Airworthiness Division

Civil Aviation Authority

Civil Aircraft Inspection Procedures

Part I–Basic

Civil Aviation Authority London

Issue 34

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PART I – BASIC

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CHECK LIST OF REFERENCES

Because the numbers of some Leaflets were changed when CAIP was divided into Parts I and II, cross-references to them in other Leaflets became incorrect. It was not considered practical to re-issue a large number of Leaflets solely for the sake of altering cross-references and information on the change of numbers was therefore included in the List of Leaflets.

Subsequent re-issues of Leaflets have considerably reduced the number of incorrect cross-references and those that remain are shown in the following Table. The Table will be amended as further Leaflets are re-issued with corrected cross-references.

Reference Is Made In	*To*	*Should Now Be To*
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Issue 21

September, 1988

FOREWORD

1 INTRODUCTION Civil Aircraft Inspection Procedures, hereinafter referred to as the 'Inspection Procedures' or 'Leaflets' are published by the Civil Aviation Authority (CAA). The Leaflets give information on a variety of matters concerned with the inspection of civil aircraft during manufacture, overhaul, repair and maintenance. Leaflets which may assist and increase the knowledge of the reader on fundamental subjects such as workshop methods and processes are also included.

1.1 The information is essentially of a general nature which does not include detail on specific types of aircraft and engines, specialised equipment and component parts fitted to civil aircraft. Manuals, published by the appropriate constructors and manufacturers, should be consulted for detailed information.

1.2 The interpretation of the Leaflets and the application of the information is greatly dependent on the background knowledge of the reader. In preparing the Leaflets it is assumed that the reader is familiar with the general engineering practices and working procedures of the civil aircraft industry. Nevertheless, a certain amount of background information is provided where this is considered necessary for the understanding of the text, exceptions being where a Leaflet deals with a specialised subject (e.g. Leaflet **RL/2-1**, ADF Loop Aerials, where it is assumed that the reader will be familiar with radio theory and practice) or where it is known that adequate text books are readily available.

2 LAYOUT The Inspection Procedures are presented as numbered Leaflets contained in two separate Parts:—

(a) **Part I.** This is the Basic Part of the Civil Aircraft Inspection Procedures and contains Leaflets on airworthiness procedures and general aeronautical engineering practices. All Leaflet numbers in the Basic Part are prefixed by the letters **'BL'**. This Part may be used without any reference to Part II.

(b) **Part II.** This Part contains Leaflets on technical matters connected with aircraft, aircraft systems and equipment, engines, propellers and radio. The Leaflets are grouped into sub-sections and each Leaflet number is prefixed by letters according to its particular sub-section. Part II is dependent on Part I for information on administrative procedures and basic engineering practices and references are made in Part II Leaflets to Part I subject matter.

2.1 As a result of the division of CAIP into two Parts, Leaflets which have been re-positioned do not follow the sequence of letters and numbers of the Section as listed, and in some cases the titles of Leaflets do not agree with those printed in the Lists of Leaflets. The information in the right hand columns of the Lists give the actual letters/numbers printed on the Leaflets. The new letters/numbers, and titles where applicable, will be printed on the next issues of the particular Leaflets.

NOTE: Reference to the List of Leaflets should be made in every case for information on the number and title of a Leaflet and its position in the volume.

3 AMENDMENTS Leaflets are reviewed periodically to ensure that the information contained in them remains valid. Leaflets which require amendment are re-issued under

a raised issue number and marginal lines are used to indicate material differences between issues. Those Leaflets which are reviewed and found not to require amendment are retained, and a statement indicating the date of the review is added against the entry in the appropriate List of Leaflets.

4 PUBLICATION AND DISTRIBUTION Subscribers may hold Part I only *or* both Parts I and II. Part II is not issued separately because of the essential cross-references to procedures in Part I.

4.1 Further copies of CAIP may be obtained from the CAA, Printing and Publication Services, Greville House, 37 Gratton Road, Cheltenham, Glos. GL50 2BN. Details of all Airworthiness Publications published by the CAA together with prices, subscription rates and the address to which applications should be made, are contained in Airworthiness Notice No. 6. Unless other arrangements have been made, a remittance should accompany the order.

5 ENQUIRIES Any enquiries regarding the technical content of the Leaflets should be addressed to the Civil Aviation Authority, Safety Regulation Group, Aviation House, Gatwick Airport, West Sussex RH6 0YR. In countries other than the United Kingdom, the airworthiness authority of the country concerned should be approached in all cases where it is recommended in the Leaflets that the CAA should be consulted. References in CAIP Leaflets to Airworthiness Division, Brabazon House, Redhill, Surrey RH1 1SQ, should be taken as reference to the above address.

6 COPYRIGHT Civil Aircraft Inspection Procedures are copyright and may not be reproduced without permission of the CAA.

BL/1-1

Issue 4

June, 1983

BASIC AIRWORTHINESS PROCEDURES

APPROVAL OF ORGANISATIONS

1 INTRODUCTION This Leaflet gives general guidance on the procedure to be followed by organisations seeking CAA Airworthiness Division approval for the design, manufacture, maintenance and overhaul of civil aircraft, engines, propellers and aircraft equipment and related activities.

1.1 In order to ensure adequate monitoring of airworthiness, the Airworthiness Division of the CAA undertakes direct survey work, when it considers this necessary, and approves suitable organisations for the design, manufacture, maintenance and overhaul of complete aircraft, engines, propellers and equipment. The approval, when granted, permits the organisation to certify work in accordance with British Civil Airworthiness Requirements (BCAR) as specified in the Schedule of Approval, making it normally unnecessary for CAA Surveyors to be involved with detailed and particular surveillance, only performing routine monitoring by sample surveillance.

1.2 Organisations are divided into a number of groups for the purposes of CAA approval, and these are described in BCAR, Section A, Sub-Section A8, which also contains the requirements prescribed for the grant, maintenance and variation of approval. Various aspects of approval procedures are covered in Leaflets **BL/1-5**, **BL/1-6**, **BL/1-7**, **BL/1-8** and **BL/1-9**. A selection of documents on approval matters is published by the CAA in a publication entitled "CAA Airworthiness Approvals Compendium" which is supplied to approved Organisations and may also be purchased from the CAA.

2 ELIGIBILITY FOR APPROVAL Any organisation based in the United Kingdom or overseas may make application for CAA approval provided their activities are classified as being within any of the groups (see paragraph 1.2) under which approval may be granted. However, applications for approval are not normally considered from organisations in the following countries:

(a) United States of America, where the CAA and the Federal Aviation Administration collaborate under arrangements covered by an exchange of notes between Governments. Excluded from this are metallic raw material manufacturers who may apply for CAA approval.

(b) France, where CAA Airworthiness Notice No. 34 procedure between authorities applies.

3 APPLICATION AND INVESTIGATION PROCEDURES Application for approval in the first instance is made by letter to the CAA Airworthiness Division, Brabazon House, Redhill, Surrey, for the attention of the Aircraft Maintenance and Approvals Section. In some cases

there may be a need for a preliminary investigation by a local Area Surveyor to verify that the applicant's proposed undertakings for aviation come within the approval groups referred to in paragraph 1.2. The applicant is then sent the following documents: Form AD457, a copy of the CAA Scheme of Charges, a copy of the BCAR Sub-Section A8 Chapter(s) relevant to the application and also the CAA Publications List.

3.1 The application form requires information on the group(s) referred to in paragraph 1.2, under which approval is sought, reference to other approvals already held, and a summary of the applicant's present and proposed undertakings for the aircraft industry. The application form must be signed by the organisation's Chief Executive, and be accompanied by payment of the charge for an application for approval as laid down in the current CAA Scheme of Charges before it is acceptable to the CAA (CAA Official Record Series 5).

3.2 On receipt of the completed Form AD457 and the required fee referred to in paragraph 3.1, arrangements are made for a CAA Surveyor or Surveyors to visit the organisation in order to discuss the application and investigate in detail the staffing procedures and facilities. Additionally, the initial visit enables the CAA to establish liaison with the Chief Executive and other senior management and technical staff and provide guidance on the implementation of CAA requirements applicable to their particular case.

3.3 In most cases the applicant is required to produce an Exposition of the organisation which has to be agreed by the CAA. Details of the basic requirements for the Exposition are to be found in BCAR, Section A, Chapter A8-1, Appendix.

3.4 The scope of the work to be undertaken by the organisation for which certification may be made in respect of compliance with BCAR is agreed with the applicant and defined in the Schedule of Approval which forms part of the approval document. This document consists of a number of Forms AD410, Air Navigation Order Approval, and there will be variations to these forms depending on the approval group(s) being granted.

3.5 The Organisation is allocated a CAA Organisation approval reference number. This will be used for identification purposes in CAA publications and letters and any other documents issued by the Organisation which are related to approval matters.

3.6 A charge is payable annually to the CAA for each approval, which includes a charge for each additional site of the Organisation required to be visited. For details of the annual charge applicable to the particular approval group, reference should be made to the CAA Scheme of Charges as in paragraph 3.1.

4 SUPERVISION OF APPROVAL After initial approval the Organisation is normally audited by the CAA once each year. The frequency of visits may be increased where discrepancies are found. Where large Organisations are concerned a team audit may be applied consisting of specialist Surveyors and the Area Surveyor. Some large Organisations may also have their approval audit arranged to coincide with the Surveyor's other work in the Organisation during the year.

4.1 The CAA Surveyor makes a written report after each audit. All discrepancies recorded will be discussed with the Organisation and where necessary a letter will be sent concerning the audit results and requesting corrective action. All reports are forwarded to the CAA Airworthiness Division, Redhill, for any required action and retention.

4.2 The CAA may revoke, suspend or vary approval granted to an Organisation in accordance with Article 59 of the Air Navigation Order 1980, as amended, if the CAA thinks sufficient grounds are shown for doing so.

5 EXTENSION OF APPROVAL If, after the initial grant of CAA approval, an Organisation wishes to obtain approval for a variation, involving additional activities in their existing approval group(s), new group(s) or additional premises, an application should be made to the CAA Airworthiness Division, Redhill.

5.1 After this application has been received the CAA will make arrangements for a visit to the Organisation by the Area Surveyor and/or specialist Surveyors to investigate staffing, facilities and draft Exposition amendments in relation to the extension of approval required. When a satisfactory recommendation has been received from the Surveyor(s) concerned a revised Schedule of Approval page (Form AD410E) will be agreed and issued to the applicant. The cost of the variation will be charged to the Organisation in accordance with the CAA Scheme of Charges referred to in paragraph 3.1.

6 GENERAL The CAA publication entitled "CAA Approved Organisations" (see CAA Airworthiness Notice No. 6) contains the names, addresses and approval reference numbers of all Organisations approved under the Air Navigation Order, and is kept up to date by the issue of new or replacement pages. The publication is available to all CAA approved Organisations and other interested persons.

BL/1-3

Issue 1.

18th May, 1978.

AIRWORTHINESS PROCEDURES

AERONAUTICAL ENGINEERING CERTIFICATES AND LICENCES

1 INTRODUCTION The Air Navigation Order (ANO) delegates to the Civil Aviation Authority (CAA) the responsibility for examining engineers for the granting and extension of Aircraft Maintenance Engineers' Licences. The CAA is also responsible for the recognition, approval, and supervision of maintenance organizations and of schools and training establishments engaged in the instruction of prospective aircraft engineers. The minimum requirements with regard to the knowledge and experience considered, by the CAA, to be necessary for the granting or renewal of the various Aircraft Maintenance Engineers' Licences are prescribed in British Civil Airworthiness Requirements, Section L, and those for the award of Aeronautical Engineering Certificates are prescribed in a CAA publication entitled "Aeronautical Engineering Certificate—Syllabus of Examinations". Further information on these subjects is published in Airworthiness Notices Nos. 2, 3, 10, 31, 46 and 84. This Leaflet explains the purposes of the certificates and licences issued by the CAA, the subjects with which a prospective holder should be conversant, and the procedures which should be adopted when making an application for an examination.

2 AERONAUTICAL ENGINEERING CERTIFICATES The Aeronautical Engineering Certificate (AEC) is a technical qualification, and is proof that the holder has attained an acceptable level of knowledge in a particular subject, and has some practical experience in aeronautical engineering. A certificate qualifies the holder for exemption from the "common syllabus" when taking examinations for related AECs, and also partial exemption from the written examinations for the appropriate category of Aircraft Maintenance Engineer's Licence. The AEC is recognized by the CAA as a qualification in the practical aspects of aeronautical engineering, and as one qualification leading to appointment as an inspector, but it does not confer certification privileges (i.e. the signing of Certificates of Compliance and Certificates of Maintenance) upon the holder.

2.1 The various AECs which may be obtained cover a wide variety of aeronautical engineering subjects, and are numbered from 1 to 12. The complete list of AECs is shown in Airworthiness Notice No. 31, and it should be noted that some subjects may only be applied for after passing the examinations for a related subject. In addition, partial passes may be accepted in certain subjects, but only in respect of subjects covered by the preceding AEC number; those subjects which have been failed can then be re-taken separately at a later date.

2.2 A prescribed period of engineering experience is necessary before a person may apply for an AEC examination. The syllabus for each examination is outlined in the CAA publication "Aeronautical Engineering Certificates—Syllabus of Examinations", and this should be obtained by prospective examinees; a list of essential and recommended books and publications is also included. The experience required by an

applicant should have been obtained in the aviation industry, and must be in a field appropriate to the AEC for which application is being made. Three years' suitable experience is normally required, but candidates who apply for certain AECs, and have successfully completed a two-year Aircraft Maintenance Engineers' Licence course approved by the CAA, may be accepted. In cases where an applicant already holds an AEC in a subject closely allied to the one for which application is being made, the additional experience requirements may be reduced to 1½ years. In all cases the candidate's experience must be confirmed to the satisfaction of the CAA.

2.3 Application for an examination should be made on Form AD 370, which should be fully completed and countersigned, and returned to the CAA, Airworthiness Division, together with the appropriate fee; an example of a completed Form AD 370 is shown in Appendix I. The application will then be processed, and, if it is acceptable, arrangements will be made for the candidate to sit the examination. If the candidate's experience is not considered to be satisfactory, then he will be advised as to his best course of action. Examinations are held on CAA premises, or at an agreed venue such as a college or training school.

2.4 All AEC examinations are of the written multi-choice type; there are no essay questions and no oral examinations are conducted. Each question is in the form of an incomplete statement, and three suggested words or phrases to complete the statement are printed below each question. Only one of these suggestions is correct, and in conjunction with the question, forms a statement which is accurate in all respects; the other two suggestions are incorrect in some way, and are not merely less desirable than the correct one. The answer sheet has provision for 200 questions, and three boxes (marked A, B and C) are placed beside each question number. The candidate must select the answer he thinks is correct, and place a tick in the appropriate box on the answer paper; e.g. if he thinks answer 'A' is correct, then he must place a tick in box 'A' against that question number.

2.4.1 The block, or blocks, of questions which must be attempted depend on which AEC is being taken and whether the candidate already holds an AEC. The questions which do not have to be answered will have been crossed off by the CAA before the answer sheet is handed to the candidate.

2.4.2 In marking the answer sheet, one mark is given for a correct answer and half a mark is deducted for an incorrect answer. If a candidate is not sure of the answer to a question, therefore, he must draw a line through all three boxes rather than make a guess. After marking of papers, the results are adjusted to a percentage.

3 AIRCRAFT MAINTENANCE ENGINEERS' LICENCES New procedures for licensing aircraft maintenance engineers were introduced by Issue 7 of BCAR, Section L, and included a two-part Licence. A "Licence Without Type Rating" does not confer certification privileges upon the holder, but does show that a satisfactory level of basic knowledge and experience has been attained in a particular technology; a "Type Rating" enables the holder to make certification in accordance with the ANO. Licences generally relate to a particular aeroplane/engine or system, or to a group of aeroplanes/engines or systems of similar complexity; Group Type Ratings have been introduced to enable experienced engineers to cover a wider field of maintenance work. Type Ratings are not granted for those aircraft listed in Airworthiness Notice No. 10 which are maintained under the "Approval for Maintenance" procedure of BCAR, Section A, Chapter A8—13; these aircraft are maintained by certain firms which have the relevant CAA Approval granted to them. The possession of an appropriate Licence Without Type Rating or a Type Rating as specified in BCAR, Chapter A8—13, is, in general, a prerequisite to the granting

of inspection approval to individuals under this scheme. The examination syllabi and practical experience required for all licences are covered in BCAR, Section L, the various categories and ratings are listed in Airworthiness Notice No. 10, and certification responsibilities are detailed in Airworthiness Notice No. 3. The remainder of this Leaflet deals with the categories of licences, the application procedures, the examinations, and particular licensing regulations and requirements.

NOTE: The privileges, responsibilities, and limitations applicable to a particular Type Rating must be ascertained by careful study of Airworthiness Notices Nos. 3 and 10.

3.1 Categories of Licence

3.1.1 **Category "A"—Aeroplanes.** This category covers the aeroplane structure and associated airframe systems. A Licence Without Type Rating may be granted for Wooden and Composite Aeroplanes, for Unpressurized Metal Aeroplanes or for Pressurized Metal Aeroplanes, and may be extended in any order to cover all three technologies. The Licence may be extended to include Type Ratings in accordance with paragraph 5 of Airworthiness Notice No. 10. An "A" Licence may also confer limited certification privileges which are normally the responsibility of certain "X" Licence holders; the limitations are detailed in Airworthiness Notice No. 3.

3.1.2 **Category "C"—Engines.** This category is concerned with all types of aeroplane engines. A Licence Without Type Rating may be granted for Unsupercharged Piston Engines, Supercharged Piston Engines, Jet-turbine Engines or Propeller-turbine Engines, and may be extended in any order to cover all four technologies. The Licence may also be extended to include Type Ratings in accordance with paragraph 6 of Airworthiness Notice No. 10. A "C" Licence may also confer limited certification privileges which are normally the responsibility of certain "X" Licence holders; the limitations are detailed in Airworthiness Notice No. 3.

3.1.3 **Categories "A" and "C"—Rotorcraft.** Category "A" and Category "C" Without Type Rating and Type Rated Licences for rotorcraft are only granted in respect of both airframe and engine together. A Licence Without Type Rating may be granted for Piston Engined Rotorcraft or Turbine Engined Rotorcraft, and may be extended in any order to cover both technologies. The Licence may also be extended to include Type Ratings in accordance with paragraph 7 of Airworthiness Notice No. 10. In all cases the certification privileges of the Type Rating in Category "C" is applicable only to the engines fitted in the rotorcraft specified in the Type Rating in Category "A".

3.1.4 **Categories "B"—Aeroplanes and "B"—Rotorcraft.** A Licence Without Type Rating is not granted in Category "B". A Category "A" Licence (or, for rotorcraft, a Category "A" and "C" Licence) with the appropriate Type Rating may be extended to include a Type Rating in Category "B" in accordance with paragraphs 5 or 7 of Airworthiness Notice No. 10. Category "B" Licences are not granted in respect of certain aircraft, and reference is made to this in the above Notice.

3.1.5 **Category "D"—Engines.** A Licence Without Type Rating is not granted in Category "D". A Type Rated Licence may be granted in accordance with paragraph 6 of Airworthiness Notice No. 10. Category "D" Licences are not granted in respect of certain engines, and reference is made to these in the above Notice.

3.1.6 **Category "X"—Electrical.** A Licence Without Type Rating may be granted for Direct Current Power, and may be extended to include Alternating Current Power. It may also be extended to include Type Ratings in accordance with paragraph 9 of Airworthiness Notice No. 10.

3.1.7 **Category "X"—Instruments.** A Licence Without Type Rating may be granted for General Aircraft Instruments, and may be extended, in the order stated, to cover Flight Path and Air Data Computation and Inertial Navigation. The Licence may also be extended to include Type Ratings in accordance with paragraph 8 of Airworthiness Notice No. 10. Type Ratings may be endorsed to cover Inertial Navigation provided this subject is included in the Licence Without Type Rating.

3.1.8 **Category "X"—Compasses.** A Licence Without Type Rating is not granted for Direct Reading Compasses, but a Type Rated Licence for Direct Reading Compasses, as specified in paragraph 15.1 of Airworthiness Notice No. 10, may be granted and extended to include a Licence Without Type Rating for Remote Reading Compasses. This Licence Without Type Rating may be extended to include Type Ratings for Remote Reading Compasses in accordance with paragraph 15.2 of Airworthiness Notice No. 10.

3.1.9 **Category "X"—Automatic-pilots.** A Licence Without Type Rating may be granted for Non-radio-coupled Automatic-pilots (Aeroplanes), and may be extended to include Radio-coupled Automatic-pilots (Aeroplanes). A Licence Without Type Rating may also be granted for Non-radio-coupled Automatic-pilots (Rotorcraft). The Licence Without Type Rating may also be extended to include Type Ratings in accordance with paragraph 13 of Airworthiness Notice No. 10.

3.1.10 **Multi-category "X".** There is no Licence Without Type Rating in this category, but a Licence Without Type Rating valid for Flight Path and Air Data Computation, Radio-coupled Automatic-pilots, and Remote Reading Compasses, may be extended to include Type Ratings in accordance with paragraph 10 of Airworthiness Notice No. 10. In certain circumstances the possession of a Category "X"—Compasses Licence is not necessary (see BCAR, Section L, Chapter **L1-12**).

3.1.11 **Category "R"—Radio.** A Licence Without Type Rating may be granted for Radio Communication and may be extended, in the order stated, to cover Radio Navigation, or Pulse and FM. It may also be extended to include Type Ratings in accordance with paragraph 12 of Airworthiness Notice No. 10.

3.1.12 **GPWS Endorsements.** Holders of certain Type Rated Licences in Category "X" or Category "R" may apply for a Ground Proximity Warning System (GPWS) endorsement to obtain certification privileges in respect of that equipment, including any associated equipment installed specifically to generate barometric height rate signals for the GPWS (refer also to Airworthiness Notice No. 84).

(a) The Type Rated Licences which may be endorsed for GPWS are as follows:—

(i) Category "X"—Instruments (paragraphs 8.1, 8.2, 8.3 or 8.4 of Airworthiness Notice No. 10).

(ii) Category "X"—Electrical (paragraphs 9.1, 9.2, 9.3 or 9.4 of Airworthiness Notice No. 10).

(iii) Multi-category "X" (any sub-paragraphs of paragraph 10 of Airworthiness Notice No. 10).

(iv) Category "R"—Radio (paragraph 12.2 of Airworthiness Notice No. 10).

3.2 **Validity of Licences**

3.2.1 Licences are valid for a period of two years, and will normally be renewed without examination provided that the Licence holder has been engaged for periods totalling at least six months on work affording experience comparable with that required for the grant of a Licence.

3.2.2 A Licence which has lapsed for less than two years may be considered for renewal without examination provided that the requirements of paragraph 3.2.1 are met, except that the qualifying period will be the 24 months preceding the date of receipt of the renewal application.

3.2.3 A Licence which has lapsed for more than two years will not be renewed without examination of the holder.

4 LICENCE APPLICATION PROCEDURE To be eligible for the grant of an Aircraft Maintenance Engineer's Licence, an applicant must be at least 21 years of age, must be able to read, write and converse in the English language, have obtained the necessary experience and have completed the examination requirements specified in the appropriate Chapter of BCAR, Section L. In the case of an application for a Type Rating for certain large or complex aircraft, engines or systems, the applicant must also have satisfactorily completed an appropriate course recognized by the CAA (see BCAR, Section L). Applications for the grant, extension, or renewal of Licences should be made as outlined in paragraphs 4.1 to 4.4, and care should be taken when completing any of the forms mentioned, since attention to detail will greatly assist CAA staff. Applicants who have attended and passed a CAA approved course at certain colleges may have the prescribed experience reduced (see BCAR, Section L).

4.1 **Grant or Extension of Licence Without Type Rating.** Initial application should be made on Form AD 300 (an example of a completed form is shown in Appendix II). If the time and experience detailed on this application are considered to be satisfactory, the applicant will be requested to complete a final application form (AD 302), and this should then be returned, with the appropriate charge, to the CAA, Airworthiness Division. An example of a completed Form AD 302 is shown in Appendix III. Following receipt of the Form AD 302 and the appropriate charge, arrangements will be made for examination of the candidate in the appropriate subjects.

4.2 **Extension of a Licence to Include a Type Rating.** The application procedure follows that outlined in paragraph 4.1 except that the application must be accompanied by a "Schedule of Inspection Work" (Form AD 301) applicable to the appropriate aircraft, engine or system (an example of a completed form is shown in Appendix IV). This form should show that the applicant's experience covers a representative selection of the relevant subjects in the syllabus appropriate to the Type Rating for which application is being made, and should give details of practical inspection experience obtained during the preceding three years; the amount of detail should be related to the construction and complexity of the aircraft, engine or system concerned. Account should also be taken of maintenance procedures, defect rectification, and other relevant technical matters, and the duties and responsibilities which devolve on the holder of a Licence. The Schedule of Inspection Work should contain a representative selection of items of work carried out or participated in, and should be itemized in accordance with the subheadings outlined in BCAR, Section L, Chapter **L1-2** Appendix, as appropriate to the category applied for.

4.2.1 Items in the Schedule of Inspection Work must show the date, the registration letters of the aircraft to which they apply, and must be confirmed by the person in charge or by a person in a similar authoritative position. Certain questions in the oral examination may relate directly to the work outlined in the Schedule of Inspection Work.

NOTES: (1) An applicant for a Type Rated Licence must hold or have applied for, the appropriate Licence Without Type Rating.

(2) Great emphasis is placed on practical experience, therefore a detailed and comprehensive Schedule of Inspection Work will reduce the possibility of an application being rejected through lack of significant experience.

4.3 **Foreign Licences.** Applications from holders of valid Aircraft Maintenance Engineers' Licences issued by countries other than the United Kingdom (UK), which are members of the International Civil Aviation Organization (ICAO) may, in certain circumstances, be considered for the grant of a UK Licence or the extension of a UK Licence, on the strength of the endorsements contained in the foreign Licence.

4.3.1 Holders of these foreign Licences who wish to be considered for the grant or extension of a UK Licence, should make application on Form AD 300, outlining their total experience in order that this may be considered against the requirements of BCAR, Section L.

(a) Evidence must also be submitted that the examinations in respect of the endorsements were carried out by the CAA, and the actual Licence (which must be valid) must be submitted for inspection.

4.3.2 Applicants meeting these conditions, will be required to attend and pass an oral examination on UK Regulations and Mandatory Modifications as applicable to the endorsements, and to pay the appropriate charge.

4.3.3 Holders of valid UK Licences meeting the requirements outlined in paragraph 4.3.1, will be requested to forward their UK Licence and the appropriate charge, in order that the endorsement may be transferred.

4.3.4 Holders of valid Licences issued by countries which are members of ICAO, who are unable to meet the requirements outlined in paragraph 4.3.1 (a) may have their application considered in accordance with the requirements of BCAR, Section L, for the grant of a Licence. Such a Licence may give partial exemption in respect of the written examination.

4.4 **Service Applicants.** Applications from members of the Royal Navy, Army and Royal Air Force, who are serving in trades related to the maintenance of aircraft and who have the necessary experience, may be given partial exemption from parts of the written examinations in accordance with the appropriate Defence Council Instruction (DCI). This information should be available from Service Resettlement Officers.

4.4.1 While still serving in the Armed Forces, an applicant should ensure that his Record of Service (RAF Form 6859 or its equivalent) is kept up to date, and that entries of work or courses undertaken are accurate, detailed, and properly confirmed by his Engineer Officer. This record will serve as proof of the experience gained during military service, and may satisfy the experience requirements for the grant of an Aircraft Maintenance Engineer's Licence (With or Without Type Rating).

4.4.2 Preliminary application should be made on Form AD 300, enclosing the Service Record Book, together with any Schedules of Work (required only if a Type Rating is being applied for). The application will be considered and, if acceptable, any exemptions from the written examination will be noted. The applicant will be sent a Form AD 302 for completion and return, together with the appropriate charge.

5 EXAMINATIONS Examinations are based on the syllabi outlined in BCAR, Section L, for the various categories of Licence. Exemptions may be granted, in certain circumstances, from part of the written examination (for example, holders of AECs, certain SLAET and City and Guilds Certificates, and members of the Armed Forces may be exempted from part of the multi-choice question paper, but not from the questions on Regulations).

5.1 The examination for a Licence Without Type Rating will normally include a multi-choice paper and an essay paper, in which candidates must reach a satisfactory standard before being advised that they are required to attend for oral examination at a suitable CAA office. Whereas the examinations for the sub-divisions of Categories "A" and "C" are not required to be taken progressively, as are those of Categories "X" and "R", every effort is made to ensure that, where the technologies overlap, a candidate is not examined twice on the same subjects.

5.2 Examinations for a Type Rating will normally be by oral examination only. When an applicant has completed and passed his written examinations and is required for oral examinations for both a Licence Without Type Rating and a Type Rating, the examinations may be arranged together.

5.3 All written examinations for a particular Licence may, where practical, be taken on the same day, but the oral examinations depend on the candidate having passed the written papers, and thus are taken after the written papers have been marked.

5.3.1 There is no prescribed limit to the number of times a candidate may attend for examinations for a particular category of Licence. However, after the failure of an examination, re-application will not be accepted until further studies have been carried out and/or additional practical experience has been completed. The minimum acceptable periods before re-application would normally be:—

(a) Licence Without Type Rating, six weeks from the date of notification of the examination failure.

(b) Type Rating, three months from the date of notification of the examination failure.

5.3.2 Applicants for Category "A" and "C"—Rotorcraft Licences who fail to reach the required standard in one category only, may be credited with a partial pass for a limited period. If the failure is in the written examination this period is six months, but if the failure is in the oral examination it is 12 months.

5.3.3 Candidates who have applied for both the Licence Without Type Rating and the Type Rating, and have failed the Licence Without Type Rating oral examination but passed the Type Rating oral examination, may have the Type Rating credited to them for a period of 12 months, but the number of re-examinations in the failed subject will be limited.

NOTE: Failure of a written examination, by a candidate applying for both the Licence Without Type Rating and the Type Rating, will entail a refund being granted for the Type Rating part of the examination.

5.3.4 Candidates who have failed an examination and wish to be re-examined, should complete and submit a Form AD 300. If the failure was in a Type Rating examination, an additional Schedule of Inspection Work must also be completed and submitted.

6 RENEWAL OF LICENCES Approximately one month before the expiry of a Licence, the CAA will forward a Form AD 302 to the holder, who should complete the form and return it to the CAA, together with the appropriate charge, before the Licence expires. It should be noted that Licences will not be back-dated, and Licence holders must ensure the prompt return of Forms AD 302 to ensure continuity of Licence coverage.

7 CAA FORMS AND PUBLICATIONS The CAA Forms and Publications referred to in this Leaflet may be obtained from the following departments:—

ANO	Her Majesty's Stationery Office, PO Box 569, London, SE1 9NH
BCAR Airworthiness Notices AEC—Syllabus of Examinations	CAA, Printing and Publication Services, Greville House, 37 Gratton Road, Cheltenham, Glos., GL50 2BN
Forms AD 300, 301, 302 and 370	CAA, Airworthiness Division, Brabazon House, Redhill, Surrey, RH1 1SQ

APPENDIX I
EXAMPLE OF COMPLETED FORM AD 370

Civil Aviation Authority

Airworthiness Division

APPLICATION FOR AERONAUTICAL ENGINEERING CERTIFICATE

1 Surname HOPE
Forenames FREDRICK JOHN
Address 63 TEMPLE ROAD
LONDON SW 19 DX
Name of Employer ENGLISH AIRWAYS
Employed as ENGINE/AIRFRAME FITTER
Probable date of release if serving in HM Forces N/A

If first application state:–
(i) Date of Birth 27-6-55
(ii) Nationality BRITISH
Day Telephone No. 01-486-2222
Date of joining

State examination for which you wish to be considered – AEC 2
Examination venue REDHILL
Date of examination (see Airworthiness Notice No. 31) 27-4-78

2 Please give details of any previous application:–
For AEC examination N/A FIRST APPLICATION
For AMEL examination N/A

3 **PARTICULARS OF AERONAUTICAL EXPERIENCE** *(Confirmation of at least 3 years experience must be provided.)*
Give in date order full particulars of employment and/or apprenticeship including any service in the Forces and any practical experience gained as a student. Also provide details of any courses undertaken.

Details and Nature of employment	*Itemise details of experience*	*Dates Day, month and year* From	To	*Referees' signature or other documentary evidence*
ENGLISH AIRWAYS AIRCRAFT ENGINEER APPRENTICE	18 MONTHS AT TRAINING CENTRE	AUG 73	FEB 74	
	6 MONTHS ENGINE WORKSHOPS	MAR 74	AUG 74	
	6 MONTHS TRIDENT MAJORS	SEP 74	FEB 75	
	6 MONTHS AIRFRAME WORKSHOPS	MAR 75	AUG 75	J.D Smith. Jan. 17 '78 App. Supn Eng
	6 MONTHS AIRFRAME MODS,	SEP 75	MAR 76	
	6 MONTHS ON LINE AAR/DEPART. DEFECTS	MAR 76	AUG 76	
FOLLOWING APPRENTICESHIP AIRFRAME/ENGINE ENGINEER	LINE MAINT. MINOR CHECKS FLEET MAINTENANCE	SEP 76	TO DATE	A Becker Jan 20th 1978 Line Maint. Supervisor English Airways.

I have studied the Syllabus of Examinations and Civil Aircraft Inspection Procedures and declare that the information given in this application is correct.

Signature of Applicant JAN 23rd. 1978 Date F.J. Hope.

AD 370

PTO

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Examinations for Aeronautical Engineering Certificates will be held in the subjects listed below. A Syllabus of Examinations may be purchased from Civil Aviation Authority, Printing and Publication Services, Greville House, 37 Gratton Road, Cheltenham, Glos. GL50 2BN.

Examination	Subject
AEC 1	UNPRESSURISED METAL AIRFRAMES
*AEC 2	METAL AIRFRAMES (includes AEC 1 and pressurised airframes)
AEC 3	SUPERCHARGED PISTON ENGINES
AEC 4	JET TURBINE ENGINES
*AEC 5	JET TURBINE AND PROPELLER TURBINE ENGINES (includes AEC 4 and propeller turbine engines)
AEC 6	HELICOPTERS less engine(s)
AEC 7	INSTRUMENT SYSTEMS EXCLUDING THOSE ASSOCIATED WITH ELECTRONIC APPARATUS
*AEC 8	INSTRUMENT SYSTEMS (includes AEC 7 and instruments associated with electronic apparatus)
AEC 9	D.C. ELECTRICAL SYSTEMS
*AEC 10	D.C. AND A.C. ELECTRICAL SYSTEMS (includes AEC 9 and aircraft main and subsidiary a.c. electrical systems)
AEC 11	INTEGRATED FLIGHT CONTROL SYSTEMS
AEC 12	AIRBORNE RADIO SYSTEMS, i.e. all systems connected with the transmission and reception of radio signals

* For examinations marked with an asterisk a partial pass is possible, but only in respect of the subjects covered by the preceding AEC subject number. In such cases re-examination would not involve this subject matter, e.g. a candidate for AEC 5 may obtain a Pass for Jet Turbine Engines, but it is not possible to obtain a Pass only for Propeller Turbine Engines.

This form should be returned to the Civil Aviation Authority, Airworthiness Division, Brabazon House, Redhill, Surrey, RH1 1SQ, together with the examination fee specified in Airworthiness Notice No. 31, not later than the 15th day of the month preceding the month in which examination is required.

NOTES: 1 A separate application and fee is required for each examination.
2 Only one examination may be taken on one day.

If you require a receipt please put a tick in the box	

Cheq./PO/Cash/MO	FOR CAA USE
£_____	
Rec'd by_____	
Date _____	
Ref._____	

APPENDIX II
EXAMPLE OF COMPLETED FORM AD 300

Civil Aviation Authority

Ref:

Airworthiness Division

PRELIMINARY APPLICATION FOR AIRCRAFT MAINTENANCE ENGINEER'S LICENCE

FULL NAME: JOHN MARTIN BLOGGS
(Block Capitals)

ADDRESS: 22 SAND LANE, SANDY, BEDFORDSHIRE

TELEPHONE NO: SANDY 1234 (STD 0767)

If first application state:
(i) Date of Birth: 4-10-39
(ii) Nationality: BRITISH

1 Give details of ALL applications made for the grant or extension of a Maintenance Engineer's licence during the last two years. (Note: Details should include applications made to overseas licensing authorities or for Aeronautical Engineering Certificates.)

Approximate date	Authority to whom application was made	Category and/or ratings	Was application accepted?	Result of examination
8-8-76	CIVIL AVIATION AUTHORITY	"C"	YES	FAIL
10-11-76	CIVIL AVIATION AUTHORITY	"C"	YES	PASS

2 Particulars of any engineer's licence held.
Licence No. 16594 Issued by CIVIL AVIATION AUTHORITY
(Any engineer's licence granted by an authority *other* than the UK Licensing Authority should be forwarded with this application.)

3 Name and Address of Present Employer ENGLISH AIRWAYS
LONDON (HEATHROW) AIRPORT

4 Date of Joining 8/9/66

5 Fill in below details of licence for which you wish to make application (see the current issues of Section L (Licensing), of British Civil Airworthiness Requirements and Airworthiness Notice No. 10).

Category	Licence	
"A"	WTR	PRESSURISED METAL AEROPLANES
"A"	TR	BOEING 707-369 LANDPLANES

6 I wish if possible to be examined at LONDON (HEATHROW) AIRPORT

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Licence No.:

Expires:

Ratings:

Regulations:

Exemptions:

Time:

Course:

To be Vetted by:

AD 301: N/A Satisfactory

Written:

Oral:

Fee: £

AD 300

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PARTICULARS OF EXPERIENCE

5 State in date order full particulars of employment and/or apprenticeship (including service in HM Forces, if applicable) together with any practical experience gained during studentship at any aeronautical school or college.

IMPORTANT: The application cannot be accepted unless (i) the information required is given in the fullest detail, (ii) the experience stated conforms in full with the current issue of Section L (Licensing) of British Civil Airworthiness Requirements for the category of licence for which application is made, (iii) the conditions of Column 4 are complied with, and (iv) acceptable Schedules of Work are submitted if applicable.

NOTE: Schedules of Work should be compiled in accordance with the Appendix to Chapter L1–2 of Section L (Licensing) of British Civil Airworthiness Requirements.

Types of Airframe, Engine or Equipment (1)	PRECISE NATURE of work, and name of person in charge of Department or in similar authoritative position. State name of employer and place of employment. (2)	DATES From Day, Month and Year	DATES To Day, Month and Year (3)	Signature of Referee. To be signed by person quoted in column 2 (see notes below). (4)
CHIPMUNK VARSITY JAVELIN SAPPHIRE CANBERRA AVON	ROYAL AIR FORCE AIRFRAME FITTER COURSE 1ST AND 2ND LINE MAINTENANCE MODIFICATION AND RECTIFICATION REMUSTERED TO ENGINE TRADE ENGINE FITTER COURSE	APRIL 1957 JUNE 1957 JUNE 1958 AUG 1961 AUG 1961	APRIL 1966 JUNE 1958 JULY 1961 APRIL 1966 AUG 1962	DETAILS CONFIRMED IN SERVICE RELEASE BOOK
BOEING 707-369 P&W JT3D-3B BOEING 707-436 RR CONWAY	MR SMITH – OUTSTATIONS SUPT. E/A. ENGLISH AIRWAYS STATION ENGINEER HONG KONG. 1ST LINE INSP. WORK AIRFRAME + ENGINE, GROUND RUNNING	SEPT 1966	JULY 1970	M P Smith Outstations Supt English Airways 3/7/70
BOEING 707 ALL SERIES P&W JT3D-3B RR CONWAY	MR JONES – HANGAR 4 SUPT. ENGLISH AIRWAYS LONDON APT. MAJOR MAINTENANCE, MODS, AND INSPECTIONS AS AN AIRFRAME/ENGINE INSPECTOR	JULY 1970 TO DATE		A Jones Hangar 4 Supt. English Airways. 12/12/77

NOTES: 1 If application is for extension *within* a Category, particulars of relevant experience required ONLY since date of last application for the Category, together with Schedules of Work on the type to which the application relates.

2 Signature in column (4) constitutes confirmation of adjacent entry in columns (1), (2), (3).

3 Column (4) must be completed by as many signatories as are necessary to cover the full and most recent period(s) of experience as detailed in the current issue of Section L (Licensing), of British Civil Airworthiness Requirements.

4 If the experience requirement stipulates completion of a Course recognised by the CAA, evidence of satisfactory completion of the Course must be provided.

6 Have you studied the following?:

*The current Air Navigation Order and amendments ..... YES .....

†Sections 'A' and 'L' of British Civil Airworthiness Requirements ..... YES .....

†Civil Aircraft Inspection Procedures ..... YES .....

†Airworthiness Notices ..... YES .....

*Obtainable from HM Stationery Office

†Obtainable from Printing and Publication Services, Civil Aviation Authority, Greville House, 37 Gratton Road, Cheltenham, Glos. GL50 2BN.

7 I hereby declare that the information given on this form is true in every respect.

SIGNATURE OF APPLICANT ..... J Bloggs .....

DATE ..... 12/12/77 .....

8 When completed, this form and relevant Schedules of Work should be returned to the Civil Aviation Authority, Airworthiness Division, Brabazon House, Redhill, Surrey RH1 1SQ, England. NO FEE TO BE SENT.

NOTES ON COMPILING FORM AD 300

1. It is in the interest of each individual to record all areas of involvement, even if the particular work is not relevant to the application at the time. This will help the assessor considerably with any future applications, particularly when an application is made for a different category of Licence.
2. Initial applications should be completed in full.
3. The ANO, BCAR, Sections A and L, and Airworthiness Notices, must have been studied before an application can be considered.

APPENDIX III
EXAMPLE OF COMPLETED FORM AD 302

Civil Aviation Authority

AIRCRAFT MAINTENANCE ENGINEER'S LICENCE

Particulars required for the Grant, Extension or Renewal of a Licence*

PART 1 (Please complete this part in block capitals)

1. Surname BLOGGS
2. Other names JOHN MARTIN
3a. Address for use in connection with this application
22 SAND LANE, SANDY, BEDFORDSHIRE
Telephone No. SANDY 1234 (STD 0767)
3b. Permanent address to be inserted in Licence
AS ABOVE
3c. Address to which Notices and Renewal Forms should be sent (see Airworthiness Notice No. 2)
AS ABOVE
4. Name of Employer ENGLISH AIRWAYS Date of Joining SEPT 1966
5. Employed at LONDON (HEATHROW) AIRPORT Employed as A/E-ENG INSPECTOR

PART 2 GRANT OR EXTENSION OF LICENCE

6.	Category	Licence Without Type Rating Sub-Division and/or Type Rating
	'A' AEROPLANES	WTR PRESSURISED METAL AEROPLANES
	'A' AEROPLANES	TR BOEING 707-369 LANDPLANES

PART 3 EXTENSION OR RENEWAL OF LICENCE

7. Licence No. 16594 Date of Expiry 4-4-79
8. Precise nature of employment SINCE LAST APPLICATION, quoting type(s) or systems:

	Period (with appropriate dates)	Confirmed by †
(i) *Airframe maintenance* MAJOR MAINTENANCE, RECTIFICATION MODIFICATION & INSPECTION ON ALL SERIES BOEING 707 AIRCRAFT.	12/12/77	
(ii) *Engine maintenance* MAJOR MAINTENANCE, RECTIFICATION MODIFICATION & INSPECTION ON P&W JT3D-3B AND RR CONWAY. ENGINE GROUND RUNNING.	TO	Dufour. Hangar 4 Supt. English Airways 13/3/78
(iii) *Duties other than above* ADMIN. DUTIES ASSOCIATED WITH THE DUTIES OF AN INSPECTOR.	13/3/78	

9. STATE THE DATE OF THE LAST CERTIFICATION YOU MADE UNDER THE AUTHORITY OF THE ABOVE LICENCE# 1/1/78

* This Form is not to be used for Initial Applications (use AD 300).
† Statements must be confirmed by a person in an authoritative position.
# Certification as an Approved Inspector or under a licence granted by another authority should NOT be mentioned.

AD 302

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PART 3 (Continued)

10. Are you conversant with the current Air Navigation Order and Regulations, Airworthiness (or ARB) Notices, Requirements and Recommendations appropriate to the holder of an Aircraft Maintenance Engineer's Licence? YES

11. Quote the Issue 2 and the Number 88 of the last Notice you received.

12. Are you the holder of any Aircraft Maintenance Engineer's Licence issued by an authority OTHER THAN the UK Licensing Authority? NO

13. If so, state:—
    (i) Issuing authority
    (ii) Licence number N/A (iii) Date of expiry N/A
    (iv) Scope of licence

FOR CAA USE
Sent
Cheque/PO/Cash/MO
£
Rec'd by
Date
1703/1237
Ref
Address 3c.

PART 4 Fees:—

GRANT OR EXTENSION — As notified — RENEWAL (without extension) £15·00
(The CA Form 1237 ONLY should be forwarded with the application for renewal)

Cheque
~~Postal Order~~
~~Currency Note~~
~~Money Order~~
for £ 30 is enclosed in payment for the charge

If you require a receipt please put a tick in the box	

I hereby declare that all the particulars given in this form are true in every respect.

Date 13/3/78 Signature of Applicant J M Blagg

FOR CAA USE

When completed, this form should be returned to the Civil Aviation Authority, Airworthiness Division, Brabazon House, Redhill, Surrey RH1 1SQ, England.

NOTES ON COMPILING FORM AD 302

1. It is in the interest of each individual to record all areas of involvement, even if the particular work is not relevant to the application at the time. This will help the assessor considerably with any future applications, particularly when an application is made for a different category of Licence.
2. Initial applications should be completed in full.

APPENDIX IV
EXAMPLE OF COMPLETED FORM AD 301

Civil Aviation Authority
Airworthiness Division

SCHEDULE OF INSPECTION WORK FOR LICENCE CATEGORY "A" TYPE RATING B707-369

NOTES:
(1) Information and guidance on the completion of this Schedule is contained in the Appendix to Section L of British Civil Airworthiness Requirements.
(2) Types of aircraft involved when applying for engines or ratings of Category 'R' and 'X' should be specified.
(3) The person in charge should certify each item when he is satisfied that the applicant has participated in or satisfactorily carried out the inspection. An applicant may be considered to have participated when he has taken an active interest in the inspection.
(4) Engineers are encouraged to maintain a personal logbook in which to record details of work carried out.
(5) Questions during the oral examination may be based upon information contained in this Schedule.

I hereby declare that the information given on this form is true in every respect.

Applicants Full Name (BLOCK CAPITALS) JOHN MARTIN BLOGGS Signature J M Bloggs Date 2-12-77

Aircraft Registration and Type	Details of Work Undertaken	Date(s) Work Undertaken	Signature and Status of Person in Charge (See Note 3) Date
	1, STRUCTURES, DOORS, WINDOWS		
	Main entry door removed, serviced, new seal fitted and re-rigged.	8/10/76	
B707-369	Main cabin window replaced	10/10/76	
G-AOVN	Captains No1 Window replaced	10/10/76	
	Crown skin inspection carried out and certain areas of rivets replaced.	7/11/76	
	Insertion Repair carried out to L/H inboard flap trailing edge	17/11/76	D H Harding QC Manager Hangar 4 29/11/77
	2, FLYING CONTROLS		
	L/H Stabilizer tab replaced + rigged, inboard aileron balance panels and seals checked.	18/11/76	
B707-369	R/H outboard aileron replaced and rigged.	13/2/77	
G-AOVH	Main Aileron bus cable replaced	2/3/77	

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NOTES ON COMPILING FORM AD 301

1. The two subjects referred to on page 17 are not an indication of the total amount of involvement required, but are a guide to the sort of work or inspection required under each sub-heading.
2. In order that an overall assessment of the schedule may be carried out, all entries should be made under the appropriate sub-headings, in the order in which they appear in the Appendix to Chapter L1-2 of BCAR.
3. It should not be assumed that the assessor is acquainted with either the applicant or the company for which he works. The assessor will be a CAA Surveyor and may also be the examiner; he may use this form to frame some of the questions relating to the practical aspects of the examination. As explained elsewhere, great emphasis is placed on practical experience, and the applicant must be able to substantiate the details entered on the form, in any subsequent oral examination.
4. "Active interest" should, in most cases, be interpreted to mean that the applicant was involved in the work in some way; he will be expected to satisfy the examiner on any or all of the stages of work for any item included in the schedule.
5. The person signing the "Person in Charge" column should ensure that the items are substantially correct, and that the applicant's practical experience is accurately reflected by the schedule.

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Issue 3.

16*th May*, 1975.

BASIC

AIRWORTHINESS PROCEDURES

ENGINEERING DRAWINGS

1 INTRODUCTION The purpose of an engineering drawing is to record and convey the designer's requirements. The drawing must, therefore, include sufficient information to enable production planning, manufacture, assembly, testing and inspection of the particular component or assembly to be carried out. So that there can be no misinterpretation of drawings, it is essential that both the person preparing the drawing and the person using the drawing should have a knowledge of the terms, symbols, abbreviations, and methods of presentation. This Leaflet gives general guidance on the various aspects of engineering drawings, and should be considered in conjunction with any special methods used by the design office responsible for a particular drawing. This Leaflet is not intended as a standard for drawing offices, but should be regarded as a general guide to drawing procedures and interpretation.

NOTE: This Leaflet deals with general engineering drawing procedures, and does not include information on specialised subjects, such as electrical or electronic drawing practice, computer produced lofting, or numerically controlled tapes.

1.1 Drawing practice in the United Kingdom generally conforms to British Standard (BS) 308. The particular requirements for companies within the aerospace industry in the UK, are covered in the recommendations contained in the Society of British Aerospace Companies' (SBAC) Technical Specification (TS) 88. Design organisations amend both the BS and SBAC drawing systems to suit their own particular requirements, and generally produce their own Drawing Office Standards.

1.2 For current projects the International Organisation for Standardisation (ISO) system for dimensioning and tolerancing of drawings is used, but, at the present time, Imperial units, terms, and tolerances, may be found on many drawings.

1.3 The abbreviations listed in Table 3, and the conventional representations of some standard features shown in Figures 10 and 15, are in accordance with BS 308, and will be found on most drawings. The terms and symbols used for tolerances in accordance with ISO recommendations, are shown in Table 5.

2 THE AUTHORITY OF THE DRAWING Civil aircraft manufactured in the United Kingdom are constructed from parts and components which have been manufactured to approved drawings. Design drawings and associated documents are, normally, produced by an organisation which has been approved by the Civil Aviation Authority, in accordance with British Civil Airworthiness Requirements (BCAR).

2.1 BCAR prescribes that all calculations on which the airworthiness of an aircraft depends, must be independently checked. Thus the design drawing itself is subject to a system of inspection, as are the parts produced to its requirements.

2.2 Drawings are used by Purchasing Departments, Production Engineers, Planners, Inspectors, and personnel engaged on the manufacture and assembly of components. A drawing must, therefore, contain all the necessary dimensions, limits of accuracy, classes of fit, material specifications, and any other information likely to be required by any of the departments concerned, so that they may carry out their respective responsibilities without reference back to the Design Department.

2.3 Any deviation from the approved drawings or associated documents during manufacture, must be covered by a Concession, the procedures for which are described in Leaflet **BL/1-5.** During overhaul, modification, maintenance and repair, the approved Organisation, or the appropriately licensed engineer, should ensure that all replacement parts, or repairs carried out, are in accordance with the approved drawings and associated documents.

3 TYPES OF DRAWINGS There are four types of drawings recommended in BS 308; single-part (unique parts or assemblies), collective (parts or assemblies of essentially similar shape, but of different dimensions), combined (a complete assembly including all individual parts on a single drawing), and constructional (an assembly drawing with sufficient dimensional and other information to describe the component parts of a construction). A complete set of drawings for an aircraft, and any documents or specifications referenced on the drawings, present a complete record of the information required to manufacture and assemble that aircraft, and they also form part of the inspection records. The manner in which a set of aircraft drawings is arranged, enables any particular component, dimension, procedure or operation, to be traced.

3.1 A main 'general arrangement' drawing of the aircraft, and 'general arrangement' drawings of the main assemblies and systems, are provided. These drawings usually contain overall profile particulars only, with locations and references of the associated main assembly and installation drawings; they provide a guide to the identification of drawing groups used by the particular design organisation.

3.2 Main assembly drawings may also contain profile particulars only, but will include the information required for the assembly of individual parts of sub-assemblies. The sequence of assembly is given where appropriate, but the information contained in single part or sub-assembly drawings, is not repeated. Parts as such are referenced, but, in the case of sub-assemblies, only the sub-assembly will be referenced and not its individual parts.

3.3 Installation drawings are issued to clarify the details of external dimensions and attitudes of components, locations, adjustments, clearances, settings, connections, adaptors, and locking methods between components and assemblies.

3.4 Sub-assembly drawings are issued to convey specific information on the assembly of component parts. When the method of assembly entails welding, or a similar process, the drawing will include details of any heat treatment or anti-corrosive treatment that may be necessary. Sub-assembly drawings are sometimes issued in connection with spares provisioning, and also in cases where assembly would be difficult without special tools, jigs or techniques.

3.5 Drawings of individual parts contain all the information necessary to enable the parts to be manufactured to design requirements. The material specification, dimensions and tolerances, machining details and surface finish, and any treatment required, will all be specified on the drawings.

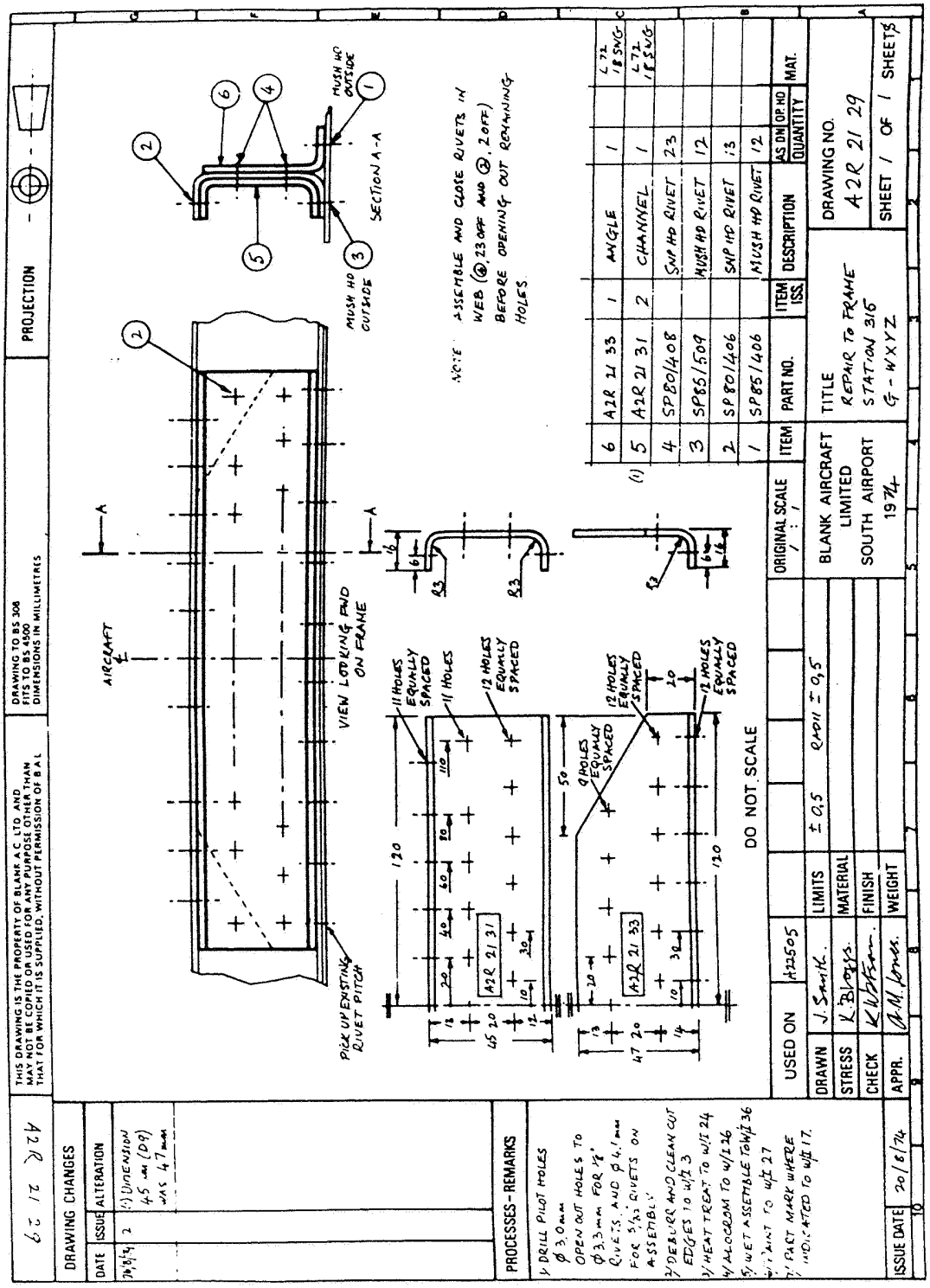


Figure 1 TYPICAL ENGINEERING DRAWING

4 DRAWING SYSTEMS Section A of BCAR, prescribes that each drawing must bear a descriptive title, drawing number, issue number, and the date of issue, it also prescribes that all alterations to drawings shall be made in accordance with a drawing amendment system which will ensure amendment to design records. If an alteration is made, a new issue number and date must be allocated to the drawing. To comply with the requirements, procedures must be introduced to progressively amend the total definition of the product in terms of its associated list of drawings at specific issues. Each particular variant of a product, and its state of modification, must be identifiable in relation to the appropriate list of drawings. The following paragraphs amplify these procedures, and explain the purposes of various parts of a drawing, together with the systems used and the methods of presentation. A typical drawing which illustrates many of the features with which this Leaflet is concerned, is shown in Figure 1.

4.1 **The Drawing Number.** No two drawings should bear identical numbers, and a design office should maintain a register of all drawings issued. The drawing number has three features, the project identity (A2 in Figure 1) the group breakdown (21 in Figure 1), and an individual register number (29 in Figure 1). TS 88 describes an acceptable numbering method, but considerable discretion is allowed for particular design office requirements. In Figure 1, A2 indicates the aircraft type, R indicates a repair, 21 indicates the front fuselage, and 29 indicates the register number in this group of drawings. Except for repair drawings, the drawing number is also, generally, the part number of the item.

4.1.1 **Handed Parts.** Drawings of handed parts usually have the left hand (port), upper, inner, or forward part drawn, this item taking the odd number, and the opposite hand the consecutive even number. Parts which are not handed have an odd drawing number. The drawing sheet bears the legend 'AS DRAWN' and 'OPP HAND' in the item quantity column. Where necessary the handed condition is indicated by a local scrap view or annotation.

4.1.2 **Sheet Numbers.** Where a complete drawing cannot be contained on a single sheet, successive sheets are used. The first sheet is identified as 'SHEET 1 of X SHEETS', as applicable, and subsequent sheets by the appropriate sheet number. Where a schedule of parts applicable to all sheets, is required, it appears on Sheet 1.

4.2 **Drawing Changes.** Any change to a design drawing, other than the correction of minor clerical errors, must be accompanied by a new issue number and date. New parts added to the drawing, or 'drawn on' parts affected by the change, take the new issue number, and parts which are not affected retain the original issue number. In all cases where interchangeability is affected, a new drawing number and part number are allocated.

4.2.1 Details of the drawing changes are recorded in the appropriate column on the drawing, or recorded separately on an 'Alteration Sheet', which is referenced on the drawing. Changes are related to the change number quoted in the change of issue columns on the drawing, and the marginal grid reference is given to identify the altered features.

4.2.2 The issue 'number' may sometimes be represented by a letter. Some organisations use alphabetical issues for prototype aircraft drawings, and numerical issues for production aircraft drawings; thus all drawings of a prototype aircraft become 'Issue 1' when production commences.

4.2.3 An alteration to a single part drawing may also result in changes to associated drawings; in addition, it may be necessary to halt manufacture or assembly of the product. The drawing office system usually makes provision for the proper recording of drawing changes, by publishing, concurrently with the re-issued drawing, an instruction detailing the effects these will have on other drawings, on work in progress, and on existing stock. As a further safeguard, some organisations publish Drawing Master Reference Lists, which give details of the current issues of all drawings which are associated with a particular component or assembly.

4.3 **Part Referencing.** Every item called up on a drawing is given an item number, which is shown in a 'balloon' on the face of the drawing, as illustrated in Figure 1. No other information is given in or adjacent to the balloon, with the exception of information necessary for manufacture or assembly, such as 'equally spaced', 'snap head inside', or the symbol 'ND', which indicates that no separate drawing exists for the part.

4.3.1 A schedule of parts is usually given in the manner shown in Figure 1, or on a separate sheet of the drawing (see paragraph 4.1.2).

4.3.2 As an alternative to the system described above, grid references may be given in the list of parts; in such instances the actual part numbers appear in the balloons. Where a part occurs a number of times on a drawing, e.g. as may be the case with rivets, bolts, etc., it may be impractical to list all grid references, in which case this column is left blank.

4.3.3 In instances where ND parts are shown as items on a drawing, the part number of such items may be that drawing number, followed by the drawing item number. Alternatively the part may be given its own part number, but will be identified as an ND part, e.g. 'A1 31 101 ND'. The information required for the manufacture of an ND part is contained in the description and material columns of the drawing, but reference may also be made to other drawings, where necessary.

4.3.4 Materials such as locking wire and shimming, which are available in rolls and sheets, will be detailed by specification number in the 'Part No' column, and the quantity will be entered as 'As Required', or 'A/R'. Standard parts to BS and SBAC Specifications will be detailed by the appropriate part numbers, but will not be drawn separately.

4.4 **Drawing Queries.** Drawing queries may arise through mistakes in draftsmanship, through ambiguity or through inability to purchase, manufacture, or assemble the items as drawn. Design Office procedures must be introduced which cater both for raising queries, and for providing satisfactory answers to those queries.

4.4.1 Drawing queries are usually raised on a Drawing Query Form, which is passed to the Design Office for action. The answer to the query may be an immediate provisional one, detailed on the query form; a temporary, fully approved answer, issued by means of a Drawing Office Instruction, and having the same authority as the drawing to which it refers; or a permanent answer provided by means of a new or re-issued drawing.

4.4.2 Drawing Query Forms and Drawing Office Instructions should be suitably identified, and should be referenced on the amended drawing. The effects on other drawings, on existing stock, and on work in progress, should be included in the answer to the query.

4.4.3 The number of Drawing Query Forms or Drawing Office Instructions permitted on a drawing, should be limited, and a new or re-issued drawing should be completed as soon as possible.

5 INTERPRETATION OF DRAWINGS The following paragraphs indicate some of the general drawing practices used on aircraft drawings. These practices are in accordance with the recommendations contained in BS 308 and TS 88, but many drawings will have been issued to previous British or foreign standards, and some degree of interpretation may be necessary. In cases of doubt the Drawing Office Handbook, or similar publication issued by the relevant Design Organisation should be consulted.

5.1 **Scale.** Drawings are normally drawn to a uniform scale, and this is normally shown in the 'ORIGINAL SCALE' box on the drawing, in the form of a ratio, e.g. 1:2 (i.e. half size). Where details or views are drawn to a different scale, this should be clearly stated on the drawing. Aircraft drawings are often full size, i.e. 1:1, but no drawing should be measured to obtain a particular dimension which is not shown; the omission should be referred to the Design Office. On earlier drawings the scale may be represented by a fraction, e.g. ¼, which is 1:4.

5.2 **Lines.** The types and thicknesses of lines recommended in BS 308 are shown in Table 1. Drawings are often completed in pencil, however, and line thickness may, in practice, vary considerably, especially after the drawing is reproduced.

TABLE 1

TYPES OF LINES

Example	Description	Width (mm)	Application
	Continuous (thick)	0·7	Visible outlines and edges.
	Continuous (thin)	0·3	Fictitious outlines and edges, dimensions and leader lines, hatching, outlines of adjacent parts and revolved sections.
	Continuous irregular (thin)	0·3	Limits of partial views or sections when the line is not on axis.
	Short dashes (thin)	0·3	Hidden outlines and edges.
	Chain (thin)	0·3	Centre lines and extreme positions of moveable parts.
	Chain (thick at ends and changes of direction, thin elsewhere).	0·7 0·3	Cutting planes.
	Chain (thick)	0·7	Indicates surfaces which have to meet special requirements.

5.3 **Projections.** The majority of drawings produced for aircraft purposes show the parts in third angle orthographic projection (paragraph 5.3.1), but a number of older drawings may have been produced in first angle orthographic projection (paragraph 5.3.2). Both systems show objects as they actually are, both in size (unless for convenience the drawing is scaled up or down) and shape, when viewed in the vertical and horizontal planes. The projection used for a drawing must be clearly stated, and the appropriate international projection symbol must be placed in a prominent position on the drawing. Any views not complying with the projection stipulated, e.g. a view showing the true shape of an inclined face, are generally marked with an arrow, and suitably annotated.

5.3.1 **Third Angle Projection.** The principle of third angle projection is shown in Figure 2. Each view represents the side of the object nearest to it in the adjacent view.

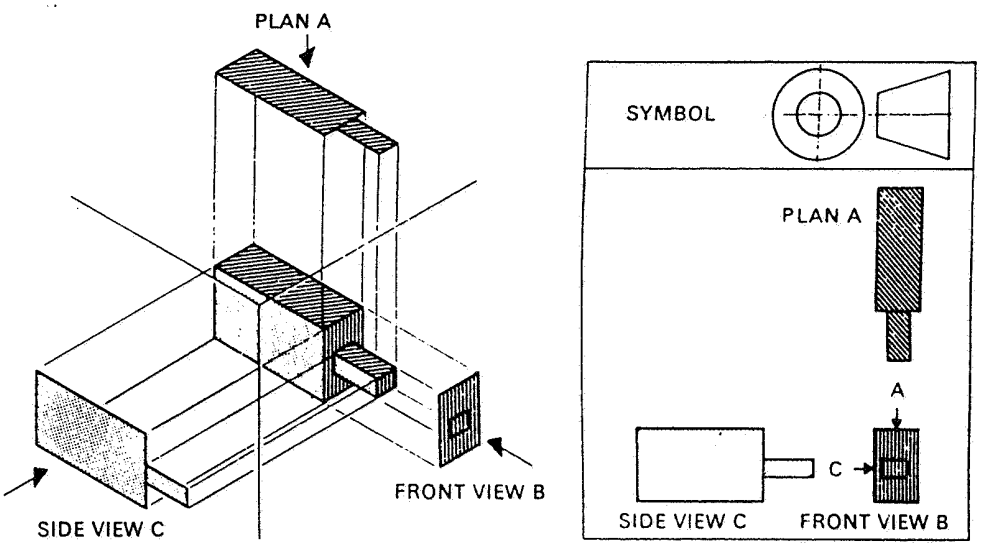


Figure 2 THIRD-ANGLE PROJECTION

5.3.2 **First Angle Projection.** The principle of first angle projection is shown in Figure 3. Each view represents the side of the object remote from it in the adjacent view.

5.3.3 **Isometric Projections.** These are pictorial views of an object, which are drawn with the three axes inclined, usually at an angle of 30°, to the plane of projection. The central drawing in Figure 2 and in Figure 3, is an isometric projection. Isometric views are sometimes used in drawings to indicate the position that the component occupies in the aircraft, or as a guide to understanding a complicated drawing.

5.4 **Views.** In general, all principal elevations are drawn looking at the left side of the aircraft, and the left hand item of handed parts is drawn. Other views are clearly annotated, e.g. 'view looking forward on frame'. The number of views shown on a drawing will depend on the complexity of the part, although two views may often be sufficient. In some cases the three main views (Figures 2 and 3) may be insufficient to clarify all the details necessary, and a number of sectional or auxiliary views may be necessary.

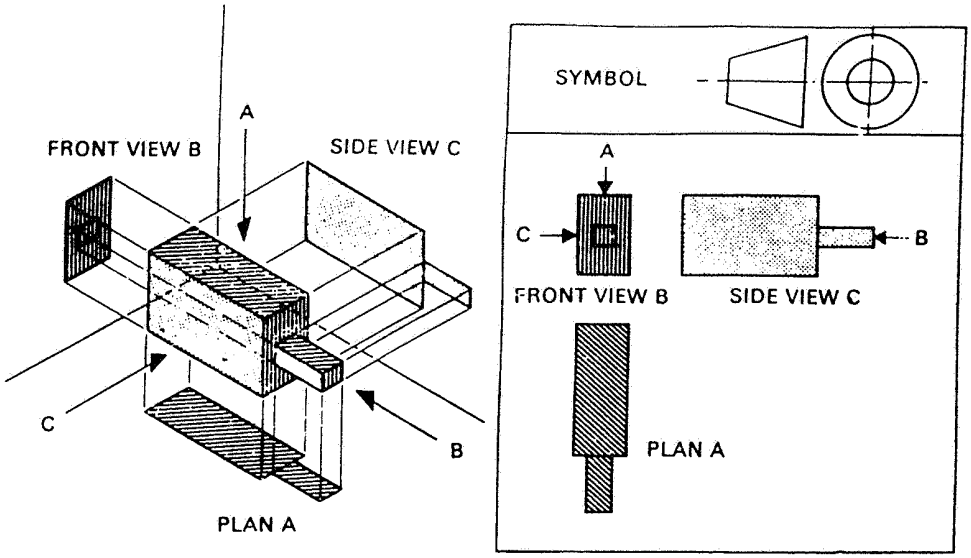


Figure 3 FIRST-ANGLE PROJECTION

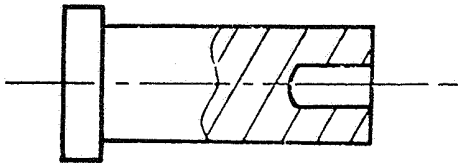


Figure 4 PART SECTION

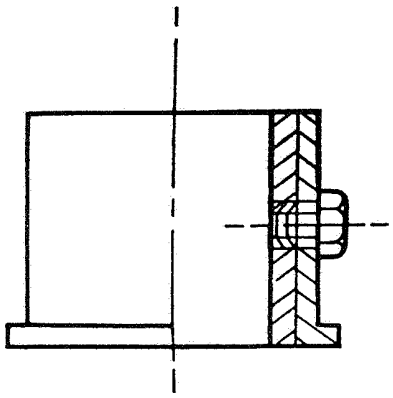


Figure 5 HALF SECTION

5.4.1 **Sectional Views.** A sectional view may show a plan or elevation in complete section, the plane of the section being along one of the main centre lines. Where full sectioning is considered unnecessary, a part or half section may be used, and staggered sections are often used to illustrate particular features. Typical sectional views are illustrated in Figures 4, 5 and 6.

(a) Hatching lines are normally used to indicate the exposed section, but these may be omitted if the drawing is clearly understandable without them. Hatching lines are usually drawn at 45° to the axis of the section, and adjacent parts are hatched in different directions.

(b) Bolts, rivets, shafts, ribs, and similar features are not normally shown in longitudinal section.

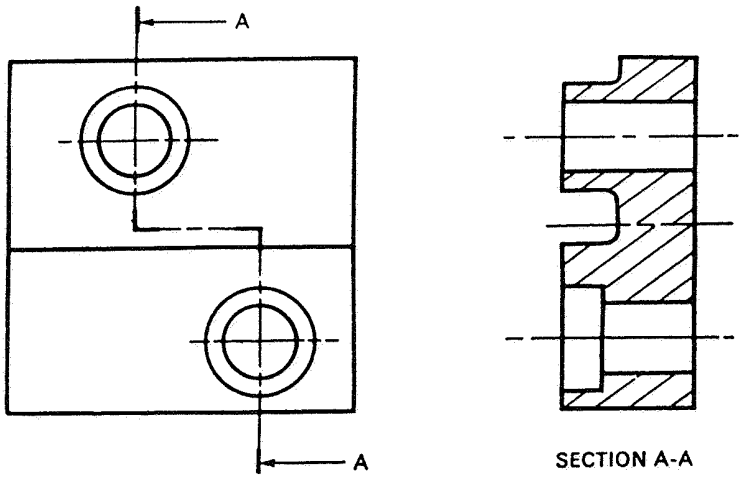


Figure 6 STAGGERED SECTION

5.4.2 **Auxiliary Views.** Neither a plan nor an elevation will show the true shape of a surface inclined to the plane of projection. The true shape of such a surface is shown by means of an auxiliary view, the auxiliary plane being imagined as being parallel to the surface being illustrated, as shown in Figure 7.

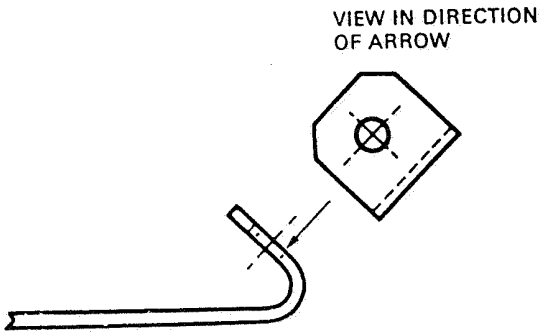


Figure 7 AUXILIARY VIEW

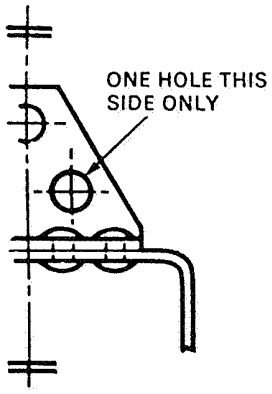


Figure 8 SYMMETRICAL PARTS

5.4.3 **Symmetrical Parts.** Parts which are symmetrical, or nearly so, may not be fully drawn. Sufficient information is normally provided by drawing one half or segment of the part; any asymmetry being identified by a note. Figure 8 shows a symmetrical part, and illustrates the method of defining the line of symmetry.

5.4.4 **Repetitive Information.** Where several features are repeated in a regular pattern, such as rivets, bolts, or slots, only the number required to establish the pattern may be shown, by marking their centrelines. Any further information will be given in a note. Figure 9 shows a typical skin joint which could be drawn in this manner.

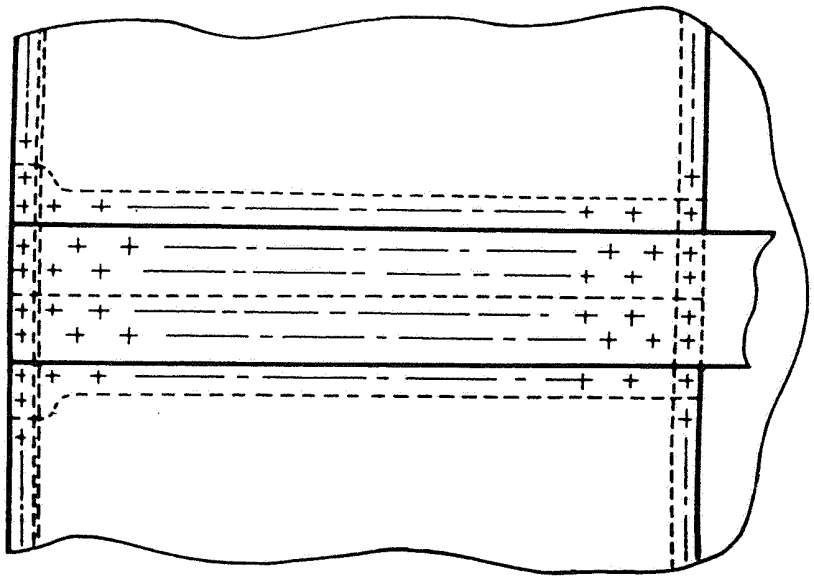


Figure 9 REPETITIVE FEATURES

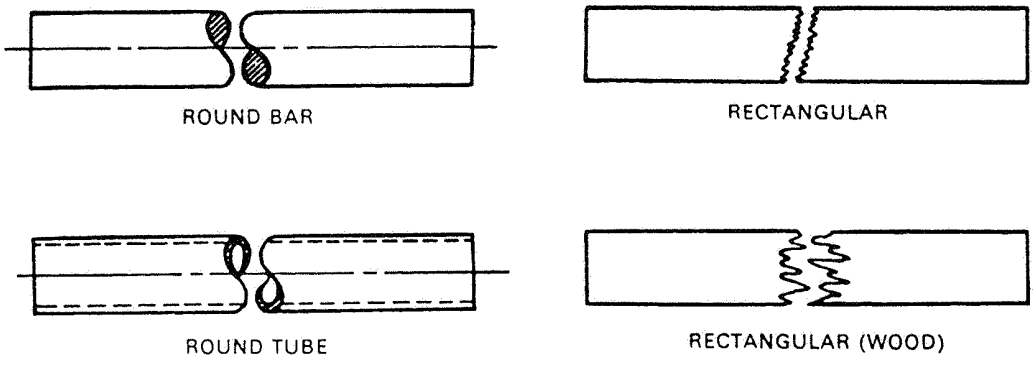


Figure 10 BREAK LINES

5.4.5 **Break Lines.** Break lines are used where it would be inconvenient (because of limited space) to draw long lengths of standard section. The types of break lines used for various components are shown in Figure 10.

5.5 **Dimensioning.** All dimensions necessary for the manufacture of the part or assembly are given on the drawing; it should not be necessary to deduce any dimension from other dimensions. To avoid confusion, dimensions are normally given once only. The units of measurement used are usually stated on the drawing, to avoid repetition, but any dimension to which this general statement does not apply will be suitably annotated. Dimensions are placed so that they may be read from the bottom or right hand side of the drawing.

5.5.1 When dimensions are given from a common datum, one of the methods shown in Figure 11 is normally used. Chain dimensioning, i.e. dimensioning between adjacent holes, is not often used, since it allows a build up of tolerances, which may not be acceptable. An alternative method, used with riveted joints, is to locate the end holes and add a note such as '11 rivets equally spaced'; this method is useful on curved surfaces.

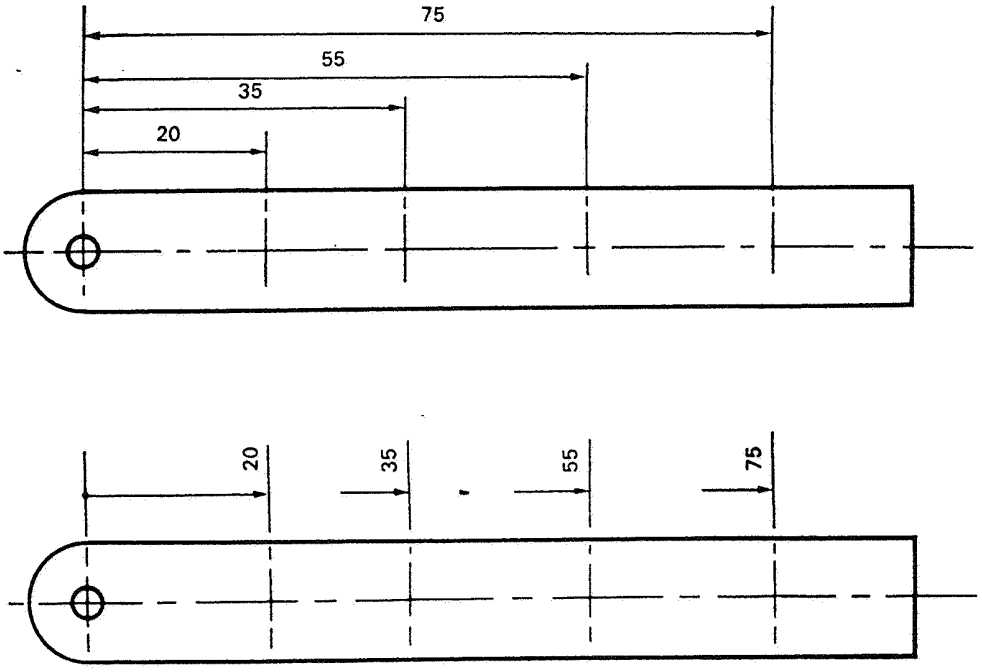


Figure 11 DIMENSIONING FROM A COMMON DATUM

5.5.2 Machined components are usually measured by a system of functional and non-functional dimensions. The functional dimensions are those which directly affect the function of the component, e.g. the length of the plain portion of a shouldered bolt. A non-functional dimension would be the depth of the bolt head, and other dimensions chosen to suit production or inspection. Auxiliary dimensions may also be given, without tolerances, for information.

