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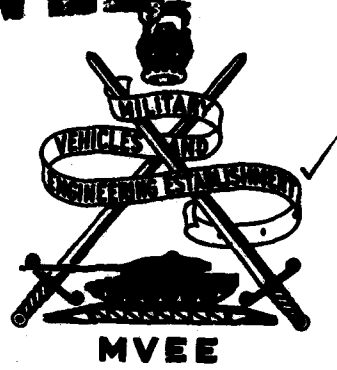
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MVEE PROCEDURE 101

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CODE OF PRACTICE  
FOR  
ENGINEERING DRAWING

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**MILITARY VEHICLES AND ENGINEERING ESTABLISHMENT**

⑭ MVEE-PROCEDURE-101  
⑪ September 1979

④ **CODE OF PRACTICE  
FOR  
ENGINEERING DRAWINGS.**

⑫ 73

**Originating Branch:  
Management Services**

⑮ DRIC

⑰ PP-71172

**SUMMARY**

This Procedure states the application of BS 308 to the preparation of engineering drawings for work for which MVEE is the Design Authority; it also contains additional requirements for specific types of MVEE work. It relates to the form, type etc., of engineering information to be provided on drawings and whilst it is basically complementary to MVEE Procedure 100, Drawing Procedure for Fighting Vehicles and Engineer Equipment, it may also be used with other drawing systems. Some of the most commonly applied Standards, Specifications, Symbols and Abbreviations are listed for reference purposes and examples of completed drawings and diagrams are included.

This document has been approved  
for use by the MVEE Design Authority  
on 15/10/79

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## CONTENTS

	Page(s)
Title Page and Summary	1
Record of Amendments	2
Distribution	3-4
Contents	5-8
Part One - Introduction	9-10
1. Scope	9
2. Application	10
Part Two - General practices for specifying and representing engineering information on drawings	10-14
3. Selection of Types and Sizes of drawings	10
4. Pencils and Erasers	10
5. General Presentation Requirements	10-13
5.1 Use of the Drawing System	10
5.2 Lines	11
5.2.1 Types of Lines	11
5.2.2 Datum Lines	11
5.2.3 Chain Lines	11
5.3 Lettering	11
5.4 Views and Orientation	11
5.4.1 Views	11
5.4.2 Orientation	11
5.5 Repetitive Information	11
5.6 Conventional Representation	12
5.7 Symbols and Abbreviations	12
5.8 Scales	12
5.9 Dimensions	12
5.10 Tolerances	13
5.10.1 General	13
5.10.2 Methods of Indication	13
5.10.3 Geometrical Tolerances	13
5.10.4 Limits and Fits	13
5.11 Mass	13
6. Units	13
7. Preferred Numbers and Sizes	13
8. Application of Standards	14
Part Three - Selection, Specification and Representation of Engineering Devices	14-17
9. Screw Threads	14-15
10. Fasteners	15-16

## CONTENTS *(continued)*

	Page(s)
10.1 Screwed Fasteners	15
10.2 Holes for Screwed Fasteners	15
10.3 Rivets	15
10.4 Cotter Pins, Split	16
11. Keys and Keyways	16
12. Splines and Serrations	16
13. Springs	16
14. Gears	16-17
15. Chains and Chainwheels	17
16. Vehicle Components	17
17. Templates	17
Part Four - Selection, Specification, and Representation of Materials and Processes	17-20
18. Materials	17-18
19. Castings	18
20. Forgings	18
21. Surface Texture	18-19
22. Protective Finishes	19
23. Hardening and Heat Treatment	19
24. Non-destructive Testing	19
25. Plate Profiling	19-20
26. Greases and Lubricants	20
27. NC Machining	20
Part Five - Preparation of Specific Categories of Drawings	20-28
28. Drawings and Diagrams for Electrical Systems	20-22
28.1 Installation Drawings	20-21
28.2 Diagrams	21-22
28.2.1 General	21
28.2.2 Symbols	21
28.2.3 Block Diagrams	21
28.2.4 Circuit Diagrams	21
28.2.5 Wiring Diagrams and Schedules	21-22
28.2.6 Interconnection Diagrams	22
28.2.7 Cableform Diagrams	22
28.2.8 Harness Assembly Diagrams	22
28.3 Related Specifications	22

## CONTENTS (continued)

	Page(s)
29 Drawings and Diagrams for Hydraulic Systems	22
30 Drawings and Diagrams for Pneumatic Systems	23
31 Drawings and Diagrams for Optical Systems	23
32 Drawings for fabricated Parts	23-25
33 Drawings for Armoured Alloys Castings, Forgings and Extrusions	25
 <b>Tables</b>	
Table 1 Sources for Symbols and Abbreviations	26
Table 2 Standards for Gears	26
Table 3 Standards for Non-destructive Testing	27
Table 4 Welding Process Specifications	27
Table 5 Armour Plate Specifications	28
Table 6 Armour Casting, Forging and Extrusion Specifications	28
Table 7 Electrical Specifications	29
 <b>Illustrations</b>	
Fig 1 ( Typical main assembly drawing with associated	30
1A ( drawing and item lists	31
1B (	32
1C (	33
1D (	34
 Fig 2 ( Sub-assembly drawing for Fig 1 with associated	 35
2A ( drawing and item lists	36
2B (	37
 Fig 3 ( Sub-assembly drawing for Fig 1 with associated	 38
3A ( drawing and item lists	39
3B (	40
 Fig 4 ( Welding sub-assembly drawing for Fig 1 with	 41
4A ( associated drawing and item lists	42
4B (	43
 Fig 5 Detail drawing relating to Fig 4	 44
 Fig 6 Radio installation drawing	 45
 Fig 7 Radio equipment block diagram	 46
 Fig 8 Vehicle Electrical circuit diagram	 47
 Fig 9 Wiring diagram, single sheet type	 48
 Fig 10 Wiring diagram, multiple sheet type	 49
 Fig 11 Radio interconnection diagram	 50
 Fig 12 Cableform diagram	 51
 Fig 13 Cable harness diagram	 52

## CONTENTS (continued)

	Page(s)
<b>Appendices</b>	<b>53-71</b>
Appendix A - Abbreviations	53
Appendix B - Standards	55-56
Appendix C - Method of giving information on drawings for springs	57
Appendix D - Gear data requirements	59
Appendix E - Armour Materials	61
Appendix F - Surface texture values	63
Appendix G - Graphical symbols for electrical purposes	65-67
Appendix H - Designation of welds by pictorial representation	69-70
Appendix J - Standard notes for drawings of fabricated parts	71
<b>Index</b>	<b>73-78</b>

## CODE OF PRACTICE FOR ENGINEERING DRAWINGS

## Part One - Introduction

## 1. Scope

- 1.1 This Procedure is issued to state and give guidance in the application of the practices to be used in the presentation of engineering information on drawings prepared by and for MVEE. It is complementary to MVEE Procedure 100 to which reference shall be made for the basic requirements of the MVEE Drawing System.
- 1.2 Wherever practicable and compatible with MVEE requirements, practices specified in Defence and British Standards are to be adopted. Reference should be made to MVEE Technical Services Section for help and guidance on relevant Standards and MVEE Specifications.
- 1.3 MVEE Procedures 100 and 101 supercede MVEE Memorandum 5022 and MVEE (Christchurch) 'Design Office Manual'.
- 1.4
  - 1.4.1 It is important that the relationship between MVEE Procedures 100, 'Drawing Procedures for Fighting Vehicles and Engineer Equipment' and 101 'Code of Practice for Engineering Drawings' is clearly understood. Broadly the relationship is as follows. The purpose of Procedure 100 is to describe the drawing system and the procedures to be followed in order to comply with it. It is essentially concerned with all matters other than the engineering information actually presented on drawings: for example the different types of drawings and associated documents, how drawings are to be kept up to date and how the various spaces ('boxes') in the standard drawing formats are to be completed. The purpose of Procedure 101 is to describe the presentation of engineering information on drawings and the Standards and Specifications for engineering devices, materials to be used and the selection of specific groups of such devices and materials for MVEE work from the broader ranges allowed by the appropriate Standards and Specifications.
  - 1.4.2 A constraint on MVEE procedure 100 however has been the need to keep it very closely aligned to Defence Standard 05-10. In fact much of the material from the Defence Standard has been incorporated in Procedure 100 in order to relieve the reader from having to consult both documents. This has meant that in a few cases it has been necessary to include in Procedure 100 some material (eg the use of metric units) which would, under the provisions of 1.4.1 above, be the concern of Procedure 101. Suitable cross-references have been inserted in the latter Procedure in such cases. Also, following Def Stan 05-10, Procedure 100 includes some completed drawings but it should be noted that these illustrate the system ie., to show what different types of drawings look like, rather than the application of it.

## 2. Application

The requirements of this Procedure are mandatory for all work for which MVEE is the Design Authority but they may also be specified for use with drawing systems other than that stated in MVEE Procedure 100.

### Part Two - General Practices for Specifying and Representing Engineering Information on Drawings

## 3. Selection of Types and Sizes of Drawings

- 3.1 Drawing types (including Lists etc.) used shall be selected from those specified in MVEE Procedure 100.
- 3.2 Guidance on the types of drawings to be used for certain specific applications is given in Part Five of this Procedure.
- 3.3 The sheet size selected for a drawing or list shall be the smallest which is consistent with the clear presentation of the drawn item and its associated manufacturing information etc.
- 3.4 Generally the single part drawing system as specified in MVEE Procedure 100 shall apply but in certain instances for pre-prototype activities ONLY, it shall be permissible for the Chief Draughtsman, Chertsey or Christchurch as applicable, to authorise the use of combined drawings (as defined in BS 308, Pt 1, clause 3.3). In such cases separate item lists shall be provided.

## 4. Pencils and Erasers

Care shall be taken to use suitable pencils and leads having smear-proof characteristics and which produce good line contrast for reproduction and micro-filming etc. Specially developed erasers for use on matt surface drafting film shall be used.

## 5. General Presentation Requirements

### 5.1 *Use of the Drawing System*

An illustration of the way in which a typical engineering device (a winch) is represented by a set of drawings meeting the requirements of the MVEE drawing system is given in Figures 1 - 5 as follows:-

- Fig 1 Main assembly drawing
- Fig 1A Drawing List relating to Fig 1
- Fig 1B )
- 1C ) Item List relating to Fig 1
- 1D )
- Fig 2 Sub-assembly relating to Fig 1
- Fig 2A Drawing List relating to Fig 2
- Fig 2B Item List relating to Fig 2
- Fig 3 Sub-assembly relating to Fig 1
- Fig 3A Drawing List relating to Fig 3
- Fig 3B Item List relating to Fig 3
- Fig 4 Welded assembly relating to Fig 1
- Fig 4A Drawing List relating to Fig 4
- Fig 4B Item List relating to Fig 4
- Fig 5 Detail Drawing relating to Fig 4

## 5.2 *Lines*

### 5.2.1 Types of Lines

The types of lines used and their presentation shall be in accordance with the requirements and recommendations of BS 308 Part 1, clause 4.

### 5.2.2 Datum Lines

Datum lines of main units and assemblies shall be laid down in the initial design stages. All General Arrangement drawings shall clearly define datum lines for main assemblies, eg., CL of turret, CL of rear suspension etc. Subsequent assembly and detail drawings shall also clearly define datum lines as applicable.

### 5.2.3 Chain Lines

Chain lines shall be used to indicate

- (a) Alternative and extreme positions of moveable parts
- (b) Essential features of equipment surrounding the titled part or assembly.
- (c) Operational space requirements of equipment or items subject to rotation eg. turret assembly 'sacred circle'.

## 5.3 *Lettering*

The requirements and recommendations of BS 308 Pt 1, clause 5 shall apply. The recommendations of BS 5535 shall also be followed, as applicable.

## 5.4 *Views and Orientation*

### 5.4.1 Views

The recommendations of BS 308, Pt 1, clauses 7 and 8 are to be adopted unless contrary requirements are specified.

### 5.4.2 Orientation

- (a) Wherever possible all notes on a drawing shall be so placed that they read from the same direction as the format; BS 308 Pt 1, clause 5.4 applies.
- (b) All Arrangement and Assembly drawings shall have their main views orientated in the sense of the main equipment pointing to the left. Detail drawings shall also follow this practice where possible.

## 5.5 *Repetitive Information*

The recommendations of BS 308, Pt 1, clause 7 shall be adopted.

## 5.6 *Conventional Representation*

Representation of features may be adopted in accordance with BS 308, Pt 1, clause 9 unless full detailing is specified.

## 5.7 *Symbols and Abbreviations*

5.7.1 Symbols may be used on drawings but they shall be in accordance with those specified in the Standards listed in Table 1. Additional symbols etc., may be used as stated in individual clauses of this Procedure.

5.7.2 A key to the symbols used or their source shall be included in the drawing concerned.

5.7.3 Abbreviations may be used on drawings and lists only if defined in any of the sources in Table 1 or if they are given in App A to this Procedure.

## 5.8 *Scales*

5.8.1 The recommendations of BS 308 Pt 1, clause 10 shall be applied except as amended in 5.8.2 below.

5.8.2 Where more than one scale is used on a drawing the principal scale shall be indicated in the appropriate panel and a note added thus:

'ORIGINAL SCALE  
--:-- , EXCEPT  
AS STATED'

The additional scales shall be stated immediately below the views to which they refer.

5.8.3 See MVEE Procedure 100, Section 8.2 for instructions on the 'Original Scale' box or drawing formats.

## 5.9 *Dimensions*

5.9.1 The requirements of BS 308, Pt 2 as amplified by MVEE Procedure 100 shall be observed.

5.9.2 Where dimensions are quoted for reference only they shall be shown in brackets thus (75.85) or (16°28').

5.9.3 For certain Service equipments, angular measurements are stated in 'mils.' The mil. or milliradian is defined in Def Stan 00-11, Appendix A, clause 3.

5.9.4 When a dimension is no longer to scale due to alteration, the dimension shall be underlined.

5.9.5 When a drawing is no longer in reasonable proportion due to dimensional alteration, it shall be re-drawn.



## 5.10 Tolerances

### 5.10.1 General

General manufacturing tolerances shall be stated on all drawings where applicable (MVEE Procedure 100, Section 8.11 refers). The tolerances shall be as generous as possible consistent with good engineering practice and the material being used. The tolerances shall always be expressed in the same units of measurement as the dimensions to which they apply.

### 5.10.2 Method of Indicating

The method of indicating tolerances shall be in conformity with BS 308, the preferred form being  $\overset{79.85}{\underset{79.66}{\longleftrightarrow}}$ . The form

$\overset{79.85}{\underset{79.66}{\longleftrightarrow}}$  is also permissible.

### 5.10.3 Geometrical Tolerances

Where geometrical tolerances are necessary they shall be clearly stated on the drawing in accordance with BS 308 Pt 3.

### 5.10.4 Limits and Fits

Preferred limits and fits shall be as specified in Def Stan 05-19.

## 5.11 Mass

Section 8.10 of MVEE Procedure 100 applies. Metric units are to be used unless otherwise specified by the Approving Authority.

## 6. Units

SI Units as specified in Def Stan 00-11 shall be used wherever possible and as applicable on drawings and in calculations. Guidance in the selection and use of SI units may be obtained from BS 5555 and its associated publication PD 5686. Conversion factors, imperial/metric, shall be in accordance with BS 350 and BS 2856; conversions shall be expressed to an appropriate degree of accuracy only.

## 7. Preferred Numbers and Sizes

The recommendations of BS 6481 shall be adopted when a series or sequence of components or items are designed provided that compatibility with other requirements can be economically achieved.

## 8. Application of Standards

8.1 Some background information on Standards and general guide to how Standards should be selected is given in Appendix B. The basic principle is that if there is a current MVEE specification covering the requirement and no later Defence Standard which also covers the requirement, the MVEE specification shall be used. Otherwise Standards are to be selected in the following order of preference; a lower order shall be used only if the required data or information is not contained in a higher order document:-

Defence Standard (or SDM(L) or SSM(L) where they  
have not yet been superseded by  
a Defence Standard)  
Defence Specification, List or Guide  
British Standard  
MOD, other than MVEE Specification or other  
Government Specification  
Manufacturers Specification

8.2 It is emphasised that for the reasons given in Appendix B, MVEE specifications are produced only when other Defence or British Standards are inadequate and therefore only cover relatively few specialised areas in comparison to the greater range of materials, processes, procedures and items of equipment covered by Defence and British Standards. Examples of areas covered by MVEE specifications are:-

- (a) Armour and associated processes eg. specifications mentioned in Tables 5 and 6.
- (b) Electrical specifications, See Table 7
- (c) Painting of vehicles eg MVEE Specification 666.

8.3 All references shall be to the latest issue of current publications.

8.4 Care shall be taken to ensure that publications quoting imperial data have not been superseded by metric versions.

### Part Three - Selection, Specification and Representation of Engineering Devices

## 9. Screw Threads

9.1 ISO metric screw threads shall be used and designated in accordance with BS 3643, Pts 1, 2 and 3. ISO metric coarse threads shall be selected from the preferred range M6, M8, M10, M12, M16, M20, M24, M30, M36, M42, M48, to reduce possible mismatches with other thread systems and sizes.

9.2 The class of fit required is normally "MEDIUM".

i.e. External threads 6g  
Internal threads 6H.

Other classes of fit may be required and shall be in accordance with BS 1916 and 3643.

