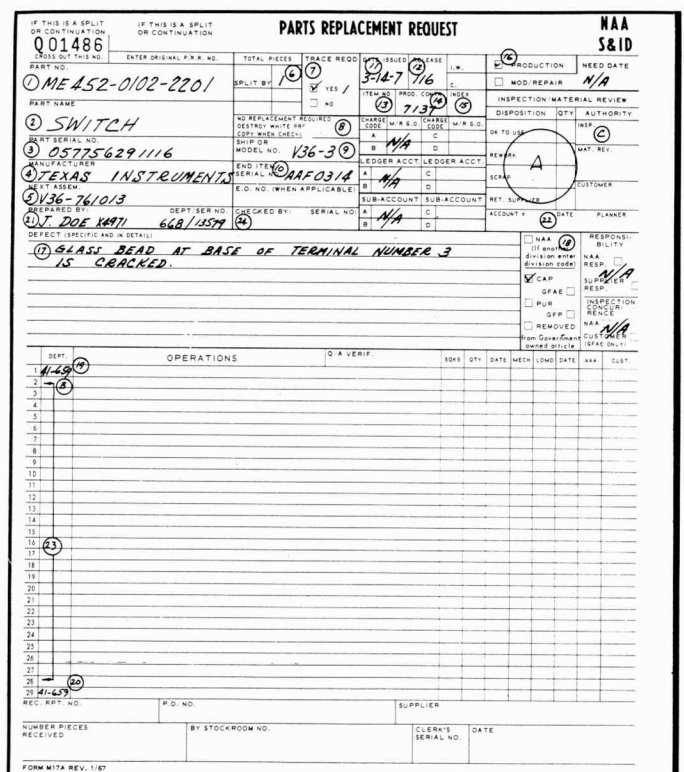
Quality & Reliability Assurance is responsible for recording all worked E.O.'s, and attaching the 902-W-1 tag to the part.

E. PARTS REPLACEMENT REQUEST (PRR)

1. The PRR is used at the Space Division to withhold and process previously inspected production items suspected of being defective. Manufacturing departments are responsible for initiating the PRR.
   NOTE: A PRR must be prepared immediately upon discovery of a defective or damaged part and processed out of the originating department within 24 hours. If unable to stop at the moment of discovery to prepare the PRR you must date and attach one to the defective part and complete the remainder of the entries as soon as practical.
   When immediate replacement of a defective part is required, a replacement part may be withdrawn from department stock or warehousing, or borrowed from another department, and then replenished or repaid when the defective part is reworked, repaired or replaced.

   Any "defective" parts must be handled with the same delicate care as new parts require.

2. INSTRUCTIONS FOR USE OF FORM M17A
   For details of each entry on Form M17A shown below, refer circled number on form to circled numbers on the following pages of PRR subject.



PARTS REPLACEMENT REQUEST

NAA S&ID

IF THIS IS A SPLIT OR CONTINUATION Q01486 CROSS OUT THIS NO. ENTER ORIGINAL P.R.R. NO.

IF THIS IS A SPLIT OR CONTINUATION

PART NO. ① ME452-0102-2201

PART NAME ② SWITCH

PART SERIAL NO. ③ 0577562911 16

MANUFACTURER ④ TEXAS INSTRUMENTS

NEXT ASSEM. ⑤ V36-761013

PREPARED BY: ⑥ J. DOE X4971 DEPT. SER NO. 668/1357

DEFECT (SPECIFIC AND IN DETAIL) ⑰ GLASS BEAD AT BASE OF TERMINAL NUMBER 3 IS CRACKED.

TOTAL PIECES ⑥ SPLIT BY 1

TRACE REQD ⑦ ☑ YES ☐ NO

NO REPLACEMENT REQUIRED: DESTROY WHITE PRT COPY WHEN CHECK ⑧

SHIP OR MODEL NO. V36-3 ⑨

END ITEM SERIAL NO. ⑩ AAF0314

E.O. NO. (WHEN APPLICABLE)

CHECKED BY: SERIAL NO. ⑭

DATE ISSUED ⑪ 3-14-7

RELEASE ⑫ 3/6

I.W. C.

ITEM NO ⑬ PROD. CONT. 713

INDEX ⑮

CHARGE CODE M/R G.O. CHARGE CODE M/R G.O.

A N/A C

B D

LEDGER ACCT. LEDGER ACCT.

A N/A C

B D

SUB-ACCOUNT SUB-ACCOUNT

A N/A C

B D

☑ PRODUCTION ☐ MOD./REPAIR NEED DATE N/A

INSPECTION MATERIAL REVIEW

DISPOSITION QTY AUTHORITY

OK TO USE A INSP. C

REMARK MAT. REV.

SCRAP CUSTOMER

RET. SUPPLIER

ACCOUNT # ㉒ DATE PLANNER

☐ NAA (If another division enter division code) ⑱ RESPONSIBILITY

☑ CAP ☐ GFAE ☐ PUR ☐ GFP ☐ REMOVED from Government owned article

NAA RESP. N/A

SUPPLIER RESP.

INSPECTION SURVEILLANCE: NAA N/A

CUSTOMER (GFAE ONLY)

DEPT.	OPERATIONS	Q.A. VERIF.	SCHS	QTY.	DATE	MECH	LOMD	DATE	NAA	CUST.
1	41-429 ⑲									
2	→ ②									
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16	㉓									
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28	→ ⑳									
29	41-659									

REC. RPT. NO. P.O. NO. SUPPLIER

NUMBER PIECES RECEIVED BY STOCKROOM NO. CLERK'S SERIAL NO. DATE

FORM M17A REV. 1/67

FIGURE 1

DOCUMENTATION-PART REPLACEMENT (PRR)	18 JUL 1967	
	DATE	DATE REVISED
	III	3.5
TITLE	SECTION	NUMBER

FORM 999 A-7 REV 4-67

① Enter part number of the item being PRR'd.

② Enter part name (in full) of the item being PRR'd.

③ Enter serial number of the part being PRR'd. This may be the model serial number, vendor's serial number, lot serial number, etc., assigned to the defective part.

④ Enter the vendor's name for defective warehouse items, if known. Otherwise leave blank.

⑤ Enter the next assembly number of the defective item.

⑥ Enter the total number of defective parts to be processed on this PRR. The defect must be the same for all of the parts to be processed on a single PRR.

⑦ Check appropriate block and show the corresponding traceable number from the FAIR ticket, or the traceable code from the blueprint.

⑧ If a replacement is not required for the defective part, check this block, and destroy the white copy of the PRR.

⑨ Enter the model or ship number which the defective part is in support of, or goes into.

⑩ Enter the serial number of the item the defective part was removed from or was scheduled to support.

⑪ Enter the date of preparation of the PRR.

⑫ Enter the release number the part was received on by the using department, or the release number of the assembly it is installed in when discovered as defective.

⑬ If the defective part is a spare or modification kit requirement or is installed in a spare or modification kit assembly when discovered as defective, enter the item number here. The item number can be found on the FAIR ticket.

⑭ Enter the general order number the defective part was received on, or of the assembly installed in, when part was discovered defective.

⑮ Enter the index number assigned to the defective part. It may be obtained from blue reference tickets for NAA fabricated parts. This block is not applicable to warehouse items.

⑯ Check this block to indicate that this is a production type PRR.

⑰ Enter the specific defect, describe in detail the discrepancy noted.

⑱ Check the appropriate block:

NAA	"C"items that are NAA fabricated and show the division code number if other than Space Division.
CAP	Company acquired property (equipment items)
GFAE	Government furnished aircraft equipment
PUR	Purchased details and assemblies, and all categories of hardware
GFP	Government furnished parts

⑲ On line 1 of routing enter the division code number, a dash, and the originating department number.

⑳ On line 29 of routing enter the division code number, a dash, and the originating department number.

(21) The signature, extension, department number, and serial number of the employee preparing the PRR.

When all of the above entries are completed the PRR is turned over to Quality & Reliability Assurance for assessment. The inspection disposition is made at (A), or if the disposition is "send to Material Review" it will be indicated on line 2 (B). Inspection Supervision signature is then obtained at (C) for entries made at (A) or (B).

(22) Planning enters appropriate account number for action to take place as a result of Q&RA disposition in entry (A) or (B), along with date and authorizing stamp.

(23) Line 3 thru 28 of routing - planning enters routing to accomplish disposition made by inspection or material review.

(24) The signature, extension, and serial number of the coordinator or supervisor accepting responsibility for the validity of all prior entries on the PRR.

F. MATERIAL REVIEW SYSTEM (MR)

1. Space Division maintains a material review system to evaluate and disposition materials, parts, assemblies or products which depart from specifications, drawings or contracts and are considered nonconforming to Space Division or customer requirements.

Policies & Procedures establishes a three-phase material review process with a Material Review Control Center (MRCC) to coordinate material review activities.

PHASE I Material Review Action - Inspection Supervision or MR Engineer, reviews the nonconformance submitted, and terminates it by a Material Review Disposition (MRD), or forwards the nonconformance for a higher level review.

PHASE II Material Review Action - An Operating Material Review Board (MRB), reviews the nonconformance submitted, and terminates it by a MRD, or forwards the nonconformance to the Primary Material Review Board (PMRB) for a higher review. An operating MRB consists of an authorized Customer Representative, authorized Engineering Representative, and an authorized Q&RA Representative.

PHASE III Material Review Action - A Primary Material Review Board, reviews the nonconformance submitted, and terminates it by a MRD on decision that contract change action should be recommended. The PMRB consists of an authorized Representative of the Customer, Program Chief Engineer, and Program Director of Q&RA.

2. PROCEDURE - When a discrepancy is observed which cannot be dispositioned by Inspection Supervision, inspection prepares a material review disposition (MRD) and forwards it to the Material Review Control Center (MRCC). The MRCC manager reviews the item and determines if PHASE II or PHASE III action is required. PHASE II nonconformances are processed as follows:

a. The assigned Material Review Engineer makes his disposition by reviewing the item and consulting with Q&RA, engineering, manufacturing, and any other department as necessary.

b. The assigned engineer prepares the disposition on the MRD and obtains Q&RA concurrence.

c. The assigned engineer approves the MRD and obtains customer approval and forwards the MRD to Q&RA for distribution to those concerned.

PHASE III Items are processed in the same manner as above except they are referred to the PMRB for further disposition approvals.

See FAIR book section of this manual for sample MRD.

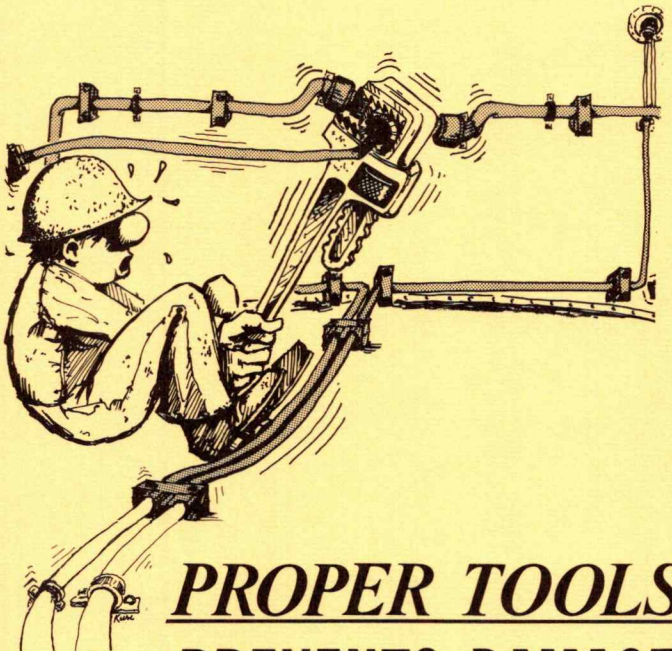
G. STANDARD REPAIRS

Space Division maintains a system to authorize the performance of standard repairs to disposition recurring nonconformances.

Material Review Engineers or Inspection Supervision may authorize the application of standard repairs which are documented on a Material Review Disposition (MRD, form 23 H-1) during the processing of nonconformances.

The STANDARD REPAIR MANUAL lists all standard repairs. Each standard repair in this manual has been approved by the Primary Material Review Board.

CORRECT USE OF...

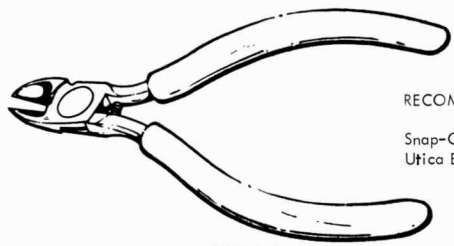


PROPER TOOLS
PREVENTS DAMAGE & ASSURES *RELIABILITY*

IV TOOLS & APPLICATION

DIAGONAL CUTTING PLIERS (DIKES)

The diagonal cutting pliers shown are used for cutting light gauge wire and component leads. They have flush cutting edges, tapered jaws and plastic-coated handles which provide ease of operation in precision work. The flush edges of these pliers should always face the direction of the part to be cut.



RECOMMENDED MANUFACTURERS

Snap-On E-707
Utica B5263

FIGURE 1

SHORT CHAIN NOSE PLIERS

The pliers shown are equipped with plastic coated springback handles and smooth radiused jaws.

LONG NEEDLE-NOSE PLIERS

The pliers shown here are of the long, smooth, radius-edged needle-nose type. Equipped with plastic-coated springback handles and long tapered jaws, they can perform light wiring and lead bending operations.

RECOMMENDED MANUFACTURERS

Utica #23 - 4-1/2" (Special AN No. B5317)
Klein (D322 - 4-1/2 C)
EREM #115

RECOMMENDED MANUFACTURERS

Utica #775 (Special AN No. B5818)
Klein #318 - 5-1/2C
EREM #14L-6

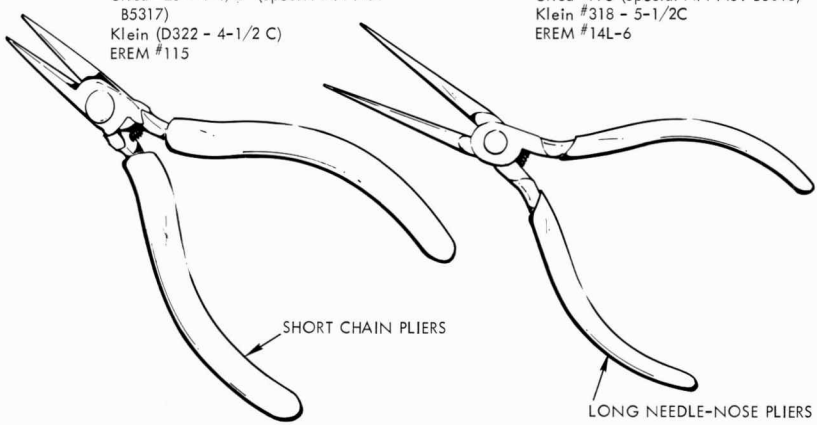
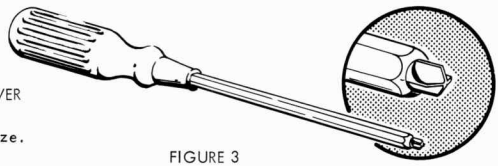


FIGURE 2

DIAGONAL CUTTERS-LONG NOSE PLIERS-SHORT CHAIN PLIERS	18 JUL 1967	
	DATE	DATE REVISED
	IV	4.1
TITLE	SECTION	NUMBER



APEX TORQUE SCREWDRIVER
#268-W-6
Last digit indicates screw size.

FIGURE 3

PLUG SUPPORTS (MATING RECEPTACLE SHELLS) TOOL NAME (JINGLE BELLS)

NOTE - When tightening or loosening threaded parts of connectors, support all plug assemblies by mating them with the proper receptacle shell as shown or holding them with an approved plug wrench.
Prior to use, check mating shell for damage or contamination.

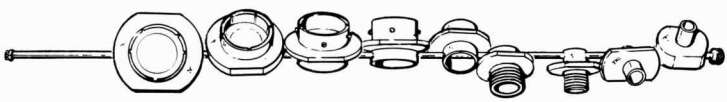
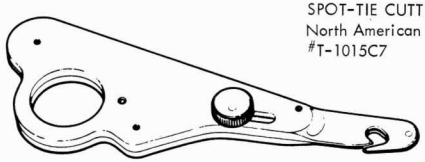
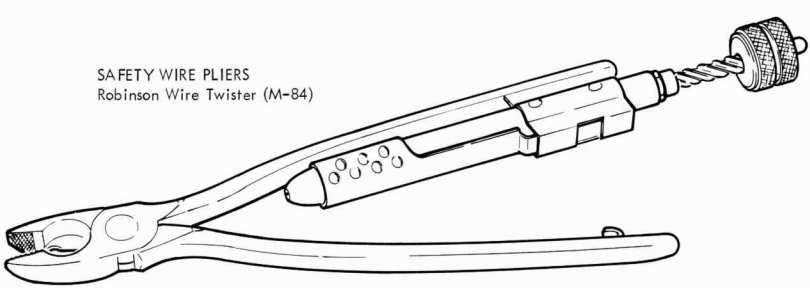


FIGURE 4



SPOT-TIE CUTTER
North American Aviation, Inc.
#T-1015C7

FIGURE 5



SAFETY WIRE PLIERS
Robinson Wire Twister (M-84)

FIGURE 6

TORQUE SCREWDRIVER - MATING RECEPTACLE SHELLS - SPOT-TIE CUTTER-SAFETY WIRE PLIERS	18 JUL 1967	
	DATE	DATE REVISED
	IV	4.1.1
TITLE	SECTION	NUMBER

AIRCRAFT TOOL INC.
CONNECTOR PLIERS

SPECIFICATIONS
AT508 WITH PLASTIC INSERTS

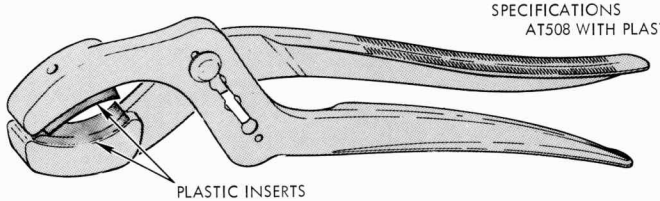
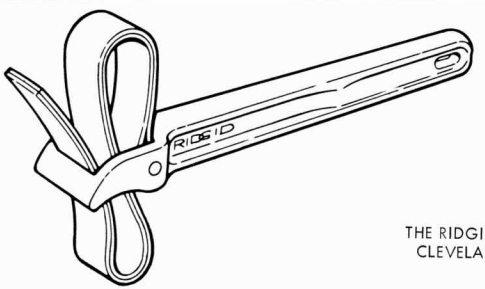


FIGURE 7

NOTE: When tightening or loosening threaded parts of connectors, support all plug assemblies by mating them with the proper receptacle or holding them with an approved plug wrench. Support receptacles by clamping flange in a vise having padded jaws. Standard strap wrenches or approved connector pliers shall be used for tightening or loosening threaded parts of connectors.

STRAP WRENCH
TOOL #2



THE RIDGID TOOL CO.
CLEVELAND, OHIO

FIGURE 8

SNAP-ON TORQUE TOOL TQ-1

This tool may be used from a position of 90 degrees away from the item being torqued, when a straight torque driver cannot be used. This tool is capable of from 0 to 15 inch pounds in either clockwise or counter-clockwise direction. Each increment on the dial represents 1/2 inch pound.

To torque in a clockwise direction, grasp the handle gently in the right hand with thumb resting against index finger, "not against the side of tool or dial". The torque attachment must be kept straight in line with the hardware being torqued. Pull handle gently until pointer is at desired position.

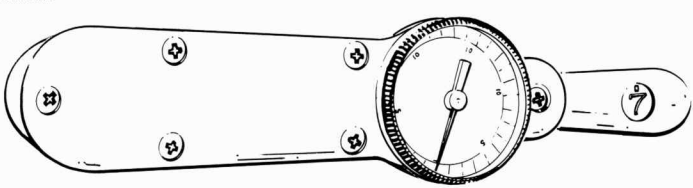


FIGURE 9

CONNECTOR PLIERS - TORQOMETER	18 JUL 1967	
	DATE	DATE REVISED
	IV	4.1.2
TITLE	SECTION	NUMBER

The THERMAL WIRE STRIPPER is used for removal of wire insulation. It can be used as a single unit or can be detached for hand-held applications. The control knob (rheostat) is used to adjust the temperature of the heating elements.

In operation the wire end is placed between the two heating elements at the stripping length desired. While one HAND closes the pincers, the other turns the wire between the thumb and index finger to melt the insulation and cause separation. The pincers are then released and the insulation is removed by hand using a pulling, twisting motion.

The wire insulator should be removed without disturbing the normal lay of the wires. If the lay is disturbed, the wire should be retwisted to its original wrap.

The insulation stripped off of the wire should have a minimum of edge flash with no damage to the wire.

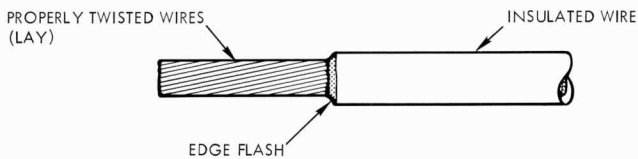
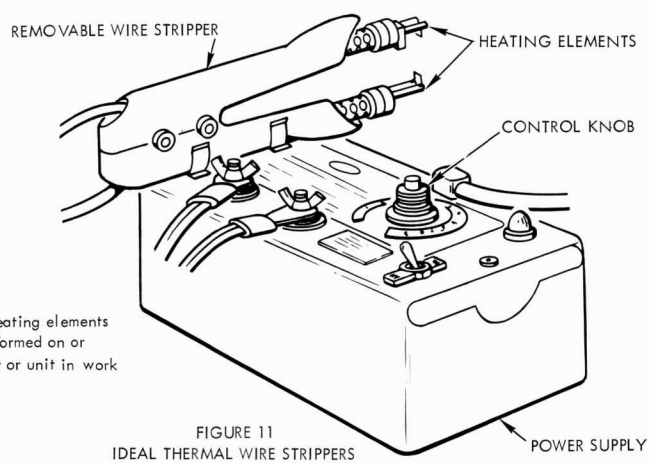


FIGURE 10

The heating element of the stripper should be cleaned frequently with a wire brush to remove melted or burned insulation, and the control unit should be turned off when not in extended use.



NOTE:
Cleaning of the heating elements should not be performed on or near any assembly or unit in work

FIGURE 11
IDEAL THERMAL WIRE STRIPPERS

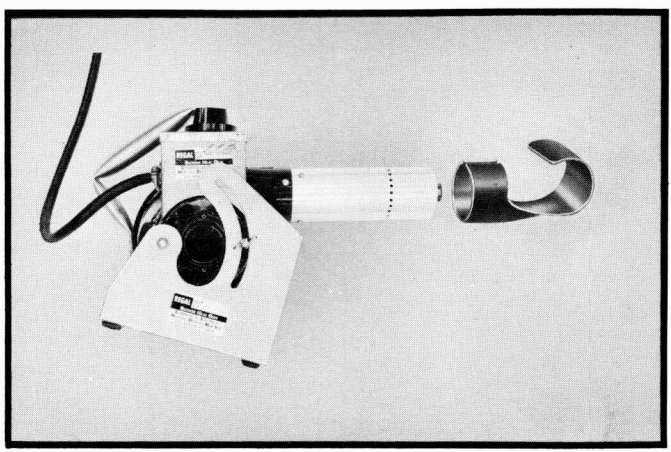
	18 JUL 1967	
STRIPPING TOOL -THERMAL-PINCER TYPE-	DATE	DATE REVISED
	IV	4.1.3
TITLE	SECTION	NUMBER

Used for shrinking sleeving on wires and terminals. It has a heat deflector that can be slipped on the end of the blower for even dissipation of heat. Refer to chart placed on heat gun by Calibration & Test for proper dial setting. Heat shields, such as heavy gauge foil, shall be used as necessary for protection of parts that may be damaged by heat.

When sleeves are to be shrunk on wires or cables with soldered terminations, the minimum distances from the soldered joint that heat may be applied and the maximum heat that may be applied shall be as follows:

a. Heat shall be applied a minimum of 12 inches from the soldered joint and shall not exceed 1000 F when MB0150-025, Class 1 through Class 4 sleeves are used.

b. Heat shall be applied a minimum of 2-1/2 inches from the soldered joint and shall not exceed 500 F when MB0150-025, Class 5 sleeves are used.



Model No. 10-18, Commercial Electrical Heating Devices & Mfg., Inc., Los Angeles.
FIGURE 12

Caution

- Apply heat no longer than necessary to produce shrinking.
- Do not use open flame for shrinking.
- Heat shrinkable sleeves will shrink when they reach approximately the temperature listed in Table I.

TABLE I

Sleeve Material	Shrinking Temperature
Teflon (TFE)	621 F
Teflon (FEP)	350 F
Silicone Rubber	350 F
Kynar	350 F

Overlaps: When two sleeves are to be overlapped, the overlap shall be approximately 1 inch or 1/2 the length of the shortest sleeve, which ever is smaller. Several shrinking operations may be necessary to install overlapping sleeves with like diameters.

Hand soldering shall be done ONLY by certified solderers. Most soldering will be done at the sub-assembly level.

1. SOLDERING IRON - A soldering iron should be selected to best suit the work to be done. Consideration should be given to tip size and shape, voltage and wattage rating, and the temperature desired. Temperature control of the iron may be accomplished thru the use of a variable voltage supply, tip selection or a combination of both. A transformer-type soldering gun or iron must not be used under any circumstances.

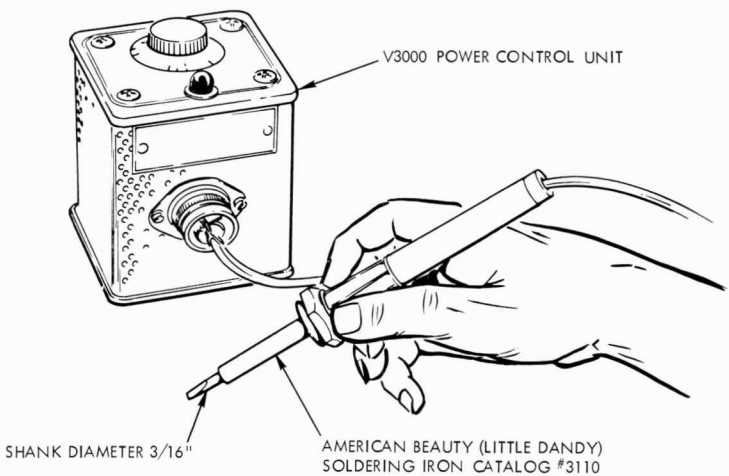


FIGURE 13

Before heat is applied to the iron check the tip for tight attachment. Tips used with corrosive flux must not be used on Apollo assemblies.

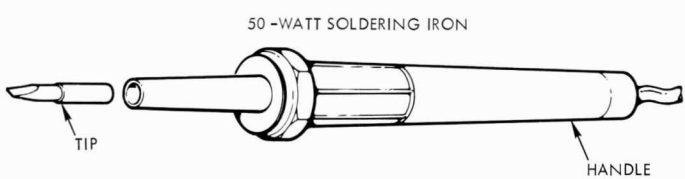


FIGURE 14

Cleaning the iron depends upon the type and temperature of the tip. Cold, unplated, copper tips should be cleaned and shaped with a flat, fine, single-cut, shear-tooth type file. Cold, plated tips may be cleaned with emery cloth or aluminum oxide cloth,approximately No. 320 grit size, until the surface is bright. Files must not be used on plated tips. After cleaning, heat the iron. When the tip reaches the lowest temperature required to melt solder, apply a thin but continuous coating of solder. Gently wipe off the excess solder with a wet sponge.

Oxidation and scale shall be removed from the soldering iron at frequent intervals to insure proper heat transfer.

NOTE - Abrasive cleaning NOT to be done near Assemblies or Equipment.

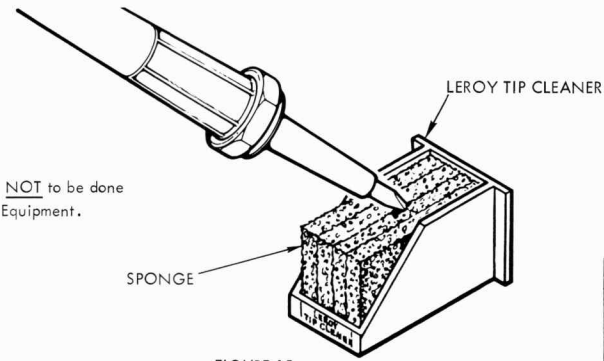


FIGURE 15

2. FLUX AND SOLDER - Tinning of wire may be done with rosin base liquid flux (MIL-F-14256 Type A) applied by brushing, swabbing, or immersion in a flux-saturated cellulose sponge. Apply solid forms solder (QQ-S-571 type SN60 or SN63) with soldering iron or a solder pot dip. Tinning may also be done with rosin core solder (QQ-S-571 Type AR) applied by a soldering iron.

   Soldering will be done with rosin core solder (QQ-S-571 type AR) only. DO NOT use solid or acid core solder.

3. SOLDER JOINTS - A solder joint should have a smooth, undisturbed appearance, no porosity, good fillet between conductors, good adherence to both parts, and no flux or excess solder visible. To remove flux clean with ethyl alcohol (Specification O-E-760 Grade I, Class A or B) or with commercial 99% pure (by volume) isopropyl alcohol and a medium stiff natural brush, a synthetic bristle brush, or a lint-free tissue. Wire brushes must not be used.

CALIBRATION

Tool calibration is performed by the Quality and Reliability Assurance (Q&RA) department with the cooperation of the Manufacturing Department. Some tools such as crimp type require control by a Q&RA gage crib or station. Tools are checked out of this crib using a DAILY CALIBRATED TOOL REQUSITION form 2906-D and returned the same shift.

Tools that are dropped or have their seals broken MUST NOT be used. Return these to the crib and obtain replacements.

Some tools are left in the work area and are calibrated periodically. Before using such a tool check the calibration due decal for the date. If the calibration date is past, inform your leadman. DO NOT use the tool.

The M1700A and M1700B tools used for contact crimping are similar in appearance. The difference is in the indentor. The M1700A has a 4 indent and the M1700B has an 8 indent pattern.

For correct operation, the contact and wire are inserted through the hole on the flat side until they "seat" in the positioner of the tool head. (REF. FIG. 2) The wire should be held straight in line with the hole in the tool positioner. When closing the handles, the indentors crimp the contact on the wire. The handles are spring-loaded and operate on a ratchet that releases when handles are fully closed. Handles should then remain fully open and wire contact removed.

DANIELS CRIMP TOOL

M1700A OR B -MS TOOL (MOST COMMONLY USED)
OTHER HEADS AVAILABLE ACCORDING TO CONTACT REQUIREMENTS.

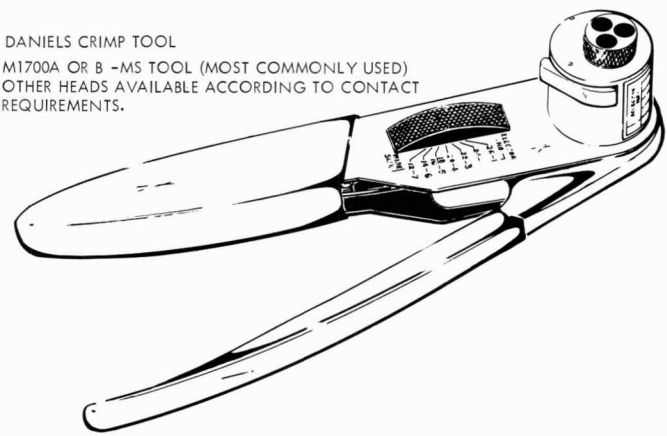


FIGURE 1

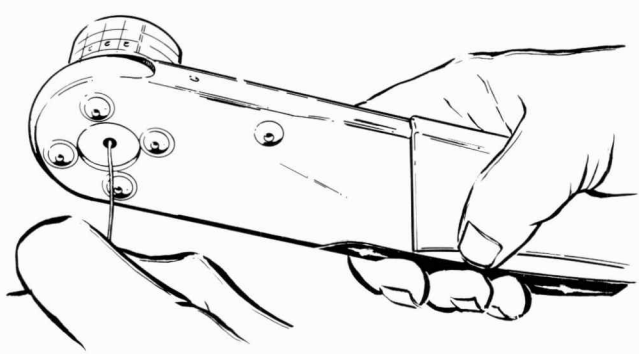


FIGURE 2

DANIELS CRIMP TOOL MINIATURE SERIES M1700A M1700B	18 JUL 1967	
	DATE	DATE REVISED
	IV	4.2
TITLE	SECTION	NUMBER

The MH750 and MH760 tool frames are the same except for indentor pattern design. They are used to secure wires within connector contacts. For correct operation, the contact is inserted into the indentor hole on the side opposite the locator head, and the pre-stripped wire is inserted into the crimp barrel of the contact. With the contact and wire properly bottomed, close the handles. Upon completion of the crimp cycle the mechanism will permit the handle to open for removal of the crimped contact. (REF. FIG.4)

The crimps produced by the MH750 tool have four indents. Those produced by the MH760 tool have eight indents.

The locator head is an accessory necessary for the proper location of the crimp on the contact.

DANIELS CRIMP TOOL
TOOL MH750 (4 INDENT PATTERN)
TOOL MH760 (8 INDENT PATTERN)

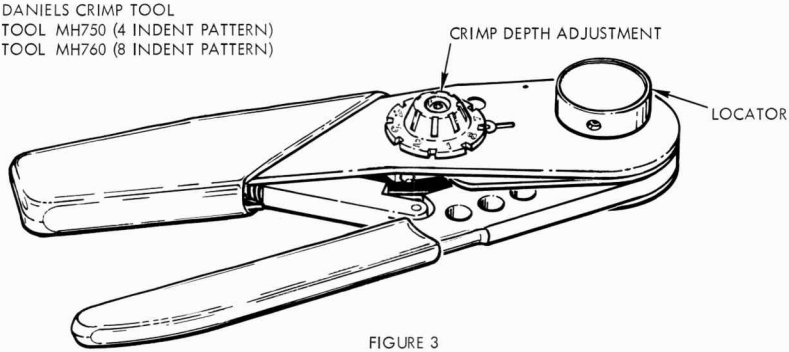


FIGURE 3

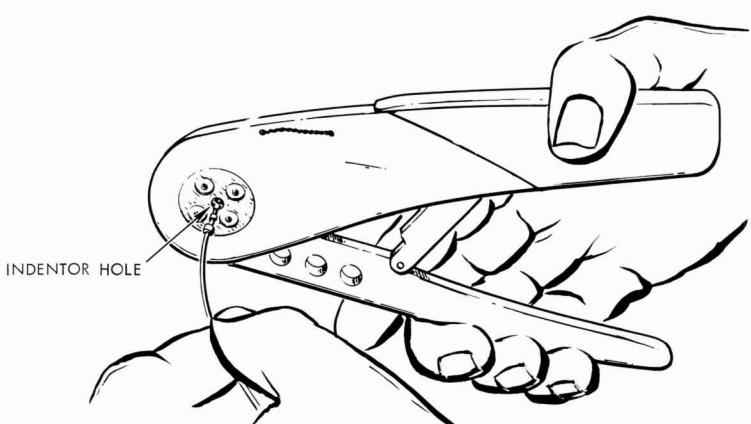


FIGURE 4

DANIELS CRIMP TOOL SUBMINIATURE SERIES MH750 MH760	18 JUL 1967	
	DATE	DATE REVISED
	IV	4.2.1
TITLE	SECTION	NUMBER

TABLE I

ELECTRICAL CONNECTORS – ALL DASH NUMBERS OF THE FOLLOWING:

CONNECTOR NUMBER	CONTACT SIZE	CONTACT NUMBER	CRIMP TOOL ▲	INSERTION TOOL ▲	EXTRACTION TOOL ▲	SEALING PLUG	TYPE I
ME414-0443 ME414-0444	20	ME418-0026-0001	M1700A-K	M15513-20	M15515-20	CP 140-1	FERROUS CONTACTS (37)

THE SEAL LIFE ON CONNECTORS IS EXTREMELY LIMITED. EXCESSIVE CONTACT INSERTION AND REMOVAL ACTIVITY MUST BE AVOIDED.