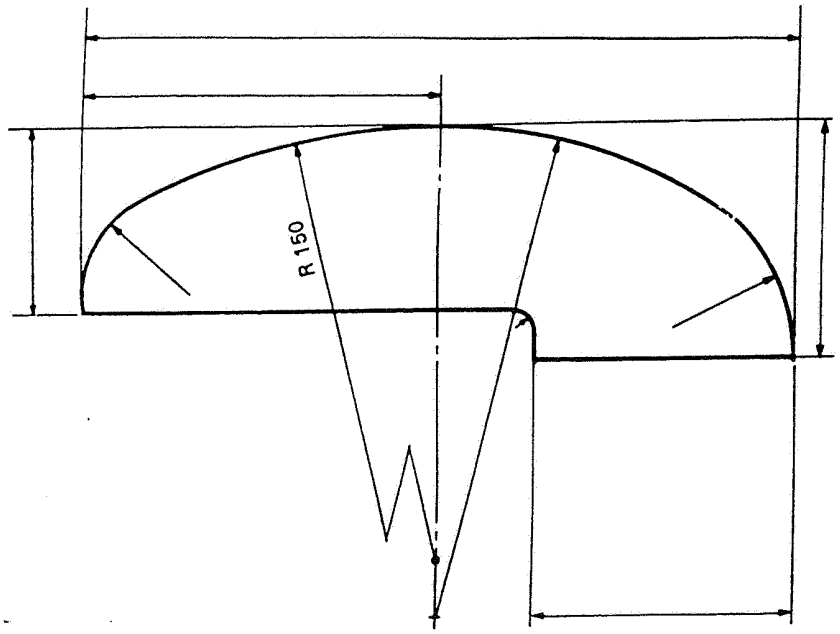


Figure 12 DIMENSIONING PROFILES BY RADII

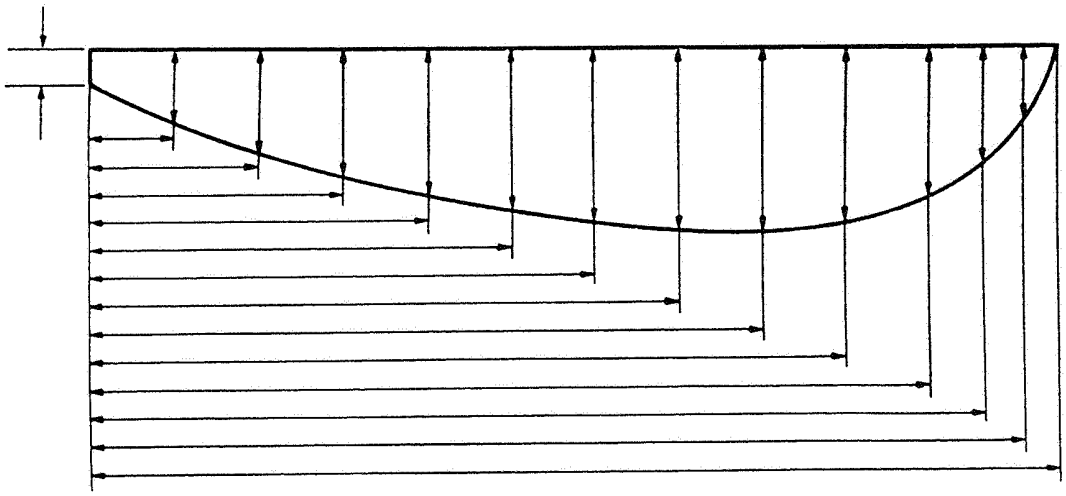


Figure 13 DIMENSIONING PROFILES BY ORDINATES

5.5.3 **Dimensioning of Curved Profiles.** Items the profiles of which are curved, are where practicable, dimensioned by means of radii, as shown in Figure 12. Where a radius is very large, and the centre of the arc could not be shown on the drawing, the method shown for the R150 dimension in Figure 12 may be used; the portion of the radius which touches the arc being in line with the true centre. Where this method cannot be employed, a system of ordinates may be used, as shown in Figure 13. The radii method is usually preferred, since accurate arcs can be produced; whereas with the ordinate system, deviations from the required curve may occur as a result of connecting the plotted points.

5.6 **Dimensional and Angular Tolerances.** A general tolerance is usually given for all dimensions on a drawing, and may be found in the appropriate box on the printed layout. Where the general tolerance is inadequate or restrictive, an individual tolerance may be given to a dimension.

5.6.1 Tolerances may be expressed by quoting the upper and lower limits, or by quoting the nominal dimension and the limits of tolerance above and below that dimension. Examples of both linear and angular tolerances are shown in Figure 14. Geometric tolerances are dealt with in paragraph 5.11.

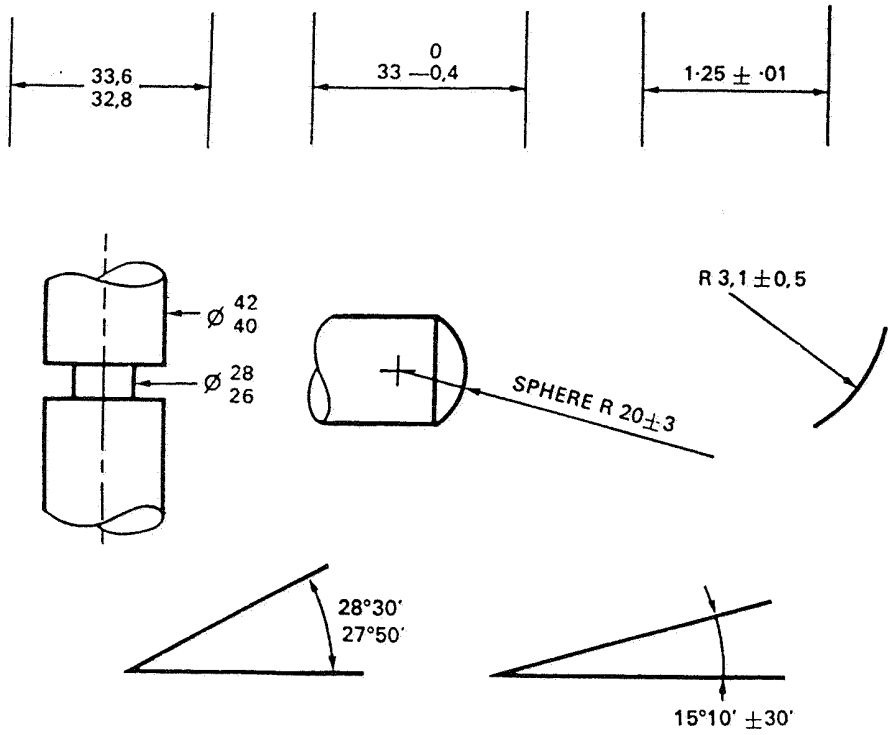


Figure 14 DIMENSIONAL TOLERANCES

5.7 **Machining and Surface Finish.** When a machining operation is required on a particular surface, the symbol ∇ is used, and is located normal to that surface. When the component is to be machined all over, the symbol ∇ ALL OVER is used, and, in some cases, the type of machining is indicated with a note such as ∇^{LAP}

5.7.1 The machining symbol is also used to indicate the surface finish required; the maximum roughness figure being added to the symbol thus: $\overset{4}{\nabla}$. The surface finish quoted on a particular drawing depends on the system being used. The relationship between the various systems is included for reference in Table 2. The centre-line average (CLA) method of surface finish measurement is generally used (**Leaflet BL/3-3**).

TABLE 2

SURFACE TEXTURE EQUIVALENTS

Nominal Values	micrometre	0·025	0·05	0·1	0·2	0·4	0·8	1·6	3·2	6·3	12·5	25	50
	microinch	1	2	4	8	16	32	63	125	250	500	1000	2000
Roughness Number		N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12

5.8 **Abbreviations and Symbols.** In order to save time and drawing space when compiling a drawing, a number of abbreviations and symbols are used. Table 3 lists the main abbreviations and symbols which will be found on both currently produced and older drawings.

5.9 **Conventional Representations.** Common features, which may appear several times on a drawing, are seldom drawn in full, since this would take up space, and drawing time, unnecessarily. These features are shown by conventional representations, some examples of which are illustrated in Figure 15.

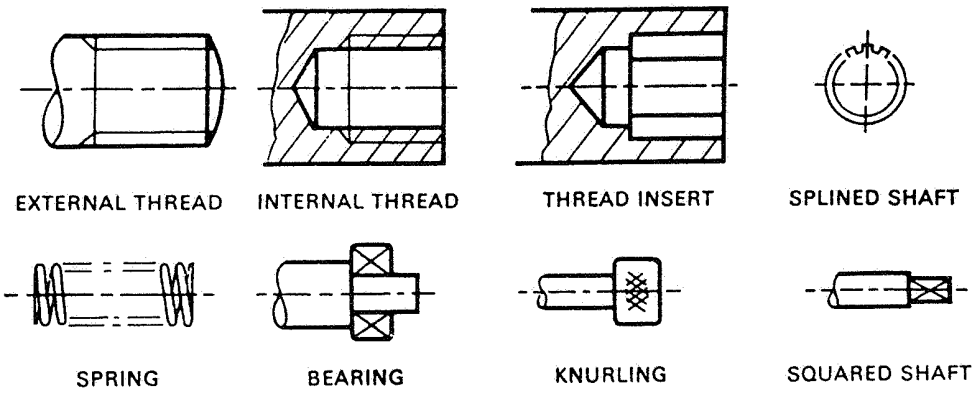
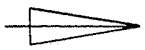


Figure 15 CONVENTIONAL REPRESENTATIONS

5.10 **Process and Identification Markings.** Drawings will often call for identification markings on parts, and will indicate both the position of the markings and the method of application, e.g. rubber stamp. In addition, it is sometimes necessary to mark the component to show that a particular process has been carried out, and this will also be specified on the drawing. Symbols are normally used for this purpose, and some of the more common ones are shown in Table 4. Some Design Organisations may use different symbols or code letters, which should be obtained from the Drawing Office Handbook, or similar publication, produced by the organisation concerned.

5.11 **Geometric Tolerances.** It is sometimes necessary to place tolerances on both geometric features and dimensions, in order to adequately control the shape of a part. On older drawings this was done by annotating the feature to be toleranced, e.g. POSN TOL, and by adding notes to the drawing, in order to specify the tolerance and the method of checking. On newer drawings, the international system recommended in BS 308 is used, and this method is outlined in the following paragraphs.

TABLE 3
ABBREVIATIONS AND SYMBOLS

Term	Abbreviation	Term	Abbreviation
Across Flats	A/F	Pattern number	PATT NO
Assembly	ASSY	Pitch circle diameter	PCD
British Standard	BS	Pneumatic	PNEU
Centres	CRS	Pound (weight)	LB
Centre line	CL or ℄	Radius	RAD or R
Chamfered	CHAM	Reference	REF
Cheese Head	CH HD	Required	REQD
Counterbore	C'BORE	Revolutions per minute	RPM or REV/MIN
Countersunk	CSK	Right hand	RH
Cylinder or cylindrical	CYL	Round head	RD HD
Degree (of angle)		Screw threads:	
Diameter—in a note	DIA	British Association	BA
—as dimension	Ø	British Standard Fine	BSF
Figure	FIG	British Standard Pipe	BSP
Full indicated movement	FIM	British Standard Whitworth	BSW
Hardness—Brinell	HB	Unified Coarse	UNC
—Rockwell	HR (+scale letter)	Unified fine	UNF
—Vickers	HV	Unified special	UNS
Hexagon	HEX	Screwed	SCR
Hexagon head	HEX HD	Second (of angle)	"
Hydraulic	HYD	Sheet	SH
Inch	IN or "	Sketch	SK
Insulated	INSUL	Specification	SPEC
Internal diameter	I/D	Spherical diameter	SPHERE Ø
Left Hand	LH	Spherical radius	SPHERE R
Long	LG	Spotface	S'FACE
Machine	M/C	Square	SQ
Machined	M/CH	Square inch	SQ IN or IN^2
Material	MATL	Standard	STD
Maximum	MAX	Standard wire gauge	SWG
Max material condition	MMC or Ⓜ	Taper	
Millimetre	MM	Threads per inch	TPI
Minimum	MIN	Undercut	U'CUT
Minute (of angle)		Volume	VOL
Not to scale	NTS	Weight	WT
Number	NO		
Outside diameter	O/D		

NOTE: Capital letters are normally used on a drawing, for clarity, but lower case letters may be used elsewhere as appropriate.

TABLE 4

PROCESS AND TREATMENT SYMBOLS

Process or Treatment	Symbol
Solution treated and not requiring precipitation	N
Solution treated and requiring precipitation	W
Precipitation treatment	P
Solution treated and precipitated	WP
Annealed	A
Hardened and tempered	HT
Mechanical test	M
Dye penetrant check	PFD
Ultra-sonic test	UFD
Anodic flaw detected	AFD
Cleaned (pipes)	AC 1
Repaired and reconditioned	R
Normalised steel parts	N
Proof loaded	PL
Stress relieved	SR
Pressure test	PT
X-ray flaw detected	XR
Salvaged	S
Electro-magnetic flaw detection	MFD
Welding	W S
Etch inspection of steel	E

5.11.1 Information relating to a particular geometric tolerance is enclosed within a rectangular frame on the drawing, an arrow from the frame indicating the location of the feature to which the tolerance applies. If the tolerance is related to a particular datum, a leader line is drawn from the frame to the datum position, or the datum is referenced separately, and identified by a letter in the frame. Unless the datum is a dimension, it is defined by a solid equilateral triangle. Examples of the methods of indicating geometric tolerances are shown in Figure 16, and the symbols used to identify the characteristic to which the tolerance is applicable are listed in Table 5. Detail (f) in Figure 16 shows a completely dimensioned component.

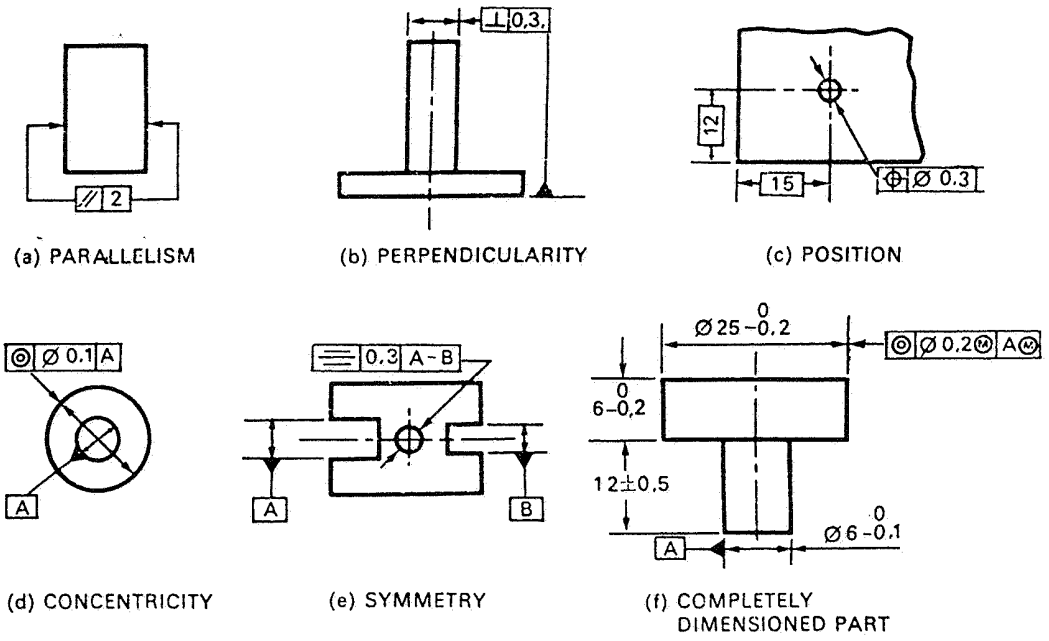


Figure 16 GEOMETRIC TOLERANCES

5.11.2 As a guide to the interpretation of a geometric tolerance, reference may be made to detail (e) of Figure 16. This indicates that a symmetry tolerance of 0·3 mm is required, with respect to datum features A and B. This tolerance indicates that the axis of the hole must be between two parallel planes, 0·3 mm apart, which are symmetrically disposed about the common median plane of the slots in the end of the part. The hole could also, if necessary, be marked to indicate a symmetry tolerance at 90° to the plane specified, and the tolerance for this could be different.

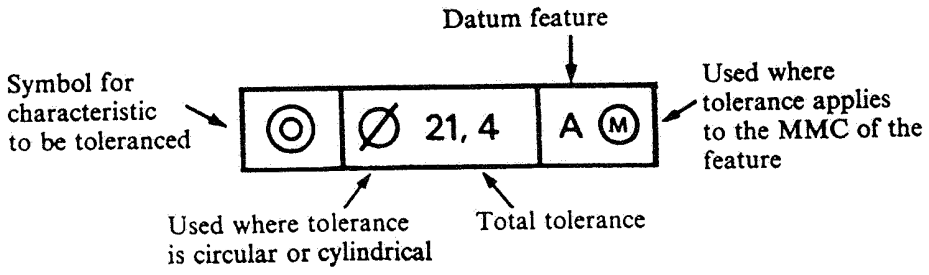
5.11.3 The symbol (M) in detail (f) of Figure 16, indicates that the tolerance applies only to the maximum material condition of the dimension or datum feature, and may be greater at the actual finished size.

TABLE 5

GEOMETRIC TOLERANCE SYMBOLS

Feature	Type of tolerance	Characteristic	Symbol
Single	Form	Straightness	
		Flatness	
		Roundness	
		Cylindricity	
		Profile of a line	
		Profile of a surface	
Related	Attitude	Parallelism	
		Squareness	
		Angularity	
	Location	Position	
		Concentricity	
		Symmetry	
	Composite	Run-out	
Maximum material condition			
Dimension which defines a true position			

Tolerance Frame



BL/1-5

Issue 3

December, 1983

BASIC

AIRWORTHINESS PROCEDURES

CONCESSIONS DURING MANUFACTURE

1 INTRODUCTION This Leaflet gives guidance on the application, authorisation and recording of concessions. The procedures described are acceptable to the CAA and are recommended for use where appropriate.

NOTE: It is common for operators of aircraft to use the word 'concession' when referring to dispensations from CAA requirements for aircraft maintenance; for example, temporary extensions of overhaul lives or maintenance check cycles. Special procedures apply to these dispensations which are not related to the concession procedures described in this Leaflet.

2 DEFINITIONS The following definitions relate to terms used in this Leaflet.

2.1 **Concession.** A concession is an authorisation to accept a limited quantity of materials, parts, assemblies and equipment which may not be strictly in accordance with the relevant drawings, specifications or other documents that define the design.

2.2 **Responsible Design Organisation.** An Organisation acceptable to the CAA for the raising of designs for aircraft, engines, controlled items of equipment or modification of such products. The Organisation would normally have been approved to the appropriate paragraphs of British Civil Airworthiness Requirements (BCAR), Sub-section A8.

3 GENERAL For an aircraft to qualify for the issue or renewal of a Certificate of Airworthiness, it is essential for all materials, parts, assemblies and equipment to have been inspected and accepted as conforming to the appropriate drawings and specifications. It is possible that some materials or items may not have been manufactured in accordance with the requirements of the drawings or specifications. These may, nevertheless, be acceptable provided that in the opinion of the Responsible Design Organisation having responsibility for the design and the quality standard the items will fulfil the design purpose, and the divergence from the relevant drawings and specifications is properly authorised and recorded.

4 BASIC PRINCIPLES All concessions must be authorised by the Responsible Design Organisation. In this matter the main responsibility is to establish an acceptable standard of quality for the products compatible with the design requirements. To achieve this, concessions should be authorised with discretion and kept to a minimum.

4.1 When a concession is authorised by the Responsible Design Organisation, it is implicit that the divergence from standard does not reduce the airworthiness level below the specified design minimum.

4.2 A copy of each concession must be retained by the authorising Responsible Design Organisation.

4.3 Concessions are not approved by the CAA, but in exceptional cases the advice of the CAA is sought. In the course of their supervisory duties the CAA Surveyors review the records of concessions, particularly before the issue of Certificates of Airworthiness.

5 CONCESSION PROCEDURE The Responsible Design Organisation should devise an application form with a title which indicates its function in relation to concessions. The same form also serves as 'Authority to Accept' when signed by the qualified representative of the Organisation. The form normally contains provision for the following information:—

(a) Name of firm. (Additionally, provision should be made for a sub-contractor using the form to enter his name.)

(b) Design Department Reference Number of concession authorisation.

(c) Date of application for the concession.

(d) Identity of the material, or part(s), which are the subject of the application, i.e. serial, part or drawing numbers.

(e) Quantity of material affected.

(f) Details of the divergence from the drawings or specifications.

(g) Effect on interchangeability.

(h) Concession(s) previously granted on these items.

(j) Authorised recovery action.

(k) Signature and observations of the responsible design personnel.

(l) Date of authorisation.

NOTE: Where necessary, adequate sketches should be provided to define precisely the divergence from drawings or specifications and the authorised recovery action.

5.1 Although requirements for concessions are often initiated by production departments, it is normally the responsibility of the quality assurance or inspection department to decide whether a concession should be sought.

5.2 After submission of the application the appropriate person(s) of the Responsible Design Organisation and quality assurance/inspection department(s), should declare on the form whether or not the particular concession is acceptable. It is essential that sufficient information is given, if necessary by appendices to the form, to leave no doubt about the standard to which the material or parts may be accepted.

5.3 A suitable reference numbering system should be in operation to provide identification for the authorisation of the particular concession.

5.4 It is the responsibility of the Responsible Design Organisation to decide which concessions should be recorded in the inspection records of particular components, assemblies or parts. In the case of components or assemblies which have serial numbers, any applicable concession reference numbers should be recorded in the relevant history record card or its equivalent.

BASIC

AIRWORTHINESS PROCEDURES

STORAGE CONDITIONS FOR AERONAUTICAL SUPPLIES

1 INTRODUCTION This Leaflet gives guidance on acceptable conditions of storage for aeronautical supplies. Generally, the Leaflet deals with the specific aeronautical materials and parts in alphabetical order, which may be used in the absence of any specific manufacturer's recommendations:—

1.1 Leaflet **BL/1-6** contains general information on procedural matters related to storage. Guidance on the identification marking of aircraft parts is given in Leaflet **BL/2-1** and on the standard colour schemes for metallic materials in Leaflet **BL/2-2**. Additional information on storage conditions may also be found in individual Leaflets of the Part II – "Aircraft" Series.

1.2 The correct handling of materials, especially the high strength aluminium alloys, is of extreme importance. Great care is necessary during loading and unloading and storage at the consignee's works to ensure that the material is not damaged by chafing, scratching, bruising or indentation, and that it is not excessively strained by bending, otherwise the mechanical properties of the material may be seriously affected. Heavy forgings, extrusions and castings should be carried and stored singly, ensuring that there is adequate support to maintain the material in its intended shape without strain.

2 GENERAL STORAGE CONDITIONS The conditions of storage of aircraft supplies are important. The premises should be clean, well ventilated (see paragraph 3.13) and maintained at an even dry temperature to minimise the effects of condensation. In many instances the manufacturer will specify the temperature and relative humidity in which the products should be stored. To ensure that these conditions are maintained within the specified range, instruments are used which measure the temperature and relative humidity of the store room.

2.1 **Temperature and Relative Humidity.** When required, the temperature and humidity should be checked at regular intervals by means of a hygrometer which measures the amount of humidity in the atmosphere. The wall-type of hygrometer is normally used and consists of wet and dry 'bulbs'; the dry bulb records the actual temperature, and a comparison between this reading and that registered by the wet bulb, when read in conjunction with a table, will indicate the percentage of relative humidity present in the atmosphere.

2.2 **Protective Materials for Storage Purposes**

2.2.1 **Vapour Phase Inhibitor (VPI).** This is a method of protection against corrosion often used for stored articles made of ferrous metals.

(a) VPI protects by its vapour, which entirely covers any article in an enclosed space. Direct contact of the solid VPI with the metal is not required. Although moisture and oxygen are necessary for corrosion to take place, VPI does not react with or remove either of them, but operates by inhibiting their corrosive action.

(b) The method most commonly used is treated paper or board, the article to be protected being wrapped in paper which has been treated with VPI or, alternatively, enclosed in a box made of VPI treated board, or lined with treated paper.

NOTE: Protection of parts by the VPI process should only be used where it is approved by the manufacturer of the part.

2.2.2 **Protective Oils, Fluids, Compounds.** Where oils, fluids or compounds are used as a temporary protection on metal articles, it should be ascertained that the material and the method of application is approved by the manufacturer of the article. Where protective oils, fluids or compounds have been used, deterioration of such fluids or compounds by handling can be minimised by wrapping in a non-absorbent material (e.g. polythene, waxed paper), which will normally increase the life of such temporary protectives by inhibiting drying out. When parts or components are stored for long periods they should be inspected at intervals to ensure that the condition of the coating is satisfactory.

2.2.3 **Desiccants.** The desiccants most commonly used in the protection of stored parts or components are silica-gel and activated alumina. Because of their hygroscopic nature these desiccants are capable of absorbing moisture either inside a packaging container or a component, thereby preventing corrosion.

(a) Desiccants should be inspected and/or renewed at specified periods or when an air-tight container has been opened. It is important when inspecting or changing a desiccant that the prescribed method is used to avoid the entry of moisture into a dry container.

(b) **Tell-Tale Desiccant.** This indicating type of desiccant is prepared with a chemical which changes colour according to its moisture content. The following table gives guidance on the relative humidity of the surrounding air.

Colour	Surrounding Relative Humidity (%)	Moisture Content of Silica-Gel (%)
Deep Blue	0–5	0·2
Blue	10	5·5
Pale Blue	20	7·5
Pinkish Blue	30	12·0
Bluish Pink	40	20·2
Pink	50	27·0

(c) Silica-gel and activated alumina can be reactivated by a simple heat treatment process. The time and temperature required to effectively dry the desiccant should be verified with the manufacturer, but a general guide is 135°C for at least two hours for silica-gel and 250°C for four hours for activated alumina. The desiccant should then be placed in a sealed container until it has cooled, after which it should be completely reactivated.

2.3 **Racks and Bins.** Open racks allow a free circulation of air and are preferable when the nature of the stock permits their use. The painted metal type of bins is more suitable than the wooden type, since with the latter there is a risk of corrosion due to mould or dampness. Polyethylene, rigid PVC, corrugated plastics or cardboard bins may also be used. Many moulded plastics bins can also be fitted with removable dividers which will allow for the segregation of small parts whilst making economic use of the space.

2.4 **Rotation of Issue.** Methods of storage should be such that batches of materials or parts are issued in strict rotation, i.e. old stock should be issued before new stock. This is of particular importance for perishable goods, instruments and other components which have definite storage limiting periods.

2.5 **Storage Limiting Period.** The manufacturers of certain aircraft units impose storage limiting periods after which time they will not guarantee the efficient functioning of the equipment. On expiry of recommended storage periods the parts should be withdrawn from stores for checking or overhaul as recommended by the manufacturer. The effective storage limiting periods of some equipment may be considerably reduced if suitable conditions of storage are not provided. Therefore, storage limiting periods quoted by manufacturers can only be applicable if the prescribed conditions of storage are in operation, and users should develop suitable limiting periods from their own experience.

2.6 **Flammable Materials.** All materials of a flammable nature, such as dope, thinners, paint, etc., should be kept in a store isolated from the main buildings. The precautions to be taken vary with the quantity and volatility of the materials, and such stores should comply with the requirements of HM Inspector of Factories and the Area Fire Authority.

2.7 **Segregation of Stock.** Care should be taken to segregate materials which may have deleterious effects on other materials, e.g. carboys of acid should not be placed in a store where escaping fumes may affect raw materials or finished parts; phenolic plastics should be segregated from cadmium-plated steel parts to prevent corrosion of the steel parts; magnesium alloys should not be stored in the vicinity of flammable materials.

2.8 **Packaging of Stock.** Stock should normally be packaged from the following:

(a) **Materials:** Plastics film, "Jiffy" bags, lanolin grease impregnated cloth, plastics film lined paper envelopes, etc.

(b) **Methods:** Oiling and placing in jars or plastics bags, individual packaging of seals, etc.

NOTE: Magnesium fittings should not normally be kept in sacks, as the materials used in making the sacks may cause corrosion of the fittings.

2.9 **Materials in Long Lengths.** It is particularly important that long lengths of material, such as extrusions, tubes, bars, etc., should generally be stored vertically, which tends to reduce problems caused by bow and handling damage. Care should also be taken when placing the material in the storage racks to prevent indentations and scratches, especially when handling the high strength aluminium alloys.

3 STORAGE CONDITIONS FOR SPECIFIC MATERIALS AND PARTS This paragraph gives guidance on recommended methods of storage for various materials and parts.

3.1 **Ball and Roller Bearings.** Ball and roller bearings should be stored in their original wrappings in dry, clean conditions with sufficient heating to prevent condensation caused by significant temperature changes.

3.1.1 If the wrapping has become damaged or if it is removed for inspection of the bearings, the bearing (providing it does not incorporate rubber seals) should be soaked and swilled in white spirit to remove storage grease and/or dirt. It is permissible to oscillate or turn the races slowly to ensure thorough cleaning, but the bearing should not be spun in this unlubricated condition because the working surfaces may become damaged. A forced jet of white spirit may be used to advantage but an efficient filter should be provided in the cleaning system.

3.1.2 In certain cases it may be preferable to clean very small bearings with benzene, but if this fluid is used, consideration should be given to the fire hazard and possible toxic effects.

NOTES: (1) There are certain proprietary light white spirits which are suitable for use with very small bearings and which eliminate some of the dangers associated with the use of benzene.

(2) Miniature steel balls and special high precision balls are immersed in instrument oil contained in plastics phials with screw-on caps.

3.1.3 After cleaning, the bearings should be inspected for signs of corrosion and then re-protected with a compound of mineral oil and lanolin and wrapped in greaseproof paper. Many miniature bearings, especially those used in instruments, are susceptible to brinelling. When such bearings have become suspect or contaminated they should be discarded.

NOTE: In many instances orders for bearings are endorsed with a requirement that special grease should be applied by the manufacturer. If this grease is removed for any reason, it is essential that grease of the correct specification is re-applied.

3.2 Aircraft Batteries

3.2.1 **Lead-Acid Batteries.** A charged battery which is to be stored for any length of time should be in the 'fully charged' condition. Before storing, the electrolyte levels should be checked and the battery bench-charged in accordance with manufacturer's instructions. When fully charged, the battery should be stored in a cool, dry, well ventilated store on an acid-resistant tray. Batteries may also be stored in the dry, uncharged state. Additional points to note are as follows:

(a) Every four to six weeks (depending on manufacturer's instructions) the battery should be removed from storage and fully recharged, i.e. until voltage and specific gravity readings cease to rise.

NOTE: Damage to the battery will occur if it is allowed to stand idle beyond the period for charging specified by the manufacturer.

(b) Regardless of periodic check charges, the battery should be given a complete charge and capacity check immediately before being put into service.

(c) For new batteries, a complete capacity test to the manufacturer's instructions should be made every six months, but if the battery has been in service this test should be made every three months.

(d) Every 12 months, or earlier if a leak is suspected, an insulation resistance test should be carried out to the manufacturer's instructions.

(e) If the conditions mentioned in the previous paragraphs are observed, a battery may remain in storage up to 18 months. A battery should not be allowed to stand in a discharged condition, and electrolyte temperatures should not exceed 48.8°C.

NOTE: Trickle charging at low rates is not recommended as damage will occur if idle batteries are subjected to this form of charging. Further information on lead-acid batteries is given in Leaflet **EEL/1—1.**

3.2.2 **Silver-Zinc Batteries and Silver-Cadmium Batteries.** These batteries should be stored in clean, dry, cool and well ventilated surroundings, not exposed to direct sunlight or stored near radiators.

(a) New batteries will normally be supplied in the dry condition with the electrolyte contained in polythene ampoules. If possible, new batteries should be stored in their original packaging together with the related ampoules of electrolyte. For storage periods of more than two years, special instructions should be requested from the manufacturers.

(b) Filled and formed batteries required for use at very short notice may be stored in the charged condition. Manufacturers normally recommend that such batteries should be discharged and recharged every four to six weeks. The manufacturer's schedule of maintenance should be applied to batteries stored in the charged condition.

(c) Batteries to be stored out of use for protracted periods should be discharged at the 40-hour rate until the voltage level, measured while discharging, falls below the equivalent of 0·8 volt per cell.

(d) Before storing batteries, the electrolyte level should be adjusted to near the maximum specified by topping up, using a potassium hydroxide solution of 1·300 s.g.

(e) The need for care in handling potassium hydroxide, because of its caustic content, is stressed. After topping up or filling, the top of the batteries should be cleaned and the connections and terminals lightly smeared with white petroleum jelly. In no circumstances should sulphuric acid or acid contaminated utensils be used in close proximity to silver-zinc or silver-cadmium batteries.

3.2.3 **Nickel-Cadmium Batteries.** This type of battery can be stored for long periods without damage, in any state of charge, provided the storage place is clean and dry and the battery is correctly filled.

(a) For the battery to be ready for use in the shortest possible time, it should be fully charged, correctly topped up, and then discharged at normal rate for a period of one hour before storage.

(b) The battery should be cleaned and dried and the terminals and connectors lightly smeared with pure mineral jelly.

(c) The battery should be inspected at intervals of six to nine months and topped up if necessary.

(d) Before going into service, the battery should be given a double charge and capacity check as recommended by the manufacturer of the particular type of battery.

(e) The battery should be stored on a shelf or rack, protected from dirt or dust, and where metallic objects such as bolts, hand-tools, etc., cannot drop onto the battery or touch the cell sides.

NOTE: The above refers to pocket plate nickel-cadmium cells and not to sintered plate nickel-cadmium cells, for which reference should be made to the manufacturer's instructions.

3.2.4 **Precautions.** It should be noted that sulphuric acid will destroy alkaline batteries; therefore, utensils which have been used for this acid should not be used with such batteries. It is also important to avoid any contamination from the fumes of lead-acid types of batteries. (See Leaflet **EEL/2-1.**)

3.3 **Braided Rubber Cord.** Braided rubber cord should be stored in a cool, dark place with an even temperature preferably not exceeding 18°C with relative humidity of approximately 65%. The cord should not come in contact with any radiant heat, grease, oil, water, organic solvents or corrosive materials.

NOTE: Storage at elevated temperatures may cause permanent deterioration of the rubber, and prolonged storage at low temperatures will cause temporary stiffening of the rubber.

3.3.1 **Storage Limiting Period.** Braided rubber cord has a storage limiting period of four years if stored in good conditions. Cord which has been issued from stores within the four year period from the date of manufacture may remain in service until the expiry of five years from that date.

(a) The date of manufacture of cordage can be determined by the colour of the threads in the cotton outer casing; light blue 1966; black 1967; mid-green 1968; heliotrope (purple) 1969; and yellow 1970. After 1970 the colours are repeated in the same sequence for a further five years and subsequently until further notice.

(b) The number of coloured threads indicate the quarter of the year in which the cord was manufactured, e.g. one thread indicates the cord was made between 1st January and 31st March inclusive.

NOTE: Details are given in British Standard Specification F51, Light Duty Braided Rubber Cord for Aeronautical Purposes.

3.4 **Compressed Gas Cylinders.** Stores which are used for storage of compressed gas cylinders should be well ventilated. The cylinders should not be exposed to the direct rays of the sun and no covering should be used which is in direct contact with the cylinders. Cylinders should not be laid on damp ground or exposed to any conditions liable to cause corrosion. Gas storage cylinders should normally be fitted with a transportation/storage cap over the shut-off valve to help prevent handling damage and contamination of parts which could cause a risk of explosion or fire. Portable gas cylinders (e.g. therapeutic oxygen, fire extinguishers) should be stored on racks and, where appropriate, control heads and gauges should be protected against impact.

3.4.1 No heating is required in stores where compressed gas cylinders are kept, unless specified by the manufacturer.

3.4.2 Lighting for stores containing combustible gas cylinders (i.e. acetylene) should be flameproof, or installed outside the building, lighting the interior through fixed windows.

3.4.3 Store rooms should be constructed of fireproof materials and the cylinders so placed to be easily removable in the event of fire. The store should be at a distance from corrosive influences, e.g. battery charging rooms.

3.4.4 Full and empty cylinders should be stored in separate rooms, and appropriate notices displayed to prevent confusion.

3.4.5 Oxygen and combustible gases such as acetylene should not be stored together. Acetylene cylinders should be stored in the upright position.

3.4.6 Oxygen cylinders are generally rounded at the bottom, thereby making it unsafe to store in an upright position without suitable support. If cylinders are stacked horizontally special wedges should be used to prevent the cylinders rolling, and the stack of cylinders should not be more than four high.

3.4.7 Breathing oxygen and welding oxygen should be segregated and properly labelled to avoid confusion. In some cases welding oxygen may be used for testing oxygen components not installed in the aircraft, but welding oxygen should not be used in aircraft oxygen systems.

3.4.8 **Precautions.** If cylinders are exposed to heat, the gas pressure will increase and the cylinder walls may be weakened, causing a dangerous condition. Cylinders should be stored at some distance from sources of heat such as furnaces, stoves, boilers, radiators, etc.

(a) Oil or grease will ignite in the presence of oxygen, and if the latter is under pressure an explosion may result. Cylinders should be kept away from sources of contamination, such as oil barrels, overhead shafting, hydraulic components or any container or component that may contain oil or grease.

(b) Smoking, exposed lights or fires should not be allowed in any room where compressed gases are stored, and oily or greasy clothes or hands should be avoided when handling the cylinders.

(c) Grit, dirt, oil and water should be prevented from entering the cylinder valves.

(d) When returning any cylinder that may have been accidentally damaged or overheated, the supplier should be notified so that any necessary action may be taken before refilling.

3.5 **Electrical Cables.** Where electrical cables are stored in large reels it is necessary that the axis of the reels are in a horizontal position. If stored with the axis vertical there is a possibility that the cable in the lowest side of the reel will become crushed.

3.6 **Fabric.** Fabric and fabric covering materials (e.g. strips and thread) should be stored in dry conditions at a temperature of about 21°C away from direct sunlight. Discoloration, such as iron mould, is sufficient to cause rejection of the material and this may be caused by unsuitable storage conditions. Most synthetic fibre fabrics should be stored away from heat sources. Rubber proofed fabrics should be stored away from plasticised materials such as PVC as it is known, in some cases, for plasticisers to leach from some plastics and have an adverse affect on rubbers.

3.7 **Forgings, Castings and Extrusions.** All large forgings, castings and extrusions should be carefully and separately stored on racks to avoid superficial damage.

NOTE: The high strength aluminium alloys are susceptible to stress corrosion when in the solution treated condition, and it is important that parts so treated should be coated with a temporary protective such as lanolin.

3.7.1 Aluminium alloy forgings which are anodised normally need no protection in a heated store. Finished details should be protected in accordance with DEF STAN 03-2.

3.7.2 Aluminium alloy castings in store should not be contained in sacks or absorbent packages. It is not normally necessary to protect castings before machining, but finished details should be protected as for forgings in paragraph 3.7.1.

3.7.3 Aluminium alloy extrusions should be protected in store with a lanolin and mineral oil solution (DEF STAN 80-34) and as finished details with DEF STAN 03-2 as in paragraph 3.7.1.

3.8 **Instruments.** The smaller types of instruments are usually delivered in plastic envelopes and these should be used during storage to minimise the possible effects of condensation. The transit containers of the larger instruments contain bags of silica-gel (paragraph 2.2.3) to absorb moisture which may enter. The gel should be examined periodically, and if its colour has changed from blue to pink it should be removed, dried out and replaced, or renewed. It is essential that all instruments should be stored in a dry, even temperature, and that the storage limiting period recommended by the manufacturer is not exceeded.

NOTE: Whenever possible instruments should be kept in transit or similar cushioned containers until required for fitment to an aircraft.

3.8.1 In the absence of any specific recommendation by the manufacturer the storage limiting period for instruments should not exceed three years and on completion of this time the item should be re-certified in accordance with the relevant Overhaul Manual. Additionally, any equipment containing gyro assemblies should be exercised and gyro wheels run for a period of 24 hours at the completion of periods not exceeding each 12 months of storage.

3.9 **Oil Coolers and Radiators.** Oil coolers and radiators are normally filled with an inhibiting fluid during storage; the fluid used should be in accordance with the manufacturer's instructions. The components should not be stored on the floor, but placed on raised wooden supports to permit a free circulation of air and minimise the possibility of damage to the matrices.

3.10 **Paints and Dopes.** For the storage of paint and related materials (i.e. all low flash point materials) it may be necessary to obtain a licence to comply with the requirements of the Petroleum Act. Paints should be kept in a dry store at a controlled temperature between 7 and 23°C.

3.10.1 Paint containers should be marked with the date of receipt so that the oldest batches may be used first, as pigments tend to 'settle out' when paint is stored. A simple method of avoiding settlement is to invert containers at regular intervals, e.g. once a month.

3.10.2 **Toxicity of Solvents.** If paints are handled or mixed in a confined space it is important to ensure adequate ventilation during such operations as the fumes from volatile liquids are harmful if inhaled in sufficient concentration.

NOTE: A point frequently overlooked in ventilating a paint store is that most solvents are heavier than air, so that ventilation is more efficient downwards than upwards.

3.10.3 Provided paints and dopes are suitably stored in their original sealed containers, the storage limiting period is normally 12 months in the United Kingdom, but this may vary elsewhere; for example, in tropical conditions the period is normally six months.

3.11 **Pipes.** Rigid pipes should be adequately supported during storage to prevent distortion. Flexible pipes should, unless otherwise stated by the manufacturer, be suitably wrapped, for example, in a sealed plastics sleeve before being stored in a darkened room, maintained at a temperature of approximately 15°C. In hot climates, flexible pipes should be stored in cool places where air circulates freely, since high temperatures tend to accelerate surface hardening of the outer cover.

3.11.1 Flexible pipes should be stored in a completely unstressed condition and, where possible, should be suspended vertically (see also paragraph 3.13.14).

3.11.2 The ends of all pipes should be blanked, using a type of blank which does not allow it to be left in position when the pipes are fitted. The use of rags or paper for this purpose is prohibited. The blanks should not be removed until just prior to fitting the pipe.

3.12 **Pyrotechnics.** Pyrotechnics should be stored in a dry, well ventilated building and kept at constant room temperature. The building should conform to the local by-laws laid down by the Local Authority.

3.12.1 At the periods specified by the manufacturer, pyrotechnics should be examined for any signs of damp or other external damage.

3.12.2 With paper-cased items, such as signal cartridges, the effect of damp is usually indicated by softening or bulging of the outer case and evidence of staining.

3.12.3 With metal-cased items, the effects of damp may often be indicated by traces of corrosion or tarnishing of the case and/or staining of the instructions label.

3.12.4 All pyrotechnics gradually deteriorate in time, although such deterioration will vary with factors such as quality or type of composition, degree of protection afforded by the containers, etc. For this reason a proportion of the items should be proof-tested at regular intervals as specified by the manufacturer; the items will also have a maximum serviceable life, regardless of proof testing, which should not be exceeded.

NOTE: The most likely effect of storage deterioration is a loss of brightness and range.

3.13 **Rubber Parts and Components Containing Rubber.** The following storage conditions are generally acceptable for a wide range of components containing rubber in their construction or parts made of rubber. In many cases manufacturers make special recommendations and these should also be observed. (Further information can also be found in BS F68 and F69.)

3.13.1 **Temperatures.** The storage temperature should be controlled between 10 and 21°C and sources of heat should be at least three feet from the stored article (unless screened) to minimise exposure to radiant heat. Some special rubber materials (e.g. neoprene) may withstand a wider range of temperature satisfactorily, i.e. −12 to 26°C, but before any rubber part is exposed to these temperatures the manufacturer's recommendations should be verified. This particularly applies to any special precautions necessary when thawing parts which have been subjected to the lower temperatures.

3.13.2 **Humidity.** The relative humidity in the store room should be about 75%. Very moist or very dry conditions should be avoided.

3.13.3 **Light.** Rubber parts should not be exposed to direct daylight or sunlight. Unless the articles are packed in opaque containers, store room windows or skylights should be screened or covered with a suitable transparent red or amber coating. Store rooms should be kept as dark as practicable. Use of artificial light which has a high ultra-violet level should be avoided.

3.13.4 **Oxygen.** Isolation from atmospheric oxygen greatly increases the storage limiting period of rubber parts. Where possible, parts should be packed in airtight containers or wrappings using talc or french chalk. Where parts are packed in airtight tins, the tins should be lined with wax paper or polythene to avoid direct contact with the metal.

3.13.5 **Ozone.** Exposure to air containing ozone even in minute quantities should be avoided. Storage rooms should not contain any apparatus liable to generate ozone, such as high voltage electrical equipment, electric motors or other plant which may give rise to electrical sparks. Free access to outdoor air, which in temperate climates always contains ozone, should be avoided. Still indoor air is normally ozone-free because wall and ceiling coverings and organic materials rapidly destroy ozone.

3.13.6 **Deformation.** Rubber parts should be stored in a 'relaxed' position free from compression or distortion, with the least possible deformation. Deformation greatly aggravates the action of ozone and also leads to permanent changes in shape and dimensions. Articles received prepacked in a strain-free condition can, with advantage, be stored in their original packing, as long as they are clearly identified and labelled.

3.13.7 **Contamination.** Rubber parts should not come in contact with liquids or vapour concentrations during storage even though they may be subsequently used in contact with a similar fluid. Contact with copper, brass or corroded iron or steel, or with any compounds of manganese, should be avoided.

NOTE: If deterioration of seals is suspected, it can usually be verified by stretching the seals to 20% of their internal diameter. If cracks are visible under x10 magnification, the seals should be rejected.

3.13.8 **Hydraulic and Pneumatic System Components.** Hydraulic and pneumatic components generally have a nominal seven year shelf life which may usually be extended for periods of two years by inspections.

NOTE: The maximum service life of seals is usually to be found in the approval Maintenance Schedule.

3.13.9 In many instances, hydraulic components are stored filled with hydraulic fluid which may leak slightly from the component; it is therefore important to ensure that fluid will not come into contact with other stored items.

3.13.10 If the stored component is filled with a fluid other than that used in the aircraft system (e.g. DTD 5540 is a hydraulic component storage fluid only) the component should be clearly labelled to ensure the removal of all traces of storage fluid prior to installation in the hydraulic system.

3.13.11 To avoid adhesion and to exercise the seals, in some cases it is recommended that the component should be operated several times at three-monthly intervals. If the seals are square or rectangular, special care should be used in the initial operation as experience has shown that there is a tendency for seal stiction on its bearing surface and, if the part incorporating the seal is moved rapidly, the seal may tend to rotate and be damaged. This applies also where spring-loaded seals are concerned; growth of the rubber may result in damage to the sealing lip.

3.13.12 **Tyres.** Tyres should be stored vertically in special racks embodying support tubes, so that each tyre is supported at two points. Two-thirds of the tyre should be above the support tubes and one-third below. By this method the weight of the tyre is taken by the tread and distortion is reduced to a minimum. The tyres should be turned to a new position every two or three months. Where tyres are delivered in bituminised hessian wrappers, the wrappers should be left on during storage.

3.13.13 **Inner Tubes.** Inner tubes should be stored in the cartons in which they were received, but where this is not possible the tubes should be lightly inflated and stored inside covers of appropriate sizes to prevent damage. Tubes should not be secured in a fixed position (such as a tight roll) by rubber bands or tapes as this may cause the rubber to crack.

3.13.14 **Storage of Rubber Hose and Hose Assemblies.** Unless otherwise specified by the manufacturer, rubber hoses should be inspected and tested every two years; they should also be inspected and tested immediately prior to installation.

(a) **Storage Conditions.** Hose and hose assemblies should be stored uncoiled and supported to relieve stresses. Air should circulate freely about the hoses unless they are contained in plastics envelopes. Temperatures in the store should be controlled as detailed in paragraph 3.13.1.

NOTE: Care should be taken to ensure that the plastics envelopes selected are compatible with the hose material, since some, including PVC, can have a deleterious effect on rubber.

(b) **Sealing Blanks.** The correct sealing blanks should always be fitted to items in store. Plugs and caps conforming with AGS specifications are suitable but, where standard blanks cannot be fitted, the blanks used must be so designed that they cannot enter the pipe or be left in position when the assembly is coupled up. It is also important that the material used for blanking purposes will not 'pick-up' or leave small particles inside a coupling after long periods of storage. Tape, rag or paper should not be used.

(c) **Bore Protection.** In some special cases, to prevent deterioration of the bore or inner lining of the hose, it may have to be stored filled with the liquid which it is intended to contain in service and instructions concerning this procedure are normally attached to the assembly. If a hose assembly is enclosed in an airtight plastics envelope, this should not be removed until the hose assembly is to be fitted. If this envelope becomes damaged during handling, it should be resealed or renewed after any desiccant inside has been checked for condition.

(d) **Markings on Hose.** Various methods are employed to mark the date of manufacture on hoses. It is sometimes stencilled on the external surface, or impressed on a tab or band secured to the hose. In instances where the external surface is of cotton braid, some of the 'picks' are woven in black and some in colour which indicates the month and year of manufacture, as required by the appropriate Specification.

3.13.15 **Cleaning.** Any cleaning of rubber parts and components containing rubber, after storage, should be done with water, soap solution or methylated spirits. If synthetic detergents are used, care should be taken to select those that are not harmful to rubber. Petrol (or other petroleum spirit), benzene, turpentine, etc., should not be used, nor may cleaning be carried out with sharp or abrasive objects such as wire brushes or emery cloth. Disinfectants should not be used. After cleaning, articles should be rinsed in water and dried at a distance from any direct heat.

3.14 **Sheet, Bar and Tube Metal.** It is recommended that sheet material should be stored on edge in racks; care being necessary to prevent the bending of single sheets. Flat stacking is not recommended (unless suction pads are used to lift the sheets) since sheets are almost invariably slid from the stack, often resulting in detrimental scratches on the sheet removed and on the adjacent sheet. Where vertical storage is employed, the material should be kept clear of the floor to prevent possible damage by scraping, splashing from disinfectants used for floor cleaning (which may cause corrosion) and the possibility of edge corrosion, which can occur with light alloy materials when in contact with composition floors. Temporary protectives, such as grease, paper or plastics coating, should be left in position until the material is required for use. If the temporary protective becomes damaged or partially removed, it should be restored without delay, and a periodic inspection of stock should be made.

3.14.1 There may be some merit in storing the sheet material in the transit cases. After the initial checking of the sheets, the case should be closed to eliminate dust/dirt which can cause surface scratching during handling operations.

3.14.2 Metal bars should be stored in racks either horizontally or vertically, well supported along the length when stored horizontally to prevent bending under weight. Metal tubing is normally stored in racks, well supported, the smaller diameter tubing being wired along the length, in bundles, to prevent damage.

NOTE: Floor cleaning fluids containing chlorides should not be allowed to contact metallic materials, particularly austenetic steel as a brittle fracture may eventually result.

3.15 **Sparking Plugs.** The plugs should be treated with light oil or other suitable corrosion inhibitor. The inhibitor should not come into contact with the plug screen, but the electrode end of the plug may be filled with oil and then emptied prior to fitting the caps. Plugs receiving this treatment should be washed out with tricloroethylene or carbon tetrachloride before use. Protector caps should be screwed on both ends of the plugs to prevent the ingress of moisture or foreign matter. The plugs should be stored in a warm dry place, preferably in a heated cupboard, as an additional precaution against the ingress of moisture.

3.16 **Survival Equipment.** Survival equipment should be stored in a room which can be maintained at a temperature between 15 and 21°C, and which is free from strong light and any concentration of ozone.

3.16.1 **Preparation for Storage.** The manufacturer's instructions should be carefully followed when preparing survival equipment for storage. These instructions normally include: ensuring that the component is completely deflated; removing easily detachable components; fitting protection blanks or pads to inflation valves and other connections; dusting the component with french chalk and folding it loosely; wrapping in waterproof paper; and placing it on a shelf above the floor.

3.16.2 A tie-on label should be attached to the wrapping stating:

(a) The type, serial number and part number of the equipment.

(b) Date of inspection and inflation tests.

(c) Date of overhaul.

(d) Date of component overhaul.

(e) Date of next inspection and/or test.

NOTE: The components should be stored with the equipment but it is preferable that any CO_2 cylinders be fitted with a transit cap and stored separately.

3.16.3 Under no circumstances should life-jackets or liferafts be stored one on top of the other without a separation of corrugated paper or similar shock absorbing material.

(a) In the case of liferafts, not more than three should be stored on top of each other.

(b) In the case of life-jackets, up to ten may be stored on top of each other.

(c) Owing to the light texture of life-jackets, it is important that they should be handled with care to avoid damage.

3.16.4 **Storage Limiting Period.** The period is normally six months if packed and stored in accordance with the manufacturer's instructions. At the end of this period survival equipment should normally be:

(a) Opened up and inspected before further storage.

(b) Inspected, tested and overhauled prior to being operationally packed for stowage in aircraft.

3.16.5 Liferafts and life-jackets not operationally packed and placed in storage for more than ten days after the last test should be re-tested before installation in an aircraft.

3.17 **Tanks (Flexible).** The precautions to be taken during storage will depend on the type of tank and the packaging method (if any) used. Some manufacturers of flexible tanks specify that the tanks should be coated with a special preparation if they are to remain empty for more than two or three days, and that this preparation should be removed before the tanks are put into service.

3.17.1 Manufacturers also specify a 'long term' or 'short term' storage procedure contingent upon special requirements.

3.17.2 'Short term' storage is the period between transport of the tanks from the manufacturer's works and delivery for immediate installation by the aircraft firm.

3.17.3 'Long term' storage covers the period during which the tanks are held following receipt by the aircraft firm before installation, or shipment to locations at home or abroad, involving an extended period of storage prior to installation.

3.17.4 Flexible tanks can be divided into two categories for packaging and storage purposes:

(a) Tanks that can be folded, e.g. those not fitted with rigid internal members, heavy coverings or fittings which would preclude satisfactory folding.

(b) Tanks with heavy protective coverings, or fitted with rigid internal members, anti-surge valves, gauge units, etc.

3.17.5 **Folding and Packing.** When packing a tank for storage purposes it is important to fold it in such a way that no strain or creasing is imposed on the folded areas, and in many instances folding diagrams are provided. All openings should be sealed with the specified blanks and corrugated cardboard interposed between the folds.

(a) After folding, the tank should be encased in an airtight wrapping, such as a polythene bag, and sealed.

(b) The tank in its airtight envelope should then be placed in a cardboard box which should also be sealed.

(c) Flexible tanks which are unsuitable for folding because of internal or external fittings, etc., are often packed in an air-inflated state suitably supported in sealed cases. This method of packing is used only for short term storage. For long term storage of this type of tank, the manufacturer's instructions should be followed which will vary with the shape and type of tank concerned.

3.17.6 **Storage Conditions.** Generally, flexible tanks should be stored in the original airtight containers supplied by the manufacturer and if this is not possible a similar airtight storage container should be used. The manufacturer's instructions should be observed closely. The tanks should be stored in cool, dry, draught-proof conditions, at a temperature not exceeding 25°C and preferably below 15°C.

3.18 **Tanks (Rigid).** Rigid tanks should be carefully cleaned and any moisture dried out before storage. All apertures should be sealed with closely-fitting blanks. A silica-gel cartridge attached to a blank and placed inside the tank assists in preventing internal condensation and subsequent corrosion.

3.19 **Timber.** Plywood panels should be stored flat, away from all sources of heat or damp. Other timber sections should be stacked with spacers between each section to permit the free circulation of air. The timber should be checked periodically for moisture content (see Leaflet **BL/6-6**).

3.20 **Transparent Acrylic Panels.** Acrylic sheets should be stored on edge, with the protective paper left in position as this will help to prevent particles of grit, etc., becoming embedded in the surfaces of the sheets. When this is not possible, the sheets should be stored on solid shelves, and soft packing, such as cotton wool, should be placed between each sheet. The pile of sheets should be kept to a minimum and not exceed 12 sheets.

3.20.1 Curved panels should be stored singly with their edges supported by stops to prevent 'spreading'.

3.20.2 There are several proprietary lacquers available for the protection of acrylic panels and shapings during handling and storage, including those complying with specifications DTD 900/5592. Protective paper may also be used and, to prevent deterioration of the adhesive between the protective paper and the sheet, store rooms should be well ventilated, cool and dry. The material should not be placed near steam pipes or radiators as hot conditions will cause the adhesive to harden and make the subsequent removal of the paper difficult.

3.20.3 Material in storage should not be exposed to strong sunlight, particularly when the light shines through a glass window. This could cause a 'lens' formation resulting in local over-heating to the detriment of the material.

3.20.4 Acrylic materials should not be stored with certain other materials because of the adverse effects which may arise from the vapours given off. A typical list of these materials is as follows:

Acetone	Dopes
Ammonia Vapour	Ethyl Alcohol
Amyl Acetate	Glacial Acetic Acid
Aviation Gasoline	Methyl Alcohol
Aviation Turbine Fuel	Nicotine
Benzene	Rust Remover
Butyl Acetate	Skydrol 500, and similar fluids
Carbon Tetrachloride	Synthetic Finishes
Cellulose Paints	Thinners
Cresol	Trichloroethylene
Deoxidine Materials	

3.20.5 When sheets are handled or moved they should be lifted off (not drawn from) the adjacent sheet. The vulnerability of transparent plastics to surface damage by scratching and bruising should be impressed on all personnel handling the material.

3.21 **Windscreen Assemblies.** All types of windscreen panels should be carefully protected from scratches, abrasions or other damage as small scratches or abrasions may considerably weaken the panels and impair their optical qualities. The manufacturer's recommendations relating to packaging or protective wrapping for storage purposes should be carefully followed.

3.21.1 **Glass Panels and Windscreen Assemblies.** All types of glass panels should be carefully protected from scratches, abrasions or other external damage.

3.21.2 **Sandwich Type Windows.** Sandwich type windows should be stored vertically in dry conditions, each window having its own desiccant cartridge attached, which should be inspected and renewed at specified periods. Spare windows are usually despatched with desiccant cartridges attached and these should not be removed until the window is to be connected to the aircraft desiccation system.

(a) Windows in transit should be allowed to 'breathe', this being particularly important when windows are transported by air, as considerable atmospheric pressure variations may be encountered.

(b) In addition to desiccant breathing cartridges, some manufacturers build into each window airspace another desiccator which consists of small discs of activated alumina strung on wire and encased in a cylindrical fabric stocking. Normally the desiccator does not require renewing.

3.21.3 **Electrically Heated Windscreens.** Extreme care is necessary in handling and storing windscreens. It is generally recommended that windscreens are stored in the manufacturer's packing, which usually consists of protecting both surfaces with adhesive polythene, wrapping in acid-free paper and cellulose wadding and storing in reinforced cartons.

(a) The panels should be stored separately in their cartons on racks, away from any strong light at a controlled temperature of approximately 10 to 21°C in well ventilated conditions.

(b) It is important that during handling or storage the thick glass laminate is kept uppermost to prevent delamination and that the polythene film is not removed until the panel is fitted to the aircraft.

3.22 **Wire Rope.** Wire rope should be stored in dry, reasonably well ventilated and temperature controlled conditions to prevent condensation. Wire ropes should not be stored where they might be exposed to the corrosive influence of acid fumes, steam or other corrosive agents, and should never be placed on a stone or concrete floor.

3.22.1 Wire rope in store should be inspected periodically for signs of corrosion or other damage and, where a wire rope dressing has been used, this should be renewed when necessary.

3.22.2 Wire rope should be wound on a reel, the diameter of which will be specified by the manufacturer according to the size and type of rope (usually 40 to 50 times the diameter of the rope).

3.22.3 If reels are made locally, it is important that oak, chestnut or western red cedar are not used in their construction as these timbers may corrode the wire rope. The inside of the reel should be lined with waterproof paper.

3.22.4 When unwinding wire rope, a spindle should be placed through the centre of the reel and fixed so that the reel is free to rotate and the free end of the cable can be pulled out in direct line with the reel. The cable should not be unwound by paying off loose coils, or by pulling the wire away from a stationary reel laid on its side. When cut-off lengths of wire rope are hand coiled, the coils should be of a diameter not less than 50 times the diameter of the wire rope concerned, with a minimum of 152 mm (6 in) diameter. When hand coils are unwound, the coil should be rotated so that the wire rope is paid out in a straight line. If the wire rope forms a loop on itself, this indicates a localisation of turn and should be eliminated by taking the turn out and not by pulling straight.

3.22.5 Before cutting the cable to length, it should be bound either side of the proposed cut to prevent loss of tension from the woven strands.

BASIC

AIRWORTHINESS PROCEDURES

LEGISLATION AND REQUIREMENTS

1 INTRODUCTION The purpose of this Leaflet is to provide guidance and advice on the significance of the legislation and Civil Aviation Authority (CAA) requirements applying to the airworthiness of civil aircraft, particularly where these matters affect Licensed Aircraft Maintenance Engineers and Approved Organisations. It is, therefore, necessary to distinguish the differences between legislation and requirements. The Air Navigation Order (ANO) and the Regulations, which are Statutory Instruments, are legislative and have the force of law. British Civil Airworthiness Requirements (BCAR) published on behalf of the CAA, and Joint Airworthiness Requirements (JAR) published on behalf of the Airworthiness Authorities Steering Committee are the Requirements referred to in this Leaflet.

2 THE INTERNATIONAL CIVIL AVIATION ORGANISATION

2.1 As a result of the International Civil Aviation Conference which took place in Chicago in 1944, the International Civil Aviation Organisation (ICAO) was set up in Montreal, Canada, on 4 April 1947 by the international contracting states of which the United Kingdom was, and remains, a participating member.

2.2 One of the primary objectives of the Chicago Convention was to promote and develop the principles and techniques of international air navigation and air transport technical standards and recommended practices.

2.3 Whenever amendments are made to the Convention or the technical standards, it is the responsibility of the CAA to advise the Department of Transport on the acceptability of those changes for final UK adoption.

3 CIVIL AVIATION ACT 1982

3.1 The Civil Aviation Act 1982, which consolidated many earlier enactments, is now the principal Act of Parliament which regulates civil aviation activities in the United Kingdom.

3.2 Section 3 of the Act specifies the functions of the CAA, which include:—

(a) Those functions conferred on it (by the Civil Aviation Act) with respect to:—

(i) the licensing of air transport,

(ii) the licensing of the provision of accommodation in aircraft,

(iii) the provision of air navigation services and,

(iv) the operation of aerodromes and the provision of assistance and information.

(b) Those functions conferred on it by, or under, the Air Navigation Order with respect to:—

(i) the registration of aircraft,

(ii) the safety of air navigation and aircraft (including airworthiness),

(iii) the control of air traffic,

(iv) the certification of operators of aircraft,

(v) the licensing of air crews and aerodromes.

3.3 To give effect to UK membership of ICAO, Section 60(2) of the Act states that:—

'An Air Navigation Order may contain such provision as appears to Her Majesty in Council to be requisite or expedient:—

(a) for carrying out the Chicago Convention, any Annex thereto relating to international standards and recommended practices (being an Annex adopted in accordance with the Convention) and any amendment of the Convention or any such Annex made in accordance with the Convention; or

(b) generally for regulating air navigation.'

4 THE AIR NAVIGATION ORDER 1985

4.1 The ANO is the principal Statutory Instrument regulating air navigation. The ANO comprises Articles (which are divided into Sub-parts) and 13 Schedules:—

Part I Registration and Marking of Aircraft

Part II Air Operators' Certificates

Part III Airworthiness and Equipment of Aircraft

Part IV Aircraft Crew and Licensing

Part V Operation of Aircraft

Part VI Fatigue of Crew

Part VII Documents and Records

Part VIII Control of Air Traffic

Part IX Aerodromes, Aeronautical Lights and Dangerous Lights

Part X General

SCHEDULES

4.2 **Air Navigation General Regulations.** In addition, the ANO empowers the Secretary of State to make Regulations on specific subjects. For example, the Air Navigation (General) Regulations 1981 is a Statutory Instrument (SI) which amplifies the ANO with respect to:—

(a) Load Sheets

(b) Weight and Performance — general provisions

(c) Weight and Performance of Public Transport Aeroplanes

(d) Noise and Vibration caused by aircraft on Aerodromes

(e) Certificates of Release to Service (issued by maintenance engineers licensed by prescribed countries)

(f) Aerodrome Facilities

(g) Pilot Maintenance — prescribed repairs or replacements

(h) Mandatory Reporting

(i) Minimum Navigation Performance

(j) Weight and Performance of Public Transport Helicopters.

4.3 There are also separate Air Navigation Orders dealing with noise certification of aircraft and aircraft engine emissions.

4.4 Although the ANO establishes in law the basis for the regulation of civil aviation, it does not provide the specific details of what is to be achieved, e.g. technical requirements. This information including the administration procedures is contained in such publications as BCAR (see paragraph 7). For example, Article 16(1) of the ANO prescribes that for;

> 'Every flying machine and glider in respect of which a Certificate of Airworthiness issued or rendered valid under this Order is in force shall be weighed, and the position of its centre of gravity determined, at such times and in such manner as the Authority may require or approve in the case of that aircraft.'

The fulfilment of this provision is provided for in BCAR Section A, Chapter **A5—1** (Weight and Balance of Aircraft) and the certification requirements of BCAR Chapters **A2—1, A2—2, A2—3, A2—4** and **A2—5**. The methods of achieving the requirements are not however prescribed, but decided against a background of current aeronautical knowledge and practice.

4.5 The above illustrates, in basic terms, the system of airworthiness control which is accomplished in conjunction with Approved Organisations and Licensed Aircraft Maintenance Engineers.

NOTE: The ANO is frequently subject to amendment, therefore the current status of the ANO should always be checked prior to use.

5 THE CIVIL AVIATION AUTHORITY — SAFETY REGULATION GROUP

5.1 The CAA was set up in 1972 to bring together the regulation of civil aviation within one body.

5.2 One of the primary responsibilities bestowed upon the CAA by the Civil Aviation Act and the Air Navigation Order, is the certification and approval of aircraft and their constituent parts. This function is carried out by the Safety Regulation Group (SRG) based in Aviation House, Gatwick Airport.

5.3 To date the SRG comprises the following divisions and departments:

(a) **Operating Standards Division** — Flight Operations Department, Sporting and Recreational Aviation Department. Operations Regulation Policy Department, Maintenance Standards Department.

(b) **Design and Manufacturing Standards Division** — Projects Department, Structures and Materials Department, Systems Department, Powerplant Department, Flight Department, Policy Development and Co-ordination Department.

(c) **Licensing Standards Division** — Flight Crew Licensing Department, Engineer Licensing Department and Aerodrome Standards Department.

(d) **Medical Division**— covering medical examination and certification and medical aspects of flight safety and research.

(e) **Support Services Division**— providing administrative and technical support services including the Safety Data and Analysis Unit and an Airworthiness Requirements Section.

5.4 The SRG also prescribes airworthiness procedures based on the current legislation, approves organisations (see BCAR Section A, Sub-section A8), and issues licences to Aircraft Maintenance Engineers, (subject to examination), to whom privileges are given to certify work done and issue maintenance certificates on specified types of aircraft, engines, and systems.

6 BRITISH CIVIL AIRWORTHINESS REQUIREMENTS

6.1 British Civil Airworthiness Requirements (BCAR) comprise minimum technical requirements, and administrative procedures, that form the basis for: the construction of aircraft; the approval of equipment; the approval of design, manufacturing and maintenance organisations; the approval of personnel; certification and continued airworthiness procedures. BCAR's set out, within the framework of current aeronautical knowledge, mandatory, imperative, and permissive objectives to allow those concerned with the design, construction and maintenance of aircraft, to show possible alternative methods of compliance with the BCAR which would offer equivalent airworthiness.

6.2 BCAR (of which Joint Airworthiness Requirements (JAR) forms a part), are sub-divided as follows:—

Section A — Certification and Approvals Procedures (**CAP 460**)
Section G — Rotorcraft (**CAP 465**) — see NOTE: (4)
Section J — Electrical (**CAP 466**)
Section K — Light Aeroplanes (**CAP 467**) — see NOTE: (4)
Section L — Licensing — Aircraft Maintenance Engineers (**CAP 468**)
Section M — Emissions Certification (**CAP 514**)
Section N — Noise (**CAP 469**)
Section Q — Non-Rigid Airships (**CAP 471**)
Section R — Radio (**CAP 472**)
Section S — Small Light Aeroplanes (**CAP 482**)
BCAR 23 — Light Aeroplanes (**CAP 531**)
BCAR 29 — Rotorcraft (**CAP 524**)
BCAR 31 — Manned Free Balloons (**CAP 494**)
JAR-1 — Definitions and Abbreviations
JAR-APU — Auxiliary Power-Units
JAR-22 — Sailplanes and Powered Sailplanes
JAR-25 — Large Aeroplanes

JAR-AWO — All Weather Operations

JAR-E — Engines

JAR-P — Propellers

NOTES: (1) See paragraph 7 for further details regarding JAR.

(2) Section P — Provisional Airworthiness Requirements for Civil Powered-Lift Aircraft are provisional requirements published by the CAA for Powered-Lift Aircraft (i.e. VTOL, STOL, CTOL) and are not, to date, formally approved.

(3) On 1 July 1979 JAR-25 replaced Section D (Aeroplanes); on 1 November 1980 JAR-22 replaced Section E (Gliders); on 1 January 1984 JAR-E and JAR-P replaced Section C (Engines and Propellers). JAR-E is now available as a complete text but the format of JAR-P is such that Section C of BCAR is necessary to present a complete text.

(4) On 11 December 1987 BCAR 23 replaced Section K — Light Aeroplanes as the UK Airworthiness Code for new types of Light Aeroplanes. On 17 December 1986 BCAR 29 replaced Section G — Rotorcraft as the UK Airworthiness Code for new types of rotorcraft.

6.3 **Amendments**

6.3.1 **Blue Papers.** For Sections G, J, K, M, N, Q, R, BCAR 23, BCAR 29 and BCAR 31, proposed amendments and additions to the Requirements are prepared by the CAA and, where this appears appropriate for the Section concerned, they are issued in a series of documents known as 'BCAR Papers'. These Papers are considered by a Requirements Co-ordinating Committee appropriate to the subject. When a Paper has been discussed by the Committee, the resulting wording is submitted to the Airworthiness Requirements Board for approval for inclusion in the appropriate Section. The wording, when approved by the Airworthiness Requirements Board, is then printed on Blue Paper, and constitutes part of the Requirements with effect from the date of publication in the form of a CAA BCAR Blue Paper.

6.3.2 **Grey Papers.** Amendments to Section A and L are effected in the form of Grey Papers which have been agreed, as appropriate, following discussions with industry. Grey Papers when approved, constitute part of the Requirements with effect from the date of publication.

6.3.3 **Orange Papers.** For JAR, proposed amendments and additions to the Requirements are issued as Notices of Proposed Amendments (NPAs) and are considered according to agreed European procedures. The CAA is responsible for UK consultations on such NPAs. The wording when approved is then printed on Orange Paper, and constitutes part of the Requirements with effect from the date of publication.

6.4 Those Sections of BCAR which deal with design and testing of aircraft, comprise the minimum requirements which must be achieved to certificate an aircraft as airworthy against a background of up-to-date aeronautical knowledge. BCAR also incorporates the standards laid down by ICAO which must be satisfied for an aircraft to operate internationally.

NOTE: Further details regarding the equipment required for international operation of aircraft are contained in the ANO 1985 Schedules 5 and 6.

6.5 In some cases, there is a general approach to a specific requirement. An example of this is to be found in the various chapters of Sub-section A8 of Section A which prescribes the Requirements for the approval of organisations. Within these chapters there is a

Requirement that 'Bonded and Quarantine stores shall be provided'. However, the general Requirement includes more than a storage room. Consideration would need to be given to providing suitable racks and bins, record systems, and methods of stock segregation and identification. It would also include other factors such as temperature and humidity control of the stores, all of which can only be decided according to the particular circumstances.

7 JOINT AIRWORTHINESS REQUIREMENTS (JAR)

7.1 JAR is a common airworthiness code accepted by a number of European Airworthiness Authorities, including the CAA, whose purpose is to prevent the proliferation of differing airworthiness codes within Europe.

7.2 Until 1979, the JAR which had been published were to be used as applicable requirements for specific projects where a country's legislation allowed its authority to select codes in this way. However, in 1979 an 'Arrangements Document' was signed in Paris by ten states. This document committed the Participating Authorities to maintain JAR, and set out the ground rules for acceptance by signatory states of products complying with JAR, and established the JAR Secretariat. At present seven JAR codes have been accepted by the CAA as the sole UK National Code and therefore are of the same status as BCAR.

8 CAA PUBLICATIONS

8.1 The CAA produces various publications which provide information on technical and administrative matters concerning airworthiness, together with notification of mandatory requirements. Airworthiness Notices Nos. 6 and 7 give general information, publication dates and latest issue numbers of all CAA publications. A summary of the publications pertinent to this Leaflet is given below.

NOTE: A full publications list (CAA Document No. 13) is obtainable from the CAA, Printing and Publication Services, Greville House, 37 Gratton Road, Cheltenham, Glos. GL50 2BN.

8.2 **Airworthiness Notices (CAP 455).** These Notices provide a means of publishing information at short notice on technical, mandatory and administrative matters concerned with airworthiness. A copy of each Notice is issued to the owner of an aircraft on the UK Register, to all Licensed Aircraft Maintenance Engineers, and Approved Organisations.

8.3 **Mandatory Aircraft Modifications and Inspections Summary (CAP 476).** This publication summarises mandatory information which is required to be complied with by UK Operators in respect of aircraft, engines, propellers, aircraft radio stations, instruments and equipment of UK construction and manufacture. In order that the Certificate of Airworthiness may remain in force, mandatory modifications and/or inspections must be incorporated or carried out as specified in the summary.

8.4 **Foreign Airworthiness Directives.** These publications deal with Airworthiness Directives relating to aircraft, constructed in foreign countries, which are on the UK Register. Airworthiness Directives contain details of those modifications and inspections which have been classified as mandatory by the Airworthiness Authorities of the countries of origin. The Directives are published as follows:—

(a) **Volume I** — Applicable to aircraft (including engines, propellers and equipment) certificated in the USA, which do not exceed 5700 kg MTWA.

(b) **Volume II** — Applicable to aircraft (including engines, propellers and equipment), certificated in the USA, which exceed 5700 kg MTWA.

NOTE: Volumes I and II are published and distributed by the USA Federal Aviation Administration (FAA) as a 'Summary of Airworthiness Directives'. The volumes and bi-weekly listings must be obtained from the DOT-FAA Aeronautical Center, Attention: AAC-23, PO Box 25461, Oklahoma City, Oklahoma 73125, USA.

(c) **Volume III (CAP 474)** — Applicable to all aircraft (including engines, propellers and equipment) constructed in foreign countries other than the USA (see also paragraph 8.5(b)).

NOTE: Volume III is published and distributed by the CAA and is obtained from the CAA, Printing and Publication Services, Greville House, 37 Gratton Road, Cheltenham, Glos. GL50 2BN.

8.5 **CAA Additional Airworthiness Directives.** These Airworthiness Directives contain details of additional UK mandatory requirements relating to aircraft, constructed in foreign countries, which are on the UK Register. These Directives are published as follows:—

(a) **CAA Additional Airworthiness Directives (CAP 473).** This publication is a summary of the additional UK mandatory requirements relating to aircraft (including engines, propellers and equipment) constructed in the USA and registered in the UK, as called for by the CAA and are associated with Volumes I and II of the FAA 'Summary of Airworthiness Directives'.

(b) **Foreign Additional Airworthiness Directives Volume III (CAP 474)** contains a summary of the additional UK mandatory requirements as called for by the CAA relating to all aircraft (including engines, propellers and equipment) constructed in foreign countries other than the USA and registered in the UK.

NOTE: Both of these publications may be obtained from the CAA, Printing and Publication Services, Greville House, 37 Gratton Road, Cheltenham, Glos. GL50 2BN.

8.6 **Airworthiness Approvals Compendium (CAP 456).** This publication provides information on CAA requirements and associated general procedures necessary for those organisations which design, manufacture, overhaul/repair, maintain civil aircraft, manufacture components and materials, apply protective treatments and special processes, store and re-issue aircraft approved materials, to obtain and maintain CAA approval.

8.7 **Air Operators' Certificates — Arrangements for Engineering Support (CAP 360 Part Two).** This publication provides information for use by applicants for, and holders of, Air Operators' Certificates (AOC), regarding the requirements which are to be met by the Operator's engineering support organisation, in order to obtain the grant, variation or continuation of an AOC.

8.8 **Registration, Certification and Maintenance of Aircraft — a Guide (CAP 396 — formerly 'Airworthiness Certification').** This publication is a reference work summarising the provisions of the ANO, BCAR and JAR with particular reference to the issue and renewal of Certificates of Airworthiness and the maintenance certification of civil aircraft.

8.9 **UK Special Conditions for Certification of Foreign Constructed Aircraft (CAP 480).** This publication contains details of the Special Conditions that are required by the CAA following design investigation of foreign constructed aircraft types, which must be satisfied before UK certification can be granted.

8.10 **Condition Monitored Maintenance: An Explanatory Handbook (CAP 418).** This publication provides general information and guidance on the concepts and practices of aircraft maintenance control by the use of Condition Monitoring.

8.11 **Air Navigation — The Order and the Regulations (CAP 393)**

8.11.1 This publication sets out the provisions of the Air Navigation Order and the regulations made thereunder. It has been prepared for those concerned with day-to-day matters relating to air navigation who require an up-to-date version of the Orders and Regulations and is edited by the Legal Adviser's Department of the CAA. Courts of Law will, however, only refer to the Queen's Printer's edition and therefore CAP 393 should not be regarded as authoritative.

8.11.2 CAP 393 contains the following:—

(a) The Air Navigation Order 1985 (as amended).

(b) The Rules of the Air and Air Traffic Control Regulations 1985.

(c) The Air Navigation (General) Regulations 1981.

(d) Restriction of Flying.

(e) The Civil Aviation Authority Regulations 1983.

(f) CAA Charges.

(g) Air Navigation (Noise Certification) Order 1987.

(h) The Civil Aviation (Investigation of Accidents) Regulations 1983 and The Air Navigation (Investigation of New Accidents involving Civil and Military Aircraft or Installations) Regulations 1986.

(i) The Air Navigation (Dangerous Goods) Regulations 1985.

8.12 **Light Aircraft Maintenance (CAP 520).** This publication provides general guidance on the implementation of the Light Aircraft Maintenance Scheme (LAMS), for aircraft not exceeding 2730 kg MTWA, with a Certificate of Airworthiness in the Transport, Aerial Work, or Private Category.

BL/1-10

Issue 2

December 1984

BASIC

AIRWORTHINESS PROCEDURES

AIRCRAFT, ENGINE AND PROPELLER LOG BOOKS

1 INTRODUCTION The Air Navigation Order (ANO), prescribes that a separate log book must be kept for each aircraft registered in the United Kingdom, for each engine, and each variable-pitch propeller fitted to such aircraft. The ANO also prescribes the information which must be recorded, the timescales within which the record must be made and the person responsible for keeping the log books. Also included in the ANO are the requirements for the retention of records, and details concerning acts in connection with log books which constitute offences under the Order.

2 PURPOSE It is intended that a log book should constitute a history of the aircraft, engine or propeller to which it refers in terms of, as appropriate:–

Constructor
Date of Construction
Constructors No./Serial No.
Aircraft Registration
Type
Aircraft/engine to which fitted
Operator
Flying hours/cycles, etc.
Maintenance
Continued compliance with mandatory requirements.

3 SOURCE AND FORMAT OF LOG BOOKS

3.1 For aircraft the maximum total weight authorised (MTWA) of which does not exceed 2730 kg, the CAA requires that all log books shall be CAA approved. CAA publications CAP 398, 399 and 400 meet this requirement for aircraft, engines and propellers respectively in this category and are intended to comprise a self-contained record of the item to which they refer.

3.2 For aircraft the MTWA of which is greater than 2730 kg, the log book can take any form acceptable to the CAA. CAA publications CAP 388, 391 and 408 are suitable log books for aircraft, engines and propellers respectively in this category.

3.3 **Alternative Form of Log Book.** To enable acceptance of an alternative technical record system the following features should be taken into account:–

(a) Compliance with the requirements of the ANO must be shown.

(b) The record must be kept in indelible hard copy form or in the form of a computer memory acceptably safeguarded against erasure and available when required as a printed-out hard copy.

(c) Any computer sysem used must be capable of a total quarantine of the record for a particular aircraft, engine or variable-pitch propeller on command and must be capable of a subsequent print-out of data in a form acceptable to the CAA.

(d) Safeguards against erasure of any computer memory must include adequate defences against fraud, malpractice, incompetence and accidents such as power failure. Any erase function must be unavailable once data is committed to the memory.

NOTE: The requirements of Article 60 of the ANO apply to all forms of technical record and must be satisfied.