- 9.3 Threaded inserts (metric) coiled wire type shall be selected from Def Stan 53-82/1 and designated by NATO Stock Number.
- 9.4 For pipe threads for tubes and fittings refer to BS 2779 or BS 21 - see below.
- (a) Where the joints are not required to be pressure tight the threads shall be in accordance with BS 2779.
- (b) Where the joints are required to be pressure tight the threads shall be in accordance with BS 21.
- 9.5 The bonding of threaded joints should be in accordance with MVEE Specification 1283.
- 9.6 For thread symbols and identification marking of threads on manufactured parts refer to Def Stan 05-34.
- 9.7 When designing threaded items, any hexagons, squares or flats required shall be dimensioned to suit standard spanners in accordance with BS 192.

## 10. Fasteners

### 10.1 *Screwed Fasteners*

The requirements of the following Standards shall apply:-

- 10.1.1 Def Stan 53-11 for general purpose bolts, nuts, screws etc.
- 10.1.2 BS 4174 for self-tapping screws
- 10.1.3 BS 4439 for screwed studs.

Note Zinc electroplated coatings to the BS's listed in the Def Stan 53 group are preferred on all screwed fasteners.

### 10.2 *Holes for Screwed Fasteners*

- 10.2.1 Clearance holes for bolts and screws shall be selected in accordance with the requirements of BS 4186.
- 10.2.2 'Fitted' bolt holes shall be dimensioned and toleranced to suit the requirement.
- 10.2.3 Drill sizes quoted on drawings shall be in accordance with those specified in Def Stan 51-5.

### 10.3 *Rivets*

These shall be specified in accordance with Def Stan 53 group, or BS 4620.

**NOTE:** Pop rivets are not covered by service specification; item lists shall refer to the manufacturers approved code.

e.g. Rivet - Pop/Domed head/3.2 mm dia x 12 long/Break Stem.

Supplies - Messrs. XYS Ltd. Code TAP/D/46/BS.  
or "APPROVED EQUIVALENT"

#### 10.4 *Cotter Pins, Split*

Cotter pins, split, shall be selected in accordance with the requirements of Def Stan 53-10.

#### 11. Keys and Keyways

Keys and keyways shall be specified in accordance with BS 4235. If, to meet special circumstances it is necessary to use imperial units (MVEE Procedure 100 refers), BS 46 shall be applied.

#### 12. Splines and Serrations

The requirements of BS 2059 for straight-sided and BS 3550 for involute, splines and serrations shall apply.

#### 13. Springs

13.1 The requirements of Def Stan 01-4 shall apply.

13.2 Springs should not be specially designed for an application unless there is no apparent proprietary or standard item available.

13.3 Spring drawings shall be in the form shown in Appendix C to this Procedure which also indicates the minimum information to be given on the drawing. Further guidance may be obtained from BS 1726.

13.4 Spring drawings shall state whether tolerances are to apply before or after the application of any protective coating (Section 22 refers).

13.5 If a spring is required to pass freely over a shaft or inside a tube, this shall be stated giving the diameter of the shaft or the bore of the tube.

#### 14. Gears

14.1 Gears shall be specified and drawn in accordance with the requirements of the relevant Standard listed in Table 2 unless contrary instructions are issued by the responsible Project Officer.

14.2 The lowest grade or class of gear which will adequately meet the requirement shall be quoted.

14.3 Gear geometrical definitions, notations, symbols etc. shall be in accordance with BS 2519.

14.4 Spur and helical gear addendum modifications shall be in accordance with BS, PD 6457.

14.5 Gear drawings shall show the essential features of the gear. Data shall be given in tabular form on the right-hand side of the drawing. Appendix D give guidance on the form of tables to be used.

14.6 Heat treatment of gears is referred to in Section 23 of this Procedure.

15. Chains and Chainwheels

Wherever possible proprietary items for chains and their wheels shall be employed and listed as a 'NOT DRAWN' item. If it is necessary to prepare chain wheel drawings, data thereon shall be given in accordance with the requirements of BS 228.

16. Vehicle Components

Def Stan 07-76 gives a comprehensive list of Standards and Specifications which have been issued for a wide variety of vehicle components eg. Controls, Electrical components, Drain plugs, Fabrics, Hoses, Mirrors etc. Wherever possible the Standards quoted in Def Stan 07-76 shall be applied.

17. Templates

17.1 Drawings of templates for profiled sheets shall be full size and not dimensioned.

17.2 Notes on the drawing shall state:

plate thickness,  
plate material specification.

17.3 'Sharp' corners in profiles shall be avoided.

17.4 Wherever possible standard drawing sheets shall be used and given numbers in the appropriate series (MVEE Proc 100 applies) but such numbers shall not be entered into drawing and item lists.

17.5 Section 25 of this Procedure also applies.

Part Four - Selection, Specification and Representation of Materials and Processes

18. Materials

18.1 The requirements of MVEE Procedure 100, Sect 8 shall apply.

Materials for specific applications shall be selected on a cost-effective basis taking into account whole-life requirements eg., manufacturing resources, availability, maintenance and accessibility in service etc. Generally the Development Project Officer shall indicate material specifications to be used.

18.2 Selected material specifications suitable for vehicle applications are quoted in Def Stan 07-76. A more detailed list of current armour material specifications is given in Appendix E to this Procedure.

18.3 Approved timbers and plywoods are stated in MVEE Specification 1123 and BS 1088 and these should be specified if possible but the prevailing supply position should be determined and alternatives quoted if necessary.

18.4 See MVEE Procedure 100 Section 8.4 for instructions on completing the 'Materials' Box on Drawing formats.

## 19. Castings

19.1 The following MVEE specification shall apply:

5030	Steel castings for use on AFV's
567	Aluminium ingots and castings for use with aluminium armour

19.2 When applicable drawings of castings are to indicate the classification of the casting in accordance with MVEE Specification 1137.

19.3 Impregnation sealing shall be specified in accordance with Def Stan O3-1 when required.

## 20. Forgings

20.1 Forging material shall be selected from the following specifications:

BS 970	Steel
BS 1472	Aluminium
IT 140 (MVEE)	Armour Steel

20.2 Forging tolerances shall be to the appropriate requirements of BS 4114.

20.3 As may be required by the importance of a forging to the safety or successful operation of the main equipment, or by the stress levels to which it will be subjected, the following information shall be provided on the forging drawing:-

Required grain flow  
Crack detection requirements  
Any test areas required.

## 21. Surface Texture

21.1 For symbols on drawings refer to BS 308 Pt 2.

21.2 The surface roughness quoted shall always be the maximum roughness allowable consistent with the correct functioning of the part; micro metres are the preferred reference.

21.3 Processes to achieve a particular finish are not generally quoted on a drawing, but when a particular process is essential to produce the correct requirements of a part then the process shall be quoted.

21.4 Typical values of the surface texture obtainable by various machining processes are shown in Appendix F.

21.5 See MVEE Procedure 100 Section 8.3 for instructions on completing the 'Surface texture' box on drawing formats.

## 22. Protective Finishes

22.1 Protective finishes shall be quoted in accordance with the appropriate system given in MVEE Specification 666.

22.2 Defence Guide 10 should be consulted regarding special protective treatment for springs.

22.3 Dimensions and surface roughness values shall apply AFTER any required plating or chemical processing has been carried out. Drawings shall be clearly annotated to this effect.

22.4 See MVEE Procedure 100 Section 8.5 for instructions on completing the 'Protective Finishes' Box on drawing formats.

## 23. Hardening and Heat-Treatment

23.1 Details of hardening and heat treatment to meet design requirements shall be given in note form on the drawing, e.g. case hardening, induction hardening, nitriding, stress relieving etc.

23.2 A typical note would be:-

"Case harden surface shown	xxxxxx
Effective case depth	0.8/1.0 mm
Surface hardness	600/650 HV"

23.3 When indicating surface hardness Vickers hardness (HV) values are preferred; see BS 427. Exceptionally, where for instance stress concentration due to indent is to be kept to a minimum e.g. forgings castings etc., Brinell hardness (HB) values are permissible; see BS 240.

## 24. Non-Destructive Testing

24.1 Some related specifications for non-destructive testing (NDT) are given in Table 3.

24.2 Terms used on drawings shall wherever possible be in accordance with glossary in BS 3683.

24.3 Non-destructive testing of a weld shall be indicated by the appropriate symbol (BS 499 Pt 2 refers) placed near to the end of the reference line.

24.4 Radiographic requirements for castings shall be stated on drawings in accordance with the requirements of MVEE Specification 1137.

## 25. Plate Profiling

25.1 When plates are to be flame cut to templates, allowances for flame diameter and subsequent machining requirements are to be made by the manufacturer.

25.2 When the plasma arc process is used to cut armour aluminium, the manufacturer must leave a minimum of 6 mm all round the contour for final machining to eliminate the stress area set up by the cutting process.

## 26. Greases and Lubricants

26.1 For the primary selection of greases and lubricants for service requirements refer to DEF STAN 01-5.

26.2 Greases and lubricants not listed in the above DEF STAN - e.g. newly marketed products - may only be specified if approved by the appropriate MVEE Project Officer.

26.3 For standard range lubrication nipples and adaptors refer to DEF STAN 47-7.

26.4 For standard range grease guns refer to DEF STAN 49-2.

26.5 For the preparation of lubrication charts and instructions refer to MVEE Spec: 2017 and MVEE Procedure 100.

NOTE The preparation of such charts shall be on MVEE standard drawing sheets.

## 27. NC Machining

When parts are machined by a numerical control (NC) system contractors are responsible for the preparation of programming requirements conforming to their particular system.

## Part Five - Preparation of Specific Categories of Drawings

### 28. Drawings and Diagrams for Electrical Systems

#### 28.1 *Installation Drawings*

28.1.1 Radio and electrical installation drawings shall show mounting plates, brackets, fasteners etc, necessary to accommodate components and interconnecting harnesses and wiring; item lists, drawing lists and schedules calling up components and associated drawings shall be prepared. A typical installation drawing is shown at Fig 6.

28.1.2 All details of welded fitments necessary to accommodate electrical equipment shall be shown in chain lines.

NOTE These welded fitments are called up on welded assembly drawings and lists. Planning circumstances may make it necessary to prepare separate welded fitment drawings.

28.1.3 Drawings shall show the run of all interconnecting cables and wire following the approximate run in relation to the structure of the vehicle or equipment.



28.1.4 The equipment called up and forming the installation shall be drawn under its own drawing structure in accordance with MVEE Procedure 100.

## 28.2 *Diagrams*

### 28.2.1 General

Electrical diagrams are to be prepared in accordance with the requirements of MVEE Procedure 100.

### 28.2.2 Symbols

Electrical symbols on drawings etc., shall be as specified in Def Stan 05-17 but additional symbols required for MVEE work are given in Appendix G to this Procedure.

### 28.2.3 Block Diagrams

- (a) Each item of equipment shown in a Block diagram shall be defined by a continuous thick line surround and identified by its name and drawing number.
- (b) A group of items, shall, if appropriate, be surrounded by a heavy chain line and annotated to indicate its location on the assembly or equipment.
- (c) A typical radio block diagram is shown in Fig 7.

### 28.2.4 Circuit Diagrams

- (a) Components included in circuit diagrams shall be clearly defined by a chain line surround.
- (b) When specified by the Project Officer responsible, special relays and, or, contactors may be designated by functional references.
- (c) A typical vehicle circuit diagram is shown in Fig 8.

### 28.2.5 Wiring Diagrams and Schedules

- (a) Wherever possible, wiring diagrams shall be contained on a single drawing sheet, Fig 9 refers. If this cannot be achieved, the wiring diagram shall be broken down into convenient sections and drawn on multiple drawing sheets, suitably cross-referenced to ensure correct continuity of wiring information, see Fig 10.
- (b) Wiring inside of a component shown on a wiring diagram shall be shown on the wiring schedule or alternatively, be drawn up on a wiring diagram.

- (c) The drawing numbers of any applicable cableforms shall be quoted on wiring diagrams.

#### 28.2.6 Interconnection Diagrams

- (a) Interconnection diagrams are mainly applied to radio installations but may also be used for electrical or electronic equipment.
- (b) Interconnected items shall be defined by full lines and given their full nomenclatures and drawing or part numbers. Connection points shall be indicated diagrammatically and defined.
- (c) A typical diagram is shown in Fig 11.

#### 28.2.7 Cableform Diagrams

Cableforms shall be applied only for the installation of radio or electrical items forming the whole or part of an installation in a vehicle or an equipment. A typical cableform diagram is shown in Fig 12.

#### 28.2.8 Harness Assembly Diagrams

All manufacturing information, including end fitting requirements shall be given. The wiring diagram shall be incorporated as shown in Fig 13.

#### 28.3 *Related Specifications*

A list of electrical specifications and standards applying to MVEE requirements is given in Table 7. It is not necessarily complete and will not be automatically up-dated; reference should be made to Technical Services Section, MVEE for further guidance (see also 1.2).

### 29. Drawings and Diagrams for Hydraulic Systems

- 29.1 Hydraulic systems and layouts shall be depicted by diagrams and items therein depicted by symbols all as recommended or specified in BS 5070 except as may be amended by any of the MVEE requirements stated below.
- 29.2 The use of special symbols to indicate specific requirements shall be supported by a note or legend indicating the applications.
- 29.3 Block diagrams shall include tabulation of pipe references, size, type, route, description and pipe identification marking.
- 29.4 Hydraulic assembly drawings shall be prepared in accordance with the requirements of BS 5070.
- 29.5 Pipe fittings and associated components such as banjo assemblies, sealing washers etc: shall, where possible, be selected from
  - (a) FV(S) series standard parts
  - (b) The Society of British Aircraft Constructors handbook of AGS parts.

- 29.6 The design of oil tanks shall conform to the requirements of MVEE Specification 1131.
- 29.7 Toroidal sealing rings (Imperial) shall be selected from SSM(L)7-17 and the dimensions of housings and recesses be in accordance with BS 1806.
- 29.8 For toroidal sealing rings (Metric) and their associated data refer to BS 4518.
- 29.9 For rotary lip seals (Metric) and their associated data refer to BS 1399.
- 29.10 All pipe couplings shall be wire locked as in FV(S) 105 using 22 s.w.g. locking wire to SSM(L)18-7 to be indicated in note form on the assembly drawing.
- 29.11 Flexible hose assembly drawings shall be prepared to meet the technical requirements stated in DEF STAN 47-2.

### 30. Drawings and Diagrams for Pneumatic Systems

The recommendations of BS 5070 shall be followed insofar as the selection and preparation of diagram types and their presentation are concerned but the requirements of MVEE Specification 1316 shall be observed, in the preparation of vehicle braking system drawings and diagrams, as applicable.

### 31. Drawings and Diagrams for Optical Systems

The requirements of BS 4301 shall be observed in the preparation of optical elements and systems; also the recommendations of BS 5070 shall be followed where diagrams are required.

### 32. Drawings for Fabricated Parts

- 32.1 When preparing drawings of welded assemblies and details reference shall be made to MVEE Memo 77005 'Design procedure for determination of safe working loads for welds in mild steel, armour steel and aluminium alloy armour', or MVEE Memo 77013 'The use of aluminium alloys in Armoured Fighting Vehicles' as appropriate.
- 32.2 Information on special welding processes and procedures is available from MVEE FS/AM branch, Welding and Fabrication Section.
- 32.3 For complicated fabricated parts the drawing shall show the basic structure. Separate welded fitment drawings showing equipment mounting pads, stud welding, etc. shall be prepared where necessary.
- 32.4 When preparing drawings for fabricated parts it is important to give attention to the following:-
  - 32.4.1 The primary means of designating welds on drawings shall be by pictorial representation. See Appendix H.

32.4.2 The terms, symbols and dimensions accompanying pictorial weld representations shall be to BS 499 Pts 1, 2 and 3.

NOTE The practice of placing the symbol below the reference line for welds on the near (arrow) side shall be adopted.

32.4.3 Size of welds shall be indicated, in millimetres, against each symbol used.

32.4.4 In specifying a fillet weld the dimension shall be clearly indicated as the minimum leg length. For obtuse angle fillet welds the design 'throat' dimension in addition to the leg length shall be specified.

32.4.5 Drawings shall give all the information necessary to ensure that assemblies are correctly constructed.

32.4.6 Adequate access to the joint by welding equipment shall be ensured.

32.4.7 Assemblies shall be designed to facilitate visual inspection and non-destructive testing at any stage.

32.4.8 The appropriate standard note, see Appendix J, shall appear on each drawing of a welded part.

32.4.9 For Studs Welding, Metric, see DEF STAN 53-80.

32.5 Master Drawings (MVEE Procedure 100, 8.7.5 and Appendix C refers) shall include the following information as applicable:-

32.5.1 Hull/Turret structure space envelope datum corners appropriately dimensioned in relation to finite faces and/or features.

32.5.2 Full size true section through each welded joint showing:

- (a) Type of weld in situ.
- (b) Dimensions of weld.
- (c) Included weld angle and plate angles.
- (d) Indication of exposed surface (ES) required to withstand ballistic attack.
- (e) Identification and form of parent material. (eg MV.....plate, MV..... forging, MV..... extrusion, etc).
- (f) Stress Corrosion Prevention treatment, where necessary, See MVEE Memorandum 77013.
- (g) All true sections shall be drawn on one drawing sheet unless the number of sections requires more than one drawing sheet.

32.5.3 Applicable manufacturing process specification(s) listed in Table 4.

32.5.4 An isometric view of the structure illustrating the welding sequence and procedure in accordance with MVEE Spec 1031.

32.6 Detail drawings of individual parts (except armoured castings, forgings, extrusions etc) for fabricated assemblies, do not normally require approval as at 32.5 above, but shall quote the specification(s) listed in Table 5 as applicable.