TABLE II

THERMOCOUPLE CONNECTORS

CONNECTOR NUMBER	CONTACT SIZE	PIN SKT	CONTACT NUMBER	CRIMP TOOL ▲	INSERTION TOOL ▲	EXTRACTION TOOL ▲	SEALING PLUG
* ME414-0436 * ME414-0438 * ME414-0439 * ME414-0441 * ME414-0442	22	P	ME418-0025-0001	MH750-P4	M15513-22A	M15515-22P/S	2213-9-0100
		P	ME418-0025-0002	MH750-P4			
		S	ME418-0024-0001	MH750-P5			
		S	ME418-0024-0002	MH750-P5			
* ME414-0446	20	S	ME418-0028-0003	M1700A-K	M15513-20	M15515-20	CP140-1
			ME418-0028-0004				
ME414-0447	16	S	ME418-0028-0001	M1700B-K	M15513-16	M15515-16	CP140-2
ME414-0448	20 COAX	S	ME418-0028-0002	M1700A-K	M15513-20	M15515-20	CP140-1
		S	ME418-0029-0001	15500-25	M15515-25	M15515-25	CP140-4
ME414-0449	22	S	ME418-0027-0001	MH750-P5	M15513-22A	M15515-22P/S	2213-9-0100

* MAY CONTAIN ALL COPPER OR MIXED COPPER AND CONSTANTAN CONTACTS. DESIGNATED DASH NUMBER DETERMINES CONTACT REQUIREMENT.

▲ Or equivalent tool as specified in Approved Tools List, pub. 549-V.

Caution

DO NOT PUSH CONTACTS INTO PLACE AT AN ANGLE. IN ORDER TO AVOID INTERNAL DAMAGE TO THE CONNECTOR, DO NOT TWIST OR TILT AT ANY TIME.

TABLE III

ELECTRICAL CONNECTORS-ALL DASH NUMBERS OF THE FOLLOWING:

ME414-0095	ME414-0117	ME414-0129	ME414-0149
ME414-0096	ME414-0119	ME414-0131	ME414-0238
ME414-0099	ME414-0120	ME414-0132	ME414-0239
ME414-0100	ME414-0121	ME414-0133	*ME414-0569 (SHELL SIZE 8 DEUTSCH)
ME414-0103	ME414-0123	ME414-0135	*ME414-0579 (SHELL SIZE 8 DEUTSCH)
ME414-0104	ME414-0124	ME414-0136	ME414-0580
ME414-0106	ME414-0125	ME414-0137	ME414-0585
ME414-0107	ME414-0127	ME414-0139	ME414-0191
ME414-0116	ME414-0128	ME414-0148	ME414-0192

CONTACT SIZE	PIN SOCKET	CONTACT NUMBER	CRIMP TOOL▲	INSERTION TOOL▲	EXTRACTION TOOL▲	SEALING PLUG
20	P	ME418-0019-0003	M1700A-MS	CIET-20	CIET-20	225-0070-000
	S	ME418-0020-0003				
16	P	ME418-0019-0002	M1700B-MS	CIET-16	CIET-16	225-0071-000
	S	ME418-0020-0002				
12	P	ME418-0019-0001	M1700B-MS	CIET-12	CIET-12	225-0072-000
	S	ME418-0020-0001				
*20	P	ME418-0040-0001	M1700A-F22	M15513-20-4	M15515-120	4113-4-2001
	S	ME418-0041-0001				

REF. MA0303-0099.

TABLE IV

ELECTRICAL CONNECTORS-ALL DASH NUMBERS OF THE FOLLOWING:

ME414-0147, ME414-0234, ME414-0235, ME414-0236, ME414-0584

CONTACT SIZE	PIN SOCKET	CONTACT NUMBER	CRIMP TOOL▲	INSERTION TOOL▲	EXTRACTION TOOL▲	SEALING PLUG
20	S	ME418-0031-0001	M1700A-MS	CIET-20	CIET-20	225-1000-000
	P	ME418-0032-0001				
16	S	ME418-0031-0002	M1700A-MS	CIET-16	CIET-16	225-0017-000
	P	ME418-0032-0002				
12	S	ME418-0031-0003	M1700B-MS	CIET-12	CIET-12	225-0018-000
	P	ME418-0032-0003				
8	S	ME418-0031-0004	CBT600	CIT-8	CET-8-2	225-0019-000
	P	ME418-0032-0004				
4	S	ME418-0031-0005	CBT600	NONE	CET-4-8	NONE
	P	ME418-0032-0005				

▲ Or equivalent tool as specified in Approved Tools List, pub. 549-V.

TABLE V
DEUTSCH SUB-MINIATURE (FRONT-INSERTABLE) CONNECTORS–ALL DASH NUMBERS OF THE FOLLOWING:
ME414-0300 ME414-0308
ME414-0302 ME414-0311
ME414-0303 ME414-0421
ME414-0305 ME414-0465
ME414-0306

CONTACT SIZE	PIN SOCKET	CONTACT NUMBER	CRIMP TOOL ▲	INSERTION TOOL ▲	EXTRACTION TOOL ▲	SEALING PLUG
22	P	ME418-0036-0001	MH750-P4	M15513-22A	M15515-22P/S	2213-9-0100
	S	ME418-0037-0001	MH750-P5			

REF. MA0303-0118

TABLE VI
COMMERCIAL TYPE CONNECTORS

TYPE	CONTACT SIZE	PIN SOCKET	CONTACT NUMBER	CRIMP TOOL ▲	INSERTION TOOL ▲	EXTRACTION TOOL ▲	SEALING PLUG
DS (DEUTSCH)	20	P	800-20/32-1	M1700A-K	M15513-20	M15515-20	CP140-1
	16	P	800-16/32-1		M15513-16	M15515-16	CP140-2
	20	S	800-20/30-1		M15513-20	M15515-20	CP140-1
	16	S	200-16/30-3		M15513-16	M15515-16	CP140-2
DTK/LPT* (DEUTSCH)	20	P	0004-058-000	M1700A-MS	15513-20	M15514-20	4113-4-2001
	16	P	0004-065-000		15513-16	M15514-16	4113-3-1601
	20	S	0007-008-000		15513-20	M15514-20	4113-4-2001
	16	S	0007-013-000		15513-16	M15514-16	4113-3-1601
DSM/ER (DEUTSCH)	22	P	2202-16-0101	MH750-P4	M15513-22A	M15515-22P/S	2213-9-0100
		S	2207-17-0101	MH750-P5			
VP9/2CE15 (VIKING)	20	S	SOLDER TYPE				017-0153-000 FOR GROMMET FOLLOWER

*EXCEPT FOR SHELL SIZE 8, SEE TABLE III

TABLE VII
MICRODOT, INC. MARC-53 SERIES

CONNECTOR PART NO.	COMMERCIAL PART NO.	CONTACT SIZE	PIN SOCKET	CONTACT PART NO.	CRIMP TOOL ▲	SEALING PLUG
MD53-06E15-61S-N (579)	087-0003-0579	22	S	082-0306	MH750-P27	086-0055
MD53-06E15-61P-N (579)	087-0017-0579		P	083-0009		
MD53-00E15-61P-N	087-0006-0000		P	083-0009		
MD53-00E15-61S-N	087-0018-0000		S	082-0306		

▲ Or equivalent tool as specified in Approved Tools List, pub. 549-V.

CANNON CRIMP TOOL #CCT-CX-2

USED FOR CRIMPING CONTACTS AND OUTER RING SLEEVES ON CONNECTOR #CX-PL-F-37 PLUGS, TYPE "CX" WITH RG-188A/U COAXIAL CABLE

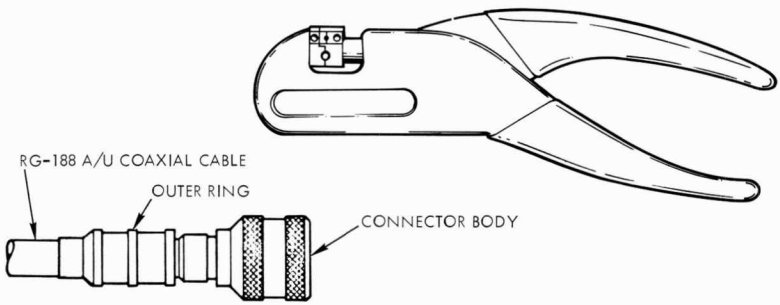


FIGURE 5

REF. MA0303-0063

DANIELS CRIMPING TOOL, **M1700A WITH -N66 HEAD

"J" - HOOK (REF.)

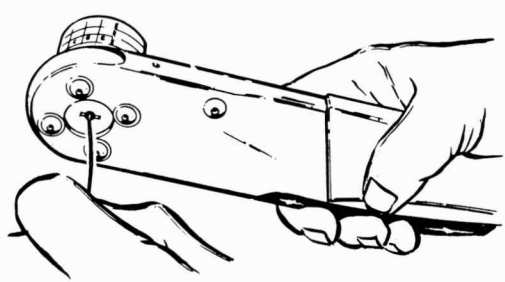


FIGURE 6

TABLE VIII

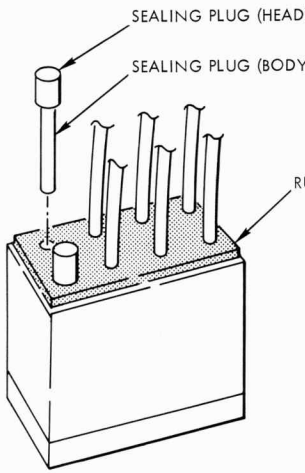
WIRE SIZE	PART NUMBER	STRIP MIN.	LENGTH MAX.	CRIMP TOOL NUMBER▲	LOCATOR COLOR CODE
18-16	PM788-2	.150	.180	**M1700A	Red
22-20	PM788-3	.150	.180	**M1700A	Red
12	PM788-7	.200	.220	**M1700A	Green

**"J" HOOK TERMINALS (CRIMP TYPE) PHYL-MAR INSTRUMENTS, INC.

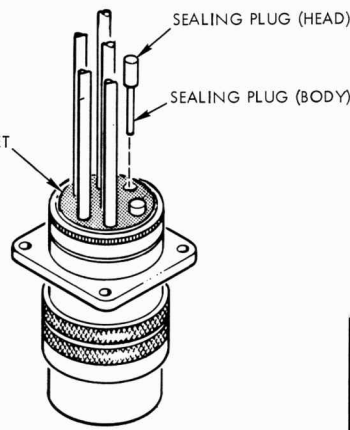
▲ Or equivalent tool as specified in Approved Tools List, pub. 549-V.

CRIMP TOOLS - J-HOOKS - COAX CONNECTORS	18 JUL 1967	
	DATE	DATE REVISED
	IV	4.2.5
TITLE	SECTION	NUMBER

Every unused insert grommet hole in a sealed terminal strip or unpotted connector will be filled with a sealing plug. The sealing plug will be inserted by hand.



SEALED TERMINAL BOARD
FIGURE 7



UNPOTTED CONNECTOR
FIGURE 8

NOTE: Bottom of sealing plug head shall be flush with or slightly above the surface of the rubber grommet.

TABLE IX
(MD417-) DEUTSCH SEALED TERMINAL BOARDS (Ref. Figure 7)

CONTACT SIZE	CONTACT NUMBER	CRIMP TOOL▲	INSERTION/ EXTRACTION▲	SEALING PLUG	COLOR CODE
*20	ME418-0035-0001	M1700B-MS	M15570-20-1	ME265-0014-0101	RED
20	ME418-0035-0005	M1700B-MS	M15570-20-1	ME265-0014-0101	RED
16	ME418-0035-0004	M1700B-MS	M15570-16-1	ME265-0014-0102	BLUE
12	ME418-0035-0003	M1700B-MS	M15570-12-1	ME265-0014-0103	YELLOW
8	ME418-0035-0002	TD7000-1	BY HAND	ME265-0014-0104	WHITE

*FOR USE WITH 22 OR 24 GA. WIRE
▲Or equivalent tool as specified in Approved Tools List, pub. 549-V.

Caution

Use life of the grommet seal is limited. DO NOT make unnecessary insertions and withdrawals of sealing plugs.

NOTES: The insertion end of the plastic insertion tools are color coded to aid in identification.

When inserting the wire into the contact insertion tool, use the thumb, not the thumb-nail.

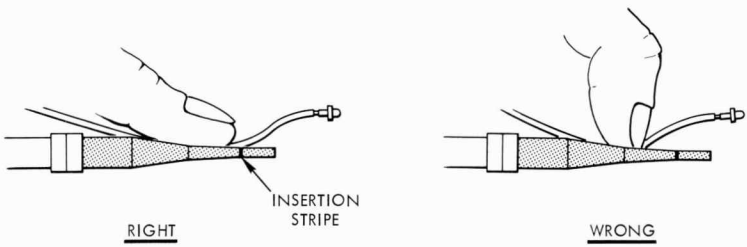


FIGURE 9
Installing Insertion Tool Around Wire Insulation

NOTE:

DO NOT TWIST INSERTION/REMOVAL TOOL AT ANY TIME DURING OPERATION. TOOL SHOULD BE INSPECTED BEFORE AND AFTER EACH INSERTION OR EXTRACTION FOR EVIDENCE OF DAMAGE SUCH AS NICKS, CRACKS OR BURRS. DO NOT USE DAMAGED TOOL.

NOTE:

Care must be used to insert contact straight into hole in grommet to avoid possible damage to the grommet. Do not insert the insertion end of the tool barrel into the grommet seal unless it is seated against the contact shoulder.

TERMINAL BOARD SEAL LIFE IS LIMITED. EXCESSIVE INSERTION AND REMOVAL ACTION MUST BE AVOIDED.

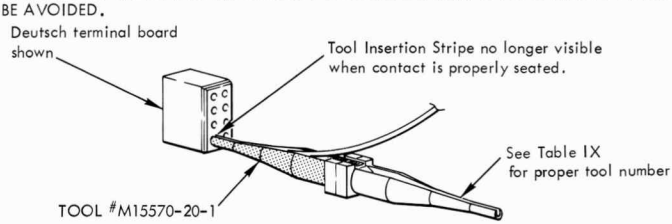


FIGURE 10
Insertion of Contact into Cavity

NOTE:

Upon removal of insertion tool a firm finger hold is required to both the tool and wire so as to perform a pull check to insure that a proper connection has been accomplished.

This tool is used to crimp two piece ferrules to shielded electrical cables.

Color coded arrows on the tool point to the hex die to be used with the corresponding color coded outer sleeve of the ferrules. The ferrules are inserted and positioned centrally in the hex die. Subsequent squeezing of the handles will cause the required crimp between the inner and outer ferrule sleeves. When crimping is completed, the ratchet release allows the crimped contact and cable to be removed.

NOTE: This tool must be returned to the responsible quality control organization for calibration at regular intervals, as specified.

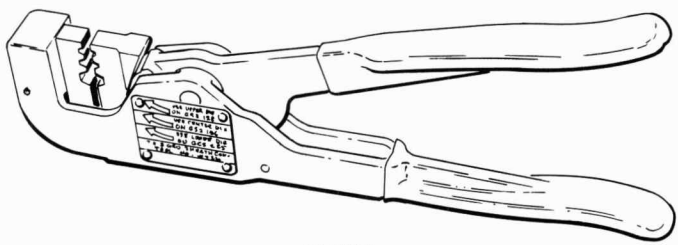


FIGURE 1

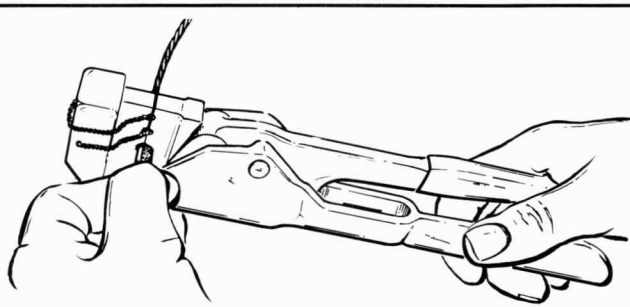


FIGURE 2

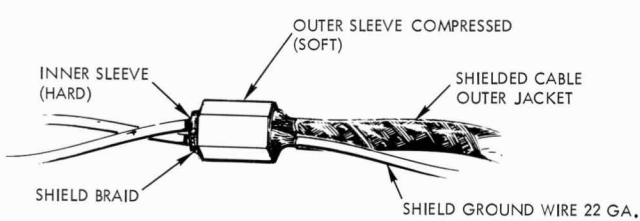


FIGURE 3

FERRULE TOOL THOMAS and BETTS (WT-230 Series)	18 JUL 1867	
	DATE	DATE REVISED
	IV	4.3
TITLE	SECTION	NUMBER

TABLE I
MULTIPLE-HEX TOOLS FOR INSTALLING GROUNDING FERRULES

Multiple-Hex Tool Number*	Single-Hex Tool Number	Installs Outer Sleeve Number	Groove Code
WT-230 (3 Positions)	WT-200	NGS128	3 - Solid
	WT-202	NGS156	2 - Solid
	WT-209	NGS225	3 - Dashed
WT-231 (3 Positions)	WT-219	NGS101	None
	WT-201	NGS149	3 - Dashed
	WT-211	NGS261	2 - Solid
WT-232 (3 Positions)	WT-203	NGS175	3 - Solid
	WT-206	NGS187	1 - Dashed
	WT-206	NGS194	1 - Solid
	WT-206	NGS199	None
	WT-210	NGS232	1 - Dashed
WT-233 (2 Positions)	WT-208	NGS205	2 - Solid
	WT-208	NGS219	2 - Dashed
	WT-212	NGS275	None
WT-234 (2 Positions)	WT-214	NGS281	3 - Dashed
	WT-214	NGS287	3 - Solid
	WT-214	NGS297	2 - Dashed
	WT-216	NGS327	None
WT-235 (2 Positions)	WT-215	NGS312	2 - Solid
	WT-217	NGS348	1 - Dashed
WT-236 (2 Positions)	WT-216	NGS327	None
	WT-218	NGS405	1 - Solid
	WT-218	NGS415	1 - Solid
WT-238 (4 Positions)	WT-219	NGS101	None
	WT-200	NGS128	3 - Solid
	WT-201	NGS149	3 - Dashed
	WT-202	NGS156	2 - Solid
WT-239 (2 Positions)	WT-206	NGS187	1 - Dashed
	WT-206	NGS194	1 - Solid
	WT-206	NGS199	None
	WT-208	NGS205	2 - Solid
	WT-208	NGS219	2 - Dashed

*Multiple-Hex tools listed perform the same task as the single-Hex tools listed.

RECOMMENDED SHIELD GROUND FERRULES FOR USE WITH SHIELDED CABLE LISTED AND MP571-0064-XXXX GROUND WIRE (#22) GAUGE

SHIELD GROUNDS NORMALLY 22 GA. UNLESS OTHERWISE SPECIFIED.

TABLE II

Part No. (Wire SCD)	No. of Cond.	Wire Size	*Inner Ferrule		Outer Ferrule		*A Dia.	
			Part No.	Groove Code	Part No.	Groove Code	Min.	Max.
MP572-0159-XXXX	1	26	HGS-046	None	NGS-128	3 - Solid	.030	.034
MP572-0160-XXXX	1	24	HGS-046	None	NGS-128	3 - Solid	.035	.039
MP572-0161-XXXX	1	22	HGS-058	2 - Solid	NGS-149	3 - Dashed	.042	.046
MP572-0162-XXXX	1	20	HGS-058	2 - Solid	NGS-149	3 - Dashed	.050	.054
MP572-0163-XXXX	1	18	HGS-071	2 - Dashed	NGS-149	3 - Dashed	.062	.068
MP572-0164-XXXX	1	16	HGS-080	3 - Solid	NGS-156	2 - Solid	.069	.075
MP572-0174-0024	2	24	HGS-090	1 - Dashed	NGS-175	3 - Solid	.074	.083
MP572-0174-0022	2	22	HGS-101	2 - Solid	NGS-175	3 - Solid	.088	.097
MP572-0174-0020	2	20	HGS-124	2 - Dashed	NGS-199	None	.104	.113
MP572-0174-0016	2	16	HGS-164	None	NGS-261	2 - Solid	.142	.155
MP572-0175-0024	3	24	HGS-090	1 - Dashed	NGS-175	3 - Solid	.079	.089
MP572-0175-0022	3	22	HGS-109	1 - Solid	NGS-187	1 - Dashed	.094	.104
MP572-0175-0020	3	20	HGS-124	2 - Dashed	NGS-199	None	.112	.121
MP572-0175-0016	3	16	HGS-175	2 - Dashed	NGS-275	None	.152	.166
MP572-0176-0024	4	24	HGS-101	2 - Solid	NGS-175	3 - Solid	.088	.099
MP572-0176-0022	4	24	HGS-124	2 - Dashed	NGS-199	None	.105	.116
MP572-0176-0020	4	20	HGS-149	3 - Solid	NGS-232	1 - Dashed	.125	.135
MP572-0177-0024	5	24	HGS-124	2 - Dashed	NGS-199	None	.099	.110
MP572-0177-0022	5	22	HGS-134	1 - Dashed	NGS-219	2 - Dashed	.117	.129
MP572-0177-0020	5	20	HGS-156	1 - Solid	NGS-261	2 - Solid	.139	.151
MP572-0178-0024	6	24	HGS-128	None	NGS-219	2 - Dashed	.109	.122
MP572-0178-0022	6	22	HGS-149	3 - Solid	NGS-232	1 - Dashed	.130	.149
MP572-0179-0024	7	24	HGS-124	2 - Dashed	NGS-199	None	.109	.122
MP572-0179-0022	7	22	HGS-156	1 - Solid	NGS-261	2 - Solid	.130	.143
MP572-0180-0022	8	22	HGS-194	3 - Solid	NGS-281	3 - Dashed	.172	.189
MP572-0181-0022	9	22	HGS-194	3 - Solid	NGS-281	3 - Dashed	.172	.189
MP572-0182-0022	10	22	HGS-194	3 - Solid	NGS-281	3 - Dashed	.172	.189
MP572-0183-0024	15	24	HGS-194	3 - Solid	NGS-281	3 - Dashed	.168	.184
MP572-0183-0022	15	22	HGS-225	2 - Solid	NGS-312	2 - Solid	.201	.221
MP572-0185-0022	30	22	HGS-375	3 - Solid	NGS-460	None	.285	.313

*Inner ferrules were selected to meet the requirements of maximum "A" diameter.

FERRULE CHART	18 JUL 1967	
	DATE	DATE REVISED
	IV	4.3.2
TITLE	SECTION	NUMBER

RECOMMENDED SHIELD GROUND FERRULES FOR USE WITH SHIELDED CABLE LISTED AND MP571-0065-XXXX GROUND WIRE (#20) GAUGE

TABLE III

Part No. (Wire SCD)	No. of Cond.	Wire Size	*Inner Ferrule		Outer Ferrule		*A Dia.	
			Part No.	Groove Code	Part No.	Groove Code	Min.	Max.
MP572-0159-XXXX	1	26	HGS-046	None	NGS-128	3 - Solid	.030	.034
MP572-0160-XXXX	1	24	HGS-046	None	NGS-128	3 - Solid	.035	.039
MP572-0161-XXXX	1	22	HGS-058	2 - Solid	NGS-149	3 - Dashed	.042	.046
MP572-0162-XXXX	1	20	HGS-058	2 - Solid	NGS-149	3 - Dashed	.050	.054
MP572-0163-XXXX	1	18	HGS-071	2 - Dashed	NGS-156	2 - Solid	.062	.068
MP572-0164-XXXX	1	16	HGS-080	2 - Solid	NGS-175	2 - Solid	.069	.075
MP572-0174-0024	2	24	HGS-090	1 - Dashed	NGS-175	3 - Solid	.074	.083
MP572-0174-0022	2	22	HGS-101	2 - Solid	NGS-187	1 - Dashed	.088	.097
MP572-0174-0020	2	20	HGS-124	2 - Dashed	NGS-205	2 - Solid	.104	.113
MP572-0174-0016	2	16	HGS-165	None	NGS-261	2 - Solid	.142	.155
MP572-0175-0024	3	24	HGS-090	1 - Dashed	NGS-187	1 - Dashed	.079	.089
MP572-0175-0022	3	22	HGS-109	1 - Solid	NGS-194	1 - Solid	.094	.104
MP572-0175-0020	3	20	HGS-124	2 - Dashed	NGS-219	2 - Dashed	.112	.121
MP572-0175-0016	3	16	HGS-175	2 - Dashed	NGS-275	None	.152	.166
MP572-0176-0024	4	24	HGS-101	2 - Solid	NGS-187	1 - Dashed	.088	.099
MP572-0176-0022	4	24	HGS-124	2 - Dashed	NGS-219	2 - Dashed	.105	.116
MP572-0176-0020	4	20	HGS-149	3 - Solid	NGS-261	2 - Solid	.125	.135
MP572-0177-0024	5	24	HGS-124	2 - Dashed	NGS-219	2 - Dashed	.099	.110
MP572-0177-0022	5	22	HGS-134	1 - Dashed	NGS-219	2 - Dashed	.117	.129
MP572-0177-0022	5	20	HGS-156	1 - Solid	NGS-261	2 - Solid	.139	.151
MP572-0178-0024	6	24	HGS-128	None	NGS-219	2 - Dashed	.109	.122
MP572-0178-0022	6	22	HGS-149	3 - Solid	NGS-261	2 - Solid	.130	.149
MP572-0179-0024	7	24	HGS-124	3 - Dashed	NGS-219	2 - Dashed	.109	.122
MP572-0179-0022	7	22	HGS-156	1 - Solid	NGS-261	2 - Solid	.130	.143
MP572-0180-0022	8	22	HGS-194	3 - Solid	NGS-297	2 - Dashed	.172	.189
MP572-0182-0022	10	22	HGS-194	3 - Solid	NGS-297	2 - Dashed	.172	.189
MP572-0183-0024	15	24	HGS-194	3 - Solid	NGS-297	2 - Dashed	.168	.184
MP572-0183-0022	15	22	HGS-225	2 - Solid	NGS-327	None	.201	.221
MP572-0185-0022	30	22	HGS-375	3 - Solid	NGS-500	2 - Dashed	.285	.313
MP572-0224-0022	4	22	HGS-124	2 - Dashed	NGS-219	2 - Dashed	.099	.111

*Inner ferrules were selected to meet the requirements of maximum "A" diameter.

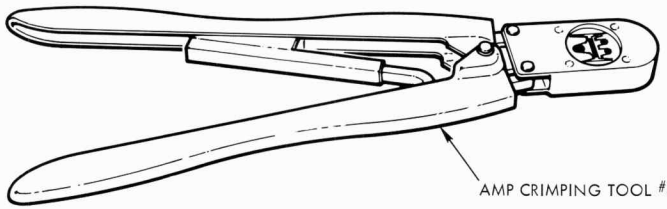


FIGURE 4

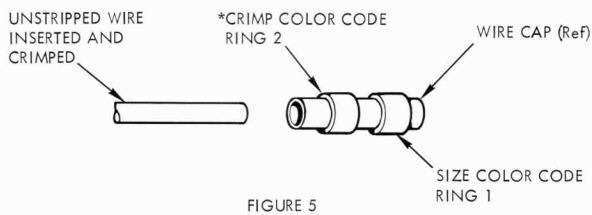


FIGURE 5

*INDICATES SECTION OF TOOL IN WHICH CAP IS TO BE CRIMPED.

TABLE IV
**CAPS, SPARE WIRE-HIGH TEMP 550 F

WIRE SIZE	CAP NUMBER	COLOR CODE		CRIMPING TOOL▲	CRIMPING TOOL
		RING 1	RING 2		COLOR CODE
24	328854	Red	Green	69272-1	Green
22	328855	Blue	Green	69272-1	Green
20	328856	Yellow	Green	69272-1	Green
18	328857	Brown	Green	69272-1	Green
16	328858	Violet	Green	69272-1	Green
14	328859	Black	Orange	69272-1	Orange
12	328860	Gray	Orange	69272-1	Orange
10	329638*	Brown		69260-1	White

*One ring only.
**AMP "Strato-Therm Teflon Pre-Insulated Caps."
▲Or equivalent tool as specified in Approved Tools List, pub. 549-V.

AMP CRIMPING TOOL - SPARE WIRE CAPS	18 JUL 1967	
	DATE	DATE REVISED
	IV	4.3.4
TITLE	SECTION	NUMBER

AMP CRIMPING TOOL
PART NO. 46447
CRIMPING RANGE #22 - #16

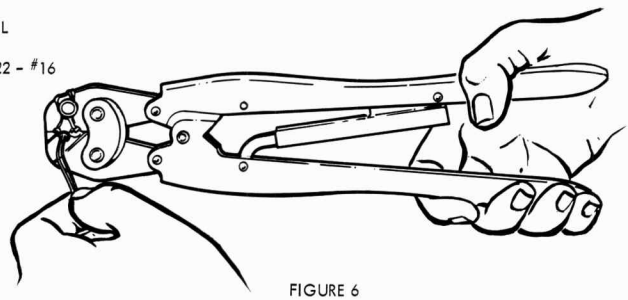


FIGURE 6

Used to crimp un-insulated Amp splices. For correct operation the pre-stripped wire or wires are inserted in terminal with brazed seam on the same side as tool indentor. Hold wire in position & squeeze handles until ratchet releases allowing tool to open for removal of crimped terminal.

STYLE - A
Non-Insul. Support (Butt Splice)

STYLE - B
Non-Insul. Support (Parallel Splice)

FIGURE 7

1200°F STRATO-THERM UN-INSULATED

TABLE V
(AMP) PARALLEL TYPE SPLICES

STYLE	SPLICE NO.	STRIP LENGTH		CRIMP TOOL NO.▲	WIRE CIRCULAR MIL AREA	SLEEVING TYPE	SLEEVING SIZE
		MIN	MAX				
B	322326	11/32	13/32	46447	509 TO 2050	MB0150-025 CLASS 4	#3
B	322347	11/32	13/32	46447	2050 - 5180	SAME	#4
B	323672	11/32	13/32	46447	5180 - 10404	SAME	#6
A	323696*	9/32	5/16	46447	5180 - 10404	SAME	#6

▲ Or equivalent tool as specified in Approved Tools List, pub. 549-V.

*Splice No. 323696 is a "Butt Type Splice" for in-line splicing (not to be used for shield ground wire termination) for 10-12 AWG and to be used only when specified on applicable engineering drawing.

Crimp procedure for butt splice 323696 shall be as specified except 2 crimps are required, crimps shall be located between wire stop and the outer edge of splice and 180° from the brazed seam.

CIRCULAR MIL AREA OF CONDUCTORS

WIRE GAUGE	CONDUCTOR CMA
24	475
22	754
20	1186
18	1900
16	2426
14	3831
12	6088
10	10404

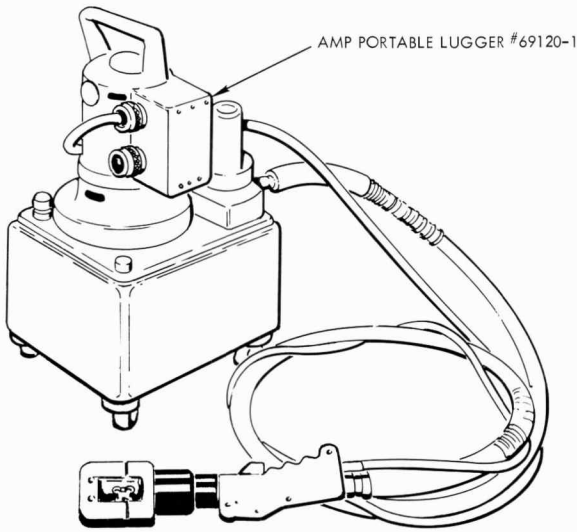


FIGURE 14

TABLE XI

AMP CRIMPING HEADS AND DIES FOR TOOL #69120-1						
WIRE SIZE	HEAD #69069	HEAD #69065		HEAD #69067 (FLAG)		HEAD #69060 DIE # INCLUDES INDENTER & NEST
		INDENTER	NEST	INDENTER	NEST	
8	8 THROUGH 2 SELF CONTAINED DIES	48355	48126	48505	48506	
6		48127	48128	48507	48508	
4		48127	48129	48507	48509	
2		48127	48130	48507	48510	
1/0		48131	48132	48511	48652	
2/0		48131	48133	48511	48805	
3/0		48131	48134	48511	48806	
4/0		48131	300430	48511	48807	
250-300 MCM						48816
300-350 MCM						48817
400 MCM						48818
500-600 MCM						48819

PORTABLE LUGGER-ELECTRIC/HYDRAULIC	18 JUL 1967	
	DATE	DATE REVISED
	IV	4.3.11
TITLE	SECTION	NUMBER

REQUIREMENTS FOR FABRICATION OF A COAXIAL CABLE ASSEMBLY

1. An engineering coaxial cable assembly drawing which will include the following:

   (a) Part number of coaxial cable
   (b) Part number of connectors
   (c) Part number of sleeving
   (d) Process specification numbers

2. Tools

   Sharp knife (X-acto) CAUTION: Tool is dangerous, use with extreme care.
   Scissors
   Diagonal cutters
   Measuring device
   Long nose pliers

3. Other tools/materials as specified per applicable engineering documents

   Soldering iron
   Heat gun
   Crimp tools
   Torque wrench
   Cable holding device
   Tubing cutter
   Megger checker
   Ohmmeter
   Insertion tool
   Extraction tool
   Heat shield
   Solder and flux
   Denatured alcohol
   Lintless cloth
   Tape
   Sleeving
   Safety wire
   Adhesive
   Dust caps
   Plastic bags

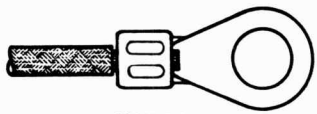


FIGURE 8

TABLE VI
*TERMINALS, UNINSULATED
STRAIGHT TYPE - RING TONGUE

*AMP "Strato-Therm" Terminals except as noted ** below.

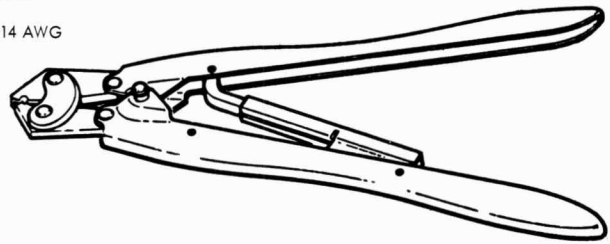
WIRE SIZE	STUD SIZE	TERMINAL PART NO.	▲HAND CRIMP TOOL	ELECTRIC-HYDRAULIC TOOL 69120-1		STRIP LENGTH	
				HEAD NO.	DIE NO.	MIN.	MAX.
22-20	1/4 3/8	324279 324280	46467			.17	.20
16	4 6 8 10 1/4 3/8	2-34104-1 328589** 328590** 328591** 324281 324282	46447			.17	.20
14	6 8 10 1/4 5/16 3/8	328593** 328594** 328595** 324283 2-34135-1 324284	46447			.20	.23
12-10	6 8 10 1/4 5/16 3/8	328597** 328598** 328599** 324285 2-33459-1 324286	46447			.27	.30
8	10 1/4 5/16 3/8	328601** 328602** 328603 328604		69099	69216	.33	.36
6	10 1/4 5/16 3/8	2-321298-1 2-321598-1 2-33466-1 2-33467-1		69099	69217	.39	.42
4	10 1/4 5/16 3/8	2-33468-1 2-31811-1 2-33115-1 2-31812-1		69099	69218	.45	.48

▲ Or equivalent tool as specified in Approved Tools List, pub. 549-V.

**SOLISTRAND TYPE—GOLD PLATED

AMP CRIMPING TOOL - UN-INSULATED STRAIGHT TERMINALS	18 JUL 1967	
	DATE	DATE REVISED
	IV	4.3.6
TITLE	SECTION	NUMBER

AMP CRIMPING TOOL
Part No. 49975
Crimping Range 16-14 AWG



Used to crimp un-insulated flag type terminals to wires. For correct operation, the pre-stripped wire or wires are inserted in the lug and the lug properly inserted with the brazed seam on the same side as the tool indentor. Hold the wire in position and squeeze the handles until the ratchet releases allowing the tool to open for removal of the crimped lug.