(e) Any recording system offered for acceptance must be capable of maintaining the required timescale for up-dating.

(f) On any occasion requiring the transfer of responsibility for the up-keep of a technical record system the form taken by the system must lend itself to removal without loss of content.

(g) In a computer system the information comprising the log book in the terms of the requirements should, when printed out, be in a coherent format and legible to the user without a need for in-depth knowledge of computer language. In addition, to enable the efficient conduct of investigations the required data should, when printed out, preferably be discrete from other data stored in excess of the requirements.

NOTE: Any extension of the log book in the form of files, appendices, subsidiary records held elsewhere such as by Non-Destructive Testing (NDT) specialists or Test Houses are deemed in a legal sense to be part of the subject log book and must be treated accordingly, including the retention of a clear cross-referenced association with the basic log book.

4 TIMESCALE LIMITATIONS FOR THE UPKEEP OF RECORDS

4.1 Apart from those entries shown in paragraph 4.2, each entry should be made as soon as is practicable after the occurrence to which it relates, but in no event more than seven days after the expiry of any Certificate of Maintenance Review (CMR) in force at the time of the subject occurrence. (See BCAR Section A, Chapter A6-4 for information on CMR.)

4.2 In engine and variable-pitch propeller log books, where the operator has chosen to record total aggregated flying time accrued since the last issue of a Certificate of Release to Service (CRS), each entry related to flight time must be made on the occasion of any work which will require the issue of the next CRS. (See BCAR Section A, Chapter A4-3 for information on CRS.)

4.3 There are aircraft which do not necessarily require a CMR or a CRS by virtue of their C of A Category and MTWA (see paragraph 5.1.5). The operators of such aircraft should, however, bear in mind that the validity of any C of A depends on continued compliance with any applicable Approved Maintenance Schedule and with all applicable mandatory requirements. It follows that a regular review of maintenance and adherence to proper standards are essential even when certifications to that effect are not legally required.

5 INFORMATION TO BE RECORDED

5.1 **Information Which Must be Recorded.** The following is, in part, quoted from the ANO.

5.1.1 **Aircraft Log Book.** The following entries shall be included in the aircraft log book:–

(a) the name of the constructor, the type of the aircraft, the number assigned to it by the constructor and the date of the construction of the aircraft,

(b) the nationality and registration marks of the aircraft,

(c) the name and address of the operator of the aircraft,

(d) the date of each flight and the duration of the period between take-off and landing, or, if more than one flight was made on that day, the number of flights and the total duration of the periods between take-off and landings on that day,

(e) particulars of all maintenance work carried out on the aircraft or its equipment,

(f) particulars of any defects occurring in the aircraft or in any equipment required to be carried therein by or under the ANO, and of the action taken to rectify such defects including a reference to the relevant entries in the technical log required by the ANO, and

(g) particulars of any overhauls, repairs, replacements and modifications relating to the aircraft or its equipment.

NOTE: Entries are not required to be made under sub-paragraphs (e), (f) and (g) in respect of any engine or variable-pitch propeller.

5.1.2 **Engine Log Book.** The following entries shall be included in the engine log book:–

(a) the name of the constructor, the type of the engine, the number assigned to it by the constructor and the date of the construction of the engine,

(b) the nationality and registration marks of each aircraft in which the engine is fitted,

(c) the name and address of the operator of each such aircraft,

(d) either,

(i) the date of each flight and the duration of the period between take-off and landing or, if more than one flight was made on that day, the number of flights and the total duration of the periods between take-offs and landings on that day, or

(ii) the aggregate duration of periods between take-off and landing for all flights made by that aircraft since the immediately preceding occasion that any maintenance, overhaul, repair, replacement, modification or inspection was undertaken on the engine,

(e) particulars of all maintenance work done on the engine,

(f) particulars of any defects occurring in the engine, and of the rectification of such defects, including a reference to the relevant entries in the technical log required by the ANO, and

(g) particulars of all overhauls, repairs, replacements and modifications relating to the engine or any of its accessories.

5.1.3 **Variable-Pitch Propeller Log Book.** The following entries shall be included in the variable-pitch propeller log book:–

(a) the name of the constructor, the type of the propeller, the number assigned to it by the constructor and the date of the construction of the propeller,

(b) the nationality and registration marks of each aircraft, and the type and number of each engine, to which the propeller is fitted,

(c) the name and address of the operator of each such aircraft,

(d) either,

(i) the date of each flight and the duration of the period between take-off and landing or, if more than one flight was made on that day, the number of flights and the total duration of the periods between take-offs and landings on that day, or

(ii) the aggregate duration of periods between take-off and landing for all flights made by that aircraft since the immediately preceding occasion that any maintenance, overhaul, repair, replacement, modification or inspection was undertaken on the propeller,

(e) particulars of all maintenance work done on the propeller,

(f) particulars of any defects occurring in the propeller, and of the rectification of such defects, including a reference to the relevant entries in the technical log required by the ANO, and

(g) particulars of any overhauls, repairs, replacements and modifications relating to the propeller.

5.1.4 A clear record of continued compliance with all applicable mandatory requirements is required.

5.1.5 Each record of work done should, when required, be covered by a CRS unless the certification has been made elsewhere, in which case it must be cross-referred to in the log book. (BCAR Section A, Chapter A4-3 refers.) Currently a CRS is required for all types of work, except on aircraft in the Special category, the MTWA of which does not exceed 2730 kg, and aircraft in the Special or Private categories of similar weight, when the work done comes within the provisions of the Air Navigation Regulation which specifies work which can be carried out personally by the owner or operator if he is a licensed pilot. In all such cases the work done should be recorded and signed for in the log book by the person carrying out the work. There may be cases when the CAA will direct that a CRS is to be issued under exceptional circumstances. In such cases the C of A will be endorsed to that effect.

5.1.6 Whenever a Certificate of Fitness for Flight is issued in accordance with BCAR Section A, Chapter A4-4, the aircraft log book should be endorsed with the reason for its issue including the condition being invoked (i.e. the specific 'A' Condition), and a copy included in the log book.

5.1.7 Duplicate inspections certified in accordance with BCAR Section A, Chapter A5-3 (see also Leaflet AL/3-7) must be recorded in the appropriate log book except that, if made elsewhere such as in the Technical Log, they may be cross-referred to in the log book.

5.1.8 For aircraft the MTWA of which exceeds 2730 kg, it is required that a separate Modification Record Book be maintained. A suitable book is available from the CAA (CAP 395).

5.2 **Information Recording Practice**

5.2.1 **General**

(a) **Maintenance and Inspection (including routine inspections)**

(i) When maintaining the record of compliance with mandatory requirements, all sources of such requirements must be complied with. The primary source is the regulatory authority of the country of design certification of the aircraft, engine, propeller or items of equipment, in addition to which there may be CAA Additional Directives imposed and CAA Airworthiness Notices of a mandatory nature.

(ii) When a mandatory requirement is of a repetitive nature it is important to highlight this fact so that it will not be confused with once-only requirements.

(iii) Inspections of an optional nature, if adopted, should be recorded. It is recommended that such inspections, when strongly recommended by the manufacturers, should either be adopted or the justification for non-adoption be recorded.

(iv) When a mandatory requirement can be complied with via a choice or combination of options, the method of compliance must be recorded, and where compliance is by a series of progressive actions the extent of compliance must be kept accurately on record.

(v) When raising log books for imported aircraft, engines or propellers, a copy of the C of A for Export should be attached. After C of A renewal, the cut-off point used in the review of the technical record should be highlighted. Usually, in log books this is achieved by ruling off the affected page, recording totals for each column and continuing on a fresh page. In order to facilitate any maintenance review required by the Order it is essential that the record is kept in a form and location readily accessible to the person carrying responsibility for the review.

(vi) When considering adjustable-pitch propellers in relation to the requirements for log books it would be sensible to deem such a propeller to be of variable pitch, resulting in a need for a log book. The alternative approach would be to treat it as any other major part with no log book i.e. all information to be included in the Aircraft Log Book.

(b) **Overhauls.** Details of any overhauls should be included in the relevant log book except that where the details are contained in another document such as an Approved Certificate or equivalent foreign certification acceptable to the CAA, it is only necessary to make a cross-reference in the log book to identify the document. Such documents should be retained as part of the record.

(c) **Replacements**

(i) Details of any replacements should be included in the relevant log book. Where any component is the subject of a life control system, it must be possible to readily establish the status of such components relative to the life control system.

(ii) Various methods are available to prove component status but two are perhaps more common, i.e. component listings and component cards. These cards must include the date and aircraft hours or other

parameter(s) at which the item was fitted and the remaining life available on the item. Note that lives can be expressed in a number of parameters apart from hours flown, and the record must be made in terms of whatever parameter is specified by the manufacturer. Particular care must be exercised where a component is the subject of a mandatory requirement to ensure that the component fitted is always in compliance with the requirement.

(iii) Where component life control is by on-condition monitoring then the performance control parameter(s) should be recorded (where possible in a way that shows any deterioration progressively) and the record kept must be compatible with the statistical system in use. In all cases the record of component changes, or the history of rectification of a system defect should show the precise identity of items removed and fitted and all known detail of life available and expended, in addition to the reason for the work.

(iv) When a major component such as an engine, wing flap, etc. is changed, a record of all parts or accessories transferred from the removed item to the fitted item should be made, showing when necessary, remaining life available. Any serviceable items being re-used without re-lifing should follow a similar procedure. The information recorded should include the origin and prior location of the item. It is thus clearly vital that parts recovered from out-of-use aircraft or major assemblies for possible future re-use must at the time of recovery only be considered acceptable if their history of use is genuinely known and on record and their condition established by a person or organisation approved for the purpose. Where a component has been recovered from an aircraft involved in an incident/accident, reference must be made to Airworthiness Notice No. 97.

(d) **Repairs**

(i) A summary of any repair must be recorded including the reason for the work, with reference to supporting documentation, and must be accompanied by a CRS made by a person appropriately authorised in relation to the scope of the repair.

(ii) The log book record must include proof of origin of all materials and parts used unless the organisation concerned is CAA Approved and operates a system under the Approval for the control of procurement and use of materials or parts.

(iii) Any record of repair involving welding should include the welder's Approval number, in addition to a CRS which must be issued by the person taking responsibility for the work.

(e) **Modifications**

(i) All modifications must be recorded in the appropriate log book and also, when required, in the Modification Record Book, quoting the title and the authorisation. The latter can take the form of an Airworthiness Approval Note number issued by the CAA, a CAA Form AD 261 reference number issued by the CAA, an Alert Service Bulletin, Service Bulletin or other document issued by an organisation taking design responsibility for the modification under a CAA Approval or by a foreign authority acceptable to the CAA. All supporting documents such as drawings, Supplemental Type Certificate, etc., should be listed or, if kept separately, cross-referred to.

(ii) When the modification is satisfying a mandatory requirement the record should highlight this fact and should be cross-referred to in the separately maintained record of compliance with mandatory requirements, showing clearly the extent of compliance.

NOTE: Further information on modification procedure is contained in BCAR Section A, Chapter A4-1.

5.2.2 **Aircraft Log Books**

(a) The identity of the engine and, where appropriate, any propellers should be included. In the case of fixed-pitch propellers for which no log book is required, the Aircraft Log Book is likely to be the only location of such information.

(b) It is usual to make provision for a range of rigging information with datums and tolerances, the completion of which would normally be the responsibility of the constructor or the person who initially issues the log book.

5.2.3 **Engine Log Books**

(a) The installed location of the engine and the identity of the aircraft to which it is fitted should be shown. The Engine Inspection and Test Certificate should be fixed into the log book. This certificate should carry the data set out in BCAR Section A, Chapter A3-1 and include the date and reference of the CAA Approval Letter, or the latest issue of the Engine Type Certificate Data Sheet, the category of release (i.e. Experimental Flight, Transport Category (Passenger) etc.), reference to inspection and test records and a list of parts subject to individual life control (overhaul, ultimate etc.).

(b) For engines of modular construction, a log must be maintained for each module and the log must be treated as part of an engine's technical record for as long as it is installed on the particular engine. The module record should include full identity details and history of use, a record of flight times and cycles, and maintenance and rectification work carried out. All life-limited components must be identified with their limiting parameters shown, e.g. the maximum permitted number of thermal cycles and proportion of life remaining. The log for that module which carries whole-engine identity and the Data Plate should in addition carry a record of module changes with identities as well as all the information normally required in an Engine Log Book. Each module record should have attached the manufacturers or overhaulers document approximating to the Engine Inspection and Test Certificate issued for a whole engine.

5.2.4 **Variable-Pitch Propellers.** The basic pitch setting should be recorded whenever it has been set, altered or verified. The identity of individual blades should be included initially and then maintained, since the log book associates with the hub.

6 THE UPKEEP OF LOG BOOKS

6.1 Permanent legibility is the keynote. Handwritten entries must be made in ink or indelible pencil. Any document kept in or with the log book should be either securely attached or kept in an attached pocket but should not prevent reference to the page to which it is attached.

6.2 Initiation of a continuation log book is the responsibility of the user and he should transfer sufficient data for continuity and should number the log books consecutively.

6.3 Each completed column of figures should be totalled and carried forward.

6.4 Any error should be corrected but remain legible. The corrections should be signed. In a machine system errors discovered after the data has been inserted into the memory should be corrected by a new entry not an erasure and the correct entry annotated as a correction with an authorisation code.

6.5 All record keepers must remain aware of those actions which constitute offences under the ANO.

7 TRANSFER OF RESPONSIBILITIES FOR UPKEEP OF A LOG BOOK SYSTEM

7.1 After a log book or records system changes hands it remains the responsibility of the previous operator or keeper to retain the existing record intact except that if the new operator or keeper demands custody of the existing records it is a requirement that the previous keeper complies with the demand, at which time full responsibility for the record is also transferred. A new operator should ensure that the records reflect the new situation and any change of ownership if applicable.

7.2 Where an alternative form of Technical Records system was being utilised, continuation by a new owner, operator, or maintenance organisation, or the introduction of any other system may not be made without the prior approval of the CAA.

7.3 All log books and associated records must be retained until two years after the aircraft engine or propeller is destroyed or permanently withdrawn from use, whoever may be the custodian of the records.

BL/1-11

Issue 2

June, 1986

BASIC

AIRWORTHINESS PROCEDURES

WEIGHT AND BALANCE OF AIRCRAFT

1 INTRODUCTION

1.1 **General.** The purpose of this Leaflet is to provide guidance on the weighing of aircraft to determine the Basic Weight and corresponding centre of gravity (c.g.). The need for accuracy when weighing aircraft is extremely important, as incorrect data could cause subsequent overloading of the aircraft resulting in an increase of structural loads, and a reduction in performance. The topics discussed in the Leaflet are as follows:—

Paragraph	Topic
1	Introduction
2	Requirements
3	The Principles of Aircraft Weight and Balance
4	Weighing Equipment
5	Determination of Basic Weight and Centre of Gravity
6	Change in Basic Weight
7	Loading of Aircraft
Appendix	Typical Weight and Centre-of-Gravity Schedule

1.2 **Definitions.** The following is a list of definitions of the terms used in this Leaflet:—

(a) **Basic Equipment.** Basic Equipment is the unconsumable fluids (e.g. coolant and hydraulic fluid) and equipment which is common to all roles for which the operator intends to use the aircraft.

(b) **Basic Weight.** Basic Weight is the weight of the aircraft and all its Basic Equipment, plus that of the declared quantity of unusable fuel and unusable oil. In the case of turbine-engined aircraft and aircraft the Maximum Total Weight Authorised (MTWA) of which does not exceed 5700 kg (12 500 lb), it may also include the weight of usable oil.

(c) **Variable Load.** Variable Load is the weight of the crew and of items such as crew baggage, removeable units, and other equipment the carriage of which depends upon the role for which the operator intends to use the aircraft for a particular flight.

(d) **Disposable Load.** Disposable Load is the weight of all persons (e.g. passengers) and items of load, including fuel and other consumable fluids carried in the aircraft, other than the Basic Equipment and Variable Load.

(e) **Maximum Total Weight Authorised (MTWA)** is the Maximum Total Weight Authorised for the aircraft and its contents, at which the aircraft may take off anywhere in the world, in the most favourable circumstances in accordance with the Certificate of Airworthiness or Flight Manual.

(f) **Reaction.** The load at each separate weighing point.

2 REQUIREMENTS

2.1 The requirements relating to the weighing of aircraft and the establishment of a Weight and Balance Schedule are prescribed in British Civil Airworthiness Requirements (BCAR) Section A, Chapter **A5—1**. An interpretation of those parts of Chapter **A5—1** which are pertinent to this Leaflet is given below.

2.2 Aircraft must be weighed to determine the Basic Weight and the corresponding c.g. position when all the manufacturing processes have been completed. Aircraft, the MTWA of which exceeds 5700 kg (12 500 lb) must be re-weighed within two years after the date of manufacture and, after this, a check weighing must be carried out at intervals not exceeding five years and at such times as the CAA may require. Aircraft, the MTWA of which does not exceed 5700 kg (12 500 lb) must be re-weighed as required by the CAA.

2.3 In making decisions on weighing, the CAA considers the history of the aircraft, its flying performance, and the probable effect on the weight after a major overhaul, or embodiment of a modification, repair or replacement.

2.4 Certain types of aircraft may be weighed on a sampling basis (i.e. a representative aircraft, as weighed, would be acceptable for others of the same standard) by agreement with the CAA.

2.5 An alternative arrangement to the periodical check weighing of individual aircraft is for the operator to establish a fleet mean weight (i.e. Basic Weight) and fleet mean centre-of-gravity position. The initial fleet mean weight is based on the mean of the weights of all the aircraft of the same type in the fleet which is revised annually by sample weighing (see BCAR Section A, Chapter **A5—1**, Appendix No 1).

2.6 When an aircraft is weighed, the equipment and other items of load such as fluid in the tanks must be recorded. This recorded load should not differ significantly from the Basic Equipment List associated with the Weight and Centre-of-Gravity Schedule (see paragraph 2.9). In circumstances where there is a significant difference between the Basic Weight of the aircraft and the operating weight (i.e. Basic Weight plus the Variable Load) not accountable to structural changes brought about by modifications/repairs, the CAA may require that the actual weights of the Variable Load items be ascertained.

2.7 All records of the weighing, including the calculations involved, must be available to the CAA. The records are retained by the aircraft manufacturer, overhauler or operator, and when the aircraft is weighed again, the previous weighing records must not be destroyed but retained with the aircraft records. Operators must maintain records of all known weight and c.g. changes which occur after the aircraft has been weighed.

2.8 **Weight and Balance Report**

2.8.1 Before the issue of a Certificate of Airworthiness for a prototype, prototype (modified) or series aircraft, where the MTWA exceeds 5700 kg (12 500 lb), a Weight and Balance Report must be prepared by a CAA Approved Organisation.

2.8.2 The Weight and Balance Report is intended to record the essential loading data to enable a particular aircraft to be correctly loaded, and to include sufficient information for an operator to produce written loading instructions in accordance with the provisions of the Air Navigation Order (ANO). The Weight and Balance Report applies to the aircraft in the condition in which it is to be delivered from the constructor to the operator.

2.8.3 The Weight and Balance Report must include the following items:—

(a) Reference number and date.

(b) Designation, constructor's number, nationality and registration marks of the aircraft.

(c) A copy of the Weighing Record.

(d) A copy of the Weight and Centre-of-Gravity Schedule (see paragraph 2.9) including the Basic Equipment List if this is separate from Part A of the Schedule.

(e) A diagram and a description of the datum points which are used for weighing and loading, and an explanation of the relationship of these points to the fuselage frame numbering systems and, where applicable, to the Standard Mean Chord (SMC).
NOTE: SMC is also referred to as the Mean Aerodynamic Chord (MAC).

(f) Information on the lever arms appropriate to items of Disposable Load. This will include the lever arms of fuel, oil and other consumable fluids or substances in the various tanks (including agricultural material in hoppers), which, if necessary, should be shown by means of diagrams or graphs, lever arms of all passengers in seats appropriate to the various seating layouts, mean lever arms of the various baggage holds or compartments.

(g) Details of any significant effect on the aircraft c.g., of any change in configuration, such as retraction of the landing gear.

2.9 Weight and Centre-of-Gravity Schedule

2.9.1 A Weight and Centre-of-Gravity Schedule details the Basic Weight and c.g. position of the aircraft, and the weight and lever arms of the various items of load, including fuel, oil and other fluids. The Schedule is normally divided into Part A — Basic Weight, Part B — Variable Load and Part C — Loading Information (Disposable Load).

(a) A Weight and Centre-of-Gravity Schedule shall be provided for each aircraft, the MTWA of which exceeds 2730 kg.

(b) For aircraft not exceeding 2730 kg MTWA, either a Weight and Centre-of-Gravity Schedule shall be provided or alternatively a Load and Distribution Schedule which complies with BCAR Section A, Chapter A5—1, paragraph 6.1.

(c) For new aircraft which exceed 2730 kg, but do not exceed 5700 kg, the information contained in Parts B and C of the Schedule may be given as part of the Weight and Balance Report.

2.9.2 A Weight and Centre-of-Gravity Schedule must provide the following. Each Schedule must be identified by the aircraft designation, the nationality and registration marks, or if these are not known, by the constructor's serial number. The date of issue must be on the Schedule and it must be signed by an authorised representative of a CAA Approved Organisation or a person suitably qualified and acceptable to the CAA, and if applicable, a statement shall be included indicating that the Schedule supersedes all earlier issues. It is also necessary to refer to the date or reference number (or both) of the Weight and Balance Report, or other acceptable information upon which the Schedule is based.

2.9.3 Operators must also issue a revised Weight and Centre-of-Gravity Schedule when it is known that the weight and c.g. has changed in excess of the maximum figure agreed by the CAA as applicable to a particular aircraft type. If the aircraft has not been re-weighed, the revised Weight and Centre-of-Gravity Schedule must state that it has been calculated on the basis of the last Weight and Balance Report and the known weight and c.g. changes. A record of the calculations involved should be retained for future reference.

2.9.4 A copy of the Schedule is to be retained by the operator with a further copy sent to the CAA Airworthiness Division which shall include any related list of Basic Equipment. Furthermore, for aircraft the MTWA of which does not exceed 5700 kg (12 500 lb) a copy of the Weight and Centre-of-Gravity Schedule must be included in the Flight Manual. If a Flight Manual is not a requirement the Schedule must be displayed or retained in a stowage which is identified in the aircraft. A similar arrangement is often used for larger types of aircraft.

2.9.5 A typical Weight and Centre-of-Gravity Schedule for an aircraft the MTWA of which does not exceed 2730 kg is shown in the Appendix to this Leaflet.

3 THE PRINCIPLES OF AIRCRAFT WEIGHT AND BALANCE

3.1 Principles of Balance

3.1.1 The theoretical principle of the weight and balance of aircraft is basically very simple, and can be compared with that of the familiar scale (as depicted in Figure 1) which, when in balance will rest horizontally on the fulcrum in perfect equilibrium provided that the two pans suspended from the beam are of equal weight and distance from the fulcrum.

3.1.2 In aeronautical terms the fulcrum can be equated to the aircraft c.g., and the weights, with the loads imposed thereof on the structure.

3.1.3 Because of the design tolerances built into aircraft, the Weight and Balance is not as critical as that of the scales in Figure 1, although it is important that they remain within those tolerances for reasons of safety, performance, and economy.

3.1.4 From Figure 1 it can be understood that the influence of weight, in relation to balance, is directly dependent upon the distance of the weight from the fulcrum.

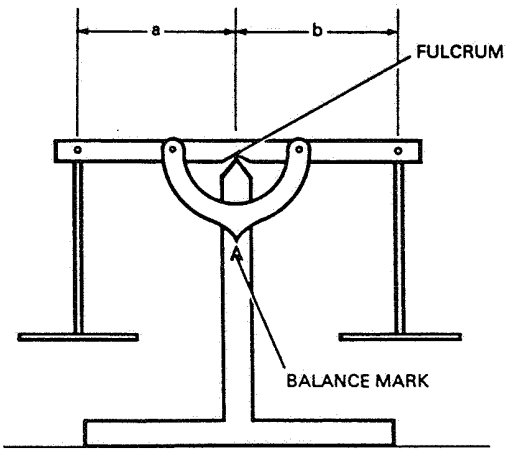


Figure 1 SIMPLE SCALE

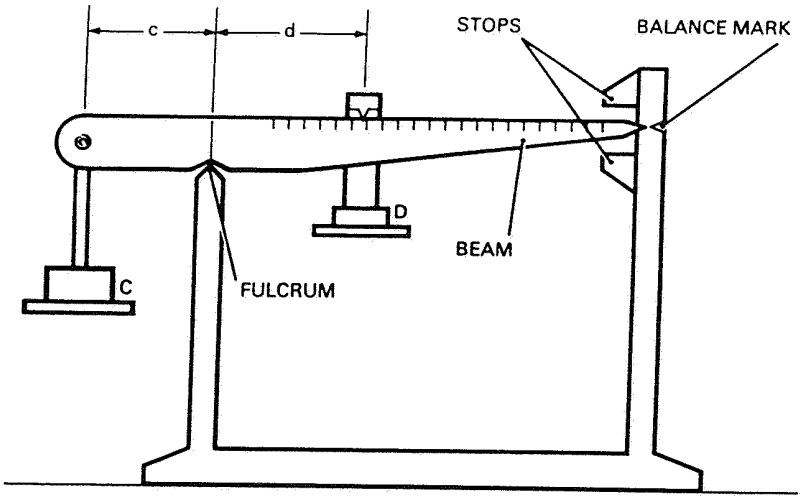


Figure 2 STEELYARD

3.1.5 Unlike the scales in Figure 1, aircraft, (apart from some helicopters) cannot practicably be suspended in such a way as to determine the relative weight, balance, and c.g. However, it can be achieved mathematically.

3.1.6 The steelyard shown in Figure 2 has a known weight "D" and, a known weight "C" set at a specific distance "c". Under normal circumstances to determine the distance required to balance "C", the known weight "D" is moved along the beam until the weight of "D" and its accompanying lever arm are equal to the weight of "C" therefore aligning the beam with the balance mark. Once achieved the distance "d" can then be read from the graduated scale.

3.1.7 Mathematically the distance can be found as follows:—

$$d = \frac{Cc}{D}$$

Where C = 50 lb

c = 10 inches

D = 20 lb

$$\frac{Cc}{D} = \frac{50 \times 10}{20}$$

d = 25 in.

3.2 **Moments**

3.2.1 The distance from the fulcrum is called the 'arm' and this distance, multiplied by the weight, is the turning effect or 'moment' about the fulcrum. The c.g. of the balanced system is the position at which the weight resting on the fulcrum may be taken to act, and will lie in a plane drawn vertically through the fulcrum. The conventional signs which are applied to arms and moments in relation to their direction from the c.g. datum are as follows:—

(a) **Horizontal** (−) forward and (+) aft of the datum.

(b) **Vertical** (−) below and (+) above the datum.

(c) **Transverse** (−) right and (+) left of the datum.

3.2.2 In a similar way to the balancing of weights, the horizontal c.g. of a system of weights can be found by calculating the moment of each weight from a selected position (e.g. reference datum) and dividing the total moment by the total weight.

NOTE: In aeronautical terms all arms forward of the reference datum are designated negative (−) and all arms aft of the datum are designated positive (+).

3.2.3 Illustrated in Figure 3 is a constant cross-section beam 80 in long and weighing 8 lb, upon which have been placed 5 loads weighing 2 lb, 6 lb, 1 lb, 4 lb and 3 lb respectively, which are 5 in, 20 in, 30 in, 60 in, 70 in, from the left-hand end of the beam, which in this example is the c.g. reference datum. It should be noted however, that although any plane normal (i.e. perpendicular) to the beam's horizontal axis could have been selected as the reference datum, the position chosen is one of convenience, and therefore all moment arms in this example are positive (+). As the beam is of a constant cross-section, the c.g. of the loaded beam in Figure 3 can be found as follows by:—

(a) calculating the moment of each load, i.e. multiplying the weight by arm (distance from the reference datum),

(b) calculating the total weight by adding together the weight of each load,

(c) adding together the moment of each load, and

(d) dividing the total moment by the total weight.

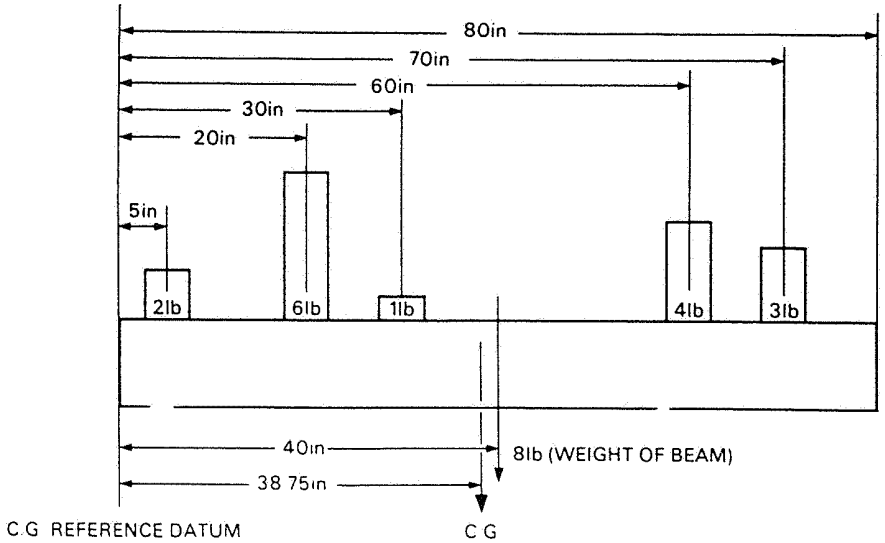


Figure 3 CENTRE OF GRAVITY OF BEAM

Item	Weight (lb)	Arm (in)	Moment (lb in)
Beam	8	40	320
1st load	2	5	10
2nd load	6	20	120
3rd load	1	30	30
4th load	4	60	240
5th load	3	70	210
TOTALS	24		930

$\therefore \frac{930 \text{ lb in}}{24 \text{ lb}} = 38{\cdot}75 \text{ in}$

$\therefore$ the c.g. of the loaded beam is 38·75 in from the reference datum.

NOTES: (1) The arm of the beam is taken as half its length.

(2) The units of weight, arm and moment used in this and subsequent paragraphs are the pound (lb), inch (in) and pound inch (lb in) respectively. Other units, such as the kilogramme (kg) and metre (m) may be used where this is more convenient for the operator but, whichever units are used, it is essential that the same units are used throughout the calculations.

3.3 Aircraft Weight and Centre of Gravity

3.3.1 The weight and c.g. of an aircraft is calculated in the same way as for the loaded beam in Figure 3. The Basic Weight and c.g. of the aircraft corresponds to the weight and c.g. of the beam, and the Variable and Disposable Loads correspond to the beam loads. Furthermore before each flight the total weight and moment of these items must be determined, and the c.g. of the aircraft calculated to ensure the aircraft remains within the approved limits. If for example, the c.g. was too far forward, it would result in a nose-heavy condition which could be potentially dangerous (particularly during take-off and landing), cause a general reduction in the performance of the aeroplane, and effect an increase in fuel consumption as a result of the drag caused by excessive balancing of the elevator trim. Where rotorcraft are concerned, a c.g. too far forward could result in excessive strain on the main rotor shaft and a general lack of control. The c.g. too far aft results in a tail-heavy condition which, with the tendency of the aeroplane to stall, makes landing more difficult, may result in a reduction in performance, and cause an increase in fuel consumption. In the case of rotorcraft it will reduce the forward speed and also the range of effective control.

3.3.2 The operational limitations for the fore and aft positions of the c.g. are defined in the aircraft Flight Manual or other document associated with the Certificate of Airworthiness, such as the Owner's Manual. Where no such document exists, the limitations are specified in the Certificate of Airworthiness.

3.3.3 Fortunately it is not necessary for an aircraft to be perfectly balanced to achieve stable flight, i.e. to an exact c.g. position. The permissible variation is called the Centre-of-Gravity Range. This is specified by the manufacturer for each aircraft type and is determined by the need to comply with various airworthiness design requirements.

4 WEIGHING EQUIPMENT

4.1 General

4.1.1 There are four main types of weighing equipment which may be used for weighing aircraft, weighbridge scales, hydrostatic weighing units, electrical and electronic weighing equipment based on the strain gauge principle. Since considerable errors can arise if small loads are checked with equipment designed for heavy loads, and scales may be calibrated in increments too coarse for accurate calculation, the capacity of the weighing equipment should be compatible with the load.

4.1.2 All weighing apparatus should be checked, adjusted and certified by a competent authority at periods not exceeding one year and, in addition, the zero indication should be checked for accuracy before any weighing is commenced.

4.2 **Weighbridge Scales.** This equipment consists of a separate weighing platform for each wheel or bogey on the aircraft, the weight at each reaction point being recorded directly on the balance arm. On some equipment a dial indicator is also provided. Large aircraft are normally weighed in a hangar, using either portable weighbridge scales or weighbridges set permanently into the floor at appropriate positions with their platforms level with the floor. The aircraft may then be rolled directly onto the platforms without the need for special equipment.

NOTES: (1) Care should be taken when moving portable weighbridge scales to prevent them becoming out of balance.

(2) It is advisable to set the approximate load on each balance arm before releasing it. Failure to do this could cause damage to the knife edge.

4.3 Hydrostatic Weighing Units

4.3.1 The operation of these units is based on the hydraulic principle that the fluid pressure in a cylinder in which a piston is working depends on the area of the piston and the load applied to it. The units are interposed between the lifting jacks and the aircraft jacking points, the weight at each position being recorded on a pressure indicator. The indicator may record directly in units of weight or may be a multi-rotational type where the readings are converted to weight by means of a conversion table peculiar to each particular unit.

4.3.2 It is important that the lifting jacks are exactly vertical and the units correctly positioned, otherwise side loads may be imposed on the weighing units and may affect the accuracy of the readings.

4.4 **Electrical Weighing Equipment.** Equipment of this type incorporates three or more weighing cells, each of which contains a metallic element of known electrical resistance. Aircraft load is measured with the variation in resistance with elastic strain by means of a galvanometer, the scale of which is calibrated in units of weight. As with the hydrostatic weighing units, the weighing cells are interposed between the lifting jacks and the aircraft jacking points and similarly care is necessary to ensure that no side loads are imposed upon them (see paragraph 4.3.2).

4.5 Electronic Weighing Equipment

4.5.1 This type of weighing equipment combines elastic strain load cells as described in paragraph 4.4 into weighbridge-type platforms which are placed either as a single unit or combination of units beneath the wheels of the aircraft undercarriage.

4.5.2 Each platform, is electrically connected to an instrumentation unit, which digitally displays the selected platform load. The number of platforms required to weigh an aircraft by this method is determined by the size of the aircraft. For example, a very large transport aircraft may require as many as 18 or more platforms to accommodate the wheel multiples of the undercarriage. The number of units that can be used is, however, limited by the terminal facility of the instrumentation unit.

4.5.3 As there is generally a requirement for aircraft weighing equipment to be portable, the platforms are normally constructed of high strength lightweight materials, with the load cells interposed between the platform table, and the base unit. Where a platform is unevenly loaded (because of structural movement or undercarriage positioning), a greater load imposed on one side of the platform will be automatically compensated for by the lesser load on the other side.

NOTE: The displayed load (or reaction) on the instrumentation unit for each platform, is a dedicated computation of all load cell inputs from that particular platform.

4.5.4 The positioning of aircraft onto electronic weighbridge platforms may be accomplished by one of the following methods:—

(a) by towing the aircraft directly onto platforms permanently set into the hangar floor (sometimes in specific appropriate positions),

(b) by supporting the aircraft on jacks and, where facilities allow, lowering the hangar floor, positioning the platforms below the extended undercarriage and then raising the hangar floor until all the weight of the aircraft is supported by the platforms, or

(c) by towing the aircraft up purpose-made ramps (approx 6%) onto the platforms.

4.5.5 The function of the instrumentation unit is to:—

(a) compute and display the loads imposed upon on each platform,

(b) provide a facility for the fine calibration of the platforms to a zero datum,

(c) record and print out the indicated data.

NOTE: Some instrumentation units (subject to the necessary inputs) also have the capability to compute both the total weight and the relative c.g. of the aircraft.

5 DETERMINATION OF THE BASIC WEIGHT AND CENTRE OF GRAVITY

5.1 **General.** Modern aircraft may be weighed using any of the equipment described in paragraph 4. Arms from the c.g. datum are predetermined distances and therefore physical measurement is seldom required. However, when weighing certain types of aircraft on their wheels, it may be necessary to take measurements due to the possibility of landing gear compression or deflection altering the length of the lever arm. Furthermore before weighing is commenced, reference should be made to the manufacturer's recommended weighing procedures.

NOTE: It is important for large fixed-wing transport aircraft to be level in both the longitudinal and lateral planes when being weighed. However, for light fixed-wing aeroplanes the emphasis is normally on the longitudinal plane.

5.2 **Preparation for Weighing**

5.2.1 The aircraft should be in the condition described in the Weight and Centre-of-Gravity Schedule, fluids such as engine oil, or fuel being partially or completely drained in accordance with the manufacturer's requirements, and equipment positioned at its normal operational location.

5.2.2 It is important to carry out the weighing of aircraft inside a closed hangar, and where possible, it is recommended that the aircraft is positioned in the hangar several hours before weighing so that it can assume an even temperature and be free from moisture. If weighing in the open is unavoidable, it should be carried out on a firm level site when wind force is at a minimum with the aircraft completely dry (i.e. not affected by frost or dew) and several readings should be taken at each reaction point to obtain a reliable average figure. Also particular care should be exercised if plumb bobs are to be used for taking measurements.

5.2.3 In order to obtain consistent results from different weighings it is essential that an aircraft is placed in the 'rigging' position (i.e. with the longitudinal axis parallel to the floor). Jigged positions are normally built into an aircraft structure for levelling purposes and these may be used in conjunction with a spirit level or plumb bob and scale. Instructions supplied by the relevant aircraft manufacturer on levelling procedures and the positioning of equipment should be carefully followed and adhered to.

5.2.4 It should be noted, however, that some light aeroplanes with tail-wheel landing gear, have a negative load on the tail when in the rigging position as a result of the c.g. being forward of the main wheel centres. In such cases, and where it is not possible to use a jack at the nose of the aeroplane, a spring balance should be anchored securely to the ground and attached to the tail wheel axle to determine the extent of the negative reaction. Since this is a minus load, it should be deducted from the total weight, and must be treated as a minus quantity when calculating the c.g. position.

NOTES: (1) The weight of the spring balance, and any rope used to secure it to the aircraft, must be added to the spring balance reading.

(2) Two positions weighings, i.e. datum horizontal and nose up or down, are sometimes used when it is necessary to determine the vertical c.g. position, but this is not normally carried out by operators.

5.3 Weighing on Weighbridge Scales or Platforms

5.3.1 This is normally carried out with the aircraft resting on its wheels, but is often necessary to jack the aircraft at either the nose or tail to level it longitudinally. In the circumstances where the normal aircraft attitude is almost level, the manufacturer may recommend that the tyres or oleo struts are partially deflated to obtain the corrected position. The weight of any equipment used for levelling must be deducted from the weight recorded at the particular scale. The example given in Figure 4 is a nosewheel aircraft on which, because of landing gear deflection, it is required to measure the distance between reaction points.

5.3.2 **Electronic Platform Weighing Equipment.** To achieve the degree of accuracy possible with this type of equipment careful preparation is important and this will include:—

(a) checking and adjusting the platforms to a horizontal level in the longitudinal and lateral planes,

(b) switching on the instrumentation unit prior to weighing to allow for temperature stabilisation of electronic circuits as specified by the relevant equipment manufacturer,

(c) adjusting and setting each platform to zero datum point through the instrumentation unit,

(d) correcting the aircraft's longitudinal level,

(e) ensuring the hangar is free from destabilising draughts e.g. hangar doors ajar, warm cold air blowers, etc.

NOTE After the aircraft has been weighed and removed from the platforms, a platform zero datum check at the instrumentation unit should be repeated.

5.3.3 With the main wheels located centrally on the weighbridge platforms and wheels checked, the wheel brakes should be released and the nose raised or lowered until the fuselage is longitudinally level. Plumb bobs should be suspended from the centrelines of the main wheel axles on the inner side of the wheels, and the two positions marked on the floor (see Figure 5). The midway point between these two marks represents the rear reaction point. A plumb bob suspended from the centrelines of the nose-jacking point will enable the distance between the front and rear reaction points to be measured (see Figures 4 and 5).

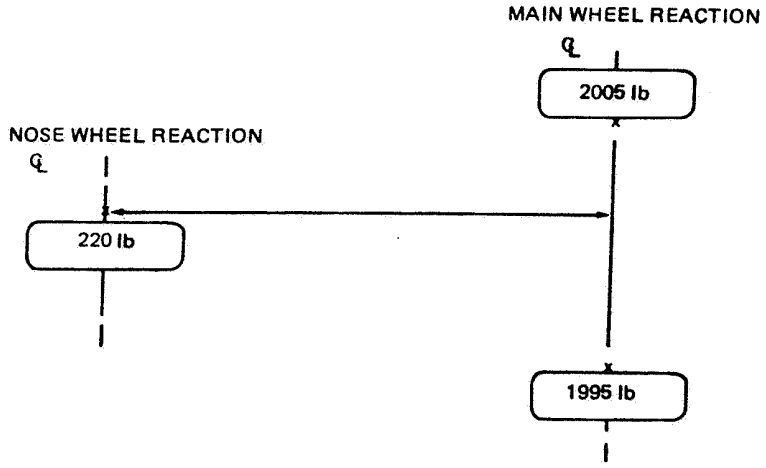
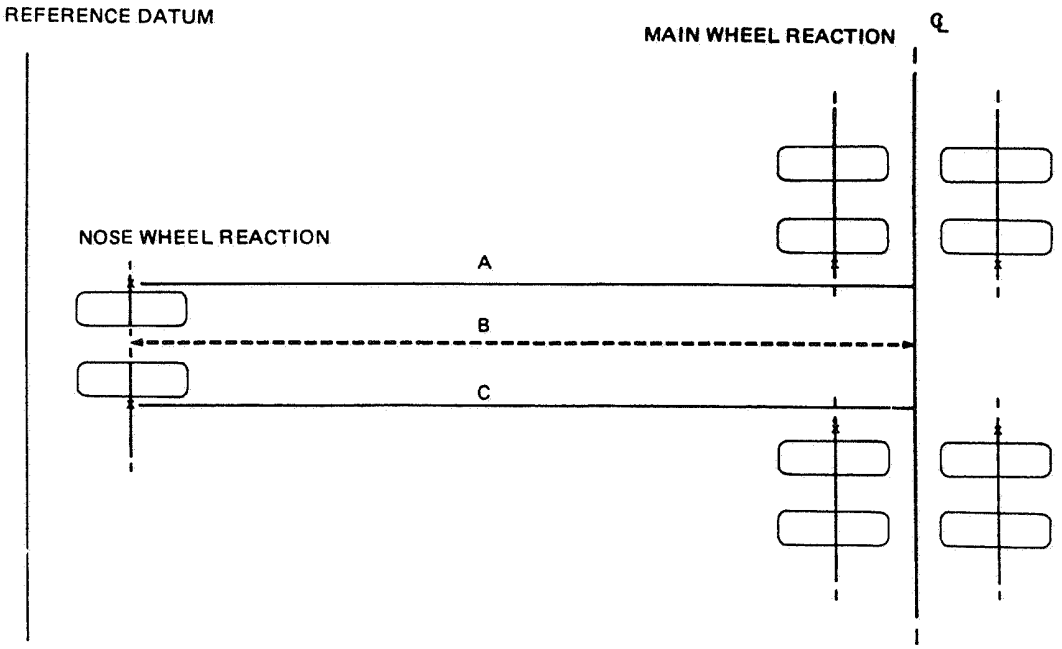


Figure 4 LIGHT AIRCRAFT



NOTE: The distance C between the front and rear reaction is a mean of the distances A and B, i.e. $C = \frac{A+B}{2}$

Figure 5 HEAVY AIRCRAFT

5.3.4 The c.g. can then be found by the following formula:—

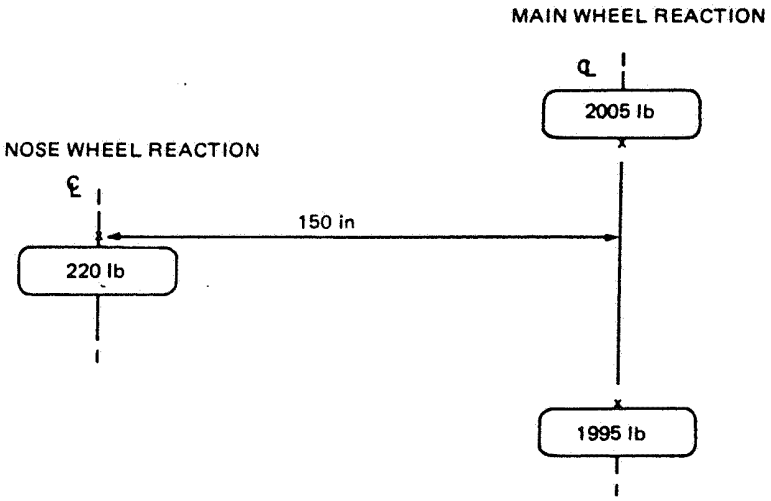
$$\frac{A \times B}{C}$$

Where A = distance between front and rear reactions

B = weight at the nose or tail wheel

C = Basic Weight.

For example:—



A = 150 in

B = 220 lb

C = 4220 lb (i.e. 220 + 1995 + 2005)

Figure 6 CENTRE OF GRAVITY RELATIVE TO THE MAIN WHEELS

Thus: $\frac{A \times B}{C} = \frac{150 \times 220}{4220 \text{ lb}}$

$= \frac{33\,000 \text{ lb in}}{4220 \text{ lb}}$

$= 7{\cdot}82$ in

∴ the c.g. is 7·82 in forward of main wheel centreline.

5.4 Reference Datums

5.4.1 Whenever a c.g. distance is reference to the main wheel centreline it should always be corrected to relate to the reference datum, and its associated moment calculated. The purposes of this correction are twofold. Firstly, in terms of measurement, it relates the c.g. to the reference datum. Secondly, in terms of total moment (and Basic Weight), it establishes the necessary mathematical datum point for subsequent calculations with regard to the operation and maintenance of the aircraft.

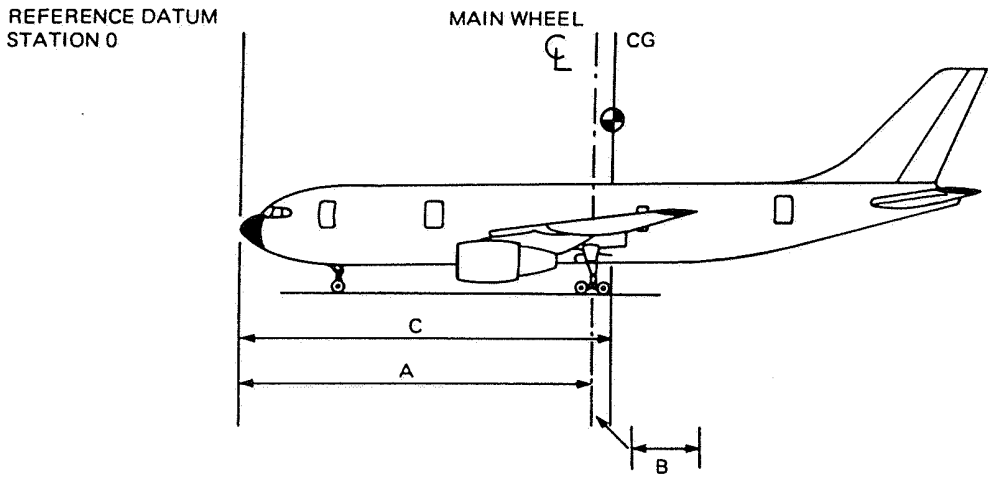
5.4.2 Centre of gravity correction to the reference datum is achieved by:

(a) suspending a plumb bob from the reference datum,

(b) measuring the distance, parallel to the aircraft's longitudinal centreline, from the reference datum to the main wheel reaction point centreline and,

(c) either adding or subtracting this measurement to or from the distance of the c.g. from the main wheel centreline.

Example 1:



A = 626 in forward of the main wheel reaction

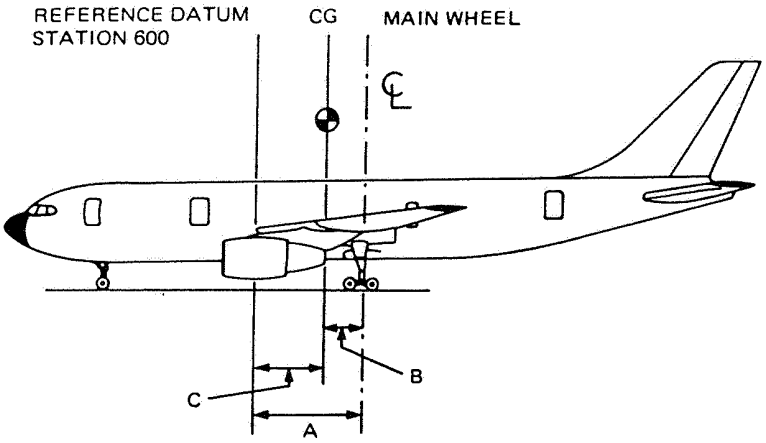
B = 50 in aft of the main wheel reaction

C = A + B

∴ the c.g. is 676 in aft of the reference datum

Figure 7 CENTRE OF GRAVITY CORRECTION TO THE REFERENCE DATUM

Example 2:



A = 260 in forward of the main wheel reaction

B = 100 in forward of the main wheel reaction

C = A − B

∴ the c.g. is 160 in aft of the reference datum

Figure 8 CENTRE OF GRAVITY CORRECTION TO THE REFERENCE DATUM

5.4.3 Total moment can then be found by the following calculation:—

Arm of the c.g. from the reference datum x Basic Weight.

For example, if a hypothetical Basic Weight of 84 000 lb is attached to the aircraft shown in Figure 7, the calculation would be as follows:—

Arm of the c.g. from reference datum	=	676 in
Basic Weight	=	84 000 lb
	=	84 000 x 676
Total Moment	=	56 784 000 lb in

Accordingly the Weight and Centre-of-Gravity Schedule will state:—

Basic Weight	: 84 000 lb
Centre of Gravity	: 676 in aft of the reference datum
Total Moment about the datum	: 567 840 lb in/100

NOTE: Once the c.g. and its related moment have been established any subsequent changes to the aircraft in terms of loading, fuel uplift or modification etc. can be re-calculated from the original Basic Weight and moment (see paragraph 6 for further details).

5.4.4 The most commonly used reference datum adopted by the majority of aircraft manufacturers is, at, or forward of, the nose of the aircraft (e.g. fuselage station zero); therefore the following will apply:—

(a) all items of equipment whether basic or additional, will be preceded by a "+" sign (i.e. aft of the datum) thereby simplifying weight and balance computations;

(b) the moment of any item can be easily calculated by its weight and distance relative to its fuselage station;

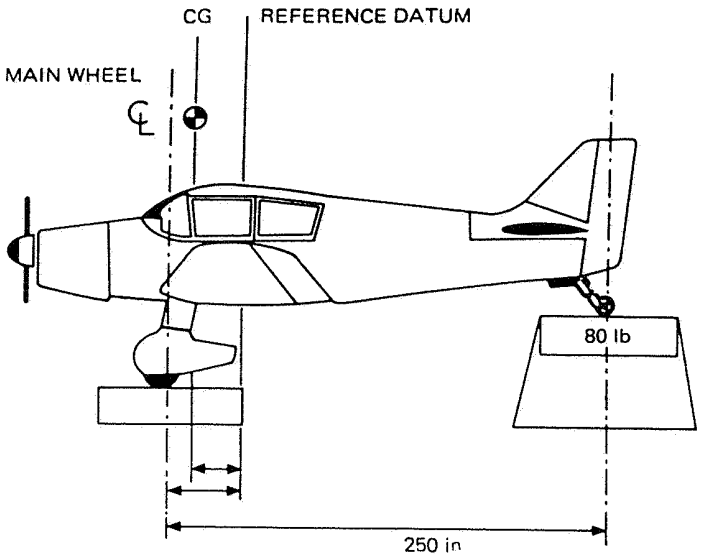
(c) it also offers an accessible point for the purposes of measurement and,

(d) will remain a common location for future "series" aircraft, of the type.

5.5 Tail-wheel Aircraft

5.5.1 Illustrated in Figure 9 is a typical tail-wheel aircraft positioned in a level attitude on weighbridge type platforms, with a reference datum aft of the main wheel centreline.

NOTE: When it is not possible to suspend a plumb bob from the nose-jacking point, due, for example, to the jack or the trestle being in the way, a measuring point should be found by suspending the plumb bob at a predetermined distance from the jacking point, this distance being used to determine the distance between the reaction points.



The weight at the right main wheel reaction	698 lb
The weight at the left main wheel reaction	702 lb
The weight at the tail wheel reaction	80 lb
TOTAL WEIGHT	1480 lb

Figure 9 TAIL-WHEEL AIRCRAFT

5.5.2 To locate the c.g. of this type of aircraft the formula described in paragraph 5.2.4 can be adopted, i.e. tail-wheel distance A is multiplied by the tail-wheel weight, the result of which is divided by the basic weight as follows:—

$$\text{c.g.} = \frac{A \times B}{C}$$

Where A = 250 in

B = 80 lb (weight at the tail wheel)

C = 1480 lb

$$= \frac{250 \times 80}{1480}$$

$$= \frac{2000}{1480}$$

= 13·513 in

∴ the c.g. is 13·513 in aft of the main wheel reaction, or alternatively 18·487 in forward of the reference datum (i.e. 32 in minus 13·513 in).

Or alternatively (see paragraph 5.6),

$$\text{c.g.} = \frac{\text{Total Moment (TM)}}{\text{Total Weight (TW)}}$$

	Weight (lb)		Arm (in)		Moment (lb in)
Right main wheel	698	x	(−) 32	=	(−) 22 336
Left main wheel	702	x	(−) 32	=	(−) 22 464
SUB TOTAL	1400				(−) 44 800
Tail wheel	80	x	(+) 218	=	(+) 17 440
				=	(−) 44 800
					(+) 17 440
TOTAL	1480				(−) 27 360

$$\text{c.g.} = \frac{TM}{TW} = \frac{27\,360}{1480}$$

= (−) 18·487 in

∴ the c.g. is 18·487 in forward of the reference datum.

5.6 An Alternative Method of Weight and Balance Calculation

5.6.1 There are various alternative methods to calculate the c.g. and moment of aircraft to that prescribed in the preceding paragraphs, once the basic weights and measurements have been established.

5.6.2 In the following example, the aircraft graphically described in Figure 10, is identical to that shown in Figure 6 except for the added reference datum. The method of calculation is the same as that used in paragraph 5.7, except that the subject aircraft has, as appropriate to this section, been weighed on platforms as opposed to aircraft jacks.

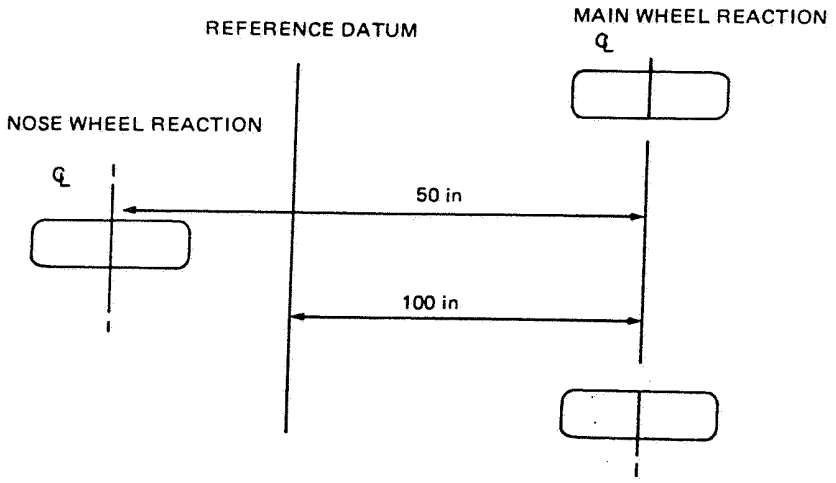


Figure 10 CENTRE OF GRAVITY RELATIVE TO THE REFERENCE DATUM

$$\text{c.g.} = \frac{\text{Total Moment (TM)}}{\text{Total Weight (TW)}}$$

	Weight (lb)		Arm (in)		Moment (lb in)
Left main wheel	1995	x	(+) 100	=	(+) 199 500
Right main wheel	2005	x	(+) 100	=	(+) 200 500
SUB TOTAL	4000				(+) 400 000
Nose wheel	220	x	(−) 50	=	(−) 11 000
TOTALS	4220				(+) 389 000

$$\frac{\text{TM}}{\text{TW}} = \frac{389\,000 \text{ lb in}}{4220 \text{ lb}}$$

= (+) 92·180 in aft of the reference datum.

Accordingly, the Weight and Centre-of-Gravity Schedule will state:—

Basic Weight : 4220 lb

Centre of Gravity : 92·180 in aft of the reference datum

Total Moment about the datum : 3890 lb in/100.

5.7 **Weighing on Aircraft Jacks**

5.7.1 It is important when weighing aircraft on jacks to strictly observe the procedures specified by the relevant aircraft manufacturer. Reference should also be made to CAIP Leaflet **GOL/1—1** — Aircraft Handling. Suitable adapters should be fitted to the aeroplane jacking points and the weighing units of adequate capacity fitted to jacks. The jacks should then be positioned under each jacking point, and the zero indication of the weighing units verified. The attitude of the aeroplane should then be checked by means of levels or plumb bobs as appropriate. The aeroplane wheel brakes should then be released and the jack situated at the lowest jacking point raised until the aeroplane is level. The remaining jacks may then be raised to contact their respective jacking points. All jacks should then be raised slowly together (maintaining a level attitude) until the aircraft wheels are clear of the ground. When final adjustments have been made to level the aircraft, readings should be taken from each weighing unit, after which the aircraft may then slowly be lowered to the ground. To ensure that representative readings are obtained when using hydrostatic units or load cells, it is essential that a second weighing is carried out.

NOTE: When electrical weighing cells are being used it is often recommended that they should be switched on 30 minutes before commencing weighing operations, in order that the circuits have time to stabilise.

5.7.2 The weight and c.g. of the aeroplane can then be calculated as in the example given below, for an aircraft whose c.g. reference datum is quoted as fuselage station zero and on which the jacking points are situated at 50 and 180 in aft of the datum.

$$\text{c.g.} = \frac{\text{Total Moment (TM)}}{\text{Total Weight (TW)}}$$

		Weight (lb)		Arm (in)		Moment (lb in)
(a)	Left jack reaction	1995	x	(+) 50	=	(+) 99 750
(b)	Right jack reaction	2005	x	(+) 50	=	(+) 100 250
(c)	Tail jack reaction	900	x	(+) 180	=	(+) 162 000
TOTAL		4900				(+) 362 000

$$\text{c.g.} = \frac{\text{Total Moment (TM)}}{\text{Total Weight (TW)}} = \frac{362\,000 \text{ lb}}{4900 \text{ lb}}$$

$$= 73{\cdot}88 \text{ in}$$

Accordingly, the Weight and Centre-of-Gravity Schedule will state:—

Basic Weight : 4900 lb

Centre of Gravity : 73·88 in aft of the reference datum

Total Moment about the datum : 3620 lb in/100.

5.8 **Weighing Rotorcraft**

5.8.1 Rotorcraft are normally weighed in a similar way to fixed-wing aircraft, four jacking points being located in the fuselage near the wheels. The c.g. datum is, however, normally located on the vertical line through the centroid of the main rotor and is marked on the side of the fuselage. Moments may therefore be either positive or negative and the permissible c.g. range extends either side of the datum.

5.8.2 The hydrostatic weighing of rotorcraft by the single point method can be used when permitted by the manufacturer. The process consists of suspending the craft from a single hydrostatic weighing unit at the rotor head. The c.g. is determined by measuring defined angles, and then entering the results into tables supplied by the manufacturer.

5.8.3 To ensure that the rotor blades are symmetrically located about the rotor axis it is usually necessary to fit locks to the rotor head. The weight of these locks must be taken into account when calculating the c.g. position.

5.8.4 On some rotorcraft it may also be necessary to determine the vertical and transverse positions of the c.g., and the manufacturer's instructions regarding the method of calculation should be followed.

5.9 **Standard Mean Chord.** Since the c.g. is an aerodynamic consideration, its position is sometimes additionally specified as a percentage of the Standard Mean Chord (SMC) of the wing, measured aft from the leading edge (see NOTE to paragraph 2.8.3). The percentage SMC may be calculated as follows:

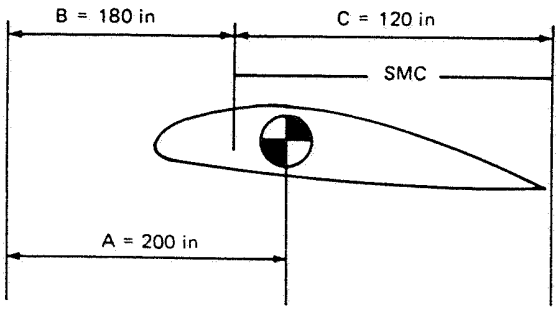
$$\frac{A - B}{C} \times 100$$

Where A = distance of the c.g. from the reference datum

B = distance of the SMC leading edge from the reference datum

C = the length of the SMC.

For example:



$$\therefore \frac{A - B}{C} \times 100 = \frac{200 - 180}{120} \times 100$$

$$= \frac{20}{120} \times 100$$

$$= 16{\cdot}6\%$$

Figure 11 STANDARD MEAN CHORD

6 CHANGE IN BASIC WEIGHT

6.1 **General.** When an item of Basic Equipment is added, removed or repositioned in an aircraft, calculations must be made to determine the effect on both Basic Weight and c.g. This information should then be used to prepare a revised Weight and Centre-of-Gravity Schedule (Part A) (see paragraph 2.9).

6.2 **Modifications.** Where the total weight and moment for additional equipment is not quoted in the appropriate Modification Leaflet, the equipment, and any parts used for attachment purposes, such as brackets, nuts, bolts, rivets, sealant, etc., must be accurately weighed. The position of the additional material must then be determined, and its moment calculated relative to the c.g. datum.

6.3 In order to find the new Basic Weight and moment of the aircraft, the weight and moment of the equipment added or removed must be considered in relation to the original Basic Weight as follows:—

(a) When equipment has been added the weight must be added to the original Basic Weight; if the arm of the new equipment is positive (i.e. aft of the c.g. reference datum) then the moment must be added to the original moment, whereas if the arm is negative (i.e. forward of the c.g. reference datum) then the moment must be subtracted from the original moment.

(b) When equipment has been removed the weight must be deducted from the original weight; if the arm of the equipment was positive then the moment must be deducted from the original moment whereas if the arm was negative then the moment must be added to the original moment.

(c) The new c.g. position is calculated by dividing the new total moment by the new basic weight.

NOTE: It may be found convenient to use mathematical signs to confirm the final action in the above calculations. For example, if equipment is added "+" and its arm is positive (+), since + x + = +, then its moment must be added to the original moment, but if equipment is removed "–" and its arm was positive (+), since – x + = –, then its moment must be subtracted from the original moment.

6.4 Examples of Alterations to Basic Weight

6.4.1 The following examples are for an aeroplane whose:

(a) Basic Weight is 15 700 lb,

(b) c.g. reference datum is at fuselage station 105, i.e. 105 in aft of fuselage station zero,

(c) c.g. is at station 130 i.e. + 25 in aft of the reference datum.

6.4.2 **Example 1.** A radar system is installed in the aeroplane which comprises:—

(a) a radar set which weighs 32 lb and is located aft of the reference datum at fuselage station 125, with

(b) a controller which weighs 2 lb and is located at fuselage station 65, forward of the reference datum, plus

(c) a scanner which weighs 25 lb and is located at fuselage station 12, forward of the reference datum.

	Weight (lb)	Arm (in)	Moment (lb in)
Original aircraft	15 700	(+) 25	(+) 392 500
Added items (a)	+ 32	(+) 20	(+) 640
(b)	+ 2	(−) 40	(−) 80
(c)	+ 25	(−) 93	(−) 2 325
Revised Basic Weight and moment	+15 759		(+) 390 735

With the revised Basic Weight and moment the c.g. can be calculated as follows:

$$\text{c.g.} = \frac{\text{TM}}{\text{TW}}$$

$$= \frac{390\,735}{15\,759}$$

$$= 24{\cdot}79 \text{ in.}$$

Accordingly, the revised Weight and Centre-of-Gravity Schedule will state:—

Basic Weight : 15 759 lb

Centre of Gravity : 24·79 in aft of the reference datum

Total Moment about the datum : 3096 lb in/100.

6.4.3 **Example 2.** The aeroplane's heating and air conditioning unit is removed from fuselage station 65 to fuselage station 180.

	Weight (lb)	Arm (in)	Moment (lb in)
Original aircraft	15 700	(+) 25	(+) 392 500
Item removed	− 120	(−) 40	(+) 4800
Item replaced	+ 120	(+) 75	(+) 9000
Revised Basic Weight and moment	+15 700		(+) 406 300

With the Basic Weight unchanged and a revised moment the calculations are as follows:

$$\text{c.g.} = \frac{\text{TM}}{\text{TW}}$$

$$= \frac{406\,300}{15\,700}$$

$$= 25{\cdot}87 \text{ in.}$$

Accordingly the revised Weight and Centre-of-Gravity Schedule will state:—

Basic Weight : 15 700 lb

Centre of Gravity : 25·87 in aft of the reference datum

Total Moment about the datum : 4063 lb in/100.

7 LOADING OF AIRCRAFT

7.1 **General.** In accordance with the Air Navigation Order, the Commander of an aircraft registered in the United Kingdom must satisfy himself, before the aircraft takes off, that the load carried is of such weight, and so distributed and secured, that it may safely be carried on the intended flight. To ensure this, the Variable and Disposable Loads must be added to the Basic Weight and c.g. of the aircraft and the total weight and c.g. determined. If the aircraft exceeds 5700 kg MTWA or has a seating capacity of 12 or more persons, the loading is based on assumed weights for persons and baggage, otherwise the actual weights must be used. For further information see Air Navigation Order (General) Regulations.

7.2 **Small Aircraft**

7.2.1 On small aircraft the calculations are fairly simple since the only item which alters appreciably during flight is the fuel quantity. Calculations should include all the variable and disposable items, at both maximum and minimum fuel states, to ensure that the c.g. will remain within the limits as fuel is used up.

NOTE: To minimise the calculations involved, some aircraft Operating Manuals include a graph of the c.g. limitations in the form of a weight/moment envelope.

7.2.2 On some aircraft the loadings which will give the maximum forward and aft c.g. positions are included in the weight and balance data. For example, on most four seat aircraft the maximum forward c.g. position is reached with the pilot only, no baggage and minimum fuel, and the maximum aft c.g. is normally obtained with pilot and two rear seat passengers, maximum baggage and maximum fuel. Provided these loadings are within limits it will not normally be necessary to calculate weights and moments before each flight. However, in the fully laden condition the maximum weight or aft c.g. limits may be exceeded, therefore, it may be necessary to offload passengers, baggage or fuel, depending upon requirements of a particular flight.

7.3 **Large Passenger and Cargo Aircraft**

7.3.1 With large aircraft the moment of items such as fuel, passengers and cargo are considerable and the procedures for determining a particular loading become complicated. In addition to the longitudinal c.g. calculation it is also usually necessary to ensure that distribution of fuel and cargo is satisfactory in a transverse (lateral) direction. Most airlines employ a specialist section dealing with loading calculations, whose responsibility it is to produce a load sheet for each flight.

7.3.2 The main item of variable moment during flight is the fuel, and although correct management of the fuel system will minimise c.g. movement, some variations will remain due to the impracticability of locating all fuel near the c.g. on modern swept-wing aircraft. The critical points in the c.g. envelope are caused by fuel usage and variations in specific gravity, these variations are calculated and applied to the envelope to curtail its boundaries.

7.3.3 The c.g. limitations are further curtailed by fixed allowances for other variable items such as the following:

(a) Seating allowance, which is calculated to provide for out-of-balance seating loads resulting from empty seats or passenger weight variation.

(b) Flight allowance, which is provided to allow for the normal movement of crew and passengers during flight.

(c) Moment changes due to operation of the landing gear or flaps.

7.3.4 Weights and moments of passengers and cargo are then calculated, the cargo being arranged within the fuselage or holds in such a way that the total weight and moment of the loaded aircraft fall within the curtailed limitations. The heavier pieces of cargo or pallets are normally located close to the c.g. to restrict their effect, due attention being paid to floor loading limitations, strength, and number of lashing points, etc.

7.3.5 On some aircraft it is also necessary to predetermine the order of loading fuel, cargo and passengers, in order to ensure that the structural limits are not exceeded, by excessive out-of-balance forces tending to tip the aircraft on its tail.

7.3.6 A Load Sheet, similar to the one shown, is prepared for each flight, the weights and moments with zero fuel and maximum fuel being entered in the c.g. envelope to ensure satisfactory balance and performance throughout all phases of flight, i.e. take-off, climb, cruise and landing.

TYPICAL LOAD SHEET

	Weight (lb)	Arm (in)	Moment (lb in/1000)	CG (% SMC*)
Basic Weight	100 000	210	21 000·00	29·2
Variable Load				
Pilot	165	100	16·50	
Navigator	165	100	16·50	
Engineer	165	120	19·50	
Steward	165	300	49·50	
Crew baggage	100	110	11·00	
Passenger seats, 50 1st class	450	170	76·50	
100 tourist	600	280	168·00	
Drinking water	250	130	32·50	
Liferaft	300	410	123·00	
Emergency transmitter	30	120	3·60	
Service equipment (food etc.)	200	400	80·00	
Operating Weight	102 590	211	21 596·60	30·0
Disposable Load				
Passengers, 1st class (35)	5 775	160	924·00	
Tourist (83)	13 695	270	3 697·65	
Cargo No 1 hold	500	100	50·00	
No 2 hold	450	200	90·00	
No 3 hold	500	280	140·00	
No 4 hold	400	350	140·00	
Zero Fuel Weight	123 910	215	26 638·55	33·3
Fuel Nos 2 and 4 tanks	10 000	150	1 500·00	
Nos 1 and 3 tanks	10 000	200	2 000·00	
Reserve tanks	5 000	240	1 200·00	
Take-off Weight	148 910	210	31 338·55	29·2

*SMC is explained in paragraph 5.9. In this example % SMC is derived from the formula $\frac{(\text{c.g. arm} - 175) \times 100}{120}$ (i.e. length of the SMC is 120 in and its leading edge is 175 in aft of fuselage station zero).

APPENDIX

TYPICAL WEIGHT AND CENTRE-OF-GRAVITY SCHEDULE FOR AIRCRAFT MTWA EXCEEDING 2730 kg

Reference	:	NAL/286
Produced by	:	Loose Aviation Ltd
Aircraft Designation	:	Flynow 2E
Nationality and Registration Marks	:	G-BZZZ
Constructor	:	FLY Co Ltd
Constructor's Serial	:	44
Maximum Total Weight Authorised (MTWA)	:	7300 lb
Centre-of-Gravity Limits	:	Refer to Flight Manual Reference Number 90/946

PART 'A' BASIC WEIGHT

The Basic Weight of the aircraft (as calculated from Weight and Balance Report/Weighing Record NAL/W/95* dated 31 August 1977) is : 5516 lb.

The c.g. of the aircraft (in the same condition at this weight and with the landing gear extended) is : 127 in aft of datum

The total moment about the datum in this condition is : 7015 lb in/100.

NOTE: The datum is at fuselage station 0 situated 114 in forward of the wing leading edge. This is the datum defined in the Flight Manual. All lever arms are distances in inches aft of datum.

The Basic Weight includes the weight of 5 gallons of unusable fuel and 1 gallon of unusable oil and the weight of the following items which comprise the list of Basic Equipment:—

Item	Weight (lb)	Lever Arm (in)
2 Marzell propellers type BL-H3Z30	127 each	76
2 engine driven 100 ampere alternators	27 each	117
1 13 Ah Ni-Cd battery CB-7 etc.	31 etc	153 etc

PART 'B' VARIABLE LOAD

The weight and lever arms of the Variable Load are shown below. The Variable Load depends upon the equipment carried for the particular role.

Item	Weight (lb)	Lever Arm (in)	Moment (lb in/100)
Pilot (one)		108	
De-icing fluid 1½ gal	12	140	17
Life-jackets (seven)	14	135	19
Row 1 passenger seats (two)	60	173	104
Row 2 passenger seats (two)	60	215	129
Row 3 passenger seats (two)	60	248	149
Table	8	256	20
One stretcher and attachments (in place of seat rows 2 and 3)	45	223	100
Medical stores	15	250	37

*Delete as appropriate

PART 'C' LOADING INFORMATION (DISPOSABLE LOAD)

The total moment change when the landing gear is retracted in lb in/100 is: −18. The appropriate lever arms are:—

Item	Weight (lb)	Lever Arm (in)	Capacity (imp gal)
Fuel in tanks 1 and 2	1368*	145	190
Engine oil	50*	70	5·5
Forward baggage		21	
Rear baggage		261	
Passengers in Row 1 seats		171	
Passengers in Row 2 seats		213	
Passengers in Row 3 seats		246	
Patient in stretcher		223	

*Densities — Petrol 7·2 lb/imp gal; kerosene: 8·1 lb/imp gal; Oil: 9·0 lb/imp gal.

NOTE: To obtain the total loaded weight of the aircraft, add to the Basic Weight and the weights of the Variable and Disposable Load items to be carried for the particular role.

This Schedule was prepared (date) ..... and supersedes all previous issues.

Signed ..... Inspector/Engineer

on behalf of .....

Approval reference .....

NOTE: (Not part of the Example Schedule). In Part 'B' Variable Load of this Schedule, the actual weight of the pilot is required in accordance with the Air Navigation (General) Regulations for aircraft the (MTWA) of which does not exceed 5700 kg or with less than 12 persons seating capacity. Hence the pilot's weight and moment are omitted in the example.

BL/1-12

Issue 2

December, 1983

BASIC AIRWORTHINESS PROCEDURES

CLEAN ROOMS

1 INTRODUCTION The higher reliability requirements specified for aircraft system components and, in particular, those associated with complex electronic (see Leaflet MMC/1-4), instrumentation and mechanical systems, necessitated the development of techniques for controlling contamination which in various forms is a common cause of component failure. It also became necessary to apply these techniques to selected areas of manufacturing and aircraft operating organisations in which the various processes of manufacture, overhaul and testing can be carried out under controlled environmental conditions. Such selected areas are referred to as Clean Rooms, the design and construction of which form part of an independent and highly specialised field of work to British Standard BS 5295 Parts 1, 2 and 3.

1.1 The information given in this Leaflet is intended purely as a guide to the subject of Clean Rooms. The following general aspects are covered:

2 SOURCES OF CONTAMINATION Any substance that causes failure or malfunctioning of a component is a contaminant, the particles of which may take a variety of forms and stem from many sources.

2.1 **Air.** The air which continually surrounds the components may be considered as a contamination storehouse containing dirt and dust particles, organic and inorganic vapours.

2.2 **Manufacture.** Contaminants are produced during all manufacturing processes, and particles, such as swarf resulting from a machining operation, or particles forced into the surface of a component during a pressing or heating process, can be of such a nature that their effect can be immediate or delayed. Depending on the composition of the particle and component materials, the alloys or compounds formed by interaction can result in serious loss of a component's structural strength over a period governed by the rate of diffusion.

2.3 **Assembly.** During the assembly process the possibility of introducing contaminants is probably greatest because of exposure to the highest levels of contaminant sources. In the soldering process for example, the vaporisation of flux causes particles to escape into the surrounding air which, on cooling, condense as droplets on a nearby cold surface of the component. Depending on the location of the particles and the forces applied to them, they can act as a contaminant with an immediate or delayed effect.

2.3.1 The use of jointing adhesives can also produce contamination similar to that of a soldering process. In addition, vapours can be given off which can migrate to other portions of an assembly and act as a delayed-action contaminant.

2.3.2 Assembly of components using threaded joints can produce fibre-shaped fragments or flakes as a result of an effect similar to wire drawing. For extremely close fit or for balancing purposes, it may be necessary to fit individual parts of a component together by grinding, lapping or honing operations. In any such operation, contaminant particles can be dispersed in the atmosphere, suspended in fluids, adhere to the surfaces of component parts, or become embedded into the surfaces.

2.3.3 Assembly of components in jigs, or while being handled or supported by tools, may result in deformation of surfaces and production of contaminant particles. For example, if during tightening of a bolt, slippage of the spanner jaws occurs, particles are produced from the bolt head. Particles are also produced from the heads of bolts or screws and component surfaces during final tightening.

2.4 **Storage and Transit.** During the storage period of assembled components and of associated independent parts, contamination can occur in several ways notwithstanding the use of protective coverings or containers. Particles from the air may be deposited as a result of gravitational settling and also as a result of electrostatic effects. Improperly cleaned containers or covers may transfer particles to components, in particular where padded containers and plastics containers are used. In the first case, the contours of the container may trap particles which are not released until the component causes deformation of the padding. In the second case, plastics containers may pick up particles from the air due to electrostatic charging, and hold them until transferred to the packed component.

2.4.1 Containers which are not hermetically sealed are subject to a 'breathing' cycle as the temperature of the container varies. During the intake portion of the cycle, particles in the air surrounding the container may be drawn into a position where they can contaminate the component.

2.4.2 The movement of packed containers during transit is also a source of contamination since it may dislodge contaminant particles not previously cleaned off, or create new particles by abrasion.

2.5 **Component Cleaning Processes.** A cleaning process is actually a process of transforming contamination from a high level of concentration to a lower one; therefore, tolerance levels must be considered relative to the component's function and required operational accuracy.

2.5.1 The transfer of contaminant particles is dependent on the methods used in the cleaning process, i.e. whether wiping or polishing with an absorbent or collecting material (dry cleaning transfer) or cleaning by means of a liquid (wet cleaning transfer). Problems exist in each of these processes.

2.5.2 The ways in which dry cleaning can contaminate include the following:

(a) Removal of fibrous particles from the cleaning material.

(b) The material, after use, may have a particle concentration sufficiently high so that as much contamination is left on the component as is removed.

(c) Wiping or polishing action can cause particle adhesion as a result of electrostatic charges.

(d) Particles can be moved about on a component surface without necessarily being lifted from the surfaces.

2.5.3 In the wet cleaning process, the contaminated surfaces are exposed to clean fluid which will wet the particles and the surfaces. The fluid or the component is then agitated so as to pull particles from the surfaces. After a specified period the component is withdrawn and the surfaces are dried. The ways in which wet cleaning can contaminate include the following:

(a) It is often difficult to obtain clean fluid and to keep it clean when handling it.

(b) Agitation of the fluid is normally done by ultrasonic means, but there is a possibility of re-contamination if the amplitude of agitation is not large enough to remove particles an appreciable distance from the surface of the component.

(c) Often a wet surface may have particles in the liquid layer that can easily be moved laterally over the surface but are removed from the liquid layer only with great difficulty.

(d) Until the component is dried, any airborne particles will collect on the wet surface and remain.

2.6 **Personnel Activity.** The activity of personnel is probably the greatest single cause of contamination which arises from several sources. The act of walking, or other movements required at a work bench, produces transient air currents which re-distribute airborne particles and the brushing off of particles from many surfaces. Another contaminant source is the shedding of skin and hair particles. The outer layers of skin flake off almost continuously, the flake rate and size depending on the amount of abrasion to which the skin is exposed and its condition.

2.6.1 Exhaled air is another source of contamination since it contains moisture-retaining solid particles and is usually acidic in nature. Perspiration from the skin is a similar hazard.

3 CONTROL OF CONTAMINATION Control of contamination is effected in two ways: by establishing a clean room, which will provide a clean atmosphere and working conditions, and by rigid routines adopted by personnel to prevent process, transfer and associated sources of contamination while working within the area of the clean room.

3.1 The construction of a clean room and its air handling system (see paragraph 8) must be designed to control airborne particles over a range of sizes and suited to the nature of the work performed in the room. Control is accomplished by filtration of the air entering the room, changing the air to remove generated particles, designing walls, floors and furnishings to be resistant to particle generation and retention, protecting components from impact and settling of particles and providing additional areas for cleaning of parts and personnel.

4 SIZE OF CONTAMINANTS The degree to which contaminants are effectively controlled is determined by measurements of the size of particles and the number in a given volume. The conventional unit of measurement is the micrometre (μm). In general, the filtration systems of clean areas are designed to control particles of 0·5 μm and larger in size.