33. Drawings for Armoured Alloy Castings, Forgings and Extrusions

Master drawings requiring approval in accordance with MVEE Procedure 100, Section 8.7.5 shall show the applicable specification from the list given in Table 6.

TABLES

SUBJECT	SPECIFICATION
General Engineering Terms and Abbreviations	BS 308 Pt 1 - Clause 11
Graphical symbols for geometrical tolerances	BS 308 Pt 3 - Clause 2.1
Graphical symbols for electrical and electronic diagrams	Appendix F to this Proc. and DEF STAN 05-17
Graphical symbols for use in diagrams for hydraulic and pneumatic systems	BS 2917
Welding terms and symbols	BS 499 and Appendix C to this Procedure
Graphical symbols for general engineering	BS 1553
Letter symbols, signs and Abbreviations	BS 1991

Table 1 - Sources for symbols and abbreviations  
(Sections 5.9 and 5.11 refer)

TYPE OF GEAR	SPECIFICATION
Bevel gears	BS 545
Spur gears	BS 436
Master spur gears	BS 3696
Helical gears	BS 436
Worm gears	BS 721 and 3027
Fine pitch gears	BS 978 and 4582

NOTE Refer to BS 6457 for addendum modifications to spur and helical gears.

Table 2 - Standard for gears (Section 14 refers)

SUBJECT	SPECIFICATION
Pipes and Tubes	BS 3889
Plate material	BS 4336
Steel castings	BS 4080
Steel forgings	BS 4124

Table 3 - NDT Standards  
(Section 24 refers)

TITLE	SPECIFICATION
Welding and gas cutting in the construction of fighting vehicles.	MVEE SPEC 1031
Automatic Stud Welders for use in the construction of fighting vehicles.	MVEE SPEC 1032
Electrodes for arc welding and stud welding equipment approved for use on armoured vehicles.	MVEE SPEC 1050
Welding and cutting aluminium alloy armour in the construction of fighting vehicles.	MVEE SPEC 1321
Specification for the repair of production armour castings by welding.	MVEE SPEC 2016

Table 4 - Welding Process Specifications  
(Section 32, 5.3 refers)

SUBJECT	SPECIFICATION
Armour plate preparation for use in the construction of fighting vehicles	MVEE Spec 1096
High strength heat treatable aluminium alloy armour plate 6 - 120 mm thickness	MVEE Spec 1318
Oxygen cutting of rolled armour plate	MVEE Spec 5014
Homogeneous machinable armour plate 15 mm nominal thickness and over	MVEE Spec IT80
Homogeneous machinable armour plate 3 to 14 mm nominal thickness	MVEE Spec IT100
Floor plates for AFV's	MVEE Spec IT 130
Aluminium alloy armour plate, weldable N8	MVEE Spec 570

Table 5 - Armour plate specifications  
(Section 32.6 refers)

SUBJECT	SPECIFICATION
Armour quality castings	MVEE Spec IT 90
Armour quality forgings	MVEE Spec IT 140
Homogeneous aluminium alloy armour extrusions of nom. section thickness 18 mm or over	MVEE Spec 517

Table 6 - Armour casting, forging and extrusion specifications  
(Section 33 refers)



SUBJECT	SPECIFICATION
Electrical and Electronic Components	DEF STAN 59 Group
Electric Wire, Power and Distribution Equipment	DEF STAN 61 Group
Lighting Fixtures and Lamps	DEF STAN 62 Group
Road Lighting of Military Vehicles	DEF STAN 25-5
General Design and Manufacturing Requirements for Service Electronic Equipment	DEF STAN 00-10
General Requirements for the Electrical Equipments of Fighting Vehicles	MVEE Spec 2051
Schedule of Approved General Purpose Electric Cables for use on Fighting Vehicles	MVEE Spec 2052
Design Procedure for Electrical Equipment	MVEE Spec 2055
Responsibilities of Contractors Providing Wiring Systems for FV's	MVEE Spec 2062
General Requirements - Fighting Vehicles Gun Control and Vehicle Mounted Electronic Equipment other than Signal Services	MVEE Spec 1222
Standard Parts (Electrical)	FV(S) Series
Graphical Symbols for electrical power A	BS 3939
Drawing Practice for Engineering Designers	BS 5070
Graphical Symbols for Electrical and Electronic Diagrams	DEF STAN 05-17

Table 7 - Electrical Specifications  
(Section 28.4 refers)

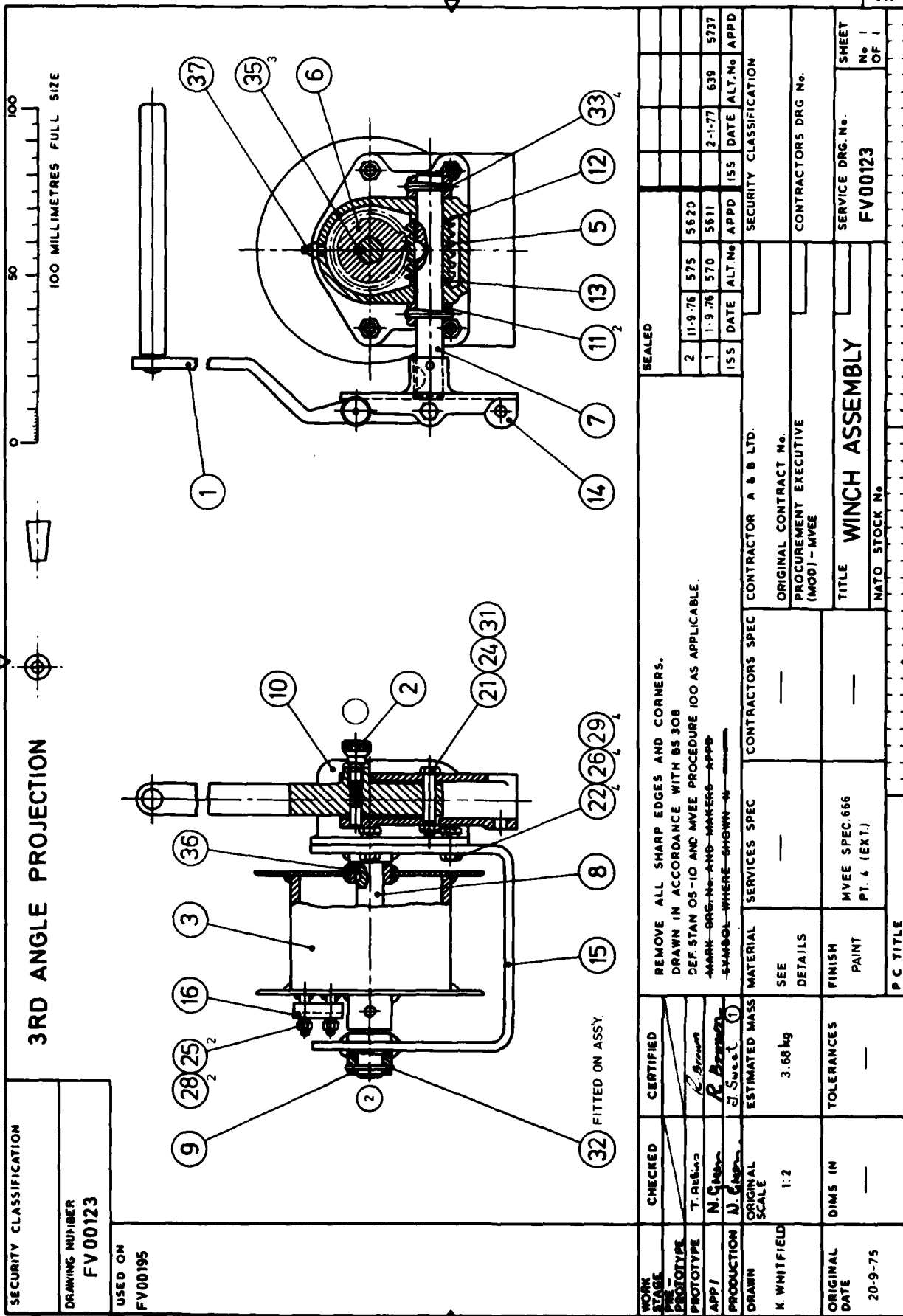


FIG.1 ASSEMBLY DRAWING (illustrating Section 5.1)

SECURITY CLASSIFICATION

USED ON FV 00195	SIZE	DRAWING No.	ISSUE	SIZE	DRAWING No.	ISSUE
	A4	DRG. LIST FOR FV00123	AS THIS SHEET	A3	FV00150	1
	A4	ITEM LIST FOR	1	A4	FV00151	
	A3	FV00123	1			
					<u>SPECIFICATIONS</u>	
	A4	DRG LIST FOR FV00124	LATEST ISSUE		DEF STAN 47 - 7	
		AND ALL DRGS			DEF STAN 53 - 10	
	A4	DRG LIST FOR FV00125	LATEST ISSUE		DEF STAN 53 - 18	
		AND ALL DRGS			DEF STAN 53 - 21	
	A4	DRG LIST FOR FV 00126	LATEST ISSUE		DEF STAN 53 - 26	
	AND ALL DRGS			DEF STAN 53 - 27		
				DEF STAN 53 - 31		
A3	FV00140	1		DEF STAN 53 - 52		
A3	FV00141	1				
A4	FV00142	1		MVEE SPEC 666		
A4	FV00143	1				
A4	FV00144	2		FV(S)69	MVEE	
A3	FV00145	1				
A4	FV00146	1				
A4	FV00147	1				
A3	FV00148	1				
WORK STAGE	CHECKED	CERTIFIED	SEALED			
PRE-PROTOTYPE						
PROTOTYPE	T. Atkins	R. Brown				
APP/PDR	N. Gann	R. Brown	1	1-9-76	570	5611
PRODUCTION	N. Gann	J. Sweet. ①	ISS	DATE	ALT.No.	APPD
CONTRACTOR A & B LTD				SECURITY CLASSIFICATION		
ORIG. CONTRACT No						
DRAWN K.WHITFIELD	PROCUREMENT EXECUTIVE (MOD) - MVEE			CONTRACTORS REF. No.		
ORIGINAL DATE 20-9-75	TITLE <b>WINCH ASSEMBLY</b>			DRG. LIST FOR DRG. No.	SHEET No. 1 OF 1	
	PC TITLE			<b>FV 00123</b>		

210mm X 297mm

FIG. 1A DRAWING LIST FOR ASSEMBLY DRAWING (illustrating Section 5.1)

SECURITY CLASSIFICATION

USED ON	ITEM	DRAWING No.	TITLE				No.OFF	REMARKS			
FV 00195		FV00123	WINCH ASSEMBLY								
	1	FV00124	HANDLE				1				
	2	FV00125	CATCH				1				
	3	FV.00126	DRUM				1				
	4										
	5	FV00140	WORM				1				
	6	FV00141	WORM WHEEL				1				
	7	FV00142	WORM SPINDLE				1				
	8	FV00143	SPINDLE				1				
	9	FV00144	COLLAR				1				
	10	FV00145	CASE				1				
	11	FV00146	COLLAR				2				
	12	FV00147	DISTANCE PIECE				1				
	13	FV00148	DISTANCE PIECE				1				
	14	FV00149	BRACKET				1				
	15	FV00150	BRACKET				1				
	16	FV00151	CLIP				1				
	17										
18											
WORK STAGE	CHECKED	CERTIFIED	SEALED								
PRE-PROTOTYPE											
PROTOTYPE	T. Atkins	R Brown									
APP	N Green	R Brown	1	1-9-76	570	5611					
PRODUCTION	N Green	S Sweet	ISS	DATE	ALT.No	APPD	ISS	DATE	ALT.No	APPD	
CONTRACTOR A & B LTD.						SECURITY CLASSIFICATION					
ORIG. CONTRACT No.											
DRAWN K.WHITFIELD	PROCUREMENT EXECUTIVE (MOD)-MVEE					CONTRACTORS REF.No.					
ORIGINAL DATE	TITLE				ITEM LIST FOR DRG.No.			SHEET			
20-9-75	WINCH ASSEMBLY				FV00123			No. 1 OF 3			
PC TITLE											

210mm X 297mm

FIG.1B ITEM LIST FOR ASSEMBLY DRAWING (illustrating Section 5.1)

SECURITY CLASSIFICATION

USED ON	ITEM	DRAWING No.	TITLE	No.OFF	REMARKS	
FV00195	19					
	20					
	21	DEF STAN 53 - 18	BOLT, HEX HEAD, STEEL	1	M6X30LONG	
		TABLE I (B)	5306 - 99 - 122 - 5245			
	22	DEF STAN 53 - 21	SCREW, HEX HEAD, STEEL	4	M16X25LONG	
		TABLE I (B)	5305 - 99 - 122 - 8682			
	23					
	24	DEF STAN 53 - 26	NUT, SLOTTED, HEX, STEEL	1	M6	
		TABLE I (B)	NATO No. NOT ALLOCATED		SERIAL No.O12	
	25	DEF STAN 53 - 27	NUT, HEX, STEEL	2	M6	
		TABLE I (E)	5310 - 99 - 122 - 5295			
	26	DEF STAN 53 - 27	NUT, HEX, STEEL	4	M8	
		TABLE I (E)	5310 - 99 - 122 - 5296			
	27					
	28	DEF STAN 53 - 31 PART 3	WASHER LOCK SINGLE COIL STEEL	2		
	TABLE I (B)	5310 - 99 - 137 - 9232		M6		
29	DEF STAN 53 - 31 PART 3	WASHER LOCK SINGLE COIL STEEL	4			
	TABLE I (B)	5310 - 99 - 138 - 9227		M8		
WORK STAGE	CHECKED	CERTIFIED	SEALED			
PRE-PROTOTYPE						
PROTOTYPE	T. Atkins	R. Brown				
APP	N Green	R Brown	1	1.9.76	570	5611
PRODUCTION	N Green	J Sweet	①	ISS	DATE	ALT.No
CONTRACTOR A & B LTD			SECURITY CLASSIFICATION			
ORIG. CONTRACT No.						
DRAWN KWHITFIELD	PROCUREMENT EXECUTIVE (MOD) - MVEE		CONTRACTORS REF.No.			
ORIGINAL DATE 20.9.75	TITLE <b>WINCH ASSEMBLY</b>		ITEM LIST FOR DRG.No. <b>FV00123</b>		SHEET No. 2 OF 4	
PC TITLE						

210mm X 297mm

FIG. 1C ITEM LIST CONTINUATION SHEET FOR ASSEMBLY DRAWING

SECURITY CLASSIFICATION											
USED ON	ITEM	DRAWING No.	TITLE				No.OFF	REMARKS			
FV00195	30										
	31	DEF STAN 53 - 10	PIN, COTTER, SPLIT.				1	1/16 X 5/8			
		TABLE 1 (B)	5315-99-948-6478								
	32	DEF STAN 53 - 52	PIN, TAPERED, PLAIN, SOLID				1	3/16 X 1 1/4 (2)			
		TABLE 1 (B)	5315-99-942-1099								
	33	DEF STAN 53 - 52	PIN TAPERED, PLAIN, SOLID				4	1/4 X 1 1/4			
		TABLE 1 (B)	5315-99-942-0861								
	34										
	35	FV(S)69/14	KEY WOODRUFF				3	1/4 X 1			
			NATO No. NOT ALLOCATED								
	36	FV(S)69/5	KEY WOODRUFF				1	1/8 X 5/8			
			NATO No. NOT ALLOCATED								
	37	DEF STAN 47 - 7	LUBRICATING NIPPLE, STRAIGHT				1	3/8 UNF (3)			
		TABLE 1 (A)	4730-99-943-9377								
WORK STAGE		CHECKED	CERTIFIED	SEALED							
PRE-PROTOTYPE											
PROTOTYPE	T. Atkins	R. Brown	2	11976	575	5620					
APP	N Green	R Brown	1	1-9-76	570	5611					
PRODUCTION	N Green	J Sweet (4)	ISS	DATE	ALT.No	APPD	ISS	DATE	ALT.No	APPD	
CONTRACTOR A & B LTD.						SECURITY CLASSIFICATION					
ORIG. CONTRACT No.											
DRAWN K.WHITFIELD						PROCUREMENT EXECUTIVE (MOD)-MVEE					
						CONTRACTORS REF.No.					
ORIGINAL DATE	TITLE				ITEM LIST FOR DRG.No.			SHEET			
20-9-75	WINCH ASSEMBLY				FV00123			No. 3 OF			
PC TITLE											