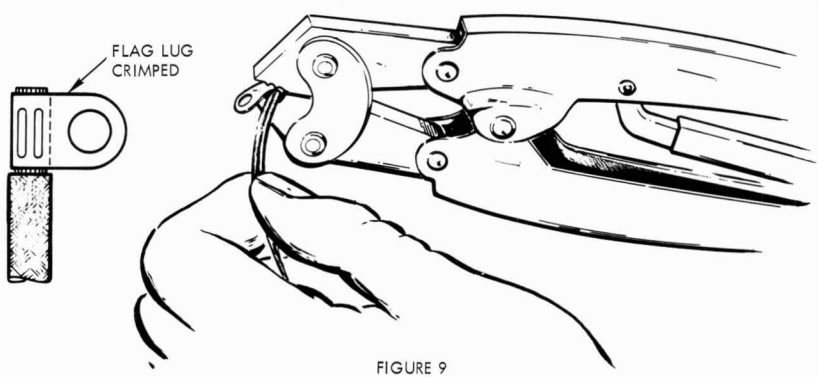


FIGURE 9

TABLE VII
(AMP) UN-INSULATED FLAG LUGS
SOLISTRAND SERIES

STYLE	LUG NO.	STRIP LENGTH		CRIMP TOOL▲	WIRE GAUGE	INSULATION SUPPORT	STUD SIZE
		MIN.	MAX.				
RING	325069	5/16	3/8	49975	16 - 14	NO	8
RING	322819	5/16	3/8	49975	16 - 14	NO	10

CONDUCTOR MAY BE FLUSH WITH END OF LUG BUT MAY EXTEND BEYOND IF PROPER INSTALLATION OF LUG IS NOT HAMPERED.
▲Or equivalent tool as specified in Approved Tools List, pub. 549-V.

AMP CRIMPING TOOL - FLAG LUG	18 JUL 1967	
	DATE	DATE REVISED
	IV	4.3.7
TITLE	SECTION	NUMBER

AMP CRIMP TOOL #46673

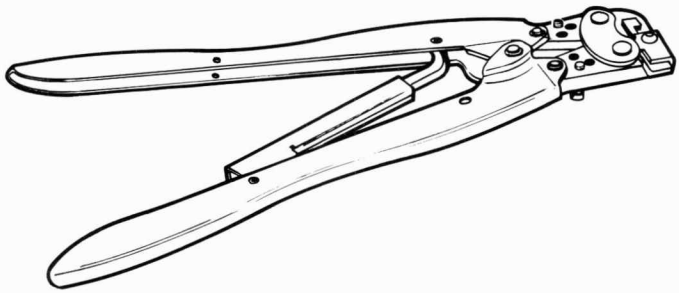
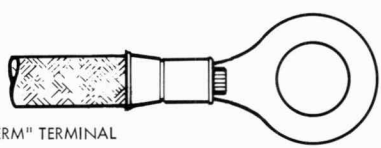


FIGURE 10



AMP "STRATO THERM" TERMINAL

FIGURE 11

TABLE VIII
AMP "STRATO THERM" TERMINALS
UN-INSULATED, STRAIGHT TYPE, RING TONGUE WITH INSULATION SUPPORT BARREL

WIRE SIZE	STUD SIZE	TERMINAL PART NO.	HAND CRIMP TOOL ▲	STRIP LENGTH	
				MIN	MAX
22-16	4	322363	46673	.17	.20
22-16	6	322364	46673	.17	.20
22-16	1/4	322367	46673	.17	.20
16-14	4	322371	46988	.20	.23

▲ Or equivalent tool as specified in Approved Tools List, pub. 549-V.

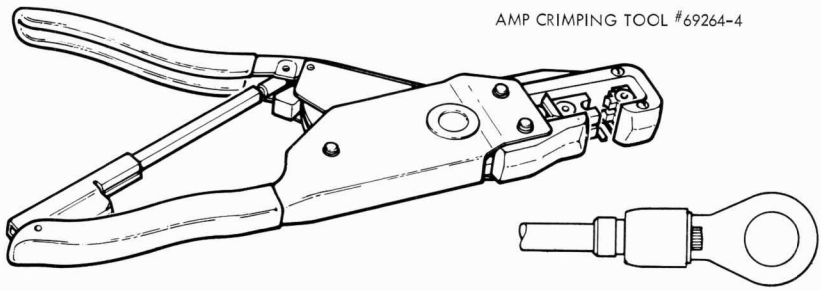


FIGURE 12

TABLE IX
*TERMINALS, PRE-INSULATED
STRAIGHT TYPE - RING TONGUE

WIRE SIZE	STUD SIZE	TERMINALS		▲ HAND TOOL	▲PNEUMATIC TOOL AND INSERTS		STRIP LENGTH	
		PART NO.	COLOR CODE		TOOL	INSERT	MIN	MAX
26-24	4	328190	YELLOW	69264-4	69100	69200	.14	.17
	6	328191	YELLOW	69264-4	69100	69200		
	8	328192	YELLOW	69264-4	69100	69200		
	10	328193	YELLOW	69264-4	69100	69200		
22-20	4	1-328194-0	WHITE	69264-4	69100	69201-2	.17	.20
	6	1-328195-3	WHITE	69264-4	69100	69201-2		
	8	1-328196-3	WHITE	69264-4	69100	69201-2		
	10	1-328197-3	WHITE	69264-4	69100	69201-2		
18-16	4	1-328198-0	RED	69264-4	69100	69202	.17	.20
	6	1-328199-4	RED	69264-4	69100	69202		
	8	1-328200-4	RED	69264-4	69100	69202		
	10	1-328201-4	RED	69264-4	69100	69202		

▲ Or equivalent tool as specified in Approved Tools List, pub. 549-V. *AMP "STRATO-THERM" TERMINALS

NOTE: THE INSERTS USED IN THE HAND TOOL AND THE PNEUMATIC TOOL ARE THE SAME.

AMP CRIMPING TOOL - PRE-INSULATED STRAIGHT TERMINALS	18 JUL 1967	
	DATE	DATE REVISED
	IV	4.3.9
TITLE	SECTION	NUMBER

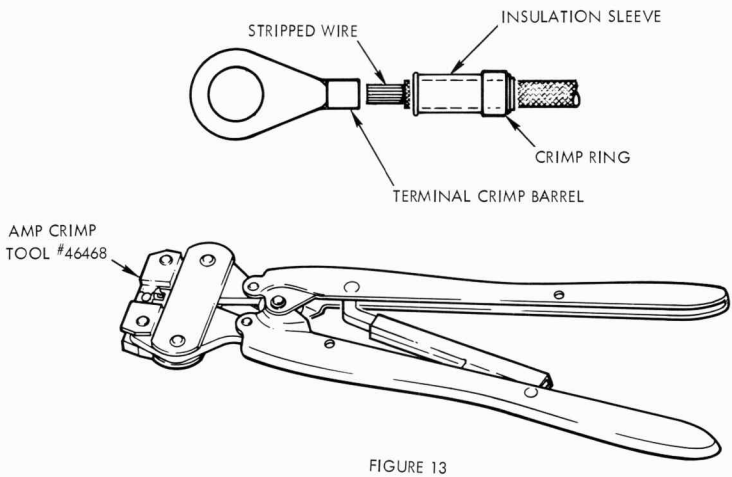


FIGURE 13

CRIMPING PROCEDURE:

a. Place the terminal in the proper crimping tool, making certain that the brazed seam faces the indenter on the crimping tool.
b. Slide the insulation sleeve, crimp ring first, on the stripped wire.
c. Insert the stripped wire into the terminal crimp barrel and crimp.
d. Slide the insulation sleeve over the terminal only far enough to completely cover the crimp barrel.
e. Position the insulation crimp ring in the proper crimping tool and complete the crimp.

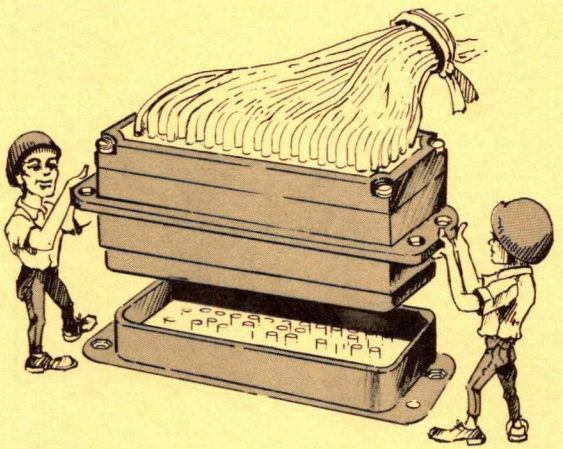
TABLE X
AMP POST - INSULATED TERMINALS, STRAIGHT TYPE, RING TONGUE

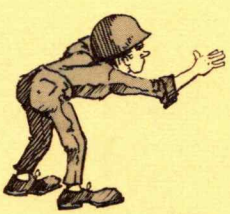
Wire Size	Stud Size	Terminal		▲ Terminal Tool	▲ Ring Tool
		Part Number	Color Code		
18-16	1/4	329553	Red	46468	46468
12-10	1/4	329573	Yellow	46470	46470

▲ Or equivalent tool as specified in Approved Tools List, pub. 549-V.

AMP CRIMPING TOOL - POST-INSULATED STRAIGHT TERMINALS	18 JUL 1967	
	DATE	DATE REVISED
	IV	4.3.10
TITLE	SECTION	NUMBER

GOOD INSTALLATION PRACTICES





reduces contamination & increases *RELIABILITY*

V INSTALLATION PRACTICES

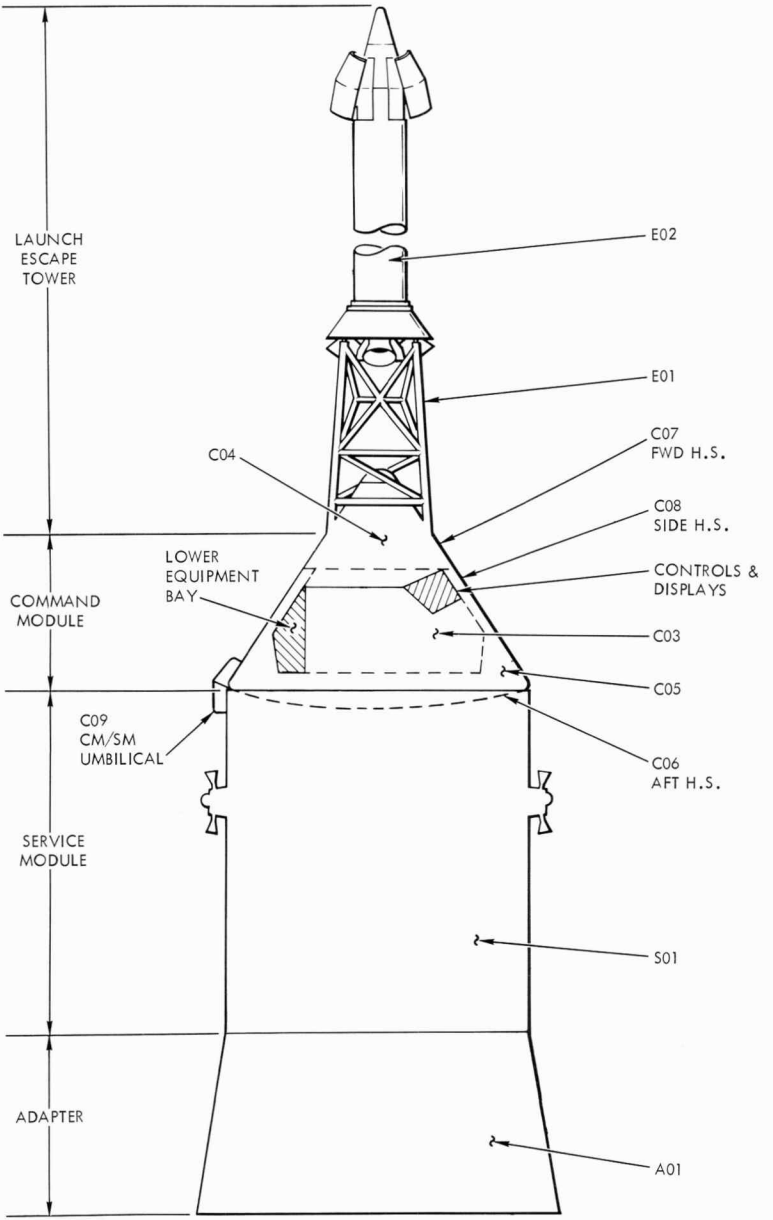


FIGURE 1

IDENTIFICATION - STACK WIRING AREA ASSIGNMENT

SCOPE - WIRING AREA ASSIGNMENT

The purpose of the Apollo Area Assignment as shown in Figure 1 is to establish a standardized reference designation system in order to meet the requirements necessary in the design of the Automated Wire List.

The module letter indicates the module in which the assembly is located and the area number identifies specific areas within the modules. The module letters and area numbers are assigned in accordance with the following list.

Module Letter	Module	Area Number	Area
E	Launch Escape Tower	01	Launch Escape Tower
		02	Launch Escape Motors
C	Command Module	03	Pressurized Compartment (Lower Equipment Bay, Controls & Displays)
		04	Forward Compartment
		05	Aft Compartment
		06	Aft Heat Shield
		07	Forward Heat Shield
		08	Side Heat Shield
		09	Command Module-Service Module Umbilical
S	Service Module	01	Service Module
A	Adapter	01	Adapter

SCOPE-WIRE AND CABLE APPLICATION

The wire and cable described herein is intended for use in the fabrication of Electrical Wiring for Harnesses and Electrical Equipment for service in Block II Apollo Space Vehicles. This wire and cable is designed to give service for periods of up to 2000 hours at conductor temperatures ranging between -290 and +500 F in environments varying from sea level atmospheric to reduced pressure pure oxygen and hard vacuum.

Caution It is MANDATORY that this wire be handled with EXTREME TENDER LOVING CARE, taking precautions to avoid any abuse by NOT scraping, scuffing, stretching, kinking, knotting, twisting, or by causing any other damage to the VERY thin wall of the primary insulation.

EXAMPLE: On a 20 gauge wire, the wall thickness of the extruded TFE (Teflon) primary insulation is ONLY five thousandths (.005) of an inch including a 250 micro inch (.000250) polyimide (ML) coating.

WIRE NUMBER COLOR CODE

The wire number and color are sufficient to differentiate between wire segments. No two wire segments will have the same wire number and color in the same vehicle. Color code abbreviations are made in accordance with the following list.

COLOR CODE AND ABBREVIATIONS

Numerical Code	Abbreviation	Definition
0	Blk	Black
1	Brn	Brown
2	Red	Red
3	Orn	Orange
4	Yel	Yellow
5	Grn	Green
6	Blu	Blue
7	Vio	Violet
8	Gy	Gray
9	Wht	White

Solid colors are identified by the abbreviation. Striped wires are identified by a series of numbers. The first number identifies the background color, and succeeding numbers identify the color of the stripes.

EXAMPLE: 903 Identifies a white background (9) with black (0) and orange (3) stripes.

TABLE I

MP571-0062-XXXX	26 AWG
MP571-0063-XXXX	24 AWG
MP571-0064-XXXX	22 AWG
MP571-0065-XXXX	20 AWG
MP571-0066-XXXX	18 AWG
MP571-0067-XXXX	16 AWG
MP571-0068-XXXX	14 AWG
MP571-0069-XXXX	12 AWG
MP571-0070-XXXX	10 AWG
MP571-0071-XXXX	8 AWG
MP571-0072-XXXX	6 AWG
MP571-0073-XXXX	4 AWG

THE FOUR DIGIT DASH NUMBER DESIGNATES THE INSULATION COLOR AND COLOR OF STRIPES

DASH NO.	BASE COLOR	FIRST STRIPE OR BAND	SECOND STRIPE OR COLOR
1000 1001	BLK BRN		
1002 1003	RED ORN		
1004 1005	YEL GRN		
1040 1041	YEL YEL	BLK BRN	
1042 1043	YEL YEL	RED ORN	
1045 1401	YEL YEL	GRN BLK	BRN
1402 1403	YEL YEL	BLK BLK	RED ORN
1405 1412	YEL YEL	BLK BRN	GRN RED
1413 1415	YEL YEL	BRN BRN	ORN GRN
1423 1425	YEL YEL	RED RED	ORN GRN
1435	YEL	ORN	GRN

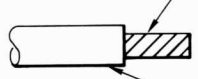


FIGURE 2

IDENTIFICATION - SINGLE CONDUCTOR WIRE	18 JUL 1967	
	DATE	DATE REVISED
	V	5.1.2
TITLE	SECTION	NUMBER

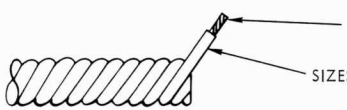
TABLE II

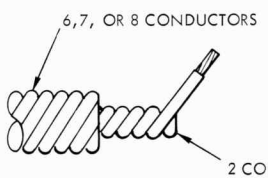
MP572-XXXX-0026	26 AWG
MP572-XXXX-0024	24 AWG
MP572-XXXX-0022	22 AWG
MP572-XXXX-0020	20 AWG
MP572-XXXX-0018	18 AWG
MP572-XXXX-0016	16 AWG
MP572-XXXX-0012	12 AWG
MP572-XXXX-0010	10 AWG
MP572-XXXX-0008	8 AWG
MP572-XXXX-0006	6 AWG
MP572-XXXX-0004	4 AWG

THE FOUR DIGIT DASH NUMBER DESIGNATES THE AMOUNT OF CONDUCTORS AND THEIR COLOR.

	COLOR	
0150	BLACK YELLOW	2 COND TWIST (26 THRU 4 AWG)
0151	RED	3 COND TWIST (26 THRU 16 AWG)
0152	GREEN	4 COND TWIST (26 THRU 16 AWG
0153	ORANGE	5 COND TWIST (26 THRU 20 AWG)
0154	BROWN	6 COND TWIST (26 THRU 16 AWG)
0155	YEL-BLK	7 COND TWIST (26 THRU 16 AWG)
0156	YEL-BRN	8 COND TWIST (26 THRU 16 AWG)
0157	YEL-RED	9 COND TWIST (26 THRU 16 AWG)
0158	YEL-ORN	10 COND TWIST (26 THRU 20 AWG)

TYPICAL CABLING
2,3,4,5,6 AND 7 CONDUCTOR





TYPICAL CABLING
8,9 AND 10 CONDUCTOR

FIGURE 3

IDENTIFICATION - TWISTED CABLE	18 JUL 1967	
	DATE	DATE REVISED
	V	5.1.3
TITLE	SECTION	NUMBER

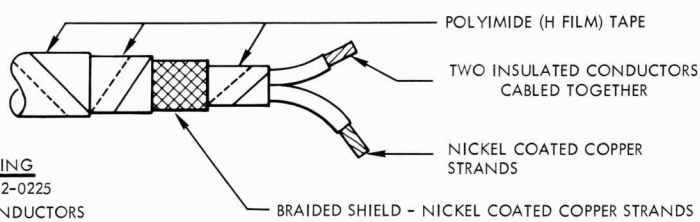
TABLE III

MP572-	XXXX	-0026	26 AWG
MP572-	XXXX	-0024	24 AWG
MP572-	XXXX	-0022	22 AWG
MP572-	XXXX	-0020	20 AWG
MP572-	XXXX	-0018	18 AWG
MP572-	XXXX	-0016	16 AWG

THE FOUR DIGIT DASH NUMBER DESIGNATES THE AMOUNT OF CONDUCTORS AND THEIR COLOR.

	COLOR	
-0225	BLK	
	YEL	2 CONDUCTORS
-0175	RED	3 CONDUCTORS
-0176	GRN	4 CONDUCTORS
-0224		4 CONDUCTORS (22 AWG ONLY)
-0177	ORN	5 CONDUCTORS
-0178	BRN	6 CONDUCTORS
-0179	YEL-BLK	7 CONDUCTORS
-0180	YEL-BRN	8 CONDUCTORS
-0181	YEL-RED	9 CONDUCTORS
-0182	YEL-ORN	10 CONDUCTORS
-0183	YEL-GRN	
	YEL-BLK/BRN	
	YEL-BLK/RED	
	YEL-BLK/ORN	
	YEL-BLK/GRN	15 CONDUCTORS
-0185	YEL-BRN/RED	
	YEL-BRN/ORN	
	YEL-BRN/GRN	
	YEL-RED/ORN	
	YEL-RED/GRN	
	YEL-ORN/GRN	
	RED-BLK	
	RED-BRN	
	RED-GRN	
	ORN-BLK	
	ORN-BRN	
	ORN-GRN	
	GRN-BLK	
	GRN-BRN	
	GRN-RED	30 CONDUCTORS

MP572-MULTIPLE CONDUCTOR SHIELDED CABLE CABLING REF: MA0303-0065



CABLING
MP572-0225
2 CONDUCTORS

FIGURE 4

IDENTIFICATION - MULTIPLE CONDUCTOR SHIELDED CABLE - TWO CONDUCTOR CABLING	18 JUL 1967	
	DATE	DATE REVISED
	V	5.1.4
TITLE	SECTION	NUMBER

CABLE, ELECTRICAL, SINGLE CONDUCTOR, SHIELDED REF: MA0303-0065

TABLE IV

MP572-0159-1004	26 AWG	YELLOW
MP572-0160-1004	24 AWG	YELLOW
MP572-0161-1004	22 AWG	YELLOW
MP572-0162-1004	20 AWG	YELLOW
MP572-0163-1004	18 AWG	YELLOW
MP572-0164-1004	16 AWG	YELLOW

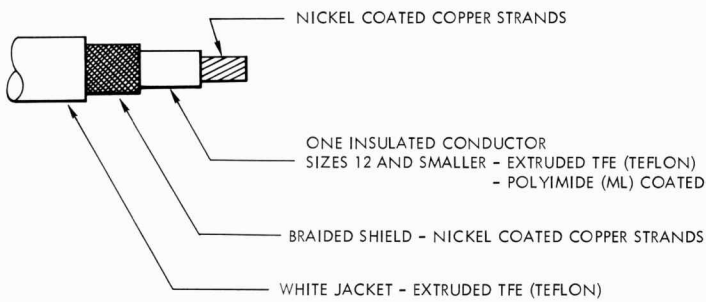


FIGURE 5

CABLE, ELECTRICAL, 20 CONDUCTOR, SHIELDED REF: MA0303-0065

TABLE V

MP572-0184-0026	26 AWG
MP572-0184-0024	24 AWG
MP572-0184-0022	22 AWG
MP572-0184-0020	20 AWG
MP572-0184-0018	18 AWG
MP572-0184-0016	16 AWG

PAIR NO.	COLOR	
1	BLK	YEL
2	RED	YEL
3	ORN	YEL
4	BRN	YEL
5	GRN	YEL
6	RED	BLK
7	RED	BRN
8	RED	ORN
9	RED	GRN
10	GRN	ORN

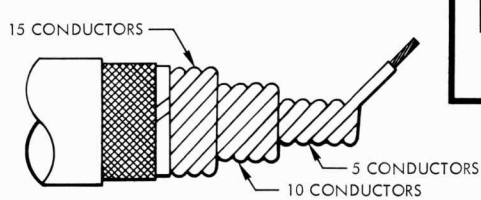


FIGURE 6

CABLING

MP572-0185 30 CONDUCTORS

IDENTIFICATION - SINGLE & 20 CONDUCTOR SHIELDED CABLE - 30 CONDUCTOR CABLING	18 JUL 1967	
	DATE	DATE REVISED
	V	5.1.5
TITLE	SECTION	NUMBER

FORM 999-A-7 REV 4-67

CABLE, ELECTRICAL, MULTIPLE CONDUCTOR, SHIELDED REF: MA0303-0065

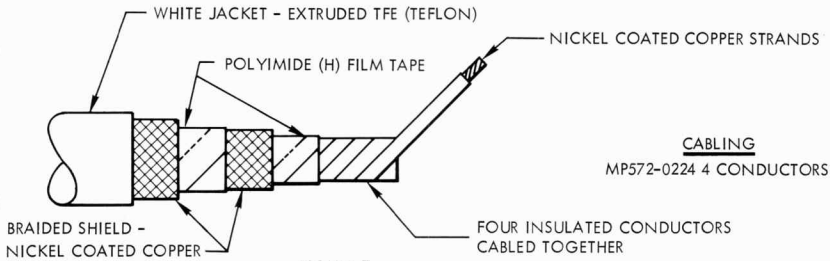


FIGURE 7

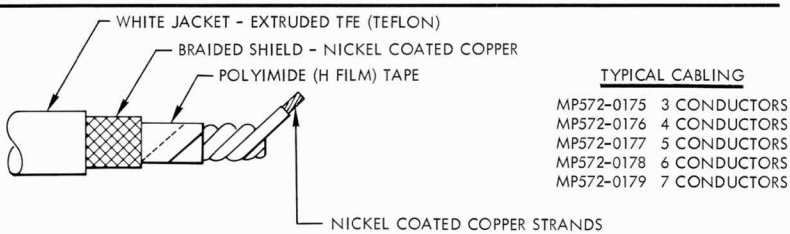


FIGURE 8

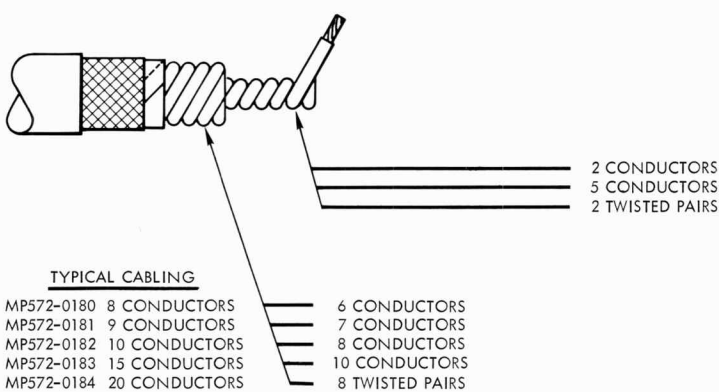
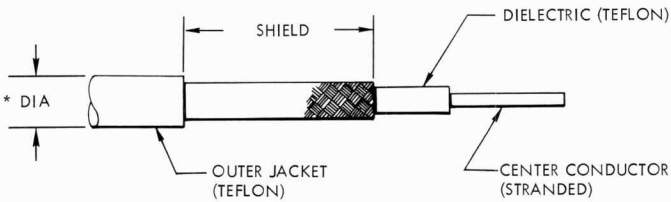


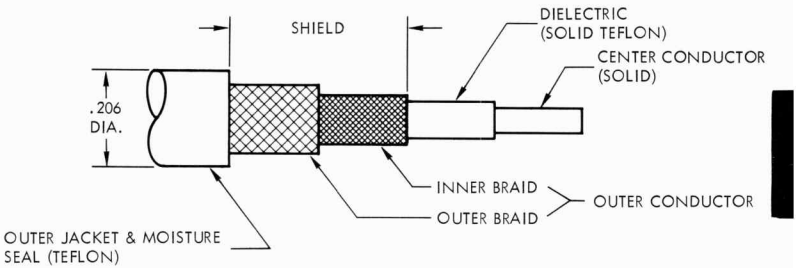
FIGURE 9

IDENTIFICATION - MULTIPLE CONDUCTOR SHIELDED CABLE CABLING	18 JUL 1967	
	DATE	DATE REVISED
	V	5.1.6
TITLE	SECTION	NUMBER



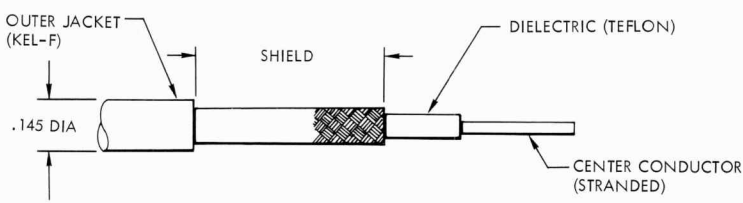
* (.110 DIA) RG-188 A/U COAXIAL CABLE - TYPICAL CONSTRUCTION PER MIL-C-17/69
(.155 DIA) RG-195A/U COAXIAL CABLE - TYPICAL CONSTRUCTION PER MIL-C-17/70

FIGURE 10



RG-142B/U COAXIAL CABLE - TYPICAL CONSTRUCTION PER MIL-C-17/60

FIGURE 11



RG-180 B/U COAXIAL CABLE - TYPICAL CONSTRUCTION PER MIL-C-17/95

FIGURE 12

IDENTIFICATION-COAX CABLE CONSTRUCTION	18 JUL 1967	
	DATE	DATE REVISED
	V	5.1.7
TITLE	SECTION	NUMBER

FORM 999-A-7 REV 4-67

SIZE SELECTION

The correct size of identification plate to be used is determined from the wire bundle diameter and shall be as shown in Figure 10 and specified in Table VI.

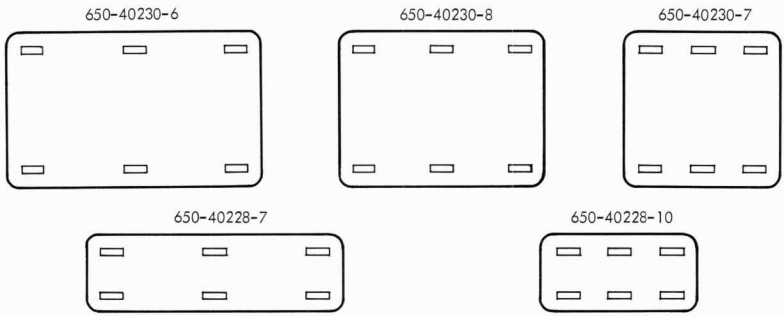


FIGURE 10

TABLE VI

PLATE PART NO.	PLATE SIZE	BUNDLE OR CABLE DIA
650-40228-7	1-1/2 X 3/4	1/4 to 1/2
650-40230-7	1-1/2 X 1-1/2	1/2 and Up
650-40230-6	2-1/2 X 1-1/2	1/2 and Up
650-40228-10	2-1/2 X 3/4	1/4 to 1/2
650-40230-8	2 X 1-1/2	1/2 and Up

INSTALLATION OF IDENTIFICATION PLATES

Identification plates for harness or connector shall be spot-tied on wire harnesses as shown in Figure 11.

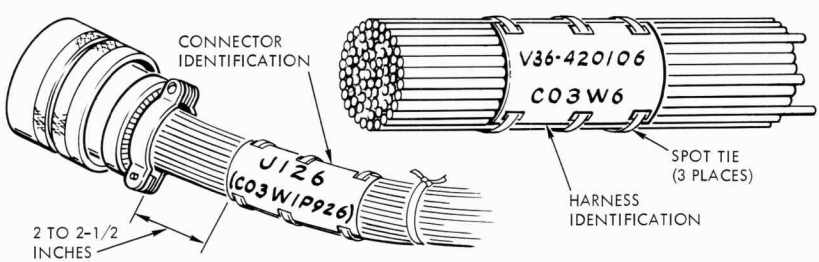


FIGURE 11

NOTE: The preferred method for installing identification plates is 2-1/2 inches from the rear of the connector or of the connector back shell if applicable. Parts may be installed closer, only when the wire run breakout is to short to maintain the 2-1/2 inch and when the installation does not compress the wires to the extent that the sealing grommet holes are opened.

IDENTIFICATION - HARNESS & CONNECTOR IDENTIFICATION PLATES	18 JUL 1967	
	DATE	DATE REVISED
	V	5.1.8
TITLE	SECTION	NUMBER

MATERIAL THERMOFIT KYNAR SLEEVING

NOTE: Temperature requirements of the sleeving to be used shall be in accordance with the applicable engineering document.

IDENTIFICATION OF TERMINAL LUGS

Each terminal lug at a terminal board shall be identified with the number of the post that it is to be terminated on. The numbers shall be imprinted on sleeves which shall be installed over the terminal lug insulation or crimp barrel and shrunk tightly in place as shown in Figure 12. When heat shrinkable sleeves are used to insulate uninsulated terminal lugs, the identification number shall be imprinted on the insulation sleeve – per MA0303-0065.

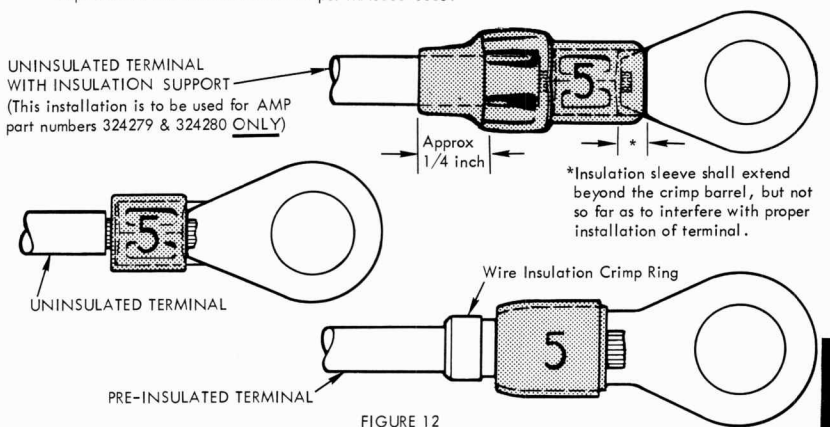


FIGURE 12

NOTE: The diameter of the sleeve shall be such that it will shrink tightly on the terminal lug insulation, crimp barrel and wire insulation without splitting or cracking.

Terminal lug identification sleeves shall not be installed on terminal lugs installed in electrical equipment, Black Boxes, Panels, etc., when conformal coating or potting are required. Insulation of these terminal lugs is required however. Reference Section VII.

IDENTIFICATION OF SPLICES

Splices shall be identified with the reference designators specified on the engineering drawing. The numbers shall be imprinted on the splice insulation sleeve which shall be installed over the splice and shrunk tightly in place as shown in Figure 13.

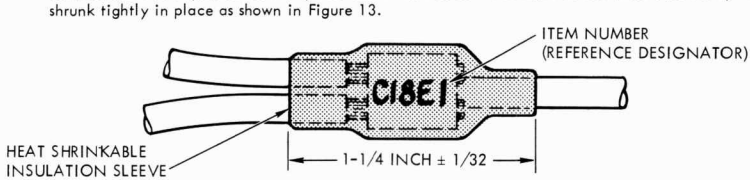


Figure 13

NOTE: Center splice in insulation sleeve and shrink sleeve in place by applying heat to the center of the splice and work out to each end. Do not apply heat for longer than one minute.

IDENTIFICATION - TERMINAL LUGS & SPLICES	18 JUL 1967	
	DATE	DATE REVISED
	V	5.1.9
TITLE	SECTION	NUMBER

SPOT-TYING

Before any operation can be accurately and efficiently performed, the skills that are involved must be mastered.

Spot-tying (binding groups of wires into neat, easy to handle bundles) is one of these skills. When a blueprint calls for wires to be routed in a group, they must be bound into a cable by means of spot-tying, as illustrated below.

Each cable group that is subject to flexing or bending should be bound by means of spot-ties.

TYING MATERIAL

STFE-40B TFE coated beta tape

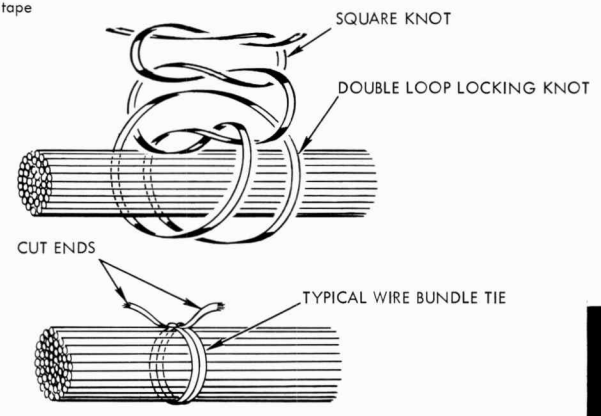


FIGURE 1

NOTE:

The cut ends of the tying material shall extend 3/8 ± 1/8 inch from the knot.

Continuous lacing shall not be used.

GROUPING

When two or more wire harnesses are to be grouped together to form one main bundle, individual spot-ties shall be removed from each small harness except that a sufficient number of spot-ties remain in order to retain the identity of the small harness in the large bundle as shown in Figure 2.

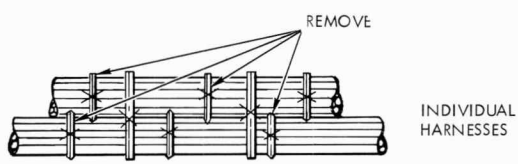


FIGURE 2

WIRE & CABLE ROUTING - SPOT-TYING - GROUPING	18 JUL 1967	
	DATE	DATE REVISED
	V	5.2
TITLE	SECTION	NUMBER

REMOVING SPOT-TIE

To remove a spot-tie from a wire bundle, thread nippers shall be used to cut spot-tie cord in a location immediately below the knot, next to the cord in-order to avoid damaging the surrounding wire insulation.