5 CLASSIFICATION OF AIR CLEANLINESS In addition to all principles of air-conditioning, certain specialised cleanliness requirements are defined by standards which establish classes of contamination level to be achieved in the design of a clean room for a specific task. Classifications relate to the number of contaminant particles 0·5 μm and larger in size, present in one cubic metre of air. Four classes of contamination level are generally adopted and these are shown in descending order of cleanliness in Table 1. Special classifications may be used for particle count levels where special conditions dictate their use. A summary of the cleanliness requirements for some typical products is given in Table 2.

TABLE 1

Controlled Environment (Clean room, work station or clean box)	Recommended Air Flow Configurations	Recommended Periodicity for Air Sampling and Particle Counting	Max. Permitted Number of Particles per m³ (equal to, or greater than, stated size)					Final Filter Efficiency %
			0·5 μm	1 μm	5 μm	10 μm	25 μm	
Class 1	Unidirectional	Daily or continuous by automatic equipment	3,000*	Not applicable	Nil	Nil	Nil	99·995
Class 2	Unidirectional	Weekly	300,000	Not applicable	2,000	30	Nil	99·95
Class 3	Unidirectional or conventional	Monthly		1,000,000	20,000	4,000	300	95·00
Class 4	Conventional	3-monthly			200,000	40,000	4,000	70·00
Controlled Area	Normal ventilation	—	—	—	—	—	—	—
Contained Work Station	Unidirectional	To suit required class and application						99·997
Portable Clean Boxes	As selected	To suit required class and application	To suit required class					To suit required class

* Subject to maximum particle size of 5 μm

6 CLASSIFICATION OF CLEAN ROOMS The cleanliness achieved by a clean room is dependent on the air-handling system's capacity to purge the room of contaminant particles. This includes not only effectiveness of the filters and the number of air changes per hour but also the distribution of the air within the room. There are two main methods of distributing air into clean rooms namely, conventional clean rooms and unidirectional-flow clean rooms, and these also serve as the basis of clean room classification.

6.1 **Conventional Clean Rooms.** Conventional clean rooms are based on recognised air-conditioning techniques. The conditioned air is highly filtered and distributed through ceiling-mounted diffuser outlets, and then exhausted from return airducts located near the floor around the periphery of the room (see Figure 1). In addition to direct emission from the diffuser outlets, spreading of conditioned air throughout the room is obtained by secondary mixing of the air caused by thermal effects of warm and cool air currents. This is an advantage from the point of view of maintaining conformity of room temperature conditions, but the turbulence created gives rise to the problem of contaminant particles being re-introduced to the airstream.

TABLE 2

Class	Particles/m³	Product
2	0·5 μm to 10 μm	Air bearings Miniature ball bearings Miniature contacts Floated gyros Hydraulic and pneumatic systems Optics Semi-conductor networks Miniature timing devices
3	1 μm to 25 μm	Hydraulic and pneumatic systems Precision timing devices Stable platforms Gyros
4	5 μm to 25 μm	Ball bearings Electronic components Engine pumps Aerospace instruments Printed circuits Valves Hydraulic and pneumatic systems Precision measuring equipment

NOTE: Class 1 is outside the scope of this Leaflet and would not normally be used.

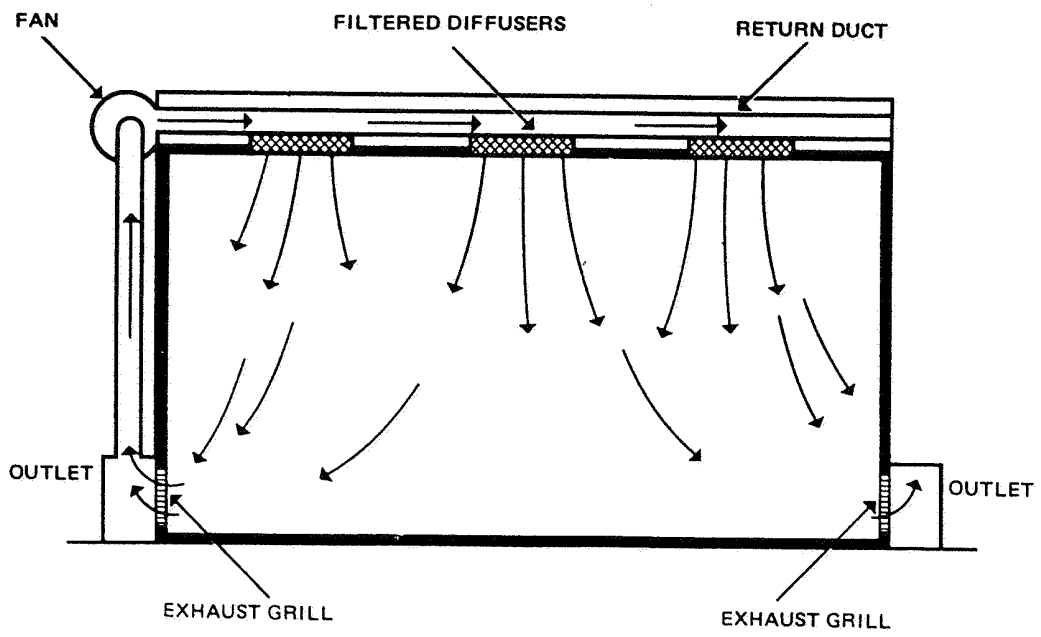


Figure 1 CONVENTIONAL FLOW SYSTEM

6.2 **Unidirectional-flow Clean Rooms.** These rooms have been developed from the conventional type of clean room and are designed to overcome three primary deficiencies associated with it; lack of self clean-up capabilities to effect contamination brought in by personnel and equipment, non-uniformity of airflow patterns and the requirement for rigid control of personnel. The major differences between the layout and operation of the two types of clean room result from the method of air distribution adopted. In a unidirectional-flow room air is introduced through a large filtered diffuser area, moves through the room and is exhausted through an outlet opposite to the diffuser and of equally large area. Such an arrangement ensures that the air moves in a straight or unidirectional-flow. The outlet is connected to return air ducts thus permitting re-cycling of the air. Two alternative airflow systems exist and are illustrated diagrammatically in Figure 2. In the vertical unidirectional-flow (down-flow room) system, the diffuser forms the complete ceiling of the room and the floor is grated to provide the outlet to return ducts. The diffuser of a horizontal flow (cross-flow room) system forms one of the end walls of the room. After passing through the room and then through an exhaust grill, the air is deflected upwards into the return ducts.

6.2.1 In some designs the use of separate return ducting may be eliminated by adopting the twin cross-flow technique of air distribution as shown in Figure 3. The total clean room area required is divided in half by a wall, with flow in one direction on one side of the wall and flow in the opposite direction on the other side. The end walls are made up of filtered diffusers and exhaust grills, and are disposed so that the clean room itself acts as a return duct.

7 ENVIRONMENT AND COMFORT CONTROL The temperature, humidity and pressure characteristics of the air passing through the air handling system (see paragraph 8) should be controlled to establish an environment suitable for work processes to be carried out in a clean room and for the comfort of clean room personnel.

7.1 **Temperature and Humidity.** The selection of temperature and humidity ranges to be controlled are dependent on the design of the component or system and the effects on their functional accuracy under varying environmental conditions. Normally a suitable temperature for working conditions is 20 ± 2°C. Humidity should be controlled and maintained at a relative humidity of 35 to 50% for all classes of clean rooms, contained work stations and clean boxes.

7.2 **Pressure.** Clean rooms are always slightly pressurised in order to maintain the required outward flow of air under closed working conditions and to prevent the entry of contaminant airborne particles when entryways or doors are opened.

7.2.1 Unidirectional-flow rooms should normally have an air velocity of 0·45 ± 0·1 m/s for horizontal flow rooms and 0·30 ± 0·05 m/s for vertical flow rooms. Air pressure for conventional flow rooms should be such that the number of air changes, including re-circulated air, should not normally be less than 20 per hour except for Class 4 rooms where not less than 10 changes per hour may be acceptable.

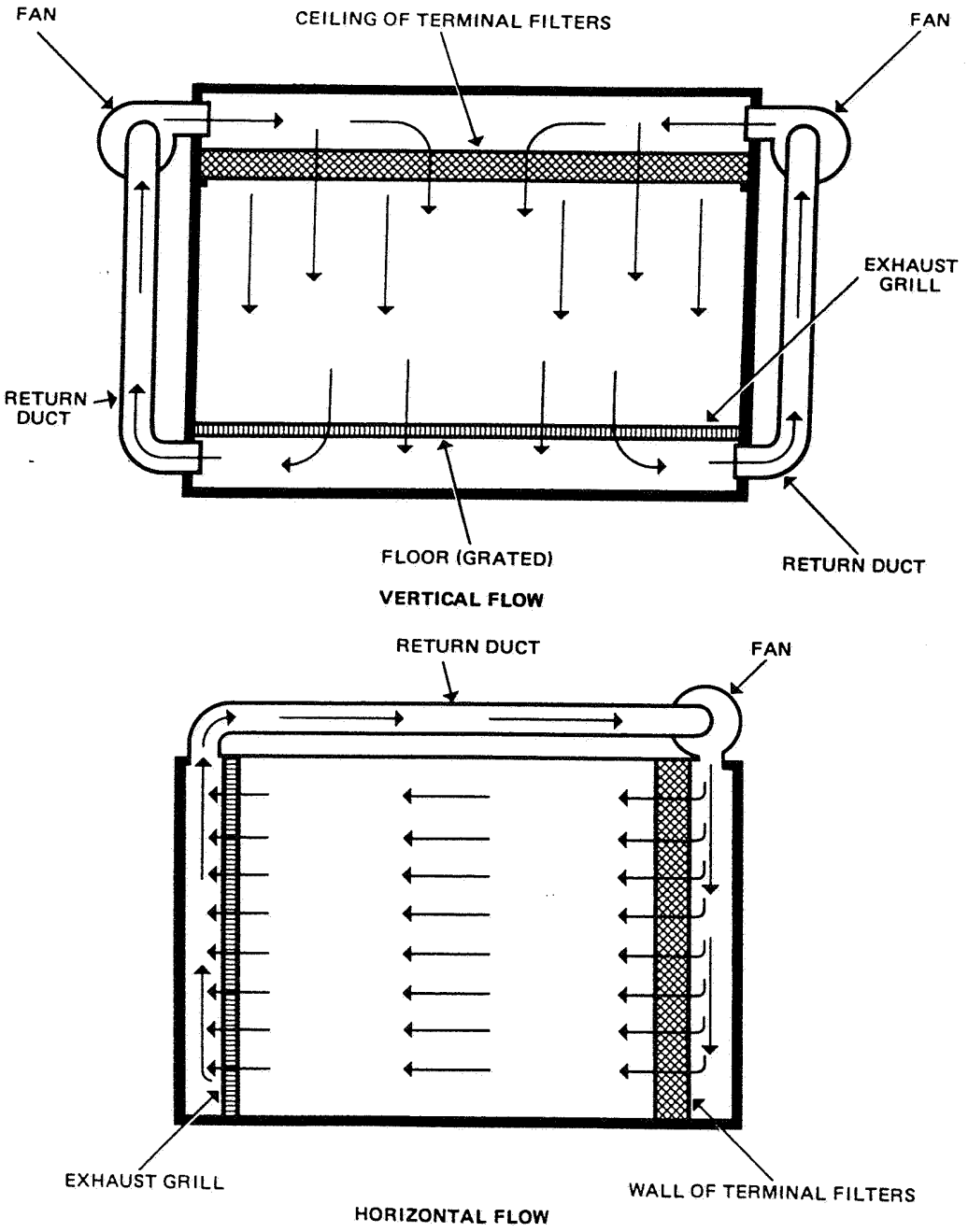


Figure 2 UNIDIRECTIONAL-FLOW SYSTEMS

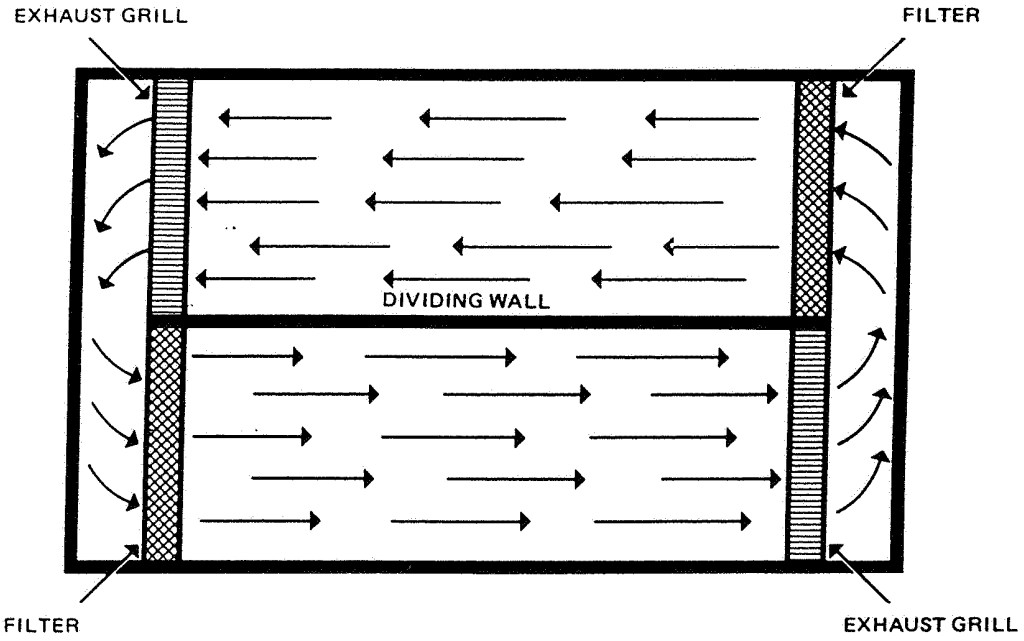


Figure 3 TWIN UNIDIRECTIONAL CROSS-FLOW SYSTEM

7.2.2 Arrangements should also be made to ensure that excessive turbulence is not produced, and every precaution should be taken to obviate the possibility of contaminated air being carried back to the work stations. Contained work stations and portable work boxes should normally conform to the requirements of the type of air flow selected. Air pressure and graduations between successive pressure areas should not normally be less than 15 Pa (1·5 mm water gauge).

NOTE: 25 Pa (2·5 mm water gauge) is normally regarded as adequate but, when selecting the actual pressure, care should be taken to ensure that in-leakage is prevented.

8 AIR HANDLING SYSTEMS The primary function of an air handling system for any type of clean room is to control the level of airborne contaminant particles by constantly filtering and re-circulating the air. The arrangement of a system depends on whether it is to be a conventional clean room, unidirectional vertical or horizontal flow clean room. In the basic form, however, it consists of a fan, ducting for inlet and exhaust air and an air filtration system. In some instances, the use of ducting may be minimised by adopting a false ceiling arrangement and by blowing air through the plenum chamber formed between two ceilings, and also by adopting a twin cross-flow system (see paragraph 6.2.1). The air is conditioned to the required temperature and humidity values (see paragraph 7.1) by adopting recognised air-conditioning principles and by the integration of an appropriate air-conditioning plant.

8.1 **Fans.** Fans are usually of the electrically-operated type designed to deliver a constant airflow rate through the clean room as the filter pressure drop increases. They should be mounted external to the ducting, where possible, to avoid heat loading of the air and introduction of further contamination. Care should also be taken to avoid contamination of the atmosphere by gaseous effluents.

8.2 **Ducting.** Ducting is constructed from materials which are non-flaking and corrosion-resistant, stainless-steel and aluminium being commonly used, or should normally be treated to prevent the introduction of contaminants from the duct.

8.3 **Filtration System.** Filtration of airborne contaminant particles is selected on the basis of cleanliness level required and, generally, a system is made up of two principal stages: pre-filter stage and final filter stage. Pre-filtering is carried out at the inlet to the air handling system and at one or more points upstream of the clean room, and final filtering directly at the inlet to the clean room. The filters are specifically designed for clean room systems and are graded at each stage, thus providing control of diminishing size particles. Filtering action depends on the particles contacting and adhering to the fibres or collecting surface of the filter medium which is made from such materials as glass-fibre and asbestos. The filters utilised for final filtering are variously known as super-inception, absolute or high-efficiency particulate air (HEPA) filters, and may be used as individual units or assembled to form a filter bank or module. In the latter case, each unit is connected to a common plenum chamber incorporating its own fan. The number of individual units in a bank is governed by design requirements for the air handling system.

9 LAYOUT OF CLEAN ROOMS The layout of a clean room is governed by many factors arising principally from the manufacturing processes and test procedures to be carried out on specific types of equipment. As a result there are a variety of design and layout specifications to meet the requirements of individual manufacturers and operators of equipment. In their basic form, however, layouts are directly related to the accepted methods of air distribution, i.e. unidirectional-flow and conventional.

9.1 **Unidirectional Clean Rooms.** The layout of a typical clean room facility is illustrated in Figure 4. The area devoted to the facility is arranged in accordance with the operating practices common to all clean rooms, i.e. components and personnel flow progressively from an uncontrolled or 'dirty' environment to one in which the desired level of cleanliness is maintained.

9.1.1 **Personnel Cleaning.** Entrance to the clean room is via a change room the purpose of which is to decontaminate personnel without introducing removed contaminant particles into the clean room. A change room is divided into three distinct areas; an uncontrolled or 'dirty' area, a wash-up (semi-contaminated) area and a change (uncontaminated) area. These areas are arranged so that personnel must follow a definite path for entry into the clean room.

(a) In the uncontrolled area lockers are provided for housing outdoor clothing such as overcoats and raincoats, and also shoe cleaning machines. From the uncontrolled area, entry to the wash-up area is made via an air shower compartment the purpose of which is to remove gross contaminant particles from personnel. The size of the compartment may be large enough to accommodate only one person or a group of persons depending on the number that must enter the clean room in a given length of time. The design of the air shower may vary but, in general, it consists of an air inlet system and an exhaust system operated by independent fans. Air flows through the compartment from air inlet nozzles or louvres mounted in the ceiling or in one wall of the compartment. The entrance and exit doors of the

compartment are interlocked so that only one of them can be opened at a time. The closing of the entrance door starts the fan and, until the cleaning cycle is completed, the exit door remains locked. The cycle may, in some cases, be interrupted by a safety override system in the event of an emergency. Air velocities are sufficiently high to cause 'flapping' of clothing but without discomfort to personnel.

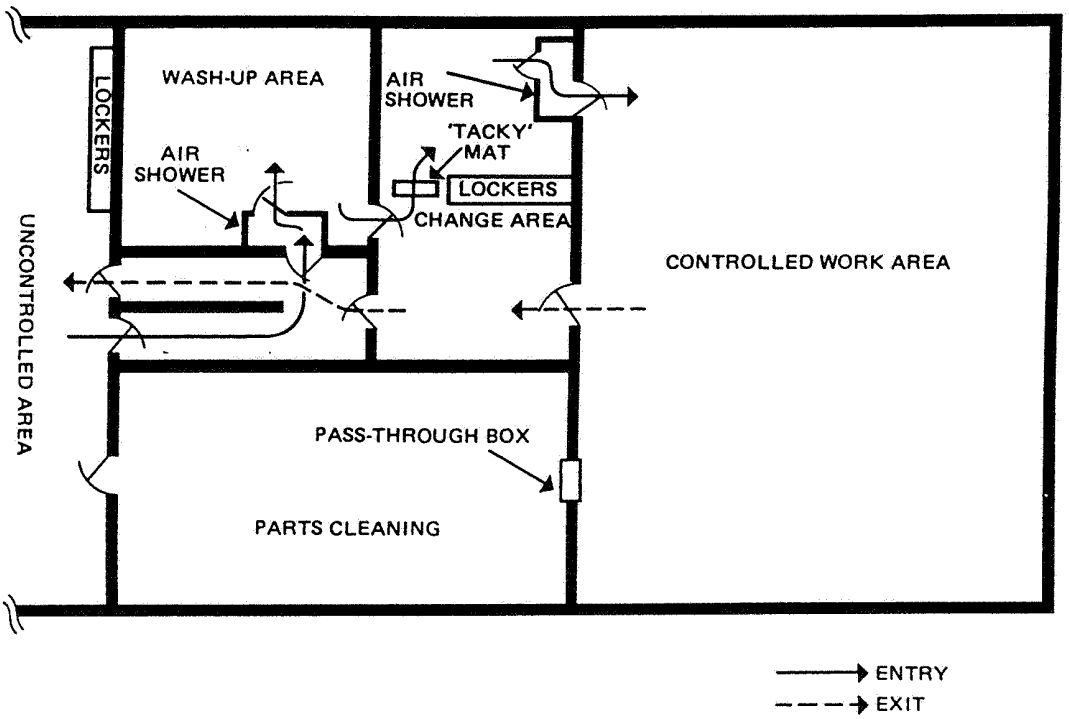


Figure 4 LAYOUT OF A UNIDIRECTIONAL CLEAN ROOM

(b) On leaving the air shower, personnel proceed to the change area via the semi-contaminated area in which washing and toilet facilities are located. These facilities include foot-controlled washstands, liquid-soap dispensing units and heated air hand-drying machines to prevent contamination from towelling. A section of the change area is provided for changing into special clean room garments (see paragraph 12) stored in racks or lockers. The entrance to this section is guarded with a tacky or sticky mat designed to remove residual contaminant particles from the undersurfaces of shoes. Entrance to the clean room after changing is made via another air shower compartment.

9.1.2 **Parts Cleaning.** Prior to entry into a clean room, all parts, tools, equipment, and material must also be decontaminated and it is therefore necessary to provide an additional area adjacent to the clean room. The layout of a parts cleaning room depends largely on the types of component and the number of work processes involved. Similarly, the cleaning methods adopted depend on the type of contaminant, the materials used in the construction of components,

and the level of cleanliness required. In general, the room is equipped with the required number of work tables, specialised equipment, cleaning machines and washing facilities for personnel.

(a) The transfer of cleaned components to the clean room is effected by means of a 'pass-through' box forming an air lock in the wall dividing the appropriate areas. Boxes are provided with double windows and doors; an interlock system ensures that only one door can be opened at a time. In some clean room facilities a 'pass-through' box may be of the circular type with a single opening so that the box must be rotated through 180° to insert or remove a component. Since the boxes are designed to prevent a direct opening between rooms, a means of verbal communication between relevant personnel must be provided adjacent to the box. This can be an intercommunication system, a voice diaphragm, or a speaking tube.

9.1.3 **Additional Support Rooms.** Since unidirectional clean rooms require more rigid control to prevent contamination entering, it is usual to make provision for additional support rooms such as offices, lunch rooms, rest rooms, etc. The construction of these rooms follows a similar pattern to that of a clean room (see paragraph 10) although the air handling system is usually not so elaborate.

9.2 **Conventional Clean Rooms.** The use of conventional flow clean rooms eliminates the necessity for support areas such as air showers and special changing rooms and, as may be seen from the typical conventional layout illustrated in Figure 5, increased working area is available and entry procedures are much simpler. The main entrance is situated at the air outlet or 'dirty' end of the room and personnel can pass through this directly from a locker room and change area. Work benches and equipment are disposed so that the cleanest operations are carried out closest to the filter bank forming the end wall, while dirty operations such as soldering, cleaning, etc., are performed toward the outlet end of the room. Parts cleaning and preparation may be performed in a manner similar to that adopted for a unidirectional clean room (see paragraph 9.1.2) or carried out in a parts cleaning room situated within the clean room itself.

10 CONSTRUCTION OF CLEAN ROOMS The construction of clean rooms involves the application of specifically developed building techniques, air-conditioning installation practices and careful selection of construction materials. This is normally undertaken by a specialist organisation working to the detailed BS 5295 Parts 1, 2 and 3 and the specification of a user organisation. The details given in the following paragraphs are therefore intended as a guide to the factors related to general constructional features.

10.1 **Noise and Vibration.** Careful consideration must be given to clean room location in relation to other work areas and the effects of noise and localised ground vibrations. Noise and vibration generated by equipment, machinery, support and administrative areas must also be considered. If vibration insulation devices are to be employed these must not generate or collect dust. Special attention must be given to the framing system of super-structures in order to prevent vibration transmission through ceilings, walls and floors into the main structure. The maximum noise level of the room, work station or clean air device, in an operational but unmanned state should not normally exceed 65 dB.

10.2 **Floors.** Floors should have long life and be highly resistant to breakdown under the shear forces created when personnel walk across them. Vinyl is particularly suitable for floors since it is tough and resilient. Floors should have a smooth surface which is easy to clean and will not collect dust. The junction between floors and walls should be radiused to facilitate cleaning operations. Joints between floor sections should be tight and sealed.

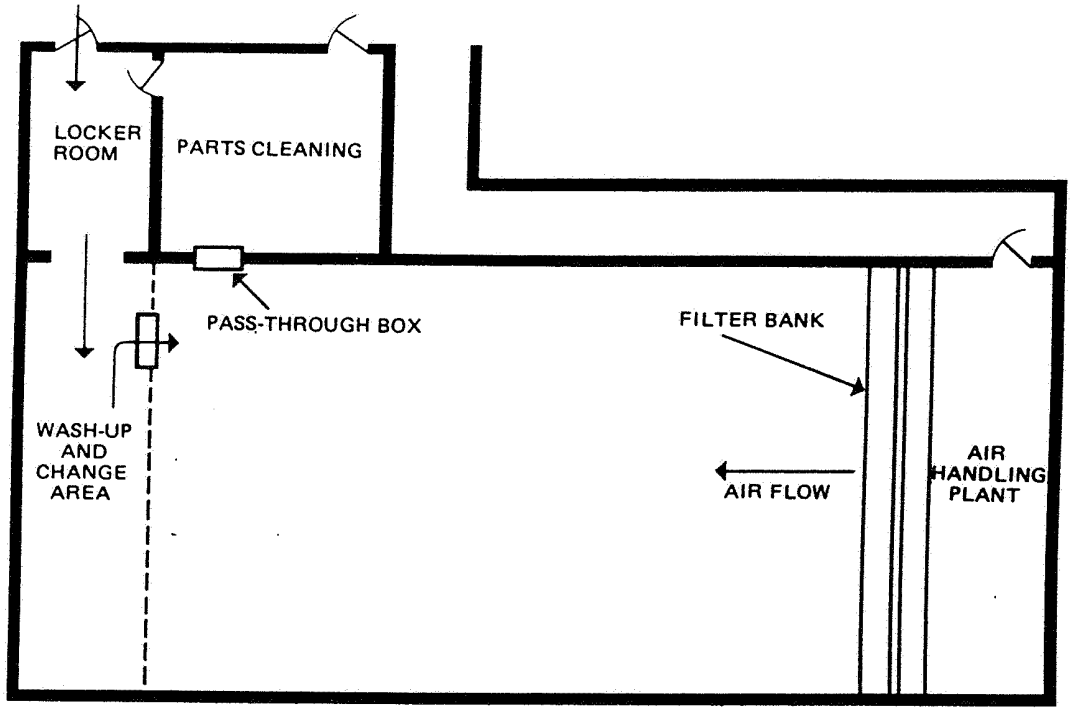


Figure 5 LAYOUT OF A TYPICAL CONVENTIONAL CLEAN ROOM

10.3 **Walls.** Walls should be covered with materials which will produce a smooth, durable surface which does not chip or flake. Stainless steel, vinyl coating, high-gloss paint, melamine decorative laminate, painted hardboard and tiles are some of the materials which are suitable. Window frames, doors and door frames may be constructed of steel, aluminium or other highly durable material, and should be set flush with the interior of the walls. The use of timber in structural elements is discouraged because it is unstable in areas where there is a change in humidity. The introduction of large volumes of console type equipment can increase the heat load of a clean room and provide possible collection and sources of contamination. Such equipment may be built into a wall thus placing the heat load outside the room and also permitting maintenance of the equipment without the necessity of entering the clean room. Gaskets should be fitted around the equipment to prevent excess loss of room air.

10.4 **Ceilings.** Since ceilings are not subjected to potential impact, they may be surfaced with any material that is easily cleaned and does not produce or collect dust. Ceiling panels should be provided with gaskets and clamped to ensure adequate sealing, allowance being made for subsequent removal and replacement.

10.5 **Lighting.** Lighting fixtures of the fluorescent type should be used and of ratings which will provide adequate light intensity at bench level of not less than 3,000 lux. Fixtures may be installed to permit servicing from within the clean room, or supported in tracks above the ceiling so that they can be slid out for servicing without entering the clean room.

10.6 **Utilities.** The distribution of utilities such as water, electrical power, vacuum and compressed air supplies must be properly planned to ensure that all required work locations are served without interference with room air distribution and work flow.

11 CLEAN ROOM FURNISHINGS Furnishings such as work benches, chairs and containers for component parts require careful selection, design and choice of materials for their construction. The main structure of work benches and chairs should be of metal and designed in such a way that contaminant particles cannot accumulate. Items that can expect to be bumped, knocked, abraded, etc., by personnel should possess a tough, resilient, low-particle generating surface such as stainless steel, melamine decorative laminate type material, or material of equivalent surface qualities.

12 CLEAN ROOM GARMENTS Clean room products can be readily contaminated by particles from clothing and it is therefore necessary to make provision for the wearing of protective garments. These take the form of smocks, overalls, caps and hoods. In addition, 'boottee' type shoe covers, separate clean room shoes and gloves must also be provided. The extent to which all the garments are used depends on the type of clean room, class of cleanliness to be achieved and the work processes carried out.

12.1 **Design.** The garments are of special design to prevent the transfer of contaminant particles from personnel and at the same time to provide the maximum of comfort. The materials from which they are fabricated are usually selected from the range of available man-made fibres which exhibit such properties as non-flammability, limited linting, and negligible electrostatic generation. These materials are available under a variety of trade names. Typical design requirements for clean room garments are given in the following paragraphs.

12.1.1 **Smocks.** Smocks should be of simple design, with no pockets and with as few seams as possible. Seams should leave no open end of material which might become frayed and give off lint or loose strands. In addition, seams should be double-stitched with thread of the same fibre as the garment. Adjustable neck bands and cuffs should be provided in preference to collars and loose sleeves and must provide a snug fit when worn.

12.1.2 **Overalls.** Overalls should have a full-length zip fastener with flap front and be provided with adjustable neck bands and cuffs. If overalls are to be used with shoe covers, the overalls should fit inside the covers. Overalls to be used with clean room shoes should be designed so that the legs of the overalls meet and slightly overlap the shoes.

12.1.3 **Caps.** These should be of the style worn in hospital operating rooms. They should fit snugly around the head, covering the hair to prevent hair particles and dandruff falling into the clean room area.

12.1.4 **Hoods.** Hoods should be designed to confine all hair under them to eliminate contamination by hair particles and dandruff, and to fit snugly inside overalls to provide complete coverage of personnel; if beards are permitted, masks must also be provided.

NOTE: Garments are usually white although in some cases a sea green colour may be chosen to minimise glare. As a means of identifying selected personnel, e.g., supervisors or personnel in charge of certain work processes, smocks and overalls may be provided with distinctively coloured neckbands. Coloured caps may also be used as a means of identification.

12.1.5 **Shoe Covers and Shoes.** Covers should be worn over normal shoes and should be high enough to hold the legs of overalls. Covers should have a reinforced sole and be of a type which will prevent personnel from slipping and falling on smooth floors and, for reasons of durability and economy, nylon is recommended as the material. To provide proper fit and comfort, and to achieve optimum cleanliness, covers should be provided with snap fasteners, and laces which can be tied around the legs and above the ankles. As an alternative to shoe covers, shoes can be issued to personnel for exclusive wear in the clean room. They should be simply designed, comfortable, washable and fabricated from materials which will not shed particles due to abrasion and wear.

12.1.6 **Gloves.** When there is a risk of contamination from contact with the hands or fingers, gloves or finger stalls must be used. Such coverings should be comfortable and should enable the user to maintain a delicate finger touch. If plastics is necessary for the 'touch' portion of gloves the remainder should be made of a material that will allow 'breathing' thus preventing overheating of the hands.

12.2 **Garment Storage and Cleaning.** When not in use, clean room garments should not be allowed to come into contact with any possible contaminant. They should always be stored on individual hangers in the lockers provided in changing rooms. Three sets of garments per person should normally be provided: one set in use, one set being cleaned, and one set in reserve.

12.2.1 Cleaning of garments is a specialised technique based on conventional laundering and dry-cleaning processes. Ideally, a laundry should be established as a specialised unit supporting clean room operations, and functioning under similar conditions of decontamination as a clean room. A typical unit is divided into three distinct areas: soiled garment receiving area, washing and dry-cleaning area, and an inspection and packaging area. Soiled garments are placed in polythene bags and transferred to the receiving area through an air lock. The garments are then emptied into specially built tubs and transported to the washing and dry-cleaning area equipped with the appropriate machines. After cleaning and drying, the garments are transferred to the third area for inspection, sampling of contamination level, and packaging and sealing in polythene bags.

13 CLEAN WORK STATIONS These stations are work benches specifically designed to incorporate their own filtered air supply system. They may be utilised in a clean room, in addition to benches or tables based on conventional patterns, or in an uncontrolled environment.

13.1 The design of work stations has been developed from bench- mounted 'dust-free' cabinets, typical examples of which are illustrated in Figure 6. Although these cabinets provide low contamination levels, depending on the type of filter, the problem of contamination while operations are performed inside arises. Contaminants move about in turbulent air and find their way out of the cabinet only at random intervals. Another design, commonly referred to as a 'glove box' is also illustrated in Figure 6. It utilises a recirculating air system and although it produces lower contamination levels than other forms of cabinet, it has the disadvantage of requiring an operator to work through arm ports and the attached gloves.

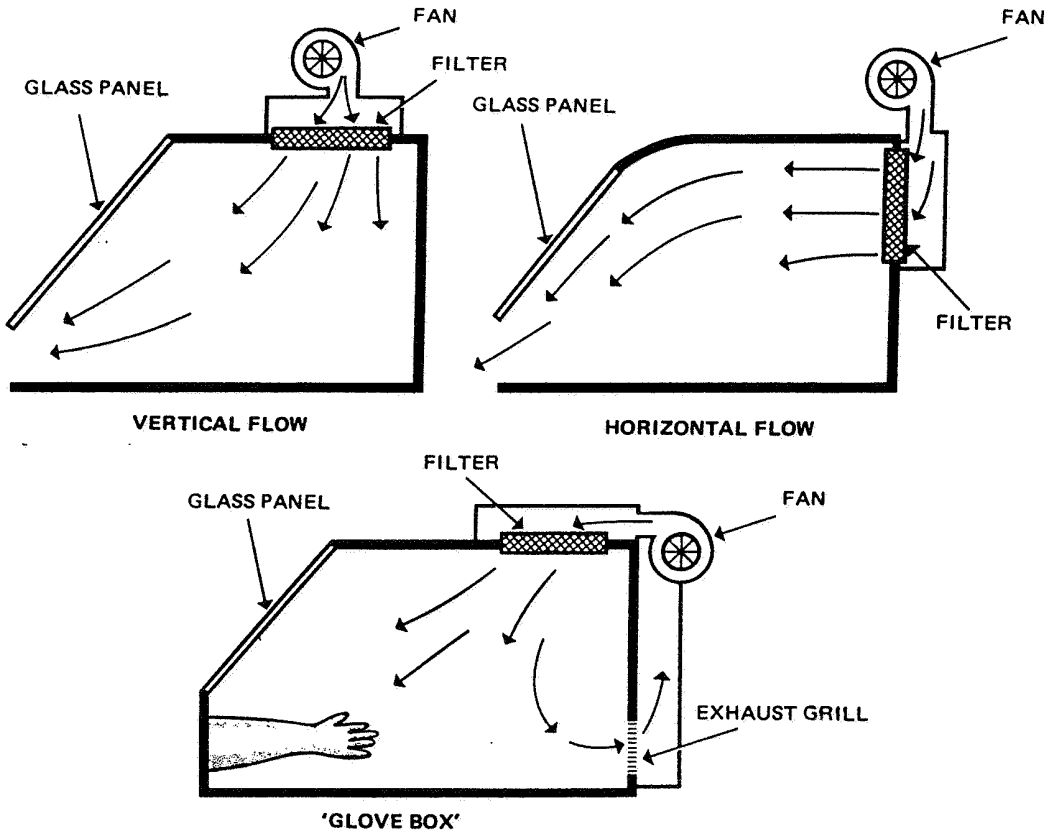


Figure 6 CLEAN WORK BOXES

13.2 Work stations overcome the deficiencies of 'dust-free' cabinets by incorporating an air distribution system which operates on principles similar to those employed in a undirectional-flow clean room (see also paragraph 6.2). The air distribution system consists of a fan and a pre-filter mounted below the work surface, and an outlet with a super-interception filter, mounted so as to produce either a horizontal flow or a vertical flow over the work surface. Figure 7 illustrates both airflow techniques as they are applied to a typical console type of work station. Glass panels form the sides of the work area which, on account of the undirectional-flow technique, is open at the front thus permitting unrestricted movement at the work surface. Illumination of the work area is provided by lighting units enclosed in the canopy above the work surface. Individual switches for lighting units and fans are located at convenient points as also are the controls for the various services required for relevant work processes.

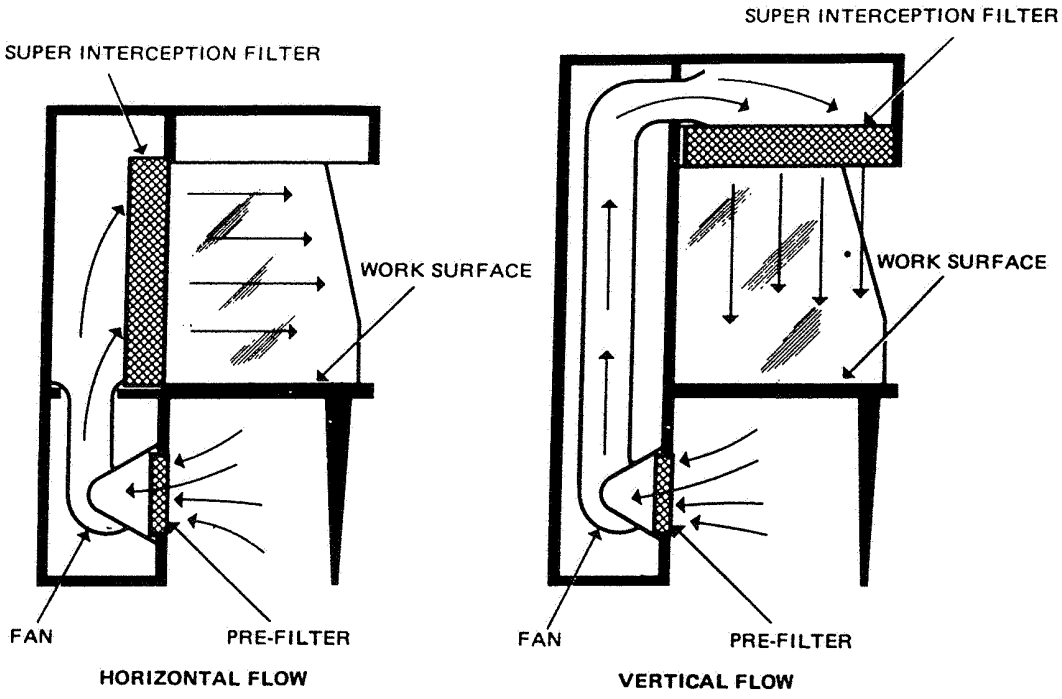


Figure 7 CLEAN WORK STATIONS

13.3 The selection of a work station best suited to a specific application involves such factors as type of airflow, size of work area, space available, and design and performance of the air distribution system. Units employing horizontal flow are generally less costly than vertical flow units for equal size of work area and can usually be provided with lower overall heights thus making them more suitable when vertical space is a critical factor. When work processes require the exhausting of fumes from the work area, or when recirculation of the air is required, vertical flow units provide for these functions more easily than horizontal flow units. Horizontal flow units, on the other hand, provide better 'clean-up' of a work area than vertical flow units of equal size.

13.4 The most important consideration in selecting a particular size of work station is to ensure that it will provide undirectional-flow over a work area of sufficient width, depth and height to accommodate the component being assembled or tested, and the necessary associated equipment. If several items of equipment must be sited around a component, a vertical flow unit tends to produce less turbulence and moves clean air in the most direct fashion from the filter to the component. The filters are of a type similar to those used in unidirectional clean rooms (see paragraph 8.3).

14 CLEAN ROOM OPERATION In addition to the air handling system, the contamination level in a clean room is kept at an acceptable level by two other methods, namely limiting the contamination entering the room and limiting the contamination generated within the room. Both these methods are controlled to a large extent by the

personnel selected for clean room operations. The contamination entering the room is limited by the wearing of proper garments (see paragraph 12), personnel cleaning, parts and equipment cleaning, etc. The contamination generated is limited by restricting movement, proper work techniques, etc. It is therefore necessary to establish routines and disciplines related to personnel selection, personal hygiene, entry procedures, and control of working activities. The extent to which certain of these routines and disciplines are applicable depends on the type of clean room; for example, a undirectional-flow clean room requires more rigid control of entry and clothing procedures than a conventional clean room due to the air handling system used (see paragraphs 9.1 and 9.2).

14.1 **Personnel Selection.** The selection of personnel for clean room duties involves consideration of both physical and human factors, including manual dexterity, visual acuity, patience, concern for detail, attitude toward repetitive operations, and reaction to the rigid disciplines that accompany confinement in a controlled environment. Certain physiological problems must also be considered and some examples which are detrimental to clean room operations are: allergies to synthetic fabrics; allergies to solvents used in cleaning processes; profuse nasal discharge; skin conditions that result in above normal skin shedding or flaking and dandruff; high amounts of acid found in the hands; severe nervous conditions such as itching, scratching or claustrophobia.

14.2 **Personal Hygiene.** The development of personal hygiene is of great importance in clean room operations, not only to limit contamination of vital components but also to maintain a healthy working environment. Personnel with colds, temporary coughing and sneezing, should be assigned to temporary jobs outside the clean room until they are sufficiently recovered. This also applies to personnel having received severe sunburn, to prevent peeling skin from contaminating a component or the surrounding area.

14.3 **Entry Procedures.** Clean rooms are necessarily restricted areas and entry must only be allowed to personnel assigned to them. The procedure to be adopted is governed by the type of clean room. Typical activities associated with entry procedures are as follows:

(a) Removal of outdoor clothing such as overcoats and raincoats and stowage in the lockers provided in the 'dirty' or uncontrolled area.
(b) Checking clothes and shoes for visible contamination such as mud, dirt, sand, etc. Removal of such contamination.
(c) Washing of face and hands using foot-controlled washstands, liquid soap dispensers and air driers.
(d) Passing through air showers and air locks to ensure adequate air scrubbing.
(e) Walking over sticky or tacky mats.
(f) Changing into the requisite clean room garments. In connection with undirectional-flow clean room operations, changing is done in the uncontaminated section of the change room adjacent to the clean room. In conventional clean rooms changing is done in an area located at the 'dirty' end of the clean room.

14.4 **General Rules for Operation.** The following are general rules which should be enforced to assist in the successful operation of clean rooms.

14.4.1 **Personal Activities**

(a) Hands should be washed often and fingernails kept clean.

(b) The specified clothing should always be worn in the approved manner.

(c) Personal items such as keys, coins, cigarettes, matches, pencils, handkerchiefs and combs should be deposited in lockers prior to changing into clean room garments. Valuable items such as wallets may be carried into a clean room in jacket or trouser pockets provided they are not removed inside the clean room.

(d) Foodstuff should not be taken into a clean room.

(e) Smoking is strictly forbidden.

(f) The wearing of jewellery such as large rings, bracelets, watches, necklaces, earrings, lockets, etc., should be avoided.

(g) Nervous mannerisms such as scratching the head, rubbing of hands or similar actions should be avoided.

(h) Movement of personnel should be restricted as much as possible to prevent stirring settled particles on the clean room floor. This applies particularly to conventional clean rooms.

(j) Solvent contact with hands should be avoided as many solvents remove natural skin oils causing excessive skin 'peeling' or flaking.

(k) Female personnel should not wear or apply fingernail polish or cosmetics in a clean room.

(l) Visitors or clean room maintenance personnel must be authorised to enter a clean room and must follow the specified entry procedures.

14.4.2 **Work Activities**

(a) All tools including personal tool kits should be kept clean and in good condition and should undergo cleaning processes in accordance with a periodic cleaning schedule. Tools not essential to specific work processes should be excluded from tool kits.

(b) Paper materials should not be allowed in a clean room unless the paper is plastic-coated or covered, sprayed to prevent linting or is a special limited-linting paper. Papers should not be subjected to excessive shuffling, handling, rolling or bending as they can generate excessive amounts of small particles under these conditions.

(c) Pencils and erasers are not allowed. All writing should be with ball-point pens.

(d) Parts of components should be kept in their individual containers until ready for assembly. They should not be left exposed on a work bench or station.

(e) Containers and any component parts surplus to requirements should always be returned to a parts cleaning area for cleaning and re-issue.

(f) Metal objects such as wire clippings and solder splashes should be deposited in waste boxes at the end of each process.

(g) Where cleaning of parts is to be carried out inside a clean room, the type of cleaning equipment and its location within the room should be carefully selected.

15 MAINTENANCE OF CLEAN ROOMS In order to maintain clean rooms to the necessary standards, good housekeeping practices and monitoring of the air handling system are of prime importance. The frequency of cleaning is usually determined by taking into account the change in contamination level that can occur due to the cleaning operation, and the number of air changes per hour. Monitoring of the air handling system should be carried out at the time a clean room is put into initial operation and at regular periods thereafter, when filters have been changed, and when it is evident that down-grading of its operating level is taking place (see Table 3).

TABLE 3

<table>
<tr><th>Controlled Environment</th><th>Sampling for Particulate Contamination</th><th>Temperature</th><th>Humidity</th><th>Air Pressure</th></tr>
<tr><td>Class 1</td><td>Daily or continuous by automatic equipment</td><td>Continuous</td><td>Continuous</td><td>Continuous</td></tr>
<tr><td>Class 2</td><td>Weekly</td><td>Continuous</td><td>Continuous</td><td>Continuous</td></tr>
<tr><td>Class 3</td><td>Monthly</td><td>4-hourly</td><td>4-hourly</td><td>Continuous</td></tr>
<tr><td>Class 4</td><td>3-monthly</td><td>12-hourly</td><td>12-hourly</td><td>Continuous</td></tr>
<tr><td>Contained Work Station</td><td>Daily or to suit the product or as Class 2</td><td colspan="2">Dependent on use</td><td>Not applicable</td></tr>
<tr><td>Controlled Area</td><td>Dependent on use</td><td colspan="2">To meet requirements of personnel and product</td><td>Not applicable</td></tr>
</table>

15.1 **Cleaning.** Rooms should be cleaned when no work processes are being performed. Minor dry floor and bench vacuuming can be done, if necessary, during normal room operation if the equipment and procedures used ensure a minimum of disturbance to settled particles.

15.1.1 Cellulose mops and sponges can be used with water which meets specific particle-count requirements. High-grade plastics buckets which are not subject to flaking should be used. If ladders are required, they should preferably be of the anodised aluminium type. The use of detergents should be restricted to those which produce the minimum amount of residue after drying. For vacuum cleaning, a central vacuum cleaning system or a specially designed portable vacuum cleaner should be employed.

15.1.2 Cleaning apparatus and utensils are prevalent sources of contamination and their movement in and out of clean rooms should be carefully scheduled. They should be thoroughly cleaned and vacuumed prior to their entry.

15.1.3 The responsibility for cleaning work benches or stations should be delegated to personnel assigned to the benches to prevent improper handling of components and equipment by room maintenance personnel.

15.1.4 Inspection, maintenance and testing of air handling system components should be carried out in accordance with the relevant maintenance instructions, at periods determined by the type of clean room operations, and when downgrading of the contamination level begins to occur.

15.2 **Monitoring of Clean Rooms.** Monitoring refers to the procedures adopted for checking the factors influencing clean room environment. Such factors are the level of contamination, temperature, humidity and pressure. The exact requirements for monitoring and methods to be employed depend on the type of clean room and classification of cleanliness level, and are therefore determined on an individual basis (see Table 3).

15.2.1 **Contamination Monitoring.** This is the most difficult monitoring problem of clean room operation owing to the variations in contamination level throughout a room and also to the many factors which must be considered in selecting a specific monitoring technique. Some of the factors causing variations in contamination level are: filtered air entering a room at one or more locations; contamination being generated in various amounts throughout a room; contaminated air exhausted from a room at one or more locations. The highest level of contamination is not necessarily at the air exhaust locations, since air from a highly contaminated area may be diluted with filtered air prior to its being exhausted. Higher and lower levels of contamination can thus readily exist within a given room. The areas of most concern are those immediately surrounding the component on which work processes are to be carried out.

(a) The locations within a clean room at which sampling of the air is to be taken should be carefully considered in order to obtain a representative contamination level. Samples should be taken at identical times or as near as possible, since contamination levels of areas vary at different periods.

(b) Various techniques may be applied to contamination monitoring and some of those most widely accepted, together with details of principles, are listed in BS 5295 Parts 1, 2 and 3.

15.2.2 **Humidity Monitoring.** This may be achieved by the use of conventional wet and dry bulb thermometers and psychrometric charts. The thermometers may be supplemented, if necessary, by automatic recording devices. Humidity can become troublesome if it is allowed to reach a level where static charges are generated by personnel or where corrosion may be a problem. In general, a humidity level of not less than 40% is desired. For those components where humidity tolerance is critical, special control measures should be employed.

15.2.3 **Pressure Monitoring.** A clean room should always be slightly pressurised and it is therefore necessary to monitor the pressure difference between the room and its outside surroundings. Monitoring may be achieved by a simple U-tube manometer, or a differential pressure gauge calibrated in mm water gauge.

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BASIC

AIRWORTHINESS PROCEDURES

OCCURRENCE REPORTING AND THE ENGINEER'S ROLE

1 INTRODUCTION This Leaflet describes the Mandatory Occurrence Reporting (MOR) Scheme, explains the work of the CAA Safety Data Unit, and outlines the responsibilities of the Licensed Aircraft Maintenance Engineer in submitting reports on occurrences which could have airworthiness implications.

2 THE MANDATORY OCCURRENCE REPORTING SCHEME The Mandatory Occurrence Reporting Scheme was introduced by the CAA in 1976 with the following objectives:—

(a) to ensure that the CAA is advised of all hazardous or potentially hazardous defects and incidents (occurrences);

(b) to ensure that all information concerning these occurrences is disseminated to operators and other interested parties;

(c) to enable an assessment to be made of the safety implications of each occurrence;

(d) to decide whether any corrective action needs to be taken.

2.1 Legislation concerning the MOR Scheme is contained in Article 79 of the Air Navigation Order 1976, as amended, in Regulation 17 of the Air Navigation (General) Regulations 1976, as amended, and in Regulation 21 of the CAA Regulations 1972, as amended. Information and guidance on the Scheme is also published in CAP 382.

2.2 The Scheme is applicable to all public transport aircraft registered in the United Kingdom the Maximum Total Weight Authorised of which exceeds 2300 kg (5,000 lb). However, in the interests of aircraft safety, the CAA will also accept and process reports concerning aircraft which are not covered by these criteria.

2.3 Any organisation concerned with the operation, manufacture, repair or overhaul of aircraft, or of any items of equipment intended for use on an aircraft, aircraft commanders, air traffic controllers, and engineers signing Certificates of Maintenance, Release or Compliance in respect of such aircraft or equipment, who become aware of a reportable occurrence (paragraph 4), are required to submit a report to the CAA, either directly or using the appropriate company procedures.

2.4 In order not to deter individuals from submitting reports on occurrences which may have resulted from a breach of regulations, the CAA has stated (in CAP 382) its views on confidentiality and disciplinary measures, and also its concern that no action should be taken by employers which could inhibit full and free reporting under the Scheme.

2.5 The CAA considers that the exchange of information resulting from the submission of reports under the MOR Scheme can be of great benefit to aircraft safety and to all those concerned with aircraft maintenance by, for example, calling attention to various defects which have occurred on particular types of aircraft. Engineers are, therefore, encouraged to study the information distributed by the CAA as it relates to their particular field of concern, and to submit reports on occurrences the knowledge of which could be of benefit to other engineers and to aircraft safety in general.

3 SAFETY DATA UNIT All reports received under the MOR Scheme are processed by a section of the CAA, called the Safety Data Unit (SDU), which is based in the Airworthiness Division at Redhill. Reports are directed from the SDU to the appropriate departments within the CAA for any necessary follow-up action.

3.1 The SDU has access to an Automatic Data Processing (ADP) System, in which it stores the information related to occurrences and accidents it considers should be recorded, and from which it extracts information for dissemination within the CAA, to the aircraft industry and other interested parties.

3.2 The SDU is responsible for providing to the airlines, manufacturers and others, the basic information contained in the reports, and summaries of this information. An "Occurrence Digest", giving details of the more serious occurrences, is issued weekly, and a summary of all occurrences is issued every four weeks. A "General Aviation Safety Information" Leaflet, relating to light aircraft, is distributed to the general aviation community every month.

3.3 The SDU also analyses occurrences and accidents to establish trends and to determine where corrective action is desirable, and provides selected flight safety information to the industry on request.

NOTES: (1) Flight safety information disseminated by the SDU is generally free, but the provision, by request, of certain selected information may be the subject of a special charge.

(2) Information may be provided to certain persons outside the aviation industry, in which case it is dis-identified and is subject to the payment of a fee.

4 REPORTABLE OCCURRENCES A reportable occurrence is defined as any incident, malfunctioning or defect in an aircraft or its equipment, or in ground facilities intended for use in connection with the operation of an aircraft, which endangers, or if not corrected could endanger, the aircraft or its occupants or any other person. Reports are thereby required on occurrences which involve, for example, a defective condition or unsatisfactory behaviour or procedure which although not actually endangering the aircraft, could, if repeated in different circumstances, do so. These criteria should be used by all persons concerned with the MOR Scheme before submitting a report, since the reporting of minor occurrences will, by the volume of data produced, tend to obscure serious occurrences, and would also be costly to both the operator and the CAA. It is, however, probable that many persons required to submit reports will be unaware of the full implications of an occurrence or its connection to previous similar occurrences, and if any doubt exists a report should be submitted so that the CAA is informed of, and may take action on, any occurrences which could affect aircraft safety.

4.1 The majority of occurrence reports result from incidents occurring in flight, and the responsibility for reporting them will rest with the aircraft commander, with Air Traffic Control, or with the operator. Licensed Aircraft Maintenance Engineers will often be involved in supplying technical details or evidence in the investigation of these

occurrences, but may also be responsible for reporting occurrences themselves. Paragraphs 4.1.1 to 4.1.6 list examples of occurrences which may be reportable by engineers under the MOR Scheme (or which, when involving aircraft not covered by the Scheme, could be reported in the same way). The decision on whether to report an occurrence will normally require judgement by the person concerned, who should consider whether the occurrence is covered by the reporting criteria (paragraph 4).

4.1.1 **Structural Damage.** Substantial damage incurred during flight constitutes a notifiable accident and should be reported to the Accidents Investigation Branch, Department of Trade. Damage discovered during a routine inspection, which falls into any of the following categories may be reportable under the MOR Scheme:—

(a) failure of aircraft primary structure;

(b) structural damage resulting from any cause, which requires a permanent repair before the aircraft can fly;

(c) serious defects in aircraft structure such as cracks in primary structure or serious cracks in secondary structure, corrosion or permanent deformation greater than expected;

(d) failure of a non-primary structure which endangers the aircraft.

4.1.2 **Injury.** Serious injury inflicted during flight constitutes a notifiable accident and should be reported as such (paragraph 4.1.1). Any injury to servicing personnel, resulting from a fault in the aircraft or from servicing procedures should be reported under the MOR Scheme.

4.1.3 **Aircraft System and Equipment.** Any fault discovered during routine servicing operations, which could have led to a hazardous situation during flight, should be reported. Faults in items included on the allowable deficiencies list should not normally be reported, since an alternative system is available if required, but the circumstances of the failure and its possible connection with other failures should be considered. The following are some examples of occurrences which might be discovered during routine servicing or when checking a snag reported by the flight crew, and which could be reportable:—

(a) malfunction, stiffness, slackness or limited range of movement of any controls;

(b) inability to feather or unfeather a propeller, to shut down an engine or to control thrust;

(c) failure or malfunction of the thrust reverser system;

(d) fuel system malfunction affecting fuel supply and distribution;

(e) malfunction of the fuel jettison system;

(f) significant leakage of fuel, oil or other fluid;

(g) use of incorrect fuel, oil or other fluid;

(h) significant failure or malfunction of the electrical, hydraulic, pneumatic or ice-protection systems, or of the radio and navigation equipment;

(j) smoke, toxic or noxious fumes inside the aircraft;

(k) significant failure of wheels, tyres or brakes;

(l) incorrect assembly of components, causing possible malfunction;

(m) on a multi-engined rotorcraft, loss of drive of one engine;

(n) operation of any rotorcraft transmission condition-warning system;

(o) operation of fire or smoke warning systems;

(p) failure or malfunction of ground equipment used for testing/checking aircraft systems or equipment.

4.1.4 **Refuelling.** Significant spillage of fuel during refuelling or defuelling operations, the use of incorrect or contaminated fuel, or failure of automatic cut-off valves in pressure refuelling systems, could all be reportable.

4.1.5 **Cargo.** Incidents arising from the carriage of cargo could be reportable if they endangered the aircraft. These include incidents related to:—

(a) the carriage of hazardous or restricted material;

(b) incorrectly packed cargo;

(c) incorrectly stowed cargo;

(d) incorrectly secured cargo;

(e) the carriage of livestock.

4.1.6 **Miscellaneous.** The following items are all examples of incidents which could occur during servicing and which could be reportable:—

(a) fire or explosion;

(b) collisions between aircraft and vehicles or other ground equipment;

(c) jet blast incidents;

(d) damage resulting from adverse weather conditions.

5 REPORTING PROCEDURES

5.1 **Operators.** To ensure compliance with the requirements, most operators have set up systems for handling all types of occurrences, whether reportable or otherwise. The operator takes the responsibility for investigating all defects and incidents which occur to his aircraft, and deciding which are reportable occurrences under the MOR Scheme. Where the operator submits reports to the CAA, he must also inform the individual submitting the original report under company procedures, as to his course of action, and should also notify the appropriate manufacturer, overhauler or repairer, by letter or by documents accompanying components returned to them.

5.2 **Individuals.** An individual who is required to submit reports under the MOR Scheme (e.g. a Licensed Aircraft Maintenance Engineer) and who has submitted a report to his employer under company procedure which has not been passed on to the CAA, should consider whether to report the occurrence directly to the CAA. An individual employed by a company not using a defined reporting procedure, must submit such reports directly to the CAA.

5.3 **Manufacturers, Overhaulers and Repairers.** A manufacturer of aircraft components or equipment, is not expected to submit reports to the CAA, as a matter of routine, on occurrences concerning his own products which have already been reported by an

operator; he should, however, submit reports on occurrences which he considers are reportable and which have not already been reported. The discovery during overhaul or repair of a serious defect, places the onus for reporting on the company concerned, even though its effect on the aircraft concerned may be difficult to assess. Similarly, the discovery of further significant information on a known or suspected defect should also be reported.

5.4 **Method of Reporting.** Reports on occurrences should be despatched to the CAA in writing within 96 hours of the occurrence coming to the notice of the person making the report; any information not known at the time of submission of the report being forwarded when it becomes available. Except in the cases of airmisses and birdstrike occurrences, and reports on air traffic control procedures, a report should normally be made on Form CA 1673 (Figure 1) or such other forms as are approved by the CAA, but a report by letter is acceptable if an official form is not available (paragraph 6). Occurrences which are considered to be particularly hazardous and to require urgent attention should be notified in the first place by telephone or telex before submission of a report. Occurrences involving a lesser degree of hazard need not be reported immediately if it is likely that further useful information will be available within the prescribed 96 hours.

5.5 **Supplementary Information.** Under the MOR Scheme, the CAA may request, and reporters are required to provide, additional information on particular occurrences, to enable the CAA to reach a satisfactory conclusion and take the appropriate action. Operators and manufacturers are also expected to provide any significant supplementary information which may have been discovered as a result of investigations they have carried out, to assist the CAA in providing a complete information service.

5.6 **Channels for Reports.** Reports should be forwarded to the CAA as outlined in paragraphs 5.6.1 to 5.6.3 according to their urgency.

5.6.1 Reports originating in the United Kingdom which are not considered urgent, should be sent to:—

Safety Data Unit,
Civil Aviation Authority,
Brabazon House,
Redhill,
Surrey RH1 1SQ

or to other CAA offices by prior arrangement.

5.6.2 Reports required to reach the CAA with the minimum of delay, and from overseas, should be sent by the following means:—

(a) by telex—No. 27100;

(b) by cable—"Bordair", Redhill;

(c) by AFTN—code EGGRYASD.

5.6.3 Reports on particularly hazardous occurrences should be sent to the CAA as follows:—

(a) During normal working hours:—

(i) Aircraft defects—Airworthiness Division Area Office (see Airworthiness Notice No. 2).

(ii) Other occurrences—SDU, telephone Redhill 65966.

BL/1-13

Civil Aviation Authority

OCCURRENCE REPORT

CA 1673

To be sent to: CAA Safety Data Unit, Brabazon House, Redhill, Surrey RH1 1SQ

Complete all sections where information is relevant; For multi choice boxes, indicate which entry is appropriate.

Date received by CAA:

CAA Occurrence No.:

Aircraft Type and Series	Registration	Operator	Date of Occurrence
1 BAC 111 (500)	2 G-AVMN	3 B.A.	4 25.03.76

FLIGHT AND WEATHER DETAILS

Flight No 5	DAY	Wind 12	Runway Used 16	Precipitation 18	Icing 19	Turbulence 20
From 6	NIGHT / TWILIGHT 9	IAS 13 kts	17 State: DRY / WET / ICE / SNOW / SLUSH	RAIN / SNOW / SLEET / HAIL — LIGHT / MOD / HEAVY	LIGHT / MOD / HEAVY	LIGHT / MOD / SEVERE / EXTREME
To 7	Time 10 GMT	Height 14 ft		Cloud Type Height/ft 21 Amount/8ths		
Geog. Position 8 MAN.	Visibility 11	O.A.T. 15 °C				

Flight Phase 22		Nature of Flight 23	
PARKED		SCHED PAX	X
TAXYING		NON-SCHED PAX	
TAKE-OFF		SCHED FREIGHT	
INIT CLIMB		NON-SCHED FRGHT	
CLIMB		SURVEY	
CRUISE		PLEASURE	
DESCENT		AGRICULTURAL	
HOLDING		BUSINESS	
APPROACH		CLUB/GROUP	
LANDING		PRIVATE	
CIRCUIT		POSITIONING	
AEROBATICS		FERRY	
HOVER		TEST	
		TRAINING	

NARRATIVE

SIDE GLAZING FRAME AT PILLAR 'C' FOUND CRACKED AT THE POSITION OF A REPAIR WHICH WAS CARRIED OUT DURING CONSTRUCTION OF THE AIRCRAFT.

AIRCRAFT POSITIONED TO L.H.R. FOR REPAIR TO APPROVED REPAIR SCHEME ED/91/A31/1.

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Continue on back

ENGINEERING DETAILS

Aircraft Constructor's No. 25	Engine Type & Series 26	Ground Phase 27	MAINTENANCE ✓ / UNATTENDED	GROUND HANDLING / TAXYING
BAC 150	R-R SPEY 512-14			

Component/Part 28	Location on aircraft 29	Manual Reference 30	Overhaul/Repair Agency 31	32 Maintnce. Prog O.C.	C.M.	H.T.	Manufctr. advised 33
SIDE GLAZING FRAME	PILLAR 'C' PORT	53.10	B.A.	✓			YES

Manufacturer 34	Part No. 35	Serial No. 36	HOURS/ ~~CYCLES~~/ ~~LANDINGS~~ 37	Total 38	Since 39	OVERHAUL/ REPAIR/ INSPECTION 40	Rel Prog Cat A Item 41
BAC	A831-103	VBD 301-3		72.33			

Any published Airworthiness Information relevant to occurrence (e.g. Mod/Insp/Repair) plus compliance status of aircraft or equipment 42

Report ORIGINAL / ~~SUPPL.~~ 43	Is report voluntary ~~YES~~/NO 46	Organization 48 B.A.	Address and Tel. No. (if not that of organization) 52
Reporter's Investigation ~~YES~~ OPEN / ~~CLOSED~~ 44	If 'Yes', can the information be disseminated in the interests of safety YES/NO 47	Position 49 QUALITY CONTROL	
Flight Data Recorder Used ~~YES~~/NO 45		Reference No. 50 / Date 51 27.03.76	Name 53 J. JOHNSON / Signature J. Johnson

Figure 1 EXAMPLE OF COMPLETED OCCURRENCE REPORT

(b) Outside normal working hours:—

(i) Aircraft defects—A Surveyor from an Airworthiness Division Area Office, or if not available, CAA Emergency Phone List 01-405 6922.

(ii) Other occurrences—CAA Emergency Phone List 01-405 6922.

6 REPORT FORMS Because of the need to store a wide variety of facts concerning occurrences in automatic data processing equipment, and to retrieve selected data for the purpose of flight safety studies, it is essential that reports should contain sufficient information for the identification, classification and comparison of all pertinent facts. The best method of achieving standardisation and of facilitating storage and retrieval of information has been found to be the use of a specially devised report form. The CAA has devised such a report form specifically for occurrence reporting (Form CA 1673), which will cover most eventualities and which should be used whenever possible. Certain companies may wish to use forms more suitable to their own particular requirements, but these must be approved by the CAA to ensure compatibility with the data processing equipment.

6.1 An example of a completed Form CA 1673 is shown in Figure 1. Each form is intended to provide a report on a single occurrence, and the presentation of the 'box' headings is generally self-explanatory. For a report on an aircraft defect the blocks for Aircraft and Operator Identification (boxes 1 to 4), Narrative (box 24), Engineering Details (boxes 25 to 42) and non-technical information (boxes 43 to 53) should be completed, the boxes being used to insert the relevant details or to delete the inappropriate choices.

6.2 The narrative should contain a clear and concise description of the occurrence, and any immediate or subsequent action taken or proposed. It should include details of all associated information, including the relationship to other occurrences which have been reported, and any comments or recommendations which may assist the CAA in any subsequent investigations.

6.3 In the 'Engineering Details' section of the form, 'Maintenance Programme' (box 32), 'O.C.' means 'on condition', 'C.M.' means 'condition monitored', and 'H.T.' means 'hard time'. Box 41 should be used to identify items included in a CAA approved reliability programme and classified as Category A.

6.4 The completion of box 52 is optional, and should be used by individuals preferring to be contacted at their home address rather than through their employer.

BL/1-15

Issue 2

September, 1988

BASIC

AIRWORTHINESS PROCEDURES

MAINTENANCE OF AIRCRAFT NOT EXCEEDING 2730 kg MTWA, INCLUDING THE STAR INSPECTION

1 INTRODUCTION

1.1 The purpose of this Leaflet is to provide guidance and advice on the maintenance, and maintenance certification procedures of aircraft certificated in the **Transport** (Passenger or Cargo), **Aerial Work, or Private Category** not exceeding 2730 kg Maximum Total Weight Authorised (MTWA), and the procedures for making recommendations to the Civil Aviation Authority (CAA) for the renewal of a Certificate of Airworthiness (C of A). The maintenance arrangements of aircraft certificated in the **Special Category** or with a **Permit to Fly** (see BCAR, Section A Chapter **A2-9**) are determined by the CAA for each individual aircraft and are not, therefore, referred to in this Leaflet in precise detail.

NOTE: All references to the Air Navigation Order (ANO) are those for the 1985 edition as amended. For further details refer to CAA Publication CAP 393.

1.2 The subject headings are as follows:

1.3 **Related Publications**

(a) British Civil Airworthiness Requirements (BCAR), Section A **(CAP 460)**

(i) Chapter A2-5 — Renewal of Certificates of Airworthiness.

(ii) Chapter A4-4 — Certificate of Fitness for Flight under "A" Conditions.

(iii) Chapter A5-1 — Weight and Balance of Aircraft.

(iv) Chapter A5-2 — Flight Testing of Aircraft.

(v) Chapter A6-4 — Maintenance of Aircraft.

(vi) Chapter A6-8 — Technical Logs.

(vii) Chapter A8-13 — Aeroplane and Rotorcraft Maintenance Organisations — Group M1.

(viii) Chapter A8-15 — Aeroplanes and Rotorcraft not exceeding 2730 kg — Maintenance Organisations — Group M3.

(b) Air Navigation — The Order and Regulations **(CAP 393)**.

(c) Light Aircraft Maintenance **(CAP 520)**.

(d) CAIP Leaflet **BL/1-10** (Aircraft, Engine and Propeller Log Books), **BL/1-9** (Legislation and Requirements) and **BL/1-11** (Weight and Balance of Aircraft).

(e) Light Aircraft Maintenance Schedules (1978).

(i) Fixed Wing Aircraft **(CAP 411)**.

(ii) Rotary Wing **(CAP 412)**.

(f) Airworthiness Notice No. 63 **(CAP 455)**.

(g) Registration, Certification, and Maintenance of Aircraft — A Guide **(CAP 396)**.

(h) Air Operators' Certificates **(CAP 360)** — Part Two — Arrangements for Engineering Support.

NOTE: All of the Civil Aviation Publications (CAPs) detailed above, are available from the Civil Aviation Authority Printing and Publication Services, Greville House, 37 Gratton Road, Cheltenham, Glos. GL50 2BN.

1.4 **Terms and Definitions**

(a) **Acceptable Deferred Defect.** A defect which can remain inoperable and/or defective within the terms of airworthiness and/or the Minimum Equipment List (MEL).

(b) **Defect.** Any confirmed abnormal condition of an item of equipment, part, unit, component, accessory, module, system or sub-system, which could, or could not, eventually result in a failure.

(c) **Flight Manual.** The Flight Manual is primarily intended for use by flight crew and forms part of the Certificate of Airworthiness. The term Flight Manual may mean any document which is accepted and approved by the CAA as a Flight Manual (e.g. Owner's Manual, Pilot's Operating Handbook). The manual contains limitations, recommended procedures, and information relating to the operation of the aircraft such that adherence to it will provide a high level of safety. Each Flight Manual bears its own exclusive serial number together with the aircraft's registration number.

(d) **Intermediate Contingency Power.** The power and/or thrust identified for use for periods of unrestricted duration after take-off when a power unit has failed or been shut down.

(e) **Maintenance.** Those actions required for restoring or maintaining an item in a serviceable condition, including servicing, repair, modification, overhaul, inspection and determination of condition.

(f) **Mandatory Inspection.** A Mandatory Inspection is an inspection classified as mandatory either by the CAA, or the Airworthiness Authority in the country of manufacturing origin, for the purpose of ascertaining whether an aircraft remains airworthy.

(g) **Mandatory Modification.** A Mandatory Modification is a modification classified as mandatory either by the CAA or the Airworthiness Authority in the country of origin.

(h) **Modification.** A modification may be regarded as: a change or alteration accomplished through rework, by the removal or installation of an item of equipment, or by the substitution of one item of equipment for another (approved) item of equipment.

(i) **Maximum Contingency Power.** The maximum power and/or thrust identified for use for a limited period from a Turbine Engine when a power unit has failed, or been shut down during: take-off, balked landing, or prior to discontinued approach.

(j) **Overhaul.** To overhaul is to restore the operational life of an item of equipment (e.g. system, sub-system module, accessory, component, unit, part) in an approved manner (i.e. those methods as prescribed in the approved maintenance or overhaul manual).

(k) **Repair.** To repair is to restore an item of equipment to a working condition.

(l) **Replacement.** Replacement is a work operation which involves the removal of an item of equipment and replacing it with an identical item of equipment or an approved alternative.

(m) **Scheduled Maintenance.** That maintenance performed at defined intervals to retain an item in a serviceable condition by systematic inspection, detection, replacement of wearout items, adjustment, calibration, cleaning, servicing etc. Also known as "Preventative Maintenance" and "Routine Maintenance.".

(n) **Scheduled Maintenance Checks.** Scheduled Maintenance Checks are those maintenance checks called for by the Approved Maintenance Schedule e.g. LAMS Check A, 50 Hour Check, 150 Hour Check, Annual Check.

(o) **Scheduled Maintenance Inspection (SMI).** A Scheduled Maintenance Inspection; commonly referred to as a Scheduled Maintenance Check, is an group of individual tests, inspections or servicing tasks which form part of the Approved Maintenance Schedule e.g. "A" Check, "C" Check, LAMS 150 Hour Check.

(p) **Weight and Centre-of-Gravity Schedule.** Refer to CAIP **BL/1-11** Weight and Balance of Aircraft, and BCAR, Section A Chapter **A5-1**.

2 GENERAL INFORMATION

2.1 In accordance with the Air Navigation Order (ANO), an aircraft shall not fly unless there is in force a valid Certificate of Airworthiness (C of A) issued under the law of the country in which the aircraft is registered, except for the following whose flights begin and end in the UK:—

(a) A Glider not being used for the Public Transport of passengers or Aerial Work.

(b) A Balloon not being used for the Public Transport of passengers.

(c) A Kite.

(d) An aircraft flying in accordance with the "A" or the "B" Conditions.

(e) An aircraft flying in accordance with the conditions of a Permit to Fly.

2.2 By definition, a C of A issued by the CAA or any other recognised airworthiness authority, is an approval document issued on the basis of satisfactory evidence that the aircraft complies with the Requirements of the authority issuing the certificate. A C of A issued by the CAA also imposes certain conditions affecting the manner in which an aircraft may be maintained and operated, and the purposes for which it may be used. These conditions are imposed in the following manner:—

(a) By placing an aircraft in Categories which indicate the uses for which the aircraft is approved.

(b) By indicating either in the C of A or associated documents.

2.3 Aircraft registered in the United Kingdom may be certificated in any one of the following categories:

(a) **Transport Category (Passenger).**

(b) **Transport Category (Cargo).**

(c) **Aerial Work Category.**

(d) **Private Category.**

(e) **Special Category.**

2.4 The purposes for which the aircraft may fly are as follows:

(a) **Transport Category (Passenger):** Any purpose.

(b) **Transport Category (Cargo):** Any purpose, other than the public transport of passengers.

(c) **Aerial Work Category:** Aerial work only.

(d) **Private Category:** Any purpose, other than public transport or aerial work.

(e) **Special Category:** Any purpose, other than public transport, specified in the C of A but not including the carriage of passengers unless expressly permitted.

3 MAINTENANCE OF AIRCRAFT

3.1 Aircraft certificated in the Transport (Passenger or Cargo) or Aerial Work Category, are required by the ANO and BCAR to be maintained in accordance with an Approved Maintenance Schedule.

3.2 Aircraft certificated in the Private Category not exceeding 2730 kg MTWA are required to be maintained in accordance with an Approved Maintenance Schedule as prescribed in BCAR, Section A Chapter A6-4. The maintenance schedule to be adopted shall be CAA/LAMS/FW/1978 (**CAP 411**) for Aeroplanes, or CAA/LAMS/H/1978 (**CAP 412**) for Rotorcraft, unless the operator requests from the CAA, approval of an alternative maintenance schedule. If, the aircraft is not maintained in accordance with the requirements of the Approved Maintenance Schedule at the intervals stated therein, and the aircraft is flown, the C of A ceases to be in force.

NOTE: Where an aeroplane is to be converted from being used for agricultural purposes (Aerial Work Category) into a passenger carrying role, certain additional inspections, as agreed by the CAA, are required to those of the Approved Maintenance Schedule, before the aeroplane is operated for the carriage of passengers (see Airworthiness Notice No. 90).

3.3 Light Aircraft Maintenance Scheme (LAMS)

3.3.1 In order to satisfy the provisions of the ANO and the requirements of BCAR, the CAA has prepared as part of the LAMS, maintenance schedules for aircraft not exceeding 2730 kg MTWA.

3.3.2 LAMS Maintenance Schedules not only provide the minimum acceptable level of maintenance as required by the ANO and BCAR for an aeroplane or helicopter and its associated equipment, but also includes provision for any supplementary special inspections or placard requirements appropriate to the particular aircraft. Operators normally adapt this schedule to suit their own aircraft, taking into account: the manufacturer's recommendations, any modifications which may have been embodied prior to the issue of a C of A, and any subsequent modifications which may have been incorporated in response to service information, or revised inspection procedures as published by the manufacturer. Maintenance certification procedures are also defined in detail.

3.4 Air Operator's Certificate (AOC)

3.4.1 Aircraft registered in the United Kingdom must not fly for the purposes of **Public Transport** (Passenger or Cargo) other than in accordance with the terms of an AOC granted by the CAA. Before granting an AOC, the CAA has to be satisfied that the operator, or in some cases, the contracted Organisation, is competent to undertake the maintenance in accordance with the Approved Maintenance Schedule(s), on the type(s) of aircraft involved.

3.4.2 The conditions for the grant of an AOC are set out in CAA publication **CAP 360** which details the requirements to be complied with by AOC applicants and holders in relation to operational matters (Part One) and arrangements for engineering support (Part Two).

4 MAINTENANCE CERTIFICATION

4.1 General

4.1.1 Aircraft registered in the UK with a Certificate of Airworthiness (C of A) in either the **Transport** (Passenger or Cargo) or **Aerial Work Category** shall not fly unless:—

(a) The aircraft has been maintained to an Approved Maintenance Schedule.

(b) There is in force a valid Certificate of Maintenance Review (CMR).

(c) A Certificate of Release to Service (CRS) has been issued if any part of the aircraft or its equipment has been overhauled, repaired, replaced, maintained or inspected in order to maintain the airworthiness of the aircraft.

4.1.2 Aircraft registered in the UK with a C of A in the **Private Category** not exceeding 2730 kg MTWA, shall not fly unless:—

(a) The Aircraft has been maintained in accordance with an Approved Maintenance Schedule.

(b) A CRS has been issued if any part of the aircraft or its equipment has been overhauled, repaired, replaced, maintained or inspected in order to maintain the airworthiness of the aircraft.

4.1.3 Aircraft registered in the UK with a C of A in the **Special Category** are required to be maintained to an Approved Maintenance Schedule when so prescribed on the particular C of A. These aircraft are, however, exempt from the certification requirements of a CMR and CRS although the statutory requirements of Article 8(7) the ANO as amended still apply i.e. the approved manner in which, overhauls, repairs, modifications, removals and replacement are carried out, the completion of any mandatory inspection or modification of the aircraft, or the requirements of the Approved Maintenance Schedule.

4.2 Certificate of Release to Service

4.2.1 A CRS, when issued (see Appendix No. 2), signifies that those maintenance tasks recorded on the certificate have been carried out in an approved manner, and as such, have been validated by the licensed or approved signatory as fit for release to service.

NOTE: For those aircraft maintained in accordance with the LAMS Maintenance Schedules using CAA Log Book (CAP 398) the CRS is contained in Part A, columns 6 and 7.

4.2.2 A CRS must be issued upon completion of any work involving overhaul, repair, replacement, modification, maintenance or inspection (scheduled or mandatory), carried out to an aircraft (registered in the United Kingdom), or any part of an aircraft, or such of its equipment as is necessary for the airworthiness of aircraft to be maintained, except for:—

(a) Certain prescribed repairs and replacements carried out on aircraft not exceeding 2730 kg MTWA with a C of A in the **Private or Special Category** where the work has been carried out by the owner or operator holding a valid pilot's licence.

(b) Where the aircraft is at a place where it is not reasonably practicable to carry out the work in such a manner that a CRS can be issued.

(c) Any Scheduled Maintenance Inspections which recur at periods less than 45 hours flying, or 28 days elapsed time, unless the inspection is classified as mandatory by the CAA.

(d) Certain Scheduled Maintenance Inspections on an aircraft not exceeding 2730 kg MTWA, with a C of A in the **Private Category**, carried out by the owner or operator holding a valid pilot's licence e.g. LAMS 50 Hour Check.

(e) Any repair, modification or overhaul of items detailed in Schedule 5 (Aircraft Equipment) paragraph 3 of the ANO as amended.

4.2.3 A CRS is required following a Scheduled Maintenance Inspection carried out in accordance with the Approved Maintenance Schedule. However, a CRS is not required on individual work cards or work sheets etc.

4.2.4 A CRS is required following work carried out on radio equipment and those items specified in Schedule 5 (Aircraft Equipment) of the ANO 1985, as amended, except paragraph 3.

4.2.5 A CRS must only be issued when the signatory is satisfied that the work has been properly carried out, having due regard to the use of:—

(a) Up-to-date technical information including manuals, drawings, specifications, CAA mandatory modifications/inspections and company procedures.