210mm X 297mm

FIG. 1D ITEM LIST CONTINUATION SHEET FOR ASSEMBLY DRAWING

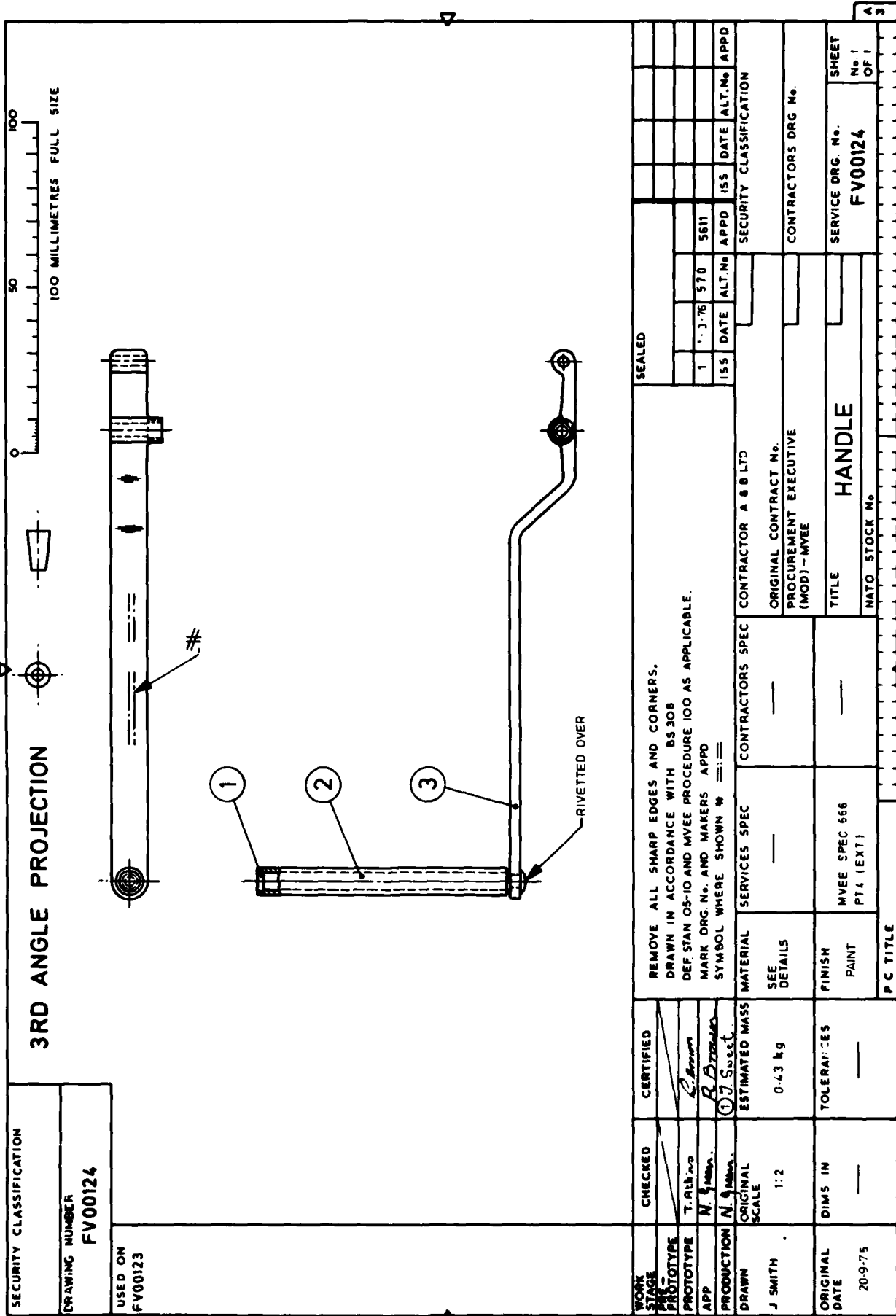


FIG. 2 SUB-ASSEMBLY DRAWING FOR FIG.1 (illustrating Section 5.1)

**SECURITY CLASSIFICATION**

USED ON FV00123	SIZE	DRAWING No.	ISSUE	SIZE	DRAWING No.	ISSUE
	A4	DRG LIST FOR FV00124	AS THIS SHEET		<u>SPECIFICATIONS</u>	
	A4	ITEM LIST FOR FV00124	1		MVEE SPEC. 666	
	A3	FV00124	1			
	A3	FV00127	1			
	A4	FV00128	1			
	A4	FV00129	1			

WORK STAGE	CHECKED	CERTIFIED	SEALED							
PRE-PROTOTYPE	/	/								
PROTOTYPE	T. Atkins	R. Brown								
APP/PBR	N. Green	R. Brown	1	1-9-76	570	5611				
PRODUCTION	N. Green	J. Sweet ①	ISS	DATE	ALT.No.	APPD	ISS	DATE	ALT.No.	APPD
CONTRACTOR A & B LTD.						SECURITY CLASSIFICATION				
ORIG. CONTRACT No.										
DRAWN K. WHITFIELD	PROCUREMENT EXECUTIVE (MOD) - MVEE					CONTRACTORS REF. No.				
ORIGINAL DATE 20-9-75	TITLE <b>HANDLE</b>					DRG. LIST FOR DRG. No. <b>FV00124</b>		SHEET No. 1 OF 1		
PC TITLE										

210mm X 297mm

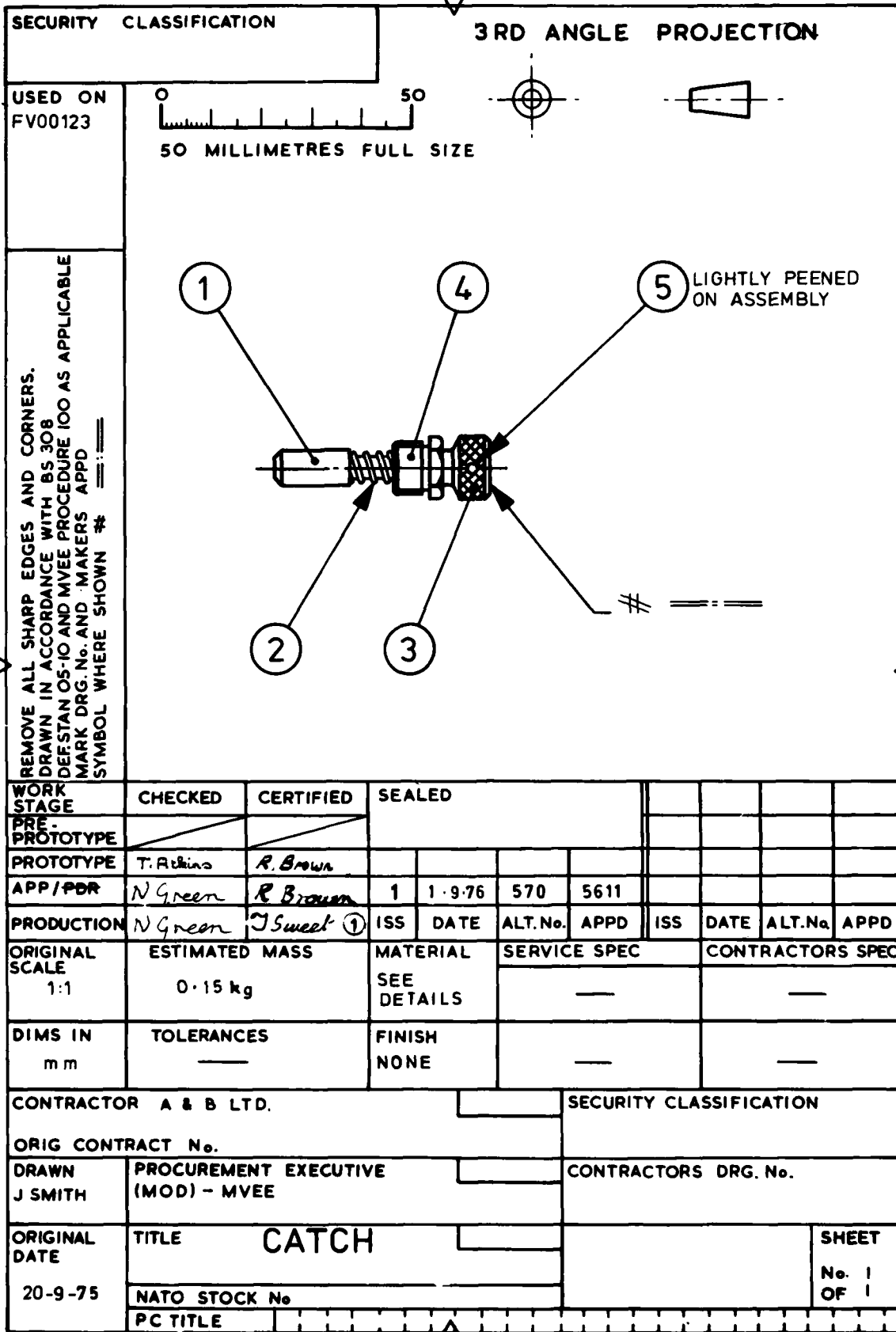
FIG. 2A. DRAWING LIST FOR SUB-ASSEMBLY (illustrating Section 5.1)



SECURITY CLASSIFICATION											
USED ON FVOO123	ITEM	DRAWING No.	TITLE				No.OFF	REMARKS			
		FVOO124	HANDLE								
	1	FVOO127	SPINDLE				1				
	2	FVOO128	ROLLER				1				
	3	FVOO129	LEVER				1				
	WORK STAGE	CHECKED	CERTIFIED	SEALED							
PRE-PROTOTYPE	/	/									
PROTOTYPE	T. Atkins	R. Brown									
APP/PDR	N Green	R Brown	1	1-9-75	570	5611					
PRODUCTION	N Green	J Sweet	①	ISS	DATE	ALT.No	APPD	ISS	DATE	ALT.No	APPD
CONTRACTOR A & B LTD.						SECURITY CLASSIFICATION					
ORIG. CONTRACT No.											
DRAWN K.WHITFIELD	PROCUREMENT EXECUTIVE (MOD)-MVEE					CONTRACTORS REF.No.					
ORIGINAL DATE 20-9-75	TITLE <b>HANDLE</b>					ITEM LIST FOR DRG No <b>FVOO124</b>			SHEET No. 1 OF 1		A 4
PC TITLE											

210mm X 297mm

FIG. 2B. ITEM LIST FOR SUB-ASSEMBLY IN FIG. 2 (illustrating Section 5.1)



210mm x 297mm

FIG. 3 SUB-ASSEMBLY DRAWING FOR FIG. 1 (illustrating Section 5.1)

SECURITY CLASSIFICATION														
USED ON	SIZE	DRAWING No.	ISSUE	SIZE	DRAWING No.	ISSUE								
FV00123	A4	DRG LIST FOR FV00125	AS THIS SHEET											
	A4	ITEM LIST FOR FV00125	I											
	A4	FV00125	I											
	A4	FV00130	I											
	A4	FV00131	I											
	A4	FV00132	I											
	A4	FV00133	I											
WORK STAGE	CHECKED	CERTIFIED	SEALED											
PRE - PROTOTYPE	/	/												
PROTOTYPE	T. Atkins	R. Brown												
APP/PDR	N. Green	R. Brown	1	1-9-76	570	5611								
PRODUCTION	N. Green	J. Sweet	ISS	DATE	ALT.No.	APPD	ISS	DATE	ALT.No.	APPD				
CONTRACTOR A & B LTD						SECURITY CLASSIFICATION								
ORIG. CONTRACT No.														
DRAWN J. SMITH	PROCUREMENT EXECUTIVE (MOD) - MVEE						CONTRACTORS REF. No.							
ORIGINAL DATE 20-9-75	TITLE <b>CATCH</b>						DRG. LIST FOR DRG. No.				SHEET No. 1 OF 1			
PC TITLE						<b>FV00125</b>				A 4				

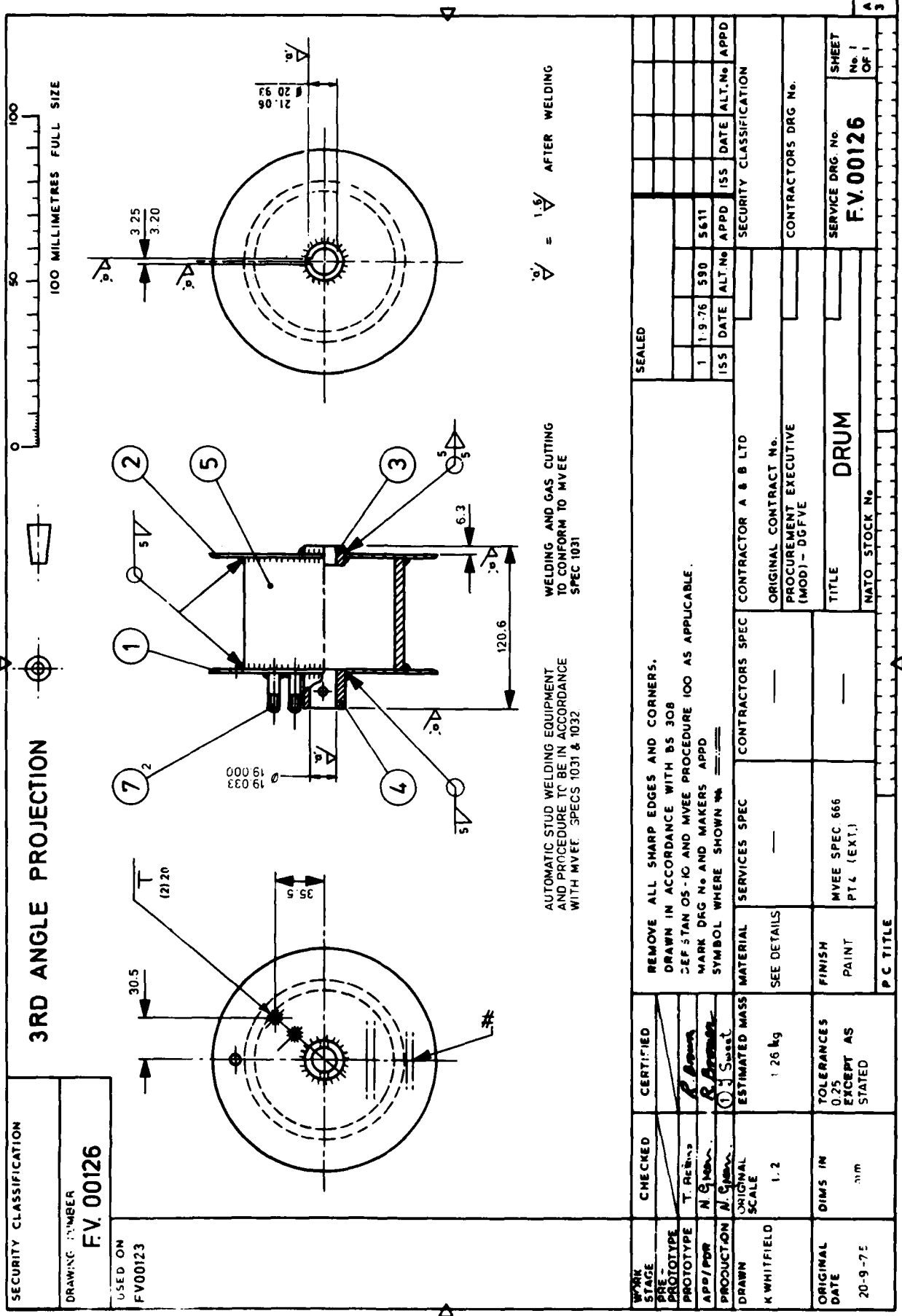
210mm X 297mm

FIG. 3A. DRAWING LIST FOR SUB-ASSEMBLY IN FIG. 3 (illustrating Section 5.1)

SECURITY CLASSIFICATION												
USED ON FV00123	ITEM	DRAWING No.	TITLE				No.OFF	REMARKS				
		FV00125	CATCH									
	1	FV00130	PLUNGER				1					
	2	FV00131	SPRING				1					
	3	FV00132	KNOB				1					
	4	FV00133	RETAINER				1					
	5	ND	PIN $\phi$ 2.5 X 22 LG				1	BS970 070M20				
	WORK STAGE	CHECKED	CERTIFIED	SEALED								
PRE-PROTOTYPE												
PROTOTYPE	T. Atkins	R. Brown										
APP/PDR	N. Green.	R. Brown	1	1-9-76	570	5611						
PRODUCTION	N. Green.	J. Sumt. ①	ISS	DATE	ALT.No	APPD	ISS	DATE	ALT.No	APPD		
CONTRACTOR A & B LTD.						SECURITY CLASSIFICATION						
ORIG. CONTRACT No.												
DRAWN K.WHITFIELD	PROCUREMENT EXECUTIVE (MOD)-MVEE					CONTRACTORS REF.No.						
ORIGINAL DATE 20.9.75	TITLE <b>CATCH</b>					ITEM LIST FOR DRG.No. <b>FV00125</b>				SHEET No. 1 OF 1		
PC TITLE												

210mm X 297mm

FIG. 3B ITEM LIST FOR SUB-ASSEMBLY IN FIG 3 (illustrating 51)



SECURITY CLASSIFICATION
DRAWING NUMBER <b>F.V. 00126</b>
USED ON FV00123

WORK STAGE	CHECKED	CERTIFIED	SEAL
PRE-PROTOTYPE			
PROTOTYPE	T. Reins	R. Brown	
APP/POR	N. G. M.	R. Brown	
PRODUCTION	A. G. M.	(1) J. S. S.	
DRAWN	ORIGINAL SCALE	ESTIMATED MASS	SECURITY CLASSIFICATION
K. WHITFIELD	1:2	1.26 kg	
ORIGINAL DATE	DIMS IN	TOLERANCES	CONTRACTORS SPEC
20-9-75	mm	0.25 EXCEPT AS STATED	CONTRACTOR A & B LTD
			ORIGINAL CONTRACT No.
			PROCUREMENT EXECUTIVE (MOD) - D67VE
			TITLE
			<b>DRUM</b>
			NATO STOCK No.
			CONTRACTORS DRG No.
			SERVICE DRG. No.
			<b>F.V. 00126</b>
			No. 1
			Of 1
			3

FIG. 4 WELDED SUB-ASSEMBLY FOR FIG.1 (illustrating Section 5.1)