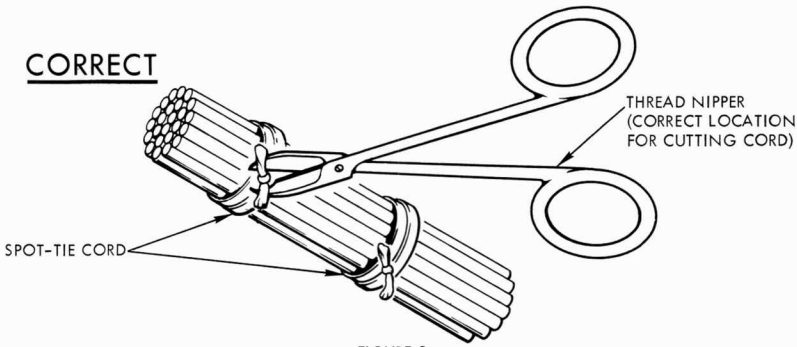


FIGURE 3

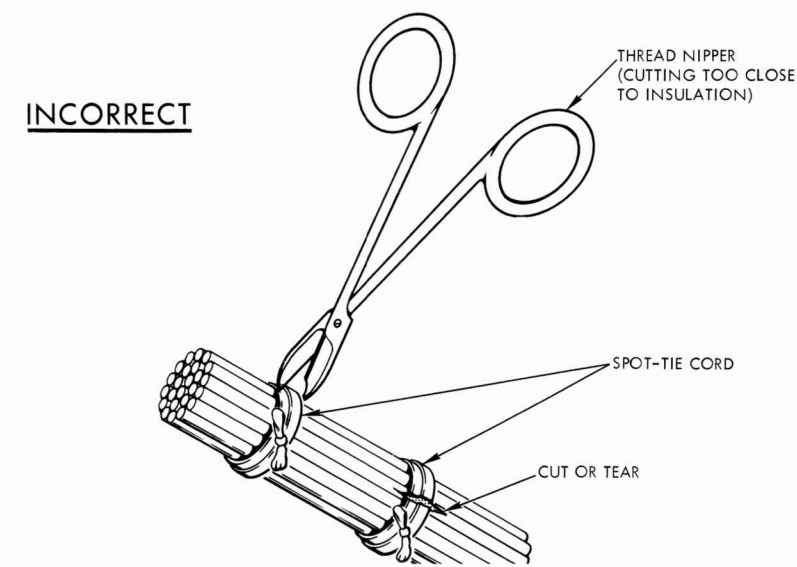


FIGURE 4

PRECAUTIONS

There shall be no slashing, scraping, tearing or nicking of the surrounding insulation of any wire when cutting spot-tie cord with thread nippers. Any wire found in this condition shall be reported/returned to the leadman or supervision for corrective action at once.

WIRE & CABLE ROUTING - SPOT TIE REMOVAL	18 JUL 1967	
	DATE	DATE REVISED
	V	5.2.1
TITLE	SECTION	NUMBER

Spot-ties shall be located on wire harnesses as shown in Figure 5.

TYPICAL DRESSED WIRE HARNESS

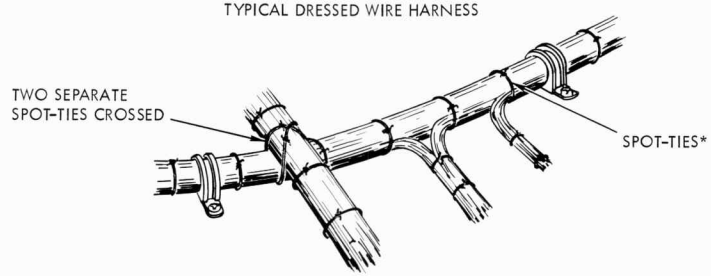


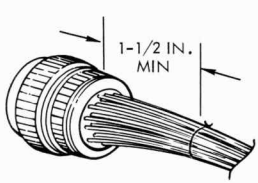
FIGURE 5

*SPOT-TIES SHALL BE UNIFORMLY SPACED AS FOLLOWS:

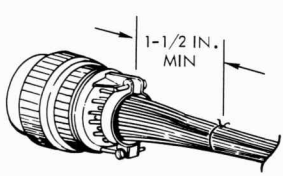
WIRE BUNDLE DIA	SPOT-TIE SPACING
UP TO 1/2"	2" MAXIMUM
1/2 TO 3"	3" MAXIMUM
3" AND LARGER	4" MAXIMUM

Spot-ties shall be installed before each breakout. The spot-tie spacing may be closer than those listed above when required due to close spacing of terminations or when good manufacturing practice so dictates.

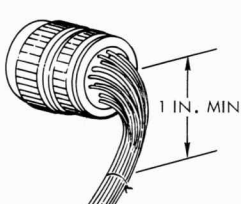
The first spot-ties shall be located on wire harnesses behind sealed connectors as shown in Figure 6.



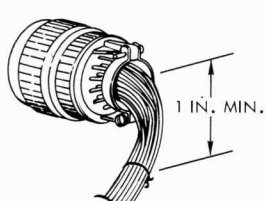
1. STRAIGHT WIRE BUNDLE WITHOUT WIRE GUIDE



2. STRAIGHT WIRE BUNDLE WITH WIRE GUIDE.



3. 90° BEND WITHOUT WIRE GUIDE



4. 90° BEND WITH WIRE GUIDE

FIGURE 6

WIRE & CABLE ROUTING - SPOT-TIE LOCATIONS - HARNESSES - CONNECTORS	18 JUL 1967	
	DATE	DATE REVISED
	V	5.2.2
TITLE	SECTION	NUMBER

Excess slack shall not be allowed in wiring unless otherwise specified on engineering drawings. Examples of harnesses with maximum and minimum allowable slack, and excessive not acceptable slack are shown in Figures 7, 8, 9 & 10.

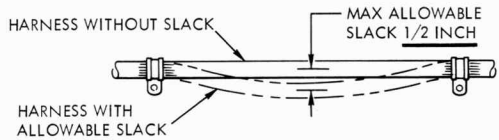


FIGURE 7

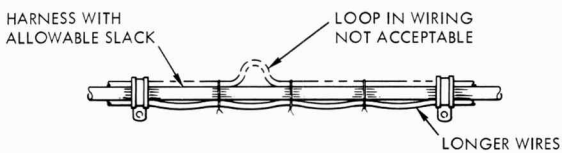


FIGURE 8

A minimum of 75% of the harness between support clamps must be of uniform length. 25% may differ in length, as to be longer only. This extra length is to be accommodated uniformly under spot-ties.

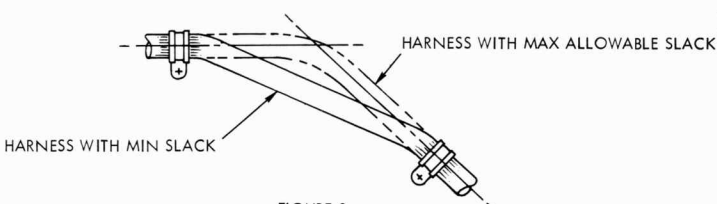


FIGURE 9

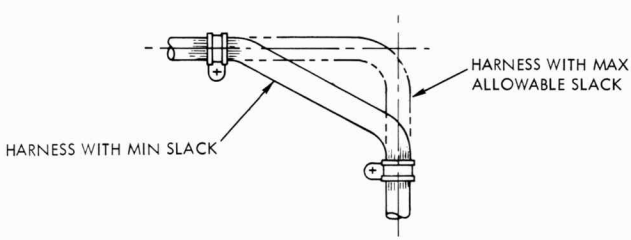


FIGURE 10

WIRE & CABLE ROUTING - SLACK - ACCEPTABLE MINIMUM & MAXIMUM - UNACCEPTABLE	18 JUL 1967	
	DATE	DATE REVISED
	V	5.2.3
TITLE	SECTION	NUMBER

Sufficient slack shall be provided to allow replacement of terminals (terminal board, connector and component) at least 2 times. Slack for this purpose shall not occur between the wire terminal and the first clamp, but between the first and third clamps as per Figures 11 & 12.

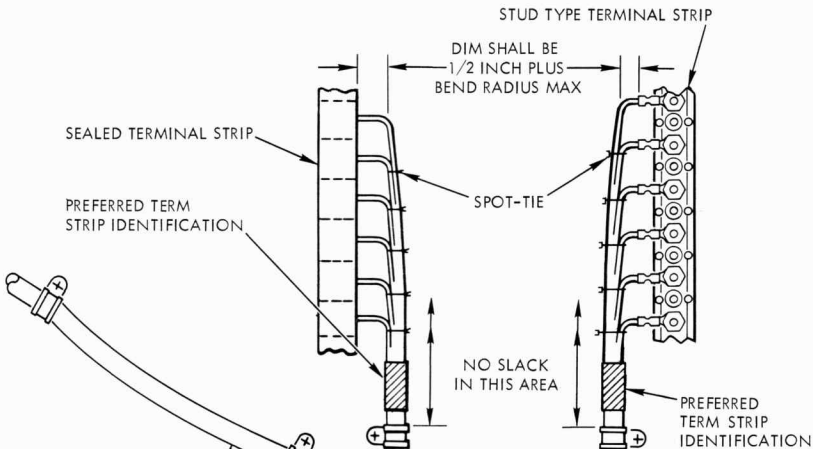


FIGURE 11

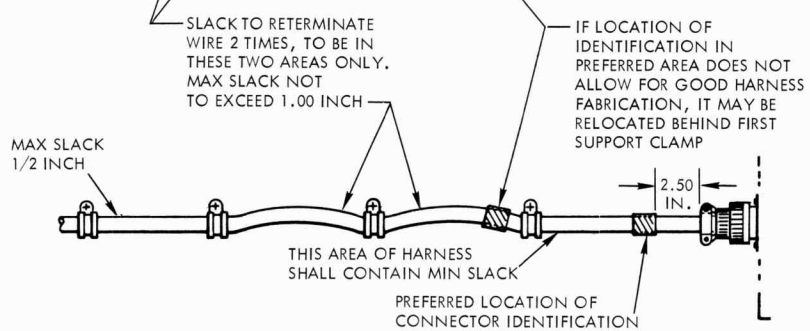


FIGURE 12

WIRE & CABLE ROUTING - WIRE HARNESSES SLACK & IDENTIFICATION LOCATIONS	18 JUL 1967	
	DATE	DATE REVISED
	V	5.2.4
TITLE	SECTION	NUMBER

NOTE: SECTION 5.3 HAS
BEEN PURPOSELY LEFT BLANK
THIS SECTION WILL BE
ADDED AT A LATER DATE

CLAMPING WIRE HARNESSES	18 JUL 1967	
	DATE	DATE REVISED
	V	5.3
TITLE	SECTION	NUMBER

NOTE: SECTION 5.4 HAS
BEEN PURPOSELY LEFT BLANK
THIS SECTION WILL BE
ADDED AT A LATER DATE.

CLEANLINESS	18 JUL 1967	
	DATE	DATE REVISED
	V	5.4
TITLE	SECTION	NUMBER

SCOPE

This section presents the requirements for the establishment of an electrical bond, creating a low resistance path for electrical circuits between two parts that are to be joined together.

BONDING TYPES

The types of bonding shall be specified on the applicable engineering drawing. The types of bonding are as follows.

TYPE I: Bonding created by the spot welding of aluminum straps.

TYPE IA: Bonding created by the riveting or bolting of aluminum straps.

TYPE II: Bonding created by the addition of jumpers, clamps, etc., attached and held together by threaded fasteners.

TYPE III: Bonding created by the joining of separate items in direct contact with each other and held firmly together by threaded fasteners.

TYPE IIIA: Bonding created by the joining of separate items together utilizing mechanical fasteners for electrical paths.

NOTE:

The location of the bonding and materials required shall be called out on the engineering drawings specifically for Types I, IA and II. All metal to metal joints shall be bonded in accordance with Types III and IIIA as they are specifically outlined in MA0613-002.

The information presented within this section sets forth the methods of Types II, III and IIIA bonding, that are used for the fabrication and assembly of APOLLO electrical assemblies or systems.

BONDING CONNECTIONS

All surfaces to be bonded must be cleaned. Bonding connections shall NOT be installed in such a manner as to interfere in any way with the operation of movable components. Where bonding connections utilize LD153-0002 or LD153-0010 washers, the color coating shall be removed by solvent cleaning with MB0210-003 trichloroethylene per MA0110-010 or by vapor degreasing per AA0110-002.

PREPARATION OF BONDING SURFACES

Paints or finishes shall be removed over an area extending 1/16 to 1/8 inch beyond the circumference of the metal faying surface, (the mating surfaces of the items to be bonded). unless otherwise specified on the applicable engineering drawing.

REMOVAL OF FINISHES

Organic finishes, paints, etc., may be removed per MA0110-023. A clean cheesecloth moistened with water may be used to remove the loosened finish and stripper. Where MA0110-023 is not applicable, or on very small areas, the method specified below for inorganic finishes may be used.

Inorganic finishes shall be removed with abrasive paper or cloth-backed abrasive, 320 grit, or a rubber abrasive tool. CARE shall be taken when finishes are removed with abrasives so as to apply a gentle and uniform pressure to insure a smooth, uniform surface, NOT to remove excessive metal, and NOT allow removed metal particles to become imbedded in the metal surface. Cleaning shall then be done as specified below.

CLEANING

Bare metal shall be cleaned with a clean cheesecloth moistened with solvent per MB0210-003, MB0200-005 or AB0210-009 to remove corrosion preventatives, oil, grease, wax, dirt and other foreign material or contaminants.

Caution

Cleaning solvents are highly flammable and toxic, and are to be handled in accordance with process specification MA0117-001.

PROTECTION OF CLEANED SURFACES

Bare metal bonding surfaces of parts to be left unprotected for more than 8 hours prior to bonding shall be coated with corrosion preventative compound MIL-C-16173, grade 4. Compound shall be removed per cleaning instructions before bonding.

DISSIMILAR METAL CONNECTIONS

Connection between dissimilar metals shall be per Table I, unless otherwise specified on the applicable engineering drawing. All such connections shall be coated per MA0108-013.

TABLE I

Metal Structure	Connection for Tinned Copper Jumpers	
	Required Washer Between Jumper and Structure	Attachment
Magnesium and Mg Base Alloys	Al or Mg washer	Screw and nut tin-plated(1)
Aluminum and Al Base Alloys	None	Screw and nut tin-plated
Steel (Except stainless Steel)	None	Screw and nut tin-plated
Tin, Lead and Pb-Sn Solders	None	Screw and nut stainless steel preferred; tin-plated optional.
Copper and Cu Base Alloys	None	Screw and nut stainless steel preferred; tin-plated optional
Nickel and Ni Base Alloys		
Chromium		
Stainless Steel		
Titanium		
Gold		
Silver		
Platinum		
Rhodium		

NOTE: (1) Cadmium-plated screws and nuts are NOT suitable for spacecraft use.

BONDING - CLEANING - PROTECTION - DISSIMILAR CONNECTIONS	18 JUL 1967	
	DATE	DATE REVISED
	V	5.5.1
TITLE	SECTION	NUMBER

CHEMICAL FILM TREATMENT

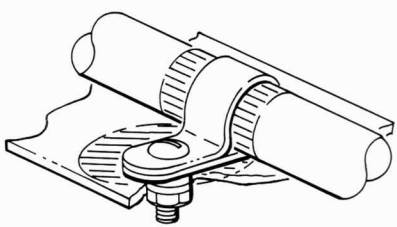
Where specified on the applicable engineering drawing, the electrical bonding surface shall be cleaned per preparation, removal and cleaning instructions, and then chemical film treated per MA0109-003. The chemical film shall not be painted over until after mechanical connections have been completed.

ASSEMBLY OF BOND CONNECTIONS

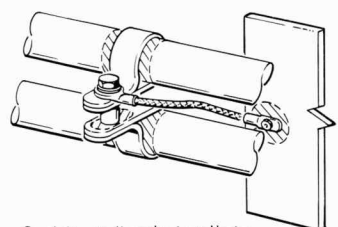
TYPE II

The finish-free and cleaned surfaces shall be assembled in accordance with the detailed installation information of the applicable engineering drawing.

Tubular or cylindrical conducting members not inhererently bonded shall be bonded by means of a metalic clamp or a metalic clamp with a jumper as shown in Figures 1 and 2.



Rigid conduit and metalic clamp
FIGURE 1



Conduit not directly installed on structure using spacer and jumper
FIGURE 2

Flexible type metal conduit bonding clamps shall be installed as shown in Figure 3, and NOT in a manner that will crimp or damage the conduit.

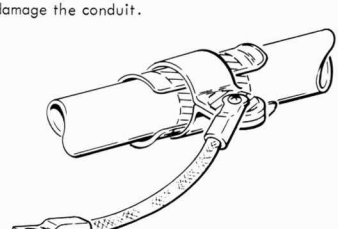


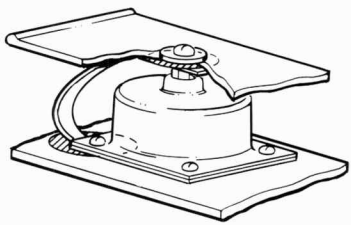
FIGURE 3. Flexible conduit, using flared split sleeve

NOTE: Cushion clamps are NOT to be used for bonding purposes.

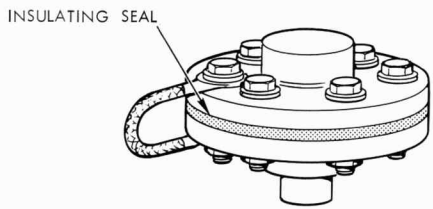
When a bonding jumper is to be installed on a clamp installation, the lug shall be placed under the screw head as shown in Figures 2 and 3.

Items on vibration isolators shall be bonded with a tin-plated beryllium-copper, tin-plated copper, or aluminum strap as shown in Figure 4.

Bonding of items separated by a gasket joint is accomplished as illustrated in Figure 5 showing a typical installation.



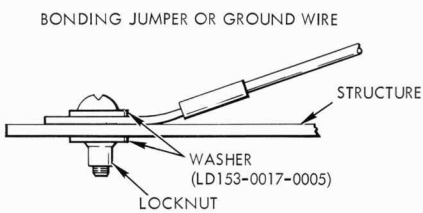
Bonding strap installed around vibration mount
FIGURE 4



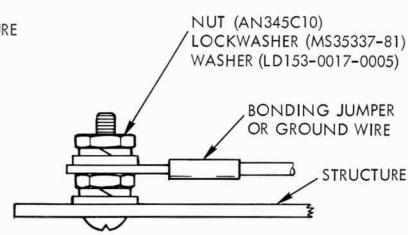
Jumper method of items separated by a seal
FIGURE 5

NOTE: The maximum length-to-width ratio of the bonding strap shall be 5 to 1, and shall be as short as possible without restricting movement of equipment.

Bonding stud installations for terminating bonding jumpers or ground wires are accomplished as shown in Figures 6 and 7.



bonding stud installation
FIGURE 6



Bonding stud installation
FIGURE 7

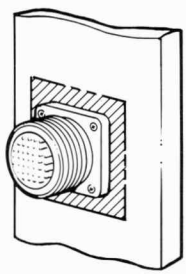
NOTE: Quick-disconnecting jumpers shall NOT be used. Cadmium-plated washers are NOT suitable for spacecraft use.

BONDING - STRAP, JUMPER & GROUND WIRE ASSEMBLY CONNECTIONS	18 JUL 1967	
	DATE	DATE REVISED
	V	5.5.3
TITLE	SECTION	NUMBER

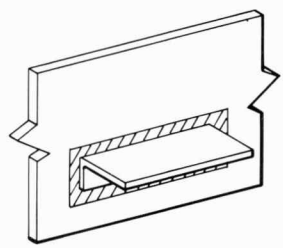
ASSEMBLY OF BOND CONNECTIONS

TYPE III

This method provides a better bond than any type of jumper or strap. The mating surfaces are directly joined together and shall be finish-free and cleaned. Typical items include metal panels, angles, brackets, cable connectors, etc. Figures 8 and 9 illustrate two such typical installations.



Electrical connector receptacle
FIGURE 8



Metal structural members
FIGURE 9

NOTE: For the bolting of angles or brackets to metal panels, only the areas around the end bolt holes of each attaching edge member need be cleaned, unless otherwise noted on the applicable engineering drawing.

Each such cleaned area shall be at least 1/2 inch in diameter. The cleaning of the entire mating surface, as shown in Figure 9 is optional.

ASSEMBLY OF BOND CONNECTIONS

TYPE III A

This method of bonding is similar to Type III, in that separate items are joined and held together by mechanical fasteners. The difference being that the electrical paths in each case are through the mechanical fasteners.

A typical example is illustrated in Figure 10, in which there is a shim or spacer between the structural members.

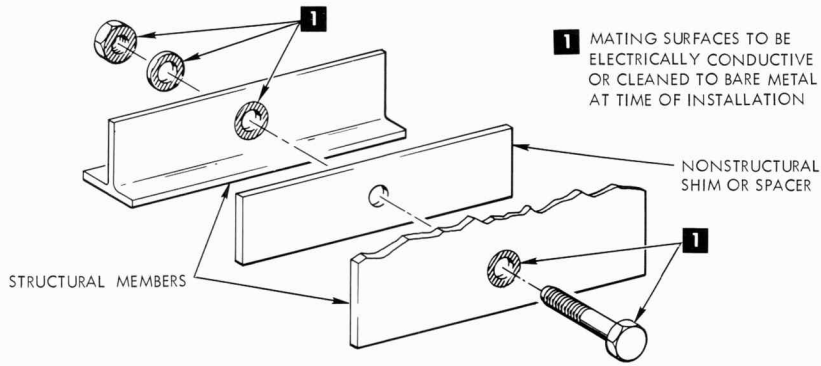


FIGURE 10 Structural members utilizing bolt & nut for bond

NOTE: For the bolting of angles or brackets to metal panels, only the areas around the end bolt heads (and nuts, if used) at each end hole on each attaching edgemember need be cleaned, unless otherwise noted on the applicable engineering drawings.

Each such cleaned area shall be 1/2 inch in diameter. Also, for a counter-sunk screw, only the area of the countersink need be cleaned.

Non-metalic material shall NOT be included in the stack of surfaces in contact between compression points, unless specified on the applicable engineering drawing.

Bonds shall NOT be attached by means of Tinnerman nuts, sheet metal screws, or self-tapping screws.

REFINISHING CLEANED AREAS AFTER COMPLETION OF ASSEMBLY

The excess area of metalic surfaces cleaned to effect the electrical bond shall be refinished within 72 hours.

If additional time is required, the bond area shall be covered with a strippable vinyl coating (MB0225-001, Type I) per MA0108-014.

Refinishing of these surfaces is as follows:

On anodized parts located in the Command Module, and affected areas of all other surfaces in the Command Module, the affected surfaces shall be solvent cleaned (Chlorothene NU), then given one coat of MB0125-019 enamel, color to match as near as possible the adjacent area; applied per MA0108-005.

The affected areas of all surfaces of the Service Module, and all surfaces other than the Command Module interior, shall be solvent cleaned, then given one coat of the original finish, applied per MA0108-005.

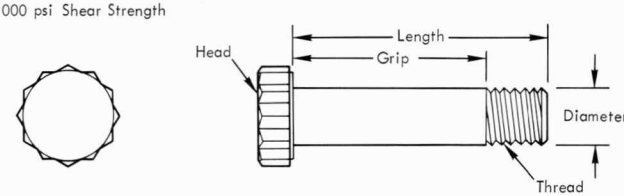
Where not prohibited by color or thermal control requirements, it shall be permissible to refinish with MB0125-033.

NOTE: Application of MB0125-033 to surfaces in contact with the crew compartment atmosphere is NOT acceptable.

Bolt numbers are made up of the basic number followed by a dash number.

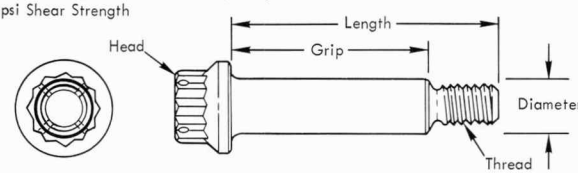
1. Basic numbers indicate the type, diameter of shank, and thread size.
2. Dash numbers indicate the length but do not increase in uniform steps. Specific lengths and grips are listed in the Mechanical Parts Manual.
3. Bolts are corrosion resistant steel (CRES).
4. For torque values, refer to torquing section.

MD111-4001 BOLT, 12 POINT HEAD (Shear)
Heat Treat: 110,000 psi Shear Strength



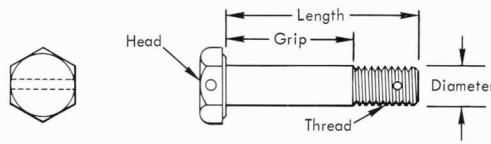
Basic Part Number	Diameter	Threads Per Inch
MD111-4001-03	#10	32
-04	1/4	28
-05	5/16	24
-06	3/8	24
-07	7/16	20
-08	1/2	20
-09	9/16	18
-10	5/8	18

MD111-4002 BOLT-SHOULDER, 12 POINT HEAD (Shear)
Heat Treat:110,000 psi Shear Strength



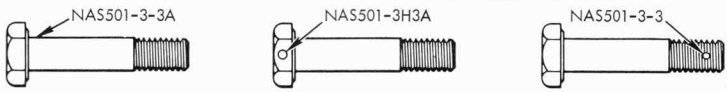
Basic Part Number	Diameter	Threads Per Inch
MD111-4002-03	#10	32
-04	1/4	28
-05	5/16	24
-06	3/8	24
-07	7/16	20
-08	1/2	20

NAS501 BOLT, HEX HEAD (Tension or Shear)



Basic Part Number	Diameter	Threads Per Inch
NAS501-3	#10	32
-4	1/4	28
-5	5/16	24
-6	3/8	24
-7	7/16	20
-8	1/2	20

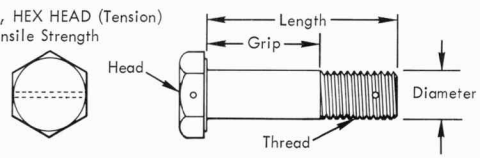
Basic Part Number	Diameter	Threads Per Inch
NAS501-9	9/16	18
-10	5/8	18
-12	3/4	16
-14	7/8	14
-18	1-1/8	12
-20	1-1/4	12



UNDRILLED HEAD ONLY DRILLED SHANK ONLY DRILLED

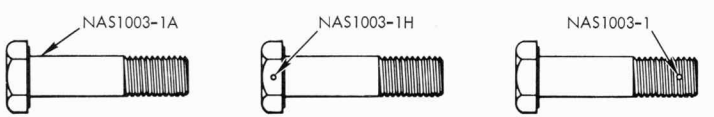
ILLUSTRATION OF DRILLED AND UNDRILLED BOLTS AND PART NUMBERS

NAS1003 THRU 1020 BOLT, HEX HEAD (Tension)
Heat Treat: 140,000 psi Tensile Strength



Basic Part Number	Diameter	Threads Per Inch
NAS1003	#10	32
1004	1/4	28
1005	5/16	24
1006	3/8	24
1007	7/16	20
1008	1/2	20

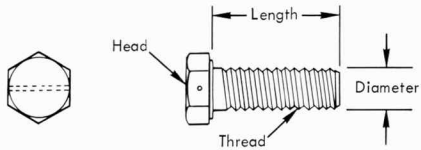
Basic Part Number	Diameter	Threads Per Inch
NAS1009	9/16	18
1010	5/8	18
1012	3/4	16
1014	7/8	14
1016	1	12
1018	1-1/8	12
1020	1-1/4	12



UNDRILLED HEAD ONLY DRILLED SHANK ONLY DRILLED

ILLUSTRATION OF DRILLED AND UNDRILLED BOLTS AND PART NUMBERS

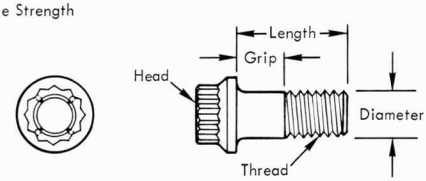
RD111-1011 & -1012 BOLT, HEX HEAD (Tension)
Heat Treat: 140,000 psi Tensile Strength



Basic Part Number		Diameter	Threads Per Inch
Drilled Head	Undrilled Head		
RD111-1011-63	RD111-1012-63	#10	32
-64	-64	1/4	28
-65	-65	5/16	24
-66	-66	3/8	24
-67	-67	7/16	20
-68	-68	1/2	20
-69	-69	9/16	18
-70	-70	5/8	18
-72	-72	3/4	16
-74	-74	7/8	14
-76	-76	1	12

(RD111-1011 ONLY)

RD111-4008 & -4009 BOLT, 12 POINT HEAD (Tension)
Heat Treat: 200,000 psi Tensile Strength



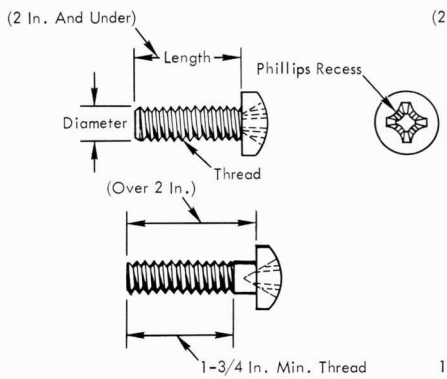
Basic Part Number		Diameter	Threads Per Inch
Drilled Head	Undrilled Head		
RD111-4008-04	RD111-4009-04	1/4	28
-05	-05	5/16	24
-06	-06	3/8	24
-07	-07	7/16	20
-08	-08	1/2	20
-09	-09	9/16	18
-10	-10	5/8	18
-12	-12	3/4	16

(RD111-4008 ONLY)

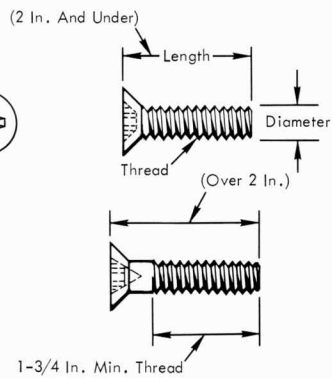
Screw numbers are made up of the basic number followed by a dash number.

1. Basic numbers indicate the type, diameter of shank, and thread size.
2. Dash numbers indicate the length but do not increase in uniform steps. Specific lengths and grips are listed in the Mechanical Parts Manual.
3. Screws are corrosion resistant steel (CRES).
4. For torque values, refer to torquing section.

MD112-1001 SCREW, PAN HEAD, PHILLIPS RECESS

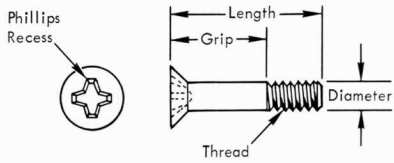


MD112-3001 SCREW, 100° FLAT HEAD, PHILLIPS RECESS



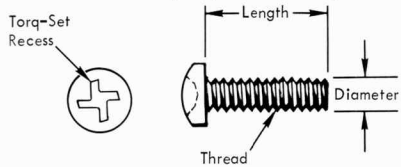
Basic Part Number		Diameter	Threads Per Inch
Pan Head	100° Flat Head		
MD112-1001-02		#2	56
-04	MD112-3001-04	#4	40
-06	-06	#6	32
-08	-08	#8	32
-30	-30	#10	32
-40	-40	V4	28
-50	-50	5/16	24
-60	-60	3/8	24

NAS560 SCREW, 100° FLAT HEAD,
PHILLIPS RECESS (Shear)
Heat Treat: 75,000 psi Tensile Strength



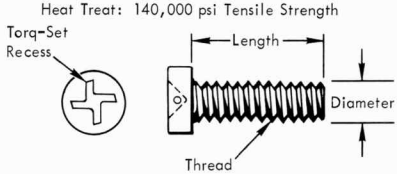
Basic Part Number	Diameter	Threads Per Inch
NAS560CK3	#10	32
CK4	1/4	28
CK5	5/16	24
CK6	3/8	24
CK7	7/16	20
CK8	1/2	20
CK9	9/16	18

NAS1100 SCREW, PAN HEAD, TORQ-SET,
FULL THREAD (Tension)
Heat Treat: 140,000 psi Tensile Strength



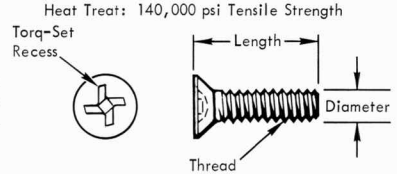
Basic Part Number	Diameter	Threads Per Inch
NAS1100C04	#4	40
C06	#6	32
C08	#8	32
C3	#10	32
C4	1/4	28
C5	5/16	24
C6	3/8	24

NAS1101 SCREW, DRILLED FILLISTER HEAD,
TORQ-SET, FULL THREAD
Heat Treat: 140,000 psi Tensile Strength



Basic Part Number	Diameter	Threads Per Inch
NAS1101C04H	#4	40
C06H	#6	32
C08H	#8	32
C3H	#10	32
C4H	1/4	28
C5H	5/16	24
C6H	3/8	24

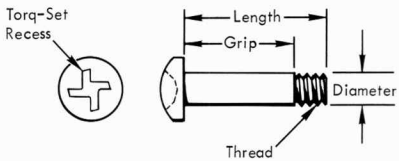
NAS1102 SCREW, 100° FLAT HEAD,
TORQ-SET, FULL THREAD
Heat Treat: 140,000 psi Tensile Strength



Basic Part Number	Diameter	Threads Per Inch
NAS1102C04	#4	40
C06	#6	32
C08	#8	32
C3	#10	32
C4	1/4	28
C5	5/16	24
C6	3/8	24

NAS1131 THRU 1138 SCREW, PAN HEAD, TORQ-SET (Shear)

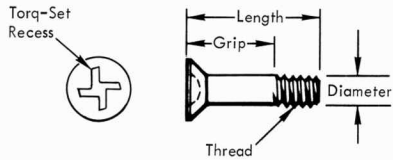
Heat Treat: 140,000 psi Tensile Strength



Basic Part Number	Diameter	Threads Per Inch
NAS1131C	#6	32
1132C	#8	32
1133C	#10	32
1134C	1/4	28
1135C	5/16	24
1136C	3/8	24
1137C	7/16	20
1138C	1/2	20

NAS1151 THRU 1158 SCREW, 100° FLAT HEAD, TORQ-SET (Shear)

Heat Treat: 140,000 psi Tensile Strength



Basic Part Number	Diameter	Threads Per Inch
NAS1151C	#6	32
1152C	#8	32
1153C	#10	32
1154C	1/4	28
1155C	5/16	24
1156C	3/8	24
1157C	7/16	20
1158C	1/2	20

NOTE: SECTION 5.7 HAS
BEEN PURPOSELY LEFT BLANK
THIS SECTION WILL BE
ADDED AT A LATER DATE.

NOTE: SECTION 5.8 HAS
BEEN PURPOSELY LEFT BLANK
THIS SECTION WILL BE
ADDED AT A LATER DATE.

TERMINAL LUG ARRANGEMENTS	18 JUL 1967	
	DATE	DATE REVISED
	V	5.8
TITLE	SECTION	NUMBER

GENERAL RULES

The information in this section applies to connector types, both crimp and solder, currently used in Apollo electrical assemblies.

Too much emphasis cannot be placed on the importance of the proper handling of the tools and the care and cleanliness required in connector assembly.

Controlled crimp tools guarantee a good crimp, but contact insertion and removal tools require a dexterity and familiarity peculiar to this operation. Contacts must not be forced into contact cavities.

The insertion/removal tool must be held in a direct straight line relative to the contact cavity to prevent contact and/or seal damage. Tools will vary but the same absolute rule applies with either front or rear loaded connectors.

Connector seal life is limited. Avoid excessive insertion and removal operations.

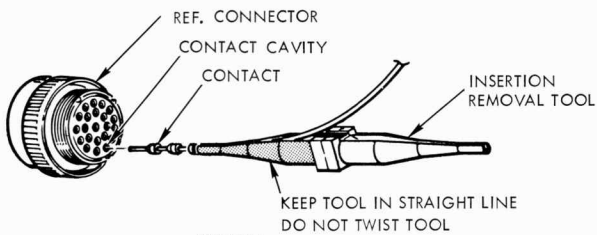


FIGURE 1

NOTE - EXAMINE INSERTION/REMOVAL TOOL CAREFULLY AFTER EACH INDIVIDUAL OPERATION
DO NOT USE DAMAGED TOOL

MOUNTING ORIENTATION

Unless otherwise specified on the applicable engineering drawing, connectors shall be mounted uniformly. Round connector types shall have their master indexing keyway at 12 o'clock, defined as +X or -Z direction.