(b) Recommended tooling and test equipment which is currently calibrated where applicable.

(c) A working environment appropriate to the work being carried out.

4.2.6 A CRS, when issued, must contain particulars of the work done or the inspection completed, the organisation and place at which the work was carried out and, depending upon the application of the CRS, details of the aircraft type and registration mark, the components used, their respective part numbers and serial numbers recorded as applicable.

4.2.7 The certification is to be worded in the following manner:—

"The work recorded above has been carried out in accordance with the requirements of the Air Navigation Order for the time being in force and in that respect the aircraft/equipment is considered fit for release to service."

4.3 **Certificate of Maintenance Review (CMR).** Aircraft certificated in either the **Transport** (Passenger or Cargo) or **Aerial Work Category** are subject to a maintenance review being carried out by those responsible and authorised to do so, at certain prescribed intervals as stated in either the Approved Maintenance Schedule, or the Approval Document of the Approved Maintenance Schedule. The review is an appraisal of the current maintenance status of the aircraft concerned with respect to, the Approved Maintenance Schedule, mandatory modifications and inspections, manufacturer's service bulletins, defects recorded in the Aircraft Log Book, and CRS entries. Once the review has been completed, the CMR is issued certifying the date on which the review was carried out, and the date when the next review is due (see Appendix No. 2).

NOTES: (1) For those aircraft maintained in accordance with LAMS, the maintenance review and its certification thereof is aligned with the Annual Check.

(2) Aircraft in either the Private or Special Category do not require a CMR.

4.4 **Maintenance Certification Signatories**

4.4.1 **Certificate of Release to Service (CRS).** The categories of persons authorised to sign and issue a CRS are as follows:—

(a) The holder of an Aircraft Maintenance Engineer's Licence granted under the ANO which entitles the holder to issue a CRS.

(b) The holder of an Aircraft Maintenance Engineer's Licence granted under the law of a country other than the UK rendered valid under the ANO, and in accordance with the privileges endorsed on the licence.

NOTE: Such countries are prescribed in the Air Navigation (General) Regulations.

(c) The holder of an Aircraft Maintenance Engineer's Licence granted under the law of any country acceptable to the CAA subject to the endorsements and conditions of such a licence.

(d) The holder of an Aircraft Maintenance Engineer's Licence or authorisation granted or issued under the law of any contracting state of the International Civil Aviation Organisation (ICAO) other than the UK, in which the overhaul, repair, replacement, modification, or inspection has been carried out on aircraft not exceeding 2730 kg MTWA and in accordance with the privileges endorsed in the licence.

(e) A person, approved by the CAA and in accordance with that approval, as being competent to issue a CRS.

(f) A person authorised by the CAA and in accordance with that authority to issue a CRS in a particular case.

NOTE: In relation only to the adjustment and compensation of direct reading magnetic compasses, the holder of a valid Airline Transport Pilot's Licence Aeroplanes or a Senior Commercial Pilot's Licence Aeroplanes or a Flight Navigator Licence granted under the ANO, may also issue a CRS.

4.4.2 A CRS issued upon completion of any scheduled maintenance inspections shall be signed in each licence/authorisation category relevant to the work speciality. However, for some specific aircraft types, the CAA may direct that Category X certifications are not required.

4.4.3 Where an aircraft is to be maintained in accordance with the LAMS maintenance schedules, the persons licensed or authorised to sign the CRS are identified in the Approval Document to the relevant Approved Maintenance Schedule.

4.4.4 **Certificate of Maintenance Review.** The categories of persons authorised to sign and issue a CMR, as specified on the Approved Maintenance Schedule or associated document are as follows:—

(a) The holder of a UK Aircraft Maintenance Engineer's Licence granted under the ANO which entitles the holder to issue a CMR.

(b) The holder of an Aircraft Maintenance Engineer's Licence granted under the law of any other country other than the UK, rendered valid under the ANO.

(c) The holder of an Aircraft Maintenance Engineer's Licence granted under the law of any country acceptable to the CAA, subject to the endorsements and conditions of such a licence.

(d) A person authorised by the CAA to issue in accordance with that authority a certificate.

(e) A person approved by the CAA as being competent to issue in accordance with the approval, a certificate.

NOTE: A CMR requires only one signature. However, with the exception of those organisations approved in accordance with BCAR, Section A Chapter A8-13, the signatory will normally be a Licensed Aircraft Maintenance Engineer Type Rated in at least two categories appropriate to the aircraft type.

5 LOG BOOKS — INCLUDING TECHNICAL LOG

5.1 All inspections, repairs, maintenance checks, overhauls, component replacements and modifications to aircraft certificated in the **Transport** (Passenger or Cargo), **Aerial Work** or **Private Categories** not exceeding 2730 kg MTWA, must be recorded in log books of a standard form as approved by the CAA. The CAA publications which meet this approval are, Aircraft Log Book **(CAP 398)**, Engine Log Book **(CAP 399)** and Variable Pitch Propeller Log Book **(CAP 400)**, which are all available from the CAA Printing and Publication Services (see Airworthiness Notice No. 6 and No. 7).

NOTE: Although there is no requirement for a log book to be kept for fixed-pitch and ground-adjustable-pitch propellers, some examples of the latter embody lifed components in respect of which a maintenance record has to be kept. Variable Pitch Propeller Log Book **(CAP 400)** could be used for this purpose, but other means may be acceptable to the CAA.

5.2 **Log Book Entries.** The CAA log books referred to in paragraph 5.1 contain appropriate references to the ANO and instructions regarding the entries to be made (see Appendix No. 1). Reference should also be made to CAIP Leaflet **BL/1-10** in respect of information to be recorded, the upkeep of log books, and the responsibilities of transferring log books. Information is also provided in respect of log books for engines of modular construction.

5.3 **Technical Log**

5.3.1 Aircraft certificated in either the **Transport** (Passenger or Cargo) or **Aerial Work Category**, are required by the ANO to carry and maintain a Technical Log irrespective of the manner in which the aircraft is used.

NOTE: For the operators of aircraft not exceeding 2730 kg MTWA who are not required to hold an Air Operator's Certificate (AOC) an alternative form of Log Book approved by the CAA may be used.

5.3.2 Upon the termination of every flight, the Commander of the aircraft must enter into the Technical Log the times at which the flight began and ended, and details of any defects in the aircraft affecting the operation or airworthiness of the aircraft. If no such defect is known an entry shall also be made to that effect.

5.3.3 Where there are a number of consecutive flights made by the same Commander, beginning and ending at the same aerodrome on the same day, the Commander may make entries in the Technical Log at the end of the last consecutive flight except where the Commander becomes aware of a defect during an earlier flight. This does not, however, apply to flights for the purpose of dropping or projecting of material for agricultural, public health or similar purposes.

5.3.4 **Basic Technical Log Requirements**

(a) A title page with the registered name and address of the operator, aircraft type and full international registration marks of the aircraft.

(b) A readily identifiable section containing pre-printed sector pages (with removable duplicates), with:—

(i) The operator's name.

(ii) The aircraft type and international registration mark.

(iii) The date and place of take-off and landing.

(iv) The times of take-off and landing of the aircraft.

(v) Details of any defect in any part of the aircraft affecting the airworthiness or safe operation of the aircraft which is known to the Commander, or if no such defect is known to that person, an entry to that effect.

(vi) The date and signature of the Commander following completion of item (iv).

(vii) Fuel state on arrival.

(viii) The quantities of fuel and oil uplifted, and the quantity available in each tank, or combination of tanks, at the beginning of each flight.

(ix) The running total of flying hours, such that the hours to the next inspection can be readily determined.

(x) A CRS in respect of any work carried out for the rectification of defects. This certificate will be entered in such a position and manner as to be readily identifiable with the entry of the defect to which it relates (e.g. Part A of the Aircraft Log Book — **CAP 398**), duly signed and dated.

(xi) Provision for pre-flight and daily inspection signatures.

(xii) The times when ground de-icing was started and completed.

(c) A valid CMR.

(d) A Maintenance Statement (see paragraph 5.4), detailing the next inspection due to comply with the inspection cycle of the Approved Maintenance Schedule and any out of phase inspection or component change due before that time.

(e) A readily identifiable section containing a series of Acceptable Deferred Defect (ADD) record pages. Each page shall be pre-printed with the operator's name and page serial number and make provision for recording the following:—

(i) A cross reference for each Deferred Defect such that the original defect can be clearly identified in the sector page section.

(ii) The original date of occurrence of the Deferred Defect.

(iii) Brief details of the defect.

(iv) A cross reference for each Deferred Defect such that the action in respect of each Deferred Defect can be readily identified on the sector record page.

5.3.5 **Supplementary Technical Log Requirements.** As assessed by the Operator and agreed by the CAA, it is required that additional information is recorded in the Technical Log for specific aircraft. The following list is a typical example of what is required but not intended to be exhaustive:—

(a) **Maximum or Intermediate Contingency Power.** It is necessary to record the duration of maximum and intermediate contingency power usage, and subsequently to transfer the information to the engine log book or maintenance record. For rotorcraft the record of each use of these powers must also subsequently be transferred to log cards or other appropriate documents applicable to those components of the transmission which always transmit the power from a single engine only, i.e. components upstream of any combining gearbox.

(b) **Landings.** The number of landings carried out will be necessary for undercarriage component life consideration.

(c) **Flight Pressure Cycles.** The number of pressure cycles will be necessary for fuselage life consideration.

5.4 Maintenance Statement

5.4.1 BCAR, Section A Chapter **A6-8** (Technical Logs) paragraph 2.1(c), requires a Maintenance Statement to be made in the Technical Log. A suitable format for a Maintenance Statement is shown in Appendix No. 2.

5.4.2 The primary purpose of this statement is to enable the Commander to establish prior to flight, the maintenance status of the aircraft, when the next Scheduled Maintenance Inspection is due, when any out of phase inspections or component changes (if any) are due in the intervening period, and by reference to the CMR, that a maintenance review is not due.

5.4.3 Where an operator has a system for controlling out of phase items and component changes to the satisfaction of the CAA, and this has been defined in the company procedures, it may be accepted in lieu of the requirement of Chapter **A6-8**.

5.4.4 In such cases, it will be necessary for the operator to include in the Technical Log instructions to the Commander of the aircraft, on how to obtain any information which is required before flight.

5.4.5 The CRS issued following the last Maintenance Inspection should also be included in the Maintenance Statement.

5.5 **Retention of the Technnical Log.** Entries in the Technical Log are required to be in duplicate, of which a copy is to be kept on the ground. Where it is not practical to do so, aeroplanes or helicopters not exceeding 2730 kg MTWA, may carry a copy of the Technical Log in a box approved by the CAA for the purpose. It is also the responsibility of the operator to ensure that the relevant information contained within the Technical Log is transferred to the organisations responsible for aircraft maintenance or component overhaul.

6 THE NOMINATED ENGINEER

6.1 **General.** Aircraft Maintenance Organisations approved in accordance with BCAR, Section A Chapter **A8-15** are as part of that approval, required to nominate personnel for acceptance by the CAA as being sufficiently qualified to:—

(a) Make assessments and recommendations to the CAA with respect to the renewal of a C of A.

(b) Perform maintenance checks with respect to the maintenance of aircraft, as prescribed by the Approved Maintenance Schedule, which are required to be completed by an Approved Maintenance Organisation.

(c) Perform the Star Inspection (see paragraph 7).

6.2 **Approval of the Nominated Engineer**

6.2.1 For the Nominated Engineer to be acceptable to the CAA, the nominee must hold an Aircraft Maintenance Engineer's Licence in both the Airframe (A) and Engine (C) categories with ratings appropriate to type for which approval is sought. Additionally the nominee must have acceptable experience with respect to the maintenance of Light Aircraft.

6.2.2 More than one such person may be nominated by an Approved Organisation, and the CAA will normally interview nominated engineers prior to acceptance. Such engineers will be expected to demonstrate an acceptable degree of knowledge on the following subjects:—

(a) BCAR, Section A Chapter **A2-5**, Procedure No. 2 — Star Inspections.

(b) Completion of Form AD 202L and amendment of Form AD 461 (Application for Approval) when necessary.

(c) Certification requirements for different categories of C of A.

(d) Assessment of Airworthiness Flight Test Reports.

(e) Weight and Balance calculations, and preparation of the Weight and Balance Report — BCAR, Section A Chapter **A5-1**.

(f) Requirements for the issue of a CRS including Scheduled Maintenance Inspections.

(g) Mandatory requirements.

(h) Assessment of Radio installation and Form AD 917 (Certificate of Approval of Aircraft Radio Installation).

(i) Type Certificate Data Sheets, etc.

(j) Technical Logs — requirements and procedures of the AOC if maintenance support is undertaken (see **CAP 360** — Part Two).

(k) Terms of Reference within the organisation.

6.3 **The Role of the Nominated Licensed Engineer** is as follows:—

(a) To make recommendations to the CAA for the renewal of the C of A.

(b) Be signatory to CMR's for aircraft in either the **Transport or Aerial Work Categories** coincident with the Annual Check.

(c) Be signatory to CRS's (see paragraph 4.4).

(d) Be signatory to Scheduled Maintenance Inspections.

NOTE: The signatories authorised for a Scheduled Maintenance Inspection are detailed in the relevant Approved Maintenance Schedule, e.g. LAMS Schedule Section 6 of **CAP 411** and **CAP 412**.

(e) Carrying out and being signatory to the "Star Inspection" coincident with C of A renewal.

(f) To be signatory to Duplicate Inspections.

NOTE: Reference should also be made to Airworthiness Notice No. 3 and BCAR, Section A Chapter **A8-15**.

7 STAR INSPECTION — RENEWAL OF THE CERTIFICATE OF AIRWORTHINESS

7.1 **General**

7.1.1 The term "Star Inspection" is one given to the overall assessment of an aircraft prior to making recommendations for the renewal of the C of A. This will include its: engine(s), propeller(s) and associated equipment and maintenance records. A Star Inspection must be carried out by suitably Licensed Aircraft Maintenance Engineers with Type Ratings appropriate to the certification to be made. The Star Inspection only applies to those aircraft not exceeding 2730 kg MTWA certificated in either the **Transport** (Passenger or Cargo), **Aerial Work, or Private Category**.

NOTE: If requested, the CAA will carry out a survey of the aircraft. However, the applicant should be prepared to meet the additional cost of such a survey.

7.1.2 The procedures for the renewal of a C of A are prescribed in BCAR, Section A, Chapter **A2-5** and paragraph 9 of this Leaflet. Further guidance on the procedures of a Star Inspection and the submission of the Report and Recommendation for Renewal of a C of A (see Appendix No. 3), are contained in the following paragraphs 7.2 to 7.11 inclusive.

NOTE: In order to maintain continuity of the maintenance schedule, the Star Inspection and Annual Check coincident with the C of A Renewal, may be anticipated by a maximum of 62 days prior to the C of A renewal date.

7.2 **The Star Inspection.** In addition to the condition of the aircraft, and the current maintenance status, the procedures of a Star Inspection require that the following are checked:—

(a) The Maintenance Records (and associated documentation).

(b) The Approved Maintenance Schedule (including manufacturers' recommendations).

(c) The appropriate Log Books.

(d) The Flight Manual, or such other document.

(e) The Weight and Centre-of-Gravity Schedule.

(f) The Certificate of Approval of Aircraft Radio Installation.

7.3 **Maintenance Records**

7.3.1 The aircraft maintenance records should be inspected to ensure that the maintenance of the aircraft has been completed, and correctly certified in accordance with the relevant requirements.

7.3.2 The status of the aircraft and its equipment should be checked against the aircraft records in respect of any manufacturers' service bulletins, manufacturers' instructions or other letters and publications requiring inspection or work to be carried out.

7.4 **The Approved Maintenance Schedule.** A check must be made to ensure that the Approved Maintenance Schedule includes the following:—

(a) All Placard and Notice Requirements additional to those made mandatory by the Type Certification of the aircraft (see section 9 of the Light Aircraft Maintenance Schedule (**CAP 411**).

(b) All Supplementary Special Instructions, appropriate to the aircraft type, derived from:—

(i) Airworthiness Directives.

(ii) Manufacturers' Service Bulletins.

(iii) Airworthiness Notices (**CAP 455**).

(c) Details of any required out of sequence servicing.

(d) Any mandatory manufacturer's instructions or recommendations which are necessary for the continued airworthiness of the aircraft.

NOTE: See also Section 3 of **CAP 411** in respect of manufacturers' recommendations, particularly paragraph 2.3 concerning compliance with recommended inspections.

7.5 **Log Books**

7.5.1 The log books should have been completed according to the "Instructions for Use" contained therein. All log books should be checked; to ensure that they have been completed correctly, that all inspections specified in the Maintenance Schedule have been carried out within the hours/cycles stipulated and have been certified by appropriately licensed/authorised persons, and where appropriate, CMR's and CRS's have been issued. Entries made in Part A should be repeated where necessary, in parts B or C and in the associated Aircraft, Engine, and Propeller Log Books as appropriate. Any separate cards used to record component lives and retained with the log books should be checked for accuracy.

7.5.2 The entries contained in the Aircraft, Engine, or Propeller Log Books, should be checked against any applicable Airworthiness Directives, Mandatory Modifications or Inspections and Airworthiness Notices.

7.6 **The Flight Manual.** The CAA provides to owners and operators a Flight Manual "Check List" for each individual aircraft. The Flight Manual should be checked against this Check List to ensure that: it is relevant to the particular aircraft, that it has been amended to the latest issue and contains only those supplements which are the result of modifications incorporated into the aircraft.

NOTE: Where there is no Flight Manual for the aircraft, references to the Flight Manual should be taken as references to the Owners Handbook, Pilots Operating Handbook (POH), Operating Manual, or such other document describing aircraft operation and limitations which has been approved by the CAA and is referred to in the C of A for the particular aircraft.

7.7 **Weight and Centre-of-Gravity Schedule.** For each aircraft, a Weight and Centre-of-Gravity Schedule (or Loading and Distribution Schedule, as appropriate), is required to be included in the aircraft records and also in the Flight Manual or, if there is no Flight Manual, retained in the aircraft in a suitable stowage. The Schedule for the aircraft concerned should also be checked against the status of the aircraft in respect of modifications, etc. Where modifications have been incorporated, and the effect on the weight or Centre-of-Gravity has not been sufficient as to warrant the issue of a revised Schedule, the engineer carrying out the Star Inspection should ensure that any subsequent repairs or modifications will not place the aircraft's weight or Centre-of-Gravity outside operating limits.

NOTE: The requirements governing Weight and Centre-of-Gravity Schedules and Loading and Distribution Schedules are prescribed in BCAR, Section A Chapter **A5-1**.

7.8 **Radio Installation.** The Certificate of Approval of Aircraft Radio Installation (**Form AD 917**) contains details of the radio equipment installed in the particular aircraft. This document should be checked to ensure that the equipment listed corresponds to the equipment actually installed in the aircraft.

7.9 **Condition of the Aircraft**

7.9.1 The condition of the aircraft should be judged against the records on previous maintenance history, and its general appearance. For example, where an aircraft has been continually maintained by an Approved Organisation, a check of selected entries in the records may be adequate. However, for an aircraft which has had inspections and maintenance work carried out at various locations, it may be necessary to carry out a more searching check of both the aircraft, and its records.

7.9.2 The status of the aircraft and its equipment should also be checked in respect of manufacturers' service information, Airworthiness Directives, Mandatory Modifications or Airworthiness Notices applicable to the aircraft type.

7.10 **Airworthiness Flight Tests (Star Inspection).** For details of the procedures for flight testing of aircraft with respect to the Star Inspection refer to paragraph 8.

7.11 **Certification of Star Inspection Work.** A brief list of all inspections and rectification work carried out as part of the Star Inspection, together with the file reference for additional details, should be entered in the appropriate log books and certified by an appropriately licensed/authorised engineer, and where necessary, Certificates of Maintenance Review and Release to Service issued. The Nominated Engineer (see paragraph 6) should then check these entries and raise a report on the Star Inspection, including details of all work carried out ensuring that the Annual Inspection and Airworthiness Flight Test have been correctly carried out and certified.

8 AIRWORTHINESS FLIGHT TESTS

8.1 **General.** The purpose of an Airworthiness Flight Test is to ensure that:—

(a) The aircraft's handling characteristics are satisfactory and have not deteriorated with time.

(b) The aircraft's performance remains as scheduled.

(c) The aircraft and its equipment function correctly.

8.2 **The Flight Test Responsibilities of the Approved Maintenance Organisation.** Maintenance Organisations approved in accordance with BCAR, Section A, Chapter **A8-15** and the Nominated Engineer, are responsible for ensuring that the Airworthiness Flight Test is carried out in a satisfactory manner, and the results of that test are acceptable. The Nominated Engineer must, therefore be fully acquainted with the procedures for checking aircraft performance and comparing test results with the tables or graphs contained in the Flight Manuals or alternative documents. **CAP 520** may also be used for the evaluation of test results. Once these results have been assessed as being acceptable they must be sent to the CAA for record purposes (see also paragraph 8.4).

NOTE: Where the C of A of the aircraft concerned has expired, a Certificate of Fitness for Flight (see BCAR, Section A, Chapter **A4-4**) must be issued prior to the Airworthiness Flight Test being carried out.

8.3 **Flight Test Pilots**

8.3.1 It is the intention of the CAA that all pilots who carry out Airworthiness Flight Tests shall be acceptable to the CAA and as such have been briefed on flight testing procedures by a CAA pilot. The CAA will provide to Approved Organisations a list of pilots considered acceptable for conducting such Flight Tests. In cases where an acceptable pilot is not available, the Nominated Engineer may submit the name of an alternative pilot for consideration, having ensured that the person under consideration has at least the following experience:—

(a) **Transport and Aerial Work Category Aircraft**

(i) A minimum of 500 hours total flying time for single-engined aircraft, or 1000 hours total flying time for twin-engined aircraft.

(ii) Recent experience on the particular aircraft type or similar aircraft types, amounting to at least 10 hours in the last 12 months for single-engined aircraft, and 20 hours in the last 12 months for twin-engined aircraft.

NOTE: Where a pilot does not have the necessary experience, other qualifications, such as the possession of an Instructor Rating or experience as a production test pilot, may be acceptable.

(b) **Private Category Aircraft.** It is preferable that a pilot with the experience outlined in (a) should carry out the Flight Test, however it is permissible for private owners to carry out the flight test on their own aircraft.

8.3.2 All pilots should be aware of the CAA requirements for Airworthiness Flight Tests and should be familiar with the contents of **CAP 520**.

8.3.3 If, following the Airworthiness Flight Test, the observed performance of an aircraft is outside the specified limits, the Nominated Engineer should ensure that such rectification as is considered necessary to restore it to an acceptable level are carried out, and consider whether a further air test is necessary.

8.4 **Flight Test Report**

8.4.1 Upon completion of the Airworthiness Flight Test, the pilot should complete a Flight Test Certificate (see BCAR, Section A Chapter **A5-2**).

8.4.2 Once accepted by the Nominated Engineer, the Flight Test Certificate, and Flight Test Results, must be forwarded to the CAA as the "Flight Test Report" for record purposes.

9 PROCEDURES FOR THE RENEWAL OF THE CERTIFICATE OF AIRWORTHINESS (C of A)

9.1 Recommendations to the CAA for the Renewal of the C of A for aircraft not exceeding 2730 kg MTWA in the Transport (Passenger or Cargo), Aerial Work or Private Category can only be made by a Licensed Aircraft Maintenance Engineer employed and nominated by an Approved Maintenance Organisation. This engineer must be acceptable to the CAA, and must be the holder of a United Kingdom Aircraft Maintenance Engineer's Licence in both the Airframe (A) and Engine (C) Categories with ratings appropriate to the class of aircraft concerned (see paragraph 6), and have acceptable experience in the maintenance of light aircraft in accordance with BCAR, Section A Chapter **A8-15**.

NOTE: The C of A for aircraft in the Transport (Passenger or Cargo), Aerial Work, or Private Category not exceeding 2730 kg MTWA, is normally valid for a period of three years.

9.2 Once the Nominated Engineer is satisfied that the aircraft and its records are in a satisfactory condition, that all deficiencies and discrepancies disclosed during the foregoing checks have been made good, and the Star Inspection has been completed, a Report and Recommendation for the Renewal of a Certificate of Airworthiness (CAA Form AD 202L) should be submitted to the CAA for acceptance (see Appendix No. 3).

9.3 **Report and Recommendation for the Renewal of a C of A (CAA Form AD 202L)**

9.3.1 CAA Form AD 202L is printed in quadruplicate, with yellow, blue, white and pink copies:—

(a) The yellow copy should be filed with the aircraft records.

(b) The blue copy should be retained by the Approved Organisation making recommendations.

(c) The white and pink copies should be forwarded to the CAA Area Office with the following:—

(i) the C of A being recommended for renewal, and

(ii) the completed Flight Manual check list.

9.3.2 However, the CAA may also request that the following be submitted:—

(a) The Flight Manual.

(b) The appropriate Log Books.

(c) The Approved Maintenance Schedule and associated records.

9.3.3 Where the Weight and Centre-of-Gravity Schedule has changed, a copy of the new Schedule should also accompany Form AD 202L for acceptance by the CAA. This also applies to the Flight Test Report which comprises the Flight Test Certificate and Flight Test Results (see paragraph 8.4).

APPENDIX NO. 1

INSTRUCTIONS FOR USE — AIRCRAFT LOG BOOK (CAP 398)

1 GENERAL

1.1 This log book shall be kept and entries shall be made in accordance with the current Air Navigation Order (ANO) as amended.

1.2 The ANO prescribes that the operator of an aircraft shall keep or cause to be kept a log book in respect of the aircraft and includes the following provisions:—

(a) Each entry in the log book shall be made as soon as is practicable after the occurrence to which it relates, but in no event more than seven days after the time of the occurrence.

(b) Entries in a log book may refer to other documents which shall be clearly identified, and any other document so referred to shall be deemed to be part of this log book.

(c) Subject to any provisions in the ANO regarding the preservation of documents, the log book shall be preserved by the operator of the aircraft until a date two years after the aircraft has been destroyed or permanently withdrawn from use.

1.3 The ANO provides that the operator of an aircraft registered in the United Kingdom shall within a reasonable time after being requested to do so by an authorised person cause a log book to be produced to that person. Other provisions included in the ANO relate to false entries, mutilation, or alteration of such a document. All entries in the log book made in writing shall be made in ink or indelible pencil.

1.4 The details entered on the Title Page shall be those appropriate to the particular aircraft. Official designations shall be used for the aircraft, engine and propeller types.

2 PART A

2.1 In Part A of this log book, there shall be entered in Columns 1, 2 and 3 the date of each flight, the duration of the period between take-off and landing, or, if more than one flight was made on that day, the number of flights and the total duration of the periods between take-offs and landings on that day. A cumulative total should be entered in Column 4.

2.2 In Column 5 of Part A there shall, if appropriate, be entered the cycles run by the engine. Cycle shall be as defined in the constructor's technical literature.

2.3 In Column 6 of Part A there shall be entered particulars of the following events relating to the aircraft, including its equipment (but excluding maintenance of engines and variable pitch propellers):—

(a) Particulars of all maintenance work done on the aircraft or its equipment.

(b) Particulars of any defects occurring in the aircraft or in any equipment required to be carried, and of the action taken to rectify such defects including a reference to the relevant entries in the Technical Log.

(c) Particulars of any overhauls, repairs, replacements and modifications relating to the aircraft or any such equipment.

NOTE: See also Part C, where further details of modifications have to be entered.

(d) Certificate(s) that in carrying out the overhauls, repairs, replacements and modifications, all mandatory requirements applicable thereto have been complied with.

2.4 In Column 7, the person making the entry in Column 6 shall enter his signature, authority and date. This signature constitutes a signature to the CRS where the entry covers work which necessitates such a certificate. The authority to be held is as prescribed in the ANO.

3 PART B In Part B there shall be entered reference numbers of any checks (e.g. Check 1, 2, 3 or 4) made in accordance with the Approved Maintenance Schedule relating to the aircraft and the date on which each function was performed together with the total airframe hours since manufacture.

4 PART C

4.1 In addition to any entry in Part A, in Part C there shall be entered in Columns 1, 2 and 3 the reference details, e.g. Bulletin Number and brief description of subject of any modifications and technical instructions, including those prescribed for the purpose of ensuring that the aircraft remains airworthy.

4.2 In Column 4 headed "Method of Compliance" the degree of compliance, e.g. "part (a) only" or "paragraph 2 inspection only" or "full compliance" shall be stated, together with the method, e.g. visual, NDT, replacement.

4.3 In Column 5 headed "One-time" a tick shall be added when total compliance has been achieved and no further action is necessary.

4.4 In Column 6 headed "Recurring" a tick shall be added when only partial compliance has been achieved, and further action is necessary to achieve full compliance or when repetitive action is specified. For such entries Column 7 headed "Next Compliance Due" shall show the date and/or hours at which further action or compliance is next due.

4.5 In Column 8 the person making the above entries shall enter his signature, authority and date. The authority to be held is as prescribed in the ANO.

APPENDIX NO. 2

MAINTENANCE STATEMENT

Aircraft Type: Registration Mark:

The next SCHEDULED MAINTENANCE INSPECTION is due at: hrs

on:

The following out of phase inspections/component changes are due before the next Scheduled Maintenance Inspection specified above:

Item	Due		Sector Log Reference on Completion
	Hrs	Date	

This maintenance statement is not complete unless a valid Certificate of Maintenance Review is attached.

MAINTENANCE STATEMENT

SCHEDULED MAINTENANCE INSPECTION CERTIFICATE OF RELEASE TO SERVICE

Aircraft Type: Registration Mark:

SCHEDULED MAINTENANCE INSPECTION: was completed

on: at: airframe hours:

Category		Lic/Auth/App No:	Signature
A	Airframe		
C	Engines		
R	Radio		
X	Electrical		
X	Instruments		
X	Autopilots		
X	Compasses		

The work recorded above has been carried out in accordance with the requirements of the Air Navigation Order for the time being in force and in that respect the aircraft/equipment is considered fit for release to service.

CERTIFICATE OF RELEASE TO SERVICE

CERTIFICATE OF MAINTENANCE REVIEW

AIRCRAFT TYPE ..... NATIONALITY & REGISTRATION MARK .....

Certified that a maintenance review of this aircraft and such of its equipment as is necessary for its airworthiness has been carried out in accordance with the requirements of the Air Navigation Order for the time being in force.

The next maintenance review is due .....

Signed .....

CAA Approval/Licence .....

Date .....

Firm .....

CERTIFICATE OF MAINTENANCE REVIEW

APPENDIX NO. 3

Civil Aviation Authority

Safety Regulation Group

REPORT AND RECOMMENDATION FOR RENEWAL OF CERTIFICATE OF AIRWORTHINESS BY AN ORGANISATION APPROVED IN ACCORDANCE WITH BCAR, SECTION A, CHAPTER A8—15

DISTRIBUTION
White — CAA Area Office
Pink — CAA Area Office
Yellow — Aircraft Records
Blue — Approved Organisation

NOTE Where an item is not applicable or appropriate the letters 'NA' should be entered.

1 AIRCRAFT DETAILS

1.1 Registration _____ Type _____ Constructor's No _____

1.2 C of A Category _____

1.3 Engine Type(s) _____ Propeller Type(s) _____

2 REPORT

2.1 Total hours flown either since manufacture or since initial issue of UK C of A* _____

2.2 Hours flown during each calendar year since C of A issue or last renewal:

19 _____ hr/19 _____ hr/19 _____ hr/19 _____ hr/Total _____ hr

2.3 Aircraft tested to Airworthiness Flight Test Schedule No: _____ Issue No _____ Date of satisfactory Flight Test _____

2.4 Radio equipment installed is in accordance with Form AD 917 dated _____

2.5 Flight Manual/Pilots Operating Handbook/Owners Manual* is in accordance with Flight Manual checklist dated: _____

2.6 Date of Current Weight Schedule: _____

2.7 Aircraft is approved for Glider Towing/Parachuting*

2.8 I confirm that all appropriate CAA requirements and Airworthiness Notices — Contents No. _____ have been complied with.

2.9 I confirm that compliance with the following, as appropriate, is recorded in the aircraft records:

(a) FAA Airworthiness Directive Vol 1 at Bi-weekly Listing No: _____

(b) CAA Mandatory Modifications and Inspections Summary, Contents and checklist of pages at Issue _____ dated _____

(c) Foreign Airworthiness Directives Vol III, Contents and checklist of pages at Issue _____ dated _____

(d) CAA Additional Directives, Contents and checklist of pages at Issue _____ dated _____

2.10 The aircraft complies with Specification/Data Sheet/Fiche No*: _____ Revision/Issue/Edition No. _____

Quote Variations

3 CERTIFICATION

3.1 STAR INSPECTION† completed on _____

Certified by

Category *Name* *AMEL No*

3.2 **Certified** that the appropriate requirements of BCAR, Section A Chapter A2—5 have been complied with and that the particulars contained herein are correct It is recommended that Certificate of Airworthiness No _____ be renewed for a period of 36 months, in the Private/Aerial work/Transport* Category

Signed _____ Name _____

Organisation _____

Approval Ref No _____ Date _____

The following documents are attached for CAA records Flight Test Schedule/Flight Manual Check List/Weight and Centre of Gravity Schedule*

*Delete as necessary †To be in addition to and coincidental with the annual check (CAIP BL 1-15)

AD 202L
170288

BL/1-16

Issue 1.

December, 1981.

BASIC

AIRWORTHINESS PROCEDURES

CONDITIONED MONITORED MAINTENANCE

1 INTRODUCTION

1.1 This Leaflet gives general information on the concepts and practices of aircraft maintenance control by the use of Condition Monitored Maintenance, and is derived directly from Civil Aviation Publication CAP 418. Definitions of the terms and abbreviations used in this Leaflet are given in paragraph 5.

NOTE: Defined terms are given an initial capital letter in the text.

1.2 Confidence in continued airworthiness has long been based on the traditional method of maintaining safety margins by the prescription of fixed component lives and by aircraft 'strip-down' policies. The call for changes to the basic philosophy of aircraft maintenance has been greatly influenced by the present day economic state of the industry as well as by changes in aircraft design philosophy allied to progress in engineering technology. These changes have, in turn, resulted in the necessity for the management and control of expensive engineering activities to take a new and more effective form.

1.3 It is from this background that a maintenance process known as Condition Monitoring has evolved. Condition Monitoring is not a separate activity but a complete process which cannot be separated from the complete maintenance programme. It is not just an identification of a single maintenance action but is a basic maintenance philosophy.

1.4 Maximum use can be made of the Condition Monitoring process (which includes a statistical reliability element, see paragraph 3.3), when it is applied to aircraft meeting the following criteria:—

(a) Modern, multi-engined, Transport Category aircraft which incorporate in their design safeguards against the complete loss of the function which a system is intended to perform.

NOTE: These safeguards are provided by the provision of either Active Redundancy or Standby Redundancy. In simple terms the safeguards take the form of more than one means of accomplishing a given function. Systems (or functions within systems) beyond those necessary for immediate requirements are installed. These are so designed that with an Active Redundancy philosophy all the redundant Items are operating simultaneously and, in simple terms, sharing the load to meet the demand. Thus in the event of failure of one of the redundant Items, the demand will continue to be met by the remaining serviceable redundant Items; this process continues up to the extent of the Redundancy provided. The extent of the Redundancy provided, within practical limits, is related to the consequences of complete loss of the system function. (The term 'multiplicity of system function' is sometimes used in this context.) With a Standby Redundancy philosophy only one redundant system is functioning at a time. If a function loss occurs, it is necessary to select (or activate) the functions provided by the 'standby" system(s). The principle is the same as for Active Redundancy and the term 'system redundancy' is sometimes used in this context.

(b) Aircraft for which the initial scheduled maintenance programme has been specified by a Maintenance Review Board and to which a Maintenance Steering Group Logic Analysis* has been applied.

NOTE: For an aircraft type introduced into service by Maintenance Review Board and Maintenance Steering Group procedures and where Condition Monitoring tasks are prescribed, a Condition Monitored Maintenance Programme (the Programme) will have to be established, even for a single aircraft.

1.5 Items which are not directly controlled by Condition Monitoring may be maintained by the traditional Hard Time or On-Condition processes, but the statistical reliability element of Condition Monitoring may, nevertheless, be applied for the purpose of monitoring their performance (but not be prescribed in the Maintenance Schedule as a primary maintenance process).

NOTE: For a statistical reliability element of a programme to be effectively used, a fleet minimum of five aircraft is normally necessary, but this can vary dependent upon the aircraft type and utilisation.

1.6 Further information on the maintenance of aircraft is given in Leaflet **BL/1-8.**

2 PRIMARY MAINTENANCE

2.1 The CAA recognises three primary maintenance processes. They are Hard Time, On-Condition and Condition Monitoring. In general terms, Hard Time and On-Condition both involve actions directly concerned with preventing failure, whereas Condition Monitoring does not. However the Condition Monitoring process is such that any need for subsequent preventative actions would be generated from the process.

2.2 The Processes

2.2.1 **Hard Time.** This is a preventative process in which known deterioration of an Item is limited to an acceptable level by the maintenance actions which are carried out at periods related to time in service (e.g. calendar time, number of cycles, number of landings). The prescribed actions normally include Servicing and such other actions as Overhaul, Partial Overhaul, Replacement, in accordance with instructions in the relevant manuals so that the Item concerned is either replaced or restored to such a condition that it can be released for service for a further specified period.

2.2.2 **On Condition.** This also is a preventative process but one in which the Item is inspected or tested, at specified periods, to an appropriate standard in order to determine whether it can continue in service (such an inspection or test may reveal a need for Servicing actions). The fundamental purpose of On-Condition is to remove an Item before its failure in service. It is not a philosophy of 'fit until failure' or 'fit and forget it'.

2.2.3 **Condition Monitoring.** This is not a preventative process, having neither Hard Time nor On-Condition elements, but one in which information on Items gained from operational experience is collected, analysed and interpreted on a continuing basis as a means of implementing corrective procedures.

2.3 Where a Maintenance Steering Group Logic Analysis has not been applied to a particular aircraft to establish and allocate the primary maintenance processes for each Item, the considerations of (a), (b) and (c) will be applied separately to all Items to determine the acceptability of the primary maintenance process.

*Should fuller details of the current Maintenance Steering Group process, or the process used in respect of a specific aircraft be required, these would have to be obtained from the regulatory authority responsible for the initial certification of that aircraft, or responsible for any subsequent Maintenance Review Board revisions employing a logic process.

(a) **Hard Time**

(i) Where the failure of the Item has a direct adverse effect on airworthiness and where evidence indicates that the Item is subject to wear or deterioration.

(ii) Where there is a Hidden Function which cannot be checked with the Item in-situ.

(iii) Where wear or deterioration exists to such an extent as to make a time limit economically desirable.

(iv) Where component condition or 'life' progression sampling is practised.

(v) Where limitations are prescribed in a Manufacturer's Warranty.

(b) **On-Condition.** Where an inspection or test of an Item to a prescribed standard (frequently in-situ) will determine the extent of deterioration, and hence the 'condition', i.e. any reduction in failure resistance.

(c) **Condition Monitoring.** Where a failure of an Item does not have a direct adverse effect on operating safety, and where (a) and (b) are not prescribed and no adverse age reliability relationship has been identified as the result of analysis of the data arising from a formalised monitoring procedure or programme.

3 CONDITION MONITORED MAINTENANCE

3.1 **Introduction.** Condition Monitored Maintenance, as a programme, is the formalised application of the maintenance processes Hard Time, On-Condition and Condition Monitoring to specific Items as prescribed in the Approved Maintenance Schedule. The controlling activity of Condition Monitored Maintenance is Condition Monitoring irrespective of whether Condition Monitoring is prescribed as a primary maintenance process in the Approved Maintenance Schedule or not. Condition Monitoring is repetitive and continuous, the key factor in its use being the introduction of aircraft embodying failure tolerant designs, which allow for replacement of some traditional failure preventative maintenance techniques by non-preventative techniques. Condition Monitoring is not a relaxation of maintenance standards or of airworthiness control; it is, in fact, more demanding of both management and engineering capabilities than the traditional preventative maintenance approaches. Each Condition Monitored Maintenance Programme is required to be approved by the CAA.

3.2 **Maintenance Activities**

3.2.1 There are three types of maintenance activity:—

(a) Maintenance applied at specified periods of time regardless of condition at that time. The maintenance activity may be a periodic overhaul, a bearing change, re-work, repaint, calibration, lubrication, etc. These result from Hard Time requirements.

(b) Periodic examinations, mostly at specified periods of time, but sometimes on an opportunity basis (e.g. when an Item is removed for access) to determine not only the extent of deterioration but also that the deterioration is within specified limits. These result from On-Condition requirements.

(c) Actions applied in response to the analysis of condition clues produced by monitoring in-flight, hangar, workshop and other types of condition information sources. These result from Condition Monitoring requirements.

3.2.2 Condition Monitoring uses data on failures as items of 'condition' information which are evaluated to establish a necessity for the production or variation of Hard Time and On-Condition requirements, or for other corrective actions to be prescribed. Failure rates and effects are analysed to establish the need for corrective actions. Condition Monitoring can be used in its own right to identify the effects of deterioration, in order that steps may be taken to maintain the level of reliability inherent in the design of the Item. Although Condition Monitoring accepts that failures will occur, it is necessary to be selective in its application. The acceptance of failures may be governed by the relative unimportance of the function, or by the fact that the function is safeguarded by system Redundancy.

3.2.3 Maintenance of a particular Item could well be some combination of the three primary maintenance processes (Hard Time, On-Condition and Condition Monitoring). There is no hierarchy of the three processes; they are applied to the various Items according to need and feasibility. Maintenance Schedules which are based on the Maintenance Steering Group principles will have Hard Time, On-Condition, or Condition Monitoring specified as the primary maintenance process for specific systems and sub-systems as well as for individual Maintenance Significant Items. Condition Monitoring can, therefore, be the primary maintenance process prescribed for an Item, in which case it has also to be used for controlling the availability of those functions which are not directly controlled by a prescribed On-Condition or Hard Time process; this control is provided by the statistical reliability element of Condition Monitored Maintenance. Items for which Hard Time and On-Condition are prescribed may, however, have the statistical reliability element of Condition Monitored Maintenance applied, not as a primary maintenance process, but as a form of Quality Surveillance.

3.3 Statistical Reliability Element

3.3.1 The assessment of defect/removal/failure rate trend, of age bands at which Items fail, or the probability of survival to a given life are, in most cases, used to measure the effect or suitability of the primary maintenance processes applied to Items. The assessment is made by examination of rates of occurrence of events such as in-flight defects, incidents, delays, use of Redundancy capability, engine unscheduled shut-downs, air turn-backs, etc., which are reported in accordance with the procedure associated with the reliability element of Condition Monitored Maintenance.

3.3.2 A statistical reliability programme, as an element of Condition Monitoring, is, in practical terms, the continuous monitoring, recording and analysing of the functioning and condition of aircraft components and systems. The results are then measured or compared against established normal behaviour levels so that the need for corrective action may be assessed and, where necessary, taken.

3.4 The Condition Monitored Maintenance Programme

3.4.1 A maintenance programme which provides for the application of Hard Time, On-Condition and Condition Monitoring is known as a Condition Monitored Maintenance Programme. A Programme has two basic functions. Firstly, by means of the statistical reliability element, to provide a summary of aircraft fleet reliability and thus reflect the effectiveness of the way in which maintenance is being done. Secondly, to provide significant and timely technical information by which improvement of reliability may be achieved through changes to the Programme or to the practices for implementing it.

3.4.2 A properly managed Programme will contribute not only to continuing airworthiness, but also to improvement of fleet reliability, to better long-term planning, and to reduced overall costs.

3.4.3 The fundamental factors of a successful Programme are the manner in which it is organised and the continuous monitoring of it by responsible personnel. Because of differences in the size and structure of the various airlines, the organisational side of any Programme is individual to each operator. Hence, it is necessary to detail the organisation and responsibilities in the Programme control documentation.

3.5 Programme Control Committee

3.5.1 Every Programme is required to have a controlling body (usually known as the Reliability Control Committee) which is responsible for the implementation, decision making and day-to-day running of the Programme. It is essential that the Reliability Control Committee should ensure that the Programme establishes not only close co-operation between all relevant departments and personnel within the Operator's own Organisation, but also liaison with other appropriate Organisations. Lines of communication are to be defined and fully understood by all concerned. The Programme objectives and a typical Organisation and Data Flow Chart are shown in Appendix A.

3.5.2 The Reliability Control Committee is responsible for, and will have full authority to take, the necessary actions to implement the objectives and processes defined in the Programme. It is normal for the Quality Manager or the Engineering Manager to head the Committee and to be responsible to the CAA for the operation of the Programme.

3.5.3 The formation of the Committee and the titles of members will vary between Operators. The structure and detailed terms of reference of the Committee and its individual members will be fully set out in the documentation for each Programme. The Committee will usually comprise the Quality or Engineering Manager, the Reliability Engineer or Co-ordinator, the Chief Development Engineer, and the Chief Production Engineer.

3.5.4 The Committee should meet frequently to review the progress of the Programme and to discuss and, where necessary, resolve current problems. The Committee should also ascertain that appropriate action is being taken, not only in respect of normal running of the Programme, but also in respect of corrective actions.

3.5.5 Formal review meetings are held with the CAA at agreed intervals to assess the effectiveness of the Programme. An additional function of the formal review meeting is to consider the policy of, and any proposed changes to, the Programme.

3.6 Data Collection

3.6.1 Data (or more realistically, collected information) will vary in type according to the needs of each Programme. For example, those parts of the Programme based on data in respect of systems and sub-systems will utilise inputs from reports by pilots, reports on engine unscheduled shut-downs and also, perhaps, reports on mechanical delays and cancellations. Those parts of the Programme based on data in respect of components will generally rely upon inputs from reports on component unscheduled removals and on workshop reports. Some of the larger Programmes embrace both 'systems' and 'component' based data inputs in the fullest of detail.

3.6.2 The principle behind the data collection process is that the information to be collected has to be adequate to ensure that any adverse defect rate, trend, or apparent reduction in failure resistance, is quickly identified for specialised attention. Some aircraft systems will function acceptably after specific component or sub-system failures; reports on such failures in such systems will, nevertheless, act as a source of data which may be used as the basis of action either to prevent the recurrence of such failures, or to control the failure rates.

3.6.3 Typical sources of data are reports on delays, in-flight defects, authorised operations with known defects (i.e. equipment inoperative at a level compatible with the Minimum Equipment List), flight incidents and accidents, air turn-backs; the findings of line, hangar and workshop investigations. Other typical sources include reports resulting from On-Condition tasks and in-flight monitoring (Airborne Integrated Data Systems); Service Bulletins; other Operators' experience, etc. The choice of a source of data, and the processes for data collection, sifting and presentation (either as individual events or as rates of occurrence) should be such as to permit adequate condition assessment to be made relative both to the individual event and to any trend.

3.6.4 **Pilot Reports**

(a) Pilot Reports, more usually known as "Pireps", are reports of occurrences and malfunctions entered in the aircraft Technical Log (see Leaflet **BL/1-8**) by the flight crew for each flight. Pireps are one of the most significant sources of information, since they are a result of operational monitoring by the crew and are thus a direct indication of aircraft reliability as experienced by the flight crew.

(b) It is usual for the Technical Log entries to be routed to the Reliability Section (or Engineer/Co-ordinator) at the end of each day, or at some other agreed interval, whereupon each entry is extracted and recorded as a count against the appropriate system. Pireps are thus monitored on a continuous basis, and at the end of the prescribed reporting period are calculated to a set base as a reliability statistic for comparison with the established Alert Levels (see paragraph 3.8) e.g. Pirep Rate per 1,000 hr, Number of Pireps per 100 departures, etc.

(c) Engine performance monitoring can also be covered by the Pirep process in a Programme. Flight crew monitoring of engine operating conditions is, in many Programmes, a source of data in the same way as reports on system malfunctions.

3.6.5 **Engine Unscheduled Shut-downs**

(a) These are flight crew reports of engine shut-downs and usually include details of the indications and symptoms prior to shut-down. When analysed, these reports provide an overall measure of propulsion system reliability, particularly when coupled with the investigations and records of engine unscheduled removals.

(b) As with Pireps, reports on engine unscheduled shut-downs are calculated to a set base and produced as a reliability statistic at the end of each reporting period. The causes of shut-downs are investigated on a continuing basis, and the findings are routed via the Reliability Section to the Power-plant Development Engineer.

3.6.6 **Aircraft Mechanical Delays and Cancellations**

(a) These are normally daily reports, made by the Operator's line maintenance staff, of delays and cancellations resulting from mechanical defects. Normally each report gives the cause of delay and clearly identifies the system or component in which the defect occurred. The details of any corrective action taken and the period of the delay are also included.

(b) The reports are monitored by the Reliability Section and are classified (usually in Air Transport Association of America, Specification 100 (ATA 100) Chapter sequence), recorded and passed to the appropriate engineering staffs for analysis. At prescribed periods, recorded delays and cancellations for each system are plotted, usually as events per 100 departures.

3.6.7 **Component Unscheduled Removals and Confirmed Failures.** At the end of the prescribed reporting period the unscheduled removals and/or confirmed failure rates for each component are calculated to a base of 1,000 hours flying, or, where relevant, to some other base related to component running hours, cycles, landings, etc.

NOTE: Reports on engine unscheduled removals, as with reports on engine performance monitoring, are also a source of data and are reported as part of the Programme.

(a) **Component Unscheduled Removals.** Every component unscheduled removal is reported to the section which monitors reliability (the 'Reliability Section') and will normally include the following information:

(i) Identification of component.

(ii) Precise reason for removal.

(iii) Aircraft registration and component location.

(iv) Date and airframe hours/running hours/landings, etc. at removal.

(v) Component hours since new/repair/overhaul/calibration.

Completed reports are routed daily to the Reliability Section for recording and for continuous monitoring for significant trends and arisings. Components exhibiting abnormal behaviour patterns are brought to the attention of the engineering staff responsible, so that detailed investigations may be made and corrective action may be taken.

(b) **Component Confirmed Failures**

(i) With the exception of self-evident cases, each unscheduled removal report is followed up by a workshop report in which the reported malfunction or defect is confirmed or denied. The report is routed to the Reliability Section. Workshop reports may be compiled from an Operator's own 'in-house' findings and/or from details supplied by component repair/overhaul contractors.

(ii) Where an unscheduled removal is justified the workshop reports will normally include details of the cause of the malfunction or defect, the corrective action taken and, where relevant, a list of replacement items. Many Programmes utilise the same type of report to highlight structural and general aircraft defects found during routine maintenance checks.

3.6.8 **Miscellaneous Reports.** Dependent upon the formation of individual Programmes, a variety of additional reports may be produced on a routine or non-routine basis. Such reports could range from formal minutes of reliability meetings to reports on the sample stripping of components, and also include special reports which

have been requested during the investigation of any item which has been highlighted by the Programme displays and reports.

3.7 **Statistical Reliability Measurement.** To assist in the assessment of reliability, Alert Levels are established for the Items which are to be controlled by the Programme. The most commonly used data and units of measurement (Pireps per 1,000 hours, Component Removals/Failures per 1,000 hours, Delays/Cancellations per 100 departures, etc.) have been mentioned in paragraph 3.6. Too much importance should not be placed upon the choice of units of measurement, provided that they are constant throughout the time the Programme runs and are appropriate to the type and frequency of the event. The choice of units of measurement will depend on the type of operation, the preference of the Operator and those required by the equipment manufacturer.

3.8 **Reliability Alert Levels**

3.8.1 A reliability alert level (or equivalent title, e.g. Performance Standard, Control Level, Reliability Index, Upper Limit) hereinafter referred to as an 'Alert Level', is purely an 'indicator' which when exceeded indicates that there has been an apparent deterioration in the normal behaviour pattern of the Item with which it is associated. When an Alert Level is exceeded the appropriate action has to be taken. It is important to realise that Alert Levels are not minimum acceptable airworthiness levels. When Alert Levels are based on a representative period of safe operation (during which failures may well have occurred) they may be considered as a form of protection against erosion of the design aims of the aircraft in terms of system function availability. In the case of a system designed to a multiple Redundancy philosophy it has been a common misunderstanding that, as Redundancy exists, an increase in failure rate can always be tolerated without corrective action being taken.

3.8.2 Alert Levels can range from 0·00 failure rate per 1,000 hours both for important components and, where failures in service have been extremely rare, to perhaps as many as 70 Pireps per 1,000 hours on a systems basis for ATA 100 Chapter 25—Equipment/Furnishings, or for 20 removals of passenger entertainment units in a like period.

3.8.3 **Establishing Alert Levels**

(a) Alert Levels should, where possible, be based on the number of events which have occurred during a representative period of safe operation of the aircraft fleet. They should be up-dated periodically to reflect operating experience, product improvement, changes in procedures, etc.

(b) When establishing Alert Levels based on operating experience, the normal period of operation taken is between two and three years dependent on fleet size and utilisation. The Alert Levels will usually be so calculated as to be appropriate to events recorded in one-monthly or three-monthly periods of operation. Large fleets will generate sufficient significant information much sooner than small fleets.

(c) Where there is insufficient operating experience, or when a programme for a new aircraft type is being established, the following approaches may be used.

(i) For a new aircraft type during the first two years of operation all malfunctions should be considered significant and should be investigated, and although Alert Levels may not be in use, Programme data will still be accumulated for future use.

(ii) For an established aircraft type with a new Operator, the experience of other Operators may be utilised until the new Operator has himself accumulated a sufficient period of his own experience. Alternatively, experience gained from operation of a similar aircraft model may be used.

(iii) A recent concept to be applied in setting Alert Levels for the latest aircraft aircraft designs, is to use computed values based on the degree of system and component in-service expected reliability assumed in the design of the aircraft. These computed values are normally quoted in terms of Mean Time Between Unscheduled Removal (MTBUR) or Mean Time Between Failure (MTBF) for both individual components and complete systems. Although these levels tend to be theoretical, they are, of course, based on a considerable amount of testing and environmental engineering and design analysis. Being purely initial predictions they should be replaced when sufficient in-service experience has been accumulated.

(d) There are several recognised methods of calculating Alert Levels, any one of which may be used provided that the method chosen is fully defined in the Operator's Programme documentation.

(e) Typical acceptable procedures for establishing Alert Levels are described briefly in paragraphs (i) to (iii), and some detailed examples of the methods of calculation are shown in Appendix B. It will be seen that the resultant Alert Levels can vary according to the method of calculation, but this need not necessarily be considered to be of significance.

(i) **Pilot Reports (Pireps).** For the following example calculations, a minimum of twelve-months' operating data has to be available, and the resultant Alert Level per 1,000 hours is:

Calculation 1. The three-monthly running average Pirep rate per 1,000 hours for each system (or sub-system), as in the Table of Example 1, is averaged over the sample operating period and is known as the Mean; the Mean is multiplied by 1·30 to produce the Level Alert for the given system. This is sometimes known as the '1·3 Mean' or '1·3$\bar{x}$' method.

Calculation 2. The Mean, as in Calculation 1, plus 3 Standard Deviations of the Mean (as illustrated in Appendix B—Example 1).

Calculation 3. The Mean, as in Calculation 1, plus the Standard Deviation of the 'Mean of the Means', plus 3 Standard Deviations of the Mean (as illustrated in Appendix B—Example 2).

(ii) **Component Unscheduled Removals.** For the following example calculations, a minimum period of seven quarters' (21 months') operating data has to be available, and the resultant Alert Level rate for the current quarter may be set in accordance with any one of the following:

Calculation 4. The Mean of the individual quarterly Component Unscheduled Removal rates for the period of seven quarters, plus 2 Standard Deviations of the Mean.

Calculation 5. The maximum acceptable number of 'Expected Component Unscheduled Removals' in a given quarter, as calculated using a statistical process in association with the Poisson Distribution of Cumulative Probabilities (as illustrated in Appendix B—Example 3).

Calculation 6. The Number of 'predicted Component Unscheduled Removals (or failures)' in a given quarter, as determined by the Weibull or other suitable statistical method.

(iii) **Component Confirmed Failures.** The period of operating experience has to be as in (ii) and the resultant Alert Level rate for the current quarter is the 'corrected' Mean of the individual quarterly Component Confirmed Failure rates for the period, plus 1 Standard Deviation of the Mean (as illustrated in Appendix B—Example 4).

3.9 **Re-calculation of Alert Levels**

(a) Both the method used for establishing an Alert Level, and the associated qualifying period, apply also when the level is re-calculated to reflect current operating experience. However, if, during the periods between re-calculation of Alert Levels, a significant change in the reliability of an Item is experienced which may be related to the introduction of a known action (e.g. modification, changes in maintenance or operating procedures) then the Alert Level applicable to the Item would be re-assessed and revised on the data subsequent to the change.

(b) All changes in Alert Levels are normally required to be approved by the CAA and the procedures, periods and conditions for re-calculation are required to be defined in each Programme.

3.10 **Programme Information Displays and Reports**

3.10.1 **General.** As soon as possible after the end of each defined reporting period of a Programme, the Operator is required to produce graphical and/or tabular displays. These displays have to reflect the fleet operating experience for the period under review. The compilation and production of these displays from the day-to-day records has to be such that the essential information for each Item is an accordance with the requirements of the Programme.

3.10.2 The main purpose of displaying the information is to provide the Operator and the CAA with an indication of aircraft fleet reliability in such a manner that the necessity for corrective actions may be assessed. The format, frequency of preparation and the distribution of displays and reports are fully detailed in the Programme documentation. Typical data displays are described in paragraphs 3.10.3 to 3.10.9 and some examples are illustrated in Appendix C.

3.10.3 **Fleet Reliability Summary.** This display (see Appendix C, Figure C1), which is related to all aircraft of the same type in the fleet, is usually produced in tabular form, and should contain the following minimum information for the defined reporting period:

(a) Number of aircraft in fleet.
(b) Number of aircraft in service.
(c) Number of operating days (less checks).
(d) Total number of flying hours.
(e) Average daily utilisation per aircraft.
(f) Average flight duration.
(g) Total number of landings.
(h) Total number of delays/cancellations.
(j) Technical Incidents.

3.10.4 **Aircraft Mechanical Delays/Cancellations.** The purpose of this type of display is to indicate the aircraft systems which have caused delay to or cancellation of flights as a result of mechanical malfunctions. It is normal for each display to show the delays/cancellations as a total for all systems (to represent fleet overall reliability, as in Appendix C, Figure C2) as well as separately for the individual systems. The displays for the separate systems will usually show the delay/cancellation rate for the defined reporting period, the three-monthly moving average rate and, where appropriate, the Alert Level, and will present the information for a minimum period of 12 months.

3.10.5 **Engine Unscheduled Shut-downs.** This display (see Appendix C, Figure C3) is the prime indication of engine in-service reliability and also, to a large degree, of total power-plant reliability. Because of the high level of reliability of engines and the consequently relatively low numbers of unscheduled shut-downs per fleet, both the actual number of shut-downs and the shut-down rate per 1,000 hours for the defined reporting period as a three monthly running average, shown as a graphical display, will provide useful information in addition to that of Appendix C, Figure C3. To be of most use, where dealing with small numbers of unscheduled shut-downs, it is usual to present both types of information in such a way as to show the trend over a two-to-three-year period.

3.10.6 **Engine Unscheduled Removals.** This display is the supporting primary indication of engine reliability and is usually presented in a similar manner to unscheduled shut-downs. Many Operators show scheduled and unscheduled engine removals and unscheduled shut-downs on the same display; this is purely a matter of preference (see Appendix C, Figure C3).

3.10.7 **Pilot Reports (Pireps).** Pireps are presented by system or sub-system (normally identified in accordance with the classifications in ATA 100) in graphical and/or tabular form as a count, or rate, per 1,000 flight hours or 100 departures for the defined reporting period, for comparison with the Alert Level (see Appendix C, Figure C5). Occasionally some Programmes include a Pirep presentation of Fleet Pilot Reports (see Appendix C, Figure C4). This presentation shows the total number of Pireps for all systems and sub-systems and thus gives an overall picture of the total Pireps for the fleet of one aircraft type.

3.10.8 **Component Unscheduled Removals and Confirmed Failures**

(a) There are various methods of displaying component information (both graphically and tabular). The display may be on the basis of each individual component which has been prematurely removed (see Appendix C, Figure C6), or on the basis of the total number of affected components per system (see Appendix C, Figure C7). Experience has shown that a tabular presentation of unscheduled removals and confirmed failures on an individual component basis, preferably giving both numbers and rates per 1,000 hours, of the defined reporting period is the most useful.

(b) The format of any display of component information should be such that:

(i) Both unscheduled removals and confirmed failure rates may be compared with the Alert Levels so as to identify when the Levels are likely to be exceeded.

(ii) Current and past periods of operation may be compared.

3.10.9 **Workshop Reports.** A summary of the results of defect investigations, based on the Workshop Reports (see Appendix C, Figure C8) is normally produced by component type for assessment by the Reliability Committee.

3.11 **Problem Identification.** Having collected the information, and having presented it in a timely manner it should now be possible to identify any problems and to assess the necessity for corrective actions. The information, having been sifted and categorised (normally in ATA 100 Chapter order) as individual events and/or rates of occurrence, can be analysed using engineering and/or statistical methods. The analysis can be made at various stages in the handling of the data to differing degrees. Initially, reports on flight defects, delay causes, engine unscheduled shut-downs, workshop and hangar findings, other operators' experience, etc., should be analysed individually to see if any immediate action is desirable. This initial individual analysis will highlight any need for immediate short term actions, e.g. the preparation of Mandatory Occurrence Reports, safety reports, fleet campaigns, with the long term corrective actions following after the later, collective, stages of analysis.

3.12 **Corrective Action**

3.12.1 The effectiveness of corrective action will normally be monitored by the very process which revealed the need for it—the Condition Monitoring process.

3.12.2 Corrective actions taken to improve the reliability of systems and components, and ultimately that of the fleet, will vary considerably and may typically include one or more of the following:

(a) Changes in operational procedures or improvements in fault-finding techniques.

(b) Changes to the scope and frequency of maintenance processes which may involve Servicing and inspection, system Tests or Checks, Overhaul, Partial Overhaul or bench testing or the introduction or variation of time limits, etc.

(c) Modification action.

(d) Non-routine inspections or adjustment.

(e) Change of materials, fuels and lubricants.

(f) Use of different repair agencies.

(g) Use of different sources of spares.

(h) Variations of storage conditions.

(j) Improvements in standards of staff training and technical literature.

(k) Amendments to the policy/procedures of the Programme.

3.13 **Threshold Sampling**

3.13.1 Threshold sampling is the process whereby a maintenance limitation prescribed in the Maintenance Schedule (e.g. Hard Time) is varied in the light of experience gained from any source (e.g. scheduled and unscheduled maintenance, unscheduled removals). The prescribed maintenance limitation is the 'threshold upper limit', and, dependent upon the experience gained, can be either substantiated or varied. Maintenance activities (e.g. time for removal, extent of restoration) are normally related to actual experience of the Item in service (known as 'the experience age band'). When it is considered that the prescribed maintenance activity may be varied, threshold sampling may be used as a means of establishing confidence in the proposal. If when the threshold upper limit is reached, the condition of the Item is such that a variation is justified, then a new threshold upper limit may be set.

3.13.2 In setting the number of samples and any other qualifying conditions, both engineering assessment of the design and service experience are taken into account. Evidence derived from other activities (e.g. unscheduled removals or removals scheduled for other purposes) will supplement scheduled sampling and the removal itself may, if representative, be substituted for a scheduled sampling removal.

3.13.3 When the optimum period for a particular workshop activity has been determined, threshold sampling will be discontinued and a Hard Time limitation for workshop activity (e.g. Overhaul) will be prescribed.

3 13.4 A typical example of the use of threshold sampling is the control of the 'release for service' periods of certain gas-turbine engines, where some of the units on the engines are subject to individual Hard Time limitations (e.g. turbine disc lives, refurbishing intervals). These individual limitations are, in most cases, established and varied by the process described in paragraphs 3.13.1 to 3.13.3. The outcome is that the engine release period for installation in the aircraft is then fixed by the expiration of the lowest unit Hard Time limitation.

3.14 Quality Management

3.14.1 With the major issues of airworthiness and the economical allocation of vast sums of money being involved, it is essential that Quality Control should be applied as an overall control of the Maintenance Programme. Each Programme will describe the managerial responsibilities and procedures for continuous monitoring of the Programme at progressive and fixed periods. Reviews, to assess the effectiveness of the Programme, will also be prescribed.

3.14.2 There are various methods, both engineering and statistical, by which the effectiveness of the Programme may be evaluated, and these include:

(a) An assessment of the Programme Document (see paragraph 4) and any subsequent amendment (e.g. with a view to possible extra activities).

(b) Surveillance of the Programme activities by the Quality Management Departments

(c) Review by the Programme Control Committee to confirm that corrective action taken are correctly related to the performance trends and to the reports produced.

NOTE: Generally there would be two levels of committee activity, functional and managerial; the functional activity covering the practicality of corrective actions, and the managerial activity covering the overall Quality management of the Programme.

(d) Assessment of reports on incidents and accidents, as these could be potential criticisms of the effectiveness of the Programme.

3.15 **Review of the Programme.** It is normal for each Operator to review the effectiveness of his Programme, in conjunction with the CAA, at annual intervals. At this review consideration will be given to any proposed major changes in the Programme structure and policy so as to obtain the optimum benefits from the operation of the Programme.

4 THE PROGRAMME DOCUMENT

4.1 **Approval.** Approval of the Programme (as identified by the 'Document') will depend on the results of an assessment as to whether or not the stated objectives can be achieved. The approval of the Document then becomes a recognition of the potential ability of the Organisation to achieve the stated objectives of the Programme.

NOTE: The Quality Department of the Organisation, together with the CAA, monitors both the performance of the Programme in practice as well as its continuing effectiveness in achieving the stated objectives.

4.2 **Essential Qualities of the Programme.** Condition Monitored Maintenance Programmes can vary from the very simple to the very complex, and thus it is impractical to describe their content in detail. However, the Document has to be such that the considerations in (a) to (j) are adequately covered.

(a) It generates a precise, specific and logical Quality assessment by the Operator of the ability of the Organisation to achieve the stated objectives.

(b) It enables the CAA initially to accept, and, with subsequent continued monitoring, to have confidence in, the ability of the Organisation to such an extent that the CAA can renew Certificates of Airworthiness, approve changes to the maintenance schedules, etc., in accordance with evidence showing that the objectives of the Programme are being achieved.

(c) It ensures that the Operator provides himself with Quality management of his Organisation.

(d) It provides the Operator with a basis for the discharge of his moral and legal obligations in respect of the operation of aircraft.

(e) It enables the CAA (as the Airworthiness Authority) to discharge its duties and legal obligations in respect of the maintenance aspects of airworthiness, and, where applicable, to delegate certain tasks to the Operator.

(f) The manner of presentation has to be acceptable to the CAA.

(g) With (a) to (f) in mind, it states the objectives of the Programme as precisely as is possible, e.g. "maintenance of designated components by reliability management in place of routine overhaul", "Condition Monitoring as a primary maintenance process".

(h) The depth of description of the details of the Programme is such that:

(i) The details can be understood by a technically qualified person.

(ii) Those factors which require formal CAA acceptance of any changes are clearly indicated.

(iii) All significant non-self-evident terms are defined.

(j) In respect of individuals or departments within the Organisation:

(i) the responsibility for the management of the Document, and

(ii) the procedures for revision of the Document, are clearly stated.

4.3 **Compliance with BCAR**

(a) The Document is required to contain at least the information prescribed in BCAR, Section A, Chapter **A6-4**.

(b) The Document may either be physically contained within the Approved Maintenance Schedule, or be identified in the Approved Maintenance Schedule by reference and issue number, in such a manner that the Approved Maintenance Schedule could be deemed to contain it by specific statement and cross-reference.

4.4 **Assessment of Programme Document.** The following questions (not necessarily definitive) may assist in making a preliminary assessment of the adequacy of the Programme Document:

(a) Is the Document to be physically contained within the Approved Maintenance Schedule? If it is to be a separate document, is it satisfactorily linked with, and identified within the Approved Maintenance Schedule?

(b) Are the objectives of the Programme clearly defined? e.g. 'Maintenance of designated Items by reliability management in place of routine overhaul', 'Confidence assessment of overhaul periods', 'Condition monitoring as a primary maintenance process', 'Airworthiness/economic Quality management of maintenance'.

(c) Does the Approved Maintenance Schedule clearly state to which Items the Programme is applicable?

(d) Is there a glossary of terms associated with the Programme?

(e) What types of data are to be collected? How? By whom? When? How is this information to be sifted, grouped, transmitted and displayed?

(f) What reports/displays are provided? By whom? To whom? When? How soon following data collection? How are delays in publishing controlled?

(g) How is all information and data analysed and interpreted to identify aircraft actual and potential condition? By whom? When?

(h) Is there provision within the Organisation for implementation of corrective actions and is this identified within the Document? How are implementation time periods, effects and time for effect manifestation provided for?

(j) Is there a requirement that the Approved Maintenance Schedule be amended, and is the method of doing so included in the Programme, e.g. variation of time limitations, additional checks?

(k) Is there a requirement that Maintenance Manuals be amended and is the method of doing so included in the Programme, e.g. maintenance practices, tools and equipment, materials?

(l) Is there a requirement that the Operations Manual/Crew Manual be amended, and is the method of doing so included in the Programme, e.g. crew drills, check lists, defect reporting?

(m) What provision is made for corrective action follow-up and for checks on compliance with original intention, e.g. those which are not working out in practice, spares provisioning, timetables for the incorporation of modifications?

(n) Who is responsible for the management of the Document?

(o) Is there a diagram of the relationship between the departments and groups concerned with the Programme and does it show the flow of Condition Monitoring data, its handling and the prescribed reaction to it?

(p) Are all of the departments involved in the Programme included and are there any responsibilities not allocated?

(q) What Quality management processes are contained within the Programme in respect of:

(i) Responsibility for the Document itself and the procedure for its amendment?

(ii) Monitoring of the performance of the Programme by statistical reliability and other methods?

(iii) Committee consideration of Programme implementation and monitoring of performance?

(iv) Consideration of reports on incidents and accidents and other events which can effect airworthiness?

(v) Programme management and discipline?

5 DEFINED TERMS AND ABBREVIATIONS

5.1 **Introduction.** Those terms and abbreviations in the text which have a specific meaning are defined in this paragraph 5.

5.2 **Terms and Abbreviations**

5.2.1 **Analysis.** The MSG Logic Analysis.

5.2.2 **ATA 100.** Air Transport Association of America, Specification 100.

5.2.3 **Check.** An examination to determine the functional capability or physical integrity of an item.

5.2.4 **Condition Monitoring.** A primary maintenance process under which data on the whole population of specified items in service is analysed to indicate whether some allocation of technical resources is required. Not a preventive maintenance process, condition monitored maintenance allows failures to occur, and relies upon analysis of operating experience information to indicate the need for appropriate action.

NOTE: Failure modes of condition monitored items do not have a direct adverse effect on operating safety.

5.2.5 **Document.** The Condition Monitored Maintenance Programme document.

5.2.6 **Failure Mode.** The way in which the failure of an item occurs.

5.2.7 **Hard Time Limit.** A maximum interval for performing maintenance tasks. This interval can apply to Overhaul of an Item, and also to removal following the expiration of life of an Item.

5.2.8 **Hidden Function.** An Item is considered to have a "hidden function" if either of the following is applicable:

(a) The Item has a function which is normally active whenever the system is in use, but there is no indication to the flight crew when that function ceases.

(b) The Item has a function which is normally inactive, but there is no prior indication to the flight crew that the function will not be available when required.

5.2.9 **Item.** Any level of hardware assembly (i.e. part, sub-system, system, accessory, component, unit, material, portion of structure, etc.).

5.2.10 **Maintenance Significant Items.** Maintenance items that are judged to be relatively the most important from a safety, reliability or economic stand-point.

5.2.11 **Minimum Equipment List.** An approved list of items which may be inoperative for flight under specified conditions.

5.2.12 **On-Condition/On-Condition Maintenance.** A primary maintenance process having repetitive inspections or tests to determine the condition of units, systems, or portions of structure with regard to continued serviceability (corrective action is taken when required by item condition).

5.2.13 **Overhaul.** The restoration of an item in accordance with the instructions defined in the relevant manual.

5.2.14 **Partial Overhaul.** The overhaul of a sub-assembly of an item with a time controlled overhaul to permit the longer-lifed item to achieve its authorised overhaul life.

5.2.15 **Pireps.** Pilot Reports.

5.2.16 **Programme.** Condition Monitored Maintenance Programme.

5.2.17 **Quality.** The totality of features and characteristics of a product or service that bear on its ability to satisfy a given need.

5.2.18 **Quality Control.** A system of programming and co-ordinating the efforts of the various groups in an organisation to maintain or improve quality, at an economical level which allows for customer satisfaction.

5.2.19 **Quality Surveillance.** Supervision by the customer, his representative, or an independent organisation of a contractor's quality control organisation and methods.

5.2.20 **Redundancy.** The existence of more than one means of accomplishing a given function. Each means of accomplishing the function need not necessarily be identical.

5.2.21 **Redundancy, Active.** That redundancy wherein all redundant items are operating simultaneously rather than being activated when needed.

5.2.22 **Redundancy, Standby.** That redundancy wherein the alternative means of performing the function is inoperative until needed and is activated upon failure of the primary means of performing the function.

5.2.23 **Replace.** The action whereby an item is removed and another item is installed in its place for any reason.

5.2.24 **Scheduled Maintenance.** That maintenance performed at defined intervals to retain an item in a serviceable condition by systematic inspection, detection, replacement of wearout items, adjustment, calibration, cleaning, etc. Also known as "Preventative Maintenance" and "Routine Maintenance".

5.2.25 **Servicing.** The replenishment of consumables needed to keep an item or aircraft in operating condition.

5.2.26 **Test.** An examination of an item in order to ensure that the item meets specified requirements.

APPENDIX A

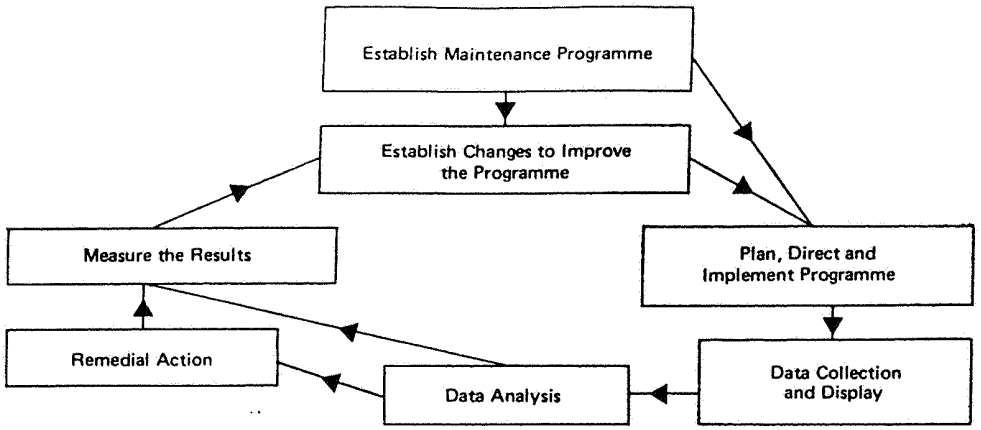

Figure A1 PROGRAMME OBJECTIVES

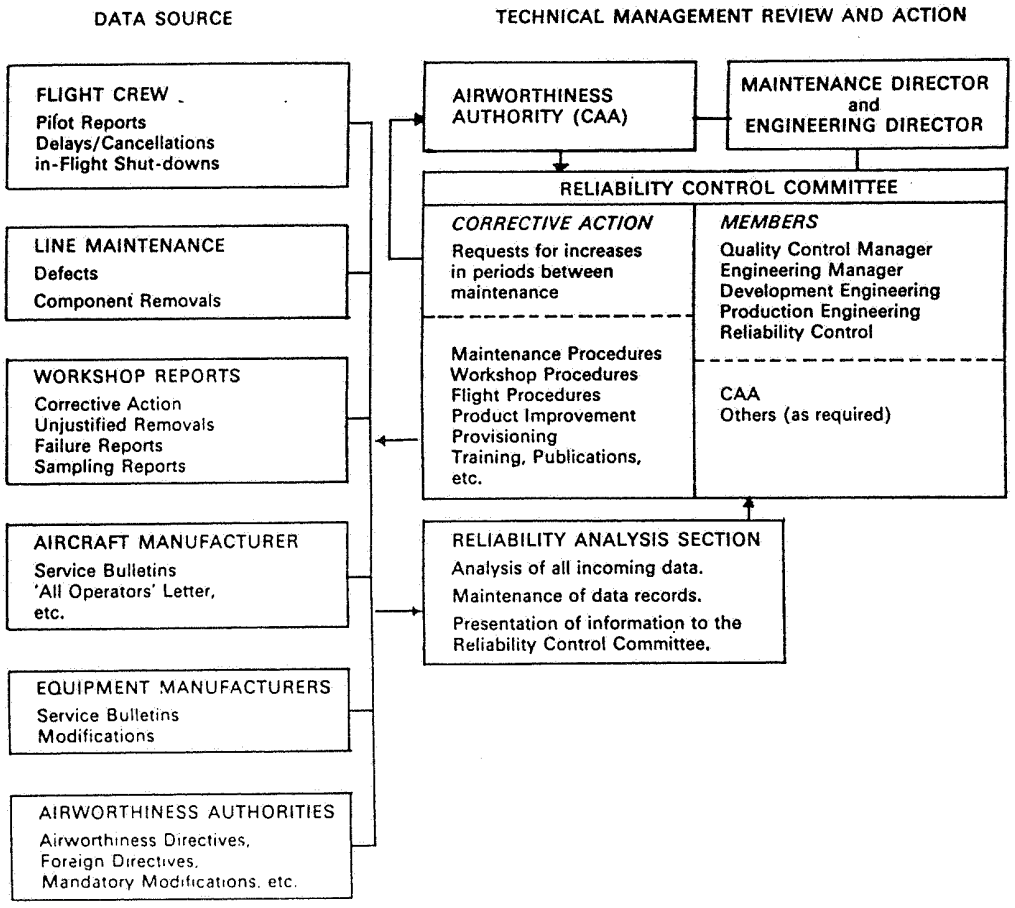

Figure A2 TYPICAL ORGANISATION AND DATA FLOW CHART

APPENDIX B—ALERT LEVEL CALCULATIONS

Example 1—Pilot Reports (Pireps) by Aircraft System per 1,000 Flight Hours

Method: Alert Level per 1,000 flight hours = Mean of the 3 monthly Running Average 'Pirep' Rates per 1,000 flight hours (for past 12 months) plus 3 Standard Deviations.

System: Aircraft Fuel System (ATA 100, Chapter 28)

Month	Pireps (monthly)	Pireps (3 months cumulative totals)	Flight Hours (monthly)	Flight Hours (3 months cumulative totals)	Pirep Rate per 1,000 hr (3 months running average) (x)
Nov	42	—	2,400	—	—
Dec	31	—	2,320	—	—
Jan	58	131	2,350	7,070	18
Feb	46	135	2,300	6,970	19
Mar	58	162	2,560	7,210	22
Apr	26	130	2,600	7,460	17
May	42	126	2,750	7,910	16
Jun	65	133	3,100	8,450	16
Jul	78	185	2,880	8,730	21
Aug	74	217	2,700	8,680	25
Sep	58	210	3,000	8,580	24
Oct	54	186	2,650	8,350	22
Nov	35	147	2,610	8,260	18
Dec	46	135	2,330	7,590	18

N(months)=12

Σ=Totals

(x)	(x−$\bar{x}$)	(x−$\bar{x}$)²
18	−2	4
19	−1	1
22	2	4
17	−3	9
16	−4	16
16	−4	16
21	1	1
25	5	25
24	4	16
22	2	4
18	−2	4
18	−2	4
Σx = 236	Σ(x−$\bar{x}$)² =	104

$$\text{MEAN}(\bar{x}) = \frac{\Sigma x}{N} = \frac{236}{12} = 19{\cdot}67 \text{ (rounded to 20)}$$

$$\text{STANDARD DEVIATION (SD)} = \sqrt{\frac{\Sigma(x-\bar{x})^2}{N}} = \sqrt{\frac{104}{12}} = \sqrt{8{\cdot}67} = 2{\cdot}94$$

3 SD = 8·82 (rounded to 9)

ALERT LEVEL = Mean + 3 SD = 20 + 9 = 29

Example 2 – Pilot Reports (Pireps) by Aircraft System per 1,000 Flight Hours

Method: Alert Level per 1,000 flight hours = The Mean (as in Example 1), plus the Standard Deviation of the 'Mean of the Means', plus 3 Standard Deviations of the Mean.