SECURITY CLASSIFICATION													
USED ON	SIZE	DRAWING No.	ISSUE	SIZE	DRAWING No.	ISSUE							
FV00123	A4	DRG LIST FOR FV00126	AS THIS SHEET		<u>SPECIFICATIONS</u>								
	A4	ITEM LIST FOR FV00126	1		DEF STAN 53-80								
	A3	FV00126	1		MVEE SPEC 666								
						MVEE SPEC 1031							
	A4	FV00134	1		MVEE SPEC 1032								
	A4	FV00135	1										
	A4	FV00136	1										
	A4	FV00137	2										
	A4	FV00138	1										
	WORK STAGE		CHECKED	CERTIFIED	SEALED								
PRE-PROTOTYPE													
PROTOTYPE		<i>T. Perkins</i>	<i>R. Brown</i>										
APP/PDR		<i>N Green</i>	<i>R. Brown</i>	1	1-9-76	570	5611						
PRODUCTION		<i>N Green</i>	<i>J Sweet</i> (1)	ISS	DATE	ALT.No.	APPD	ISS	DATE	ALT.No.	APPD		
CONTRACTOR A & B LTD						SECURITY CLASSIFICATION							
ORIG. CONTRACT No.						CONTRACTORS REF. No.							
DRAWN J. SMITH		PROCUREMENT EXECUTIVE (MOD) - DGFVE				CONTRACTORS REF. No.							
ORIGINAL DATE 20-9-75		TITLE <b>DRUM</b>				DRG. LIST FOR DRG. No. <b>FV00126</b>				SHEET No. 1 OF 1		A4	
PC TITLE													

210mm X 297mm

FIG. 4A. DRAWING LIST FOR WELDED SUB-ASSEMBLY IN FIG.4 (illustrating Section 5.1)

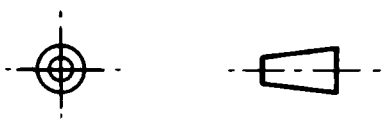
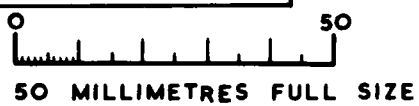
SECURITY CLASSIFICATION											
USED ON	ITEM	DRAWING No.	TITLE				No.OFF	REMARKS			
FV00123		FV00126	DRUM								
	1	FV00134	PLATE				1				
	2	FV00135	PLATE				1				
	3	FV00136	BOSS				1				
	4	FV00137	BOSS				1				
	5	FV00138	BARREL				1				
	6										
	7	DEF STAN 53-80 TABLE 1	STUD WELDING				2	M6 X 30 LAW.			
			5307-99-138-4614								
WORK STAGE	CHECKED	CERTIFIED	SEALED								
PRE-PROTOTYPE	/										
PROTOTYPE	T. Atkins	R. Brown									
APP/PDR	N Green	R Brown	1	1-9-76	570	5611					
PRODUCTION	N Green	J. Sweet ①	ISS	DATE	ALT.No	APPD	ISS	DATE	ALT.No	APPD	
CONTRACTOR A & B LTD.						SECURITY CLASSIFICATION					
ORIG. CONTRACT No.											
DRAWN J.SMITH	PROCUREMENT EXECUTIVE (MOD) - DGFVE					CONTRACTORS REF.No.					
ORIGINAL DATE 20-9-75	TITLE <b>DRUM</b>					ITEM LIST FOR DRG.No. <b>FV00126</b>				SHEET No. 1 OF 1	
PC TITLE											

210mm X 297mm

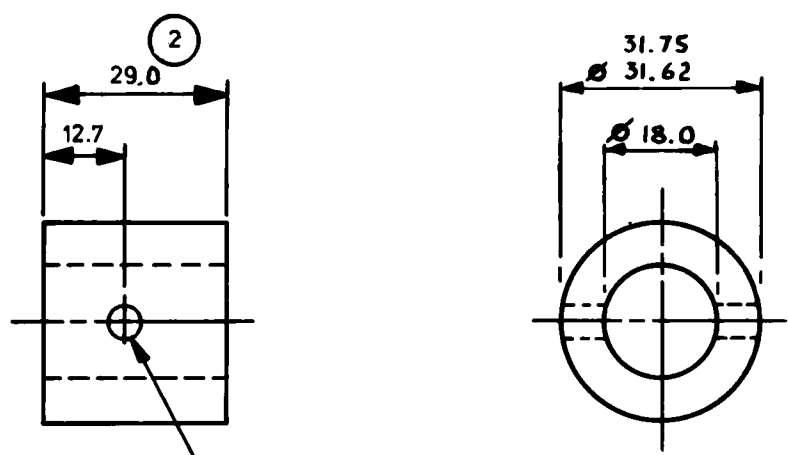
FIG. 4B ITEM LIST FOR WELDED SUB-ASSEMBLY IN FIG. 4 (illustrating Section 5.1)

SECURITY CLASSIFICATION 3RD ANGLE PROJECTION

USED ON  
F.V. 00126



REMOVE ALL SHARP EDGES AND CORNERS.  
 DRAWN IN ACCORDANCE WITH BS 308  
 DEF. STAN 05-10 AND MVEE PROCEDURE 100 AS APPLICABLE.  
 MARK DRG. No. AND MAKERS APPD  
 SYMBOL WHERE SHOWN



DRILL Ø 5.6 PILOT HOLE  
FOR Ø 6.3 TAPER PIN

WORK STAGE	CHECKED	CERTIFIED	SEALED							
PRE-PROTOTYPE										
PROTOTYPE	T. Figgins	R. Brown	2	11-9-76	575	5620				
APP/PDR	N. Green		1	1-9-76	570	5611				
PRODUCTION	N. Green	J. Sweet ①	ISS	DATE	ALT.No.	APPD	ISS	DATE	ALT.No.	
ORIGINAL SCALE	ESTIMATED MASS		MATERIAL		SERVICE SPEC		CONTRACTORS SPEC			
1:1	.11 kg		STEEL		BS 970 070 M20		—			
DIMS IN mm	TOLERANCES ±0.25 EXCEPT AS STATED		FINISH NONE		—		—			

CONTRACTOR A & B LTD			SECURITY CLASSIFICATION		
ORIG CONTRACT No.					
DRAWN J. SMITH	PROCUREMENT EXECUTIVE (MOD) -		CONTRACTORS DRG. No.		
ORIGINAL DATE 20-9-75	TITLE <b>BOSS</b>		SERVICE DRG. No. <b>F.V.00137</b>		SHEET No. 1 OF 1
NATO STOCK No					
PC TITLE					

210mm x 297mm

FIG. 5 DETAIL DRAWING FOR WELDED ASSEMBLY IN FIG. 4 (illustrating Section 5.1)



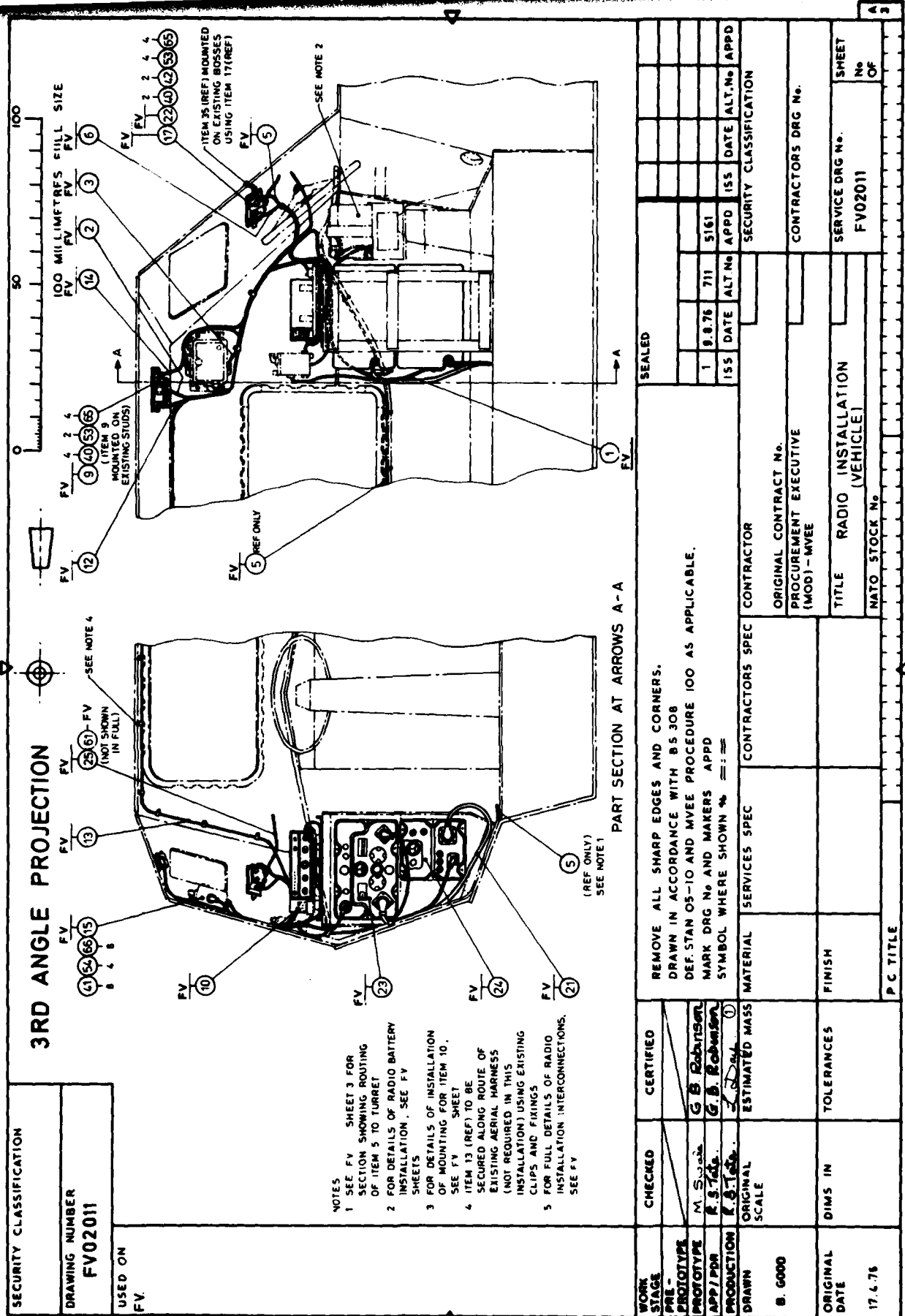


FIG.6 RADIO INSTALLATION DRAWING (illustrating Section 23.1.1)

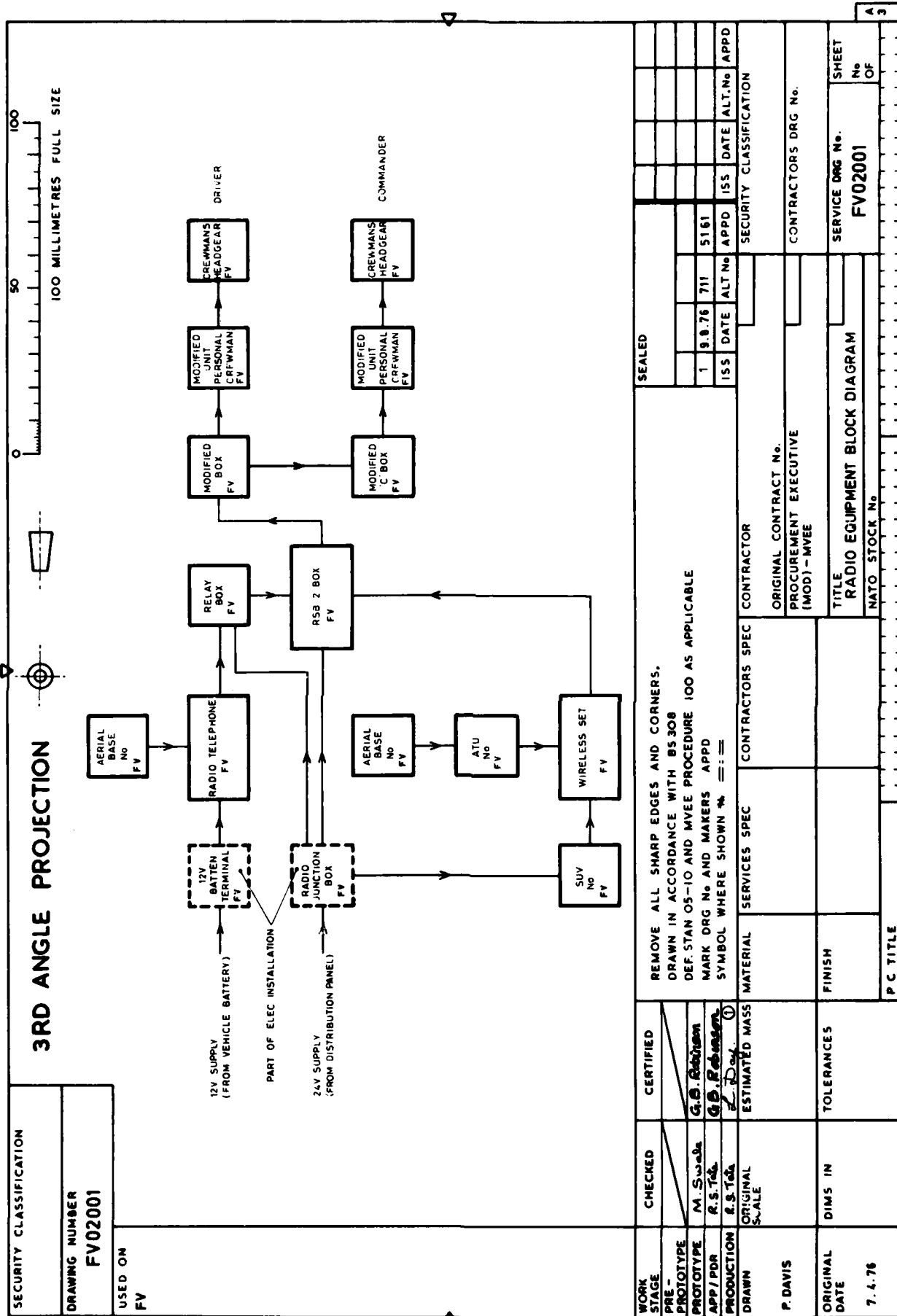


FIG.7 RADIO EQUIPMENT BLOCK DIAGRAM (illustrating Section 28.2.3)

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 DATE 03-01-2001 BY 60322 UCBAW



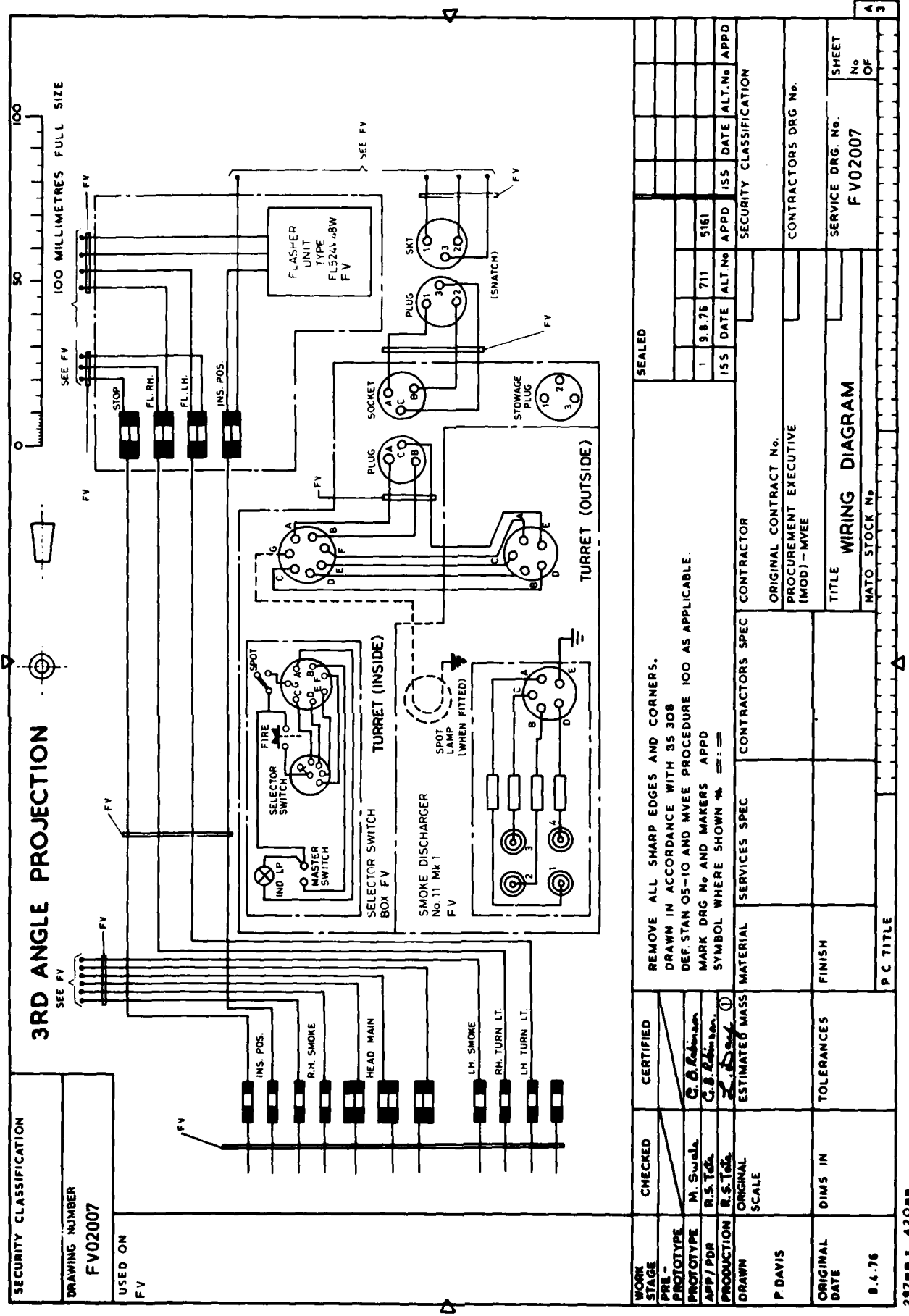


FIG. 9 WIRING DIAGRAM (illustrating Section 28.2.5)