Rectangular connectors shall be mounted with the number 1 or A pin towards the +X or -Z direction.

Keyway orientation for connectors mating with components shall be determined during the mockup phase of manufacturing operations.

DRAINAGE

Connectors shall be positioned so that fluids run out, not into connectors.

Above requirement does not apply to potted or environmentally sealed connectors.

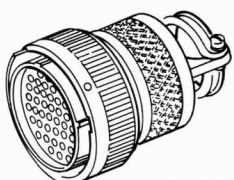
CONNECTORS MUST BE KEPT CLEAN AND FREE OF ALL FOREIGN MATTER

This information presents the requirements and procedures for the handling and assembly of the General Purpose and Rectangular Connector Assemblies on Apollo Spacecraft.

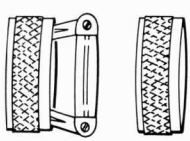
APPLICABLE TO - Procurement Specifications MC414-0148, MC414-0365, and the following Specification Control Drawings:

TABLE I

CRIMP TYPE			SOLDER TYPE
ME414-0095	ME414-0121	ME414-0133	ME414-0099
ME414-0096	ME414-0122	ME414-0135	ME414-0100
ME414-0103	ME414-0123	ME414-0137	ME414-0102
ME414-0104	ME414-0124	ME414-0137	ME414-0170 -THRU -0178
ME414-0106	ME414-0125	ME414-0139	ME414-0179 -THRU -0187
ME414-0107	ME414-0127	ME414-0148	ME414-0434
ME414-0116	ME414-0128	ME414-0149	ME414-0503
ME414-0117	ME414-0129	ME414-0238	ME414-0512
ME414-0119	ME414-0131	ME414-0239	ME414-0528
ME414-0120	ME414-0132		ME414-0529
			ME414-0542 -THRU -0550
			ME414-0559
			ME414-0580
CRIMP INFORMATION REFERENCE SECTION IV TOOLING			SOLDER INFORMATION REFERENCE SECTION IV TOOLING



CIRCULAR TYPE



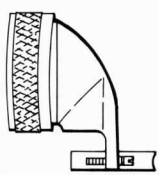


FIGURE 2 BACKSHELL TYPES

BULKHEAD AND RECTANGULAR TYPE NOT SHOWN

CONTACT INSERTION SHELL SIZE 10 THRU 24

To install the contacts in the connector, the colored end of the insertion/extraction tool is snapped around the wire insulation with the tip of the tool butting against the rear shoulder of the contact. The contact is then inserted into the proper cavity in the rear of the connector and pushed forward until it bottoms in the insert.

CONTACT REMOVAL SHELL SIZE 10 THRU 24

To remove the contacts from the connector, the white end of the insertion/extraction tool is snapped around the wire and pushed forward until it bottoms against the contact shoulder. When fully inserted the largest diameter of the extraction tip expands the tangs of the retaining clip beyond the contact shoulder, allowing the contact and tool to be easily extracted from the insert. This is done by pulling the tool and wire straight out from the connector.

Every unused insert hole in a connector shall be filled with a sealing plug.

CONNECTORS MUST BE KEPT CLEAN AND FREE OF ALL FOREIGN MATTER

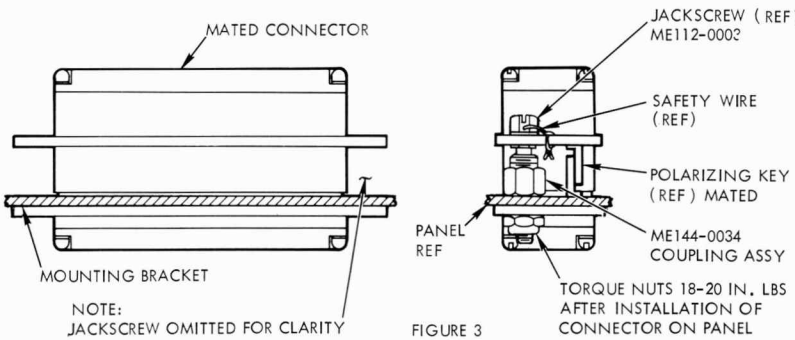


FIGURE 3

INSTALLATION OF JACKSCREW ASSEMBLY

When required by engineering drawing to install jackscrew assemblies on rectangular connectors, the following shall apply:

1. Place one thrust washer on the jackscrew SEE FIGURE 5
2. Insert the jackscrew in the hole in the flange of the connector from the rear or cable entry side.
3. Place second thrust washer over the threaded end of the jackscrew and slide it in position against the connector flange.
4. Using the snap ring tool RE-15, place the truarc ring over the threaded portion of the jackscrew and engage in the groove provided in the shank. See Figure 3 for nomenclature and finished configuration.

NOTE: If the applicable engineering drawing specifies a V36-42130 coupling screw, the above assembly procedure shall be followed except the snap ring shall be installed using the tool detailed in FIGURE 4

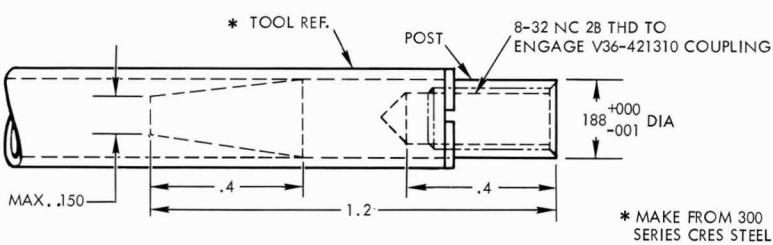


FIGURE 4 JACKSCREW INSTALLATION

CONNECTORS - RECTANGULAR JACKSCREW INSTALLATION	18 JUL 1967	
	DATE	DATE REVISED
	V	5.9.2
TITLE	SECTION	NUMBER

INSTALLATION OF GROUNDING STUDS (RECTANGULAR CONNECTORS ONLY)

When ground wires are called out on the Automated Wire List they shall be grounded in the following manner.

1. Remove backshell screw nearest the number one contact and, if necessary, the screw diagonally opposite.
2. Insert V36-444258 Ground Stud in place of the removed screw, using the lockwasher furnished with the connector and torque to the requirement for a No. 4-40 screw.
3. Install no more than two ground wire lugs per stud. The crimp barrel of the terminal lug shall be oriented to minimize breakage and loosening see FIGURE 5.
4. While holding the hex portion of the stud, torque the lug screw to the requirements for a No. 6-32 screw.

Caution

Do not tighten the No. 4-40 screw while torquing the No. 6-32 screw

TABLE II

TORQUE VALUE	SCREW SIZE
3-5 IN. LBS	4-40
6-9 IN. LBS	6-32

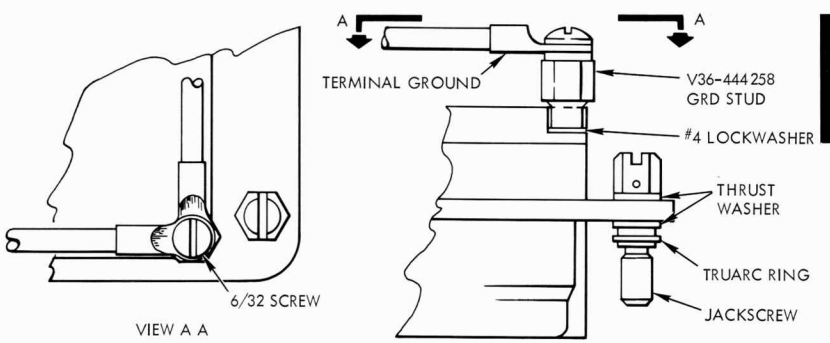


FIGURE 5

Caution

SPECIAL PRECAUTIONS must be taken with these connectors to align the polarizing keys and the jackscrews with the corresponding parts on the mating connector.

Misalignment may cause connector or contact damage. After mating tighten each jackscrew alternately no more than 2 turns at a time until they bottom. Torque each jackscrew 7-8 in. lbs. For unmating follow the same procedure in reverse.

Unequal tightening will damage the connector and/or the contacts.

CONNECTORS - RECTANGULAR GROUND WIRE INSTALLATION	18 JUL 1967	
	DATE	DATE REVISED
	V	5.9.3
TITLE	SECTION	NUMBER

FACE VIEW OF ENGAGING SIDE

For ME414-0148 & ME414-0238 PLUG ONLY.	For ME414-0149 & ME414-0239 RECEPTACLE ONLY

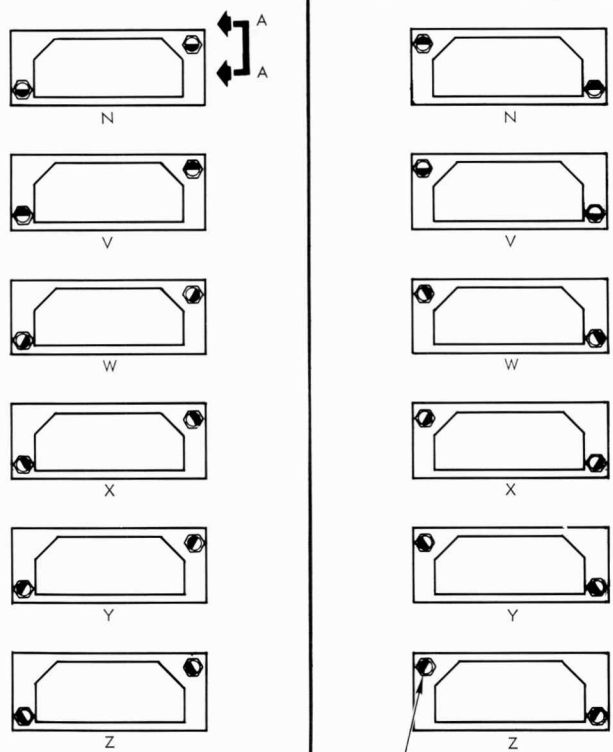
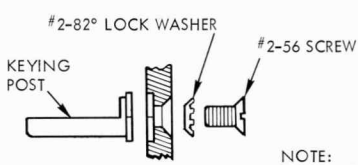


FIGURE 6



VIEW A-A

Shaded area indicates extended portion of polarizing post as viewed from engaging face of receptacle or plugs.

Posts are adjustable and letter under each illustration represents polarizing post position.

NOTE:
Torque #2-56 screw 1.5 to 2 in. lbs.

CONNECTORS - RECTANGULAR POLARIZATION POSITIONS	18 JUL 1967	
	DATE	DATE REVISED
	V	5.9.4
TITLE	SECTION	NUMBER

ALL CONNECTOR WIRE GUIDES SHALL BE INSULATED, EXCEPT ME414-0503 SERIES

STRAIGHT WIRE GUIDES - SHELL SIZE 12 THROUGH 24

Remove the wire guide saddles from the connector endbell and slide a teflon sleeve, per MB0150-025 Class I Size 8, on each saddle. The sleeve shall extend a minimum of 1/2 inch past the corner of the saddle with the threaded insert (see Figure 7A). Shrink the sleeve in position and trim the protruding end of the sleeve into a tab as shown in (Figure 7B).

Reassemble the saddles on the connector endbell and position the tabs so that they will cover all surfaces of the wire guide which may contact the wires.

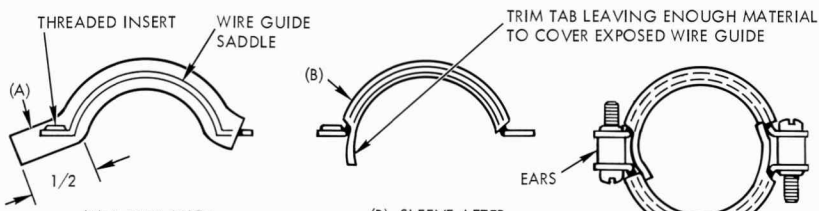


FIGURE 7

RIGHT ANGLE (90°) WIRE GUIDES - SHELL SIZE 14 THROUGH 24

Remove the wire guide saddle. Cut the required length piece of G51T-E grommet (caterpillar). The length of the grommet shall be such that it will come in contact with the entire inner surface of the wire guide when the saddle is tightened. The raised portions, or feet, of the grommet shall be trimmed to clear portions of the inner surface of the wire guide to facilitate installation and trimmed flush or slightly above the outer surface of the wire guide (see Figure 8).

CONNECTORS MUST BE KEPT CLEAN AND FREE OF ALL FOREIGN MATTER

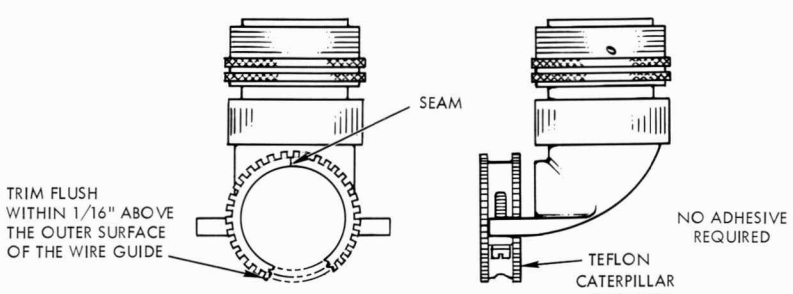


FIGURE 8

CONNECTORS - CIRCULAR WIRE GUIDE INSULATION	18 JUL 1967	
	DATE	DATE REVISED
	V	5.9.5
TITLE	SECTION	NUMBER

STRAIGHT AND RIGHT ANGLE (90°) WIRE GUIDES - SHELL SIZE 8 AND 10

Remove the wire guide saddles, if required, and place a split Teflon Sheet TYPE E7A per AMS3651 of the required length over the wire bundle. Overlap the sleeve and spot-tie in place, as shown in FIGURE 9. Sleeve overlap shall be sufficient so that wire guide will secure the sleeve in place (minimum 50% overlap). Reinstall wire guide saddles if they were removed for the harness sleeving installation operation.

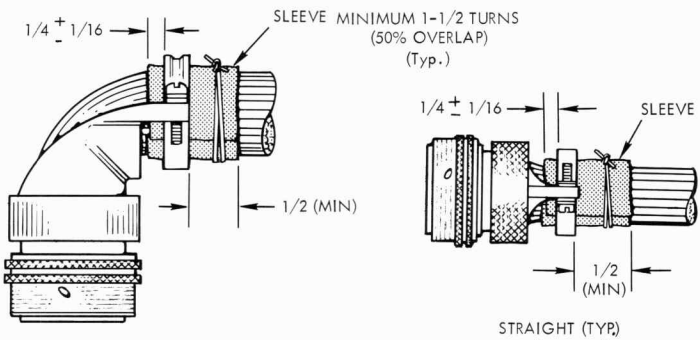


FIGURE 9

NOTE: Deutsch Shell Size No.8 connectors may have a silicone rubber sleeve installed and in this case they are exempt from this requirement.

When tightening or loosening threaded parts of connectors, support all plug assemblies by mating them with the proper receptacle or holding them with an approved plug wrench. Support receptacles by clamping flange in a vise having padded jaws. Standard strap wrenches or approved connector pliers shall be used for tightening or loosening threaded parts of connectors.

CLEANING

During assembly, or disassembly of a connector, the inserts, contacts and inside surfaces of the shell shall be kept free of all oil, dirt, grease and any other foreign material. If these substances are present, they shall be removed by wiping with a clean cloth soaked in cleaning fluid followed by wiping with a clean dry cloth. No immersion type cleaning process shall be used.

CONNECTORS MUST BE KEPT CLEAN AND FREE OF ALL FOREIGN MATTER

TERMINATION OF WIRES ON CONNECTOR BACKSHELLS

When "1T" OR "2T" appears on the engineering drawing or wire list as a terminating point the wires shall be terminated on the connector backshell. When the connector has a wire guide clamp the wires shall be installed between the backshell ear and clamps as shown in Figure 10. No more than 2 terminal lugs shall be installed per side. When the connector has no wire guide clamp the wires shall be terminated per the applicable connector fabrication specification, engineering drawing or wire list. If possible the termination shall be made on the ear nearest the side where the wire breaks out of the wire bundle.

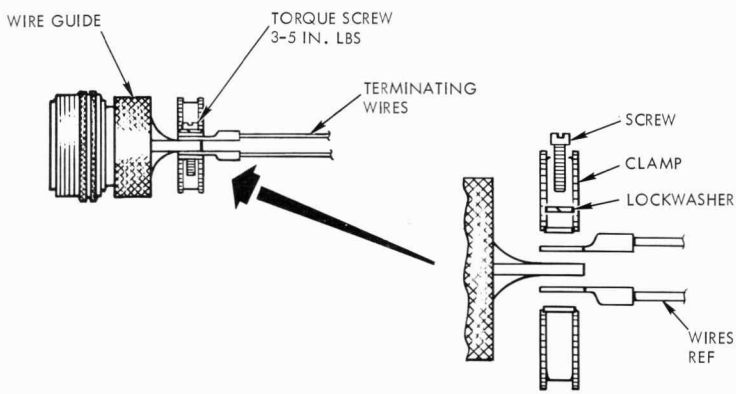


FIGURE 10

NOTE: 1. Screws shall extend through the clamp a minimum of 1-1/2 threads after terminals are installed. Replace screw with MD112-1001-04XX and washer MS35337-78 if necessary for proper screw length.
2. "1T" and "2T" ref only. Not to be marked on terminal lug.

CONNECTORS MUST BE KEPT CLEAN AND FREE OF ALL FOREIGN MATTER

CONNECTOR FABRICATION SHELL SIZE 8 — ALL 20 GA. FRONT LOADED CONTACTS

SEQUENCE OF CONNECTOR COMPONENTS AND ACCESSORIES

Prior to stripping or crimping contacts on the wires, slide the end bell assembly as specified by the applicable drawing, on the wires.

CONTACT INSERTION SHELL SIZE 8

Insert wires through proper contact cavity from the rear face and extend to a convenient distance beyond the front face of the connector. After crimping contacts, draw terminated wire back through insert until contact is approximately half-way into the contact cavity, then using the proper tool, push contact the remaining distance into connector. An audible "click" will be heard when contact seats in connector.

CONTACT REMOVAL SHELL SIZE 8

To remove contacts, insert proper tool into rear face of connector and push desired contact out through front face of connector.

NOTE: During assembly or disassembly of a connector, the inserts, contacts and inside surfaces of the shell shall be kept free of all oil, dirt, grease and any other foreign material. If these substances are present, they shall be removed by wiping with a clean cloth soaked in cleaning fluid followed by wiping with a clean dry cloth. No immersion type cleaning process shall be used.

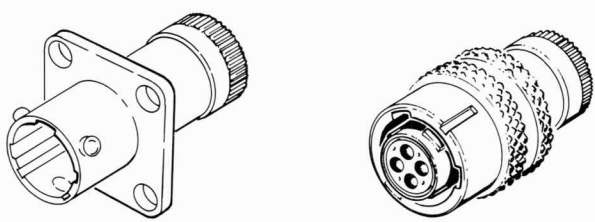


FIGURE 11

ME414-0569 AND ME414-0570-0001, -0002, -0003, -0007, -0008, -0011, -0012, AND -0013 REQUIRE ME418-0040-0001 PIN CONTACTS.

ME414-0569 AND ME414-0570-0004, -0005, -0006, -0009, -0010, -0010, 0014, -0015, -0016, REQUIRE ME418-0041-0001 SOCKET CONTACTS.

CRIMPING INFORMATION REF. TOOLING SECTION IV

SEALING OF UNUSED CONNECTOR INSERT - GROMMET HOLES

Every unused insert grommet hole and insert hole in a connector shall be filled with a sealing plug. The sealing plug shall be inserted by hand. No contacts shall be installed in unused contact cavities.

CONNECTORS MUST BE KEPT CLEAN AND FREE OF ALL FOREIGN MATTER

ME414-0503-XXXX CONNECTOR

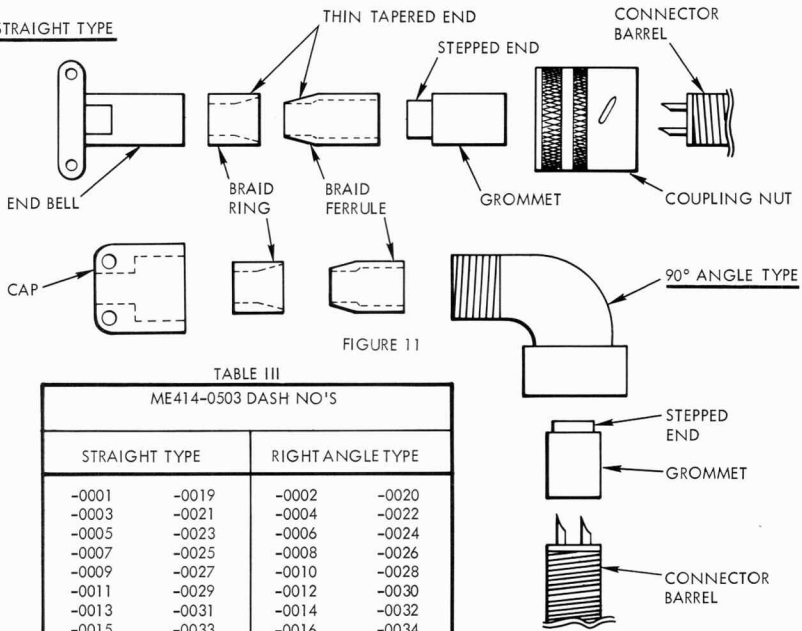


FIGURE 11

TABLE III

ME414-0503 DASH NO'S			
STRAIGHT TYPE		RIGHT ANGLE TYPE	
-0001	-0019	-0002	-0020
-0003	-0021	-0004	-0022
-0005	-0023	-0006	-0024
-0007	-0025	-0008	-0026
-0009	-0027	-0010	-0028
-0011	-0029	-0012	-0030
-0013	-0031	-0014	-0032
-0015	-0033	-0016	-0034
-0017	-0035	-0018	-0036

INSULATION STRIP BACK VARIES FOR WIRE TYPE AND/OR 90° ANGLE CONNECTORS. REFER TO INDICATED PROCESS SPECIFICATION FOR CURRENT REQUIREMENTS.

Caution Do not break shield braid strands or damage conductor insulation in processing shielded cable.

Push conductor through appropriate cavities in the grommet. Insert the wires into the stepped end of the grommet. If difficulty is encountered in passing wires through the grommet, the wire may be cut at an angle of 45 degrees.

Slide the grommet back along conductors and into braid ferrule on the straight type connector.

On 90° angle connectors slide grommet back into angle end bell until seated, keeping wires taut and straight at all times.

Prepare conductors for soldering to connector contacts.

Install sealing plugs P/N 4113-4-2001 in unused grommet holes.

SOLDERING INFORMATION REF. TOOLING SECTION IV

CONNECTORS MUST BE KEPT CLEAN AND FREE OF ALL FOREIGN MATTER

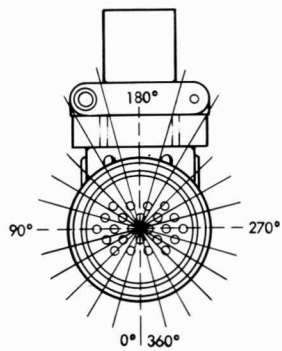
ENVIRONMENTALLY SEALED SOLDER TYPE CONNECTOR 360° SHIELDING	18 JUL 1967	
	DATE	DATE REVISED
	V	5.9.8
TITLE	SECTION	NUMBER

"Clocking" is the term used to describe the method of positioning angle connector plugs to the desired direction of "take-off" of the wire bundle relative to the polarizing key or keyway.

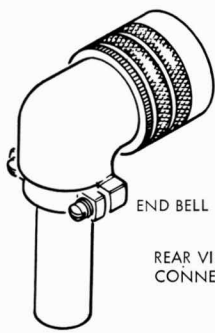
Loosen endbell and rotate to required position without distorting harness assembly. A deviation of ±15° is permissible.

USE CARE

In Positioning 90° angle connectors to insure that there is no undue strain on the wire harness and/or the contacts within the connector assembly.



FACE VIEW ENGAGING SIDE OF CONNECTOR



REAR VIEW OF CONNECTOR

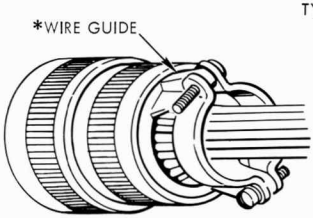
FIGURE 12

ILLUSTRATION SHOWN ABOVE IN 15° INCREMENTS

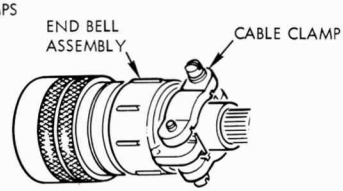
Clocking of angle connectors shall be determined by the ELECTRICAL MOCKUP GROUP of the ELECTRICAL ASSEMBLY DEPARTMENT and shall be as specified in their manufacturing assembly procedure books.

Depending on the type of connector being used, the cable clamp, end bell assembly or wire guide may or may not clamp the wire harness firmly.

TYPES OF CLAMPS



DOES NOT REQUIRE SLEEVING BUILD-UP.



DOES REQUIRE SLEEVING BUILD-UP.

*SHOWN WITHOUT INSULATION INSTALLED

FIGURE 13

CONNECTORS MUST BE KEPT CLEAN AND FREE OF ALL FOREIGN MATTER

CONNECTORS - 90° ANGLE CLOCKING CLAMP TYPES	18 JUL 1967	
	DATE	DATE REVISED
	V	5.9.9
TITLE	SECTION	NUMBER

This information is applicable to electrical connectors covered by PROCUREMENT SPECIFICATIONS MC414-0147 AND MC414-0233 and the following S.C.D.'s ME414-0147, ME414-0234, ME414-0235, ME414-0236 and ME414-0584.

All straight electrical connectors shall be assembled without strain relief grommets. Insulation sleeving shall be installed around groups of wires in graduating diameters under strain relief clamp. Split sleeving may be used to complete wire bundle size under clamp.

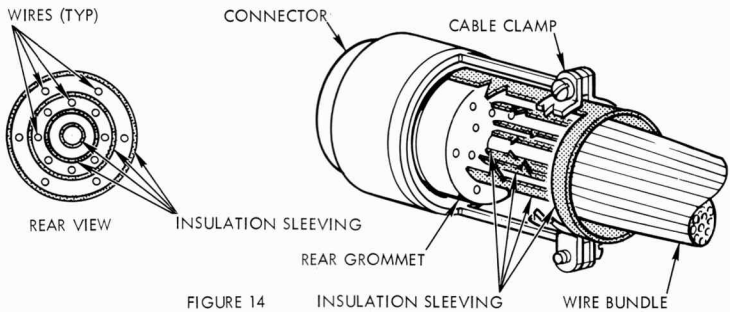


FIGURE 14

CRIMPING INFORMATION REF. TOOLING SECTION IV

CONTACT INSERTION

To install the contacts in the connector, the colored end of the insertion/extraction tool is snapped around the wire insulation with the tip of the tool butting against the rear shoulder of the contact. The contact is then inserted into the proper cavity in the rear of the connector and pushed forward until it bottoms in the insert.

CONTACT REMOVAL

To remove the contacts from the connector, the white end of the insertion/extraction tool is snapped around the wire and pushed forward until it bottoms against the contact shoulder. When fully inserted the larger diameter of the extraction tip expands the tangs of the retaining clip beyond the contact shoulder, allowing the contact and tool to be easily extracted from the insert. This is done by pulling the tool and wire straight out from the connector.

SEALING PLUGS:
Are to be installed in each unused grommet hole.

VERIFY:
That a sealing washer is installed in the connector, if not, install new one from table shown.

TABLE IV

Connector Shell Size	* Sealing Washer
20	075-1120-000
24	075-1121-000
28	075-1122-000
36	075-1123-000
40	075-1124-000
44	075-1125-000

* ITT CANNON

CONNECTORS MUST BE KEPT CLEAN AND FREE OF ALL FOREIGN MATTER

This information is applicable to the connector assemblies covered by PROCUREMENT SPECIFICATION MC414-0409 and the following SCD's.

TABLE V

CRIMP TYPE		SOLDER
ME414-0300	ME414-0308	ME414-0304
ME414-0302	ME414-0311	ME414-0312
ME414-0303	ME414-0421	ME414-0541
ME414-0305	ME414-0465	ME414-0558
ME414-0306		ME414-0560

ALL 22 GA. CONTACTS

FRONT INSERTABLE CONNECTORS

CONTACT INSTALLATION - CIRCULAR CONNECTORS

Draw terminated wire back through the insert until contact is half way into the contact cavity. If pin contacts are being installed, use the end of the insertion tool marked "PIN". This is a sleeve that is located over the engaging portion of the contact. Push straight into the contact cavity until a positive stop has been reached. An audible "click" will indicate when a positive stop has been reached and the contact is fully seated in the insert. If socket contacts are being inserted, use end of the insertion tool marked "SOC". This end is a probe that is placed in the flared end of the socket contact. Push straight into contact cavity until a positive stop has been reached. Continue in a like manner to install the remainder of the contacts. It is recommended insertion be started at the center contacts, working outward. When completed, a visual check shall be made at the mating end of the connector to verify that all contacts are properly inserted to an equal distance.

CONTACT INSTALLATION - RECTANGULAR CONNECTORS

Contact installation in the rectangular connector is similar to the circular except that there are two clocking pins to be installed in the connector half containing pins and two clocking holes that must be left vacant in the socket connector half. Hermetic rectangular connectors will be clocked at the factory and no further clocking can be added. The applicable Automated Wire List or wiring diagram will specify where pins shall be placed and where holes shall remain. All unused cavities (those not containing wired contacts, clocking pins and not used as clocking holes) shall be filled with unwired contacts (pins or sockets).

NOTE: Unless otherwise specified, every unused insert grommet hole and insert hole in a connector shall be filled with a sealing plug and contacts. * Environmentally sealed rectangular receptacles shall have the metal shell retaining screw secured with Epoxy per MA0108-002 during connector fabrication.

CONNECTORS MUST BE KEPT CLEAN AND FREE OF ALL FOREIGN MATTER

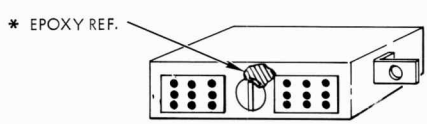


FIGURE 15

SOLDERING AND CRIMPING INFORMATION REF.TOOLING SECTION IV

ME414-0306 TYPE

Deutsch rectangular connectors

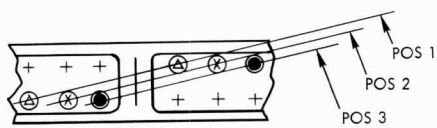
TABLE VI

SHELL SIZE	POS 1	POS 2	POS 3	POS 4	POS 5
2	F2-C1	E2-B1	D2-A1	NONE	NONE
3	K2-G1	J2-F1	H2-E1	NONE	NONE
4	H3-G1	K3-E1	J2-F2	K1-E3	H1-G3
6	H3-G1	K3-E1	J2-F2	K1-E3	H1-G3
7	L4-K2	N4-H2	M3-J3	N2-H4	L2-K4

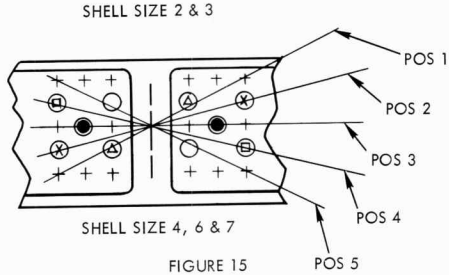
DEUTSCH Clocking Pin P/N 2302-217800

NOTE: Some installations may use no clocking.

TORQUE VALUE SUBMINIATURE JACKSCREWS 20 IN. LBS



SHELL SIZE 2 & 3



SHELL SIZE 4, 6 & 7

FIGURE 15

WIRE GUIDE INFORMATION

INSTALL TUBING MB0150-025 CLASS 2 SIZE 16 (4 PLACES) OF SUFFICIENT LENGTH TO COVER ALL METAL TABS THAT CAN CONTACT WIRE HARNESS

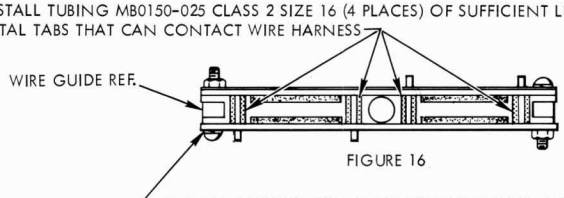


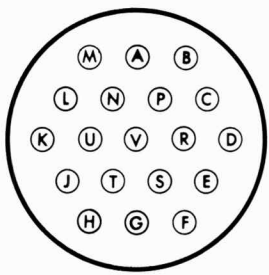
FIGURE 16

Caution

Extreme care must be employed in the handling and assembling of these subminiature series connectors to avoid damage to seals and/or contacts.

CONNECTOR

ME414-0145-0001, -0002, -0020 CRYOGENIC HYDROGEN SUBSTORAGE SYSTEM



CONTACT CONFIGURATION
FACE VIEW ENGAGING SIDE

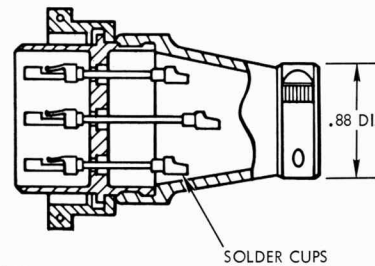


FIGURE 17

SOLDERING INFORMATION REFERENCE TOOLING SECTION IV

TABLE VII

ME414-0145-0001 ME414-0145-0020	
PIN NUMBER	CUP SIZE
A	20
B	20
C	20
D	20
E	16
F	16
G	16
H	16
J	20
K	20
L	20
M	20
N	20
P	20
R	20
S	20
T	20
U	20
V	20

ME414-0145-0002	
PIN NUMBER	CUP SIZE
A	22
B	22
C	22
D	22
E	14
F	14
G	14
H	14
J	22
K	22
L	22
M	14
N	30
P	30
R	30
S	30
T	30
U	30
V	22

CONNECTOR MUST BE KEPT CLEAN AND FREE OF GREASE AND OIL AND ALL FOREIGN MATTER

SOLDERING INFORMATION REFERENCE TOOLING SECTION IV

ME414-0146-00XX CRYOGENIC OXYGEN STORAGE SUBSYSTEM CONNECTOR

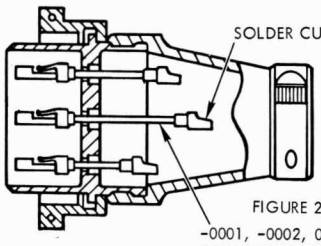


FIGURE 20

-0001, -0002, 0020 CONFIGURATION

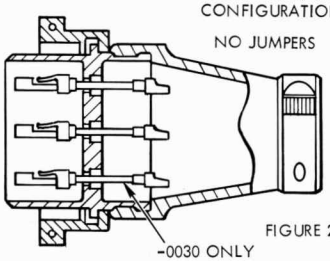
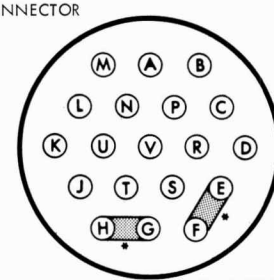


FIGURE 21

TABLE VIII

ME414-0146-0001 ME414-0146-0020 ME414-0146-0030	
PIN NUMBER	CUP GAUGE
A	20
B	20
C	20
D	20
E	16
F	16
G	16
H	16
J	20
K	20
L	20
M	20
N	20
P	20
R	20
S	20
T	20
U	20
V	20



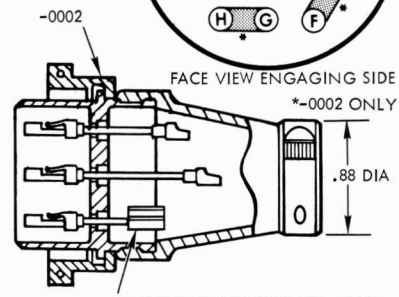


FIGURE 22

JUMPER TYPE FOR PINS E&F, G&H #304 ST. ST. PER SPEC FED QQ-S-763 COND A. SOLDER CUP FOR AWG 14 WIRE PART SUPPLIED BY VENDOR

TABLE IX

ME414-0146-0002	
PIN NUMBER	CUP GAUGE
A	22
B	22
C	22
D	22
E	14
F	14
G	14
H	14
J	22
K	22
L	22
M	14
N	30
P	30
R	30
S	30
T	30
U	30
V	22

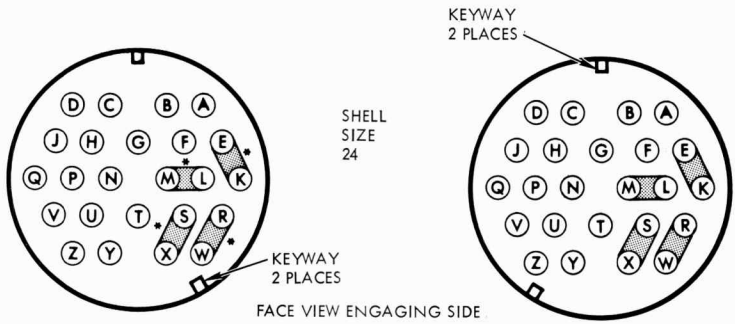
NOTE: JUMPERS -0002 ONLY

CONNECTORS MUST BE KEPT CLEAN AND FREE OF ALL FOREIGN MATTER

CONNECTORS - OXYGEN CRYOGENIC SUBSYSTEM USAGE	18 JUL 1967	
	DATE	DATE REVISED
	V	5.9.14
TITLE	SECTION	NUMBER

ME414-0581-00XX PLUG HYDROGEN TANK

ME414-0582-0001 PLUG OXYGEN TANK



FACE VIEW ENGAGING SIDE

*-0001 ONLY

FIGURE 18

-0010 CONNECTOR HAS SAME CONFIGURATION BUT NO JUMPERS

CONNECTOR CONTAINS 24 ONE PIECE 16 GA SOLDER CUPS EXCEPT FOR THE JUMPER PINS.