Data as in Example 1

System: Aircraft Fuel System (ATA 100, Chapter 28)

Pirep Rate per 1,000 hr— 3 months running Av. (x)	Mean of x (X)	Difference of X from $\overline{X}$ (D)	(D^2)
18	18·5	1·3	1·69
19	20·5	0·7	0·49
22	19·5	0·3	0·09
17	16·5	3·3	10·69
16	16·0	3·8	14·44
16	18·5	1·3	1·69
21	23·0	3·2	10·24
25	24·5	4·7	22·09
24	23·0	3·2	10·24
22	20·0	0·2	0·04
18	18·0	1·7	2·89
18			
	218·0=ΣX	23·7=ΣD	74·79= Σ(D^2)

N (months) now = 11 and thus $\overline{X}$ (the mean of the means) will = $\frac{\Sigma X}{N} = \frac{218}{11} = \underline{19{\cdot}8}$

Σ = Totals

STANDARD DEVIATION OF MEAN OF MEANS

$$= \sqrt{\frac{\Sigma(D^2)}{N} - \left(\frac{\Sigma D}{N}\right)^2} = \sqrt{\frac{74{\cdot}79}{11} - \left(\frac{23{\cdot}7}{11}\right)^2}$$

$$= \sqrt{6{\cdot}80 - 4{\cdot}64} = \underline{1{\cdot}47}$$

Therefore ALERT LEVEL = MEAN ($\bar{x}$) + STANDARD DEVIATION OF MEAN OF MEANS ($\overline{X}$) + 3 SD

= 19·67 (as in Example 1) + 1·47 + 8·82 (as in Example 1)

= 29·96 (rounded to 30)

Example 3—**Component Unscheduled Removals by Individual Components in a Three-Monthly Period**

Method: Alert Level = 95% cumulative probability of the Poisson Distribution based on past 21 months experience* to provide an Alert Level for use as a three-monthly period of comparison.

(a) **Component: Auto-pilot Pitch Amplifier**

number of components per aircraft,	$n = 1$
number of unscheduled removals in past 21 months,	$N = 62$
fleet utilisation hours in past 21 months,	$H = 36840$
number of component running hours in past 21 months,	$T = (n \times H) = 36840$
fleet utilisation hours in current 3 months,	$h = 5895$
number of component running hours in current 3 months,	$t = (n \times h) = 5895$
number of unscheduled removals in current 3 months,	$x = 12$

Mean unscheduled removal rate, $\lambda = \frac{N}{T} = 0{\cdot}00168$

Expected number of unscheduled removals in current 3 months

$= \lambda t$
$= 0{\cdot}00168 \times 5895$
$= 9{\cdot}9$ (rounded to 10)

Referring to Figure B1 by entering the graph at $\lambda t = 10$ the intersection with 0·95 (95% probability) gives the maximum acceptable number of unscheduled component removals (A value) for the 3 month period as 15.

By comparing the current value of $x = 12$ one can see that an 'alert' situation does not exist for this component.

(b) **Component: Temperature Control Valve**

$n = 3$, $N = 31$, $H = 36840$, $T = 3 \times 36840 = 110520$, $h = 5895$, $t = 3 \times 5895 = 17685$, $x = 9$

$\lambda = \frac{31}{110520} = 0{\cdot}00028$, $\lambda t = 0{\cdot}00028 \times 17685 = 5{\cdot}01$ (rounded to 5)

from graph, acceptable A value = 8. Current value of $x = 9$, therefore Alert Level is exceeded.

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*For large fleets the past twelve months experience may be used with a one-monthly period of comparison.

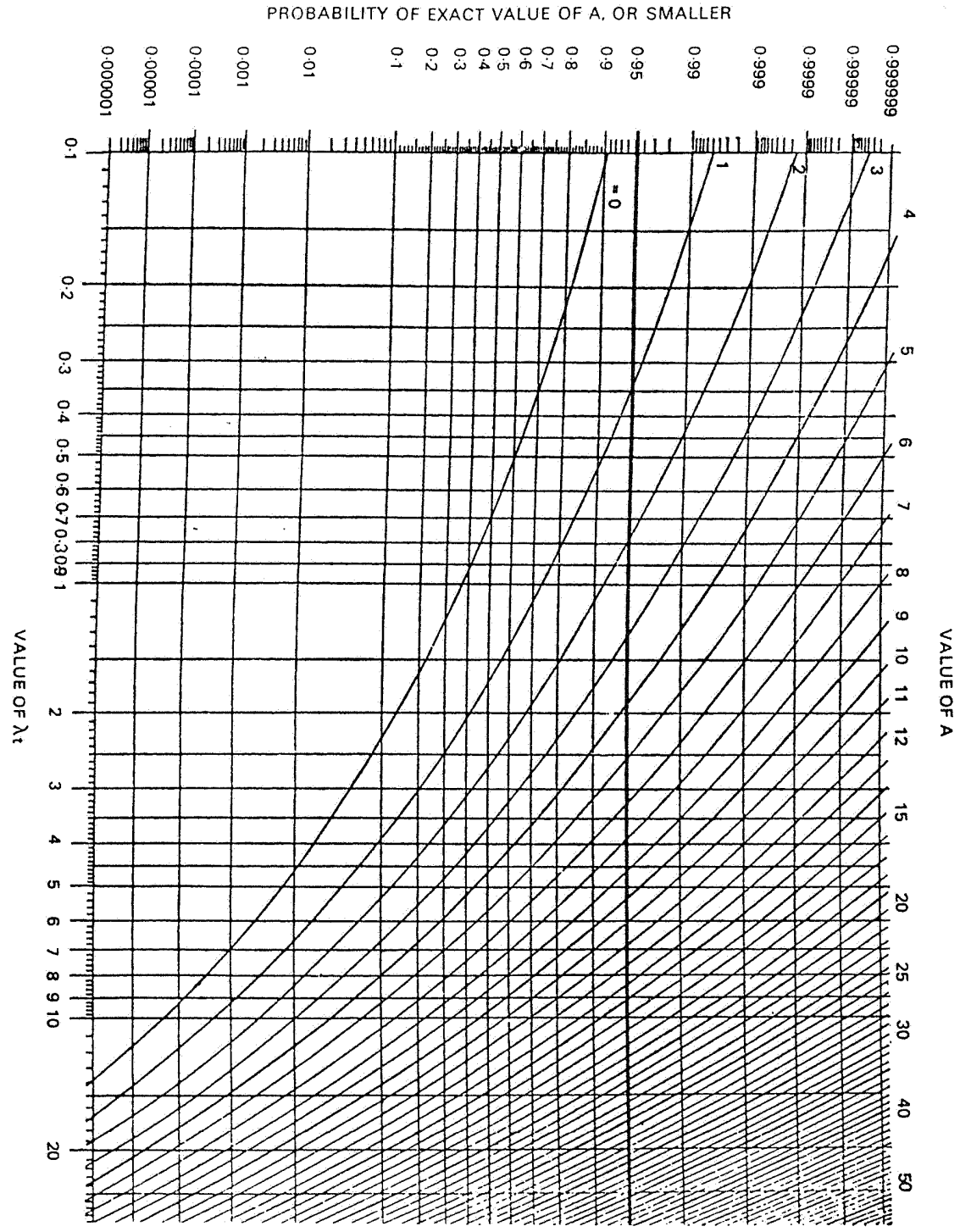


Figure B1 POISSON CUMULATIVE PROBABILITIES

Example 4—Component Confirmed Failures by Individual Components in a Three-Monthly Period

Method: Alert Level = The 'corrected' Mean of the Quarterly Failure Rates plus 1 Standard Deviation of this mean, based on past seven calendar quarters of confirmed component failure rates per 1,000 hours to provide an Alert Level for use as a quarterly period of comparison.

Component: Main Generator

Calendar Quarter	Quarterly Failure Rate (u)	Corrected Rate (C)	(C^2)
2/74	0·21	0·63*	0·397
3/74	3·38	0·38	0·144
4/74	0·42	0·42	0·176
1/75	0·84	0·84	0·706
2/75	0·59	0·59	0·348
3/75	0·57	0·57	0·325
4/75	1·38	0·63*	0·397
	4·39Σ(u)	4·06Σ(C)	2·493Σ(C^2)

N (months) = 7
Σ = Totals

$$\text{QUARTERLY MEAN FAILURE RATE} = \frac{\Sigma(u)}{N} = \frac{4{\cdot}39}{7} = 0{\cdot}63$$

$$\text{CORRECTED MEAN FAILURE RATE } \bar{C} = \frac{\Sigma C}{N} = \frac{4{\cdot}06}{7} = \underline{0{\cdot}58}$$

$$\text{STANDARD DEVIATION, SD} = \sqrt{\frac{\Sigma(C^2) - \frac{(\Sigma C)^2}{N}}{N-1}}$$

$$= \sqrt{\frac{2{\cdot}493 - \frac{(4{\cdot}06)^2}{7}}{6}}$$

$$= \sqrt{\frac{2{\cdot}493 - 2{\cdot}355}{6}}$$

$$= \underline{0{\cdot}15}$$

$$\text{ALERT LEVEL} = \bar{C} + 1\,\text{SD} = 0{\cdot}58 + 0{\cdot}15 = \underline{0{\cdot}73}$$

*Where an individual Quarterly Failure Rate falls outside plus or minus 50% of the uncorrected Quarterly Mean Failure Rate (0·63 in this case), then this Mean is to be used as a Corrected Rate in place of the uncorrected Quarterly Failure Rate.

APPENDIX C—TYPICAL DATA DISPLAYS

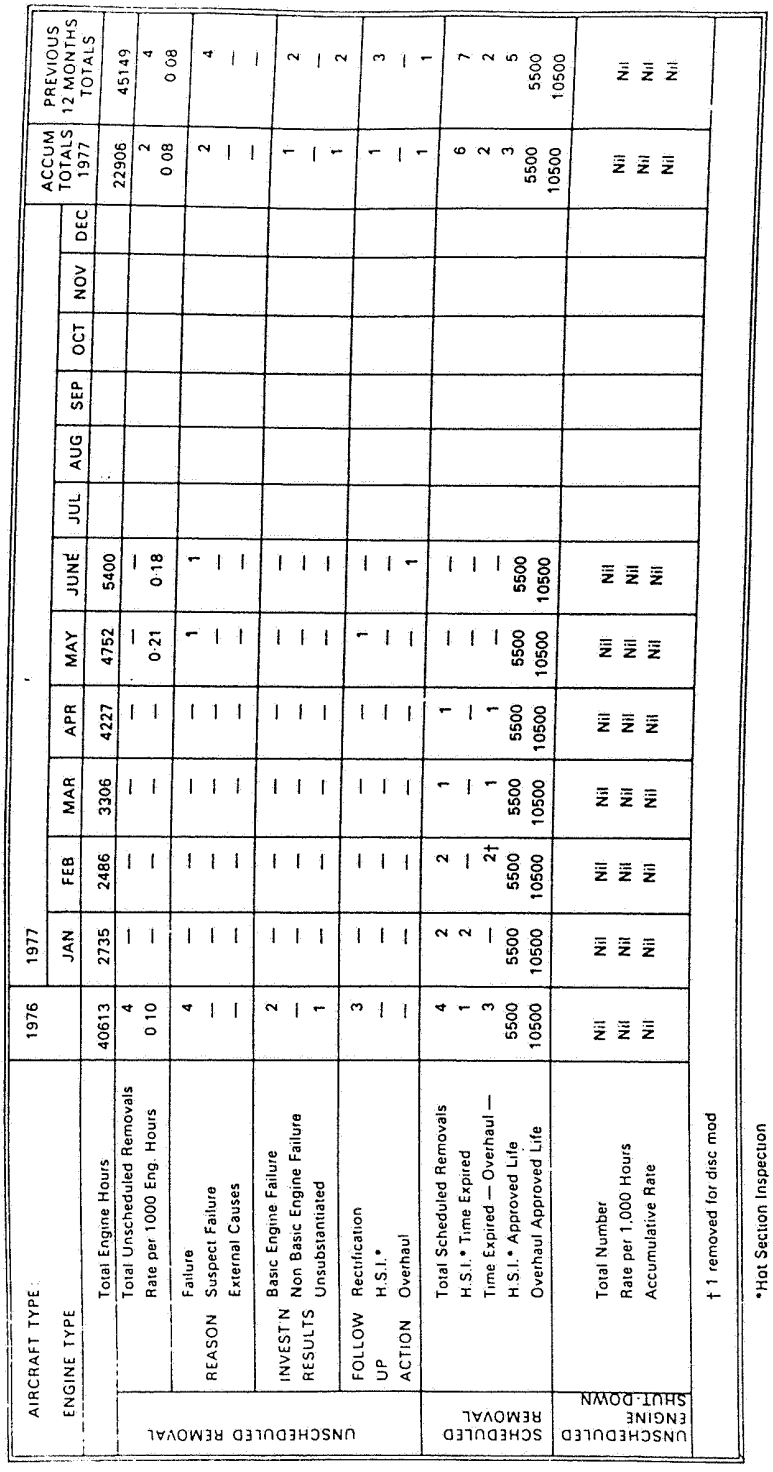
AIRCRAFT TYPE:		1976	1977											ACCUM TOTALS
			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
NUMBER OF AIRCRAFT IN FLEET		6	6	6	6	6	6	6							6
NUMBER OF AIRCRAFT IN SERVICE		6	5	5	5	6	6	6							6
NO OF OPERATING DAYS (less checks)		1634	153	144	152	160	186	174							969
FLYING HOURS (hr:min)	Revenue —	13400:39	907	801	1068	1374	1571	1798							7519
	Non Revenue —	39:38	5	4	8	3	0:5	1							21:5
	Training —	97:24	—	24	25	32	12:5	1							94:5
	TOTAL	13537:41	912	828	1102	1409	1584	1800							7635
DAILY UTILIZATION (average/aircraft) (hr:min)		8:17	5:57	5:45	7:15	8:48	8:31	10:20							7:52
AVERAGE FLIGHT DURATION (hr:min)		2:32	2:52	2:43	2:42	2:36	2:23	2:23							2:36
LANDINGS	Revenue —	5277	316	293	395	528	658	752							2942
	Non Revenue —	45	5	2	2	5	2	3							19
	Training —	275	3	55	100	104	34	4							300
	TOTAL	5597	324	360	497	637	694	759							3261
TECHNICAL DELAYS — REVENUE (more than 15 mins)	Number of Movements —	5277	316	293	395	528	658	762							2942
	Number of delays —	134	8	6	9	17	13	16							69
	Total Delay Time —	310:32	38	13	9	27	22	33							142
	Average Delay (%)	2·64	2·63	2·04	2·27	3·22	1·97	2·12							2 35
TECHNICAL CANCELLATIONS		—	—	—	—	—	—	—							—
TECHNICAL INCIDENTS	Interrupted Flights —	7	Nil	Nil	Nil	Nil	Nil	Nil							Nil
	Engine Shut Downs —	Nil	Nil	Nil	Nil	Nil	Nil	Nil							Nil
	Fire Warnings —	Nil	Nil	Nil	Nil	Nil	Nil	Nil							Nil
	Fire Warnings (false) —	Nil	Nil	Nil	Nil	Nil	Nil	Nil							Nil
	Fuel Dumpings —	Nil	Nil	Nil	Nil	Nil	Nil	Nil							Nil
REMARKS															

Figure C1 FLEET RELIABILITY SUMMARY

AIRCRAFT TYPE:	1976	1977											
%	Average	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
5													
4		3·80											
3			2·65										
2	1·73			1·98									
1													

BASE	NO. OF MOVEMENTS			NO. OF TECH. DELAYS			TOTAL DELAY TIME (hr:min)			AVERAGE DELAY (%)			REMARKS
	JAN	FEB	MAR	JAN	FEB	MAR	JAN	FEB	MAR	JAN	FEB	MAR	
Gatwick	171	159	174	9	4	4*	9:50	7:20	11:35	5·26	2·34	2·29	*1 Overseas
Manchester	44	46	17	1	3	0	0:30	2:51	—	2·27	6·52	—	
Berlin	127	59	111	3	—	2	13:19	—	4:21	2·36	—	1·80	
TOTALS	342	264	302	13	7	6	23:39	10:11	15:56	3·80	2·65	1·98	

Figure C2 AIRCRAFT MECHANICAL DELAYS/CANCELLATIONS



AIRCRAFT TYPE:		1976	1977												ACCUM TOTALS 1977	PREVIOUS 12 MONTHS TOTALS
ENGINE TYPE			JAN	FEB	MAR	APR	MAY	JUNE	JUL	AUG	SEP	OCT	NOV	DEC		
	Total Engine Hours	40613	2735	2486	3306	4227	4752	5400							22906	45149
UNSCHEDULED REMOVAL	Total Unscheduled Removals	4	—	—	—	—	—	—							2	4
	Rate per 1000 Eng. Hours	0 10	—	—	—	—	0·21	0·18							0 08	0 08
	REASON Failure	4	—	—	—	—	1	1							2	4
	REASON Suspect Failure	—	—	—	—	—	—	—							—	—
	REASON External Causes	—	—	—	—	—	—	—							—	—
	INVEST N Basic Engine Failure	2	—	—	—	—	—	—							1	2
	RESULTS Non Basic Engine Failure	—	—	—	—	—	—	—							—	—
	RESULTS Unsubstantiated	1	—	—	—	—	—	—							1	2
	FOLLOW Rectification	3	—	—	—	—	1	—							1	3
	UP H.S.I.*	—	—	—	—	—	—	—							—	—
	ACTION Overhaul	—	—	—	—	—	—	1							1	1
SCHEDULED REMOVAL	Total Scheduled Removals	4	2	2	1	1	—	—							6	7
	H.S.I.* Time Expired	1	2	—	—	—	—	—							2	2
	Time Expired — Overhaul —	3	—	2†	1	1	—	—							3	5
	H.S.I.* Approved Life	5500	5500	5500	5500	5500	5500	5500							5500	5500
	Overhaul Approved Life	10500	10500	10500	10500	10500	10500	10500							10500	10500
UNSCHEDULED ENGINE SHUT-DOWN	Total Number	Nil	Nil	Nil	Nil	Nil	Nil	Nil							Nil	Nil
	Rate per 1,000 Hours	Nil	Nil	Nil	Nil	Nil	Nil	Nil							Nil	Nil
	Accumulative Rate	Nil	Nil	Nil	Nil	Nil	Nil	Nil							Nil	Nil

† 1 removed for disc mod

*Hot Section Inspection

Figure C3 ENGINE REMOVALS AND UNSCHEDULED SHUT-DOWNS

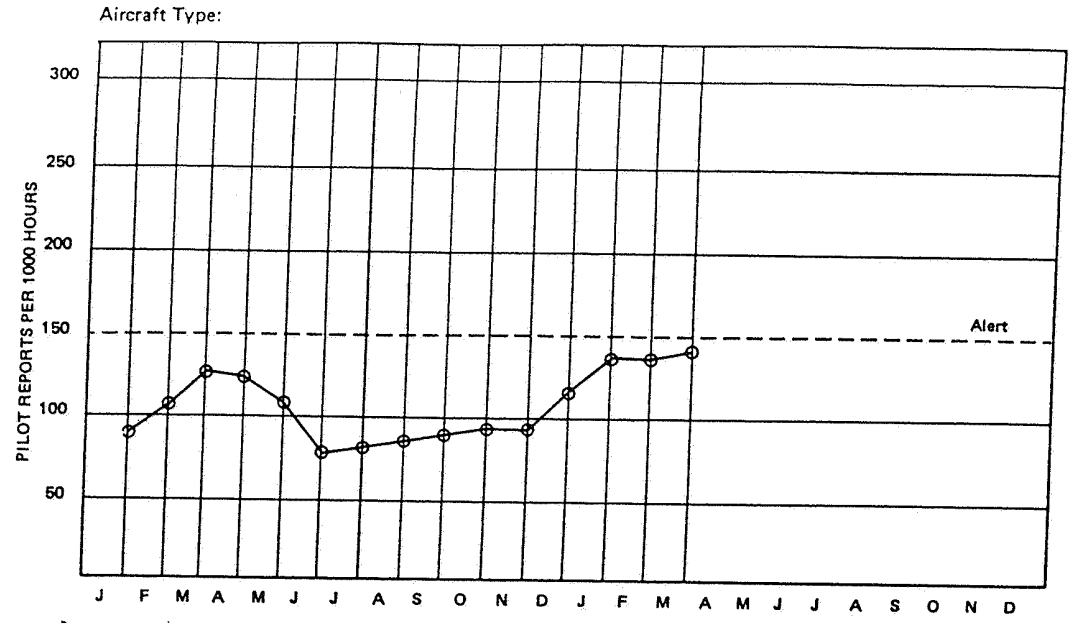


Figure C4 FLEET PILOT REPORTS

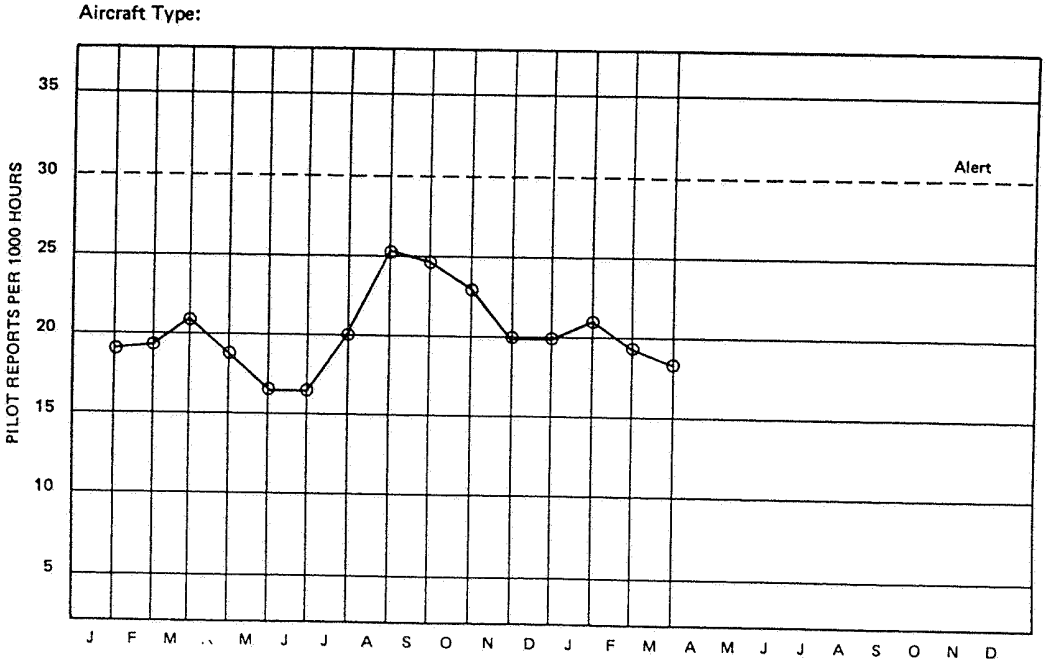


Figure C5 PILOT REPORTS ATA 21—AIR CONDITIONING SYSTEM

AIRCRAFT TYPE.
Air Conditioning/Pressurization (ATA 100 Chapter 21)

SCH. REF	PART NUMBER	NO PER A/O	COMPONENT	FLYING HOURS 13408 PERIOD 1975 A*	B*	C*	2495 1st Qtr 1976 A*	B*	C*		A*	B*	C*	ALERT LEVEL	ACCUMULATIVE COMPONENT CONFIRMED FAILURES SINCE 1.1.74 A*	B*	†MTBF
30/4	131046-1	1	Manual Pressure Controller	—	—	—	2	0·80	—	X*				—	2	0 06	16[illegible]
30/5	102518-3-1	1	Auto Cabin Pressure Controller	4	0·29		—	—	—					0 60	9	0 28	355[illegible]
30/6	10-3280-5-1	2	Cabin Outflow Valve	9	0·26	2	1	—	1					0 50	9	0 14	711[illegible]
51/1	178040-2-1	4	Heat Exchanger	3	0 05		—	—	—					0 15	5	0 04	25601
51/2	204050-10-1	2	Air Cycle Machine	2	0 07		—	—	—					0 30	4	0 06	16000
51/5	129150-2-1	2	35° Thermostat Pack Anti-icing	1	0 03		—	—	—					0·30	1	0 015	64020
51/6	321674-3-1	2	Valve — Pack Shut-Off	5	0 11	2	—	—	—					0 30	5	0 08	12800
52/2	541248-2-1	2	Actuator — Ram Air	1	0 03		—	—	—					0·30	2	0 03	32000
52/7	207562-1	2	Fan Cooling Pack	2	0 07		—	—	—					0 30	8	0 13	8000
58/3	18801-5	1	Detector — Air Flow Sensor	—	—	—	—	—	—					—	1	0 03	3200[illegible]
61/1	321402-1-1	2	Valve/Actuator — Control Mix	—	—	—	1	0·20	—					0·30	5	0 08	12809
61/2	548376-5	1	Controller — Air Temp	1	0 07		—	—	—					0 60	2	0 06	16000
61/9	67321-10-190	3	Temperature Sensor	—	—	—	—	—	—					0·15	1	0 01	96061
62/2	163BL501	2	Indicator — Pack Temp.	—	—	—	—	—	—					0·30	1	0 015	64020
30/7	132322-2-1	1	Fan Venturi	2	0·14		1	0·40	—					0·60	4	0·13	8000
61/3	548392-1-1	2	Cabin Temp. Sensor	1	0 03		—	—	—					0·30	1	0 015	64020
42/1	32-2684-002	1	Cargo Outflow Valve	—	—	—	1	0·40	—					0·60	2	0 06	16000
58/8	123266-2-1/ 123544.1.1	2	Hot Air Check Valve	—	—	—	1	0·20	—					0·30	1	0 015	6402
23/1	500702-4620	2	Gasper Fan	—	—	—	—	—	—					0·60	4	0 06	16000
51/3	178050-2-1	2	Water Separator	—	—	—	—	—	—					0·60	2	0 03	32001
51/4	10-60506-4	2	35° Valve Pack Anti-icing Cont	—	—	—	—	—	—					0·30	—	—	—

*A — No. of unscheduled removals
*C — Non-confirmed Defects
*B — Failure Rate per 1,000 hours
*X — Failure Rate above Alert Level

†MTBF — Mean Time Between Failures

Figure C6 COMPONENT UNSCHEDULED REMOVALS AND CONFIRMED FAILURES

AIRCRAFT TYPE:		JANUARY 1971			1970 FIRST HALF			1970 LAST HALF		
ATA 100 CHAPTER	ALERT LEVEL	UR*	URR†	FR‡	UR*	URR†	FR‡	UR*	URR†	FR‡
21 — Air Conditioning	·35	2	·53	·33	14	·34	·32	15	·36	·31
22 — Auto-pilot	·80	4	1·33	·33	16	·98	·29	19	·98	·32
23 — Communications	·92	2	·67	·48	10	·57	·48	8	·56	37
24 — Electric Power	·20	2	·08	·02	8	·06	·02	9	·07	·03
27 — Flight Controls	·30	1	·20	·09	7	·12	·10	6	·10	·08
28 — Fuel	·23	0	·00	·00	2	·64	·30	1	·09	·06
29 — Hydraulic	·38	1	·42	·40	2	·26	·18	4	·46	22
30 — Ice & Rain Protection	·15	0	·00	·00	2	·14	·08	2	·14	08
31 — Instruments	·65	4	·63	·34	20	·61	·31	16	·57	20
32 — Landing Gear	·33	1	·04	·02	7	·05	·03	9	·09	04
34 — Navigation	·73	3	·66	·21	20	·69	·24	24	·71	·29
35 — Oxygen	·30	2	·66	·32	11	·65	·31	9	·64	·30
36 — Pneumatic	·20	0	·00	·00	2	·01	·01	4	·02	·02
38 — Water/Waste	·24	1	·09	·06	6	·16	·15	7	·17	·16
49 — APU	·48	1	·33	·32	7	·34	·34	4	·26	·29
73 — Engine Fuel & Control	·39	0	·00	·02	4	·10	·06	2	·06	·05
75 — Engine Air	·28	1	·17	·16	5	·16	·14	3	·12	·12
77 — Engine Indicating	·30	5	·42	·17	26	·46	·18	22	·44	·17
79 — Oil	·22	0	·00	·00	2	·04	·02	3	·06	·04
80 — Starting	·50	1	·17	·11	6	·18	·12	3	·09	·10

*UR — Unscheduled Removals
†URR — Unscheduled Removal Rate
‡FR — Confirmed Failure Rate (3 months cum. av.)

Figure C7 COMPONENT UNSCHEDULED REMOVALS AND CONFIRMED FAILURES

AIRCRAFT TYPE:

SERIAL NO.	AIRCRAFT & POSITION	HRS RUN	DEFECT	RESULTS OF WORKSHOP INVESTIGATION & ACTION TAKEN
1170108	G—	848 TSR* 9375 TSN†	Losing altitude in turns	Test wing levelling not operative; recalibrated.
0290329	G—	11110 TSR 16771 TSN	Rolls rapidly to right when heading hold engaged.	Various internal outputs were drifting and distorted. Replaced tacho, roll CT and resolver, servo amp and valve amplifier.
0920575	G—	99 TSR 4014 TSN	Altitude hold sloppy in turns.	Roll computer out of calibration limits. Mod D to Lateral Path Coupler embodied to improve interface between Sxxxx equipment and Cxxxx receiver.
1280330	G—	36 TSR 7664 TSN	A/C will not maintain heading — ends up with 30° bank.	No fault found but extensive investigation revealed A3A1A2B output 1·5V — should be zero volts.

CONCLUSIONS	REMEDIAL ACTION
All channel assemblies are now sent to Manufacturer for investigation. Histories are reviewed and any channels which have previous 'NFF'‡ findings are being extensively tested to isolate components which may be drifting out of tolerance. This should result in improved MTBF§, but will probably show more confirmed failures for a while.	

REPORT REF. NO.	PART NO.	ITEM
22-10-14/20 Sheet 1 of 1	1Q75-22-2H	2588812-901	Roll channel assy.

* Time since repaired ‡ 'No fault found'

† Time since new § Mean Time Between Failures

Figure C8 WORKSHOP REPORT

BL/2-1

Issue 4.

December, 1979.

BASIC

IDENTIFICATION MARKING

IDENTIFICATION MARKING PROCESSES FOR AIRCRAFT PARTS

1 INTRODUCTION This Leaflet gives general guidance on processes for marking aircraft parts for the purpose of identification. The information given is not applicable to individual items of equipment such as radio equipment and instruments, and does not override any instructions given on drawings. Guidance on the determination and position of identification marking of metallic materials is given in Leaflet **BL/2-2** and **BL/2-4.**

1.1 Schedule 1 of the Air Navigation Order prescribes that all registered aircraft must have a metal nameplate fixed near the main entrance of the aircraft, upon which is stamped or engraved the nationality and registration marks and the registered owner's name and address. This metal plate must be fireproof so that there will be means of identification in the event of the aircraft being destroyed by fire. The CAA recommends the use of a stainless steel plate.

1.2 To obviate the need for the revision of this Leaflet when new issues of specifications referred to are published, the prefix or suffix indicating the issue number of the specification has been omitted.

2 IDENTIFICATION MARKINGS Identification markings consist basically of the drawing number, drawing issue number and the inspection acceptance stamp. With some parts further information is necessary, e.g. a batch number, a process symbol or reference number, a non-destructive examination symbol, an assembly drawing number, a serial number, and a date. Organisations manufacturing parts should, therefore, have 'in-house' procedures defining the form and method of part numbering and identification of details, parts and components, so as to ensure that suitable methods, related to the nature, material and form of the part, are consistently applied.

2.1 The procedures should recognise that the application of the inspection stamp alongside the part and issue number (being an indication that the part complies with the full requirements of the drawing) has to be permanently legible.

2.2 There may also be a need to mark other information on components progressively during manufacture, so as to indicate satisfactory completion of processes or tests. These markings, however, may not need to be legible on the item in the fully finished condition.

2.3 Company procedures should define the form of marking for inspection clearance of part-finished items in such a way as to ensure that such parts are not confused with finished parts.

2.4 Where the marking process indents the surface of the part, parts for non-destructive examination (such as radiography) should be marked prior to examination. Unless a marking medium which will not damage the coating is used, parts should also be marked prior to the application of a protective treatment, e.g. anodising.

3 MARKING MEDIUM The medium selected for marking a part must be based on such factors as the purpose of the part, material from which it is made, and critical features such as fatigue and notch sensitivity. Marking should not be made on highly stressed areas, near edges or on sensitive surfaces which may be needed to seal or conjoin. Processes available include etching, engraving, embossing, grit blasting, stamping, transfers, adhesive labels, marking inks and the attachment of metal plates, clips or tags. The following sub-paragraphs give information on the application of the various processes.

3.1 **Acid Etching.** Acid etching is widely used for marking hardened or delicate steel parts. The etching fluid can be applied to the surface of the part either by a glass pen fitted with a rubber suction cap or by a rubber stamp. Alternatively, the surface of the part may be coated in a suitable substance, e.g. beeswax, and the required markings cut into this, followed by the application of etching fluid.

3.1.1 Before etching operations are commenced, the surface of the metal should be thoroughly cleaned. Immediately after marking is completed, the part should be thoroughly washed, dried, and protected from corrosion. Pens and stamps used for applying the etching fluid should not be used for any other purpose.

NOTE: During the etching process care should be taken to avoid contact of the etching fluid with hands or clothing.

3.1.2 A fluid often specified for etching steels, other than corrosion-resisting or nitrided steels, is of the following composition:—

Selenious Acid	20 g
Copper Sulphate (Crystals)	10 g
Concentrated Nitric Acid	15 ml
Water	80 ml

NOTE: When the fluid is applied to polished surfaces, a black deposit of iron-copper selenite will result.

3.1.3 A fluid often specified for etching corrosion-resisting and nitrided steels is of the following composition:—

Selenious Acid	20 g
Copper Sulphate (Crystals)	10 g
Nitric Acid	25 ml
Hydrochloric Acid	60 ml
Water	10 ml

(a) The grey surface film of nitrided steels should be removed in the area to be etched. With corrosion-resisting steels, the fumes from the fluid tend to stain the surface of the parts; therefore, only the area to be marked should be free from storage grease or other protective compound.

(b) The method of application of the fluid and the general precautions to be taken are similar to those given in paragraph 3.1.1. In addition, special care must be taken not to inhale the etching fluid fumes.

3.2 **Electro-Chemical Etching.** This method of marking is generally restricted to corrosion-resisting steels, aluminium and its alloys, titanium and its alloys, and copper based alloys. This process utilises an electrolytic principle by which marks can be produced on metal surfaces by using an electrolyte in conjunction with a low-voltage, low-amperage current. The process is simple and easy to apply, and in general has no significant effect on the strength of metal parts. The colour and depth of marking is directly related to the voltage and amperage, to the direction and duration of current flow, and also to the electrolytic etching fluid used.

3.2.1 Equipment and materials should be checked at regular intervals by etching a test piece and measuring the depth of etched area. This depth should not normally exceed 0·001 in. In addition, different types of metals require different etching fluids, and the instructions given on the relevant drawing or process specifications should, therefore, be closely followed. This method of marking cannot be used on non-conductive surfaces.

3.2.2 The equipment required for the electro-chemical process consists of an electrical power-unit with a means of output adjustment (which usually embodies an automatic timing control), stencils and electrical contact devices. The marks to be etched can be produced either on paper stencils by typing, by stylus or metal stamp, or on plastics stencils by an electronic process. Paper stencils have an approximate life of 200 impressions, whereas plastics stencils have an approximate life of 2,000 impressions. Electrical contact devices may take the form of a bench pad, marking control head, roller, and various types of pen. Basically all contact devices provide a means of connecting the part to be marked to the power-unit via the stencil and a felt or cotton-wool pad impregnated with the electrolytic etching fluid. The circuit is completed by the attachment of a ground pin which may be embodied in the electrical contact device, but which, in any case, must make a good electrical contact and be attached adjacent to the area which is to be marked.

3.2.3 Before etching is commenced the surface of the part should be thoroughly cleaned. The stencils should be in good condition and should be discarded if they are distorted or ruptured, or the mark becomes obliterated. Pad holders should be used with the same electrolytic etching fluid throughout their life, and the pad should always be kept moist with electrolyte and renewed when discoloured. All electrical plugs, sockets and ground pins should be checked to ensure good electrical contact. After etching, the part must be neutralised by the application of a suitable agent and thoroughly washed and dried.

3.3 **Electrical Etching.** Etching by the use of an electrical pencil, employing either the constant contact or intermittent principle of operation, causes the material to be severely overheated locally and should not be used for the marking of aircraft parts.

3.4 **Vibro-Etch Engraving.** This is a vibro-percussive engraving process, also known as 'Vibro-Peen' or 'Vibro-Percussion'. Generally, an electrically or pneumatically operated hand tool with a vibrating stylus is used. Marking by this process avoids the local overheating caused by electrical etching and if lightly applied has little effect on the fatigue life of the part. Nevertheless, careful supervision is necessary to control the depth of marking, and to have strict control of tip radius. Its use in a highly stressed area is not recommended. Inspectors' personal identification letters and numbers should be encircled with a vibro-etched ring to distinguish them from part numbers, issue numbers or date codes.

3.5 **Machine Engraving.** In this process the identification marks are produced by a mechanically guided rotating cutter or grinder normally controlled via a pantograph. The mark dimensions are limited by the size of the cutter and the size of the pantograph used. This process is sometimes used for stressed parts of high-grade steels or high grade aluminium alloys. The depth of the marks is normally kept to the minimum compatible with clarity. The cutter or grinder used must be rounded, so that sharp corners or cuts are not produced on the part. This method is also used for engraving information or instructions on placards and name-plates.

3.6 **Embossing.** In this process, which is suitable for castings, forgings, and mouldings, the identification markings are inherent in the mould or die, and are, therefore, produced as part of the manufacturing process. The marks may either be raised or depressed but should not be located on an area of the part which is subject to subsequent machining.

3.6.1 The embossing process is also suitable for application to polytetrafluoroethylene (PTFE) and plastics materials after manufacture of parts. In this case the identification marks are produced by application of controlled heat and pressure via the medium of a die so as to transfer pigment from specially prepared coloured foils onto the prepared area of the part. Colours should be selected to contrast with the background colour of the part.

3.7 **Grit Blasting.** In this process, marks are produced by applying a controlled jet of abrasive material, in conjunction with rubber or plastics stencils, to specific areas. This process may be employed with advantage in certain circumstances, e.g. marking transparent plastics and hard anodised surfaces. The type and grade of abrasive material, air pressure, and period of application is normally specified on the drawing. The process is not suitable where contamination by the abrasive material can occur, e.g. parts containing ball, needle or roller bearings and hollow parts. The depth of marking produced by this process is slight and is, therefore, not suitable for parts to which a protective finish will subsequently be applied. This process is not normally permissible for magnesium alloy materials.

3.8 **Stamping.** In this process, steel stamps are used for marking and these can be applied either by mechanical means or by hand in accordance with the drawing instructions. There are various types of machine available for marking parts with steel stamps, and it is quite usual for a machine to be specified for this operation, as it can be pre-set to control the depth of the impression.

3.8.1 The indentations resulting from this form of marking can, unless carefully controlled, have a serious effect on the strength of parts, and may lead to a considerable reduction of resistance to fatigue. Normally steel stamps are not used on aluminium alloy sheet thinner than 20 swg or on high strength aluminium alloy parts, or parts made from steel with an ultimate tensile strength in excess of 850 MN/m^2 (55 $tonf/in^2$).

3.8.2 When steel stamps are used, they should not be larger than is necessary for clarity and a type size of 1·58 mm (0·0625 in) or 2·38 mm (0·09375 in) is usually found to be satisfactory. The symbol should not embody sharp points, and should be shaped to produce a depression of 'U' rather than 'V' form. The depth of the impression produced should be kept to the minimum, and, particularly when applied to parts fabricated from sheet material, the impression should not result in embossment of the reverse surface. Worn stamps should not be used, since the additional hammering necessary to obtain an impression may affect the characteristics of the material. During any stamping operation, the part should be adequately supported by a backing block which has a smooth surface.

3.9 **Transfers.** In this process, marks are produced by the application of a prepared wet transfer, bearing the required markings, on the surface of the part to be marked. When dry, the transfer backing is removed leaving a film of the marking which is finally coated with a protective varnish. It is essential that the area of the part to be marked is thoroughly cleaned before the application of the transfer. Transfer markings do not physically alter the surface of the part, and, therefore, are suitable for application after completion of protective treatment. In general, this method can only be regarded as semi-permanent, and its use is only recommended for the identification of assemblies.

3.10 **Adhesive Labels.** In this process, marks are produced by the application of a label consisting of a foil (backed with adhesive) on which the marks are impressed prior to its being attached to the part. Such labels are often used for the identification of highly stressed components, and, since the adhesive is unaffected by temperature and most fluids, they provide a permanent identification without any indentation of the part. Where difficulty is experienced in the adhesion of such labels or where metal labels without adhesive backing are used, the application of a suitable flexible adhesive is specified. The possibility of dissimilar metals in juxtaposition setting up corrosion should be borne in mind, and, in particular, aluminium or zinc labels should not be used on parts manufactured from nickel base alloys, unless they have been cadmium plated.

3.11 **Marking Inks.** Marking by means of a suitable ink applied by rubber stamps or stencil is often specified for marking timber, plastics, fabrics, or metal parts which can only be marked after the completion of a protective treatment. It is common practice, particularly with metal parts, to have the area to be marked first painted with a white primer on to which the marks are applied; the area then being protected with an environmentally suitable clear varnish. To avoid deterioration of some materials, as a result of chemical reaction from the ink, it is important that only the ink specified is used (for an example see paragraph 5.9).

3.12 **Metal Clips, Plates or Tags.** In general, marking of parts by the attachment of clips, plates or tags is used where the size, shape, finish or material of the part precludes the application of markings to the surface. Further information on metal clips, etc., and other special applications is given in paragraph 5.

4 POSITION OF MARKINGS The position of the markings, and the process to be employed, is usually indicated on the drawing. The location selected for application of markings should always be remote from bearing surfaces, edges, holes, bends, changes of section, narrow or highly stressed areas and surfaces which have been hardened for a specific purpose. Certain manufacturers standardise the marking medium to be used on various materials and issue this information to the workshops as an internal specification, usually by adding a code number on the drawing. Any mark signifying inspection approval should be applied adjacent to the identification markings.

4.1 All markings should, if possible, be grouped together, and positioned where they will not be obliterated or concealed by subsequent machining or assembly.

4.2 When sheet metal parts are heat-treated prior to manipulation, it is usual, where steel stamping is permitted, to apply a cipher to the parts so that the particular heat treatment batch can be identified subsequently. The position of the cipher should be carefully selected before heat treatment and manipulation. If after manipulation the cipher appeared on a bend this would usually lead to rejection of the part.

4.3 There are several reasons why the marking of some parts is unpractical, amongst these being size, hardness and fragility. Typical examples are hardened steel springs, bolts of less than 6·35 mm (0·25 in) diameter, nuts of less than 9·52 mm (0·375 in) diameter, split pins and taper pins. In such instances it is permissible to pack the parts in a suitable container, which should be sealed, and identification and inspection approval applied.

4.4 When individual parts are fabricated into assemblies, the appropriate assembly drawing number and drawing issue number should be applied, together with the inspection approval mark, in the manner, and position, indicated on the drawing.

4.5 Information on the application of serial numbers is given in paragraph 6.

5 SPECIAL APPLICATIONS Because of factors such as shape, material characteristics, etc., it is not always possible to mark all parts in the normal way, and in the following paragraphs guidance is given on the marking of such items.

5.1 **Bolts.** Part numbers and inspection stamps should be marked on the flat portion of the head; marking of the shank is not permissible. With cold-headed bolts, the inspection stamp may be omitted, provided the bolts bear the maker's identification symbol and are packed in sealed containers bearing evidence of inspection approval.

5.2 **Cable Assemblies.** It is recommended that swaged-end cable assemblies should be marked on the swaged shank of the end fittings by a rolling process, but if the necessary equipment is not available, the markings should be applied by a vibro-etching process.

5.2.1 If identification tags are fitted on swaged-end cables, they would have to comply with a specification such as British Standard SP51-52, and should be fitted as shown in Figure 1 or, when fitted to cable ends without locking wire holes, in accordance with the approved cable assembly drawings. Tags not covered by a specification, or tags fitted in a manner other than as given above, are unacceptable.

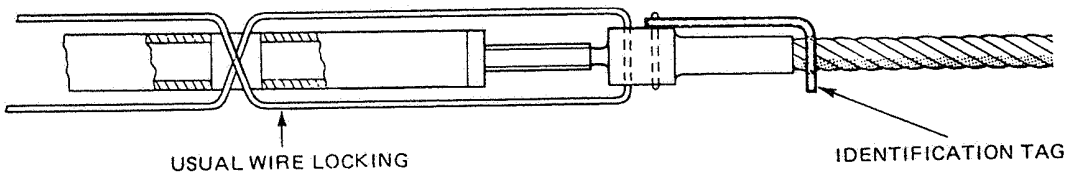


Figure 1 CABLE ASSEMBLY IDENTIFICATION

5.2.2 Identification tags should be attached to spliced cables as shown in Figure 2. Where cast or pulley type thimbles are used, the identification marks can be applied direct to these items.

NOTE: If after the installation of a cable in an aircraft there appears to be any likelihood of the tag subsequently coming loose or causing jamming, it should be removed and the particulars on the tag should be entered in the aircraft log book or maintenance record.

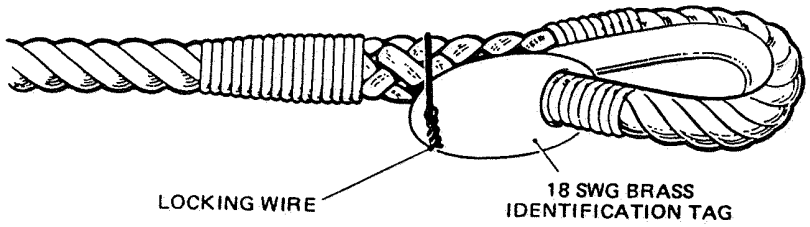


Figure 2 METHOD OF ATTACHING IDENTIFICATION TAG TO SPLICED CABLE

5.3 **Castings.** Castings should be marked, batched or tallied as soon as possible after removal from the mould, in a manner which will enable them to be correlated with the relevant mechanical tests and analytical records. The position of the marks should be in accordance with the relevant drawings, but if the position is not indicated on the drawing, thin sections liable to damage should be avoided and, if possible, the markings should be placed where they will not be removed by subsequent manufacturing processes.

5.3.1 In many instances raised panels are produced as part of a casting especially for the application of identification marks; in which case the casting should not be marked in any other position.

5.3.2 Small castings from the same batch and for which the size is inconsistent with the display of part marking with adequate clarity may be packed in bags or bundles, and the appropriate markings should be stamped on a metal label securely attached to each bag or bundle.

5.4 **Nuts.** Where identification marks are necessary, i.e. on nuts of 9·52 mm (0·375 in) diameter or more, they should always be applied to the hexagonal sides of the nuts, and in no circumstances to the mating surfaces, since this could result in the scoring of underlying metal when the nut is assembled.

5.5 **Pipes.** Pipes manufactured of material which may be soft soldered are usually marked by means of a brass plate bearing the appropriate data. The inspection stamp should be impressed on the plate just before it is assembled, but in instances where this procedure is unpractical, the stamp may be impressed in a blob of solder beside the plate. It is essential to ensure a complete soldered bond between the plate and the pipe, since flux residue may cause corrosion. (Information on soft soldering is given in Leaflet **BL/6-1**).

5.5.1 Where soldering is unpractical, pipes may be marked by electro-chemical etching, see paragraphs 3.2, or by a rubber stamp using a non-corrosive dye, or by a specially made flexible slip-on sleeve. In some instances an adhesive label is used, but wrap-round or tie-on metal identification tags should not be used.

NOTE: Cases have occurred where metal identification tags have worn a pipe to paper thinness and in the course of time, have produced a pin hole leak under the tag.

5.5.2 Information on the identification marking of aircraft pipe systems is given in British Standard M23.

5.6 **Plastics.** The method of marking plastics parts depends on the thickness, shape and material of the part to be marked. With the majority of plastics produced by a moulding process, the identification markings are included in the moulding, but in the following paragraphs consideration is given to the marking of plastics produced by other processes.

5.6.1 **Glass-fibre Reinforced Plastics Laminates**

(a) On equipment subject to stress, vibro-etching should not be used because it can break strands and create stress raisers. In such cases the component should be marked with either white paint and indian ink, or a rubber stamp on a white painted surface.

(b) In instances where the weave pattern of the reinforcing cloth stands slightly proud of the surface, a rubber stamp and marking ink may be used. Before applying the mark it is essential that the release agent should be removed from the surface of the sheet in the area where it is to be marked. White spirit will remove most release agents, which differ according to the type of material, but it will not remove all traces of silicone. For most purposes, it is recommended that the area to be marked should be lightly rubbed with fine abrasive cloth.

(c) For non-stressed parts, and if the laminate has a smooth surface, the use of a vibro-etching process is suitable. An ink or dye can be wiped over the etched surface so that the letters show more clearly.

5.6.2 **Thermo-plastics.** Thermo-plastics, such as cellulose derivatives and vinyl resins, are materials which can be made pliable by heat and which retain their original properties when cooled, it being possible to repeat the process any number of times without appreciable change in properties. All thermo-plastics, with the exception of certain forms of celluloid and vinyl acetates, can be marked satisfactorily with heated dies, but this method may not be suitable for tubular sections. However, the die temperatures vary with different materials, and the recommended temperature should be ascertained from the manufacturer.

5.6.3 **Thermo-setting Plastics.** Thermo-setting plastics are materials in which a chemical reaction takes place while they are being moulded under heat and pressure. The chemical and physical properties of the material are entirely changed and it is subsequently resistant to further applications of heat. The heated die process is not suitable for materials in this group, and for the majority of applications the vibro-etching method can be used, but where this may cause damage to the material, white paint and marking ink may be preferable.

5.6.4 **Transparent Plastics.** The marking of parts manufactured of transparent plastics materials should be avoided where possible. If the material is bonded permanently to a metal frame it is preferable to apply the marking to the metal portion. However, if it is necessary to apply identification markings to transparent plastics, these should be applied to the inner face of the panel by means of mild sandblasting and stencil. When it is necessary to mark a part temporarily, a label should be affixed by means of masking tape but labels should not be stuck directly to the material. When parts are annealed by the process prescribed in specification DTD 925, this should be indicated by marking the part in the manner described above, with the legend "DTD 925", followed by the date.

5.7 **Propellers**

5.7.1 In the case of wooden propellers, it is usual to apply steel identification stamps on the rounded portion of the boss, so positioned that the markings will not be obscured by the engine hub or the spinner. Inspection stamps are usually applied to indicate approval of the various stages of inspection, i.e. timber and cementing, inspection in the white, and final inspection.

5.7.2 In the case of metal propellers, identification marks may be applied by using a suitable acid etching process. It is essential, however, that careful control of this process be exercised to avoid weakening the metal or setting up stress raisers as a result of etching to an excessive depth.

5.8 **Radiators and Oil Coolers.** With the exception of components manufactured of light alloy, the identification marking should be stamped on a brass plate soft soldered to the casing adjacent to the inlet neck. Inspection approval is usually indicated by the application of a metal stamp in a blob of solder adjacent to the plate. (Information on soft soldering is given in **Leaflet BL/6-1**).

5.9 **Rescue Equipment.** Rescue equipment such as dinghies and life jackets should be marked with the manufacturer's identification symbol, the date of manufacture, the serial number and an inspection stamp. The marking medium used should have no deleterious effect on the fabrics to which they are applied. An ink containing phenol should not be used on nylon, and an ink containing copper should not be used on rubber fabric as it would cause considerable damage after ageing and exposure to the air.

5.9.1 A record should be maintained by the manufacturer by which the serial number of each component can be correlated with the roll numbers of the fabric from which it was made, and also with the batch number of such items as valves, CO_2 cylinders and webbing.

5.9.2 When rescue equipment components are repaired, inspection approval should be signified by the application of an inspection stamp and the date of that repair along with the part number for that component, on a record label attached to the component. Where overhauls or inspections are completed in accordance with the time/life requirements of an approved Maintenance Schedule, it is recommended that the date when the next inspection or overhaul is due is also entered on the record label.

5.10 **Tanks.** Tanks manufactured of light alloy material not provided with a metal data plate should be marked by coloured paint or ink on a white paint background. A rubber inspection stamp should be used, and, when the markings are complete, they should be protected by a coat of clear varnish.

5.11 **Timber.** All timber parts should be marked with a rubber stamp and ink and should be date stamped to enable the age of the part to be subsequently ascertained.

5.12 **Tubes and Tubular Structures.** Difficulty is sometimes experienced with marking steel tubes. A steel or brass plate applied in a manner similar to that described in paragraph 5.8 is sometimes used, but it should be noted that soldering H.T. steel tubes can adversely affect the fatigue resistance. In some instances a rubber stamping procedure is used. This consists of applying a rubber stamp, using a suitable ink, to a white paint background and then protecting the markings with a specified clear varnish. Adhesive labels are also often used.

5.12.1 In instances where the diameter of the tube is sufficiently large and at least one end is open, the markings may be applied around the circumference of the tube near one end, while the tube is supported internally by means of a suitable mandrel.

5.12.2 If the structure is to be painted, the identification markings should be temporarily masked until painting is complete.

6 SERIAL NUMBERS Company procedures should be raised to cover the allocation and control of serial numbers, so that traceability to assembly, test and overhaul records can be achieved. Additionally, it provides a reliable reference for general recording purposes.

6.1 Where possible, serial numbers should be prefixed by a combination of letters which enables the manufacturer to be identified, and in the majority of instances they should be identical to those used on the firm's inspection stamps. Where components are being produced by a sub-contractor, the serial numbers may be allotted either by the main contractor or the sub-contractor, but in no circumstances should the same combination of symbols and serial numbers be used by the main and sub-contractors for identical components.

6.2 Where possible, the serial number of the item, together with the drawing number and issue number of the drawing and the date of inspection, should be stamped on a plate similar to that illustrated in Figure 3. The plate should be manufactured of a material compatible with the component, and should be attached to the component using a jointing compound to prevent corrosion. Where a plate cannot be used, the data should be painted on the component and protected with a coat of clear varnish.

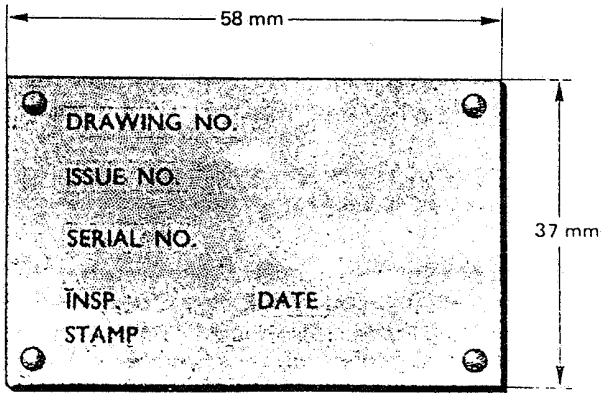


Figure 3 IDENTIFICATION PLATE

6.3 Wherever possible, the serial number should be so positioned that it can be seen when the component is installed in the aircraft or on the engine; on certain components, the provision of a window, or a rip-off patch, may be necessary to achieve this.

6.4 The markings on the plate should be legible and not obliterated by paint, etc. During overhaul the plate should be checked for security since, should the plate be lost, difficulty may be experienced in proving the identity of the component and hence its state of serviceability. The identification plates of condemned components should be destroyed.

6.5 The serial numbers of fabric covered components are often reproduced externally on the fabric by stencils. Such markings are not necessarily permanent due to the periodical renewal of fabric and dope. Care is necessary to ensure that the markings correspond at all times with those displayed on the permanent plate.

6.6 Additional serial numbers must not be added to components by repair or overhaul organisations. When an area of a component bearing a serial number is renewed, or where extensive repairs are carried out, a copy of the original identification plate should be fitted, on which the letter "R" should be placed after the serial number as a stroke number. The inspection stamp signifying approval of the repair and the date on which the repair was inspected should also be added.

7 MODIFICATIONS A record of modifications incorporated in a component should be listed on a modification record plate, so that the modification state of the component can be subsequently identified. Where possible, the plate should be positioned adjacent to the identification plate and should show the serial number and date of manufacture of the component with the modification numbers tabulated below. Where a plate cannot be used, the data should be painted on the component and protected with clear varnish.

BL/2-2

Issue 7

June, 1985

BASIC

IDENTIFICATION MARKING

STANDARD COLOUR SCHEMES FOR METALLIC MATERIALS

1 INTRODUCTION This Leaflet gives guidance on a standard colour scheme for the identification marking of metallic materials. Guidance on the marking of metallic materials during manufacture is given in Leaflet **BL/2-4**, entitled Identification Marking of Metallic Materials.

1.1 Since the identification markings detailed in Leaflet **BL/2-4** are not readily seen when the material is handled under production conditions, it is necessary to use an additional method of identification which indicates the specification and the condition of each piece of material. The most suitable method is to employ a standard colour scheme such as that indicated in the following paragraphs and in the Appendices, but an acceptable alternative is overall marking by a suitable printing process (paragraph 1.3). When not applied by the manufacturer, the colour coding should be applied before the material is placed in bonded store.

1.2 The colour scheme, as a means of ready identification, is additional to the identification requirements specified in the various specifications.

1.3 When overall marking is used as an alternative to colour code identification it should only be used if the surface condition is receptive to the printing and if such marking is durable under normal storage conditions. In order to permit the re-marking of material with the specification and condition after further heat treatment, the ink should be of a type which is obliterated by heat and does not etch the surface.

2 COLOUR CODES Colour codes for all British Standards and DTD metallic materials were, until 31 March 1981, allocated by the Ministry of Defence (MOD) and published in their Leaflet QTR 7/AQD (formerly QTR/AQD/D2). From that date the Ministry of Defence has been unable to allocate colour codes for non-aerospace specifications (e.g. BS General Engineering Series Specifications) and has confined the allocation of colour codes to BS Aerospace Specifications only. Leaflet QTR 7/AQD is retained in its existing form, but those parts dealing with non-aerospace specifications will progressively become out of date; users have been advised to make alternative arrangements for the identification of materials to non-aerospace specifications.

2.1 This Leaflet **BL/2-2** follows the procedures of MOD Leaflet QTR 7/AQD and only the aerospace specifications can be considered to be up to date. Whenever amendments to MOD Leaflet QTR 7/AQD are published, Appendix IV to this Leaflet **BL/2-2** will be re-issued in order to keep the aerospace specifications as current as possible.

2.2 Certain materials differing only in surface condition or intended usage which are of the same metallurgical condition and properties are given the same colour code, e.g.:–

(a) S82A, bars and billets for forging-softened; green, red, yellow.

(b) S82B, black bars for machining-softened; green, red, yellow.

(c) S82D, bright bars for machining-softened; green, red, yellow.

2.3 Materials with the same specification number but different conditions and properties have different colour codes, e.g.:–

(a) S154 A, bars and billets for forging-softened; blue, green, brown, green, blue.

(b) S154 B and D (black and bright) bars for machining-finally heat-treated; blue, green, yellow, green, blue.

2.4 It is sometimes necessary for material to be ordered to cancelled specifications, e.g. for repairs, and the colour coding for such material will be retained in this Leaflet for five years after cancellation of the specification.

2.5 When the specification reference of a material is changed, e.g. when a DTD Specification becomes a British Standard, the colour code will not be changed unless a significant difference is introduced by the new Specification.

2.6 This Leaflet lists colour codes for solid and cored cast stick to specifications BS 1400 and BS 1490 as used for the manufacture of bearings and bushings. These should not be confused with those listed in BS 1400 and BS 1490 for ingot supplies.

3 COLOURS The colours used for current specifications are black, blue, brown, green, red, white and yellow (and violet for light alloy rivet materials only).

3.1 Difficulties in identification may be caused by the colours fading, or being rendered indistinct or even obliterated during handling. In order that the markings may be as permanent as possible the use of paint complying with specification DEF 1052 is recommended. This paint is available lead-free, and should be ordered in the shades shown in Table 1.

TABLE 1

Colour	BS 381C	
	Shade No.	Description
Blue	104	Blue Azure
Brown	410	Light Brown
Green	221	Brilliant Green
Orange	557	Light Orange
Red	537	Signal Red
Yellow	355	Lemon Yellow

4 APPLICATION OF THE COLOUR SCHEME

4.1 **Bars and Tubes.** Each bar and tube should be painted, preferably at both ends, with the stipulated colour or colours in the following manner:–

(a) For one colour – 1 band 200 mm (8 in) wide.

(b) For two colours – 2 bands each 100 mm (4 in) wide.

(c) For three colours – 3 bands each 75 mm (3 in) wide.

(d) For four colours – 4 bands each 50 mm (2 in) wide.

(e) For five colours – 5 bands each 35 mm (1·5 in) wide.

4.2 **Sheets and Strips.** One of the following methods should be used:–

(a) A band or bands of the required colours should be painted on each sheet or strip diagonally across the corner bearing the identification stamp marks. The width of the band or bands should be in accordance with that given in paragraph 4.1 and the painting should commence 150 mm (6 in) from the corner, measured at right angles to the band. Sheets and strips less than 300 mm (12 in) wide should be painted at one end in a similar manner to bars.

(b) Each sheet or strip should be painted with a disc. For a single colour the disc should be 75 mm (3 in) in diameter, additional colours when required being applied in concentric rings 35 mm (1·5 in) wide.

(c) A method suitable for large scale production of sheets and flat strips is to stack the sheets and slide them endwise so that 35 mm (1·5 in) of each sheet is exposed. Bands of paint of the width specified in paragraph 4.1 should then be painted on the sheets in one operation, resulting in an identification mark on each sheet. The paint must be applied to that face and end of the sheets which bears the identification stamp marks.

4.3 **Wires and Rods.** The required colours should be painted in bands on the outside of each bundle and the outer turns of each coil. The band or bands should be at right angles to the wires and rods and should not be less than 75 mm (3 in) total width, e.g. one band 75 mm (3 in) wide or three bands 25 mm (1 in) wide. The paint marks should extend at least halfway round the wires or rods at the selected part of the coil.

4.4 **Protective Treatment.** Contracts normally require metallic materials for aeronautical purposes to be colour identified by the manufacturer; such material may be required to be protected from corrosion by the application of a lanolin resin protective to Specification DTD 663. This protective is red, and to avoid confusion, the colour identification markings should be applied first and, at the edge of the colour bands remote from the edge of the material, an additional band of black paint 12 mm (0·5 in) wide should be added. The protective may then be added up to the black band, leaving the colour code free of protective. When the protective treatment is applied by dipping, the protective should be cleaned from the colour code using white spirit or kerosene.

5 APPENDICES Colour codes for the various materials and specifications are listed as follows:-

(a) **Appendix I – British Standards**
Section I – Aluminium and Aluminium Alloys
Section II – Brass, Bronze and Copper Alloys
Section III – Nickel and Heat Resisting Alloys
Section IV – Titanium and Titanium Alloys
Section V – Solders
Section VI – Steels
Section VII – Welding – Filler Rods and Wires

(b) **Appendix II – Other Specifications**
Section I – DTD Specifications
Section II – American Specifications
Section III – French Specifications

(c) **Appendix III – Reverse Colour Codes**
(List of all materials and specifications in Appendices I and II presented with the colour code first.)

(d) **Appendix IV – Handwritten Amendments**
(Amending Appendices I, II and III.)

Issue 2

June, 1985

APPENDIX I TO LEAFLET BL/2-2

BRITISH STANDARDS

ALUMINIUM AND ALUMINIUM ALLOYS

SECTION I

NUMBER	DESCRIPTION	COLOUR
L16	Aluminium sheets (half hard)	Blue
L17	Aluminium sheets (soft)	Black
L25A	Aluminium alloy bars and billets for forging	Red, black, white
L34	99 per cent aluminium bars and sections	Black, red
L36	(Section 1) - Aluminium rods and wires for rivets	Black
L37	Aluminium alloy rivets:	
	Section II Rods and wires for rivets	Red, black, red
	Section III Tubes for rivets	Red, black, red
L44	Soft aluminium alloy extruded bars and sections	Green, white
L54	99 per cent aluminium tubes	Blue, red
L56	Aluminium 2 per cent magnesium alloy tubes (soft)	White, brown, yellow
L58	Aluminium 5 per cent magnesium alloy wire for rivets	Green
L59	Aluminium-manganese alloy sheets and strips (three quarter hard)	Black, red, blue
L60	Aluminium-manganese alloy sheets and strips (quarter hard)	Green, black, green
L61	Aluminium-manganese alloy sheets and strips (soft)	Blue, yellow, blue
L63	Aluminium-copper-magnesium-silicon-manganese alloy tubes (solution treated and precipitation treated)	Red, black, red
L65	Aluminium-copper-magnesium-silicon-manganese alloy bars, extruded sections and forgings (solution treated and precipitation treated):	
	Bars for machining and extruded sections	Black, yellow, black
	Bars for machining and extruded sections which have been solution treated but not precipitation treated	Red, green, red
L70	Aluminium-copper-magnesium-silicon-manganese alloy sheets and strips (solution treated and aged at room temperature):	Green, black, yellow
	Annealed	Green, yellow, red
	As rolled	Brown, red, green
L72	Aluminium-coated aluminium-copper-magnesium-silicon-manganese alloy sheets and strips (solution treated and aged at room temperature)	Black, brown
	Annealed	Brown, yellow, red
	As rolled	Brown, yellow, green

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NUMBER	DESCRIPTION	COLOUR
L73	Aluminium-coated aluminium-copper-magnesium-silicon-manganese alloy sheets and strips (solution treated and precipitation treated)	Black, green, blue
L77	Aluminium-copper-magnesium-silicon-manganese alloy billets and bars for forging	Brown, red, green
L80	Aluminium 2½ per cent. magnesium alloy sheets and coils (soft)	Green, black, red
L81	Aluminium 2½ per cent magnesium alloy sheets and coils (½ hard)	Blue, brown, blue
L83	Aluminium-copper-nickel-magnesium-iron-silicon alloy bars and extruded sections:	
	Bars and billets for forging	Green, red, yellow
	Bars for machining and extruded sections	Red, black, yellow
	Bars for machining and extruded sections which have been solution treated but not precipitation treated	Red, blue, yellow
L84	Aluminium-copper-silicon-magnesium alloy bars and extruded sections: Bars for machining and extruded sections	Red, brown, red
L85	**Aluminium-copper-silicon-magnesium alloy forging stock, bars and extruded sections:**	
	Bars and billets for forging	**Green, black, red**
	Bars for machining and extruded sections, solution treated and precipitation treated	**Blue, yellow, blue**
	Bars for machining and extruded sections which have been solution treated but not precipitation treated	**Blue, black, green**
L86	**Aluminium-copper-magnesium alloy for rivets**	
	Annealed and drawn	**Yellow**
	Solution treated and naturally aged	**Violet**
L87	**Aluminium-copper-magnesium-silicon-manganese alloy hexagonal bars for nuts, couplings, etc.**	
	Solution treated and precipitation treated	**Black, red, black**
L88	Aluminium alloy coated aluminium zinc magnesium-copper-chromium alloy sheet and strip	
	Solution treated and precipitation treated.	Green, brown, green
	Annealed condition	Green, yellow, white
L89	Aluminium coated aluminium-copper-magnesium-silicon-manganese alloy sheet and strip to close tolerances	
	Solution treated and aged at room temperature	Blue, green, red
	Annealed condition	Red, yellow, white
L90	Aluminium coated aluminium-copper-magnesium-silicon-manganese alloy sheet and strip to close tolerances.	
	Solution treated and precipitation treated.	Black, blue, black
	Annealed condition	Brown, yellow, white
L93	Aluminium-copper-magnesium-silicon-manganese plate (Solution treated controlled stretched and precipitation treated):	Black, white, green
	(Solution treated and controlled stretched)	Black, red, white
	Solution treated condition	White, brown, white
L94	Aluminium-copper-magnesium-silicon-manganese plate	
	(Solution-treated and precipitation treated not controlled stretched):	Blue, black, red
	(As rolled):	Blue, brown, yellow
	(Annealed):	Blue, red, brown
	(Solution treated):	Blue, black, white

NUMBER	DESCRIPTION	COLOUR
L95	Aluminium-zinc-magnesium-copper-chromium alloy plate	
	(Solution treated, controlled stretched and precipitation treated):	Brown, green, brown
	(Solution treated):	Blue, yellow, white
L96	Aluminium-zinc-magnesium-copper-chromium alloy plate	
	(Solution treated and precipitation treated not controlled stretched):	Blue, white, red
	(As rolled):	Brown, white, brown
	(Annealed):	Blue, yellow, brown
	(Solution treated):	Brown, blue, white
L97	Aluminium-copper-magnesium-manganese alloy plate	
	(Solution treated, controlled stretched, aged at room temperature):	Red, white, red
L98	Aluminium-copper-magnesium-manganese alloy plate	
	(Solution treated and aged at room temperature, not controlled stretched):	Green, red, green
	(As rolled):	Green, white, yellow
	(Annealed):	Green, red, white
L102	Aluminium-copper-magnesium-silicon-Manganese Bars and sections	Green, brown, green
L103	Aluminium-copper-magnesium-silicon-Manganese forging stock	Black, white, green
L104	Aluminium-copper-magnesium-silicon-Manganese sheet and strip	Black, white, red
L105	Aluminium-copper-magnesium-silicon-Manganese tube	Blue, yellow, green
L106	Aluminium-copper-magnesium-silicon-manganese Sheet and strip	Brown, red, green
L107	Aluminium coated aluminium-copper-magnesium-silicon-manganese Sheet and strip	Brown, yellow, green
L108	Close tolerance aluminium coated aluminium-copper-magnesium-silicon-manganese Sheet and strip	Red, black, white
L109	Aluminium coated aluminium-copper-magnesium-manganese Sheet and strip	Blue, green
L110	Aluminium coated aluminium-copper-magnesium-manganese Sheet and strip	Blue, red, white
L111	Aluminium-magnesium-silicon-manganese bars and sections	Red, white, red
	Solution treated condition	Black, red, white, red
L112	Aluminium-magnesium-silicon-manganese Forging stock	White, green, white
L113	Aluminium-magnesium-silicon-manganese Sheet and strip	
	Solution treated condition	Black, white, yellow, black
	Solution treated, flattened, precipitation treated	Black, white, yellow
	Annealed condition	Yellow, black, white, yellow
L114	Aluminium-magnesium-silicon-manganese tube	
	Solution treated condition	Green, black, yellow, red
	Solution treated, drawn, precipitation treated	Green, black, yellow
	Annealed condition	Green, black, yellow green
L115	Aluminium-magnesium-silicon-manganese Plate	
	Solution treated condition	Black, blue, black, brown
	Solution treated, controlled stretched, precipitation treated	Blue, black, brown

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NUMBER	DESCRIPTION	COLOUR
L116	Aluminium Tube - Cold drawn	Black
L117	Aluminium-magnesium-silicon-copper-chromium alloy tube (not tested hydraulically) Solution treated and artificially aged	Black, blue, brown, blue
L118	Aluminium-magnesium-silicon-copper-chromium alloy tube (tested hydraulically) Solution treated and artificially aged	Black, blue, green, black
L150	Aluminium-copper-magnesium-silicon-manganese alloy sheet and strip Solution treated and artificially aged	Black, blue, black, blue
L151	Aluminium coated aluminium-copper-magnesium-silicon-manganese alloy sheet and strip Solution treated and aged at room temperature	Black, blue, white, black
L152	Aluminium coated aluminium-copper-magnesium-silicon-manganese alloy sheet and strip: Solution treated and artificially aged	Black, brown, black, white
L153	Aluminium coated aluminium-copper-magnesium-silicon-manganese alloy sheet and strip: Supplied for solution treatment by the user	Black, brown, blue, brown
L156	Aluminium-copper-magnesium-silicon-manganese sheet and strip - (Solution treated and aged at room temperature).	
	Temper F - as rolled	Black, green, black, red
	T4 - solution treated, straightened, naturally aged	Black, green, brown, green
	T42 - solution treated, naturally aged	Black, green, red, blue
L157	Aluminium-copper-magnesium-silicon-manganese sheet and strip - (Solution treated and artificially aged).	
	T6 - solution treated, straightened, artificially aged	Black, red, black, blue
	T62 - solution treated, artificially aged	Black, red, green, brown
L158	Aluminium-copper-magnesium-silicon-manganese sheet and strip, close toleranced - (Solution treated and aged at room temperature).	
	Temper F as rolled	Brown, black, brown, green
	T4 - solution treated, straightened, naturally aged	Brown, black, red, brown
	T42 - solution treated, naturally aged	Brown, black, green, red
L159	Aluminium-copper-magnesium-silicon-manganese sheet and strip, close toleranced - (Solution treated and artificially aged).	
	T6 - solution treated, straightened, artificially aged	Brown, blue, brown, red
	T62 - solution treated, artificially aged	Brown, blue, green, yellow
L160	Aluminium-zinc-magnesium-copper-chromium alloy Bars and sections in T7351 condition	Black, blue, brown, blue
L163	Aluminium coated aluminium-copper-magnesium-silicon-manganese sheet and strip - (Solution treated, cold worked for flattening and aged at room temperature).	
	T3 - solution treated, straightened, naturally aged	Black, brown

NUMBER	DESCRIPTION	COLOUR
L164	Aluminium-coated aluminium-copper-magnesium-silicon-manganese sheet and strip - (Solution treated and aged at room temperature).	
	Temper F - as rolled	Blue, black, blue, green
	T4 - solution treated, straightened, naturally aged	Blue, black, brown, blue
	T42 - solution treated, naturally aged	Blue, black, green, red
L165	Aluminium-coated aluminium-copper-magnesium-silicon-manganese sheet and strip - (Solution treated and artificially aged).	
	T6 - solution treated, straightened, artificially aged	Blue, brown, blue, green
	T62 - solution treated, artificially aged	Blue, brown, green, red
L166	Aluminium-coated aluminium-copper-magnesium-silicon-manganese sheet and strip, close toleranced - (Solution treated and aged at room temperature).	
	Temper F - as rolled	Green, brown, green, red
	T4 - solution treated, straightened, naturally aged	Green, brown, yellow, green
	T42 - solution treated, naturally aged	Green, brown, blue, yellow
L167	Aluminium-coated aluminium-copper-magnesium-silicon-manganese sheet and strip, close toleranced - (Solution treated and artificially aged).	
	T6 - solution treated, straightened, artificially aged	Green, blue, brown, green
	T62 - solution treated, artificially aged	Green, blue, red, yellow
L168	Bars and extruded sections of aluminium-copper-magnesium-silicon-manganese alloy - (Solution treated and artificially aged).	
	To the requirements of BS 3L100 Section 5:	
	T6 - solution treated and artificially aged	Blue, brown, blue, brown
	T6510 - solution treated, controlled stretched, no additional straightening after stretching, artificially aged	Brown, green, blue, red
	T6511 - solution treated, controlled stretched, straightened, artificially aged	Brown, green, blue, green
	To the requirements of BS 3L100 Section 6:	
	T6510 - solution treated, controlled stretched, no additional straightening after stretching, artificially aged	Brown, green, red, brown
	T6511 - solution treated, controlled stretched, straightened, artificially aged	Brown, green, red, green
L503	Magnesium-aluminium-zinc alloy extruded tubes	Black, blue, white
L504	Magnesium - 3% zinc-zirconium alloy sheets and strip	Red, white
L505	Magnesium - 3% zinc-zirconium alloy extruded bars and sections	Red, white
L508	Magnesium 1¼% zinc-zirconium alloy extruded bars and sections	Red, green, yellow
L509	Magnesium 1¼% zinc-zirconium alloy extruded tubes	Red, green, yellow
L512	Bars and extruded sections of magnesium - 6% aluminium-zinc alloy	White, brown, white

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NUMBER	DESCRIPTION	COLOUR
L513	Forging stock (and forgings) of magnesium - 6% aluminium-zinc alloy	Blue, red, yellow, red
L514	Forging stock (and forgings) of magnesium - 3% zinc-aluminium alloy	Blue, white, yellow, blue
L515	Sheet and strip of magnesium 1½% zinc-zirconium alloy	Blue, white, brown, white
BS 1470	Wrought aluminium and aluminium alloy plate, sheet and strip:	
S1-0	Annealed (soft)	Red, green, red
-H4	Half hard	Red, green, yellow
-H8	Hard	Red, yellow, red
S1A-M	As manufactured	Brown, blue, yellow, brown
-0	Annealed (soft)	Brown, blue, yellow
-H4	Half hard	Brown, blue, red
-H8	Hard	Brown, blue, black
S1B-0	Annealed (soft)	Black, green, red
-H4	Half hard	Black, green, brown
-H8	Hard	Black, green, yellow
S1C-M	As manufactured	Yellow, black, blue, yellow
-0	Annealed (soft)	Black, blue
-H2	Quarter hard	Black, yellow, brown
-H4	Half hard	Black, yellow, green
-H6	Three quarter hard	Black, yellow, blue
-H8	Hard	Brown, red
NS3-0	Annealed (soft)	Blue, black, blue
-H2	Quarter hard	Blue, black, green
-H4	Half hard	Blue, yellow, red
-H6	Three quarter hard	Blue, green, blue
-H8	Hard	Blue, yellow, green
NS4-M	As manufactured	Brown, black, green, brown
-0	Annealed (soft)	Brown, black, green
-H3		Brown, black, green, yellow
-H6		Brown, green, blue, green
NS5-0	Annealed (soft)	Blue, green, yellow
-H2	Quarter hard	Blue, green, brown
-H4	Half hard	Blue, red
NS8-M	As manufactured	Green, yellow, green, red
-0	Annealed (soft)	Yellow, black, yellow
-H2	Quarter hard	Yellow, brown, yellow
-H4	Half hard	Black, yellow, brown, yellow
HS15-TB	Solution treated naturally aged	Blue, brown
-TF	Solution treated and precipitation treated	Blue, brown, blue, yellow
HC15-TB	Solution treated naturally aged	Red, black, yellow
-TF	Solution treated precipitation treated	Red, yellow
HS30-0	Annealed (soft)	Black, brown, black
-TB	Solution treated naturally aged	Black, brown, blue
-TF	Solution treated precipitation treated	Black, brown, green
BS 1471	Wrought aluminium and aluminium alloy drawn tube	
T1B-0	Annealed (soft)	Black, green, red
-H4	Half hard	Green, black, green, red
-H8	Hard	Black, green, red, green
T1C-0	Annealed (soft)	Black, blue
-H4	Half hard	Black, blue, black, yellow
-H8	Hard	Green, black, blue, red
NT4-0	Annealed (soft)	Brown, black, green
-H4	Half hard	Brown, black, red
NT5-0	Annealed (soft)	Blue, green, yellow
-H4	Half hard	Blue, green, brown

NUMBER	DESCRIPTION	COLOUR
NT8-0	Annealed (soft)	Red, green, red, yellow
-H2	Quarter hard	Red, yellow, brown, yellow
HT9-0	Annealed (soft)	Black, green
-TB	Solution treated naturally aged	Blue, black, green
-TF	Solution treated precipitation treated	Brown, blue, green
HT15-TB	Solution treated naturally aged	Blue, brown
-TF	Solution treated precipitation treated	Blue, brown, red
HT20-H4	Half hard	Brown, green, red, green
-TB	Solution treated naturally aged	Brown, green, red
-TF	Solution treated precipitation treated	Green, black, green
HT30-TB	Solution treated naturally aged	Blue, Black, yellow
-TF	Solution treated precipitation treated	Black, brown, yellow
BS 1472	Wrought aluminium and aluminium alloy forging stock	
FIB-M	As manufactured	Black, green, red
NF4-M	As manufactured	Brown, black, green
NF5-M	As manufactured	Blue, green, yellow
NF8-M	As manufactured	Black, green, black
HF9-M	As manufactured	Brown, white, yellow
HF12-M	As manufactured	Red, blue, red
HF15-M	As manufactured	Brown, red, yellow
HF16-M	As manufactured	Green, yellow, blue, yellow
HF30-M	As manufactured	Blue, brown, yellow
BS 1473	Wrought aluminium and aluminium alloy rivet bolt and screw stock	
RIB-H5	Strain hardened	Black, white, black, yellow
NR5-0	Annealed (soft)	Brown, red, white
-M	As manufactured	Blue, green, yellow
	Annealed and drawn	Brown, yellow, brown
NR6-0	Annealed (soft)	Green, brown, red
-M	As manufactured	Yellow, black, yellow
	Annealed and drawn	Black, red, white
HR15	Annealed and drawn	Brown, yellow, green
HR30	Annealed and drawn	Blue, brown, blue
NB6-H4	Half hard	Black, white, brown
HB15	Annealed and drawn	Brown, yellow, green
HB20-TH	Solution treated - cold worked and precipitation treated	Black, blue, yellow, red
HB30	Annealed and drawn	Blue, brown, blue
HB30-TF	Solution treated precipitation treated	Black, red, blue, yellow
BS 1474	Wrought aluminium and aluminium alloy bar extruded round tube and sections	
E1B-M	As manufactured	Black, green, red
E1C-M	As manufactured	Black, brown, blue
NE4-M	As manufactured	Brown, black, green
NE5-0	Annealed (soft)	Blue, red, white, red
NE5-M	As manufactured	Blue, green, yellow
NE8-0	Annealed (soft)	Green, brown, white
NE8-M	As manufactured	Black, green, black
HE9-0	Annealed (soft)	Blue, red, blue, white
HE9-M	As manufactured	Brown, white, yellow
HE9-TB	Solution treated naturally aged	Blue, green, white
HE9-TE	Cooled from forming temperature, precipitation treated	Brown, green, brown, green
HE9-TF	Solution treated precipitation treated	Blue, green, blue
HE15-TB	Solution treated naturally aged	Blue, brown
HE15-TF	Solution treated precipitation treated	Blue, brown, red