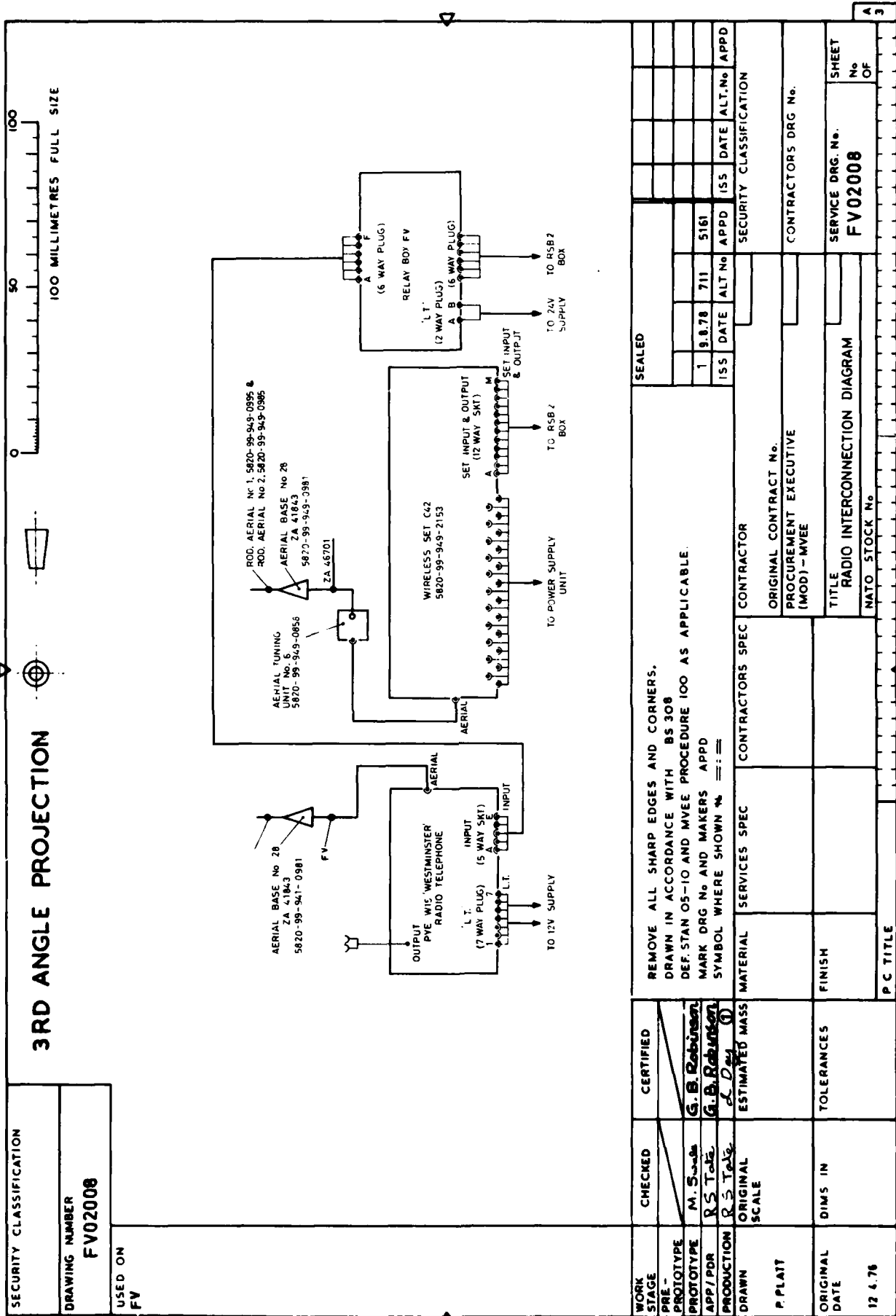


FIG.11 RADIO INTERCONNECTION DIAGRAM (illustrating Section 28.2.6)

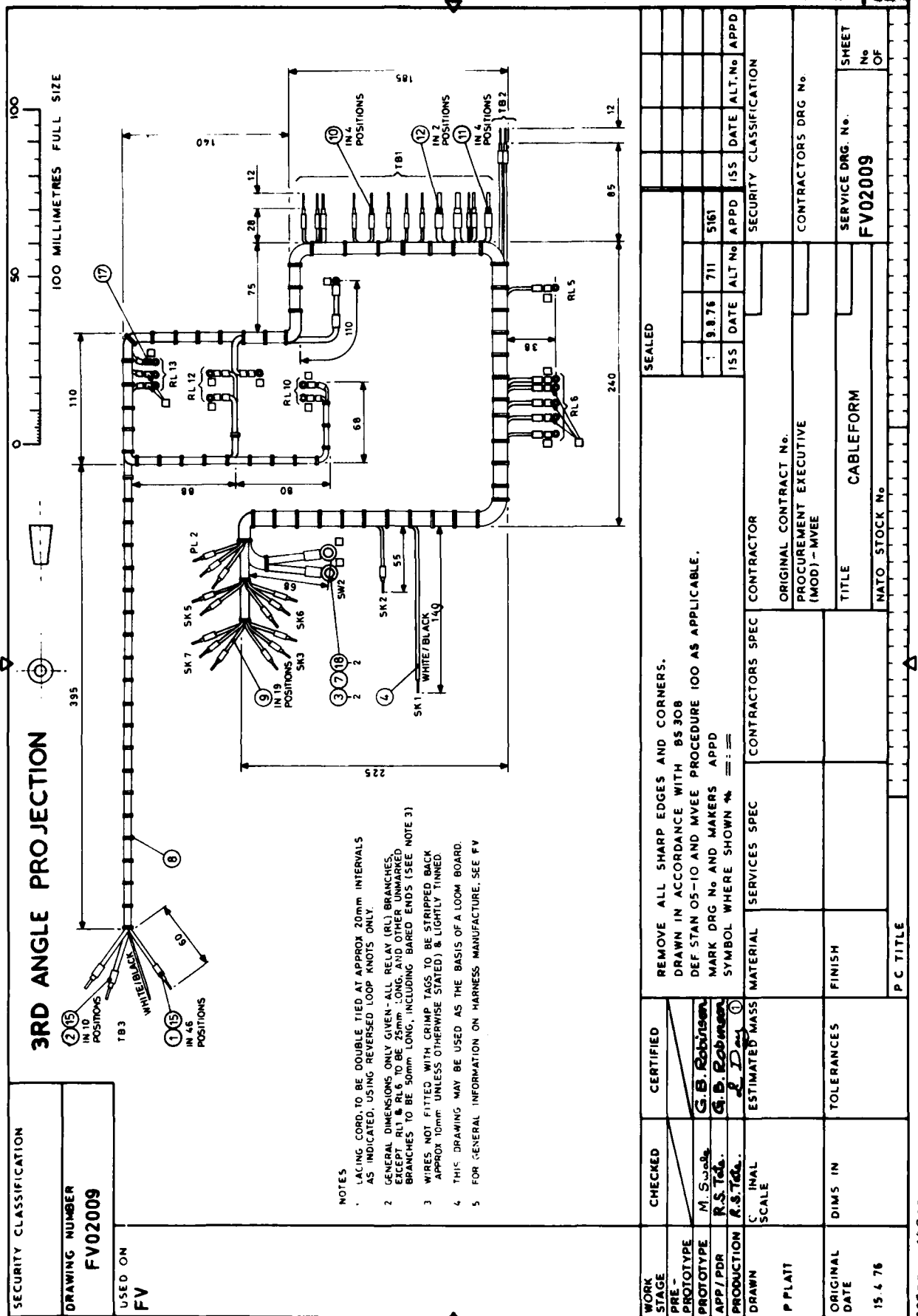
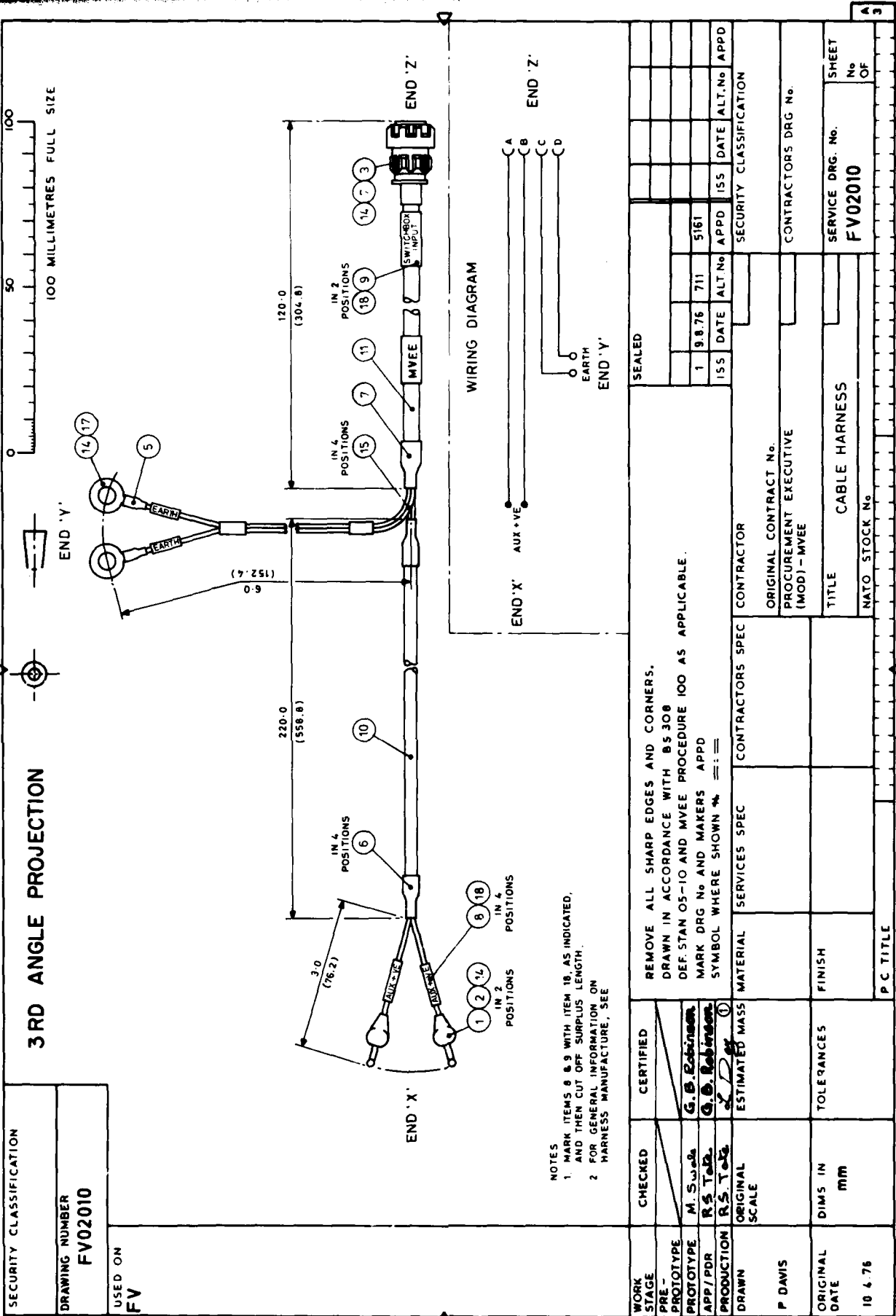


FIG. 12 CABLEFORM DRAWING (illustrating Section 28.2.7)



NOTES  
 1. MARK ITEMS 8 & 9 WITH ITEM 18, AS INDICATED, AND THEN CUT OFF SURPLUS LENGTH.  
 2. FOR GENERAL INFORMATION ON HARNESS MANUFACTURE, SEE

SECURITY CLASSIFICATION							
DRAWING NUMBER	FV02010	REMOVE ALL SHARP EDGES AND CORNERS. DRAWN IN ACCORDANCE WITH BS 308 DEF. STAN 05-10 AND MVEE PROCEDURE 100 AS APPLICABLE.		SEALING			
USED ON	FV	MARK DRG NO AND MAKERS APPD SYMBOL WHERE SHOWN % = = =		DATE		ISS DATE	
		MATERIAL		SERVICES SPEC		CONTRACTORS SPEC	
		ESTIMATED MASS		CONTRACTOR		SECURITY CLASSIFICATION	
		ORIGINAL SCALE		ORIGINAL CONTRACT No.		CONTRACTORS DRG No.	
		DIMENSIONS IN mm		PROCUREMENT EXECUTIVE (MOD) - MVEE			
		TOLERANCES		TITLE		SERVICE DRG. No.	
				CABLE HARNESS		FV02010	
				NATO STOCK No.		SHEET No OF	
				P.C. TITLE		3	

297mm x 420mm

FIG. 13 CABLE HARNESS DRAWING (illustrating Section 28.2.8)



ABBREVIATIONS (SECTION 5.7 REFERS)

- A1. When an abbreviation is specified in this Procedure or any of the associated documents to which it makes reference, that abbreviation and no other shall be used. Terms or words for which no abbreviation is specified may be abbreviated provided that ambiguity is avoided and the meaning is clear.
- A2. Abbreviations should be followed by a full stop ONLY when they form another word eg PRESS. for pressure.
- A3. Unless otherwise specified, all abbreviations on drawings shall be in upper case letters.
- A4. The following list gives approved abbreviations which may be used on MVEE drawings in addition to those given in BS 308 and BS 1991 all of which are mandatory:

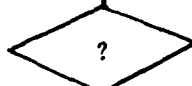
<u>Term</u>	<u>Abbreviation</u>
And	&
Approved	APPD
Approximate	APPROX
Centre of gravity	CG
Circular pitch	CP
Circumference	CIRC
Code Number	CODE NO.
Diametral pitch	DP
Dimension	DIM
Horizontal	HORIZ
Left hand	LH
Manufacture(d)	MANUF
Module	M
Printed Wiring Board	PWB
Pressure	PRESS.
Numerical Control	NC
Reference	REF
Reference number	REF NO.
Right hand	RH
Specific gravity	SP GR
Temperature	TEMP
Thick	THK
Thread	THD
Through	THRO
Tolerance	TOL
Vacuum	VAC
Vertical	VERT

STANDARDS (SECTION 8 APPLIES)

- B1. When selecting Standards or Specifications to be applied in the design of equipment and the way in which these Standards are called up on a drawing it is important to appreciate the considerations which govern whether or not a particular standard or specification is produced in the first place.
- B2. In general a Defence Standard (or its equivalent eg SDM(L)) covering a particular area is only produced when either there is no British Standard covering that area, or there is a British Standard but which is considered by the MOD to be in some way inadequate (eg the range of acceptable alternatives allowed is too wide) for Defence purposes.
- B3. Exactly the same considerations apply to the production of MOD Divisional Standards (of which MVEE Specifications and Procedures are an example) in relation to Defence or British Standards. A MVEE specification will only be produced if there is either no Defence or British publication covering a particular aspect of work, or existing Standards are in some way inadequate for MVEE's particular circumstances.
- B4. Normally a MVFE specification covering an area for which there is no adequate Defence Standard will be put up to the Directorate of Standardization for adoption as a Defence Standard if it is considered to be of wide enough application, and if a Defence Standard is issued the MVEE specification is withdrawn.
- B5. Further background information on Standards is given in Appendix 'Q' to MVEE Procedure 110.
- B6. The procedure for selecting Standards is given in the flow diagram at Figure B1.

SELECTION OF STANDARDS

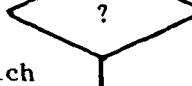
Is there an MVEE Specification covering the material, process, procedure or equipment required?



No

Yes

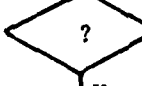
Is there a later Defence Standard which covers the particular requirement (even though it may not have completely superseded the MVEE Specification?)



No

Use MVEE Specification

Is there a Def Stan, SDM(L), SSM(L) or Def Spec List or Guide covering the requirement



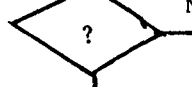
No

Yes

Yes

Use DEF STAN, SDM(L), SSM(L), Def Spec, List or Guide as Appropriate

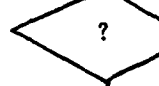
Is there a British Standard covering the requirement?