SOCKET CONTACTS

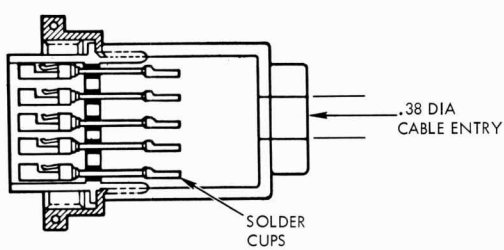


FIGURE 19

THESE CONNECTORS MUST BE KEPT FREE OF GREASE AND OIL CONTAMINATION

SOLDERING INFORMATION REFERENCE TOOLING SECTION IV

CONNECTORS - HYDROGEN - OXYGEN TANKS	18 JUL 1967	
	DATE	DATE REVISED
	V	5.9.15
TITLE	SECTION	NUMBER

This information shall be used in the assembly of electrical umbilical connectors per NAA/S&ID Procurement Documents MC414-0067 and MC414-0191. The applicable Specification Control Drawings are ME414-0067, ME414-0150, ME414-0191, and ME414-0192.

ME414-0150 (ALL DASH NUMBERS) ARE SOLDER TYPE RECEPTACLES. (CANNON)

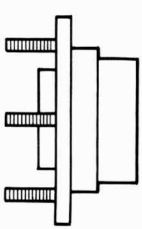
REFER TO THE MA0303-0100 PROCESS SPECIFICATION FOR CURRENT ASSEMBLY REQUIREMENTS, SPARE WIRES, ENCAPSULATION,ETC. SOLDERING INFORMATION REFERENCE TOOLING SECTION IV

ME414-0191 AND ME414-0192(ALL DASH NUMBERS)ARE CRIMP TYPE CONNECTORS.(CANNON)

ME414-0191 (ALL DASH NUMBERS) IS A LANYARD RELEASE TYPE CONNECTOR WITH A STRAIN RELIEF CLAMP AS FURNISHED BY THE VENDOR. POLARIZING KEY MUST BE 90°±20° ROTATED FROM CLAMP EARS, LOOKING AT MATING FACE.

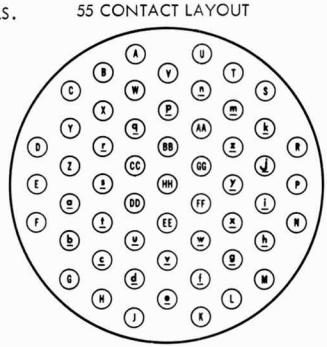
S.C.D. ME414-0150-0001, -0002 (36 CONTACTS) AND ME414-0150-0003, -0004 (55 CONTACTS) MATE WITH CONNECTORS COVERED BY S.C.D. ME414-0067 EXCEPT -0005 (61 CONTACTS) TO MATE WITH ME414-0191 ALL DASH NO.'S.

ME414-0150 DASH NO'S.



SOLDER

55 CONTACT LAYOUT



FACE VIEW ENGAGING SIDE

FIGURE 23

ME414-0067 DASH NO'S.
ME414-0191 DASH NO'S.
LANYARD TYPE

FIGURE 24
CRIMP

NOTE:

ME414-0192 DASH NO.'S BULKHEAD CONNECTOR CRIMP TYPE NOT ILLUSTRATED.

ME414-0150 IF POTTED MUST CONFORM TO THE APPLICABLE PROCESS SPECIFICATION OR SUPERSEDING ENGINEERING INFORMATION.

CONNECTORS MUST BE KEPT CLEAN AND FREE OF ALL FOREIGN MATERIAL

SOLDERING AND CRIMPING INFORMATION REFERENCE TOOLING SECTION IV

CONNECTORS - UMBILICAL AND LAUNCH ESCAPE	18 JUL 1967	
	DATE	DATE REVISED
	V	5.9.16
TITLE	SECTION	NUMBER

SPECIAL CONNECTOR

MICRODOT 087-0018-0000 CONNECTOR

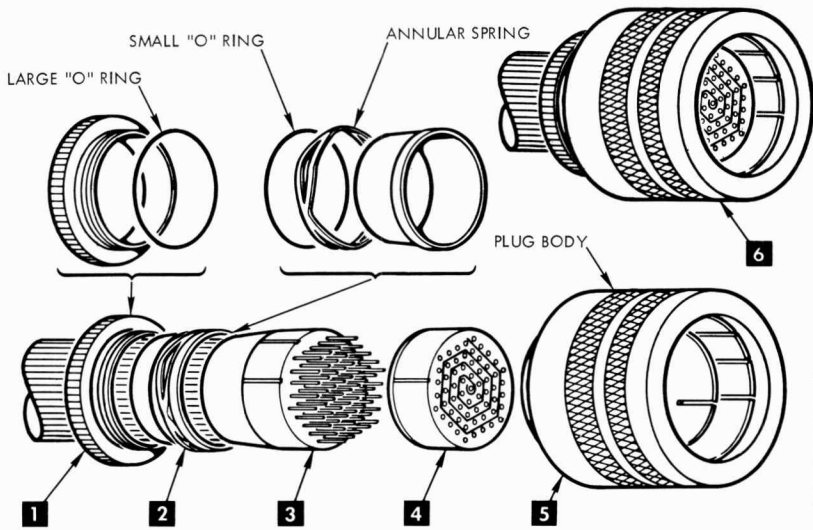
FRONT LOADED CONNECTOR.

REQUIRES NO INSERTION OR REMOVAL TOOLS.

TABLE X

CATALOG P/N	INTERNAL P/N
MD53-06E15-61S-N (579)	087-0003-0579
MD53-06E15-61P-N (579)	087-0017-0579
MD53-00E15-61P-N	087-0006-0000
MD53-00E15-61S-N	087-0018-0000

CRIMPING TOOL MH750-P27



NOTE:STRIP INSULATION 5/32 ± 1/64 FIGURE 25 SEALING PLUG 086-0055 22 GA. CONTACTS PIN 083-0009 SKT 082-0306

1 RETAINING NUT: Slide on harness first.

2 FOLLOWER ASSEMBLY : Slide on next as shown.

3 REAR INSERT: Insert wires in correct cavity far enough to install contacts. After crimping pull wires back until contact bottoms in the insert. #1 cavity is in center of insert.

4 FRONT INSERT:With white master keyways aligned, place insert front #4 over the contacts. Lubricate outside diameter of grommet with an approved Apollo lubricant and slide followup grommet #2 over sub-assy #3. Place small "O" ring in "O" ring groove of followup sub-assy #2. Do not nick "O" ring.

5 PLUG BODY: Slowly rotate retaining nut over "O" ring of followup sub-assy until it rests against annular spring. Install large "O" ring over thread relief of the retaining nut.

6 COMPLETED ASSEMBLY: Place insert assembly into plug assembly. Slowly rotate until keys align, then tighten retaining nut finger tight.

FILL ALL UNUSED GROMMET HOLES WITH SEALING PLUGS

CONNECTORS MUST BE KEPT CLEAN AND FREE OF ALL FOREIGN MATTER

CONNECTORS - MICRODOT MARC 53 - STANDARD ASSEMBLY INSTRUCTIONS	18 JUL 1967	
	DATE	DATE REVISED
	V	5.9.17
TITLE	SECTION	NUMBER

THIS INFORMATION PERTAINS TO CONNECTOR TYPES REF. MA0303-0118

CANNON DDM-50S 50 #20 GAUGE SOCKET CONTACTS

PIN FACE VIEW

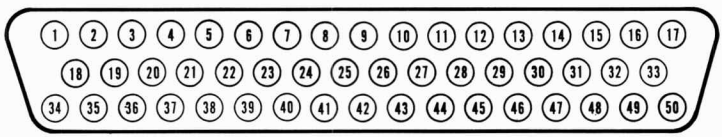
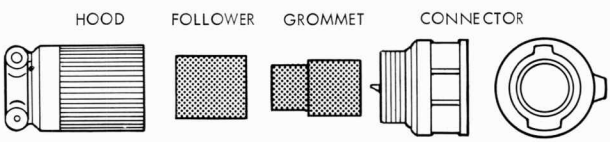


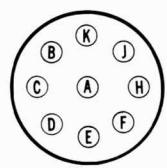
FIGURE 26

SOLDERING INFORMATION REF. TOOLING SECTION IV

VIKING VP9/2CE15 9 SOCKETS SOLDER TYPE

AVAILABLE WITH LONG OR SHORT HOOD (SHOWN) AND 2, 3, 4, 5, 7, 9, 13 AND 19 CONTACTS





GROMMET SEAL PLUG 017-0153-000

FIGURE 27

SOLDERING INFORMATION REF. TOOLING SECTION IV

CONTACT FACE VIEW

ME414-0588-0001 DEUTSCH P/N 17080-7S

CONNECTOR FOR ENGINE SYSTEM OF MAN-RATED VEHICLE.

423° F ELECTRICAL PLUG

SPECIAL USAGE

DS TYPE CONNECTOR CRIMP TYPE SOCKETS

ALL 20 GA. CONTACTS

CRIMPING INFORMATION REF. TOOLING SECTION IV

REAR VIEW

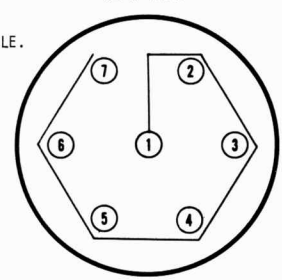


FIGURE 28

CONNECTORS MUST BE KEPT CLEAN AND FREE OF ALL FOREIGN MATTER

CONNECTORS - SPECIAL AND COMMERCIAL TYPES	18 JUL 1967	
	DATE	DATE REVISED
	V	5.9.18
TITLE	SECTION	NUMBER

SUBMINIATURE TYPE
REF. ME414-0436-DASH NUMBERS
ME414-0438-DASH NUMBERS
ME414-0439-DASH NUMBERS

TABLE XI

SCD DASH NO.	TYPE OF CONTACTS
-0001	ALL COPPER
-0002	COPPER EXCEPT 3,6,9,12,15,18,21,24,27, 30,33,36,39,42,45,48,51, 54,57,60 ARE CONSTANTAN

CRIMPING INFORMATION REFERENCE SECTION IV TOOLING

NORMAL POSITION

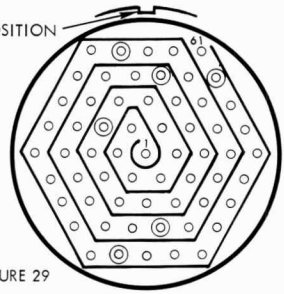


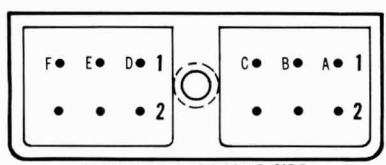
FIGURE 29
FACE VIEW ENGAGING SIDE

ME414-0441-000X
ME414-0442-000X

TABLE XII

SCD DASH NO.	TYPE OF CONTACTS
-0001	ALL COPPER
-0002	A1, A2, F1, F2 CONSTANTAN
	B1, B2, C1, C2, D1, D2, E1, E2, COPPER

CRIMPING INFORMATION REFERENCE SECTION IV TOOLING



FACE VIEW ENGAGING SIDE
FIGURE 30

DEUTSCH DS SERIES
FACE VIEW ENGAGING SIDE

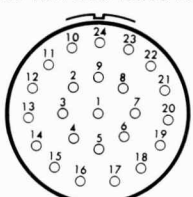


FIGURE 31

ME414-0446 ALL 20 GA SOCKETS SEE FIGURE 31
ME414-0447 ALL 20 GAGE SOCKETS
ME414-0448 7 COAX +6 #20 GA SOCKETS NOT ILLUSTRATED

"DS" SERIES CONN. REF: MA0303-0118

CRIMPING INFORMATION REF. SECTION IV TOOLING

CONNECTORS MUST BE KEPT CLEAN AND FREE OF ALL FOREIGN MATTER

ME414-0443 AND -0444 ARE "DS" TYPE 37 CONTACT CONNECTORS
37 CONTACT CONFIGURATION NOT ILLUSTRATED.

REFER TO APPLICABLE SPECS FOR LATEST ENGINEERING CHANGES, IN ALL CASES

100, 22 GAGE SOCKET CONTACTS.

ALL CONTACTS SHALL BE COPPER.

ME414-0449-0001, -0002

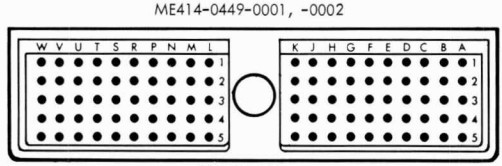


FIGURE 32

CRIMPING INFORMATION REFERENCE TOOLING SECTION IV FACE VIEW ENGAGING SIDE

CONNECTORS - SPECIAL APPLICATIONS	18 JUL 1967	
	DATE	DATE REVISED
	V	5.9.19
TITLE	SECTION	NUMBER

TABLE I

TORQUE VALUES IN INCH-POUNDS FOR TIGHTENING NUTS

Bolt, Stud or Screw Size		On Standard Bolts, Studs & Screws Having a Tensile Strength of 125,000 - 140,000 psi		On Bolts, Studs & Screws Having a Tensile Strength of 140,000-160,000 psi	On High Strength Bolts, Studs & Screws Having a Tensile Strength of 160,000, psi and Over
Coarse Thread	Fine Thread	Shear-Type Nuts (AN320, AN364, or Equivalent)	Tension-Type Nuts & Threaded Machine Parts (AN310, AN365, or Equivalent)	Any Nut, Except Shear-Type (Including NAS1291 and MS21042)	Any Nut, Except Shear-Type (NAS1291, MS21042)
8 - 32 10 - 24	8 - 36 10 - 32	7 - 9 12 - 15	12 - 15 20 - 25	14 - 17 23 - 30	15 - 18 25 - 35
1/4 - 20	1/4 - 28	25 - 30 30 - 40	40 - 50 50 - 70	45 - 59 60 - 80	50 - 68 70 - 90
5/16 - 18	5/16 - 24	48 - 55 60 - 85	80 - 90 100 - 140	85 - 117 120 - 172	90 - 144 140 - 203
3/8 - 16	3/8 - 24	95 - 110 95 - 110	160 - 185 160 - 190	173 - 217 175 - 271	185 - 248 190 - 351
7/16 - 14	7/16 - 20	140 - 155 270 - 300	235 - 255 450 - 500	245 - 342 475 - 628	255 - 428 500 - 756
1/2 - 13	1/2 - 20	240 - 290 290 - 410	400 - 480 480 - 690	440 - 636 585 - 840	480 - 792 690 - 990
9/16 - 12	9/16 - 18	300 - 420 480 - 600	500 - 700 800 - 1,000	600 - 845 900 - 1,220	700 - 990 1,000 - 1,440
5/8 - 11	5/8 - 18	420 - 540 660 - 780	700 - 900 1,100 - 1,300	800 - 1,125 1,200 - 1,730	900 - 1,350 1,300 - 2,160
3/4 - 10	3/4 - 16	700 - 950 1,300 - 1,500	1,150 - 1,600 2,300 - 2,500	1,380 - 1,925 2,400 - 3,500	1,600 - 2,250 2,500 - 4,500
7/8 - 9	7/8 - 14	1,300 - 1,800 1,500 - 1,800	2,200 - 3,000 2,500 - 3,000	2,600 - 3,570 2,750 - 4,650	3,000 - 4,140 3,000 - 6,300
1" - 8	1" - 14	2,200 - 3,000 2,200 - 3,300	3,700 - 5,000 3,700 - 5,500	4,350 - 5,920 4,600 - 7,250	5,000 - 6,840 5,500 - 9,000
1-1/8 - 8	1-1/8 - 12	3,300 - 4,000 3,000 - 4,200	5,500 - 6,500 5,000 - 7,000	6,000 - 8,650 6,000 - 10,250	6,500 - 10,800 7,000 - 13,500
1-1/4 - 8	1-1/4 - 12	4,000 - 5,000 5,400 - 6,600	6,500 - 8,000 9,000 - 11,000	7,250 - 11,000 10,000 - 16,750	8,000 - 14,000 11,000 - 22,500

NOTES:

1. To obtain values in foot-pounds, divide inch-pound values by twelve (12).

2. When a nut is to be secured to the fastener with a cotter pin or lockwire, tighten the nut to the low side of the selected torque range (unless otherwise shown on the drawing) and, if necessary, continue tightening until the next slot aligns with the hole. Nuts shall NOT be loosened to obtain alignment.

3. When it is necessary to tighten the fastener from the head side, the high side of the selected torque range should be approached whenever possible, but in NO case shall the maximum torque exceed ten percent above the high side of the selected torque range.

4. For heat-treated, corrosion-resistant steel nuts, torque values shown for tension-type nuts shall be used and for non-heat treated corrosion resistant steel nuts, the torque values for shear-type nuts shall be used.

5. The use of shear-type nuts requires the use of torque values given for shear-type nuts. Use of a wrench graduated in inch-pounds for these fasteners is recommended.

6. The maximum acceptable tilt under the heads of bolts and protruding head screws, and the maximum acceptable gap under the head of flush head fasteners shall not exceed 0.005.

7. Maximum torque values are to be used only when materials and surfaces being fastened together have sufficient area, thickness, or strength to resist breaking, warping, or other damage.

8. When torquing ultra-high tensile bolts to values greater than indicated in Table I, or to special drawing torque callouts, care must be taken to use heavy enough sockets to prevent socket breakage which may result in heavy damage to adjacent structure or components. Special heavy-walled sockets are available through the tool crib.

MATERIAL:

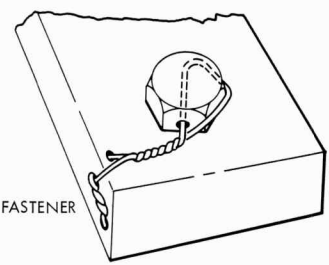
Only inconel lockwire MS20995N shall be used.
MS20995N32 lockwire (.032 inch diameter)
MS20995N20 lockwire (.020 inch diameter)

DOUBLE-TWIST METHOD

The double-twist method of safety-wiring shall be used as the common method of safety-wiring per examples shown in Figure 1.

All mechanical detachable components that have no other method of being locked in the mated condition shall be safety-wired.

MULTIPLE FASTENER



SINGLE FASTENER

FIGURE 1

When widely spaced multiple groups (4 to 6 inches apart) are being safety-wired, three units shall be the maximum number in a series.

NOTE: .032 inch diameter lockwire shall be the minimum diameter used, except on parts having a hole diameter of less than .045 inch when it is permissible to use .020 inch diameter lockwire.

Safety wire shall be new upon each application.

Precautions should be taken so as not to damage any component that is to be safety-wired. The correct tool shall be used as specified in Section IV.

Lock-wiring shall not be used to secure items spaced more than 6 inches apart, unless tie points are provided on adjacent parts to shorten the span of the lockwire to less than 6 inches.

Parts shall be safety-wired in such a manner that the safety-wire shall be put in tension when the part tends to loosen.

SINGLE-WIRE METHOD

The single-wire method of safety-wiring is permissible in a closely spaced, closed geometrical pattern (triangle, square, rectangle, circle, etc.), on parts in electrical systems, and in places that would make the single-wire method more advisable as shown in Figure 2.

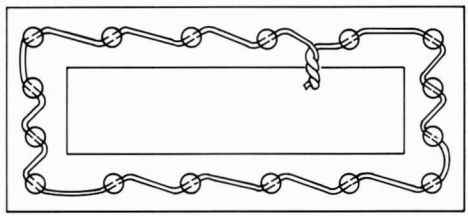


FIGURE 2. SMALL SCREWS IN CLOSELY SPACED PATTERN

NOTE: When the single-wire method of safetying is employed, the largest size diameter lockwire which the hole will accomodate shall be used. The number of units that can be safety-wired by a 24 inch length of wire shall be the maximum number in a series.

FINISHING THE SAFETY-WIRING END

A pigtail of 1/4 to 1/2 inch (3 to 6 twists) shall be made at the end of the wiring. This pigtail shall be bent back or under to prevent it from becoming a snag as shown in Figure 3.

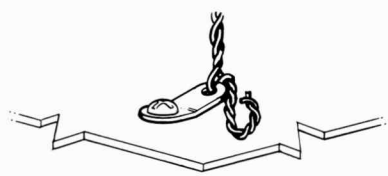


FIGURE 3

SAFETY-WIRING ELECTRICAL CONNECTORS

Unless otherwise specified on the applicable engineering document, all connectors that are provided with safety wire holes shall be safety wired. This requirement does not apply to bayonet lock or ball-detent lock connectors.

TYPICAL SAFETY-WIRING INSTALLATION

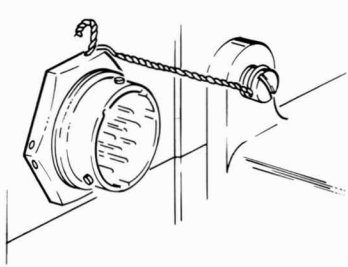


FIGURE 4

RECTANGULAR CONNECTORS

Jack screws on rectangular connectors shall be safety-wired to the connector flange as shown in Figure 5.

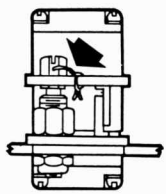


FIGURE 5

CONNECTORS WITH WIRE GUIDES

Connectors that are provided with safety-wire holes shall be safety-wired per Figure 6. Connectors without wire guides (Class E) shall not be safety-wired.

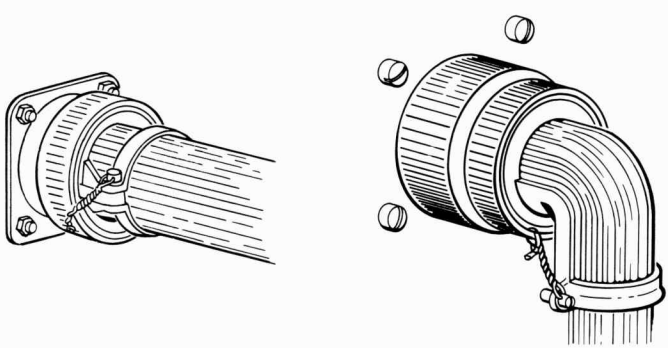


FIGURE 6

NOTE: If screws in wire guides do not have drilled heads they shall be removed and replaced with NAS1101C04H5 screws which have drilled heads to facilitate safety-wiring. Existing lockwashers on wire guides shall be retained and used with replacement screws.

SAFETY-WIRING AN UNMATED ELECTRICAL CONNECTOR

CARE shall be taken when performing the safety-wiring of a harness connector that is NOT mated or secured.

The connector shall be held as shown in Figure 7, to eliminate all possibility of any undue "FORCE" or "STRAIN" from being transferred to the harness wires, wire terminations or contacts within the connector.

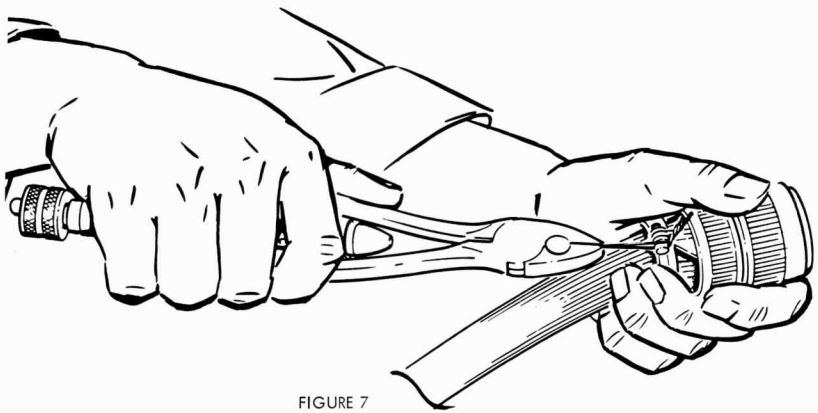


FIGURE 7

REMOVING SAFETY WIRE

CARE shall be exercised to avoid damage to any component when it is necessary to remove a safety wire installation. The proper manner of removal is to first cut, or cut off the pigtail end as shown in Figure 8 allowing the wire to become slack, and thereby making it easy to remove.

NOTE: The portion of the safety wire that has been twisted shall NOT be pulled through the safety wire holes.

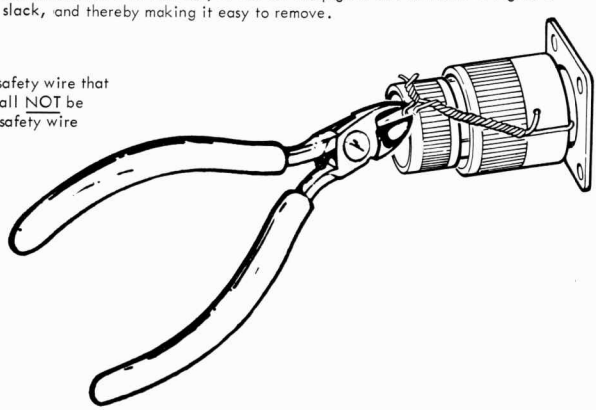


FIGURE 8

STOWAGE

Stowage applies to termination and securing of unused (spares) wires, cables, and protection of unmated electrical connectors.

SPARES

Spares are wires, cables, or connectors which are installed but not used in electrical circuits.

MATERIAL

Spare wire caps and tools shall be used as specified in Section IV.

Insulation Sleeving and connector protective covers shall be used as specified in Section VII.

Wires and connectors that are to be stowed shall be handled in accordance with the following information.

WIRES OR CABLES

Wires or cables to be stowed shall be spot-tied to a supported wire or cable bundle or clamped to a structural member to prevent movement of the wires or cables.

Stowed wires and cables shall not have the insulation stripped back unless otherwise specified.

Wires or cables shall be stowed in such a manner that the wire identification may be easily read.

Insulated or protected ends of wire or cables shall not be terminated under clamps.

In cases where wire or cable is doubled back on itself, the bend radius shall not affect the electrical characteristics of the wire or cable and shall be provided with adequate support.

Allowances shall be made for wires or cables, which are to be stowed, to provide adequate length for proper termination in the event the wires or cables are subsequently used.

METHODS OF TERMINATING ENDS OF ELECTRICAL WIRES AND CABLES FOR STOWAGE.

SINGLE NON-SHIELDED WIRE

Single non-shielded wire shall be terminated with a spare wire cap.

NON-SHIELDED MULTI-CONDUCTOR TWISTED CABLE

Each conductor in the cable to be stowed shall be terminated in the same manner as single conductor non-shielded wire.

SINGLE CONDUCTOR SHIELDED CABLE

Single conductor shielded cable shall be terminated with a spare wire cap and insulation sleeve (heat shrinkable) as shown in Figure 1.

The outer insulation jacket shall be stripped with thermal strippers.

Shield braid may be flush or extend a maximum of 1/16 inch beyond outer insulation jacket.

MULTI-CONDUCTOR SHIELDED CABLE

Multi-conductor shielded cable shall be terminated in the same manner as single conductor shielded cable.

INSTALLATION OF TEFLON SPARE WIRE CAP FOR SINGLE CONDUCTOR SHIELDED CABLE

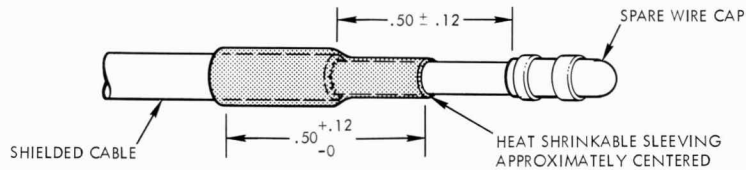


FIGURE 1

METHODS OF STOWING ELECTRICAL WIRES AND CABLES

When more than one wire or cable is to be stowed, the wire lengths shall be staggered in a manner which will provide a minimum cable diameter buildup.

Wires or cables to be stowed by tying to existing bundle, shall be secured on the outer circumference of the wire or cable bundle, if possible. Spot ties shall be located around the complete bundle at intervals which provide support within 1/2 inch of spare wire caps. Additional spot ties shall be used to prevent movement of the stowed wires or cables as per Figure 2.

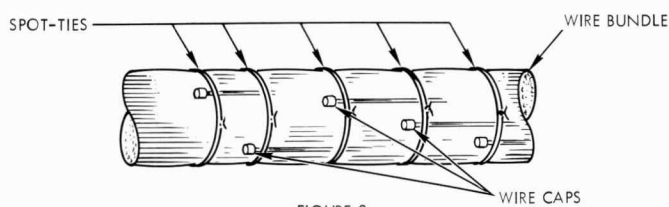


FIGURE 2

STOWAGE OF ELECTRICAL CONNECTORS

Electrical connectors shall be adequately protected at all times to prevent damage to the connector pins, sockets, body or shell and to prevent foreign material, such as dust, solder, glass braid, wire and shield braid clippings, etc., from entering the connector. Refer to SECTION VII for protective devices.

TEMPORARY STOWAGE OF CONNECTORS

Unmated electrical connectors shall be protected with temporary protective covers (plastic dust caps) installed over the contact area and enclosed in plastic bags prior to and after assembly of the connectors.

PERMANENT STOWAGE OF CONNECTORS

Unmated electrical connectors to be stowed during operation shall be protected by the use of permanent type protective cover (metal cap) installed over the contact area in accordance with the applicable engineering drawing.

Whenever possible, stowed connectors shall be visible for identification and inspection.

SCOPE

This section establishes the materials and processes to be used for conformal coating wire terminations, component terminals, and other conductive surfaces of electrical and electronic equipment (except printed circuit boards) with a room temperature vulcanizing silicone rubber to provide protection against high humidity.

PRELIMINARY INSPECTION

Due to the complete sealing off of all exposed wire terminations by the conformal coating, the component and assembled wiring shall have passed an inspection for workmanship and conformance to the applicable assembly drawing, including specifically ALL required checks for electrical continuity.

PRIMER

A primer shall be used on all surfaces prior to applying the silicone conformal coating.

CLEANLINESS

All necessary precautions shall be taken to prevent contamination of cleaned surfaces to which primer or coating is to be applied. Clean low-lint fabric gloves shall be worn during handling of cleaned or primed components.

FLUOROCARBON WIRE TERMINATIONS

All teflon TFE and FEP wire terminations, (10 awg and larger) shall have been etched per MA0110-029 prior to application of primer. Etching of wires shall NOT be performed on or in the vehicle.

TERMINAL BOARDS

The bottom stud cavities of NAS1066 terminal board assemblies shall be cleaned and then potted with MB0130-019 type III compound BEFORE assembly as shown in Figure 1.

DIODES

All exposed visible surfaces of diodes, including mounting washers, shall be cleaned, primed, and coated.

SURFACE PREPARATION (Cleaning)

The equipment or parts (component terminations or wiring terminations together with approximately six inches of emergent wiring) shall be cleaned to remove all grease, oil, wax, or other surface soils which reduce adhesion, as follows:

The surfaces shall be cleaned with a mixture containing 50 ± 2 volume percent of TT-N-95 naphtha, the remainder being TT-I-735 isopropyl alcohol. The mixture may be applied by brush, dip, or squeeze bottle.

The surfaces shall be spray-rinsed with MB0210-005 cleaning agent, then dried by evaporation.

NOTE:

When a wire harness cannot be brought into the spray booth, or where rinsing is required in the spacecraft, rinsing with a squeeze bottle is permitted.

The cleaning procedure shall be repeated if a clean, white, lint-free cloth shows evidence of oil, grease, or other contaminating material when wiped over the cleaned surface (or portion of the cleaned surface).

The surfaces shall be dried at a temperature of 130 ± 10F FOR 60 ± 10 minutes or by a stream of dry nitrogen. There shall be no residual solvent visually evident.

PRIMER APPLICATION:

MB0125-038 primer shall be applied to the cleaned surfaces by brushing or spraying. Individual wires shall be primed so that each wire, when coated, will meet the coverage requirements. The surface, after priming, shall be uniformly colored a bright, translucent pink. A dark, red-pink color indicates too much primer, an almost colorless pink, too little

Primer shall be allowed to cure at least 30 minutes but not longer than 24 hours at ambient temperature before applying coating.

Caution

Chemicals and cleaning solvents are highly flammable and toxic, and are to be handled in accordance with process specification MA0117-001.

APPLICATION OF COATING:

The silicone rubber shall be applied to the primed surfaces to a minimum thickness of 1/64 inch, except that the coating may taper off at edges away from terminations. Each individual wire shall be coated for a length of at least 1/2 inch, as indicated on Figures 2 and 3. Where two or more wires are terminated at the same point, the wires shall be separated and the coating material applied around each individual wire. All conductive surfaces shall be sealed off completely by the coating. Excessive thickness buildup shall be avoided, and the coating shall not be applied to any unprimed area. More than one coat may be applied, if necessary, with a minimum drying time of one hour between coats.

On NAS1066 terminal boards only, the studs and wire terminations shall be coated to a thickness of 1/16 inch minimum for abrasion resistance as indicated on Figure 2.

As an alternate method, potting per MA0106-036 is permissible in cases where terminals are so close together that conventional conformal coating is impractical.

CURING:

The coating shall be cured for 72 hours minimum at ambient temperature or for 3 to 4 hours at ambient temperature, then for 20 hours at 130±10F.

Components shall not be moved until a tack-free surface has been attained (24 hours at ambient temperature or 8 hours at 130±10F). The coating shall not be stressed until full cure has been accomplished.

MARKINGS:

Nameplates and markings shall be left uncovered, where possible. If identification markings have been covered, the markings shall be replaced over the coating, or other methods of identification shall be used when specified per engineering document.

Figures 2 and 3 illustrate the conformal coating of typical component terminals, including the 1/2-inch minimum coverage on wires; however, these are not the only configurations which may be required.

REWORK PROCEDURES:

Tacky or soft coating, loose coating, or coating which must be removed to replace wire terminations, shall be carefully peeled away. EXTREME CARE shall be used in order to prevent damage to wire, terminals, or adjacent electronic components. The cleaning and coating procedures shall be repeated.

Voids or occasional bubbles over 1/8 inch in diameter, or any void which exposes a conductive surface, shall be reworked by filling the void with coating. Primer shall not be applied on cured silicone rubber surfaces.

The cure cycle for rework shall be 4 hours ± 10 minutes at ambient temperature, followed by 2 hours ± 10 minutes at 130 ± 10°F; an alternate cure cycle of 10 hours minimum at ambient temperature is permissible. This cure cycle shall be applicable to only those reworks covering less than 5 percent of the total coated surface.