NUMBER	DESCRIPTION	COLOUR
HE20-TB	Solution treated naturally aged	Black, yellow, brown
HE20-TF	Solution treated precipitation treated	Blue, black, yellow
HE30-0	Annealed (soft)	Brown, yellow, white, green
HE30-M	As manufactured	Blue, green, brown
HE30-TB	Solution treated naturally aged	Brown, black, red
HE30-TF	Solution treated precipitation treated	Brown, black, yellow
BS 1475	Wrought aluminium and aluminium alloy - Wire:	
G1A-0	Annealed (soft)	Brown, blue, green
-M	As manufactured	Black, blue
-H8	Hard	Brown, blue, brown
G1B-0	Annealed (soft)	Brown, green, yellow
-M	As manufactured	Black, green
-H8	Hard	Brown, green, brown
NG2-M	As manufactured	Black, yellow
NG21-M	As manufactured	Green, red
NG3-0	Annealed (soft)	Red, brown, white
-M	As manufactured	Black, yellow, blue
-H8	Hard	Red, green, yellow
NG4-0	Annealed (soft)	Brown, black, green
-M	As manufactured	Brown, black, green, brown
-H8	Hard	Green, black, green, yellow
NG5-M	As manufactured	Blue, green
NG6-0	Annealed (soft)	Green, brown, red
-M	As manufactured	Blue, red
NG6-H4	Half hard	Black, white, brown
-H8	Hard	Black, white, red
NG61-M	As manufactured	Brown, yellow, brown
HG9-M	As manufactured	Brown, blue, white, yellow
-TB	Solution treated and naturally aged	Blue, green, white
-TF	Solution treated precipitation treated	Blue, green, blue
-TD	Solution treated cold worked naturally aged	Blue, green, red
HG15-TB	Solution treated naturally aged	Blue, brown
-TF	Solution treated precipitation treated	Blue, brown, red
HG20-TH	Solution treated cold worked precipitation treated	Green, white, red

BRASS, BRONZE AND COPPER ALLOYS

SECTION II

NUMBER	DESCRIPTION	COLOUR
B8	Phosphor bronze, cast bars	Yellow
B11	Brass bars suitable for brazing or silver soldering	Brown
T51	High pressure seamless copper tubes	Black

NUMBER	DESCRIPTION	COLOUR
BS1400-AB2	Aluminium bronze (copper aluminium) castings (solid and cored sticks)	Brown, blue, yellow
BS1400-PB1	Phosphor bronze castings (solid and cored sticks)	Black, red, black
BS1400-PB2	Phosphorbronze castings (solid and cored sticks)	Black, green, black
BS1400-PB3	Phosphor bronze castings (solid and cored sticks)	Black, white, black
BS1400-PB4	Phosphor bronze castings (solid and cored sticks)	Black, blue, black, yellow
BS1400 LPB1	Leaded phosphor bronze castings (solid and cored sticks)	Brown, blue, red
BS1400-LB1	76/9/0/15 leaded castings (solid and cored sticks)	Black, blue, red
BS1400-LB2	80/10/0/10 leaded bronze castings (solid and cored sticks)	Red, white, red
BS1400-LB3	85/10/0/5 leaded bronze castings (solid and cored sticks)	Green, brown, red
BS1400-LB4	85/5/0/10 leaded bronze castings (solid and cored sticks)	White, green, white, yellow
BS1400-LB5	75/5/0/20 leaded bronze castings (solid and cored sticks)	White, brown, yellow, white
BS1400-G1	88/10/2 gunmetal castings (solid and cored sticks)	Blue, green, blue
BS1400-G2	88/8/4 gunmetal castings (solid and cored sticks)	Blue, brown, blue
BS1400-LG1	83/3/9/5 leaded gunmetal castings (solid and cored sticks)	Green, black, green
BS1400-LG2	85/5/5/5 leaded gunmetal castings (solid and cored sticks)	Green, brown, green
BS1400-LG3	86/7/5/2 leaded gunmetal castings (solid and cored sticks)	Green, white, green
BS1432 C101 and C102	Copper for electrial purposes. Sheets and strips	
	Annealed	Red, black, red
	Medium hard	Blue, red
	Hard	Black, green, red
C103	Copper for electrical purposes. Sheet and strips	
	Annealed, 0	Black
	Medium hard, ½H	Black, blue
	Hard, H	Black, blue, white
BS1433	Copper for electrical purposes. Bar and rod:	
	Annealed	Red, black, red
	Medium hard	Blue, red
	Hard	Black, green, red
BS1434	Copper for electrical purposes. Commutator bars	Green, blue, green

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NUMBER	DESCRIPTION		COLOUR
BS1977	Copper tubes for electrical purposes to BS1036 purity		
(C101)	Annealed		White, green, yellow
	As drawn		White, red, yellow
BS1977	Copper tubes for electrical purposes to BS1037 purity		
(C102)	Annealed		White, yellow, white
	As drawn		Yellow, black, yellow
BS1977	Copper tubes for electrical purposes to BS1861 purity		
(C103)	Annealed		Yellow, blue, yellow
BS2786	Round hard drawn brass wire		Blue, black, brown
	As drawn (M)		Blue, brown, green
BS2870	Rolled - copper and copper alloys. Sheet strip and foil		
C101	Electrolytic tough pitch HC Copper	O	Black, blue, red
C101	Electrolytic tough pitch HC Copper	½H	Black, green
C101	Electrolytic tough pitch HC Copper	H	Black, red, yellow
C102	Fire refined tough pitch HC Copper	O	Black, yellow, blue
C102	Fire refined tough pitch HC Copper	½H	Black, yellow, brown
C102	Fire refined tough pitch HC Copper	H	Black, yellow, red
C103	Oxygen free HC Copper	O	Blue, black, green
C103	Oxygen free HC Copper	½H	Blue, brown, blue
C103	Oxygen free HC Copper	H	Blue, green, brown
C104	Tough pitch non-arsenical copper	M/O	Blue, red, white
C104	Tough pitch non-arsenical copper	½H	Blue, red, yellow
C104	Tough pitch non-arsenical copper	H	Blue, white, green
C105	Tough pitch arsenical copper	M/O	Blue, yellow
C105	Tough pitch arsenical copper	½H	Brown, black, brown
C105	Tough pitch arsenical copper	H	Brown, black, red
C106	Phosphorous deoxidized non-arsenical copper	M/O	Green, black, red
C106	Phosphorous deoxidized non-arsenical copper	½H	Green, blue, yellow
C106	Phosphorous deoxidized non-arsenical copper	H	Green, brown, white
C107	Phosphorous deoxidized non-arsenical copper	M/O	Green, yellow, green
C107	Phosphorous deoxidized non-arsenical copper	½H	White, black, yellow
C107	Phosphorous deoxidized non-arsenical copper	H	White, brown, white
CZ101	90/10 brass	O	Black, red, brown, red
CZ101	90/10 brass	½H	Black, red, green, red
CZ101	90/10 brass	H	Black, green, white, black
CZ102	85/15 brass	O	Black, red, yellow, brown
CZ102	85/15 brass	½H	Black, white, yellow, black
CZ102	85/15 brass	H	Black, white, green, white
CZ103	80/20 brass	O	Black, yellow, black, brown
CZ103	80/20 brass	½H	Black, yellow, black, white
CZ103	80/20 brass	H	Black, yellow, blue, yellow
CZ106	70/30 brass	O	White, green, yellow
CZ106	70/30 brass	¼H	White, red, white
CZ106	70/30 brass	½H	White, red, yellow
CZ106	70/30 brass	H	White, yellow
CZ107	2/1 brass	O	Green, red
CZ107	2/1 brass	¼H	Red, yellow, red
CZ107	2/1 brass	½H	Blue, red, green
CZ107	2/1 brass	H	Blue, brown
CZ107	2/1 brass	EH	Blue, black, red
CZ108	Common brass	O	Green
CZ108	Common brass	¼H	Yellow, black, yellow
CZ108	Common brass	½H	Red
CZ108	Common brass	H	Blue
CZ108	Common brass	EH	Brown, yellow, brown
CZ110	Aluminium brass	M	Black, yellow, brown, red

NUMBER	DESCRIPTION		COLOUR
CZ110	Aluminium brass	0	Black, yellow, green, yellow
CZ112	Naval brass	M	Black, blue, brown
CZ112	Naval brass	0	Black, red, green
CZ112	Naval brass	H	Green, blue, red
CZ118	Leaded brass 64% copper 1% lead	½H	Black, yellow, white, yellow
CZ118	Leaded brass 64% copper 1% lead	H	Blue, black, brown, green
CZ118	Leaded brass 64% copper 1% lead	EH	Blue, black, green, white
CZ119	Leaded brass 62% copper 2% lead	½H	Blue, black, yellow, blue
CZ119	Leaded brass 62% copper 2% lead	H	Blue, black, white, blue
CZ119	Leaded brass 62% copper 2% lead	EH	Blue, brown, black, brown
CZ120	Leaded brass 59% copper 2% lead	½H	Blue, brown, blue, brown
CZ120	Leaded brass 59% copper 2% lead	H	Blue, brown, blue, white
CZ120	Leaded brass 59% copper 2% lead	EH	Blue, brown, red, blue
CZ123	60/40 brass	M	Blue, brown, white, brown
CZ125	Cap copper	0	Blue, brown, yellow, red
CB101	Copper-beryllium	0	Blue, black, brown, yellow
CB101	Copper-beryllium	W	Black, blue, yellow
CB101	Copper-beryllium	W(¼H)	Black, brown, white
CB101	Copper-beryllium	W(½H)	Black, green, white
CB101	Copper-beryllium	W(H)	Black, yellow, white
CN102	90/10 copper-nickel-iron	M	Blue, green, white, blue
CN101	95/5 copper-nickel-iron	M	Blue, green, brown, green
CN102	90/10 copper-nickel-iron	0	Blue, red, black, red
CN103	85/15 copper-nickel	0	Blue, red, brown, white
CN104	80/20 copper-nickel	0	Black, blue, black, white
CN105	75/25 copper-nickel	0	Black, blue, brown, green
CN106	70/30 copper-nickel	0	Black, blue, green, blue
CN107	70/30 copper-nickel	0	Black, blue, red, brown
CS101	Silicon bronze (copper-silicon)	M	Black, blue, white, green
NS103	10% nickel silver (copper-nickel-zinc)	½H	Black, blue, yellow, black
NS103	10% nickel silver (copper-nickel-zinc)	H	Black, brown, black, white
NS103	10% nickel silver (copper-nickel-zinc)	EH	Black, brown, blue, yellow
NS103	10% nickel silver (copper-nickel-zinc)	0	Black, brown, green, yellow
NS104	12% nickel silver (copper-nickel-zinc)	½H	Black, brown, red, white
NS104	12% nickel silver (copper-nickel-zinc)	H	Black, brown, white, yellow
NS104	12% nickel silver (copper-nickel-zinc)	EH	Black, brown, yellow, red
NS104	12% nickel silver (copper-nickel-zinc)	0	Blue, red, white, blue
NS105	15% nickel silver (copper-nickel-zinc)	½H	Blue, red, yellow, blue
NS105	15% nickel silver (copper-nickel-zinc)	H	Blue, white, black, brown
NS105	15% nickel silver (copper-nickel-zinc)	EH	Blue, white, blue, green
NS106	18% nickel silver (copper-nickel-zinc)	0	Black, blue, black, red
NS106	18% nickel silver (copper-nickel-zinc)	½H	Black, blue, red, green
NS106	18% nickel silver (copper-nickel-zinc)	H	Black, green, white, green
NS106	18% nickel silver (copper-nickel-zinc)	EH	Black, red, blue, red
NS107	18% nickel silver (copper-nickel-zinc)		Black, red, brown, yellow
NS108	20% nickel silver (copper-nickel-zinc)	0	Blue, white, green, red
NS108	20% nickel silver (copper-nickel-zinc)	½H	Blue, white, red, brown
NS108	20% nickel silver (copper-nickel-zinc)	H	Blue, white, yellow, blue
NS108	20% nickel silver (copper-nickel-zinc)	EH	Blue, yellow, black, green
NS109	25% nickel silver (copper-nickel-zinc)	0	Blue, red, white, green
NS109	25% nickel silver (copper-nickel-zinc)	½H	Blue, red, yellow, green
NS109	25% nickel silver (copper-nickel-zinc)	EH	Blue, white, blue, white
NS109	25% nickel silver (copper-nickel-zinc)	H	Blue, white, black, red
PB101	3% phosphor bronze (copper-tin-phosphorous)	0	Black, green, yellow
PB101	3% phosphor bronze (copper-tin-phosphorous)	¼H	Black, green, blue
PB101	3% phosphor bronze (copper-tin-phosphorous)	½H	Brown, blue, yellow
PB101	3% phosphor bronze (copper-tin-phosphorous)	H	Blue, black, white
PB101	3% phosphor bronze (copper-tin-phosphorous)	EH	Black, white, blue
PB102	5% phosphor bronze (copper-tin-phosphorous)	0	Black, brown, red
PB102	5% phosphor bronze (copper-tin-phosphorous)	¼H	Black, red, blue

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NUMBER	DESCRIPTION		COLOUR
PB102	5% phosphor bronze (copper-tin-phosphorous)	½H	Blue, yellow, brown
PB102	5% phosphor bronze (copper-tin-phosphorous)	H	Blue, black, blue
PB102	5% phosphor bronze (copper-tin-phosphorous)	EH	Brown, blue, white
PB103	7% phosphor bronze (copper-tin-phosphorous)	0	Brown, red, green
PB103	7% phosphor bronze (copper-tin-phosphorous)	¼H	Brown, blue, red
PB103	7% phosphor bronze (copper-tin-phosphorous)	½H	Black, brown, black
PB103	7% phosphor bronze (copper-tin-phosphorous)	H	Black, white, black
PB103	7% phosphor bronze (copper-tin-phosphorous)	EH	Brown, green, white
PB103	7% phosphor bronze (copper-tin-phosphorous)	SH	Green, red, white
PB103	7% phosphor bronze (copper-tin-phosphorous)	ESH	Red, black, white
BS2871	Copper and copper alloys Part 2 tubes for general purposes Table 2		
C101	Electrolytic tough pitch HC copper	M	Blue, brown, green
C101	Electrolytic tough pitch HC copper	00	Blue, brown, blue
C102	Fire refined tough pitch HC copper	M	Black, blue, black, red
C102	Fire refined tough pitch HC copper	0	Black, blue, red, blue
C103	Oxygen-free HC copper	M	Black, blue, white, black
C103	Oxygen-free HC copper	0	Black, brown, black, blue
C106	Phosphorous deoxidized non-arsenical copper	0	Black, green, white
C106	Phosphorous deoxidized non-arsenical copper	½H	Green, blue, yellow
C106	Phosphorous deoxidized non-arsenical copper	M	Black, red, green
C107	Phosphorous deoxidized arsenical copper	0	Black, blue, red
C107	Phosphorous deoxidized arsenical copper	½H	Black, brown, blue, brown
C107	Phosphorous deoxidized arsenical copper	M	Black, blue, black
CN102	90/10 copper-nickel-iron	M	Black, green, blue, green
CN102	90/10 copper-nickel-iron	0	Black, green, brown, green
CN107	70/30 copper-nickel	M	Black, green, red, green
CN107	70/30 copper-nickel	0	Black, green, white, black
CZ108	Brass 63% copper	0	Black, blue, black, yellow
		TA	Black, blue, brown, red
		M	Black, blue, green, black
CZ110	Aluminium brass	0	Black, brown, green, black
CZ110	Aluminium brass	TA	Black, brown, red, brown
CZ110	Aluminium brass	M	Black, brown, white, black
CZ119	Leaded brass 62% copper 2% lead	M	Black, brown, yellow, black
CZ119	Leaded brass 62% copper 2% lead	0	Black, green, black, red
CZ126	Special 70/30 arsenical brass	0	Black, brown, yellow
CZ126	Special 70/30 arsenical brass	TA	Black, blue, yellow, red
CZ126	Special 70/30 arsenical brass	M	Black, blue, green, red
CZ127	Special 18/20	0	Green, white, brown, white
CZ127	Special 18/20	M	Green, red, yellow, red
~~NT8-M~~	~~As manufactured~~		~~Blue, white, black, white~~
BS2872	Copper and copper alloys forging stock Table 1		
CA103	9% aluminium bronze (copper-aluminium)	M	Black, red, white, black
CA104	10% aluminium bronze (copper-al-nickel-iron)	M	Black, white, black, blue
CA106	7% aluminium bronze (copper-aluminium-iron)	M	Black, white, black, white
CS101	Copper silicon	M	Black, white, green, blue
CZ109	Lead free 60/40 brass	M	Blue, brown, green
CZ112	Naval brass	M	Black, blue
CZ114	High tensile brass	M	Black, blue, green, yellow
CZ114	High tensile brass	0	Black, blue, yellow, white
CZ115	High tensile brass (soldering quality)	M	Black, green, white, brown
CZ116	High tensile brass	M	Black, red, black, blue
CZ122	Leaded brass 58% copper 2% lead	M	Black, red, black, yellow
CZ123	60/40 brass	M	Black, red, blue, yellow
NS101	Leaded 10% nickel brass	M	Black, white, blue, white

NUMBER	DESCRIPTION		COLOUR
BS2873	Copper and copper alloys - Wire		
C101	Electrolytic tough pitch HC copper	0	Brown, blue, black, green
C102	Fire refined tough pitch HC copper	H	Brown, blue, brown, green
C103	Oxygen-free HC copper		Brown, blue, brown, yellow
C106	Phosphorous deox non-arsenical copper		Brown, blue, green, brown
C108	Copper-cadmium	H	Brown, blue, red, green
CZ101	90/10 brass	0	Brown, blue, white, brown
CZ101	90/10 brass	½H	Brown, blue, yellow, green
CZ101	90/10 brass	H	Brown, green, black, white
CZ102	85/15 brass	0	Brown, green, blue, red
CZ102	85/15 brass	½H	Brown, green, brown, green
CZ102	85/15 brass	H	Brown, green, red, brown
CZ103	80/20 brass	0	Brown, green, white, green
CZ103	80/20 brass	½H	Brown, green, yellow, white
CZ103	80/20 brass	H	Brown, red, black, green
CZ106	70/30 brass	0	Brown, red, black, yellow
CZ106	70/30 brass	½H	Black, green, white, red
CZ106	70/30 brass	H	Brown, red, blue, white
CZ107	2/1 brass	0	Brown, red, green, red
CZ107	2/1 brass	½H	Brown, red, white, green
CZ107	2/1 brass	H	Brown, red, yellow, brown
CZ107	2/1 brass	EH	Brown, white, black, green
CZ108	Common brass	0	Brown, white, blue, red
CZ108	Common brass	½H	Blue, green, red, brown
CZ108	Common brass	H	Red, brown, red
CZ108	Common brass	EH	Brown, white, brown, red
CZ119	Leaded brass 62% copper 2% lead	0	Brown, white, red, green
CZ119	Leaded brass 62% copper 2% lead	½H	Brown, white, yellow, brown
CZ119	Leaded brass 62% copper 2% lead	H	Brown, yellow, black, green
CB101	Copper-beryllium	W	Brown, yellow, blue, red
CB101	Copper-beryllium	W(H)	Brown, yellow, blue, yellow
CB101	Copper-beryllium		Brown, yellow, brown, red
NS103	10% nickel silver (copper-nickel-zinc)	½H	Brown, yellow, red, green
NS103	10% nickel silver (copper-nickel-zinc)	0	Brown, yellow, brown, yellow
NS103	10% nickel silver (copper-nickel-zinc)	H	Brown, yellow, white, red
NS104	12% nickel silver (copper-nickel-zinc)	0	Green, black, blue, green
NS104	12% nickel silver (copper-nickel-zinc)	½H	Green, black, brown, red
NS104	12% nickel silver (copper-nickel-zinc)	H	Green, black, green, white
NS105	15% nickel silver (copper-nickel-zinc)	0	Green, black, red, yellow
NS105	15% nickel silver (copper-nickel-zinc)	½H	Green, black, white, red
NS105	15% nickel silver (copper-nickel-zinc)	H	Green, blue, black, red
NS106	18% nickel silver (copper-nickel-zinc)	0	Green, blue, brown, green
NS106	18% nickel silver (copper-nickel-zinc)	½H	Green, blue, brown, yellow
NS106	18% nickel silver (copper-nickel-zinc)	H	Green, blue, ~~brown~~ green, yellow
NS107	18% nickel silver (copper-nickel-zinc)	0	Green, blue, ~~red~~ green
NS107	18% nickel silver (copper-nickel-zinc)	½H	Green, blue, white, yellow
NS107	18% nickel silver (copper-nickel-zinc)	H	Green, brown, black, red
NS108	20% nickel silver (copper-nickel-zinc)	0	Green, brown, black, yellow
NS108	20% nickel silver (copper-nickel-zinc)	½H	Green, brown, green, red
NS108	20% nickel silver (copper-nickel-zinc)	H	Green, brown, red, green
NS109	25% nickel silver (copper-nickel-zinc)	0	Green, brown, white, red
NS109	25% nickel silver (copper-nickel-zinc)	½H	Green, brown, yellow, white
NS109	25% nickel silver (copper-nickel-zinc)	H	Green, red, black, red
PB101	3% phosphor bronze (copper-tin-phosphorous)	0	Green, red, blue, red
PB101	3% phosphor bronze (copper-tin-phosphorous)	½H	Green, red, brown, white
PB101	3% phosphor bronze (copper-tin-phosphorous)	H	Green, red, green, red
PB101	3% phosphor bronze (copper-tin-phosphorous)	EH	Green, red, white, green
PB103	7% phosphor bronze (copper-tin-phosphorous)	0	Green, red, yellow, green
PB103	7% phosphor bronze (copper-tin-phosphorous)	½H	Green, red, yellow, white
PB103	7% phosphor bronze (copper-tin-phosphorous)	H	Green, white, black, yellow
PB103	7% phosphor bronze (copper-tin-phosphorous)	EH	Green, white, blue, white

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NUMBER	DESCRIPTION		COLOUR
BS2874	Copper and copper alloys Rods and sections (other than forging stock)		
C101	Electrolytic tough pitch HC copper	0	Black, red, yellow, black
C102	Fire refined tough pitch HC copper	½H	Blue, green, yellow
C103	Oxygen-free HC copper	H	Black, red, yellow, red
C106	Phosphorous deoxidized non-arsenical copper	M	Black, white, black, green
C106	Phosphorous deoxidized non-arsenical copper	0	Black, white, blue, brown
C109	Copper-tellurium	M	Black, white, brown, blue
C109	Copper-tellurium	0	Black, white, green, brown
C111	Copper sulphur	M	Black, white, green, yellow
C111	Copper sulphur	0	Black, white, red, blue
CA103	9% aluminium bronze (copper-aluminium)	M	Black, green, brown
CA104	10% aluminium bronze (copper-alum-nickel-iron)	M	Blue, brown, red
CA106	7% aluminium bronze (copper-aluminium-iron)	M	Black, yellow, green, white
CA106	7% aluminium bronze (copper-aluminium-iron)	0	Black, yellow, red, blue
CS101	Copper-silicon	M	Black, yellow, white, brown
CS101	Copper-silicon	0	Blue, black, blue, brown
CZ103	80/20 brass	M	Black, white, yellow, black
CZ104	Leaded 80/20 brass	M	Black, yellow, black, blue
CZ106	70/30 brass	M	Black, yellow, black, red
CZ109	Lead free 60/40 brass	M	Black, blue, black
CZ112	Naval brass	M	Blue
CZ113	Naval brass (special mixture)	M	Black, yellow, blue, brown
CZ114	High tensile brass	M	Black, brown, white
CZ114	High tensile brass	H	Black, Brown, Red, Black
CZ115	High tensile brass	M	-
		(Hot)	Blue, red, yellow, white
CZ115	High tensile brass	M	-
		(C & SR)	Blue, white, blue, yellow
CZ116	High tensile brass	M	Black, yellow, blue, white
CZ119	Leaded brass 58% copper 2% lead	M	Black, yellow, brown, red
CZ121	Leaded brass 58% copper 3% lead	M	Black
CZ122	Leaded brass 58% copper 2% lead	M	Black, yellow, green, blue
CZ122	Leaded brass 58% copper 2% lead	H	Black, brown, black
CZ123	60/40 brass	M	Black, blue, brown
CZ124	Leaded brass 62% copper 3% lead	M	Black, red, black, red
CZ124	Leaded brass 62% copper 3% lead	½H	Blue, white, red
CZ124	Leaded brass 62% copper 3% lead	H	Black, green, yellow, green
NS101	Leaded 10% nickel brass	M	Blue, black, brown, blue
NS102	Leaded 14% nickel brass	M	Blue, black, green, brown
NS111	Leaded 10% nickel silver	M	Blue, black, red, blue
NS112	Leaded 15% nickel silver	M	Blue, black, red, green
NS113	Leaded 18% nickel silver	M	Black, yellow, white, red
PB102	5% phosphor bronze (copper-tin-phosophorous)	M	Green, yellow, green
BS4109	Copper for electrical purposes - Wire Wire for general electrical purposes and for insulated cables		
C101	Electrolytic tough pitch HC copper	0	Green, yellow, black, yellow
	Electrolytic tough pitch HC copper	H	Green, white, yellow, red
C102	Fire refined tough pitch HC copper	0	Green, white, green, white
	Fire refined tough pitch HC copper	H	Green, white, brown, yellow
C103	Oxygen free HC copper	0	Green, yellow, black, red
	Oxygen free HC copper	H	Green, yellow, blue, red

NICKEL AND HEAT RESISTING ALLOYS

SECTION III

NUMBER	DESCRIPTION	COLOUR
HR1	Nickel base heat resisting alloys:	
	Solution treated bar and section for machining	White, blue, black, yellow
	Softened section for forming	Blue, green, blue, green
	Forging stock	Red, brown, white, yellow
HR2	Nickel base heat resisting alloy:	
	Solution treated bar and section for machining	White, red, black, yellow
	Softened section for forming	Blue, green, red, brown
	Forging stock	Green, black, white
HR3	Nickel base heat resisting alloy:	
	Heat treated (Stages 1 & 2) bar and section for machining	Blue, green, red, white
	Softened section for forming	Blue, green, white, blue
	Forging stock	Blue, green, yellow, brown
HR4	Nickel base heat resisting alloy:	
	Fully heat treated bar and section for machining	Black, blue, brown, blue
	Forging stock	Black, blue, brown, black
HR5	Nickel base heat resisting alloy:	
	Annealed bar for machining	Black, green, blue, red
	Softened sections for forming	Black, brown, yellow, green
	Forging stock	Black, green, brown, white
HR6	Nickel base heat resisting alloy:	
	Annealed bar and section for machining	Blue, green, yellow, red
	Forging stock	Blue, red, blue, white
HR10	Nickel base heat resisting alloy:	
	Solution treated bar and section for machining	Blue, red, black, brown
	Softened section for forming	Blue, red, black, yellow
	Forging stock	Blue, red, green, brown
HR11	Nickel base heat resisting alloy:	
	Solution treated bar and section for machining	Blue, red, white, yellow
	Softened section for forming	Blue, red, yellow, brown
	Forging stock	Brown, green, black, green
HR40	Cobalt base heat resisting alloy:	
	Annealed bar and section for machining	Green, black, blue, red
	Forging stock	Green, black, blue, white
HR51	Nickel chromium iron heat resisting alloy:	
	Annealed bars and section for machining	Green, black, brown, red
	Forging stock	Green, black, brown, white
HR52	Nickel chromium iron heat resisting alloy:	
	Annealed bars and section for machining	Green, black, green, red
	Forging stock	Green, black, green, yellow
HR53	Nickel chromium iron heat resisting alloy:	
	Annealed bars and section for machining	Green, black, blue, yellow
	Forging stock	Green, black, white, red
HR54	Heat resistant martensitic steel:	
	Heat treated bars for machining	Yellow, black, white, yellow
	Forging stock	Yellow, blue, green, yellow
HR201	Nickel base heat resisting alloy plate sheet and strip:	
	Softened and descaled	Green, white, black, white

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NUMBER	DESCRIPTION	COLOUR
HR202	Nickel base heat resisting alloy plate sheet and strip: Softened and descaled Solution treated	Blue, yellow, white, yellow Brown, black, yellow, brown
HR203	Nickel base heat resisting alloy plate sheet and strip: Softened and descaled	Blue, yellow, red
HR204	Nickel base heat resisting alloy plate sheet and strip: Softened and descaled	Black, green, black, yellow
HR206	Nickel base heat resisting alloy plate sheet and strip: Softened and descaled	Black, red, yellow, black
HR207	Nickel base heat resisting alloy plate sheet and strip: Softened and descaled	Black, brown, red, brown
HR240	Cobalt base heat resisting alloy plate sheet and strip: Annealed and descaled	Black, white, black, blue
HR251	Nickel chromium iron heat resisting alloy plate sheet and strip: Solution treated and descaled	Black, white, blue, yellow
HR401	Nickel base heat resisting alloy tube Cold worked and softened	Green, white, black, white
HR402	Nickel base heat resisting alloy tube Cold worked and softened	Black, white, black, yellow
HR403	Nickel base heat resisting alloy tube Cold worked and softened	Black, red, yellow, red
HR404	Nickel base heat resisting alloy tube Cold worked and softened	Black, blue, green, black
HR501	Nickel base heat resisting alloy wire for springs Cold drawn	Black, white, brown, white
HR502	Nickel base heat resisting alloy wire for springs Cold drawn and solution treated	Black, white, red, blue
HR503	Nickel base heat resisting alloy wire for thread inserts Cold drawn	Black, white, yellow, brown
HR504	Nickel base heat resisting bar and wire for rivets Annealed	White, red, yellow, white
HR601	Nickel-chromium-titanium-aluminium heat resisting bar and wire for fasteners: Cold worked and ground Cold worked, solution treated and ground or descaled	Black, green, yellow, blue Black, yellow, green, blue
HR650	Nickel base heat resisting bar for bolts and nuts Solution treated and machined Fully heat treated and machined Forging stock	Black ~~Blue~~, red, blue, green Black, green, yellow, red Black, yellow, red, white
BS1824	Nickel silver strip and foil for the Telecommunication Industries	
NS104	12% nickel silver - Temper grade 2	Yellow, black, brown, yellow
NS104	12% nickel silver - Temper grade 3	Yellow, black, green, yellow
NS104	12% nickel silver - Temper grade 4	Yellow, black, red, yellow
NS104	12% nickel silver - Temper grade 5 (Soft)	Yellow, black, white, yellow
NS104	12% nickel silver - Temper Extra Hard (non-standard condition)	Blue, yellow, white

NUMBER	DESCRIPTION	COLOUR
NS107	18% nickel silver - Temper grade 1 (Extra Hard)	Red, white, black, yellow
NS107	18% nickel silver - Temper grade 2	Red, green, brown, white
NS107	18% nickel silver - Temper grade 3	Red, green, black, yellow
NS107	18% nickel silver - Temper grade 4	Red, white, blue, white
NS107	18% nickel silver - Temper grade 5 (Soft)	Red, white, green, yellow
BS2857	Nickel-iron transformer and choke laminations	
	Class A - 76% Ni	Black, brown, blue
	Class B - 50% Ni, 50% Fe	Blue, white, red
BS3072	Nickel and nickel alloy sheet and plate	
NA13	Cold rolled and annealed	Green, white, green, yellow
BS3073	Nickel and nickel alloy strip	
NA11	Cold rolled, Hard	Brown, green, red.
BS3074	Nickel and nickel alloys, tubes	
NA11	Cold drawn and annealed	Blue, white, blue
NA12	Cold drawn and annealed	Blue, white, green
NA13	Cold drawn and annealed	Blue, white, yellow
NA14	Cold drawn and annealed	Blue, yellow, brown
BS3075	Nickel and nickel alloy wire	
NA11	Cold drawn	Brown, green, red
NA11	Cold drawn and annealed	Blue, white, blue
NA13	Cold drawn	Blue, black, white
NA13	Cold drawn and annealed	Blue, brown, red
BS3076	Nickel and nickel alloy rods and sections	
NA13	Cold drawn	Black, red, brown
	Cold drawn and annealed	Black, red, green
	Hot-rolled	Black, blue, white
	Hot-rolled and annealed	Brown, white, brown
NA14	Cold drawn	Blue, yellow, brown
NA18	Cold worked and precipitated	Green, white, blue, red
NA18	Cold worked, solution treated and precipitated	Green, white, blue, yellow
NA18	Hot worked and precipitated	Green, white, yellow, red
NA18	Hot worked, solution treated and precipitated	Green, yellow, black, white
TA1	Commercially pure titanium sheets and strips (Tensile strength 19-27 tonsf/inch^2)	Black, white, blue, white
TA2	Commercially pure titanium sheets and strips (Tensile strength 390-540 N/mm^2)	Black, brown, black, green
TA3	Commercially pure titanium bars for machining (Tensile strength 390-540 N/mm^2)	Green, brown, red, green
TA4	Commercially pure titanium forging stock (Tensile strength 390-540 N/mm^2)	Green, brown, white, yellow

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NUMBER	DESCRIPTION	COLOUR
TA6	Commercially pure titanium sheets and strips (Tensile strength 570-730 N/mm^2)	Green, blue, red, green
TA7	Commercially pure titanium bars for machining (Tensile strength 540-740 N/mm^2)	Green, blue, brown, green
TA8	Commercially pure titanium forging stock (Tensile strength 540-740 N/mm^2)	Green, black, yellow, white
TA10	Titanium-aluminium-vanadium alloy sheets (Tensile strength 62-82 tonsf/inch^2)	Black, blue, yellow, blue
TA11	Titanium-aluminium-vanadium alloy bars for machining (Tensile strength 58-75 tonsf/inch^2)	Brown, red, brown, green
TA12	Titanium-aluminium-vanadium alloy forging stock (Tensile strength 58-75 tonsf/inch^2)	Green, black, brown, yellow
TA18	Titanium-tin-zirconium-aluminium-molybdenum-silicon alloy bars for machining (Tensile strength 111-134 hbar)(Limiting Ruling Section 50 mm)	Red, blue, black, yellow
TA19	Titanium-tin-zirconium-aluminium-molybdenum-silicon alloy forging stock (Tensile strength 111-134 hbar)(Limiting Ruling Section 50 mm)	Green, black, white, yellow
TA21	Titanium-copper alloy sheet (Tensile strength 54-77 hbar)	Brown, green, brown, yellow
TA22	Titanium-copper alloy bars for machining (Tensile strength 54-77 hbar)	Brown, blue, yellow, brown
TA23	Titanium-copper alloy forging stock (Tensile strength 54-77 hbar)	Green, yellow, brown, white
TA25	Titanium-tin-zirconium-aluminium-molybdenum-silicon bars for machining (Tensile strength 103-127 hbar)(Limiting Ruling Section 75 mm)	Red, blue, black, yellow
TA26	Titanium-tin-zirconium-aluminium-molybdenum-silicon forging stock (Tensile strength 103-127 hbar)(Limiting Ruling Section 75 mm)	White green blue ~~Green, black, white~~, yellow
TA28	Titanium-aluminium-vanadium alloy forging stock (Tensile strength 110-130 hbar)(Limiting Ruling Section 19 mm)	Blue, green, yellow, blue
TA38	Titanium-aluminium-molybdenum-tin-silicon carbon alloy bar for machining (Tensile strength 1250-1420 N/mm^2)(Limiting Ruling Section 25 mm)	White, black, blue, white
TA39	Titanium-aluminium-molybdenum -tin-silicon carbon alloy forging stock (Tensile strength 1250-1420 N/mm^2)(Limiting Ruling Section 25 mm)	White, black, blue, yellow
TA40	Titanium-aluminium-molybdenum -tin-silicon carbon alloy bar for machining (Tensile strength 1205-1375 N/mm^2)(Limiting Ruling Section 25 mm up to and including 75 mm)	White, brown, red, yellow
TA41	Titanium-aluminium-molybdenum-tin-silicon carbon alloy forging stock (Tensile strengt. 1205-1375 N/mm^2)(Limiting Ruling Section 25 mm up to and including 75 mm)	Yellow, brown, red, yellow

NUMBER	DESCRIPTION	COLOUR
TA43	Forging stock of titanium-aluminium-zirconium-molybdenum-silicon alloy (Tensile strength 990-1140 N/mm^2) (Limiting Ruling Section 65 mm)	Yellow, green, red, yellow
TA45	Bar and section after machining of titanium-aluminium-molybdenum-tin-silicon alloy (Tensile strength 1100-1280 N/mm^2)(Limiting Ruling Section 25 mm)	Red, green, white, yellow
TA46	Bar and section for machining of titanium-aluminium-molybdenum-tin-silicon alloy (Tensile strength 1050-1220 N/mm^2)(Limiting Ruling Section over 25 mm up to and including 100 mm)	Red, white, brown, yellow
TA47	Forging stock of titanium-aluminium-molybdenum-tin-silicon alloy (Tensile strength 1050-1220 N/mm^2)(Limiting Ruling Section 100 mm)	Yellow, red, white, yellow
TA49	Bar and section for machining of titanium-aluminium-molybdenum-tin-silicon alloy (Tensile strength 1000-1200 N/mm^2)(Limiting Ruling Section over 100 mm up to and including 150 mm)	Red, yellow, black, white
TA50	Forging stock of titanium-aluminium-molybdenum-tin-silicon alloy (Tensile strength 1000-1200 N/mm^2)(Limiting Ruling Section over 100 mm up to and including 150 mm)	Yellow, brown, green, yellow
TA52	Sheet and strip of titanium copper alloy for machining (Tensile strength 690-920 N/mm^2)	Red, yellow, brown, white
TA53	Bar and section for machining of titanium copper alloy (Tensile strength 650-880 N/mm^2)(Limiting Ruling Section 75 mm)	Red, yellow, brown, white
TA54	Forging stock of titanium copper alloy (Tensile strength 650-880 N/mm^2)(Limiting Ruling Section 75 mm)	White, black, red, white
TA56	Titanium-aluminium-vanadium alloy plate (Tensile strength 895-1150 MPa)	Black, blue, white, brown
TA57	Titanium-aluminium-molybdenum-tin-silicon alloy plate (Tensile strength 1030-1220 MPa)	Black, blue, green, yellow
TA58	Titanium-copper alloy plate (Tensile strength 520-640 MPa)	Black, blue, yellow, green

SOLDERS

SECTION V

NUMBER	DESCRIPTION	COLOUR
BS219	Soft Solders	
	Tin-Lead	
	Grade A	Blue
	AP	Blue, green
	K	Brown, red
	KP	Blue, yellow
	F	Black, red
	R	Brown, red, brown
	G	Green
	H	Black, green, black
	J	Brown, green
	V	Green, black, green
	W	Green, yellow
	Tin-lead-antimony	
	Grade B	Yellow
	M	Red
	C	Black
	L	Blue, brown, blue
	D	Brown
	N	Blue, red, blue
	Tin-Antimony	
	Grade 95A	Black, blue
	Tin-silver	
	Grade 96S	Brown, black, brown
	Tin-lead-silver	
	Grade 5S	Black, green
	62S	Black, red, black
	Tin-lead-cadmium	
	Grade T	Blue, black, blue

STEELS

SECTION VI

NUMBER	DESCRIPTION	COLOUR
S1	Bright 35/45-ton carbon steel bars	Yellow
S14	Carbon case-hardening steel bars	Brown, yellow
S15(A)	3 per cent nickel case-hardening steel bars: Bars and billets for forging	Brown, yellow, brown
S15(B)+D	3 per cent nickel case-hardening steel bars: Black and bright bars for machining	Yellow, brown, yellow
S21	"20" carbon steel	Blue, yellow
S28	Air hardening 4½ per cent, nickel-chromium-molybdenum steel bars	Blue, red
S61A	35-ton, 12 per cent chromium steel (corrosion-resisting) bars for forging	Black, yellow, red

NUMBER	DESCRIPTION	COLOUR
S61B + D	35-ton, 12 per cent chromium steel (corrosion-resisting) bars for machining	Brown, yellow, red
S62A	45/55-ton, 12 per cent chromium steel (corrosion-resisting) bars for forging	Yellow, red, yellow
S62B	45/55-ton, 12 per cent chromium steel (corrosion-resisting) bars for machining	Yellow, black, yellow
S70A	"55" carbon steel bars for forging	Blue, green
S70B	"55" carbon steel (normalised)	White, blue, yellow
S79A	"55" carbon steel bars for forging	Blue, red, green
S79B	"55" carbon steel bars for forging: Hardened and tempered	Red, green, white
S80A	55-ton high chromium-nickel steel (corrosion-resisting) bars for forging	Black, yellow, brown
S80B & D	55-ton high chromium-nickel steel (corrosion-resisting) bars for machining	Brown, black, red
S82	4½ per cent nickel-chromium-molybdenum case-hardening steel bars	Green, red, yellow
S91A	Mild steel bars for forging	Black, green, brown
S91B	Mild steel bars for machining	Black, green, white
S92A	40-ton carbon-manganese steel bars for forging	Brown, green, yellow
S92B	40-ton carbon-manganese steel bars for machining	Black, white
S93A	35-ton steel (~~normalised~~) bars for forging	Brown, green
S93B	35-ton steel (normalised) bars for machining	Red, white
S95A	55-ton, 1½ per cent nickel-chromium-molybdenum steel bars for forging	Black, green, blue
S95B	55-ton, 1½ per cent nickel-chromium-molybdenum steel bars for machining	Black, green, red
S96A	55-ton, 2½ per cent nickel-chromium-molybdenum steel bars for forging	Black, red, black
S96B	55-ton, 2½ per cent nickel-chromium-molybdenum steel bars for machining	Black, red, blue
S97A	65-ton, 2½ per cent nickel-chromium-molybdenum steel bars for forging	Black, white, green
S97B	65-ton, 2½ per cent nickel-chromium-molybdenum steel bars for machining	Black, white, red
S98A	75-ton, 2½ per cent nickel-chromium-molybdenum steel (high carbon) bars for forging	Blue, green, yellow
S98B	75-ton, 2½ per cent nickel-chromium-molybdenum steel (high carbon) bars for machining	Blue, brown, blue
S99	80-ton, 2½ per cent nickel-chromium-molybdenum steel, high carbon (limiting ruling section 6-ins):	
	Bars and billets in the softened condition	Blue, green, brown
	Bars and billets in hardened and tempered condition	Blue, brown, yellow
S102	Carbon-molybdenum steel (bar for forged bolts only)	Blue, black, green
S105	Carbon steel wires:	
	Type 1	Black, blue, green
	Type 2	Black, blue, red
	Type 3	Black, blue, yellow
S106A	60-ton, 3 per cent chromium-molybdenum steel (suitable for nitrogen hardening) bars for forging	Blue, brown, red
S106B	60-ton, 3 per cent chromium-molybdenum steel (suitable for nitrogen hardening) bars for machining	Brown, red, green
S107	3 per cent nickel-chromium-molybdenum case-hardening steel bars	Green, white
S111A	High nickel high chromium steel bars for forging	Red, yellow, red

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NUMBER	DESCRIPTION	COLOUR
S111D	High nickel high chromium steel bars for machining (valve steel)	Yellow, blue, white, yellow
S112	40-ton semi-free cutting steel. Bright bars for machining	Black, blue, green
S113	45-ton carbon steel. Bright bars for machining	Black, blue, yellow
S114 B+D	55-ton manganese-molybdenum steel. Bright bars for machining	Black, brown, green
S116	55-ton carbon steel. Bright bars for machining	Black, blue, black
S117	55-ton, 1 per cent chromium steel:	
	Bars and billets for forging	Blue, green, red
	Bars for machining	Black, yellow, blue
S119	65-ton, 1½ per cent nickel-chromium-molybdenum steel (limiting ruling section 2½-ins):	
	Bars and billets in soft condition	Black, white, yellow
	Bars in hardened and tempered condition	Black, brown, black
S120	100-ton, 2½ per cent nickel-chromium-molybdenum steel (oil hardening) (limiting ruling section 2½-ins)	Blue, white, red
S124	Corrosion-resisting chromium steel. Bars and billets for forging:	
	Softened condition	Brown, yellow, green
	Bright and black bars for machining hardened and tempered	White, red, white
S125	23/14 chromium nickel heat resisting steel (Ti stabilised):	
	Bars and billets for forging (S125A) (as rolled or forged)	Black, blue
	Bars for machining (S125B & D) (fully heat treated)	Black, blue, red
S126	23/14 chromium-nickel heat resisting steel (Nb stabilised):	
	Bars and billets for forging (S126A) (as rolled or forged)	Black, brown
	Bars for machining (S126B & D) (fully heat treated)	Black, brown, red
S127	24/17 chromium-nickel heat resisting steel (Ti stabilised):	
	Bars and billets for forging (S127A) (as rolled or forged)	Black, green
	Bars for machining (S127B & D) (fully heat treated)	Black, yellow
S128	24/17 chromium-nickel heat resisting steel (Nb stabilised):	
	Bars and billets for forging (S128A) (as rolled or forged)	Blue, brown
	Bars for machining (S128B & D) (fully heat treated)	Brown, blue, brown
S129	18/9 chromium-nickel heat resisting steel (Ti stabilised):	
	Bars and billets for forging (129A) (as rolled or forged)	Green, blue, green
	Bars for machining (S129B & D) (fully heat treated)	Brown, blue, red
S130	18/9 chromium-nickel heat resisting steel (Nb stabilised):	
	Bars and billets for forging (S130A) (as rolled or forged)	Red, black, white
	Bars for machining (S130B & D) (fully heat treated)	Brown, green, red
S131A, B & D	High Thermal Expansion steel	
S131 B+D	Bars and billets for forging	Blue, green, white
	Bars for machining	Blue, red, blue

NUMBER	DESCRIPTION	COLOUR
S132	3% chromium-molybdenum steel (suitable for nitriding)	
	Bars for forging, black and bright bars for machining	Black, white, blue
	Fully heat treated - not nitrided	Green, brown, red, yellow
S133	¾% nickel-chromium case hardening steel Bars for forging, black and bright bars for machining	Brown, red, brown
S134	3 per cent chromium-molybdenum-vanadium steel (air hardening) bars for forging, black and bright bars for machining	Brown, white, red
S135	1 per cent carbon-chromium steel bars for forging	
	Black and bright bars for machining	Black, red, green
S136	1 per cent chromium steel vacuum re-melted	Green, red
S137	High chromium nickel corrosion resisting steel Bright bars (free machining)	White, brown, white
S138	3% chromium-molybdenum-vanadium steel Vacuum re-melted air hardening (softened)	Red, brown, red
S139A	1½% nickel-chromium-molybdenum steel bars for forging - softened	Black, green, black
S139B & D	1½% nickel-chromium-molybdenum steel black and bright bars for machining	Black, green, yellow
S140A	2½% nickel-chromium-molybdenum steel bars for forging - softened	Blue, black, white
S140B & D	2½% nickel-chromium-molybdenum steel black and bright bars for machining	Blue, white, green
S141A	12% chromium corrosion resisting steel bars for forging - softened	Brown, black, brown
S141B & D	12% chromium corrosion resisting steel black and bright bars for machining	Blue, black, green
S142A	1% chromium-molybdenum steel (suitable for welding)	
	Bars for forging - softened	Green, white, green
S142B & D	1% chromium-molybdenum-steel (suitable for welding)	
	Black and bright bars for machining	Green, black, red
S143	Chromium-nickel-copper-molybdenum corrosion resisting steel (precipitation hardening)	
A	Bars for forging	Brown, black, white
B and D	Bars for machining	Green, brown, green
S144	Chromium-nickel-copper-molybdenum corrosion resisting steel (precipitation hardening)	
A	Bars for forging	Blue, yellow, white
B and D	Bars for machining	Green, brown, red
S145	Chromium-nickel-copper-molybdenum corrosion resisting steel (precipitation hardening)	
A	Bars for forging	Green, white, yellow
B and D	Bars for machining	Blue, white, brown
S146	4% nickel-chromium-molybdenum steel (air hardening vacuum melted)	Brown, black, green
S147	Nickel-chromium-molybdenum steel bar	Blue, black, blue
S148	Low nickel chromium steel bar	Black, red, yellow
S149	1.75% nickel-chromium-molybdenum steel bar	Brown, blue, green
S150	Chromium-molybdenum-vanadium-niobium heat resisting steel	
	Bars and billets for forging (softened)	Blue, black, blue, black, blue
	Bright and black bars for machining	Blue, black, green, black, blue
S151	Chromium-nickel-molybdenum-vanadium heat resisting steel	
	Bars and billets for forging (softened)	Blue, black, red, black, blue
	Bright and black bars for machining	Blue, black, yellow, black, blue

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NUMBER	DESCRIPTION	COLOUR
S152	Chromium-cobalt-molybdenum-vandiam niobium heat resisting steel	
	Bars and billets for forging (softened)	Blue, brown, black, brown, blue
	Bright and black bars for machining	Blue, brown, red, brown, blue
S153	2½% nickel-chromium-molybdenum steel	
	Bars and billets for forging (softened)	Blue, brown, white, brown, blue
	Bright and black bars for machining	Blue, green, blue, green, blue
S154	2½% nickel-chromium-molybdenum steel	
	Bars and billets for forging (softened)	Blue, green, brown, green, blue
	Bright and black bars for machining	Blue, green, yellow, green, blue
S155	Nickel-silicon-chromium-molybdenum-vanadium steel (Vacuum arc remelted)	
	Normalised and softened bars for machining	Blue, red, blue, red, blue
	Softened forging stock	Blue, red, brown, red, blue
S156	4% nickel-chromium-molybdenum case-hardening steel (Vacuum arc remelted)	
	Black or bright bars for machining	Blue, red, green, red, blue
	Softened forging stock	Blue, red, white, red, blue
S157	3% nickel-chromium-molybdenum case-hardening steel	
	Black or bright bars for machining	Blue, yellow, blue, yellow, blue
	Softened forging stock	Blue, yellow, black, yellow, blue
S201	Patented cold drawn carbon steel wire and springs	Red, black, brown, red
S202	Patented cold drawn carbon steel wire and springs	Red, brown, white, red
S203	Carbon steel wire and springs	Red, green, white, red
S204	Chromium vanadium steel wire and springs	Yellow, black, brown, yellow
S205	Austenitic chromium-nickel steel wire and springs	
	Rods	Black, brown, yellow, black
	Wire	Black, blue, yellow, black
S510	28-ton carbon steel sheets and strips (suitable for welding)	Green
S511	Deep drawing carbon steel sheets and strips (suitable for welding)	Black, green, blue
S513	Spring steel strips:	
	Softened condition	Black, green, red
	Hardened and tempered	Blue, black, yellow
S514	50-ton carbon-manganese steel sheets and strips (40-ton 0.1 per cent proof stress) (suitable for welding):	
	Softened condition	Green, red, white
	Hardened and tempered or cold rolled and tempered	Green, blue, red
S515	30-ton carbon-manganese steel sheets and strips (softened) (suitable for welding)	Red, blue, yellow
S516	60-ton carbon-manganese steel sheets and strips (50-ton 0.1 per cent proof stress):	
	Softened condition	Green, blue, white
	Hardened and tempered or cold-rolled and tempered	Brown, blue, red
S517	75-ton carbon-manganese steel sheets and strips (65-ton 0.1 per cent proof stress):	
	Softened condition	White, black, white
	Hardened and tempered ~~(40 ton 0.1 per cent proof stress)~~ (suitable for welding)	Blue, green, red
	Softened condition	Green, yellow, red
	Hardened and tempered or as cold-rolled and tempered	Green, yellow, white

NUMBER	DESCRIPTION	COLOUR
S518	50-ton chromium-molybdenum steel sheets and strips (40-ton 0.1% proof stress)(suitable for welding):	
	Softened condition	Green, yellow, red
	Hardened and tempered or as cold-rolled and tempered	Green, yellow, white
S524	Cold-rolled 18/10 chromium-nickel corrosion-resisting steel sheet and strip (titanium stabilized: 80 hbar)	Blue, brown, yellow
S525	Cold-rolled 18/10 chromium-nickel corrosion-resisting steel sheet and strip (niobium stabilized: 80 hbar)	Blue, green, yellow
S526	Softened 18/10 chromium-nickel corrosion-resisting steel sheet and strip (titanium stabilized: 54 hbar)	Red, yellow, red
S527	Softened 18/10 chromium-nickel corrosion-resisting steel sheet and strip (niobium stabilized: 54 hbar)	Red, green, yellow
S528	23/14 chromium-nickel heat resisting steel sheet and strip (titanium stabilized: 54 hbar)	Black, red, yellow
S529	23/14 chromium-nickel heat resisting steel sheet and strip (niobium stabilized: 54 hbar)	Black, brown, red
S530	24/17 chromium-nickel heat resisting steel sheet and strip (titanium stabilized: 54 hbar)	Black, red, green
S531	24/17 chromium-nickel heat resisting steel sheet and strip (niobium stabilized: 54 hbar)	Black, yellow, blue
S532	Chromium-nickel-copper-molybdenum corrosion resisting steel sheet and strip (precipitation hardening 98/118 hbar)	Blue, yellow, green
S533	Chromium-nickel-copper-molybdenum corrosion resisting steel sheet and strip (precipitation hardening 118/137 hbar)	Brown, black, red
S534	Chromium-molybdenum steel sheet and strip (88/108 hbar) (suitable for welding):	
	Softened condition	Green, blue, green
	Hardened and tempered	Brown, red, green
S535	Chromium-molybdenum steel sheet and strip (115/130 hbar) (suitable for welding)	
	Softened condition	Green, brown, green
	Hardened and tempered	Brown, blue, yellow
S536	Low carbon 18/10 chromium-nickel corrosion resisting steel sheet and strip (50 hbar)	Red, brown, white
S537	Low carbon 17/12 chromium-nickel corrosion resisting steel sheet and strip (50 hbar)	Green, yellow, green
S538	Chromium-nickel-molybdenum-vanadium heat resisting steel sheet and strip:	
	Softened condition	Red, brown, yellow

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NUMBER	DESCRIPTION	COLOUR
T2	85-ton nickel-chromium steel tubes	Red
T45	45-ton steel tubes (suitable for welding)	Black, brown, blue
T50	50-ton steel tubes	Brown, yellow
T53	45-ton chrome-molybdenum steel tubes (suitable for welding)	Black, green, yellow
T57	75-ton nickel-chromium steel tubes	Black, brown, yellow
T60	75-ton chrome-molybdenum steel tubes (suitable for welding)	Red, white
T62	Mild steel tube	Red, blue, yellow
T63	Softened mild steel tube for hydraulic purposes	Brown, yellow, red
T64	Carbon manganese steel tube	Blue, yellow, green
T65	Chromium-molydenum steel tube	Green, blue, yellow
T66	18/10 chromium-nickel corrosion resisting steel tube	Green, brown, white
T67	18/10 chromium-nickel corrosion resisting steel tube	Green, yellow, red
T68	Cold drawn 18/10 chromium-nickel corrosion resisting steel tube (niobium stabilised)	Red, green, red
T69	Cold drawn 18/10 chromium-nickel corrosion resisting steel tube (titanium stabilised)	Yellow, black, yellow
T70	24/17 chromium-nickel heat resisting steel tube (niobium stabilised)	Brown, black, red
T71	24/17 chromium-nickel heat resisting steel tube (titanium stabilised)	Green, white, green
T72	18/10 chromium-nickel corrosion resisting steel tube for hydraulic purposes niobium stabilised 550 MPa	Black, blue, brown
T73	18/10 chromium-nickel corrosion resisting steel tube for hydraulic purposes titanium stabilised 550 MPa	Black, red, yellow
T74	Low carbon 18/10 chromium-nickel corrosion resisting steel tube	Yellow, red, yellow
T75	Low carbon 17/12 chromium-nickel-molybdenum corrosion resisting steel tube	White, blue, yellow
T76	Chromium-molybdenum steel tube (770 MPa) (weldable)	Green, brown, blue, red
BS970 Pt 1	Carbon steels:	
015 A03	Low carbon: As rolled or forged (black bars)	White, black, green, black, white
030 A04	Low carbon: As rolled or forged (black bars)	White, black, yellow, black, white
040 A04	Low carbon: As rolled or forged (black bars)	Green, red, green, red
050 A04	Low carbon: As rolled or forged (black bars)	White, blue, white, blue, white
040 A10	Low carbon: As rolled or forged (black bars)	Red, yellow, red, yellow
045 A10	Low carbon: As rolled or forged (black bars)	White, brown, green, brown, white
060 A10	Low carbon: As rolled or forged (black bars)	White, green, brown, green, white
040 A12	Low carbon: As rolled or forged (black bars)	Black, white, green, blue
050 A12	Low carbon: As rolled or forged (black bars)	White, green, yellow, green, white
060 A12	Low carbon: As rolled or forged (black bars)	White, red, white, red, white
040 A15	Low carbon: As rolled or forged (black bars)	White, red, blue, red, white

NUMBER	DESCRIPTION	COLOUR
050 A15	Low carbon:	
	As rolled or forged (black bars)	White, red, brown, red, white
060 A15	Low carbon:	
	As rolled or forged (black bars)	White, yellow, white, yellow, white
080 A15	Low carbon:	
	As rolled or forged (black bars)	White, yellow, black, yellow, white
040 A17	Low carbon:	
	As rolled or forged (black bars)	White, yellow, brown, yellow, white
050 A17	Low carbon:	
	As rolled or forged (black bars)	White, yellow, green, yellow, white
060 A17	Low carbon:	
	As rolled or forged (black bars)	Yellow, black, yellow, black, yellow
080 A17	Low carbon:	
	As rolled or forged (black bars)	Yellow, black, blue, black, yellow
040 A20	'20' carbon:	
	As rolled or forged (black bars)	Yellow, black, brown, black, yellow
050 A20	'20' carbon:	
	As rolled or forged (black bars)	Green, white, green, white
060 A20	'20' carbon:	
	As rolled or forged (black bars)	Yellow, black, green, black, yellow
070 M20	'20' carbon:	
	As rolled or normalized	Brown, white, brown, white
	P condition	Black, brown, yellow, white
	Cold drawn from hot rolled	Black, yellow, blue, yellow, black
080 A20	'20' carbon:	
	As rolled or forged (black bars)	Yellow, black, red, black, yellow
040 A22	'22' carbon:	
	As rolled or forged (black bars)	Red, white, red, white
050 A22	'22' carbon:	
	As rolled or forged (black bars)	Yellow, black, white, black, yellow
060 A22	'22' carbon:	
	As rolled or forged (black bars)	Yellow, blue, yellow, blue, yellow
080 A22	'22' carbon:	
	As rolled or forged (black bars)	Yellow, blue, black, blue, yellow
060 A25	'25' carbon:	
	As rolled or forged (black bars)	Yellow, blue, brown, blue, yellow
080 A25	'25' carbon:	
	As rolled or forged (black bars)	Yellow, blue, green, blue, yellow
070 M26	'26' carbon:	
	As rolled or forged (black bars)	Yellow, blue, red, blue, yellow
	Normalized condition	Yellow, brown, blue, brown, yellow
	P condition	Yellow, brown, green, brown, yellow
	Q condition	Yellow, green, blue, green, yellow
	Cold drawn from hot rolled	Yellow, red, yellow, red, yellow
060 A27	'27' carbon:	
	As rolled or forged (black bars)	Yellow, blue, white, blue, yellow
080 A27	'27' carbon:	
	As rolled or forged (black bars)	Blue, white, black, red
060 A30	'30' carbon:	
	As rolled or forged (black bars)	Yellow, brown, black,brown, yellow
080 A30	'30' carbon:	
	As rolled or forged (black bars)	Blue, yellow, black, white
080 M30	'30' carbon:	
	As rolled or forged (black bars)	Blue, yellow, white, green
	Normalized condition	White, yellow, white, yellow
	P condition	Black, blue, black, brown
	Q condition	Black, blue, brown, green
	Cold drawn from hot rolled	Yellow, brown, red, brown, yellow

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NUMBER	DESCRIPTION	COLOUR
060 A32	'32' carbon:	
	As rolled or forged (black bars)	Yellow, brown, white, brown, yellow
080 A32	'32' carbon:	
	As rolled or forged (black bars)	Blue, white, brown, green
060 A35	'35' carbon:	
	As rolled or forged (black bars)	Yellow, green, yellow, green, yellow
080 A35	'35' carbon:	
	As rolled or forged (black bars)	Brown, blue, black, red
080 M36	'36' carbon:	
	As rolled or forged (black bars)	Yellow, white, black, white, yellow
	Normalized condition	Yellow, green, black, green, yellow
	Q condition	Yellow, red, blue, red, yellow
	R condition	Yellow, white, blue, white, yellow
	Cold drawn from hot rolled	Yellow, green, brown, green, yellow
060 A37	'37' carbon:	
	As rolled or forged (black bars)	Yellow, red, black, red, yellow
080 A37	'37' carbon:	
	As rolled or forged (black bars)	Brown, blue, black, white
060 A40	'40' carbon:	
	As rolled or forged (black bars)	Yellow, green, red, green, yellow
080 A40	'40' carbon:	
	As rolled or forged (black bars)	Brown, blue, black, yellow
080 M40	'40' carbon:	
	As rolled or forged (black bars)	Blue, white, brown, red
	Normalized condition	Black, blue, white, red
	Q condition	Blue, white, blue, black
	R condition	Black, blue, red, black
	Cold drawn from hot rolled	Brown, blue, black, green
060 A42	'42' carbon:	
	As rolled or forged (black bars)	Yellow, red, brown, red, yellow
080 A42	'42' carbon:	
	As rolled or forged (black bars)	Blue, white, black, yellow
080 M46	'46' carbon:	
	As rolled or forged (black bars)	Yellow, white, yellow, white, yellow
	Normalized condition	Yellow, red, green, red, yellow
	Q condition	Yellow, white, green, white, yellow
	R condition	Yellow, red, white, red, yellow
	S condition	Yellow, white, red, white, yellow
	Cold drawn from hot rolled	Green, red, brown, white
060 A47	'47' carbon:	
	As rolled or forged (black bars)	Yellow, green, white, green, yellow
080 A47	'47' carbon:	
	As rolled or forged (black bars)	Brown, blue, white, red
080 M50	'50' carbon:	
	As rolled or forged (black bars)	Brown, black, white, red
	Normalized condition	Red, yellow, red, green
	R condition	Red, yellow, red, white
	S condition	Blue, brown, black, green
	T condition	Green, white, brown, yellow
	Cold drawn from normalized	Brown, black, white, yellow
060 A52	'52' carbon:	
	As rolled or forged (black bars)	Yellow, white, brown, white, yellow
080 A52	'52' carbon:	
	As rolled or forged (black bars)	Brown, blue, white, yellow
070 M55	'55' carbon:	
	As rolled or forged (black bars)	Green, red, white, yellow
	Normalized condition	Green, yellow, blue, red
	R condition	Green, red, brown, yellow
	S condition	Green, red, yellow, white
	T condition	Green, yellow, blue, white
	Cold drawn from normalized	Green, red, blue, yellow

NUMBER	DESCRIPTION	COLOUR
060 A57	'57' carbon:	
	As rolled or forged (black bars)	Green, yellow, brown, red
080 A57	'57' carbon:	
	As rolled or forged (black bars)	Green, yellow, red, white
060 A62	'62' carbon:	
	As rolled or forged (black bars)	Green, yellow, white, red
080 A62	'62' carbon:	
	As rolled or forged (black bars)	Brown, red, white, green
060 A67	'67' carbon:	
	As rolled or forged (black bars)	Red, black, blue, white
080 A67	'67' carbon:	
	As rolled or forged (black bars)	Brown, red, white, yellow
060 A72	'72' carbon:	
	As rolled or forged (black bars)	Red, black, brown, white
070 A72	'72' carbon:	
	As rolled or forged (black bars)	Red, black, brown, yellow
080 A72	'72' carbon:	
	As rolled or forged (black bars)	Red, black, green, red
060 A78	'78' carbon:	
	As rolled or forged (black bars)	Red, black, green, yellow
~~060~~ 070 A78	'78' carbon:	
	As rolled or forged (black bars)	Red, black, white, red
080 A78	'78' carbon:	
	As rolled or forged (black bars)	Red, black, white, yellow
060 A83	'83' carbon:	
	As rolled or forged (black bars)	Red, black, yellow, white
080 A83	'83' carbon:	
	As rolled or forged (black bars)	Red, blue, black, white
050 A86	'86' carbon:	
	As rolled or forged (black bars)	Red, blue, brown, white
060 A86	'86' carbon:	
	As rolled or forged (black bars)	Red, blue, brown, yellow
080 A86	'86' carbon:	
	As rolled or forged (black bars)	Red, blue, green, white
060 A96	'96' carbon:	
	As rolled or forged (black bars)	Red, blue, green, yellow
060 A99	1% carbon:	
	As rolled or forged (black bars)	Red, blue, white, yellow
120 M19	'19' carbon - 1.2% manganese:	
	As rolled or forged (black bars)	Red, blue, yellow, red
	Normalized condition	White, black, green, yellow
	P condition	Red, yellow, green, white
	Q condition	White, red, blue, yellow
	R condition	Black, green, blue, yellow
	Cold drawn from hot rolled	Red, brown, blue, yellow
150 M19	'19' carbon - 1.5% manganese:	
	As rolled or forged (black bars)	Brown, black, blue, yellow
	Normalized condition	Blue, brown, blue, yellow
	P condition	Red, blue, yellow, white
	Q condition	Blue, green, blue, yellow
	R condition	Black, brown, blue, red
120 M28	'28' carbon - 1.2% manganese:	
	As rolled or forged (black bars)	Red, brown, black, white
	Normalized condition	Red, brown, yellow, red
	Q condition	White, black, red, yellow
	R condition	White, red, green, yellow
	Cold drawn from hot rolled	Black, green, blue, green

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NUMBER	DESCRIPTION	COLOUR
150 M28	'28' carbon - 1.5% manganese:	
	As rolled or forged (black bars)	Brown, green, blue, red
	Normalized condition	Blue, white, blue, brown
	Q condition	Brown, black, brown, green
	R condition	Black, brown, blue, white
	S condition	Red, brown, black, yellow
120 M36	'36' carbon - 1.2% manganese:	
	As rolled or forged (black bars)	Brown, red, blue, white
	Normalized condition	Red, brown, blue, white
	Q condition	Blue, white, blue, red
	R condition	Black, brown, green, yellow
	S condition	Black, brown, red, green
	Cold drawn from hot rolled	White, green, yellow, white
150 M36	'36' carbon - 1.5% manganese:	
	As rolled or forged (black bars)	Brown, green, blue, yellow
	Normalized condition	Red, brown, green, white
	Q condition	Blue, white, blue, green
	R condition	Black, brown, blue, yellow
	S condition	Black, brown, green, black
	T condition	White, black, brown, white
220 M07	Low carbon, free cutting:	
	Hot rolled	Black, yellow, black, yellow
	Cold drawn	Blue, white, yellow, brown
230 M07	Low carbon, free cutting:	
	Hot rolled	Black, green, blue, white
	Cold drawn	Black, red, green, blue
240 M07	Low carbon, free cutting:	
	Hot rolled	Brown, green, brown, green
	Cold drawn	Brown, black, green, brown
216 M28	'28' carbon, free cutting	
	As rolled or forged (black bars)	Red, green, black, yellow
	P condition	Red, green, blue, white
	Q condition	Red, white, blue, yellow
	Cold drawn from hot rolled	Red, yellow, blue, white
212 M36	'36' carbon, free cutting:	
	As rolled or forged (black bars)	Brown, green, black, yellow
	P condition	Red, green, blue, yellow
	Q condition	Black, white, black, brown
	R condition	Black, blue, white, brown
	Cold drawn from hot rolled	Brown, red, black, green
216 M36	'36' carbon, free cutting:	
	As rolled or forged (black bars)	Brown, red, blue, green
	P condition	Red, white, brown, yellow
	Q condition	Red, green, brown, yellow
	R condition	Blue, yellow, blue, brown
	Cold drawn from hot rolled	White, green, black, yellow
225 M36	'36' carbon, free cutting:	
	As rolled or forged (black bars)	Red, green, yellow, red
	Q condition	Red, white, yellow, red
	R condition	White, green, red, yellow
	Cold drawn from hot rolled	White, blue, yellow, white
212 A37	'37' carbon, free cutting:	
	As rolled or forged (black bars)	Brown, red, black, yellow
212 A42	'42' carbon, free cutting:	
	As rolled or forged (black bars)	Brown, white, black, green
212 M44	'44' carbon, free cutting:	
	As rolled or forged (black bars)	Red, green, yellow, white
	Q condition	White, black, yellow, white
	R condition	White, brown, blue, yellow
	S condition	White, red, brown, yellow

NUMBER	DESCRIPTION	COLOUR
225 M44	'44' carbon, free cutting:	
	As rolled or forged (black bars)	White, blue, brown, yellow
	R condition	White, brown, red, white
	S condition	Black, brown, yellow, blue
	T condition	Black, green, brown, blue
BS970 Pt 2	Alloy steels:	
503 M40	1% nickel:	
	As rolled	Blue, white, green, brown
	Normalized	Black, red, black, yellow
	Q condition	Black, white, black, yellow
	R condition	Red, black, red, black, red
	S condition	Red, black, blue, black, red
503 A37	1% nickel:	
	As rolled	Brown, black, blue, green
	Hardened and tempered	Blue, brown, blue, white
503 A42	1% nickel:	
	As rolled	Brown, black, blue, red
	Hardened and tempered	Blue, green, blue, white
503 H37	1% nickel:	
	As rolled	Black, blue, white, blue, black
	Heat treated	Black, brown, black, brown, black
503 H42	1% nickel:	
	As rolled	Black, brown, blue, brown, black
	Heat treated	Black, brown, green, brown, black
526 M60	¾% chromium:	
	As rolled	Brown, yellow, black, white
	T condition	Black, red, black, white
	V condition	Black, brown, blue, green
530 M40	1% chromium:	
	As rolled	Blue, white, green, yellow
	R condition	Brown, blue, brown, black
	S condition	Black, green, white, yellow
	T condition	Black, green, yellow, black
530 A30	1% chromium:	
	As rolled	Brown, yellow, blue, ~~red~~ brown
	Hardened and tempered	Green, yellow, green, brown
530 A32	1% chromium:	
	As rolled	Brown, yellow, blue, green
	Hardened and tempered	Brown, blue, brown, green
530 A36	1% chromium:	
	As rolled	Brown, yellow, blue, red
	Hardened and tempered	Brown, blue, brown, red
530 A40	1% chromium:	
	As rolled	Brown, yellow, blue, white
	Hardened and tempered	Brown, blue, brown, white
530 H30	1% chromium:	
	As rolled	Black, brown, red, brown, black
	Heat treated	Black, brown, yellow, brown, black
530 H32	1% chromium:	
	As rolled	Black, brown, white, brown, black
	Heat treated	Black, green, black, green, black
530 H36	1% chromium:	
	As rolled	Black, green, blue, green, black
	Heat treated	Black, green, brown, green, black
530 H40	1% chromium:	
	As rolled	Black, green, yellow, green, black
	Heat treated	Black, red, blue, red, black

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NUMBER	DESCRIPTION	COLOUR
534 A99	1½% chromium (1% carbon):	
	As rolled	Brown, blue, red, yellow
535 A99	1½% chromium (1% carbon):	
	As rolled	Red, white, red, white, red
605 M30	1½% manganese molybdenum (water hardening):	
	As rolled	Brown, white, blue, red
	R condition	Brown, black, brown, red
	S condition	Black, green, brown, yellow
	T condition	Black, green, red, brown
	U condition	Black, green, red, white
	V condition	Black, green, red, yellow
605 M36	1½% manganese molybdenum:	
	As rolled	Blue, white, brown, yellow
	R condition	Blue, white, blue, yellow
	S condition	Black, brown, red, yellow
	T condition	Black, brown, white, blue
	U condition	Black, brown, white, green
	V condition	Black, brown, white, red
695 A32	1½% manganese molybdenum:	
	As rolled	Brown, white, blue, brown
	Hardened and tempered	Blue, yellow, blue, red
605 A37	1½% manganese molybdenum:	
	As rolled	Brown, white, blue, green
	Hardened and tempered	Blue, yellow, blue, white
605 H32	1½% manganese molybdenum:	
	As rolled	Red, white, blue, white, red
	Heat treated	Red, white, brown, white, red
605 H37	1½% manganese molybdenum:	
	As rolled	Red, white, green, white, red
	Heat treated	Red, white, yellow, white, red
606 M36	1½% manganese molybdenum (free cutting):	
	As rolled	Brown, white, blue, yellow
	R condition	Brown, black, brown, white
	S condition	Black, blue, brown, blue, black
	T condition	Black, blue, yellow, blue, black
608 M38	1½% manganese molybdenum (higher molybdenum):	
	As rolled	Blue, white, green, red
	R condition	Brown, black, brown, yellow
	S condition	Black, green, white, black
	T condition	Black, green, white, blue
	U condition	Black, green, white, brown
	V condition	Black, green, white, red
608 H37	1½% manganese molybdenum (higher molybdenum):	
	As rolled	Red, brown, blue, brown, red
	Heat treated	Red, brown, green, brown, red
640 M40	1¾% nickel chromium:	
	As rolled	Red, black, red, brown
	R condition	Yellow, white, yellow, red
	S condition	Blue, red, brown, yellow
	T condition	Blue, red, green, black
	U condition	Blue, red, green, blue
640 A35	1¾% nickel chromium:	
	As rolled	Green, blue, green, yellow
	Hardened and tempered	Green, brown, green, black
640 H35	1¾% nickel chromium:	
	As rolled	Red, green, brown, green, red
	Heat treated	Red, yellow, blue, yellow, red

NUMBER	DESCRIPTION	COLOUR
653 M31	3% nickel chromium:	
	As rolled	Brown, red, green, brown
	S condition	Brown, red, brown, yellow
	T condition	Black, yellow, white, blue
	U condition	Black, yellow, white, brown
708 M40	1% chromium molybdenum:	
	As rolled	Brown, black, green, white
	R condition	Brown, green, brown, black
	S condition	Black, red, green, yellow
	T condition	Black, red, white, black
	U condition	Black, red, white, blue
708 A37	1% chromium molybdenum:	
	As rolled	Brown, black, green, yellow
	Hardened and tempered	Brown, green, brown, blue
708 A42	1% chromium molybdenum:	
	As rolled	Brown, blue, green, red
	Hardened and tempered	Brown, green, brown, white
708 H37	1% chromium molybdenum:	
	As rolled	Red, brown, yellow, brown, red
	Heat treated	Red, brown, white, brown, red
708 H42	1% chromium molybdenum:	
	As rolled	Red, green, red, green, red
	Heat treated	Red, green, black, green, red
709 M40	1% chromium molybdenum (high molybdenum):	
	As rolled	Brown, black, green, red
	R condition	Brown, blue, brown, yellow
	S condition	Black, red, brown, black
	T condition	Black, red, brown, green
	U condition	Black, red, brown, white
	V condition	Black, red, brown, yellow
722 M24	3% chromium molybdenum (suitable for nitriding):	
	As rolled	Brown, white, red, yellow
	T condition	Blue, black, yellow, blue
	U condition	Blue, black, yellow, brown
785 M19	1½% manganese nickel molybdenum:	
	As rolled	Brown, black, blue, white
	Q condition	Blue, brown, blue, black
816 M40	1½% nickel chromium molybdenum (low molybdenum):	
	As rolled	Green, white, black, yellow
	S condition	Yellow, white, yellow, green
	T condition	Blue, red, brown, black
	U condition	Blue, red, brown, blue
	V condition	Blue, red, brown, green
817 M40	1½% nickel chromium molybdenum:	
	As rolled	Blue, yellow, black, green
	T condition	Black, yellow, white, red
	U condition	Black, red, yellow, blue
	V condition	Black, red, yellow, brown
	W condition	Black, red, yellow, green
	X condition	Black, red, yellow, white
	Z condition	Black, white, blue, green
823 M30	2% nickel chromium molybdenum:	
	As rolled	Red, black, white, black, red
	T condition	Red, blue, red, blue, red
	U condition	Red, blue, brown, blue, red
	V condition	Red, blue, green, blue, red
	W condition	Red, blue, yellow, blue, red
	X condition	Red, blue, white, blue, red
	Z condition	Red, brown, red, brown, red

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NUMBER	DESCRIPTION	COLOUR
826 M31	2½% nickel chromium molybdenum (medium carbon):	
	As rolled	Blue, yellow, black, red
	T condition	Brown, white, brown, blue
	U condition	Black, white, blue, red
	V condition	Black, white, blue, yellow
	W condition	Black, white, brown, black
	X condition	Black, white, brown, green
	Z condition	Black, white, brown, yellow
826 M40	2½% nickel chromium molybdenum (high carbon):	
	As rolled	Brown, white, green, brown
	U condition	Brown, white, brown, green
	V condition	Black, white, green, brown
	W condition	Black, white, green, red
	X condition	Black, white, green, yellow
	Y condition	Black, white, red, brown
	Z condition	Black, white, red, green
830 M31	3% nickel chromium molybdenum:	
	As rolled	Brown, white, green, yellow
	T condition	Brown, white, brown, red
	U condition	Black, white, red, yellow
	V condition	Black, white, yellow, blue
	W condition	Black, white, yellow, brown
835 M30	4% nickel chromium molybdenum:	
	As rolled	Blue, white, red, brown
	Z condition	Black, blue, green, white
897 M39	3½% chromium molybdenum vanadium (suitable for nitriding in 85-ton condition):	
	As rolled	Brown, yellow, red, brown
	85 tonf/in^2	Red, brown, red, yellow
	Z condition (100 tonf/in^2)	Red, black, green, black, red
905 M31	1½% chromium aluminium molybdenum nitriding (medium carbon):	
	As rolled	Brown, yellow, red, white
	R condition	Red, green, red, black
	S condition	Blue, black, yellow, green
905 M39	1½% chromium aluminium molybdenum nitriding (high carbon):	
	As rolled	Brown, black, white, green
	R condition	Red, green, red, blue
	S condition	Blue, black, yellow, white
	T condition	Blue, brown, black, blue
945 M38	1½% manganese nickel chromium molybdenum:	
	As rolled	Blue, brown, blue, brown
	R condition	Yellow, red, yellow, brown
	S condition	Blue, green, black, yellow
	T condition	Blue, green, brown, black
	U condition	Blue, green, brown, red
	V condition	Blue, green, brown, white
945 A40	1½% manganese nickel chromium molybdenum:	
	As rolled	Red, black, red, green
BS970 Pt 3	Steels for case hardening:	
045 M10	'10' carbon steel:	
	As rolled or forged and bright bars	Green, black, green, blue
080 M15	'15' carbon steel:	
	As rolled or forged and bright bars	Blue, white, red, yellow
210 M15	'15' carbon, free cutting:	
	As rolled or forged and bright bars	Green, black, green, white