No

Use BS

Is there a Government Department Specification of a type not mentioned above



No

Yes

Use it

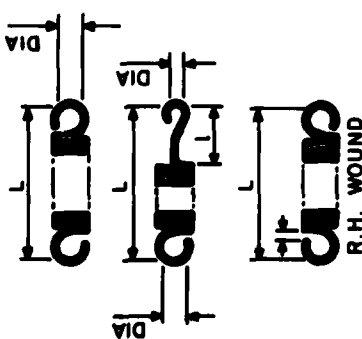
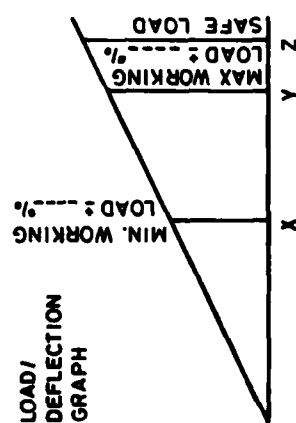
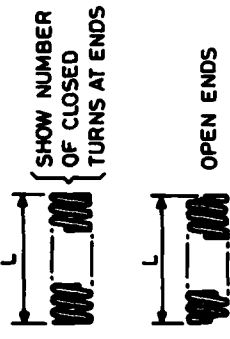
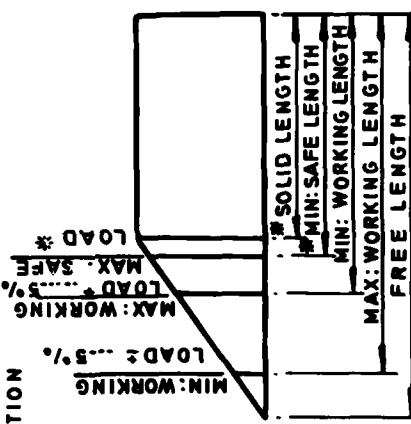
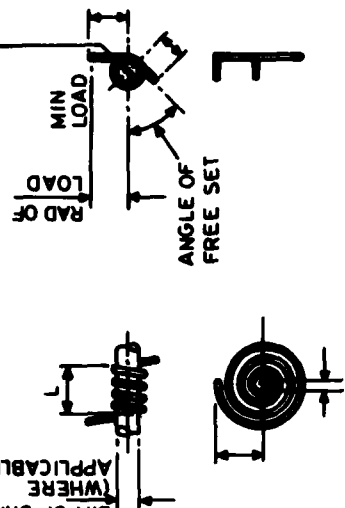
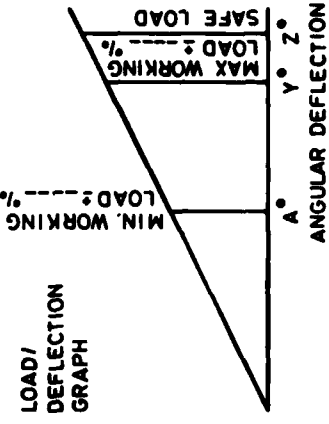
Use Manufacturers Specification if Appropriate

FIGURE B1

METHOD OF GIVING INFORMATION ON DRAWINGS FOR SPRINGS

(Section 13.3 refers)

METHOD OF GIVING INFORMATION ON DRAWINGS FOR SPRINGS

TENSION	COMPRESSION	TORSION
 <p>R.H. WOUND</p> <p>THE NECESSARY INFORMATION SHALL BE SELECTED FROM THE ITEMS BELOW IN ACCORDANCE WITH B S 1726</p> <p>(a) LOAD/ DEFLECTION GRAPH</p>  <p>(b) WIRE DIAMETER, FOR CIRCULAR SECTIONS, OR WIDTH (RADIAL) &amp; HEIGHT (AXIAL) OF CROSS SECTION FOR RECTANGULAR SECTIONS (NOMINAL DIMENSIONS)</p> <p>(c) MEAN COIL DIAMETER</p> <p>(d) FORM OF END COILS REQUIRED</p> <p>(e) TOTAL NUMBER OF COILS END TO END</p> <p>(f) FREE LENGTH</p> <p>(g) MATERIAL</p> <p>(h) FREQUENCY OF OPERATION PER SEC (IF NECESSARY)</p> <p>(i) FINISH</p>	 <p>THE NECESSARY INFORMATION SHALL BE SELECTED FROM THE ITEMS BELOW IN ACCORDANCE WITH B S 1726</p> <p>(a) LOAD/ DEFLECTION GRAPH</p>  <p>* AS APPLICABLE</p> <p>(b) WIRE DIAMETER, FOR CIRCULAR SECTIONS, OR WIDTH (RADIAL) &amp; HEIGHT (AXIAL) OF CROSS SECTION FOR RECTANGULAR SECTIONS (NOMINAL DIMENSIONS)</p> <p>(c) MEAN COIL DIAMETER</p> <p>(d) FORM OF END COILS REQUIRED</p> <p>(e) TOTAL NUMBER OF COILS END TO END</p> <p>(f) FREE LENGTH</p> <p>(g) MATERIAL</p> <p>(h) FREQUENCY OF OPERATION PER SEC (IF NECESSARY)</p> <p>(i) FINISH</p>	 <p>INTERNAL DIA WITH LIMITS</p> <p>MIN LOAD</p> <p>LOAD q</p> <p>ANGLE OF FREE SET</p> <p>THE NECESSARY INFORMATION SHALL BE SELECTED FROM THE ITEMS BELOW IN ACCORDANCE WITH B S 1726</p> <p>(a) LOAD/ DEFLECTION GRAPH</p>  <p>(b) WIRE DIAMETER, FOR CIRCULAR SECTIONS, OR WIDTH (RADIAL) &amp; HEIGHT (AXIAL) OF CROSS SECTION FOR RECTANGULAR SECTIONS (NOMINAL DIMENSIONS)</p> <p>(c) MEAN COIL DIAMETER</p> <p>(d) FORM OF END COILS REQUIRED</p> <p>(e) TOTAL NUMBER OF COILS END TO END</p> <p>(f) FREE LENGTH</p> <p>(g) TOTAL ANGLE OF WORKING DEFLECTION</p> <p>(h) MATERIAL</p> <p>(i) FREQUENCY OF OPERATION PER SEC (IF NECESSARY)</p> <p>(j) FINISH</p>

**GEAR DATA**

(Section 14 refers)

**SPUR AND HELICAL GEAR DATA**

<b>NUMBER OF TEETH</b>	
<b>MODULE</b>	
<b>PRESSURE ANGLE</b>	
<b>HELIX ANGLE</b>	
<b>HAND OF HELIX</b>	
<b>WHOLE DEPTH OF TOOTH</b>	
<b>CORRECTION</b>	
<b>CONSTANT CHORD HEIGHT</b>	
<b>CONSTANT CHORD THICKNESS</b>	
<b>MATING GEAR PART No.</b>	
<b>CENTRES</b>	
<b>COMBINED BACKLASH</b>	
<b>GEARS TO B.S.436, CLASS (as applicable)</b>	

**STRAIGHT & SPIRAL BEVEL GEAR DATA**

<b>NUMBER OF TEETH</b>	
<b>MODULE</b>	
<b>PITCH DIA</b>	
<b>SHAFT ANGLE</b>	
<b>PRESSURE ANGLE</b>	
<b>SPIRAL ANGLE</b>	
<b>HAND OF SPIRAL</b>	
<b>ROOT ANGLE</b>	
<b>ADDENDUM</b>	
<b>WHOLE DEPTH OF TOOTH</b>	
<b>CIRCULAR THICKNESS (THEOR)</b>	
<b>MATING GEAR PART No.</b>	
<b>No. OF TEETH IN MATING GEAR</b>	
<b>CONE DISTANCE</b>	
<b>COMBINED BACKLASH</b>	
<b>GEARS TO B.S.545, CLASS (as applicable)</b>	

ARMOUR MATERIALS (SECTION 18 REFERS)

MATERIAL	SPECIFICATION
<b>ARMOUR STEEL</b>	
Homogeneous machineable plate 15 mm nominal thickness and over	MVEE IT 80F
Armour quality castings	MVEE IT 90G
Homogeneous machineable armour plate 3 to 14 mm nominal thickness	MVEE IT 100E
Floor plates for AFV's	MVEE IT 130B
Armour quality forgings	MVEE IT 140A
<b>ARMOUR ALUMINIUM</b>	
High strength heat treatable aluminium alloy armour plate, nominal thickness 6 to 120 mm	MVEE 1318B
Homogeneous aluminium alloy armour extrusions of nominal section, 18 mm and over thick	MVEE 517
Ingots and weldable non-armour sand castings for use in aluminium alloy armoured vehicles.	MVEE 567

SURFACE TEXTURE (SECTION 21 REFERS)

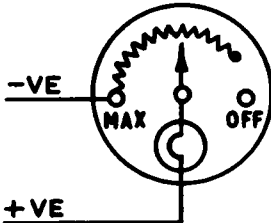







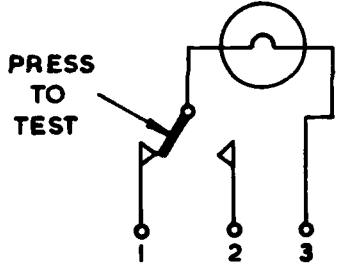


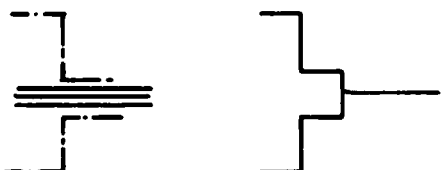
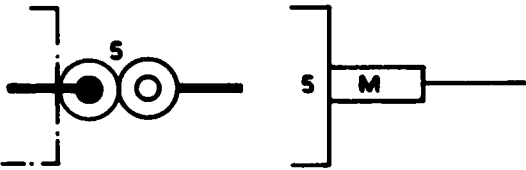
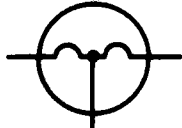
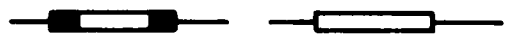
ROUGHNESS No.	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	
CLA Micrometers	0	0.025	0.05	0.1	0.2	0.4	0.8	1.6	3.2	6.3	12.5

PROCESS	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10
Gauge grinding	█									
Diamond turning and boring, lapping polishing and superfinishing	█									
Fine grinding			█							
Honing, fine turning and boring			█							
Gear Shaving				█						
Broaching				█						
Shaping, hobbing planing, milling of gear					█					
Reaming and general grinding					█					
Finish turning, boring milling, planing, slotting shaping						█				
Precision die-casting extrusions etc							█			
Drilling							█			
Rough turning and general machining								█		

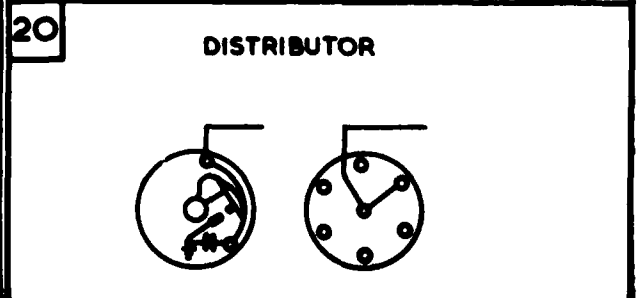
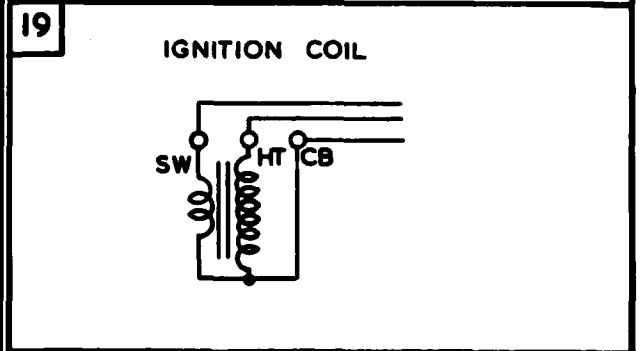
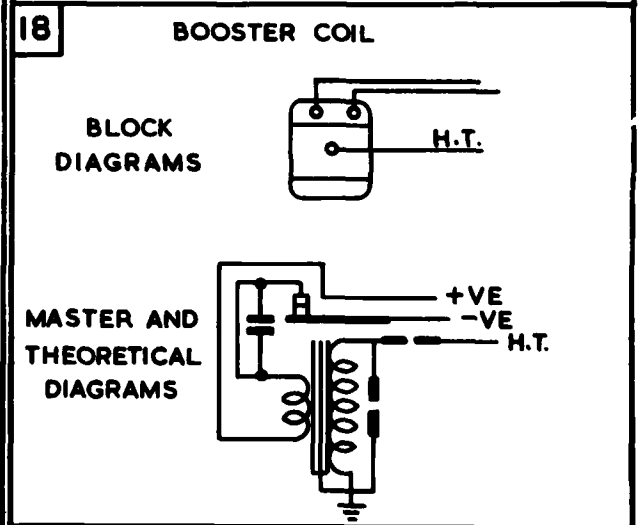
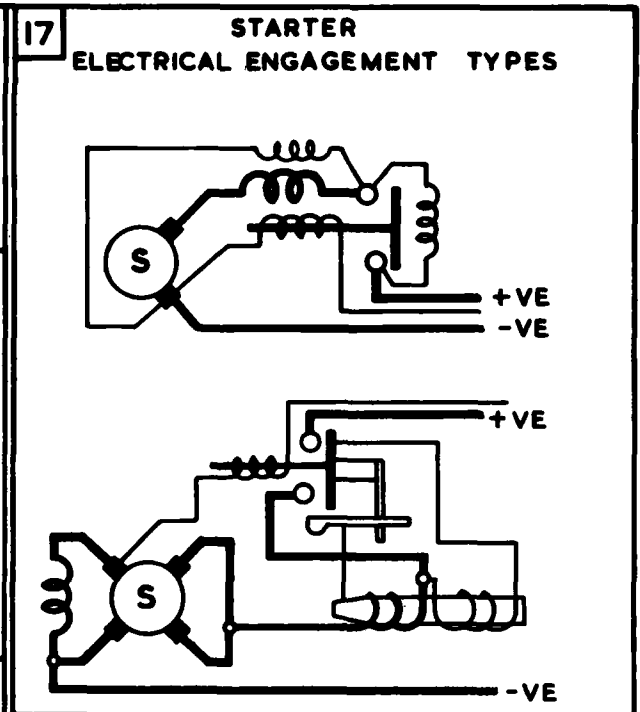
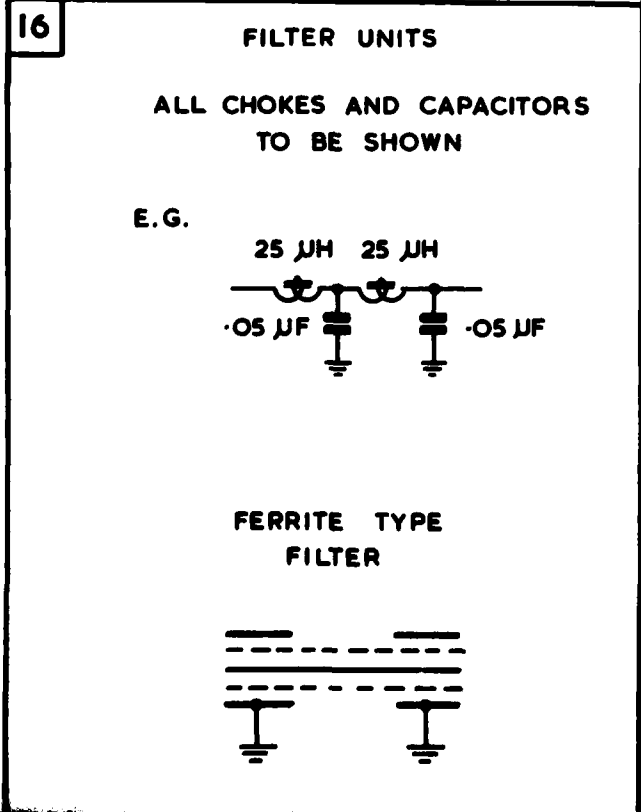
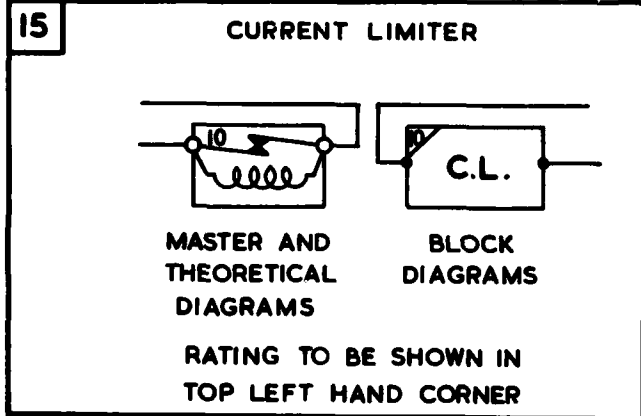
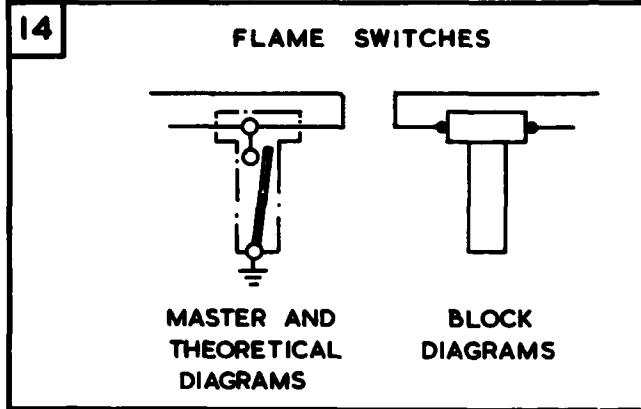
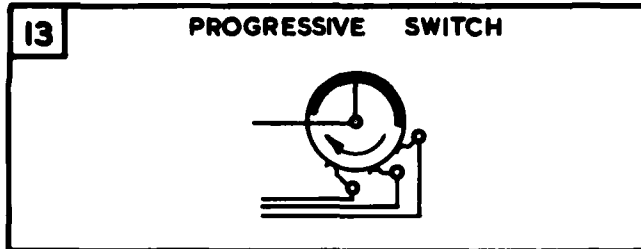
### GRAPHICAL SYMBOLS FOR ELECTRICAL PURPOSES

(Section 28.2.2 refers)