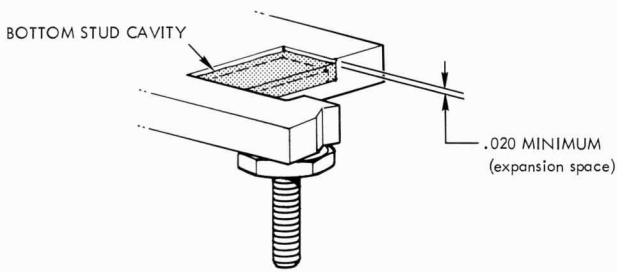


FIGURE 1. TERMINAL BOARD STUD SEALING

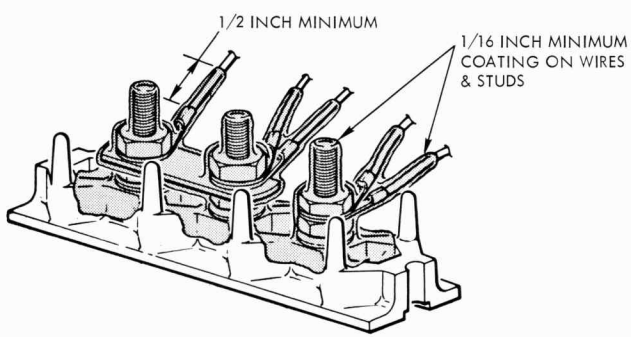


FIGURE 2. MINIMUM COATING FOR NAS1066 TERMINAL STRIP

CONFORMAL COATING - REWORK PROCEDURE - MINIMUM COATING	18 JUL 1967	
	DATE	DATE REVISED
	V	5.13.2
TITLE	SECTION	NUMBER

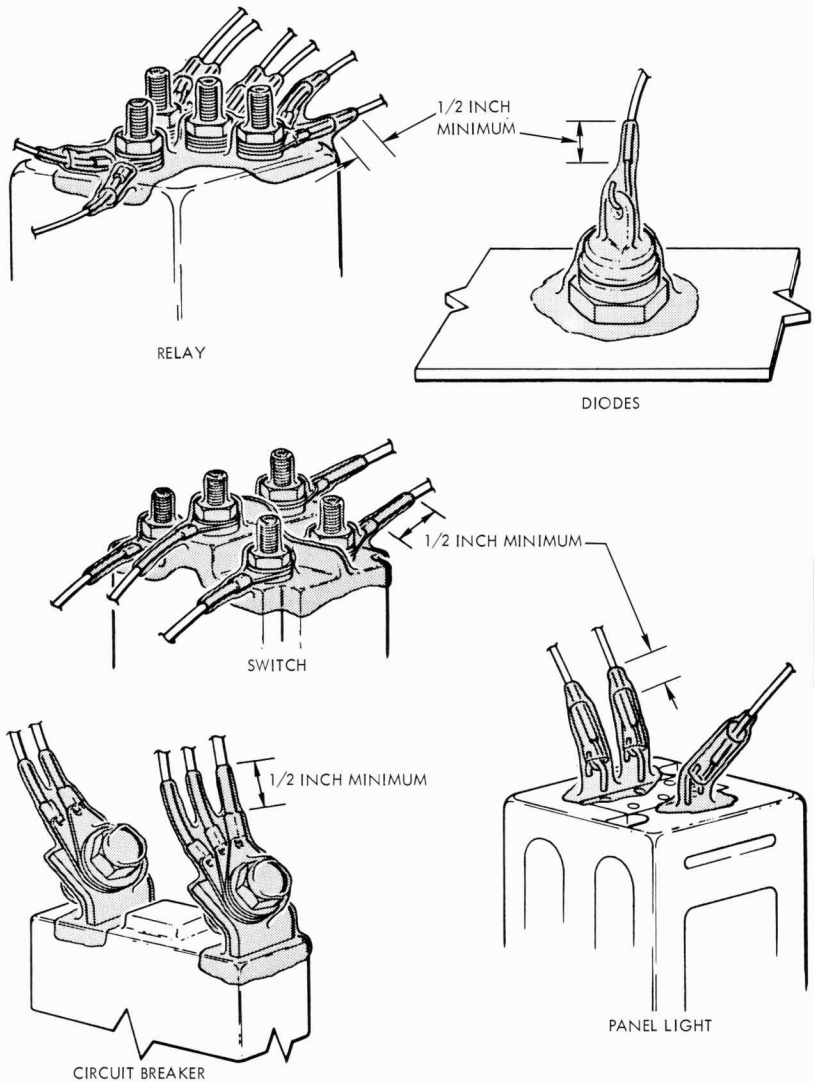
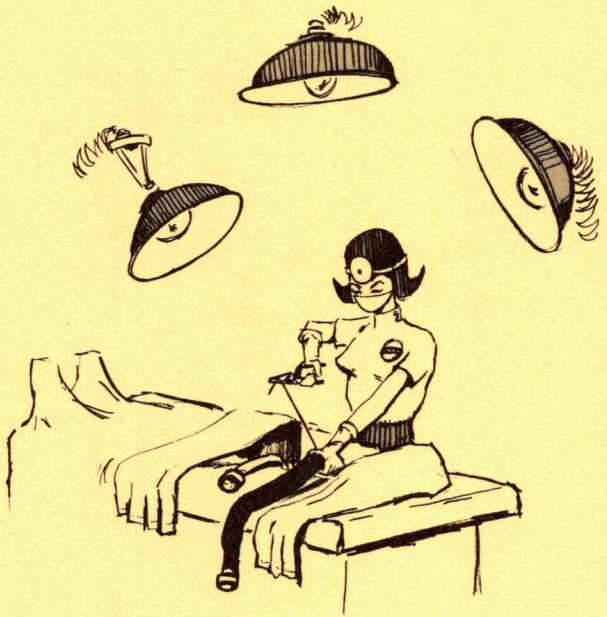


FIGURE 3. MINIMUM COATING REQUIREMENTS

CONFORMAL COATING - MINUMUM COATING REQUIREMENTS	18 JUL 1967	
	DATE	DATE REVISED
	V	5.13.3
TITLE	SECTION	NUMBER

COAX ASSEMBLIES



REQUIRE THE *ULTIMATE TREATMENT*

VI COAX

HANDLING:

Handling shall be held to a minimum at all times. Extra care shall be exercised to prevent exposure of cables or connectors to dirt, foreign matter or moisture.

WORKMANSHIP:

Workmanship shall be in accordance with high quality space vehicle wiring and equipment installation practice of sufficient quality to insure safery, proper operation, and service life.

WORKMANSHIP PRACTICES:

The following are a few specific examples of workmanship which must be rigidly adhered to in order to insure a high quality end item.

(a) Compressed air shall not be used for removing scraps, chips, loose hardware, dust, or other foreign materials from assembly or installation area or from vehicles.

(b) Components shall always be handled and protected in such a manner that undue stress is not imposed on coaxial cables or connectors.

(c) Extreme care shall be used in unrolling the cable or cable assembly to avoid bends of less than ten times the diameter of the cable at any point. The cable shall not be pulled or stretched at any time.

(d) Contacts, connectors and cable conductors shall not be altered, such as increasing or decreasing hole size or diameters or by removing material from any connector components unless otherwise specified in the applicable process specification.

CLEANING:

During handling of the connectors and cables, the inserts, insulators, pins, inside surface of the shell, etc., shall be kept free of all oil, dirt, grease or any other foreign material. If these substances are present, they shall be removed by wiping with a clean lintless cloth soaked in cleaning fluid followed by wiping with a clean dry lintless cloth. Cleaning fluid shall be per specification MIL-A-6091, (Alcohol ethyl - specially denatured).

Warning Cleaning solvents are highly flammable and toxic, and are to be handled in accordance with process specification MA0117-001.

QUALITY ASSURANCE:

All cable assemblies shall be inspected as follows:

(a) Before and during each fabrication sequence.

(b) After fabrication and/or installation to verify correct assembly sequence and dimensions and to insure that there are no flaws in the outer jacket or connector and components.

NOTE: Defective cable, connectors and components shall be rejected.

RG-115A/U COAXIAL CABLE - TYPICAL CONSTRUCTION PER MIL-C-17/92
(FOR OTHER CABLE CONSTRUCTION SEE SECTION V.)

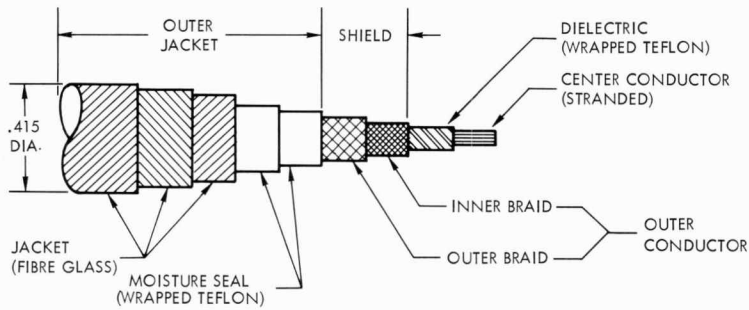


FIGURE 1

ME414-0250-0207 PLUG TYPE "TNC" FOR USE WITH RG-115A/U

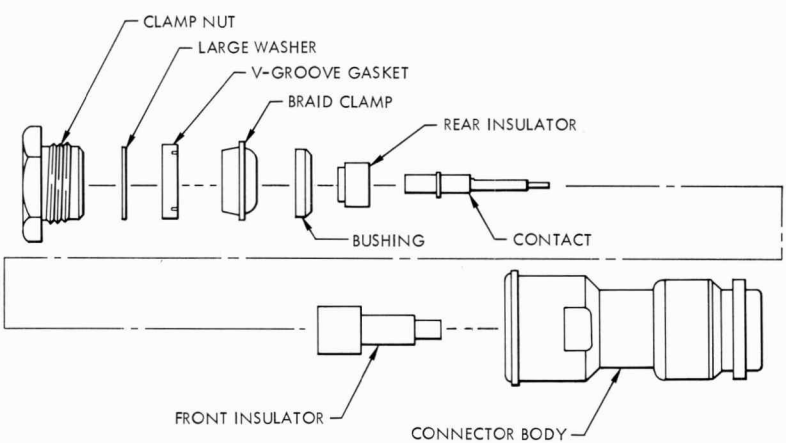


FIGURE 2

COAX CABLE - RG-115 A/U - CONNECTOR ME414-0250-0207	18 JUL 1967	
	DATE	DATE REVISED
	VI	6.3
TITLE	SECTION	NUMBER

Slip a length of identification sleeving (MB0150-007, type, class and color per applicable drawing), clamp nut, washer and v-groove gasket (v-groove toward cable end) over the cable. Refer to Figure 3.

At a distance of 0.531±0.010 inch from the end of the cable, place a legible mark around the cable with pen, pencil or other suitable marking method. (Figure 3.)

Apply a coating of EC866 as specified in MA0305-0013 to the area shown in Figure 3. Allow the EC866 to dry before starting trimming operations.

NOTE - DIMENSIONS SHALL BE CLOSELY ADHERED TO

Caution

EC866 is highly flammable and toxic. During handling, adequate ventilation is required.

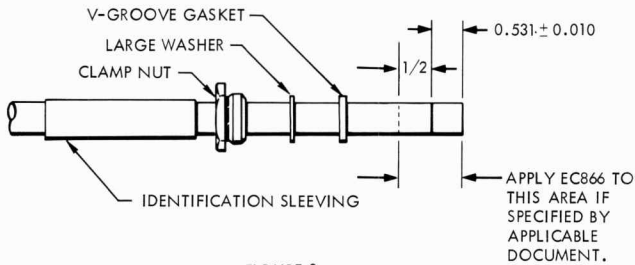


FIGURE 3

Note - EC866 is used to prevent fraying of cable outer jacket

Trim the cable jacket evenly to the 0.531 inch mark, exercising care not to nick or cut the braided shield wires. Refer to Figure 4.

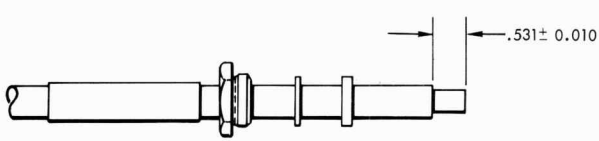


FIGURE 4

Slide the braid clamp over the shield braid, carefully seating the internal shoulder of the braid clamp against the trimmed edge of the cable jacket. Check to insure that the shield braid has not been pushed back. (Figure 5.)

Quality Assurance approval as specified in MA0305-0013.

Unbraid and comb out shield wires smoothly, then bend shield wires back over braid clamp, keeping overlap or crossing of individual wires to a minimum. Trim the shield wires so that no wire extends over the rear shoulder of the braid clamp. Place small bushing over cable dielectric, firmly against the wire braid. (See Figure 5.)

Trim the cable dielectric true and square from the bushing face to 0.052 (±0.003) inch, carefully. Avoid nicking or cutting center conductor. End of dielectric shall be flat and square. Trim the center conductor to 0.364 (±0.010) inch.

Quality Assurance approval as specified in MA0305-0013.

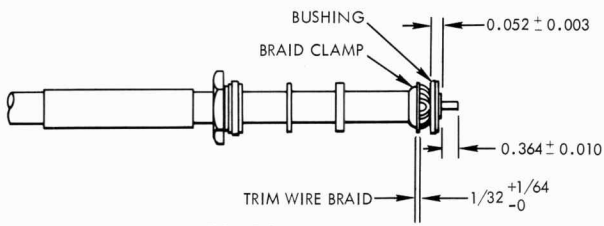


FIGURE 5

Place rear insulator (smaller dielectric washer), larger counterbore toward clamp nut, over cable. Insulator must be flush against bushing (Figure 6.)

Install the contact over the center conductor until it butts evenly against the rear insulator. Center conductor must be visible through inspection hole in contact.

Quality Assurance approval as specified in MA0305-0013.

Secure contact to center conductor by crimping, using Cannon Crimp Tool No. CCT-C-4 in accordance with MSC-ASPO-C3C.

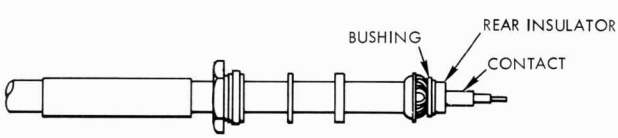


FIGURE 6

Quality Assurance approval as specified in MA0305-0013.

Place front insulator, (large dielectric washer), over contact pin. (Figure 7.)

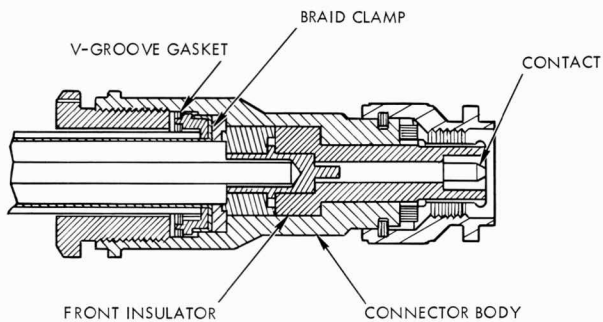


FIGURE 7

Slide the v-groove gasket into the knife edge of the braid clamp, insuring that knife edge of braid clamp will seat correctly into v-groove of gasket. Insert cable and connector parts into the connector body. Rotate body slightly to insure that all components seat correctly. Thread clamp nut into body by hand carefully to avoid cross-threading. (Figure 7.)

Tighten clamp nut to 25±5 inch pounds using a torque wrench on the clamp nut while holding the connector body with a strap wrench. This operation will cut the v-groove gasket. Do not remove.

Quality Assurance approval as specified in MA0305-0013

Perform electrical integrity check as specified in MA0305-0013.

Quality Assurance approval as specified in MA0305-0013.

NOTE: The following steps shall be completed on this cable/connector combination prior to any other operations. Quality Assurance approval as specified in MA0305-0013, is required after each step.

Exercising care, remove the clamp nut carefully to ensure that all other components remain in position. Do not move cable with respect to connector. Do not change position of cable in connector body.

Apply adhesive MB0120-008, prepared as specified in MA0305-0013, to the connector as shown in Figure 8. Insure that area shown is completely covered, but do not over fill.

Replace the clamp nut carefully, to insure that cable has not moved with respect to the connector.

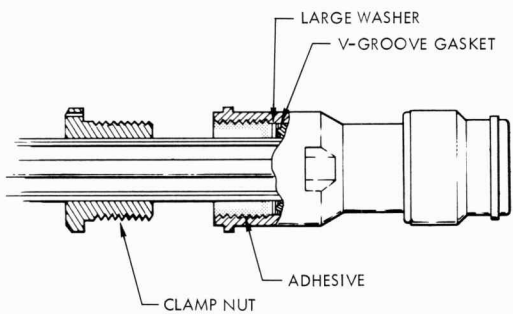


FIGURE 8

Torque the clamp nut 90±5 inch pounds, using a torque wrench on the clamp nut while holding the connector body with a strap wrench. This will force some adhesive up around the cable to form a bead approximately 1/16 inch in size at the clamp nut. Do not remove the bead.

Safety wire clamp nut to connector body per MA0101-005 using MS20995N20 wire.

Quality Assurance approval as specified in MA0305-0013.

Cure the adhesive at 140 F±10 F for 1 hour ±5 minutes.

Quality Assurance approval as specified in MA0305-0013.

Perform electrical integrity check as specified in MA0305-0013.

Quality Assurance approval as specified in MA0305-0013.

Position identification sleeving as specified in MA0305-0013, or applicable drawing, and locate permanently by heat shrinking in accordance with specification RA0105-003.

Quality Assurance approval as specified in MA0305-0013.

Preparation for delivery and the quality assurance provisions of all coaxial cable assemblies shall be in accordance with MA0305-0013.

All coaxial cable assemblies shall be identified by the use of imprinted, heat shrinkable sleeving, unless otherwise specified.

The marking on each identification sleeve shall include:

A. The applicable drawing number.
B. The connector identification code per applicable drawing.
C. The serial number.
D. The mating connector number in parenthesis. (See Figure 1).

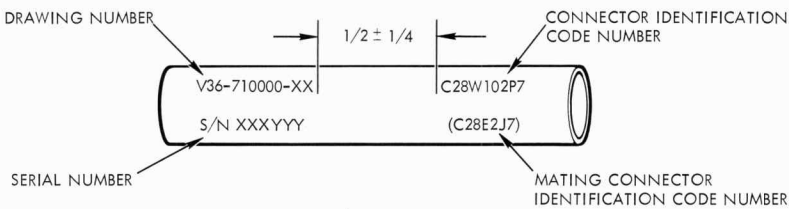


FIGURE 1

The identification sleeving shall be 4 ± 1/8 inch long and shall be located as shown on the applicable drawing.

(TYPICAL) COAX CABLE ASSEMBLY (REF)

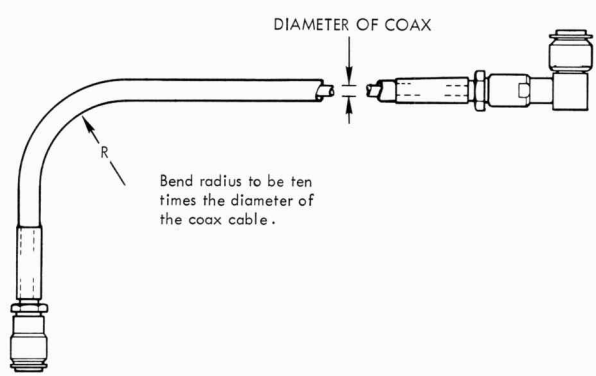
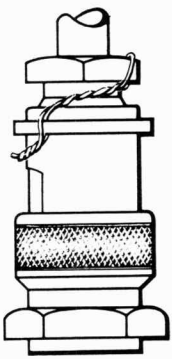


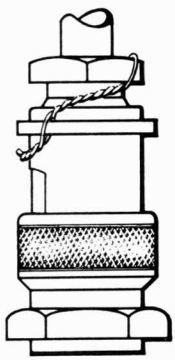
FIGURE 2

COAXIAL CABLE - I.D. SLEEVE MARKING - CABLE BENDING PRECAUTION	18 JUL 1967	
	DATE	DATE REVISED
	VI	6.4
TITLE	SECTION	NUMBER

Safety wire shall be twisted clockwise, as shown. Wire twists should conform to the table shown. Wire twist count is based upon a full 180° overlap of both wire strands. Acceptable.



Safety wire has exceeded the maximum twist requirement. Excessive twists may cause a wire break. Unacceptable.



Excessive twists have resulted in broken wire (arrow) as shown. This is caused by the extreme stress of over-twisting wires. Unacceptable.

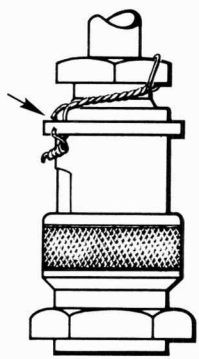


FIGURE 1

NOTE: A pigtail of 1/4 to 1/2 inch (3 to 6 twists) shall be made at the end of the wiring. This pigtail shall be bent back or under to prevent it from becoming a snag.

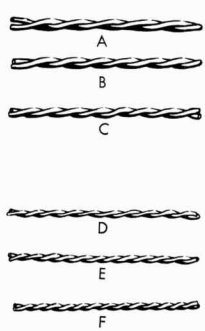
Safety wire shall be new upon each application.

For clarity, 0.020 inch diameter wire is shown in use, on this standard.

TABLE I

FIG.	WIRE DIA.	TWISTS
A	0.032	6
B		7
C		8
D	0.020	10
E		12
F		14

Table indicates acceptable ranges for safety wire twists.



COAXIAL CABLE - SAFETY WIRE, DOUBLE - CONNECTOR - WIRE TWIST	18 JUL 1967	
	DATE	DATE REVISED
	VI	6.5
TITLE	SECTION	NUMBER

NOTE - Any and all damaged parts will be rejected, including v-groove gasket. Rework to coaxial cabling before or after installation shall be only in accordance with authorized and engineering documents.

APPLICABLE DOCUMENTS:

1. Rework F.A.I.R. ticket for unit to be reworked.
2. Authorized engineering drawings, E.O.'s or specifications for unit to be reworked.

MATERIAL AND EQUIPMENT:

1. The material and equipment will be as stated in the authorized documents.

   NOTE - Prior to any rework the materials are to be verified as correct, such as, cable type, length, identification and connector types.

2. Tools used for removal/installation shall be approved for clean room use. All contaminents such as oils/grease shall be removed and only approved lubricants and materials used.

COAX CONNECTOR UNMATING:

Before unmating a coaxial cable connection, remove enough fastenings, (clamps or other fasteners), to obtain sufficient slack to prevent strain on the cable to connector junction.

RADIUS BEND OF COAXIAL CABLE:

The radius bend of coaxial cable shall be a minimum of ten times the diameter of the cable, unless otherwise, specified on approved engineering document.

CABLE ROUTING:

Coax cables shall be grouped, bundled and routed in accordance with applicable engineering documents.

MATING AND CLAMPING:

Coax connectors shall be hand mated, until mating halves bottom at both ends to their termination, prevention of cable twisting should be excercised, then clamping as required per engineering document may be fully performed; clamps may be used in a loose position as a temporary holding device during the routing of coax cable.

SILICONE GREASE:

Silicone grease shall be used on connectors as required on applicable document.

SPOT TIES:

Spot ties shall not be made directly to coaxial cables. Spot ties on coax cables shall be permitted only by approved engineering drawings or documents.

IDENTIFICATION AND MARKING OF ASSEMBLIES:

All Coaxial cable assemblies shall be identified by the use of imprinted, heat shrinkable sleeving, unless otherwise specified.

- Identification sleeving shall be per specification, (color as specified on drawing).
- The sleeving shall be imprinted with an approved wire marking machine as specified.
- The marking on each identification sleeving shall include:

  A. The applicable drawing number
  B. The connector identification code per applicable drawing.
  C. The serial number (shown on cable assembly drawing).
  D. The mating connector number in parenthesis.

INSTALLATION OF IDENTIFICATION SLEEVING:

The identification sleeving shall be installed with the, "Connector Identification Code Number", next to the connector, or as specified on drawing.

TORQUE VALUES:

Torque values vary with each type of connector, if a torque is required it will be on the specific engineering document.

NOTE - Torque is not required on some types of connectors.

SAFETY WIRING: (NOTE - Upon each application new wire will be used.)

All coax connectors that have no other method of being locked in the mated condition shall be safety wired in a manner as to hold the component in a locked position in accordance with specification MA0101-005.

NOTE - Some connectors will have been safety wired on bench procedure, do not disturb this wire.

HAND SAFETY WIRING:

When safety wiring by hand, twist wire, under slight tension, in a clockwise lay, six to eight turns per inch for .032 dia. wire and ten to fourteen turns for .020 dia. wire. Pliers shall be used for final twist to apply tension and to secure ends of wire. (Ref Page 6.6)

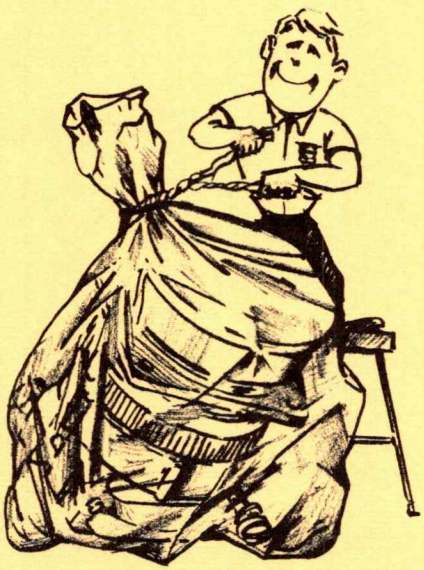
TEST AND CHECK:

The applicable drawing for a cable will supply the test and check specification, this will be done with all ends disconnected.

QUALITY ASSURANCE:

All operations will be performed under strict surveillance of Q.A.

BE SURE....



INSURE QUALITY.... PACKAGE PROPERLY

VII PROTECTIVE MATERIAL

TABLE I

Design Standard Number	No. of Cond.	Wire Size	Insulation Diameter		*Insulation Sleeving	
			Min.	Max.	Size	Min. Exp. I.D. (inch)
MP572-0159-XXXX	1	26	.068	.080	17	.085
MP572-0160-XXXX	1	24	.073	.085	16	.093
MP572-0161-XXXX	1	22	.080	.092	15	.110
MP572-0162-XXXX	1	20	.088	.100	15	.110
MP572-0163-XXXX	1	18	.100	.114	14	.120
MP572-0164-XXXX	1	16	.107	.121	13	.140
MP572-0174-0026	2	26	.097	.113	14	.120
MP572-0174-0024	2	24	.112	.128	13	.140
MP572-0174-0022	2	22	.126	.142	12	.150
MP572-0174-0020	2	20	.142	.158	11	.170
MP572-0174-0018	2	18	.170	.190	9	.205
MP572-0174-0016	2	16	.184	.204	1/8 inch	.215
MP572-0175-0026	3	26	.110	.127	13	.140
MP572-0175-0024	3	24	.121	.138	12	.150
MP572-0175-0022	3	22	.136	.153	11	.170
MP572-0175-0020	3	20	.153	.170	10	.191
MP572-0175-0018	3	18	.179	.200	9	.205
MP572-0175-0016	3	16	.194	.215	8	.240
MP572-0176-0026	4	26	.118	.136	13	.140
MP572-0176-0024	4	24	.130	.147	12	.150
MP572-0176-0022	4	22	.147	.164	11	.170
MP572-0176-0020	4	20	.166	.183	10	.191
MP572-0176-0018	4	18	.194	.217	8	.240
MP572-0176-0016	4	16	.211	.234	8	.240
MP572-0177-0026	5	26	.127	.146	12	.150
MP572-0177-0024	5	24	.140	.159	11	.170

*MB0150-025, Class 1 (TFE), heat shrinkable sleeving

PROTECTIVE MATERIAL	18 JUL 1967	
UNGROUNDED SHIELDED CABLES	DATE	DATE REVISED
1 THRU 5 CONDUCTOR	VII	7.1
TITLE	SECTION	NUMBER

TABLE II

Design Standard Number	No. of Cond.	Wire Size	Insulation Diameter		*Insulation Sleeving	
			Min.	Max.	Size	Min. Exp. I.D. (inch)
MP572-0177-0022	5	22	.159	.178	10	.191
MP572-0177-0020	5	20	.181	.199	9	.205
MP572-0177-0018	5	18	.213	.238	7	.270
MP572-0177-0016	5	16	.232	.257	7	.270
MP572-0178-0026	6	26	.136	.156	11	.170
MP572-0178-0024	6	24	.151	.171	10	.191
MP572-0178-0022	6	22	.172	.192	9	.205
MP572-0178-0820	6	20	.196	.216	8	.240
MP572-0178-0018	6	18	.232	.258	7	.270
MP572-0178-0016	6	16	.253	.279	6	.302
MP572-0179-0026	7	26	.136	.156	11	.170
MP572-0179-0024	7	24	.151	.171	10	.191
MP572-0179-0022	7	22	.172	.192	9	.205
MP572-0179-0020	7	20	.196	.216	8	.240
MP572-0179-0018	7	18	.232	.258	7	.270
MP572-0179-0016	7	16	.233	.279	6	.302
MP572-0180-0026	8	26	.166	.190	9	.205
MP572-0180-0024	8	24	.186	.210	1/8 inch	.215
MP572-0180-0022	8	22	.214	.238	7	.270
MP572-0180-0020	8	20	.246	.270	6	.302
MP572-0180-0018	8	18	.294	.326	4	.370
MP572-0180-0016	8	16	.326	.358	4	.370
MP572-0181-0026	9	26	.166	.190	9	.205
MP572-0181-0024	9	24	.186	.210	1/8 inch	.215
MP572-0181-0022	9	22	.214	.238	7	.270
MP572-0181-0020	9	20	.246	.270	6	.302

*MB0150-025, Class 1 (TFE), heat shrinkable sleeving

PROTECTIVE MATERIAL UNGROUNDED SHIELDED CABLES 5 THRU 9 CONDUCTOR	18 JUL 1967	
	DATE	DATE REVISED
	VII	7.1.1
TITLE	SECTION	NUMBER

TABLE III

Design Standard Number	No. of Cond.	Wire Size	Insulation Diameter		*Insulation Sleeving	
			Min.	Max.	Size	Min. Exp. I.D. (inch)
MP572-0181-0018	9	18	.294	.326	4	.370
MP572-0181-0016	9	16	.326	.358	4	.370
MP572-0182-0026	10	26	.166	.190	9	.205
MP572-0182-0024	10	24	.186	.210	1/8 inch	.215
MP572-0182-0022	10	22	.214	.238	7	.270
MP572-0182-0020	10	20	.246	.270	6	.302
MP572-0182-0018	10	18	.294	.326	4	.370
MP572-0182-0016	10	16	.326	.358	4	.370
MP572-0183-0026	15	26	.187	.214	8	.240
MP572-0183-0024	15	24	.210	.233	8	.240
MP572-0183-0022	15	22	.243	.270	6	.302
MP572-0183-0020	15	20	.281	.308	5	.320
MP572-0183-0018	15	18	.341	.378	3	.390
MP572-0183-0016	15	16	.374	.411	2	.430
MP572-0184-0026	20	26	.241	.275	10	.191
MP572-0184-0024	20	24	.273	.308	5	.320
MP572-0184-0022	20	22	.318	.353	4	.370
MP572-0184-0020	20	20	.371	.405	1/4 inch	.410
MP572-0184-0018	20	18	.449	.496	3/8 inch	.560
MP572-0184-0016	20	16	.498	.546	3/8 inch	.560
MP572-0185-0026	30	26	.241	.275	6	.302
MP572-0185-0024	30	24	.273	.308	5	.320
MP572-0185-0022	30	22	.318	.353	4	.370
MP572-0185-0020	30	20	.371	.405	1/4 inch	.410
MP572-0185-0018	30	18	.449	.496	3/8 inch	.560
MP572-0185-0016	30	16	.498	.546	3/8 inch	.560

*MB0150-025, Class 1 (TFE), heat shrinkable sleeving

INSULATION OF UNINSULATED PARALLEL SPLICES

a. Diameter of insulation and filler sleeves shall be selected in accordance with the following methods.

(1) MB0150-025, Class 4 sleeving will be used & is determined by the size of the butt splice used.

(2) MB0150-025, Class 5 sleeves (used for filler material to obtain moisture seal)

NOTE: In some instances, due to the configuration at wire combination being spliced, it may be physically impossible to shrink the outer insulation sleeve (MB0150-025, Class 4) tightly onto the wire. In these cases it shall be required to build up the wire or wires with additional MB0150-025, Class 5 sleeving until a tight seal is obtained.

(3) The length of the sleeves shall be as shown in Figure 1.

b. Slide MB0150-025, Class 4 and Class 5 insulation sleeves on the wires as shown in Figure 1.

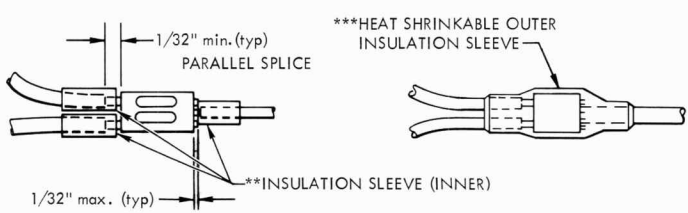
c. Select the proper insulation sleeve to be used over the parallel splice and shrink in place as shown in MA0303-0064.

**Inner sleeves shall be approximately 3/8 inch long and shall be used only when outer insulation sleeve will not shrink tightly on wire insulation, and when more than one wire is to be installed in the same end of a parallel splice.

Shrink the sleeves in place and check each sleeve carefully to insure that the sleeves are tightly on the wires.

Center the outer insulation sleeve over the splice and shrink in place in accordance with MA0303-0065 and Figure 1.

NOTE: When using the heat gun apply the heat at the center of the splice and work out to each end. Do not apply the heat for more than one minute. Each end must be sealed tightly to prevent moisture from entering into the parallel or butt splice. If necessary to reapply heat to seal ends, wait at least until the sleeve is cool to the touch.



***INSULATION SLEEVE SHALL BE 1-1/4 INCH LONG ±1/32. SPLICE SHALL BE CENTERED IN SLEEVE.

FIGURE 1

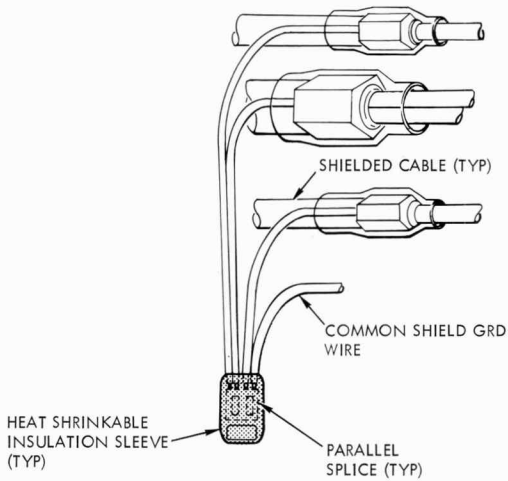


FIGURE 2

Center the crimped parallel splice in a 1 inch ± 1/8 inch length of MB0150-025, Class 4, heat shrinkable sleeving. The sleeve diameter shall be small enough to allow the sleeve to shrink tightly around the wires and splice. Apply heat and shrink the sleeve in accordance with MA0303-0065. While the sleeve is still hot and the inner wall melted use a pair of long nose pliers to close and fuse the open end.

Slide outer insulation sleeve over shield braid and shrink in place, as shown. When splice reference designators are assigned the reference designators and corresponding wire insulation colors shall be marked on the sleeve as shown.

FIGURE 3

*INSULATION SLEEVE SHALL EXTEND APPROXIMATELY 1/2 INCH OVER EACH END OF THE SHIELDED CABLE OUTER INSULATION JACKET.

Use of Insulation Sleeving - A piece of insulation sleeving shall be used to:

a. Cover a shield ground ferrule installation including the area where the outer insulation jacket is stripped back.

b. Cover uninsulated splices where they have been used to splice shielded cables or terminate shield ground wire.

c. Cover the ungrounded end of a cable shield.

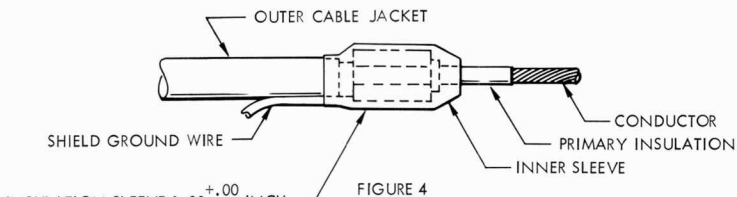


FIGURE 4

NOTE: THE SAME PROCEDURE AS SHOWN ABOVE SHALL BE USED FOR MULTI-CONDUCTOR SHIELDED CABLE.