WHEN PREPARING WIRING DIAGRAMS THE GRAPHICAL SYMBOLS SHALL BE IN ACCORDANCE WITH B.S. 108, B.S. 530 AND THE FOLLOWING ADDITIONS, WHICH ARE REQUIRED FOR AUTOMOTIVE ENGINEERING

<p><b>1</b> ALL ASSEMBLIES TO BE SHOWN IN BOLD CONTINUOUS LINES ON BLOCK DIAGRAMS AND AS CHAIN DOT LINES ON MASTER DIAGRAMS</p>	<p><b>7</b> INTERIOR LIGHT COMPLETE WITH DIMMER AND SWITCH</p> 
<p><b>2</b> WHEN ILLUSTRATING CABLES, THE THICKNESS OF THE LINE SHOULD BE COMPARABLE TO THE SIZE OF CONDUCTOR ACTUALLY USED THUS :-</p> <p>UP TO 24 AMPS </p> <p>50 - 75 AMPS </p> <p>100 AMPS UPWARDS </p> <p>MULTICORE UNSCREENED </p> <p>MULTICORE SCREENED </p>	<p><b>8</b> INSPECTION SOCKET</p> 
<p><b>3</b> FLEXIBLE CONDUIT (BRAIDED)</p> 	<p><b>9</b> PRESS TO TEST LAMP</p> 
<p><b>4</b> ARMoured OUTLET</p> 	<p><b>10</b> INTER-VEHICLE SOCKET</p> 
<p><b>5</b> GLAND</p>  <p>MASTER AND THEORETICAL DIAGRAMS</p> <p>BLOCK DIAGRAMS</p>	<p><b>11</b> HEAVY DUTY CONNECTORS</p>  <p>MASTER AND THEORETICAL DIAGRAMS</p> <p>BLOCK DIAGRAMS</p>
<p><b>6</b></p>  <p>DOUBLE FILAMENT LAMP</p>	<p><b>12</b> NIPPLE CONNECTORS</p>  <p>MASTER AND THEORETICAL DIAGRAMS</p> <p>BLOCK DIAGRAMS</p>





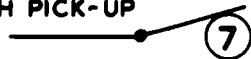
21

ROTARY BASE JUNCTION

BRAID PICK-UP



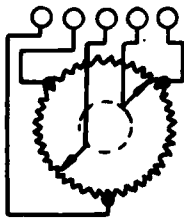
BRUSH PICK-UP



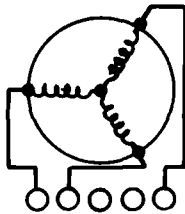
DETAIL EACH RING AS ABOVE  
 AND MARK WITH RING  
 IDENTIFICATION NUMBER  
 BRAID OR BRUSH SHOULD BE  
 SHOWN RIGHT OR LEFT HAND  
 AS ACTUALLY OCCURING

22

DESYNN TYPE TRANSMITTER

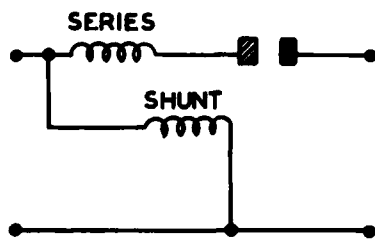


DESYNN TYPE INDICATOR



23

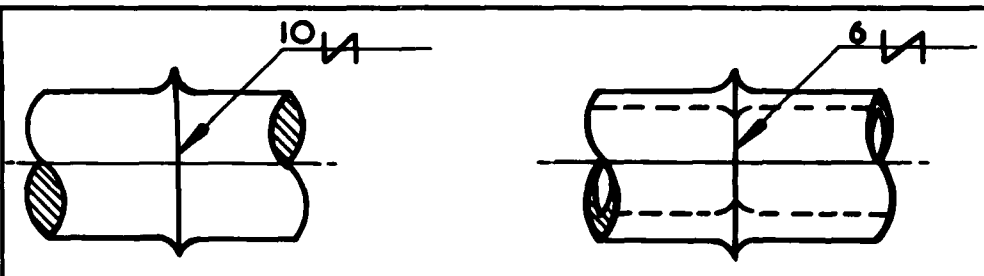
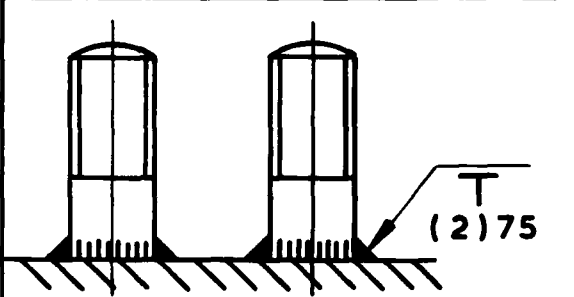
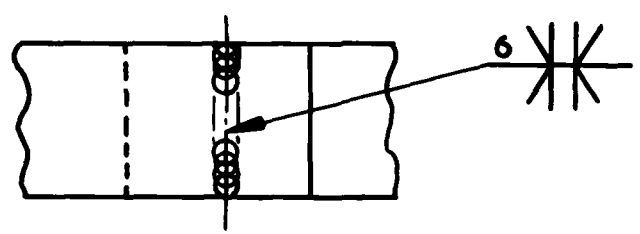
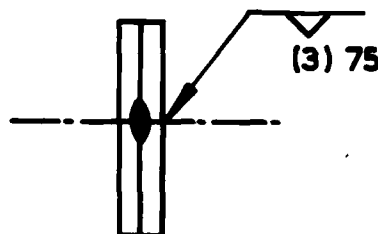
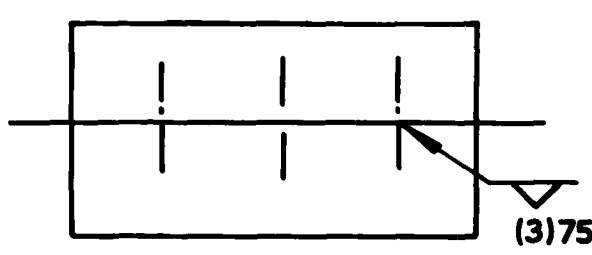
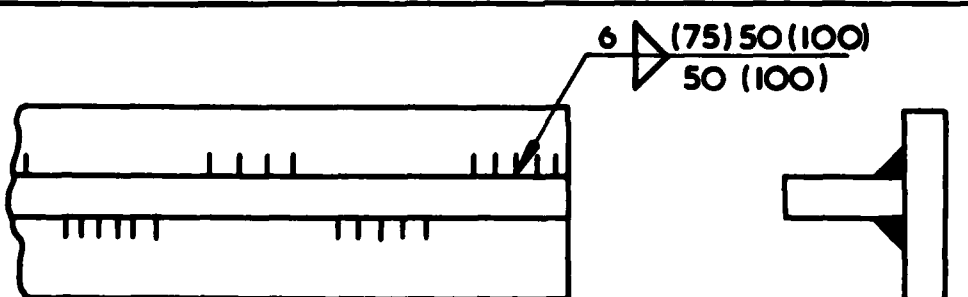
CUT - OUT



## DESIGNATION OF WELDS BY PICTORIAL REPRESENTATION

(Section 32 refers)

	<p><b>GENERAL NOTES</b></p> <p>(i) WELDS ON FAR SIDE TO BE SHOWN AS BROKEN LINES WHERE THIS IS NOT POSSIBLE A SEPARATE NOTE OR VIEW MAY BE ADDED</p> <p>(ii) WELDS IN SECTION OR END ELEVATION TO BE SHOWN IN SOLID BLACK</p> <p>(iii) SPECIAL PREPARATIONS ETC MUST BE SHOWN BY ADDITIONAL VIEWS &amp; / OR DESCRIPTIONS.</p>	
<b>BUTT WELDS</b>	<p>ROD OR BAR <math>\overline{10}</math></p>	<p>TUBE <math>\overline{10}</math></p>
<b>FILLET WELDS</b>		
<b>SPOT WELDS</b>		
<b>SEAM WELDS</b>		

DESIGNATION OF WELDS BY PICTORIAL REPRESENTATION (Section 32 refers)	
FLASH WELDS	 <p>ROD OR BAR</p> <p>TUBE</p>
STUD WELDS	 <p><u>NOTE MAY BE ADDED TO INDICATE METHOD OF WELDING E.G. AUTOMATIC OR ARC ETC.</u></p>
STITCH WELDS	
PROJECTION WELDS	 
INTERMITTENT WELDS	

STANDARD NOTES FOR APPENDING TO  
DRAWINGS OF FABRICATED PARTS (SECTION 32 REFERS)

COMPONENT MATERIAL(S)	METHOD OF WELDING	STANDARD NOTE
Weldable steels, 3 mm thick and over: Armour to armour Armour to non-armour Non-armour to non-armour	Arc Welding	Welding and Gas Cutting to conform to MVEE Spec 1031
Weldable steels under 3 mm thick Non-armour to non-armour	Gas, arc or spot welding  Gas Welding  Spot Welding	May be gas, arc or spot welded in accordance with MVEE Spec 1031  Gas welding to conform to MVEE Spec 1031  Spot welding to conform to MVEE Spec 1031
Weldable steel studs to weldable armour steel and non-armour steel	Automatic Stud Welding	Automatic Stud Welding Equipment and Procedure to conform to MVEE Specs 1031 and 1032
Weldable aluminium, 6 mm thick and over: Armour to armour Armour to non-armour Non-armour to non-armour	MIG Welding	Welding and Cutting to conform to MVEE Spec 1321. Use filler wire NG.....* or approved equivalent, to BS 2901, Part 4
Weldable aluminium under 6 mm thick:	MIG or TIG Welding	Welding and Cutting to conform to MVEE Spec 1321 or BS 3019. Part 1. Use filler wire NG.....* to BS 2901 Part 4

\*Compatible filler wires shall be quoted. Refer to MVEE Memorandum 77013. Further information is available from MVEE, FS/AM(A) Branch, Welding and Fabrication Section.

## INDEX

Abbreviations, permissible use of,	5.7.3
Armour materials, specifications for,	18.2, 19.1, 20.1, 32.1, 33
Bolts,	
holes for	10.2.1, 10.2.2, 10.2.3
requirements for,	10.1.1
Bonding of threaded joints	9.5
Castings,	
aluminium,	19.1
armoured alloy, mfg. process	33
classification of,	19.2
impregnation of,	19.3
inspection requirements	24.1, 24.4
steel	19.1, 19.2
Chains,	
drawings for,	15
selection of,	15
Chain wheels,	
drawings for	15
selection of,	15
Conversion factors for SI units	6
Cotter pins, split, selection of,	10.4
Crack detection of forgings	20.3
Dimensions,	
altered	5.9.4, 5.9.5
angular measurement for,	5.9.3
fabrication parts and welds	32.4.2, 32.4.3, 32.4.4, 32.5.2
preferred numbers and sizes	7
reference	5.9.2
requirements for	5.9.1, 22.3
Drawings, for,	
armour alloy castings, forgings and extrusions	33
castings	19.2, 19.3
chains and chain wheels	15
electrical systems	28.1 - 28.3 incl
fabricated parts	32.1, 32.3, -32.6 incl.
flexible hoses	29.11
forgings	20.3
gears	14.5
hydraulic systems	29.1, 29.3, 29.4, 29.11
lubrication charts	26.5
optical systems	31
pneumatic systems	30
springs	13.3 - 13.5 incl.
templates	17.1, - 17.4 incl
Drawings, combined, authorisation of,	3.4

## INDEX

Drawing,	
preparation, method of,	5.1 - 5.11 incl
sheet size	3.3
system	3.4, 5.1
types	3.1, 3.2
typical	5.1
Drills, sizes for bolt and screw holes	10.2.3
Electrical systems,	
diagrams,	
Block	28.2.3
cableforms	28.2.7
circuit	28.2.4
harness assemblies	28.2.8
interconnection	28.2.6
requirements for	28.2.1
symbols for	28.2.2
wiring	28.2.5
installations,	
drawing requirements	28.1.1, 28.1.4
interconnections	28.1.3
welded fitments for,	28.1.2
printed wiring boards	
related specifications	28.3
Erasers, type of	4
Extrusions, armour alloy, specification for	33
Fabricated parts,	
access to joints	32.4.6
designation of welds	32.4.1
dimensioning	32.4.2 - 32.4.4 incl
	32.5.1, 32.5.2
drawing requirements for,	32.1, 32.3 - 32.6 incl
fillet welds	32.4.4
inspection of	32.4.7
NDT	32.4.7
pictorial representation of welds	32.4.1, 32.4.2
standard notes for drawings	32.4.8
studs for,	32.4.9
symbols	32.4.2
safe working loads	32.1
sequence for welding	32.5.4
aluminium alloys, use of	32.1
welds, special processes	32.2
welded fitments, drawings for	32.3
Flexible hoses, drawing requirements	29.11
Forgings,	
safety of,	20.3
specifications	20.1, 33
tolerances	20.2
grain flow	20.3
Gears,	
addendum modifications	14.4
classes	14.2
data tables	14.5
definitions, notations and symbols	14.3
drawings	14.5
heat treatment	14.6
specifications	14.1

## INDEX

Grain flow, forgings	20.3
Greases and Lubricants	
charts	26.5
guns for,	26.4
nipples and adaptors	26.3
selection of,	26.1, 26.2
Heat treatment,	
specifying	23.1, 23.2
surface hardness values	23.3
Hoses, flexible for hydraulic systems	29.11
Hydraulic systems,	
block diagrams for,	29.3
drawing requirements	29.1, 29.4
flexible hoses for,	29.11
oil tanks	29.6
pipe couplings, locking of,	29.10
sealing rings	29.7, 29.8, 29.9
selection of items	29.5
symbols for,	29.1, 29.2
Impregnation, sealing of castings	19.3
Ingots, aluminium, specification for	19.1
Keys and Keyways, specification for,	11
Lettering	5.3
Lists,	
Combined drawings, for,	3.4
preparation, method of,	5.1
sizes	3.3
types	3.1
typical	5.1
Lines,	
centre	5.2.2
chain	5.2.3, 28.1.2
datum	5.2.2
types	5.2.1
Lubrication, see under 'Greases and Lubricants'	
Mass, statement of,	5.11
Materials,	
aluminium	18.2, 19.1, 20.1
armour	18.2, App E
selection of	18.1, 18.2, 18.3, 18.4
timber	18.3
Mil (miliradian)	5.19.3
Moving parts, definition of limits	5.2.3
NC machining, programming for,	27
Non-destructive testing (NDT)	
terms	24.2
specifications	24.1, 24.2
symbols	24.3
welds, for,	32.4.7



## INDEX

Numbers, preferred	7
Oil tanks, for hydraulic systems	29.6
Optical systems, drawings and diagrams	31
Pencils	4
Pipe couplings, locking of,	29.10
Profiling,	
allowances for flame cutting	25.1
machining	25.1, 25.2
plasma arc	25.2
templates	17.1 - 17.5 incl.
Plywood, specifications	18.3
Pop rivets	10.3
Pneumatic systems	30
Protective finishes,	
allowances for,	22.3
springs, for	22.2
specifications	22.1
Radiographic requirements for castings	24.4
Rivets,	
'Pop'	10.3
specifications	10.3
Roughness, surface, see 'Surface texture'	
'Sacred circle' for turret assembly	5.2.3
Screws,	
requirements for	10.1.1
self-tapping	10.1.2
Screw threads,	
bonding of,	9.5
fits	9.2
identification	9.6
inserts	9.3
pipes, for	9.4
preferred range	9.1
spanner sizes	9.7
symbols	9.6
Sealing of castings	19.3
Sealing rings,	
housings for,	29.7
selection of	29.7, 29.8
rotary lip	29.9
Serrations, see Splines	
Sequences, preferred numbers for	7
Self-tapping screws	10.1.2
Series, preferred numbers for,	7
SI units,	
conversion factors for,	6
guidance in the use of,	6
Space requirements, indication of,	5.2.3
Spanners, designing for use of,	9.7

## INDEX

Splines,	
involute	12
straight sided	12
Split pins, selection of	10.4
Springs,	
design	13.2
drawings	13.3, 13.4
proprietary	13.2
protective finishes	22.2
requirements	13.1
tolerances	13.4, 13.5
Standards,	
application	8.1
hydraulic elements, for,	29.5
references to	8.2
selection of	8.1, 8.3
vehicle components, for	16
Steel,	
armour	18.2
castings, for AFV's	19.1
classification	19.2
forgings	20.1
Studs, screwed	10.1.3
Surface hardness, see 'Heat treatment'	
Surface roughness, see 'Surface Textures'	
Surface Textures,	
processes	21.3
specifications	21.2, 22.3
symbols	21.1
typical values	21.4 and App F
Surround equipment, representation of	5.2.3
Symbols,	
approved	5.7.1
electrical	28.2.2 and App G
gears	14.3
hydraulic	29.1, 29.2
key to,	5.9.2
NDT welds	24.3
surface texture	21.1
welds	32.4.2
screw threads	9.6
Templates,	
drawings	17.1 - 17.4 incl.
flame cutting, for,	25.1
Threads, see 'Screw threads'	
Threaded inserts, selection of,	9.3
Timber, specifications	18.3
Tolerances,	
clearance holes	10.2.1
fitted holes	10.2.2
forgings, for	20.2

MVEE PROCEDURE 101

INDEX

geometrical	5.10.3
indication of	5.10.2
limits and fits	5.10.4
plate profiling, for	25.1, 25.2
practice	5.10.1, 5.10.4
screw threads	9.2
springs	13.4, 13.5
units	5.10.1
Vehicle components, Standards and Specifications	16
Views, drawing, orientation	5.4.2
Welds and welding see 'Fabricated parts'	
Zinc coating for screwed fasteners	10.1