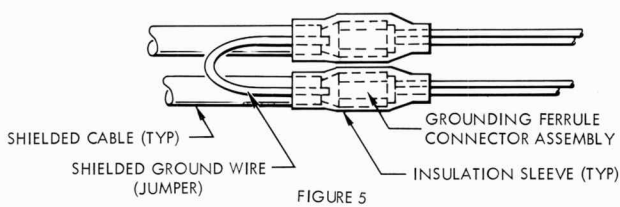


FIGURE 5

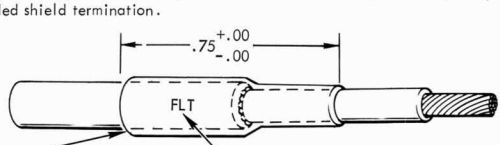
TERMINATION OF UNGROUNDED ENDS OF 2 CABLE SHIELDS

Sleeving Installation Requirements

To properly fulfill the requirements the following shall apply:

a. Type of Sleeving - The type of sleeving used shall be as specified.

b. Length of Sleeving - The sleeving shall be of sufficient length to adequately insulate the grounded or ungrounded shield termination.



INSULATION SLEEVING APPROXIMATELY CENTERED (HEAT SHRINKABLE) SEE PAGE 7.1

Typical ungrounded end of shield as specified on the applicable engineering drawing (AWL). Identification information for reference purposes only and shall not be marked on the sleeve.

FIGURE 6

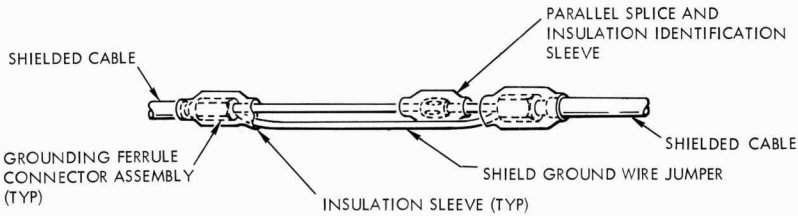


FIGURE 7

NOTE: THE SAME METHOD MAY BE USED FOR APPLICATION OTHER THAN SINGLE CONDUCTOR SHIELDED CABLES AS SHOWN, WHEN SPECIFIED ON THE APPLICABLE ENGINEERING DRAWING.

When sleeves are to be shrunk on wires or cables with soldered terminations, the minimum distances from the soldered joint that heat may be applied and the maximum heat that may be applied shall be as follows:

a. Heat shall be applied a minimum of 12 inches from the soldered joint and shall not exceed 1000F when MB0150-025, Class 1 through 4 sleeves are used.

b. Heat shall be applied a minimum of 2-1/2 inches from the soldered joint and shall not exceed 500F when MB0150-025, Class 5 sleeves are used.

When a heat gun with a deflector is used to shrink sleeves, locate the sleeve near the center of the deflector while applying heat. It is not necessary to rotate the sleeve or gun since the deflector will apply the heat uniformly around the sleeve. Teflon sleeves will change from a milky or translucent color to clear when the sleeves have reached the temperature required for shrinking, at this time the heat must be removed, allowing the sleeve to shrink and return to its original color. All other types of sleeves will shrink as the heat is applied.

When a heat gun without a deflector is used to shrink sleeves, the heat gun or the sleeve must be manipulated to assure that the heat is applied uniformly around the sleeve in order to uniformly shrink the sleeve. It is preferable to use a deflector on heat guns since a shorter shrinking time is required and the sleeve will be more uniformly shrunk.

Caution

- Apply heat no longer than necessary to produce shrinking.
- Do not use open flame for shrinking.
- Heat shrinkable sleeves will shrink when they reach approximately the temperatures listed on Table 1.

TABLE I

SLEEVE MATERIAL	SHRINKING TEMPERATURE
TEFLON (TFE)	621 F
TEFLON (FEP)	350 F
KYNAR	350 F

NOTE: Wire, connectors, & terminal boards, that may be damaged by heat from heat gun shall be protected by the use of heat shields such as heavy gauge aluminum foil or asbestos sheet.

PROTECTIVE MATERIAL	18 JUL 1967	
	DATE	DATE REVISED
INSULATION - SHIELD CABLE SPLICE	VII	7.2.3
TITLE	SECTION	NUMBER

NOTE: SECTION 7.3 HAS
BEEN PURPOSELY LEFT BLANK
THIS SECTION WILL BE
ADDED AT A LATER DATE

PROTECTIVE COVERS

Protective covers are classified as permanent and temporary.

Permanent type covers are constructed of metal and become a permanent attached assembly of the wire harness when specified on the engineering drawing.

Temporary type covers are constructed of plastic (polyethylene or equivalent) and do not become a permanent attached assembly of the wire harness. These covers are used during storage, shipping, fabrication, installation, and testing until the connectors have been mated.

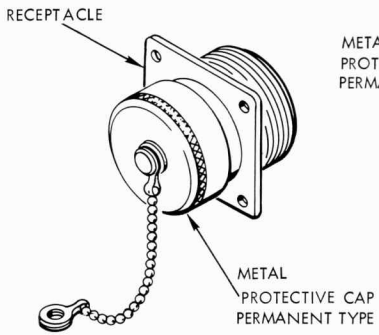


FIGURE 1

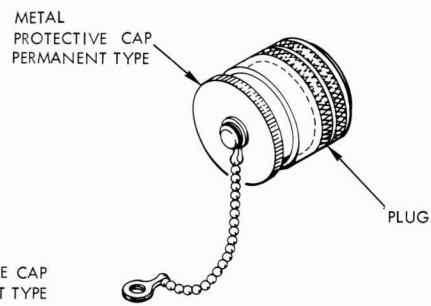


FIGURE 2

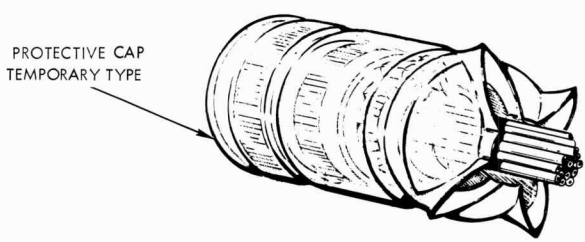


FIGURE 3

NOTE: It is the responsibility of the using activity to assure the cleanliness of protective devices before use.

PROTECTIVE DEVICES

Unmated electrical connectors shall be protected with plastic dust caps installed over the contact area and enclosed in plastic bags prior to assembly of the connectors.

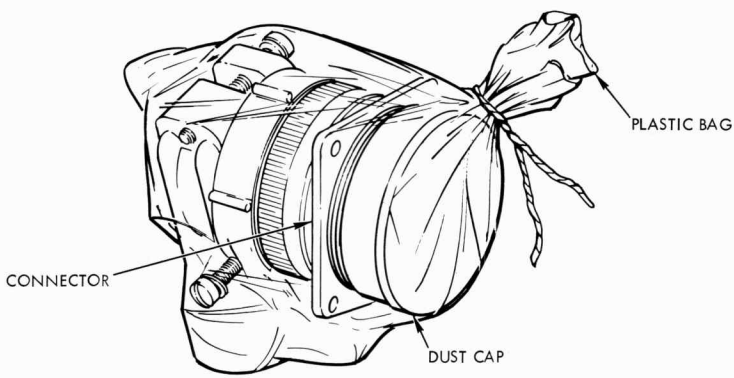


FIGURE 4

These protective devices shall be installed by the fabricating department immediately after the completed connector assembly has been inspected, and shall remain in place at all times except when the connector plug or receptacle is joined to its mating part.

NOTE: It is the responsibility of the using activity to assure the cleanliness of protective devices before use.

Protective devices shall be installed on all connectors as specified. These protective devices shall be installed by the manufacturing department immediately after the complete connector assembly has been inspected, and shall remain in place at all times except when the connector plug or receptacle is joined to its mating part.

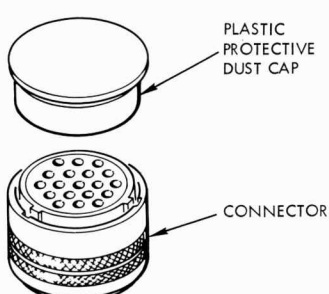


FIGURE 5

PLASTIC PROTECTIVE CAPS FOR STANDARD CIRCULAR SHELL SIZES

TABLE I

SHELL SIZE	*CAPLUG PLUG	*CAPLUG RECEPTACLE	**CANNON PLUG	**CANNON RECEPTACLE
8	EP-8	EC-8	458	459
10	EP-10	EC-10	477	460
12	EP-12	EC-12	478	462
14	EP-14	EC-14	479	463
16	EP-16	EC-16	480	498
18	EP-18	EC-18	484	507
20	EP-20	EC-20	467	468
22	EP-22	EC-22	486	469
24	EP-24	EC-24	487	510
28	EP-28	EC-28	488	501
32	EP-32	EC-32	489	502
36	EP-36	EC-36	490	503
40	EP-40	EC-40	491	504
44		EC-44	492	511
48		EC-48	493	505

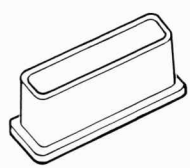
*Caplugs Division
Protective Closures Co., Inc.
2207 Elmwood Ave.
Buffalo, New York 14216
(CAPLUG)

**ITT Cannon Electric Company
Los Angeles, California

RECTANGULAR PROTECTIVE CAPS FOR CONNECTORS PROCURED TO MC414-0148

TABLE II

CONNECTOR PART NO.	**DUST CAP PART NO.
ME414-0148	DPKB-59
ME414-0149	DPKB-60
ME414-0238	DPKA-59
ME414-0239	DPKA-60
ME414-0522	DPKA-59
ME414-0529	DPKB-60



**ITT Cannon Electric Company
Los Angeles, California

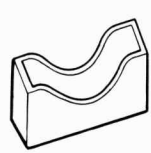
RECTANGULAR PROTECTIVE CAPS FOR DEUTSCH SUBMINIATURE CONNECTORS PROCURED TO MC414-0409.

TABLE III

SHELL SIZE	NO. OF PINS	***DUST CAP PART NO.
2	12	212
3	28	328
4	42	442
6	70	670
7	100	700

NOTE:

When electrical connectors are not mated they shall be protected by dust caps in accordance with MA0303-0062.



***The Deutsch Company
Electronic Components Division
Banning, California

NOTE: It is the responsibility of the using activity to assure the cleanliness of protective devices before use.

PROTECTIVE MATERIAL	18 JUL 1967	
	DATE	DATE REVISED
CONNECTOR PROTECTIVE CAPS	VII	7.4.2
TITLE	SECTION	NUMBER

MOLDED DEVISES
DIVISION OF BUNDY CO
SANTA MONICA CALIF

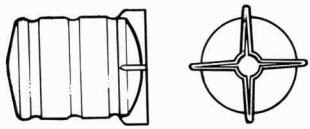


TABLE I

GUARD SLEEVE	
PART NO.	SIZE I.D. DIA.LENGTH
15-17	1-1/2" X 1-3/4"
15-22	1-1/2" X 2-1/4"
15-27	1-1/2" X 2-3/4"
15-32	1-1/2" X 3-1/4"
15-37	1-1/2" X 3-3/4"
15-42	1-1/2" X 4-1/4"
20-17	2" X 1-3/4"
20-22	2" X 2-1/4"
20-27	2" X 2-3/4"
20-32	2" X 3-1/4"
20-27	2" X 3-3/4"
20-42	2" X 4-1/4"
20-52	2" X 5-1/4"
25-22	2-1/2" X 2-1/4"
25-27	2-1/2" X 2-3/4"
25-32	2-1/2" X 3-1/4"
25-37	2-1/2" X 3-3/4"
25-42	2-1/2" X 4-1/4"
25-52	2-1/2" X 5-1/4"
25-62	2-1/2" X 6-1/4"
25-72	2-1/2" X 7-1/4"
30-35	3" X 3-1/2"
30-45	3" X 4-1/2"
30-55	3" X 5-1/2"
30-65	3" X 6-1/2"
30-75	3" X 7-1/2"
35-35	3-1/2" X 3-1/2"
35-45	3-1/2" X 4-1/2"
35-55	3-1/2" X 5-1/2"
35-65	3-1/2" X 6-1/2"
35-75	3-1/2" X 7-1/2"

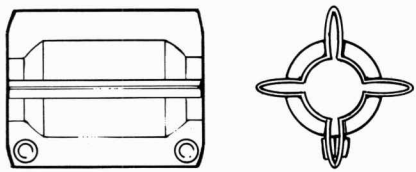


TABLE II

EXPAND-O-GUARD	
PART NO.	SIZE I.D. DIA. LENGTH
20-06	2" X 2"
20-12	4-1/2" X 2"
40-06	2" X 4"
40-12	4-1/2" X 4"
60-06	2" X 6"
60-12	4-1/2" X 6"

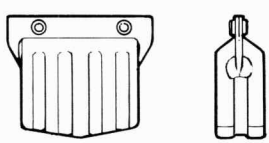


TABLE III

GUARD POUCH	
PART NO.	SIZE I.D. DIA. LENGTH
15-10	1-1/4" X 3/4"
20-15	1-3/4" X 1"
25-20	2-1/4" X 1-1/2"
30-25	2-3/4" X 2"
40-30	3-1/2" X 2-1/4"

Guard pouch, guard sleeve, & expand-o-guards are end opening vinyl protective sleeves for all size electrical connectors. They protect against nicks, scratches, impact, & damage to the wire harness.

Guards will be installed on all wire harness connectors when not in work, or mated with mating connectors, Expand-o-guards shall be used when connectors are mated with checkout equipment to keep connectors from damaging the wire harness.

NOTE: It is the responsibility of the using activity to assure the cleanliness of protective devices before use.

PROTECTIVE MATERIALS	18 JUL 1967	
CONNECTOR PLASTIC GUARDS	DATE	DATE REVISED
	VII	7.4.3
TITLE	SECTION	NUMBER

PURPOSE:

To protect the Command and Service Module wire harness assemblies, jig boards, and holding/transport fixtures during handling, transport, and storage operations.

METHOD:

Protect all connectors, terminals, leads, etc., with protective caps, plugs or polyethylene envelopes or wrap secure with tape. (Tape shall not come in contact with wire, cable or harness.) Overwrap connectors with plastic guard sleeves. Install cover, over assembly and/or transport fixture. Secure inner edge of cover with Velcro tape provided, outer edge with drawstring.

PROTECTIVE COVERING JIG BOARDS AND JIG AIDS:

Jig boards & jig aids when not in work should be covered with polyethylene wrap for protection from dust & dirt.

PROTECTIVE COVERING WIRE HARNESS:

Protective covering will be installed on the wire harness after the Delta "B" rework and before delivery to final installations.

This protective coyering is made of clear plastic with a color coded Velcro lock. Blue for exposed area, green for close-out area, and white for clamp marker.

It is made in numerous sizes to fit all wire bundles and break-outs.

The green and white covering will be removed as the harness is installed in the S/C and the blue will remain until wire harness installation is complete.

PROTECTIVE COVER MAIN DISPLAY PANEL:

All MDC panels while in the fabrication department are to have lucite protective covers face & rear at all times when not in work. When completed & ready for delivery to final installation department, the lucite covers are removed & permanent fiberglass covers installed on the rear of the panels. The protective cover on the face of the panel remains on the panel when delivered & installed in the S/C.

NOTE:

Care should be taken at all times when working or handling MDC panels. Panels that do not have a holding device should be laid on foam padding to avoid damage to switches, meters, & panel face. When touch up is required call the responsible group to insure a proper paint match.

GARMENTS & ACCESSORIES:

The following garments & accessories shall be used in all environmentally controlled areas. Areas where conditions such as temperature, humidity, & air-borne particle count are controlled & recorded.

A. Overclothing such as coveralls, smocks, coats, gloves, head & shoe covers.

Garments other than gloves shall be made from 100 percent dacron or nylon. The color of the garment shall be white or of a pastel color which is colorfast. Gloves shall be made of monofilament nylon & shall be form fitting.

B. ACCESSORIES:

Wiping cloths shall be of nylon 14 x 14 inches with all edges bound.

PARTS PROTECTION

Parts Protection shall be considered as the application of protective measures to prevent damage from physical and climatic environments during intra/inter-plant handling, transportation and storage.

INTRA PLANT TRANSPORTATION

Intra-Plant Transportation shall be considered as handling and transport of items within an area covered by one roof.

INTER PLANT TRANSPORTATION

Inter-Plant Transportation shall be considered as handling and transport functions from one building or facility to another and not connected under one roof.

PROTECTION LEVEL CRITERIA

Parts, components, sub-assemblies and assemblies manufactured, assembled, stored and handled require protection to varying degrees depending on the nature of the item or a combination of items. The acceptance and/or reliability of parts and assemblies may be affected by physical or noticeable damage, or by concealed damage. Care must be exercised in handling and transport to prevent any damage which could result in costly rework, scrap or product malfunction.

SEMI-CRITICAL PROTECTION LEVEL

Semi-Critical items are those that require a moderate degree of protection from various environments. These items, without adequate protection, may be damaged by normal handling, exposure to corrosive atmosphere or contamination; e.g., dust, water or water-vapor, vibration, etc.

CRITICAL PROTECTION LEVEL

Critical items are those items that require a high degree of protection from various environments. These items are fragile and perishable in nature and are easily damaged by minor shock and vibration, temperature extremes, water or water-vapor, dust, dirt or corrosive atmosphere.

INTRA-INTERPLANT PARTS PROTECTION REQUIREMENTS

PLASTIC MODULAR TOTE BOX

USE

Handling container for parts, sub-assemblies and assemblies for short term storage and handling.

DIMPLE CUSHIONED ENVELOPE

USE

Provides neutral cushioning protection against minor shock for delicate parts, and sub-assemblies. Envelope is re-usable.

SKIN PACKAGING MATERIAL

USE

For item packaging between a flexible plastic film and a backing board. When vacuum is applied, the backing board forms an adhesive seal with the film, securing the item in position.

METHOD

Place one or more items or packages in a tote box, install cover and secure with a minimum of (4) clips. When additional protection by separation is required, utilize appropriate dividers.

Tote box size shall be selected so that the contents generally fill the box, but do not interfere with installing the cover. Net weight shall not exceed 25 pounds.

Items that are too large for a tote box shall be containerized as follows:

Place item(s) in a carton and seal with tape.

Net weight shall not exceed 40 pounds.

It is the responsibility of the using activity to assure the cleanliness of containers before use and re-use.

FIGURE 1

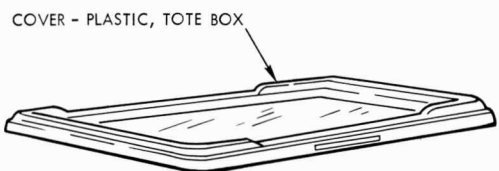


FIGURE 2

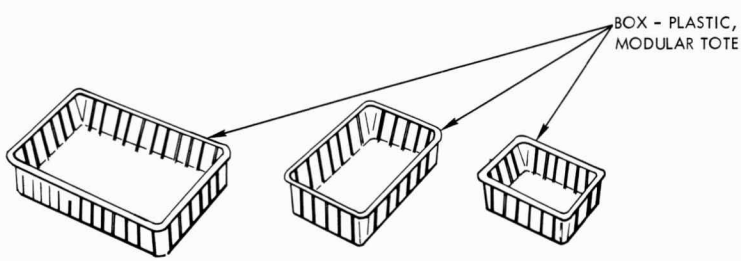


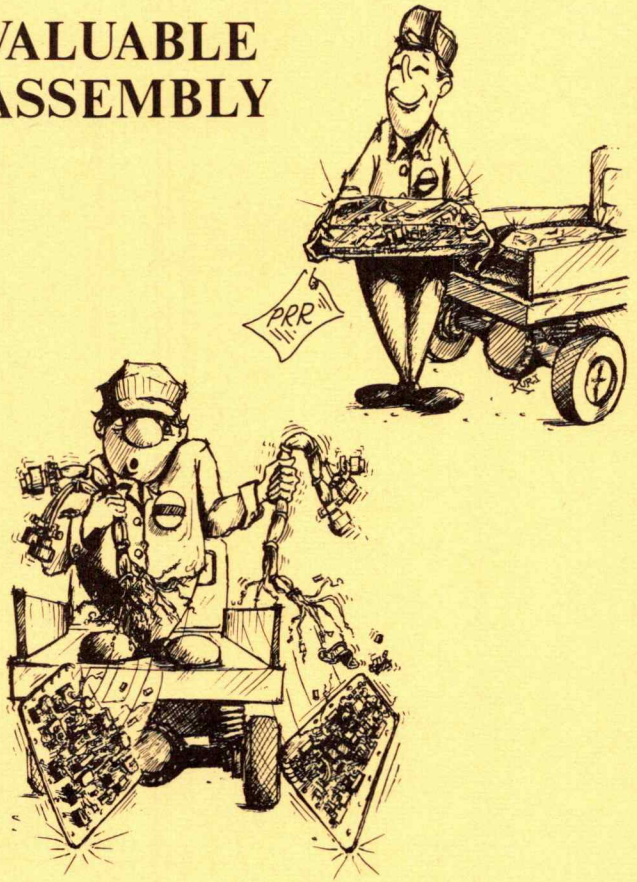
FIGURE 3

THE TOTE BOX IS A HANDLING CONTAINER FOR THE PROTECTION OF PARTS, SUB-ASSEMBLIES & ASSEMBLIES, FOR SHORT TERM STORAGE & HANDLING.

PROTECTIVE MATERIAL TOTE BOX	18 JUL 1967 DATE	 DATE REVISED
	VII SECTION	7.5.2 NUMBER

FORM 999-A-7 REV 4-67

VALUABLE ASSEMBLY



handle with extreme care

BE RESPONSIBLE !

VIII MODIFICATION PROCEDURE

I. SCOPE:

This document outlines the requirements and procedure to be used for reworking of wire harnesses and electrical equipment.

II. APPLICABLE DOCUMENTS:

(1) Rework F.A.I.R. ticket for unit to be reworked.

(2) Rework procedure for unit to be reworked. Procedure to be approved by Q.E.

III. MATERIAL AND EQUIPMENT:

(1) The material and equipment will be as stated in the rework procedure.

IV. GENERAL REQUIREMENTS:

(1) Authorization is required for all rework.

(2) All rework is documented on F.A.I.R. ticket.

(3) No work is to be performed that is not called for in the rework procedure.

(4) Approval is required from Quality Control to perform any rework, such as; removing parts, installing parts, re-routing wires, adding wires, removing wires or revising wiring of any component.

(5) Approval is required from Quality Control on all completed rework.

(6) Rework shall be closely controlled. All wire bundles, components, etc., shall be thoroughly vacuumed and solvent cleaned after rework has been accomplished. Special attention shall be given to such particles as wire and insulation clippings, loose spot-tie materials, solder splatter, flux, unattached hardware, tools, etc., which may be lodged within the wire bundle or equipment.

(7) Any operations such as adding a terminal or contact on a new wire shall be performed outside of the unit, if possible.

(8) Etching of wires shall not be performed on or in the vehicle.

NOTE: All 10, 8, 6 and 4 gage wire that would require etching on or in the vehicle, due to authorized engineering rework, shall not be performed. The electrical engineering group will be notified of this in writing and an engineering disposition will be required prior to any rework.

V. REWORK OF GENERAL PURPOSE AND RECTANGULAR CONNECTORS:

Rework is to be performed by certified personnel when solder and crimp type work is required. If possible, rework will be performed outside of the space vehicle.

(1) Unfasten and slide identification sleeving along wire bundle.

(2) Loosen and slide backshell hardware along wire bundle.

(3) If wire is to be removed, remove wire from connector using correct removal tool. Install sealing plug and/or unwired contact.

(4) To add a wire, remove sealing plug and/or unwired contact.

(5) Strip wire as required using thermal type strippers. If new wire is a shielded cable terminate per rework procedure.

(6) Crimp contact to wire using approved calibrated tool.

(7) Install wired contact in connector using approved insertion tool.

(8) Assemble connector, safety wire if required.

(9) Re-tie I.D. sleeving.

VI. ROUTING OF NEW WIRES AND RE-ROUTING OF EXISTING WIRES:

(1) New wires shall be routed parallel along the existing harness through all applicable loosened clamps. All added wires to existing harnesses shall be dressed to provide maximum protection for all conductors. Spot-ties on individual harnesses shall be removed and replaced making the existing and added harness unified.

(2) Wires, sleeving or other materials on bundles shall not be compressed between mounting tabs of cable clamps or between contact surfaces of terminals or bus bars. Splices, ferrules, spot-ties, wire caps and similar items shall not be located in clamps.

(3) Routing of wires shall be as specified on procedure.

(4) Re-routed wires shall be removed from item or items and routed as new wires unless otherwise specified.

VII. REWORK OF "E" POINTS (SPLICES):

(1) When a wire has been removed from an "E" point, the parallel or butt splice is to be removed. Obtain a replacement parallel or butt splice. Strip wires as required using thermal type strippers. Slide I.D. sleeve for "E" point over wires. Use filler sleeves if required & shrink in place after crimping is completed, then shrink I.D. sleeve in place.

VIII. REWORK OF SHIELD GROUND:

(1) A shielded cable that is to be changed from a shield ground to a floating shield will be reworked in accordance with the authorized engineering document.

IX. DELETION OF A WIRE:

(1) To remove a wire from a wire harness remove wire from each termination point and carefully remove wire from harness. PRIOR to wire removal, remove spot-ties and loosen clamps or any other clamping devices.

(2) If wire is to be stowed remove from existing termination and install wire cap as called for in rework procedure. Do not strip wire.

(3) If wire is removed from a terminal board using nuts to secure the terminal, the nuts must be re-torqued as required.

X. REMOVAL OR REPLACING OF A COMPONENT:

(1) Disconnect wires.

(2) Remove mounting hardware if required.

(3) Remove component.

(4) Remove and/or re-route wires if required.

(5) Bond if required per rework procedure.

(6) Mount new component, torque hardware per rework procedure.

(7) Finish wires as required.

(8) Hook up wires.

XI. CHECK OUT OF ELECTRICAL CONNECTORS:

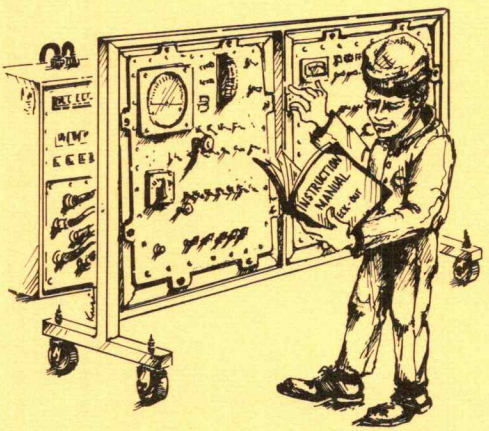
(1) Under no circumstances shall a connector be probed with a test lead. Mating plugs shall be used to check a wired connector, except as follows:

(2) When it is required to check a wired connector, due to rework or changes to a wire harness, after the harness is installed in the vehicle, mating pins or sockets may be used only when mating plugs or receptacles are not available.

(3) The mating pin or socket shall be properly installed on a piece of stranded wire, the same size as the pin or socket, and mated with the connector contact being checked. The test leads shall then be attached to the wire, making certain that undue stress is not applied on the connector contacts. Under no circumstances shall a connector be probed with a test lead probe.

(4) All personnel performing electrical checks shall be adequately trained in checkout and handling requirements. There shall be adequate supervision to assure that extreme care is used to avoid damage to electrical connectors.

AVOID PROBLEMS



Utilize approved methods
&
equipment

IX CHECKOUT PROCEDURE

The following checkout procedure applies only to wires that have been reworked or added since initial installation and insulation, resistance and hi- pot tests:

1. Checkout of Electrical Connectors.
   Mating plugs or receptacles shall be used to check a wired connector, except as follows:
   (a) When it is required to check a wired connector, due to rework or changes to a wire harness, after the harness is installed in the vehicle, mating pins or sockets may be used only when mating plugs or receptacles are not available.
   (b) The mating pin or socket shall be properly installed on a piece of stranded wire, the same size as the pin or socket, and mated with the connector contact being checked. The test leads shall then be attached to the wire, making certain that undue stress is not applied on the connector contacts.

   UNDER NO CIRCUMSTANCES SHALL WIRE INSULATION BE PROBED WITH A TEST LEAD PROBE

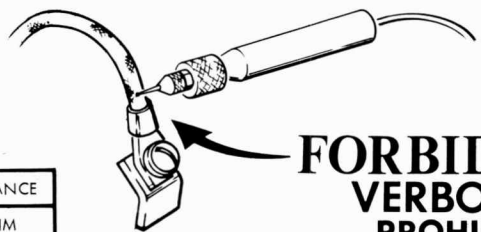


FIGURE 1

TABLE I

WIRE SIZE	RESISTANCE
4 thru 22	1 OHM
24 thru 26	2 OHMS

2. Test equipment will be manual type and capable of performing tests per the following:
   (a) All reworked cables must be tested for continuity. Continuity shall be to the applicable engineering drawings, wire lists, or E.O.'s.
   (b) Any circuit having a resistance exceeding that shown in Table I, (excluding the resistance of the test cable or equipment) shall constitute a failure.

3. When the wiring is reworked prior to the completion of the electrical power distribution test (MA0201-3097), all reworked wires and adjacent wires (wires that could be damaged during rework process) shall be tested for insulation resistance - only - when:
   (a) Disconnection of all reworked wires and adjacent wires from electrical or electronic components or units is necessary to accomplish the rework.
   (b) The rework wires and adjacent wires are not connected to electrical or electronic components or units.

4. When wiring is reworked after completion of electrical power distribution test, insulation and resistance tests shall not be performed unless the extent of the rework requires that the power distribution tests be re-programmed.

5. An authorized quality control representative shall monitor performance of all tests specified and shall verify compliance to the specifications by signing or stamping applicable documents including all test data recorded.

   When specified on the applicable engineering drawings, a continuity/ insulation resistance test and high potential test of wire harnesses shall be made in accordance with MA0201-3075 before connection is made to the equipment items.

ALL PERSONNEL PERFORMING ELECTRICAL CHECKS SHALL BE ADEQUATELY TRAINED IN CHECKOUT AND HANDLING REQUIREMENTS.

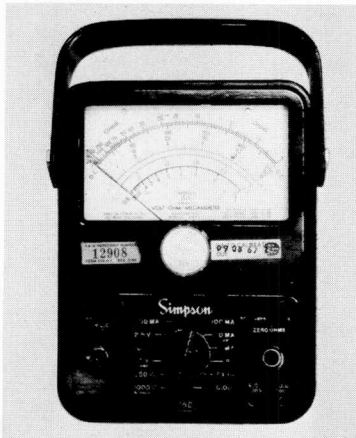


FIGURE 1

Precautions for Meter protection:

1. Circuit power must be OFF before checking for continuity or measuring resistances.
2. Always connect the meter IN SERIES when reading milliamperes or amps.
3. When in doubt as to the values to be read, always set the range selector switch to the HIGHEST value first.
4. Report a defective meter immediately to your leadman

METER SETTINGS

VALUE TO BE READ	PROD POSITIONS	AC-DC SWITCH POS	RANGE SELECTOR SWITCH POS	SCALE TO READ
2 VDC	COMMON & +	DC	2.5V	0 TO 250 VDC & DIVIDE BY 100
28 VDC	COMMON & +	DC	50V	0 TO 50 VDC
300 VDC	COMMON & +	DC	1000V	0 TO 10 VDC MULTIPLY BY 100
5000 VDC	COMMON & 5000 VDC	DC	1000 & 5000 V	0 TO 50 VDC MULTIPLY BY 100
AC 3V	COMMON & +	AC	10V	0 TO 10 VAC
AC 26V	COMMON & +	AC	50V	0 TO 50 VAC
AC 115V	COMMON & +	AC	250V	0 TO 250 VAC
AC 5000V	COMMON & 5000 VAC	AC	1000 & 5000V	0 TO 50 VAC MULTIPLY BY 100
CONTINUITY	COMMON & +	DC	R X 1	0 TO 2M OHMS (ZERO ADJUST)
1 TO 99 OHMS	COMMON & +	DC	R X 1	0 TO 2M OHMS (ZERO ADJUST)
100 TO 10,000	COMMON & +	DC	R X 100	0 TO 2M OHMS MULTIPLY BY 100 (ZERO ADJUST)
OVER 10,000	COMMON & +	DC	R X 10,000	0 TO 2M OHMS MULTIPLY BY 10,000
0 TO 10 A DC	-10A & +10A	DC	500 MA	0 TO 10 DC
MILLIAMPERES	COMMON & +	DC	500 MA	0 TO 50 DC MULTIPLY BY 10
MICRO AMPERES	COMMON & +	DC	100 MICRO AMPS	0 TO 10 DC MULTIPLY BY 10
DB VALUES	COMMON & +	AC	1 OF 5 DB POS	-12 TO +3 DB

CORRECT SETUP OF SIMPSON #260 MULTI-METER (STANDARD GENERAL PURPOSE METER USED AT S&ID.)

CONTINUITY & RESISTANCE	18 JUL 1967	
	DATE	DATE REVISED
	IX	9.2
TITLE	SECTION	NUMBER

MEGOHMMETER TYPE 1862-B

FIGURE 1

High Potential Test - High potential test voltage shall be 1500 VDC ± 75V applied in five pulses of one-half second duration each with a maximum of one-half second between pulses. A leakage current of .5 milliamp or greater shall constitute a failure.
The test voltage shall be applied between the following points:

a. Between each conductor and all other conductors in the same harness assembly.

b. Between each conductor terminating in a connector (except ground wires) and the connector shell.

c. Between each conductor (except shield ground leads) and each shield in the same harness assembly.

d. Between each spare contact and all other contacts (wired or spare) in the same connector and between each spare contact and the connector shell.

e. Between each conductor and ground, except conductors that are grounded per the applicable engineering drawing.

Insulation Resistance Test - Insulation Resistance Test voltage shall be 500VDC ± 50V (SEE FIGURE 1). The test voltage dwell time shall be adequate to allow the insulation resistance to stabilize. The minimum insulation resistance shall be 100 megohms between the following points:

a. Between each conductor and all other conductors in the same harness assembly.

b. Between each conductor terminating in a connector and the connector shell.

c. Between each conductor (except shield ground leads) and each shield in the same harness assembly.

d. Between each shield terminating at a connector and the connector shell, except shields that terminate on the connector shell per the applicable engineering drawing.

e. Between each spare contact and all other contacts (wired or spare) in the same connector and between each spare contact and the connector shell.

f. Between each conductor or shield and ground except conductors or shields that are grounded per the applicable engineering drawing. This shall apply only to harnesses that have been installed.

FAILURES - Any partial failure shall mean complete failure and rejection of the assembly.

SHALL CROSS, NO. 670 SERIES, TEST SET

The milliohmmeter is an instrument for measuring low resistance from 0.0001 ohms to 0.100 ohms on a linear scale. It is recommended for use where an even bridge is too slow and impracticable and an ordinary non-linear ohmmeter is too inaccurate and limited in range. In production line setups, good or bad bonds or welds are easily and accurately detected.

There are six ranges 0.001, 0.005, 0.01, 0.05, 0.10, 0.50, with an accuracy of ±5%.

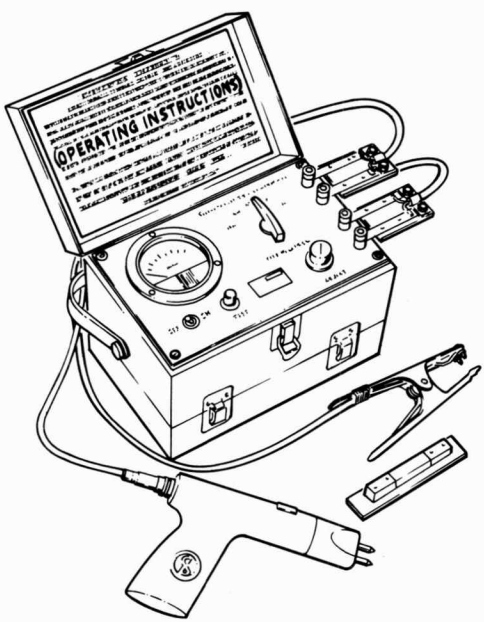


FIGURE 1

RESISTANCE TEST
SHALL CROSS MILLIOHMMETER

APOLLO INSTALLATION MANUAL ELECTRICAL

PUB 943-G-32