NUMBER	DESCRIPTION	COLOUR
130 M15	'15' carbon 1.3% manganese: As rolled or forged and bright bars	Green, brown, green, white
214 M15	'15' carbon 1.4% manganese, free cutting: As rolled or forged and bright bars	Green, brown, green, yellow
523 A14	½% chromium: As rolled or forged and bright bars	Green, red, green, black
523 M15	½% chromium: As rolled or forged and bright bars	Black, red, brown, red, black
527 A19	¾% chromium: As rolled or forged and bright bars	Green, red, green, blue
527 M20	¾% chromium: As rolled or forged and bright bars	Black, red, green, red, black
635 A14	¾% nickel chromium: As rolled or forged and bright bars	Black, red, yellow, red, black
635 H15	¾% nickel chromium: As rolled or forged and bright bars	Black, red, white, red, black
635 M15	¾% nickel chromium: As rolled or forged and bright bars	Green, red, green, white
637 A16	1% nickel chromium: As rolled or forged and bright bars	Black, yellow, green, yellow, black
637 H17	1% nickel chromium: As rolled or forged and bright bars	Black, yellow, red, yellow, black
637 M17	1% nickel chromium: As rolled or forged and bright bars	Green, red, green, yellow
655 A12	3½% nickel chromium: As rolled or forged and bright bars	Black, yellow, white, yellow, black
655 H13	3½% nickel chromium: As rolled or forged and bright bars	Black, white, black, white, black
655 M13	3½% nickel chromium: As rolled or forged and bright bars	Black, white, blue, white, black
659 A15	4% nickel chromium: As rolled or forged and bright bars	Black, white, brown, white, black
659 H15	4% nickel chromium: As rolled or forged and bright bars	Black, white, green, white, black
659 M15	4% nickel chromium: As rolled or forged and bright bars	Red, brown, red, black
665 A17	1¾% nickel molybdenum: As rolled or forged and bright bars	Black, white, red, white, black
665 H17	1¾% nickel molybdenum: As rolled or forged and bright bars	Black, white, yellow, white, black
665 M17	1¾% nickel molybdenum: As rolled or forged and bright bars	Blue, yellow, brown, green
665 A19	1¾% nickel molybdenum: As rolled or forged and bright bars	Green, black, blue, black, green
665 H20	1¾% nickel molybdenum: As rolled or forged and bright bars	Green, black, brown, black, green
665 M20	1¾% nickel molybdenum: As rolled or forged and bright bars	Green, black, yellow, black, green
665 A22	1¾% nickel molybdenum: As rolled or forged and bright bars	Green, blue, green, red
665 H23	1¾% nickel molybdenum: As rolled or forged and bright bars	Green, black, white, black, green
665 M23	1¾% nickel molybdenum: As rolled or forged and bright bars	Green, blue, green, brown
665 A24	1¾% nickel molybdenum: As rolled or forged and bright bars	Green, blue, green, white
805 A15	¼% nickel chromium molybdenum: As rolled or forged and bright bars	Green, blue, green, blue, green
805 A17	¼% nickel chromium molybdenum: As rolled or forged and bright bars	Green, blue, brown, blue, green
805 H17	¼% nickel chromium molybdenum: As rolled or forged and bright bars	Green, blue, red, blue, green

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NUMBER	DESCRIPTION	COLOUR
805 M17	½% nickel chromium molybdenum: As rolled or forged and bright bars	Green, white, green, red
805 A20	½% nickel chromium molybdenum: As rolled or forged and bright bars	Green, blue, yellow, blue, green
805 H20	½% nickel chromium molybdenum: As rolled or forged and bright bars	Green, blue, white, blue, green
805 M20	½% nickel chromium molybdenum: As rolled or forged and bright bars	Green, white, green, yellow
805 A22	½% nickel chromium molybdenum: As rolled or forged and bright bars	Green, brown, black, brown, green
805 H22	½% nickel chromium molybdenum: As rolled or forged and bright bars	Green, brown, blue, brown, green
805 M22	½% nickel chromium molybdenum: As rolled or forged and bright bars	Green, brown, red, brown, green
805 A24	½% nickel chromium molybdenum: As rolled or forged and bright bars	Green, brown, yellow, brown, green
805 H25	½% nickel chromium molybdenum: As rolled or forged and bright bars	Green, red, green, red, green
805 M25	½% nickel chromium molybdenum: As rolled or forged and bright bars	Green, yellow, green, black
815 A16	1½% nickel chromium molybdenum: As rolled or forged and bright bars	Green, red, black, red, green
815 H17	1½% nickel chromium molybdenum: As rolled or forged and bright bars	Green, red, blue, red, green
815 M17	1½% nickel chromium molybdenum: As rolled or forged and bright bars	Green, white, green, black
820 A16	1¾% nickel chromium molybdenum: As rolled or forged and bright bars	Green, red, brown, red, green
820 H17	1¾% nickel chromium molybdenum: As rolled or forged and bright bars	Green, red, yellow, red, green
820 M17	1¾% nickel chromium molybdenum: As rolled or forged and bright bars	Green, white, green, blue
822 A17	2% nickel chromium molybdenum: As rolled or forged and bright bars	Green, red, white, red, green
822 H17	2% nickel chromium molybdenum: As rolled or forged and bright bars	Green, yellow, green, yellow, green
822 M17	2% nickel chromium molybdenum: As rolled or forged and bright bars	Green, white, green, brown
832 H13	3½% nickel chromium molybdenum: As rolled or forged and bright bars	Green, yellow, black, yellow, green
832 M13	3½% nickel chromium molybdenum: As rolled or forged and bright bars	Red, blue, red, green
835 A15	4% nickel chromium molybdenum: As rolled or forged and bright bars	Green, yellow, blue, yellow, green
835 H15	4% nickel chromium molybdenum: As rolled or forged and bright bars	Green, yellow, brown, yellow, green
835 M15	4% nickel chromium molybdenum: As rolled or forged and bright bars	Red, brown, red, blue
BS970 Pt 4	Stainless, heat resisting and valve steels:	
302 S25	Cr Ni 18/9, C 0.12 austenitic steel:	
	As rolled	Blue, yellow, brown, yellow, blue
	Softened	Brown, blue, black, blue, brown
	Cold drawn	Brown, blue, brown, blue, brown
303 S21	Cr Ni 18/9, S bearing, free machining austenitic steel:	
	As rolled	Brown, blue, red, blue, brown
	Softened	Red, yellow, green, yellow, red
	Cold drawn	Brown, blue, yellow, blue, brown

NUMBER	DESCRIPTION	COLOUR
303 S41	Cr Ni 18/9. Se bearing, free machining austenitic steel:	
	Softened	Yellow, green, yellow, red, yellow
	Cold drawn	Brown, blue, white, blue, brown
304 S12	Cr Ni 18/10, C 0.03 austenitic steel:	
	As rolled	Brown, green, blue, green, brown
	Softened	Red, green, white, green, red
304 S15	Cr Ni 18/9, C 0.06 austenitic steel:	
	As rolled	Green, black, green, brown, green
	Softened	Red, yellow, brown, yellow, red
	Cold drawn	Brown, green, black, green, brown
310 S24	Cr Ni 25/20 austenitic steel:	
	As rolled	Brown, green, brown, green, brown
	Softened	Brown, green, yellow, green, brown
315 S16	Cr Ni Mo 17/10/1½, C 0.07 austenitic steel:	
	As rolled	Brown, green, white, green, brown
	Softened	Brown, red, blue, red, brown
316 S12	Cr Ni Mo 17/12/2½, C 0.03 austenitic steel:	
	As rolled	Brown, red, black, red, brown
	Softened	Brown, red, brown, red, brown
316 S16	Cr Ni Mo 17/11/2½, C 0.07 austenitic steel:	
	As rolled	Brown, red, green, red, brown
	Softened	Brown, red, yellow, red, brown
	Cold drawn	Brown, red, white, red, brown
317 S12	Cr Ni Mo 18/15/3½, C 0.03 austenitic steel:	
	As rolled	Brown, yellow, blue, yellow, brown
	Softened	Brown, yellow, black, yellow, brown
317 S16	Cr Ni Mo 18/13/3½, C 0.06 austenitic steel:	
	As rolled	Brown, yellow, brown, yellow, brown
	Softened	Brown, yellow, green, yellow, brown
320 S17	Cr Ni Mo 17/12/2½ + Ti, C 0.08 austenitic steel:	
	As rolled	Brown, yellow, red, yellow, brown
	Softened	Brown, yellow, white, yellow, brown
321 S12	Cr Ni 18/9/Ti, C 0.08 austenitic steel:	
	As rolled	Black, blue, black, blue, black
	Softened	Black, blue, green, blue, black
	Cold drawn	Black, blue, red, blue, black
321 S20	Cr Ni 18/9/Ti, C 0.12 austenitic steel:	
	As rolled	Black, green, white, green, black
	Softened	Black, red, black, red, black
	Cold drawn	Black, yellow, black, yellow, black
325 S21	Cr Ni 18/9/Ti, S bearing, free machining austenitic steel:	
	Softened	Red, yellow, red, yellow, red
	Cold drawn	Brown, white, blue, white, brown
326 S36	Cr Ni Mo 17/11/2½, Se bearing, free machining austenitic steel:	
	Softened	Brown, white, black, white, brown
	Cold drawn	Brown, white, brown, white, brown
331 S40	Ni Cr W 14/14/2½ valve steel	
	As rolled or soft	Brown, white, green, white, brown
331 S42	Ni Cr W 14/14/2½ + Mo valve steel:	
	As rolled or softened	Brown, white, red, white, brown
347 S17	Cr Ni 18/9/Nb, C 0.08 austenitic steel:	
	As rolled	Brown, black, brown, black, brown
	Softened	Brown, black, blue, black, brown
349 S52	Cr Mn Ni, 21/4 N valve steel:	
	As rolled and stress relieved	Brown, black, green, black, brown
349 S54	Cr Mn Ni, 21/4 N, S bearing valve steel:	
	As rolled and stress relieved	Brown, black, red, black, brown
352 S52	Cr Mn Ni, 21/4 N + Nb valve steel:	
	As rolled and stress relieved	Brown, black, yellow, black, brown

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NUMBER	DESCRIPTION	COLOUR
352 S54	Cr Mn Ni, 21/4 N + Nb, S bearing valve steel:	
	As rolled and stress relieved	Brown, black, red, black, brown
381 S34	Cr Ni, 21/11 + N valve steel:	
	As rolled and stress relieved	Brown, white, yellow, white, brown
401 S45	Si Cr, 3/8 valve steel:	
	As rolled and stress relieved	Blue, black, brown, black, blue
403 S17	13 Cr, C 0.08 max ferritic steel:	
	Softened	Blue, black, white, black, blue
410 S21	13 Cr, C 0.12 martensitic steel:	
	P condition	Blue, brown, blue, brown, blue
	Softened	Blue, brown, green, brown, blue
416 S21	13 Cr, C 0.12, S bearing, free machining martensitic steel:	
	P condition	Red, green, yellow, green, red
416 S29	13 Cr, C 0.17, S bearing, free machining martensitic steel:	
	R condition	Blue, green, black, green, blue
	S condition	Blue, green, red, green, blue
416 S37	13 Cr, C 0.24, S bearing, free machining martensitic steel:	
	R condition	Blue, red, black, red, blue
	S condition	Blue, red, yellow, red, blue
416 S41	13 Cr, C 0.12, Se bearing, free machining martensitic steel:	
	P condition	Red, white, black, white, red
	R condition	Red, black, yellow, black, red
420 S29	13 Cr, C 0.17 martensitic steel:	
	Softened	Blue, yellow, green, yellow, blue
	R condition	Blue, brown, yellow, brown, blue
	S condition	Blue, green, white, green, blue
420 S37	13 Cr C 0.24 martensitic steel:	
	R condition	Blue, yellow, red, yellow, blue
	S condition	Blue, yellow, white, yellow, blue
	Softened	Blue, white, blue, white, blue
420 S45	13 Cr C 0.32 martensitic steel:	
	R condition	Blue, white, black, white, blue
	S condition	Blue, white, brown, white, blue
	Softened	Blue, white, green, white, blue
430 S15	17 Cr, C 0.10 ferritic steel:	
	Softened	Blue, white, red, white, blue
431 S29	17 Cr, 2½ Ni, C 0.15 martensitic steel:	
	Softened	Green, blue, black, green
	Hardened and tempered, & T condition	Yellow, blue, yellow, red
441 S29	17 Cr, 2½ Ni, C 0.15, S bearing, free machining martensitic steel:	
	Softened	Red, yellow, white, yellow, red
	Hardened and tempered	Red, green, blue, green, red
	T condition	Red, blue, black, blue, red
441 S49	17 Cr, 2½ Ni, C 0.15, Se bearing free machining martensitic steel:	
	Softened	Red, black, brown, black, red
	Hardened and tempered	Red, brown, black, brown, red
	T condition	Red, yellow, black, yellow, red
443 S65	Cr Ni Si, 20/1½/2 valve steel:	
	As rolled and stress relieved	Blue, white, yellow, white, blue
BS970 Pt 5	Carbon and alloy spring steels:	
080 A52	'52' carbon:	
	As rolled or forged	Red, yellow, red, black
080 A67	'67' carbon:	
	As rolled or forged	Green, yellow, red, yellow, green

NUMBER	DESCRIPTION	COLOUR
070 A72	'72' carbon: As rolled or forged	Red, green, red, brown
070 A78	'78' carbon: As rolled or forged	Green, yellow, white, yellow, green
060 A96	'96' carbon: As rolled or forged	White, blue, white, red
250 A53	Silico-manganese '53' carbon: As rolled or forged	White, brown, white, red
250 A58	Silico-manganese '58' carbon: As rolled or forged	White, brown, white, yellow
250 A61	Silico-manganese '61' carbon: As rolled or forged	Green, white, green, white, green
527 A60	¾% chromium: As rolled or forged	Green, white, black, white, green
527 H60	¾% chromium: As rolled or forged	Green, white, blue, white, green
735 A50	1% chromium vanadium: As rolled or forged	Blue, yellow, red, green
805 A60	½% nickel chromium molybdenum: As rolled or forged	Green, white, brown, white, green
805 H60	½% nickel chromium molybdenum: As rolled or forged	Green, white, red, white, green
925 A60	Silicon-manganese chromium molybdenum: As rolled or forged	Green, white, yellow, white, green
BS980	Steel tubes for automobile purposes:	
CDS-1	Mild steel, soft: Annealed or normalized	Blue, brown, blue
CDS-2	Mild steel, hard: As drawn, tempered	Red, black, yellow
CDS-3	Low carbon case-hardening steel: As drawn, or as drawn and tempered	Blue, brown, red
CDS-3A	Low carbon case-hardening steel: Annealed or normalized	Blue, brown, white
CDS-4	Low carbon case-hardening steel (free machining): As drawn or as drawn and tempered	Blue, brown, yellow
CDS-5	'30' carbon steel, soft: Annealed or normalized	Blue, green, brown
CDS-6	'30' carbon steel, hard: As drawn or as drawn and tempered	Blue, green, red
CDS-7	'45' carbon steel, soft: Annealed or normalized	Blue, green, yellow
CDS-8	'45' carbon steel, hard: As drawn or as drawn and tempered	Blue, red, blue
CDS-9	Carbon-manganese steel, soft (suitable for welding): Annealed	Blue, red, white
CDS-10	Carbon-manganese steel, hard (suitable for welding): As drawn or as drawn and tempered	Blue, red, yellow
CDS-11	'26' carbon-manganese-molybdenum steel (suitable for welding): As drawn and tempered or heat treated	Blue, white, brown
CDS-12	1 per cent chromium-molybdenum steel (suitable for welding): As drawn and tempered or heat treated	Blue, yellow, blue
CDS-13	1 per cent, chromium-molybdenum steel, hard: As drawn or heat treated	Blue, yellow, white
CDS-14	3 per cent nickel steel, hard: As drawn or heat treated	Brown, blue, brown

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NUMBER	DESCRIPTION	COLOUR
CDS-15	70 ton steel: Heat treated	Brown, blue, green
CDS-16	75 ton nickel-chromium steel: Hardened and tempered	Brown, blue, red
CDS-17	85 ton nickel-chromium steel: Hardened and tempered	Brown, blue, white
CDS-18	12 per cent chromium steel, soft: Annealed and descaled	Brown, blue, yellow
CDS-19	Austenitic chromium-nickel steel, soft: Softened and descaled	Brown, green, red
CDS-20	Austenitic chromium-nickel steel, soft (suitable for welding): Softened and descaled	Brown, green, white
ERW 1	Carbon steel: As welded	Brown, green, yellow
ERW 2	Carbon steel: As welded	Brown, red, brown
ERW 3	Carbon steel: As welded	Brown, red, green
CEW 1	Mild steel, soft: Annealed or normalized	Brown, white, brown
CEW 2	Mild steel, hard: As drawn or as drawn and tempered	Brown, white, green
CEW 3	'30' carbon steel, soft: Annealed or normalized	Brown, white, red
CEW 4	'30' carbon steel, hard: As drawn or as drawn and tempered	Brown, yellow, brown
BS1052	Mild steel wire for general engineering purposes: Annealed condition	Black, blue, white, green
BS1408-C	High duty unground steel spring wire Range 3	Green, white, green, yellow
BS1449	Steel plate, sheet and strip:	
En 21A	3 per cent nickel steel: As rolled, normalized and/or tempered	Red, white, red, white
En 42E	Carbon spring steel (hardening and tempering quality):	
	Cold-rolled and annealed	Red, yellow, red, white
	As cold-rolled	Green, black, green, blue
	Hardened and tempered	Red, yellow, red, yellow
	Hot-rolled or normalized	Green, black, green, brown
En 42F	Cold-rolled and annealed	Red, brown, red, green
	As cold-rolled	Green, black, green, red
	Hardened and tempered	Red, brown, red, white
	Hot-rolled or normalized	Green, black, green, yellow
En 42G	Cold-rolled and annealed	White, blue, white, blue
	As cold-rolled	Green, blue, green, black
	Hardened and tempered	White, blue, white, brown
	Hot-rolled or normalized	Green, blue, green, brown
En 42J	Cold-rolled and annealed	White, blue, white, green
	As cold-rolled	Green, blue, green, red
	Hardened and tempered	White, blue, white, red
	Hot-rolled or normalized	Green, blue, green, yellow

NUMBER	DESCRIPTION	COLOUR
En 43G	Carbon spring steel (hardening and tempering quality):	
	Cold-rolled and annealed	Red, white, red, yellow
	As cold-rolled	Green, brown, green, black
	Hardened and tempered	Red, yellow, red, blue
	Hot-rolled or normalized	Green, brown, green, red
En 43J	Cold-rolled and annealed	Red, yellow, red, brown
	As cold-rolled	Green, brown, green, yellow
	Hardened and tempered	Red, yellow, red, green
	Hot-rolled or normalized	Green, red, green, black
En 44D	Carbon spring steel (hardening and tempering quality):	
	Cold-rolled and annealed	White, blue, white, yellow
	As cold-rolled	Green, red, green, blue
	Hardened and tempered	White, brown, white, blue
	Hot-rolled or normalized	Red, green, red, brown
En 44E	Cold-rolled and annealed	White, brown, white, brown
	As cold-rolled	Green, white, green, black
	Hardened and tempered	White, brown, white, green
	Hot-rolled or normalized	Green, yellow, green, black
En 56A	Chromium rust-resisting steel sheet and strip:	
	Softened	White, brown, white, red
	Hardened and tempered	White, brown, white, yellow
En 56B	Softened	White, green, white, blue
	Hardened and tempered	White, green, white, brown
En 56C	Softened	White, green, white, green
	Hardened and tempered	White, green, white, red
En 56D	Softened	White, green, white, yellow
	Hardened and tempered	White, red, white, blue
En 56R	Hardened and tempered	Yellow, blue, yellow, red
En 56T	Hardened and tempered	Yellow, brown, yellow, black
En 56V	Hardened and tempered	Yellow, brown, yellow, green
En 57	Martensitic chromium-nickel rust-resisting steel sheet and strip:	
	Softened	White, red, white, brown
	Hardened and tempered	White, red, white, green
En 58A	Austenitic chromium-nickel rust, acid and heat resisting steel sheet and strip:	
	Softened	Blue, green, blue, black
	Cold-rolled	White, red, white, yellow
Fn 58B	Softened	White, yellow, white, blue
	Cold-rolled	White, yellow, white, brown
En 58C	Softened	White, yellow, white, green
	Cold-rolled	White, yellow, white, red
En 58D	Softened	White, yellow, white, yellow
	Cold-rolled	Blue, brown, blue, brown
En 58E	Softened	Blue, brown, blue, green
	Cold-rolled	Blue, brown, blue, red
En 58F	Softened	Blue, brown, blue, white
	Cold-rolled	Blue, brown, blue, yellow
En 58G	Softened	Blue, green, blue, brown
	Cold-rolled	Blue, green, blue, green
En 58H	Softened	Blue, green, blue, red
	Cold-rolled	Blue, green, blue, white
En 58J	Softened	Blue, green, blue, yellow
	Cold-rolled	Blue, red, blue, brown
En 60	Ferritic chromium rust-resisting steel sheet and strip:	
	Softened	Blue, red, blue, green
En 61	Softened	Blue, red, blue, white

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NUMBER	DESCRIPTION	COLOUR
BS1449 1962 Steel plate sheet and strip, Grades:		
	HR1, HRP1)	Blue, green, red, white
	HR11, HRP11)	
EN2A/1	HR2, HRP2)	Blue, green, white, blue
	HR12, HRP12)	
	HR2-VE	Blue, green, yellow, blue
	NHR12	Blue, green, white, brown
	HS23B	Green, red, blue, white
	HS23C	Red, brown, white, red
	CS12A	Red, blue, black, white
	CS12B	Red, black, green, yellow
	CS12C	Green, brown, black, white
	CS17A	Blue, brown, black, white
	CS17B	Blue, brown, green, blue
	CS17C	Blue, green, black, brown
	CS22A	White, blue, black, yellow
	CS22B	White, green, yellow, white
	CS22C	White, yellow, red, yellow
	NHR22	White, brown, green, yellow
	HR6A, HRP6A)	Green, yellow, blue, red
	HR17A, HRP17A)	
	HR6B, HRP6B)	Green, red, yellow, green
	HR17B, HRP17B)	
	HR6C, HRP6C)	Green, red, brown, yellow
	HR17C, HRP17C)	
	HR17/1	Green, white, green, red
	NHR23	Green, yellow, blue, white
	EN2D	Brown, red, blue, red
	EN2D/A	Green, brown, red, green
	EN2D/B	Green, brown, yellow, green
	HR7A, HRP7A	Green, yellow, green, white
	HR7B, HRP7B	Green, yellow, white, yellow
	HR7C, HRP7C	Red, yellow, red, white
	NHR24	Red, white, brown, yellow
	EN5 (Part 2B)	Yellow, blue, brown, yellow
	HS30	White, green, red, white
	HR8B, HRP8B	Red, blue, green, yellow
	HR8C, HRP8C	Red, brown, blue, white
	NHR25	Red, brown, white, yellow
	EN5 (Part 2B)	Brown, red, white, red
	EN14A (Part 2B)	Green, red, white, red
	HS20	Brown, green, yellow, white
	HS40	Brown, red, green, white
	CS30	Brown, red, black, white
	CS40	Brown, red, blue, green
	HS50	White, yellow, green, yellow
	HS60	Yellow, blue, green, yellow
	HS70	White, blue, red, yellow
	HS80	Green, yellow, red, white
	HS90	Red, brown, blue, yellow
	HS100	Green, white, yellow, green
	CS50	Brown, red, brown, yellow
	CS60	Brown, red, green, yellow
	CS70	Brown, red, yellow, brown
	CS80 Annealed	Brown, white, black, yellow
	CS80 Hardened and tempered	Green, white, black, yellow
	CS90	Brown, white, brown, green
	CS100	Brown, white, green, yellow
	HS1	Blue, green, red, yellow
	HS2	Blue, green, white, green
	CR1/GP	Blue, red, black, brown
	CR1/FF	Blue, red, black, green

NUMBER	DESCRIPTION	COLOUR
	CR1/VE	Blue, red, black, red
	CR2/GP	Blue, green, yellow, brown
	CR2/FF	Blue, green, yellow, green
	CR2/VE	Blue, green, yellow, red
	CS1	Blue, green, white, red
	CS2	Blue, green, white, yellow
EN2A	HR3, HRP3)	Blue, red, white, green
	HR13, HRP13)	
	HR3/VE	Blue, red, white, yellow
	NHR13	Blue, red, yellow, blue
	HS3	Blue, red, yellow, brown
	CR3-GP	Blue, white, blue, brown
	CR3-FF	Blue, white, blue, green
	CR3-VE	Blue, white, blue, red
	EN2A Part 2B	Blue, red, blue, red
	CS3	Blue, white, black, brown
	HR4, HRP4)	Blue, white, green, white
	HR14, HRP24)	
	HR4-VE	Blue, white, green, yellow
	NHR-14	Blue, white, red, green
	HS4A	Blue, white, red, white
	HS4B	Blue, white, yellow, blue
	CR4-GP	Blue, white, yellow, brown
	CR4-FF	Blue, white, yellow, green
	CR4-VE	Blue, white, yellow, red
	CS4-Annealed	Blue, white, red, yellow
	-Skin passed	Blue, white, yellow, white
	-¼H	Blue, yellow, black, brown
	-½H	Blue, yellow, black, green
	-H	Blue, yellow, black, red
	EN2B	Blue, yellow, blue, green
	EN2B/B	Blue, white, green, red
	NHR15	Red, green, white, red
	EN2 (Part 2B)	Brown, yellow, brown, red
	HR5A, HRP5A)	Red, white, yellow, red
	HR16A, HRP16A)	
	HR5B, HRP5B)	Red, yellow, brown, yellow
	HR16B, HRP16B)	
	HR5C, HRP5C)	Red, green, yellow, white
	HR16C, HRP16C)	
	HR16/1, HRP16/1	Red, yellow, green, white
	NHR21	White, green, red, yellow
	EN2C/2 (Part 2B)	Red, green, red, white
	EN2C	Red, black, yellow, red
	EN2C/A	Black, yellow, green, yellow
	EN2C/B	Red, yellow, green, yellow
	HS12A	Brown, yellow, green, yellow
	HS12B	Brown, white, yellow, brown
	HS12C	Brown, yellow, blue, green
	HS17A	Brown, yellow, white, green
	HS17B	Brown, yellow, red, yellow
	HS17C	Red, blue, white, yellow
	HS22A	Brown, yellow, green, red
	HS22B	Red, blue, brown, white
	HS22C	Green, yellow, white, red
	HS23A	Green, brown, red, white

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NUMBER	DESCRIPTION	COLOUR
BS1554	Rust, acid and heat-resisting steel wire:	
En 56A	Martensitic chromium rust-resisting steel:	
	Softened	Red, blue, black, red
	Hardened and tempered	White, blue, black, white
	Drawn	Brown, green, black, red
En 56B	Softened	Red, blue, black, white
	Hardened and tempered	White, blue, black, yellow
	Drawn	Brown, green, black, white
En 56c	Softened	Red, blue, black, yellow
	Hardened and tempered	White, brown, blue, white
	Drawn	Brown, green, black, yellow
En 56D	Softened	Red, green, black, red
	Hardened and tempered	White, brown, blue, yellow
	Drawn	Black, green, black, brown
En 57	Martensitic chromium-nickel rust-resisting steel, high tensile:	
	Softened	Red, green, black, white
	Hardened and tempered	White, green, blue, white
	Drawn	White, red, blue, white
En 58A	Austenitic chromium-nickel steel:	
	Softened	Red, green, black, yellow
	Drawn	White, red, blue, yellow
En 58B	Softened	Red, white, black, red
	Drawn	White, yellow, blue, white
En 58C	Softened	Red, white, black, yellow
	Drawn	White, black, brown, yellow
En 58D	Softened	Red, yellow, black, red
	Drawn	White, blue, brown, yellow
En 58E	Softened	Red, black, blue, white
	Drawn	White, green, brown, white
En 58F	Softened	Red, black, blue, yellow
	Drawn	White, green, brown, yellow
En 58G	Softened	Red, brown, blue, red
	Drawn	White, red, brown, white
En 58H	Softened	Red, brown, blue, white
	Drawn	White, red, brown, yellow
En 58J	Softened	Red, brown, blue, yellow
	Drawn	White, yellow, brown, white
BS1775	Steel tubes for mechanical structural and general engineering purposes:	
CDS 11	Cold drawn seamless Grade 11	Blue, brown, green, blue
CDS 13	Cold drawn seamless Grade 13	Blue, brown, red, green
CDS 16	Cold drawn seamless Grade 16	Blue, brown, green, white
CDS 20	Cold drawn seamless Grade 20	Blue, brown, green, red
CDS 23	Cold drawn seamless Grade 23	Blue, brown, black, red
CDS 24	Cold drawn seamless Grade 24	Blue, brown, white, brown
CDS 28	Cold drawn seamless Grade 28	Blue, brown, white, yellow
CDS 35	Cold drawn seamless Grade 35	Blue, brown, yellow, red
CEW 11	Cold drawn electrical resistance welded Grade 11	Black, brown, red, blue
CEW 16	Cold drawn electrical resistance welded Grade 16	Black, brown, red, white
CEW 23	Cold drawn electrical resistance welded Grade 23	Black, blue, white, red
CEW 24	Cold drawn electrical resistance welded Grade 24	Black, brown, red, brown
CEW 28	Cold drawn electrical resistance welded Grade 28	Black, brown, red, black

NUMBER	DESCRIPTION	COLOUR
EFW 16	Electric fusion welded Grade 16	Blue, black, yellow, green
ERW 11	Electrical resistance welded Grade 11	Black, brown, green, blue
ERW 16	Electrical resistance welded Grade 16	Black, brown, green, white
ERW 20	Electrical resistance welded Grade 20	Black, brown, green, red
ERW 23	Electrical resistance welded Grade 23	Black, blue, green, brown
HFS 11	Hot finished seamless Grade 11	Blue, black, brown, blue
HFS 13	Hot finished seamless Grade 13	Blue, black, brown, green
HFS 16	Hot finished seamless Grade 16	Blue, black, brown, white
HFS 20	Hot finished seamless Grade 20	Blue, black, brown, red
HFS 23	Hot finished seamless Grade 23	Blue, black, blue, green
HFW 11	Hot finished welded Grade 11	Black, blue, brown, blue
HFW 13	Hot finished welded Grade 13	Black, blue, brown, green
HFW 16	Hot finished welded Grade 16	Black, blue, brown, white
HFW 20	Hot finished welded Grade 20	Black, blue, brown, red
HFW 23	Hot finished welded Grade 23	Black, blue, brown, yellow
HLW 16	Hydraulic lap welded Grade 16	Blue, brown, black, yellow
OAW 11	Oxy-acetylene welded Grade 11	Blue, black, white, blue
BS 2056	Rust, acid and heat-resisting steel wire for springs:	
	Martensitic chromium rust-resisting steel:	
	Softened	White, brown, white, red
	Drawn	Black, blue, black, brown
En 56B	Softened	White, green, white, blue
	Drawn	Black, blue, black, green
En 56C	Softened	White, green, white, green
	Drawn	Black, blue, black, red
En 56D	Softened	White, green, white, yellow
	Drawn	Black, blue, black, yellow
En 57	Martensitic chromium-nickel rust-resisting steel, high tensile:	
	Softened	White, red, white, brown
	Drawn	Black, blue, black, white
En 58A	Austenitic chromium-nickel steel:	
	Cold drawn	Blue, yellow, brown, white
En 58B	Cold drawn	Black, brown, black, blue
En 58C	Cold drawn	Black, brown, black, brown
En 58D	Cold drawn	Black, brown, black, green
En 58E	Cold drawn	Black, brown, black, red
En 58F	Cold drawn	Black, green, black, green
En 58G	Cold drawn	Black, brown, black, yellow
En 58H	Cold drawn	Black, brown, black, white
En 58J	Cold drawn	Black, green, black, blue
BS 3601	Steel tubes for pressure purposes - Carbon steel with specified room temperature properties:	
BW 320	Butt welded Grade 320	Red, black, brown, white
ERW 320	Electric resistance welded and induction welded Grade 320	Red, black, green, white
ERW 360	Electric resistance welded and induction welded Grade 360	Red, black, brown, yellow
ERW 410	Electric resistance welded and induction welded Grade 410	Red, black, blue, white
S 320	Seamless Grade 320	Red, blue, brown, yellow
S 360	Seamless Grade 360	Red, blue, green, white
S 410	Seamless Grade 410	Red, blue, black, yellow
SAW 410	Submerged arc welded Grade 410	Red, black, white, yellow

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NUMBER	DESCRIPTION	COLOUR
BS 3602	Steel tubes for pressure purposes Carbon steel: High duties	
CDS23	Cold drawn seamless Grade 23	Green, red, brown, red
CDS27	Cold drawn seamless Grade 27	Green, red, white, red
CDS35	Cold drawn seamless Grade 35	Green, red, white, yellow
ERW23	Electric resistance welded Grade 23	Black, red, green, brown
ERW27	Electric resistance welded Grade 27	Black, red, green, red
HFS23	Hot finished seamless Grade 23	Brown, red, white, brown
HFS27	Hot finished seamless Grade 27	Brown, red, white, red
HFS35	Hot finished seamless Grade 35	Brown, red, white, yellow
BS3603	Steel tubes for pressure purposes Carbon and alloy steel: Low temperature duties:	
CDS27LT30	Cold drawn seamless Grade 27LT30	Green, white, yellow, green
CDS27LT50	Cold drawn seamless Grade 27LT50	Green, white, yellow, red
CDS503LT100	Cold drawn seamless Grade 503LT100	Green, white, yellow, white
HFS27LT30	Hot finished seamless Grade 27LT30	Brown, white, black, green
HFS27LT50	Hot finished seamless Grade 27LT50	Brown, white, black, red
HFS503LT100	Hot finished seamless Grade 503LT100	Brown, white, black, white
BS3604	Steel tubes for pressure purposes Low and medium alloy steel	
CD620	Cold drawn seamless 1% chromium-molybdenum steel	Green, yellow, black, red
CD621	Cold drawn seamless 1¼% chromium-molybdenum steel	Green, yellow, black, white
CD622,27	Cold drawn seamless 2¼% chromium-molybdenum steel - annealed	Green, yellow, blue, red
CD622,35	Cold drawn seamless 2¼% chromium-molybdenum steel - normalized	Green, yellow, blue, yellow
CD625	Cold drawn seamless 5% chromium-molybdenum steel	Green, yellow, brown, red
CD660	Cold drawn seamless chromium-molybdenum vanadium steel	Green, yellow, red, white
HF620	Hot finished seamless 1% chromium-molybdenum steel	Brown, yellow, black, green
HF621	Hot finished seamless 1¼% chromium-molybdenum steel	Brown, yellow, black, white
HF622,27	Hot finished seamless 2¼% chromium-molybdenum steel - annealed	Brown, yellow, blue, red
HF622,35	Hot finished seamless 2¼% chromium-molybdenum steel - normalized	Brown, yellow, blue, yellow
HF625	Hot finished seamless 5% chromium-molybdenum steel	Brown, yellow, brown, green
HF660	Hot finished seamless chromium-molybdenum vanadium steel	Brown, yellow, red, green
BS4360	Weldable structural steels	
43A	Bar and plate	* Green, brown, yellow
43C	Bar, plate and hollow sections	* Red, white, green, yellow
50B	Bar, plate and hollow sections	* Black, green, yellow, brown

*These colours are in addition to any that may be applied with reference to Appendix D of the specification

WELDING - FILLER RODS AND WIRES

SECTION VII

NUMBER	DESCRIPTION	COLOUR
BS1453	Filler materials for gas welding:	
	Ferritic steels	
A1		Black
A2		Black, blue
A3		Yellow
A4		Black, red
A5		Black, white
A6		Black, yellow
A7		Black, brown
A32		Black, brown, black
A33		Black, brown, blue
	Cast iron	
B1		Green, black, green
B2		Green, blue, green
B3		Green, red, green
	Austenitic stainless steels	
309 S94		Blue, white, blue
310 S94		Blue, white, yellow
311 S94		Blue, white, green
313 S94		Blue, yellow, red
316 S96		Blue, green, blue
318 S96		Blue, red, white
347 S96		Black, white, yellow
	Copper and copper alloys	
C1		Black
C2		Black, white
C2B		Blue, black, green
C2C		Blue, brown, blue
C3		Blue, green, brown
C4		Black, red
C5		Black, blue
C6		Black, yellow
	Aluminium and aluminium alloys	
G1B		Black, green
NG2		Black, yellow
NG3		Black, yellow, blue
NG5		Blue, green
NG6		Blue, red
NG21		Green, red
NG52		Blue, yellow, brown
	Magnesium alloys	
D1		Green, yellow
D2		Red
BS2901 Pt 1	Filler rods and wires for gas shielded arc welding:	
	Ferritic steels	
A15		Black, blue, black
A16		Black, green, black
A17		Black, white, black
A18		Black, blue, green, blue
A19		Black, green, blue
A30		Black, green, brown
A31		Black, green, red
A32		Black, brown, black
A33		Black, brown, blue
A34		Black, red, blue

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NUMBER	DESCRIPTION	COLOUR
Pt 2	Austenitic stainless steels	
308 S92		Black, red, brown
308 S93		Black, white, blue
308 S96		Black, red, green
309 S94		Blue, white, blue
310 S94		Blue, white, yellow
310 S98		Blue, yellow, green
311 S94		Blue, white, green
313 S94		Blue, yellow, red
316 S92		Blue, green, red
316 S93		Blue, brown, white
316 S96		Blue, green, blue
317 S96		Blue, brown, yellow
318 S96		Blue, red, white
347 S96		Black, white, yellow
Pt 3	Copper and copper alloys	
C7		Blue
C8		Blue, green
C9		Blue, red
C10		Blue, yellow
C11		Green, red
C12		Green, white
C12 Fe		Blue, green, white
C13		Green, yellow
C16		Red, yellow
C18		Red, black, red
C20		Red, white, red
C21		Red, yellow, red
C22		Blue, red, green
Pt 4	Aluminium and aluminium alloys	
G1A		Black, blue
G1B		Black, green
NG3		Black, yellow, blue
NG5		Blue, green
NG6		Blue, red
NG21		Green, red
NG52		Blue, yellow, brown
NG61		Red, yellow, white
Pt 4	Magnesium alloys	
D1		Green, yellow
D2		Red
D3		Red, yellow
D4		Green, black, green
D5		Green, blue, green
D6		Green, red, green
D7		Green, yellow, green
D8		Blue, red, blue
Pt 5	Nickel and nickel alloys	
NA32		Yellow, blue, yellow
NA33		White
NA34		Yellow, green, yellow
NA35		White, black, white
NA36		White, blue, yellow
NA37		White, green, white
NA38		Yellow, red, yellow
NA39		Yellow, white, yellow
NA40		Red, black, white
NA41		Red, black, yellow
NA42		Red, brown, red

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APPENDIX II TO LEAFLET BL/2-2

OTHER SPECIFICATIONS

DTD SPECIFICATIONS

SECTION I

NUMBER	DESCRIPTION	COLOUR
DTD10	High nickel-copper alloy sheets	Blue, red
DTD97	Low tensile corrosion-resisting steel tubes	Black, yellow, red
DTD118	Magnesium alloy sheets (suitable for welding)	Black, blue, red
DTD142	15-ton magnesium alloy bars	Black, blue, red
DTD150A	Bars for forging	White, green, yellow
DTD161	Corrosion-resisting steel rods and wire	Brown, yellow, white
DTD164	Aluminium-nickel-iron bronze bars	Black, blue, white
DTD167	45-ton steel tubes	Blue, yellow, red
DTD189	Chromium-nickel corrosion-resisting steel rods	Black, white, brown
DTD192	High nickel-copper alloy hot-rolled or forged bars	Black, red, blue
DTD196	Cold-rolled or cold-drawn and annealed high nickel-copper alloy bars (suitable for cold bending)	Blue, red, white
DTD197	Aluminium-nickel-iron bronze bars:	
	(Section II) bars and billets for forging	Green
	(Section III) bars for machining	Black, yellow, white
DTD200	Hard-drawn high nickel-copper alloy bars and strips	Black, red, white
DTD203	50-ton corrosion-resisting steel tubes	Black, brown, white
DTD204	High nickel-copper alloy rods, wire and tubes:	
	(Section II) rods and wires for rivets	Black, white, green
	(Section III) tubes for rivets	Black, white, green
DTD232	45 per cent nickel alloy sheets and strips of 40/50 tons 0.1 per cent proof stress	Red, white, red
DTD237	45 per cent nickel alloy sheets and strips of 15 tons 0.1 per cent proof stress	Red, white, yellow
DTD246	Aluminium-copper-nickel-magnesium-iron silicon alloy bars and billets for forging	Green, red, yellow
DTD253	Aluminimum-nickel-silicon brass tubes	Red, green, white
DTD265	Hard drawn phosphor-bronze bars and tubes (suitable for bushes)	Blue, black, white
DTD267	Silicon-brass sheets (half hard)	Brown, black, white
DTD268	45 per cent nickel alloy rods and tubes	Black, white, red
DTD271	Corrosion-resisting steel strips (suitable for magneto contact breaker springs)	White, black, yellow
DTD283	Aluminium-nickel-silicon brass sheets (annealed)	White, blue, white
DTD297	7 per cent magnesium-aluminium alloy bars and extruded sections (softened):	
	(Section II) bars and billets for forging	Black, blue, black
	(Section III) bars for machining and extruded sections	Black, brown, green
DTD319	Aluminium-nickel-silicon brass bars	Black, green

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NUMBER	DESCRIPTION	COLOUR
DTD324B	Aluminium-silicon-magnesium-copper nickel alloy forgings (forging stock)	Black, blue, white
DTD326	Corrosion-resisting steel wire	Blue, yellow, blue
DTD328	Nickel-chromium alloy sheets and strips	White, yellow, white
DTD372B	Aluminium-magnesium-silicon alloy extruded bars and sections (suitable for welding):	
	Quenched at the extrusion die, straightened and aged at room temperature	Brown, black, brown
	Solution treated, straightened and aged at room temperature	Black, blue, yellow
DTD412	Aluminium bronze cast billets for forgings	See DTD197 (Section II)
DTD477	High nickel-copper alloy tubes	Blue, green
DTD487	Aluminium-copper-nickel alloy cold headed bolts:	
	(Section II) rod and wire	Red, green, red
DTD498	Silicon-nickel-copper alloy bars and forgings:	
	Bars and billets for forging	Black, yellow, red
	Bars for machining	Blue, red, green
DTD503	Steel tubes (suitable for high-pressure hydraulic systems)	Yellow, white, yellow
DTD504	Silicon-nickel-copper alloy bars	Green, red, green
DTD607	Copper strip for radiators and coolers	Green, black, green
DTD627	Brass rod or wire for machined components subject to a riveting operation	Blue, white, blue
DTD713	2½ per cent nickel-chromium-molybdenum steel tubes (75 tons):	
	Softened condition	Brown, yellow, green
DTD717	Aluminium-copper-magnesium-nickel-iron alloy forgings - Forging stock	Brown, blue, white
DTD720	"15" carbon steel (not exceeding ¾-in diameter)	Black, red, white
DTD723	2½ per cent nickel-chromium-molybdenum steel tubes (90 tons):	
	Softened condition	Brown, red, white
DTD731	Aluminium-copper-magnesium-nickel-iron alloy bars and billets for forging	Brown, blue, red
DTD734	Chromium-nickel non-corrodible steel wire (suitable for wire thread inserts)	Black, brown, green
DTD737	Magnesium-manganese alloy tubes	Black, blue, red
DTD740	40-ton molybdenum-boron steel tubes (suitable for welding)	Red, yellow, red
DTD745	Aluminium-copper-magnesium-nickel-iron alloy bars and billets for forging	Brown, blue, red
DTD5004	Bars for forging	White, blue, white
DTD5010	Aluminium-copper-magnesium-silicon-manganese alloy plate (solution treated and aged at room temperature)	Green, blue, yellow
DTD5013	Commercially pure titanium bars and billets (ultimate tensile stress not greater than 30-tons)	Red, yellow, white
DTD5014	Aluminium-copper-magnesium-nickel-iron alloy bars and extruded sections	Green, blue, yellow
DTD5016	Stainless steel tubing	Black, blue, brown
DTD5019	Aluminium-nickel-silicon brass tubes	Red, black, red
DTD5023	Commercially pure titanium sheets and strip (25/40-tons ultimate stress)(suitable for welding)	Black, white, brown
DTD5024	Aluminium-zinc-magnesium-copper-manganese alloy forgings	
	Extruded and rolled bars and billets for forging	Green, black, yellow
DTD5030	Aluminium-coated aluminium-copper-magnesium-silicon-manganese alloy plate (solution treated and aged at room temperature)	Black, red, yellow

NUMBER	DESCRIPTION	COLOUR
DTD5032	Carbon steel for tierods	Black, green, yellow, white
DTD5037	Iron-nickel-chromium-molybdenum-weldable-heat resisting alloy sheet and strip	Black, brown, black, brown
DTD5040	Aluminium-coated aluminium-copper-magnesium-silicon-manganese alloy plate (solution treated and precipitation treated)	Blue, brown, red
DTD5041	Magnesium-zinc-zirconium bars and sections	Red, brown, white
DTD5042	80-ton nickel-chromium-molybdenum-vanadium steel	White, yellow, white
DTD5044	Aluminium-zinc-magnesium-copper-manganese alloy bars and extruded sections. Not exceeding 10 inches diameter or minor sectional dimensions. (Solution treated and precipitation treated)	Yellow, brown, yellow
DTD5046	12 per cent chromium-molybdenum-vanadium-oxidation resistant and corrosion resistant steel sheet and strip - softened	Red, brown, yellow
DTD5052	80-ton nickel-chromium-molybdenum-vanadium steel plate (limiting ruling section 6-ins)	Green, blue, yellow
DTD5056	Chromium-nickel corrosion resistant steel for cold headed bolts and set screws - Rod Wire	White, brown, green, white Brown, white, blue, white
DTD5057	Nickel-chromium-cobalt-molybdenum weldable heat resisting alloy sheet and strip	Black, brown, green, brown
DTD5062	Forty ton molybdenum-boron steel sheet and strip suitable for welding	Blue, brown, blue
DTD5066	12 per cent chromium heat resisting steel for bolts-studs-set screws and nuts Bars for machining (heat treated) Bars for forging (softened)	 Yellow, blue, yellow White, black, white
DTD5070	Aluminium-coated aluminium-copper-magnesium-nickel-iron sheet and strip (solution treated and precipitation treated)	Black, red, brown
DTD5073	Commercially pure titanium tubes (suitable for pipe lines and high pressure etc)	Black, red, blue
DTD5076	High expansion heat resisting steel for the manufacture of bolts, studs, set screws and nuts vacuum melted - limiting ruling Section 20 mm Annealed cold reduced and solution treated Annealed cold reduced and finally heat treated Annealed and cold reduced	 Yellow, black, green, yellow Yellow, black, red, yellow Yellow, blue, brown, yellow
DTD5081	Magnesium-zinc-zirconium alloy plate	Brown, red, brown
DTD5082	75-ton, 1 per cent chromium-molybdenum steel: Softened condition Softened and cold rolled	 Brown, white, green Blue, white, blue
DTD5084	Aluminium-copper-magnesium-nickel-iron alloy bars and billets for forging	Brown, blue, red
DTD5086	17-7 chromium-nickel precipitation hardening stainless steel, rod, wire and springs Rod-solution annealed Wire-cold drawn	 Yellow, black, blue, yellow White, yellow, brown, yellow
DTD5091	Magnesium-zinc-manganese alloy sheet and strip (soft)	Green, yellow, green, yellow
DTD5092	Soft iron for dynamo-electric machines (Type A): As manufactured Heat treated	 Green, black, yellow Black, blue, white
DTD5094	Aluminium-zinc-magnesium-copper-manganese alloy bars and billets for forging	Yellow, white, yellow
DTD5100	Aluminium coated aluminium-copper-magnesium-manganese alloy plate	Brown, red, brown, red

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NUMBER	DESCRIPTION	COLOUR
DTD5101	Magnesium-zinc-manganese alloy sheet and strip (Half hard)	Blue, white, blue, white
DTD5102	Soft iron for dynamo-electric machines (Type B):	
	As manufactured	Black, yellow, white
	Heat treated	White, red, yellow
DTD5104	Aluminium-zinc-magnesium-copper-manganese alloy bars and billets for forging	Yellow, white, yellow
DTD5110	Aluminium-alloy coated plate of aluminium-zinc-magnesium-copper-chromium alloy (solution treated, controlled stretched and precipitation treated)	Black, blue, red, blue
	(Solution treated and controlled stretched)	Black, red, black, red
DTD5112	80-ton, 1 per cent chromium-molybdenum steel sheet:	
	Hot-rolled	Blue, red, yellow
	Cold-rolled	Brown, blue, brown
DTD5114	Bars and extruded sections of aluminium-zinc-magnesium-copper-chromium alloy (solution treated and precipitation treated)	Black, blue, red, black
DTD5122	75-ton, 1 per cent chromium-molybdenum steel:	
	Softened condition	Brown, white
DTD5124	Bars and extruded sections of aluminium-zinc-magnesium-copper-chromium alloy (solution treated and precipitation treated)	Black, brown, black, blue
	Solution treated	Black, red, blue, brown
DTD5132	80-ton 1% chromium-molybdenum steel tubes (as drawn and tempered condition)	Black, blue, yellow, blue
DTD5142	80-ton 1 per cent chromium-molybdenum steel tubes	
	Hot-rolled	Yellow, black, blue, yellow
DTD5152	1 per cent chromium-molybdenum steel wire	White, blue, yellow, white
DTD5192	Nickel-chromium-molybdenum-vanadium steel softened	Green, white, yellow, green
DTD5202	0.5 per cent molybdenum-boron steel - normalized	Green, red, yellow, green
DTD5212	Maraging steel 18 per cent nickel-cobalt-molybdenum (double vacuum melted) solution treated:	
	Bars for machining	Green, red, black, red
	Bars for forging	Green, brown, white, green
DTD5222	5 per cent chromium-molybdenum-vanadium steel suitable for forged bolts (vacuum re-melted)	Red, brown, green, red
DTD5232	Maraging steel 18 per cent nickel-cobalt-molybdenum (vacuum re-melted) solution treated:	
	Bars for machining	Blue, green, yellow, green
	As forged bars for forging	Blue, green, brown, yellow
DTD5273	Bars for machining or commercially pure titanium Annealed condition	Black, blue, red, yellow
DTD5283	Forging stock of commercially pure titanium bars and billets for forging	Black, brown, yellow, red
DTD5303	Bar and section for machining of titanium-aluminium-vanadium alloy. Annealed condition	Black, green, brown, red
DTD5313	Forging stock of titanium-aluminium-vanadium alloy bars and billets for forging	Black, brown, white, yellow

AMERICAN SPECIFICATIONS

SECTION II

NUMBER	DESCRIPTION	COLOUR
AMS 4900F	Titanium sheet, strip and plate annealed 379 MPa yield strength	Black, green, blue, yellow
AMS 5572C	Steel tube, seamless, corrosion and heat resistant, 25 Cr - 20 Ni	White, blue, green, blue, white
AMS 5643	Steel bars (and forgings) - corrosion resistant 17/4 P.H.	White, green, black, green, white
MIL-S-6758A	Steel - chromium molybdenum (4130) - bars and reforging stock (aircraft quality)	
	A and B condition (forged or rolled)	White, black, white, black, white
	C condition (annealed)	White, blue, black, blue, white
	F condition (hardened and tempered)	White, brown, blue, brown, white
MIL-S-7720A	Steel, corrosion resistant (18-8) bars, wire and forging stock (aircraft quality)	
	A condition (annealed)	White, green, white, green, white
	B condition (cold finished)	White, blue, yellow, blue, white
	C condition (hot rolled or forged)	White, blue, brown, blue, white
MIL-T-6736B	Steel - chromium molybdenum (4130) - tube, seamless and welded (aircraft quality)	
	A condition (annealed)	White, red, blue, red, white
	N condition (normalised)	White, green, red, green, white
	HT 125 condition	White, brown, green, brown, white
	HT 150 condition	White, black, red, black, white
	HT 180 condition	White, yellow, white, yellow, white
MIL-T-8504	Steel 18/8 corrosion resistant tube Annealed condition.	Green, blue, black, blue, green
MIL-T-9047E	Titanium and titanium alloy bars, (forgings) and forging stock composition 6 (6AL, 4V) Annealed condition	Black, blue, red, green
QQ-A-200/3D	Aluminium alloy bar, rod, sections, tube and wire extruded, 2024. Bar and sections - T351.	White, blue, brown, blue, white
QQ-A-200/8D	Aluminium alloy bar, rod, sections, tube and wire extruded, 6061. Temper 6511 - as supplied.	Brown, red, green, red.
QQ-A-225/6D	Aluminium alloy bar, rod and wire, rolled, drawn, or cold finished, 2024. Wire and rod - T351.	White, black, red, black, white
QQ-A-225/9D	Aluminium alloy bar, rod, wire and special sections, rolled, drawn or cold finished, 7075. Condition - T7351.	White, yellow, black, yellow, white
QQ-A-250/4E	Aluminium alloy 2024, plate and sheet	
	Condition - 0	White, red, white, red, white
	Condition - T3 (as supplied)	White, green, brown, green, white
	Condition - T351	White, black, green, black, white
QQ-A-250/5F	Aluminium alloy Alclad 2024, plate and sheet	
	Condition - T351	White, blue, white, blue, white
QQ-A-250/11E	Aluminium alloy 6061, plate and sheet	
	Condition - Temper 0	White, brown, black, brown, white
	Condition - T4 (as supplied)	White, red, brown, red, white
	Condition - T6 (as supplied)	White, yellow, brown, yellow, white
QQ-B-637A 485	Naval brass: bar, rod, sections, strip, wire ½ hard	Blue, red, green, white

NUMBER	DESCRIPTION	COLOUR
QQ-C-530	Copper - beryllium alloy bar, rod, and wire (copper alloy numbers 172 and 173) H condition (hot worked, or cold worked, solution treated and worked hard)	Black, blue, white, blue
QQ-S-763	Steel bars, sections (and forgings) - corrosion resisting Type 440C - condition A (annealed)	Green, brown, green, brown, green
QQ-S-764B	Steel bar, corrosion resisting, free machining	
303 SE	Austenitic chromium-nickel-steel Condition A - cold finished	Brown, green, red, green, brown
QQ-S-766C	Steel plates, sheets and strip, corrosion resisting	
301	Sheet - temper full hard (cold rolled)	Brown, green, brown, red

FRENCH SPECIFICATIONS

SECTION III

NUMBER	DESCRIPTION	COLOUR
AIR 9050C	Aluminium alloy	
A-U4G1	Tube	
	T4 condition	Black, blue, brown, black
AIR 9160B	Steel - corrosion resisting	
15CDV6	Low alloy steel, bar, sheet, tube	
	Annealed condition	Brown, blue, green, blue, brown
	Hardened and tempered - 980/1130 MPa	White, black, blue, black, white
	Hardened and tempered - 1030/1180 MPa	White, black, brown, black, white
35NC6	Low alloy steel bar	
	Annealed condition	Green, blue, black, blue, green
	Hardened and tempered - 880/1080 MPa	White, blue, green, blue, white
	Hardened and tempered - 1030/1180 MPa	White, blue, red, blue, white
AIR 9160C	Steel - corrosion resisting	
25 CD4S	Low alloy steel, bar, sheet, tube	
	Hardened and tempered - 880/1080 MPa	Green, brown, white, brown, green
30 CD12	3% Cr nitriding steel bar	
	Annealed condition	Blue, green, white, yellow
	Hardened and tempered - 930/1080 MPa	Green, blue, yellow, red
	Hardened and tempered - 1080/1270 MPa	Green, blue, white, red
35 CD4	Low alloy steel bar	
	Annealed condition	White, yellow, red, yellow, white
30 NCD16	Low alloy steel bar	
	Annealed condition	White, black, red, black, white
	Hardened and tempered - 1080/1230 MPa	Black, red, blue, brown
	Hardened and tempered - 1220/1370 MPa	Black, red, blue, yellow
Z100 CD17	Rolled steel bar, sheet	
	Annealed condition	White, brown, white, brown, white

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REVERSE COLOUR CODES

COLOURS	SPECIFICATIONS
Black	L17, L36, L67, L116, T51, BS219-C, BS249, BS1432-C103-0, BS1453-A1, BS1453-C1, BS2874-CZ121(3% Pb)-M.
Blue	L16, BS219-A, BS251-CZ112, BS885(annealed), BS2870-CZ108-H, BS2874-CZ112-M, BS2901-C7.
Brown	B11, BS219-D.
Green	L58, L121, S510, BS219-G, BS2870-CZ108-0, DTD197 (Section II), DTD412 (cast billets for forging).
Red	T2, BS219-M, BS1453-D2, BS2901-D2, BS2870-CZ108-½H.
White	BS2901-NA33.
Yellow	B8, L86 (annealed and drawn), S1, BS219-B, BS1453-A3.
Violet	L86 (solution treated and naturally aged).
Black, blue	S125-A, BS219-95A, BS251-CZ112 (forging stock), BS378-70/30, BS1432-C103-½H, BS1453-A2, BS1453-C5, BS1470-S1C-0, BS1471-T1C-0, BS1475-G1A-M, BS2872-CZ112-M, BS2901-G1A.
Black, brown	L72, S126A, BS1453-A7.
Black, green	S127A, BS219-5S, BS1453-G1B, BS1471-HT9-0, BS1475-G1B-M, BS2870-C101-½H, BS2901-G1B, DTD319, DTD5070 (annealed).
Black, red	L34, T55, BS219-F, BS1453-A4, BS1453-C4.
Black, white	S92B, BS1453-A5, BS1453-C2.
Black, yellow	S127 B & D, BS219-1S, BS1453-A6, BS 1453-C6, BS1453-NG2, BS1475-NG2-M.
Blue, brown	S128A, T59, BS1470-HS15-TB, BS1471-HT15-TB, BS1474-HE15-TB, BS1475-HG15-TB, BS2870-CZ107-H.
Blue, green	L109, S70A, BS219-AP, BS1453-NG5, BS1475-NG5-M, BS2901-C8, BS2901-NG5, DTD477.
Blue, red	L54, S28, BS885 (as drawn), BS1432-C101 (medium hard), BS1432-C102 (medium hard), BS1433 (medium hard), BS 1453-NG6, BS1470-NS5-H4, BS1475-NG6-M, BS2901-C9, BS2901-NG6, DTD10.
Blue, white	B21, BS384
Blue, yellow	S21, T26 (Section II), BS219-KP, BS2870-C105-M/O, BS2901-C10.
Brown, green	S93A, BS219-J.
Brown, red	BS219-K, BS1470-S1C-H8.
Brown, white	L128, DTD 5122 (softened).
Brown, yellow	S14, T50.
Green, red	S136, BS1453-NG21, BS1475-NG21-M, BS2901-C11, BS2901-NG21, BS2870-CZ107-0.
Green, white	L44, S107, BS2901-C12, DTD214, DTD5005.
Green, yellow	BS219-W, BS1453-D1, BS1470-NS3-M, BS2901-D1, BS2901-C13.
Red, white	L504, L505, S93B, T60.
Red, yellow	T26 (Section III), BS1470-HC15-TF, BS2901-C16, BS2901-D3.
White, yellow	BS2870-CZ106-H.

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COLOURS	SPECIFICATIONS
Black, blue, black	L90 (solution treated and precipitation treated), S116, BS374 (Class I), BS2871-C107-M, BS2874-CZ109-M, BS2901-A15, DTD297 (Section II).
Black, blue, brown	T72, BS409 (as rolled), BS1470-S1A-H8, BS2874-CZ123-M, DTD5016, BS2870-CZ112-M.
Black, blue, green	S105 (Type 1), S112, T58.
Black, blue, red	S105 (Type 2), S125 B and D, BS1400-LB1, BS2870-C101-0, BS2871-C107-0, DTD118, DTD142, DTD737.
Black, blue, white	L503, BS1432-C103-H, BS3076-NA13 (hot rolled), DTD164, DTD324B, DTD5070-W, DTD5092 (heat treated).
Black, blue, yellow	S105 (Type 3), S113, BS2870-CB101-W, DTD372B (solution treated, straightened and naturally aged).
Black, brown, black	S119 (hardened and tempered), T35, BS407-PB103-½H, BS1453-A32, BS1470-HS30-0, BS2870-PB103-½H, BS2874-CZ122-H, BS2901-A32.
Black, brown, blue	T45, BS1453-A33, BS1470-HS30-TB, BS1474-E1C-M, BS2857 (Class A), BS2901-A33.
Black, brown, green	S114 B and D, BS1470-HS30-TF, DTD297 (Section III), DTD734.
Black, brown, red	S126 B and D, S529, BS407-PB102-0, BS2870-PB102-0.
Black, brown, white	BS2870-CB101-W(½H), BS2874-CZ114-M, DTD203.
Black, brown, yellow	T57, BS1471-HT30-TF, BS2871-CZ126-0, DTD5074-W.
Black, green, black	S139A, BS219-H, BS374 (Class 2), BS885 (AL-BRASS, annealed), BS1400-PB2, BS1472-NF8-M, BS1474-NE8-M, BS2901-A16.
Black, green, blue	L73, S95A, S511, BS407-PB101-½H, BS2870-PB101-½H, BS2901-A19.
Black, green, brown	S91A, BS1470-S1B-H4, BS2874-CA103-M, BS2901-A30.
Black, green, red	S95B, S513 (softened), T45 (annealed), BS659-C106-M, BS1432-C101-H, BS1432-C102-H, BS1433 (hard), BS1470-S1B-0, BS1471-T1B-0, BS1472-F1B-M, BS1474-E1B-M, BS2901-A31.
Black, green, white	S91B, BS1001, BS2870-CB101-W(½H), BS2871-C106-0, DTD5044 (annealed).
Black, green, yellow	S139 B and D, T53, BS407-PB101-0, BS1470-S1B-H8, BS1475-HG9-0, BS2870-PB101-0.
Black, red, black	L87 (solution treated and precipitation treated), S96A, BS219-62S, BS374 (Class 3), BS1052 (tinned), BS1400-PB1, DTD604.
Black, red, blue	L59, S96B, BS407-PB102-½H, BS659-C107-M, BS2870-PB102-½H, BS2901-A34, DTD192, DTD5073.
Black, red, brown	BS2901-308-S92, BS3076-NA13 (cold drawn), DTD5070.
Black, red, green	S135 B and D, S530, BS409 (annealed), BS2870-CZ112-0, BS2871-C106-M, BS2901-308-S96, BS3076-NA13 (cold drawn and annealed).
Black, red, white	L93 (solution treated and controlled stretched), BS1473-NR6 (annealed and drawn), DTD200, DTD720.
Black, red, yellow	S148, S528, T73, BS2870-C101-H, DTD5030.
Black, white, black	BS407-PB103-H, BS1400-PB3, BS2870-PB103-H, BS2901-A17.
Black, white, blue	L501, S132 (black and bright), BS407-PB101-EH, BS2870-PB101-EH, BS2901-308-S93.
Black, white, brown	BS1473-NB6-H4, BS1475-NG6-H4, DTD189, DTD5023.
Black, white, green	L93 (solution treated, controlled stretched, precipitation treated), L103, S97A, DTD204 (Sections II and III).
Black, white, red	L104, S97B, BS1475-NG6-H8, DTD268.
Black, white, yellow	L113 (solution treated, flattened, precipitation treated), S119 (softened), BS1453-347-S96, BS2901-347-S96.

COLOURS	SPECIFICATIONS
Black, yellow, black	L65 (solution treated and precipitation treated), BS374 (Class 4).
Black, yellow, blue	S117 (bars for machining), S531, BS1453-NG3, BS1470-S1C-H6, BS147S-NG3-M, BS2870-C102-0, BS2901-NG3.
Black, yellow, brown	S80A, BS1470-S1C-H2, BS1474-H E20-TB, BS-2870-C102-½H.
Black, yellow, green	BS1470-S1C-H4.
Black, yellow, red	S61A, BS2870-C102-H, BS4300/5-TF, DTD97, DTD498 (bars and billets for forging).
Black, yellow, white	BS2870-CB101-W(H), DTD197 (Section III), DTD5051, DTD5102 (as manufactured).
Blue, black, blue	S147, BS219-T, BS252-CZ113-M, BS407-PB102-H, BS1470-NS3-0, BS1473-HR30 (annealed and drawn), BS2870-PB102-H.
Blue, black, brown	L115 (solution treated, controlled stretched, preciptation treated), BS2786.
Blue, black, green	L85 (bars for machining and extruded sections solution treated but not precipitation treated), S141 B and D, S102, BS1453-C2B, BS1470-NS3-H2, BS1471-HT9-TB, BS2870-C103-0.
Blue, black, red	L94 (solution treated and precipitation treated, not controlled stretched), BS1845-AL1, BS2870-CZ107-EH.
Blue, black, white	L94 (solution treated), S140a, BS407-PB101-H, BS2870-PB101-H, BS3075-NA13 (cold drawn), DTD265.
Blue, black, yellow	S513 (hardened and tempered), BS1471-HT30-TB, BS1474-HE20-TF.
Blue, brown, blue	L81, S98B, BS219-L, BS980-CDS-1, BS1400-G2, BS1453-C2C, BS1473-HB30 (annealed and drawn), BS1473-HR30 (annealed and drawn), BS2870-C103-½H, BS2871-C101-0, DTD5062.
Blue, brown, green	BS2871-C101-M, BS2872-CZ109-M.
Blue, brown, red	S106A, BS980-CDS-3, BS1471-HT15-TF, BS1474-HE15-TF, BS1475-HG15-TF, BS2874-CA104-M, BS3075-NA13 (cold drawn and annealed), DTD5040.
Blue, brown, white	BS980-CDS-3A, BS2901-316-S93, DTD5061.
Blue, brown, yellow	L94 (as rolled), S99 (bars and billets, hardened and tempered), S524, BS980-CDS-4, BS1472-HF30-M, BS2901-317-S96.
Blue, green, blue	BS1400-G1, BS1453-316-S96, BS1470-NS3-H6, BS1474-HE9-TF, BS1475-HG9-TF, BS2901-316-S96.
Blue, green, brown	S99 (softened), BS980-CDS-5, BS1453-C3, BS1470-NS5-H2, BS1471-NT5-H4, BS1474-HE30-M, BS2870-C103-H.
Blue, green, red	L89 (solution treated and aged at room temperature) S117 (bars and billets for forging), S517 (hardened and tempered), BS980-CDS-6, BS1475-HG9-TD, BS2901-316-S92
Blue, green, white	S131A, BS1474-HE9-TB, BS1475-HG9-TB, BS2901-C12Fe, DTD5071.
Blue, green, yellow	S98A, S525, BS980-CDS-7, BS1470-NS5-0, BS1471-NT5-0, BS1472-NF5-M, BS1473-NR5-M, BS1474-NE5-M, BS2874-C102-½H.
Blue, red, blue	S131B and D, BS219-N, BS980-CDS-8, BS2901-D8.
Blue, Red, Brown	L94 (annealed).
Blue, red, green	S79A, BS2870-CZ107-½H, BS2901-C22, DTD498 (bars for machining), DTD5074-WP.
Blue, red, white	L110, BS980-CDS-9, BS1453-318-S96, BS2870-C104-M/0, BS2901-318-S96, DTD196.
Blue, red, yellow	BS980-CDS-10, BS2870-C104-½H, DTD5112 (hot rolled).
Blue, white, blue	BS1453-309-S94, BS2901-309-S94, BS3074-NA11, BS3075-NA11 (cold drawn and annealed), DTD627, DTD5082 (softened and cold rolled).

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COLOURS	SPECIFICATIONS
Blue, white, brown	S145 B and D, BS980-CDS-11.
Blue, white, green	S140 B and D, BS1453-311-S94, BS2901-311-S94, BS2870-C104-H, BS3074-NA12.
Blue, white, red	L96 (solution treated and precipitation treated, not controlled stretched), S120, BS2857 (Class B), BS2874-CZ124-½H.
Blue, white, yellow	BS1453-310-S94, BS2901-310-S94, BS3074-NA13.
Blue, yellow, blue	L61, L85 (Solution treated and precipitation treated), BS980-CDS-12, DTD 326.
Blue, yellow, brown	L96 (annealed), BS407-PB102-½H, BS1453-NG52, BS2870-PB102-½H, BS2901-NG52, BS3074-NA14, BS3076-NA14.
Blue, yellow, green	L105, S532, T64, BS1470-NS3-H8, BS2901-310-S98, DTD5074 (softened).
Blue, yellow, red	HR203 (softened and descaled), BS1453-313-S94, BS1470-NS3-H4, BS2901-313-S94, DTD167.
Blue, yellow, white	L95 (solution treated), S144A, BS980-CDS-13, BS1824-NS104 (extra hard), DTD5054 (annealed).
Brown, black, brown	S141A, BS219-96S, BS2870-C105-½H, DTD372B (quenched at die, straightened and aged at room temperature.
Brown, black, green	S146, BS1470-NS4-0, BS1471-NT4-0, BS1472-NF4-M, BS1474-NE4-M, BS1475-NG4-0.
Brown, black, red	S80 B and D, S533, T70, BS1471-NT4-H4, BS1474-HE30-TB, BS2870-C105-H.
Brown, black, white	S143A, T61, DTD267.
Brown, black, yellow	BS1474-HE30-TF.
Brown, blue, brown	S128 B and D, BS885 (al brass, as drawn), BS980-CDS-14, BS1475-G1A-H8, DTD5112 (cold rolled).
Brown, blue, green	S149, BS980-CDS-15, BS1471-HT9-TF, BS1475-G1A-0.
Brown, blue, red	S129 B and D, S516 (hardened and tempered or cold rolled and tempered), BS407-PB103-½H, BS980-CDS-16, BS1400-LPB1, BS1470-S1A-H4, BS2870-PB103-½H, DTD731, DTD745, DTD5084.
Brown, blue, white	L96 (solution treated), BS407-PB102-EH, BS980-CDS-17, BS2870-PB102-EH, DTD717.
Brown, blue, yellow	S535 (hardened and tempered), BS407-PB101-½H, BS980-CDS-18, BS1400-AB2, BS1470-S1A-0, BS2870-PB101-½H.
Brown, green, brown	L95 (solution treated, controlled stretched and precipitation treated), BS1475-G1B-H8.
Brown, green, red	S130B and D, BS980-CDS-19, BS1471-HT20-TB, BS3073-NA11, BS3075-NA11.
Brown, green, white	BS407-PB103-EH, BS980-CDS-20, BS2870-PB103-EH.
Brown, green, yellow	S92A, BS980-ERW-1, BS1475-G1B-0.
Brown, red, brown	S133, BS219-R, BS980-ERW-2, DTD5054, DTD5081.
Brown, red, green	L70 (as rolled), L77, L106, S106B, S534 (hardened and tempered), BS407-PB103-0, BS980-ERW-3, BS2870-PB103-0.
Brown, red, white	L511, BS1473-NR5-0, DTD723 (softened).
Brown, red, yellow	BS1472-HF15-M.
Brown, white, brown	L96 (as rolled), BS980-CEW-1, BS3076-NA13 (hot rolled and annealed).
Brown, white, green	BS980-CEW-2, DTD5082 (softened).
Brown, white, red	S134, BS980-CEW-3.
Brown, white, yellow	BS1472-HF9-M, BS1474-HE9-M.
Brown, yellow, brown	S15A, BS980-CEW-4, BS1473-NR5 (annealed and drawn), BS1475-NG61-M, BS2870-CZ108-EH.
Brown, yellow, green	L72 (as rolled), L107, S124 (softened), BS1473-HB15-OD, BS1473-HR15-OD, DTD713 (softened).
Brown, yellow, red	L72 (annealed), S61B and D, T63.
Brown, yellow, white	L90 (annealed), DTD161.

COLOURS	SPECIFICATIONS
Green, black, green	L60, BS219-V, BS1387-C, BS1400-LG1, BS1453-B1, BS1471-HT20-TF, BS2901-D4, DTD607.
Green, black, red	L80, L85 (bars and billets for forging), S142 B and D, BS2870-C106-M/0.
Green, black, white	HR2 (forging stock).
Green, black, yellow	L70 (solution treated and aged at room temperature), L114 (solution treated, drawn, precipitation treated), DTD5024, DTD5092 (as manufactured).
Green, blue, green	S129A, S534 (softened), BS713 (annealed), BS1434, BS1453-B2, BS2901-D5.
Green, blue, red	S514 (hardened and tempered, or cold rolled and tempered), BS2870-CZ112-H.
Green, blue, white	S516 (softened), BS1824-T2-¾H, L502.
Green, blue, yellow	T65, BS2870-C106-½H, BS2871-C106-½H, DTD5010, DTD5014, DTD5052.
Green, brown, green	L88 (solution treated and precipitation treated), L102, S143B and D, S535 (softened), BS713-½H, BS1400-LG2.
Green, brown, red	S144B and D, BS1400-LB3, BS1473-NR6-0, BS1475-NG6-0.
Green, brown, white	T66, BS1474-NE8-0, BS2870-C106-H.
Green, brown, yellow	BS713 (hard), BS4360-43A.
Green, red, green	L98 (solution treated and aged at room temperature, not controlled stretched), BS1453-B3, BS2901-D6, DTD504.
Green, red, white	L98 (annealed), S514 (softened), BS407-PB103-SH, BS2870-PB103-SH.
Green, red, yellow	L83 (bars and billets for forging), S82, DTD246.
Green, white, green	S142A, T71, BS1400-LG3.
Green, white, red	BS1475-HG20-TH.
Green, white, yellow	L98 (as rolled), S145A.
Green, yellow, green	S537, BS1407, BS2870-C107-M/0, BS2874-PB102-M, BS2901-D7.
Green, yellow, red	L70 (annealed), S518 (softened), T67.
Green, yellow, white	L88 (annealed), S518 (hardened and tempered, or as cold rolled and tempered).
Red, black, red	L37 (Sections II and III), L63, BS1432-C101 (annealed), BS1432-C102 (annealed), BS1433 (annealed), BS2901-C18, DTD5019.
Red, black, white	L25A, L108, S130A, BS407-PB103-ESH, BS2870-PB103-ESH, BS2901-NA40.
Red, black, yellow	L83 (bars for machining and extruded sections), BS980-CDS-2, BS1470-HC15-TB, BS2901-NA41.
Red, blue, red	BS1472-HF12-M.
Red, blue, white	
Red, blue, yellow	L83 (bars for machining and extruded sections solution treated but not precipitation treated), S515, T62.
Red, brown, red	L84 (bars for machining and extruded sections), S539, BS2873-CZ108-H, BS2901-NA42.
Red, brown, white	S536, BS1475-NG3-0, DTD5041.
Red, brown, yellow	S538 (softened), DTD5046 (softened).
Red, green, red	L65 (bars for machining and extruded sections solution treated but not precipitation treated), T64, BS1470-S1-0, DTD487 (Section II).
Red, green, white	S79B, DTD253.
Red, green, yellow	L508, L509, S527, BS1470-S1-H4, BS1475-NG3-H8.
Red, white, red	L97 (solution treated, controlled, stretched, aged at room temperature), L111, S114A, BS1400-LB2, BS2901-C20, DTD232.
Red , white, yellow	DTD237.
Red, yellow, red	S111A, S526, BS1470-S1-H8, BS2870-CZ107-¼H,

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COLOURS

Red, yellow, white
White, black, white
White, black, yellow
White, blue, white
White, blue, yellow
White, brown, white

White, brown, yellow
White, green, white
White, green, yellow

White, red, white

White, red, yellow

White, yellow, white
Yellow, black, yellow

Yellow, blue, yellow

Yellow, brown, yellow
Yellow, green, yellow
Yellow, red, yellow
Yellow, white, yellow

Black, blue, black, blue
Black, blue, black, brown

Black, blue, black, green
Black, blue, black, red

Black, blue, black, white
Black, blue, black, yellow

Black, blue, brown, black
Black, blue, brown, blue

Black, blue, brown, green
Black, blue, brown, red
Black, blue, brown, white

Black, blue, brown, yellow
Black, blue, green, black

Black, blue, green, blue

Black, blue, green, brown
Black, blue, green, red
Black, blue, green, white
Black, blue, green, yellow
Black, blue, red, black
Black, blue, red, blue

Black, blue, red, brown
Black, blue, red, green
Black, blue, red, white
Black, blue, red, yellow
Black, blue, white, black
Black, blue, white, blue

SPECIFICATIONS

BS2901-C21, DTD740.
L89 (annealed), BS2901-NG61, DTD5013.
S517 (softened), BS2901-NA35, DTD5066 (softened).
L506, BS2870-C107-½H, DTD271.
DTD283, DTD5004 (bars for forging).
S70B, T75, BS2901-NA36.
L93 (solution treated, not controlled stretched), L512, S137, BS2870-C107-H.
L56.
L112, BS2901-NA37.
BS1977-C101 (annealed), BS2870-CZ106-0, DTD150A (bars for forging).
L507, S124 (bright and black bars for machining, hardened and tempered), BS2870-CZ106-¼H.
BS1977-C101 (as drawn), BS2870-CZ106-½H, DTD5102 (heat treated).
BS1977-C102 (annealed), DTD328, DTD5042.
S62B, T69, BS1470-NS8-0, BS1473-NR6-M, BS1977-C102 (as drawn), BS2870-CZ108-¼H.
BS1977-C103-0, BS2901-NA32, DTD5066 (bars for machining, heat treated).
S15B and D, BS1470-NS8-H2, DTD5044.
BS1977-C103 (as drawn), BS2901-NA34.
S62A, T74, BS2901-NA38.
BS2901-NA39, DTD503, DTD5094 (bars and billets for forging), DTD5104 (bars and billets for forging).
L150.
L115 (solution treated), BS970-080-M30-P, BS2056-En 56A (drawn), BS3601-BW22.
BS2056 - En 56B (drawn).
BS2056 - En 56C (drawn), BS2870-NS106-0, BS2871-C102-M.
BS2056 - En 57 (drawn), BS2870-CN104-0.
BS1400-PB4, BS1471-T1C-H4, BS2056-En 56D (drawn), BS2871-CZ108-0.
HR4 (forging stock), AIR 9050C-A-U4G1-T4.
L117, L160, HR4 (FHT bar and section for machining), BS1775-HFW11.
BS970-080-M30-Q, BS1775-HFW-13, BS2870-CN105-0.
BS1775-HFW-20, BS2871-CZ108-TA.
BS970-785-M19-Q, BS1449-302-S25 (annealed), BS1775-HFW-16.
BS1449-321-S12 (soft), BS1775-HFW-23.
L118, HR404 (cold worked and softened), BS2871-CZ108-M.
BS1449-304-S16 (softened), BS2870-CN106-0, BS2901-A18, DTD5017 (bars and billets for forging).
BS1775-ERW-23.
BS1449-302-S25 (cold rolled), BS2871-CZ126-M.
BS970-835-M30-Z, BS1470-NS3-M.
TA57, BS2872-CZ114-M.
BS970-080-M40-R, DTD5114.
BS2871-C102-0, DTD5017 (bars for machining), DTD5110 (solution treated, controlled stretched and precipitation treated).
BS2870-CN107-0.
BS2870-NS106-½H, MIL-T-9047E (6AL, 4V) (annealed).

DTD5273 (annealed).
L151, BS2871-C103-M.
QQ-C-530-H.

COLOURS	SPECIFICATIONS
Black, blue, white, brown	TA56, BS970-212-M36-R.
Black, blue, white, green	BS1052 (annealed), BS2870-CS101-M.
Black, blue, white, red	BS970-080-M40 (normalised), BS1775-CEW-23.
Black, blue, white, yellow	BS1449-302-S17 (annealed).
Black, blue, yellow, black	S205 (wire), BS2870-NS103-½H.
Black, blue, yellow, blue	TA10, DTD5132 (as drawn and tempered).
Black, blue, yellow, brown	
Black, blue, yellow, green	TA58
Black, blue, yellow, red	BS1473-HB20-TH, BS2871-CZ126-TA.
Black, blue, yellow, white	BS2872-CZ114-0.
Black, brown, black, blue	BS2056-En58B (cold drawn), BS2871-C103-0, DTD5124 (solution treated and precipitation treated).
Black, brown, black, brown	BS2056-En58C (cold drawn), BS3601-ERW-22, DTD5037.
Black, brown, black, green	TA2, BS2056-En58D (cold drawn).
Black, brown, black, red	BS2056-En58E (cold drawn), BS3601-ERW-27.
Black, brown, black, white	L152, BS2056-En58H (cold drawn), BS2870-NS103-H.
Black; brown, black, yellow	BS2056-En58G (cold drawn).
Black, brown, blue, brown	L153, BS2871-C107-½H.
Black, brown, blue, green	BS970-526-M60-V.
Black, brown, blue, red	BS970-150-M19-R.
Black, brown, blue, white	BS970-150-M28-R.
Black, brown, blue, yellow	BS970-150-M36-R, BS2870-NS103-EH.
Black, brown, green, black	BS970-150-M36-S, BS2871-CZ110-0.
Black, brown, green, blue	BS1775-ERW-11.
Black, brown, green, brown	DTD5057.
Black, brown, green, red	BS1775-ERW-20.
Black, brown, green, white	BS1775-ERW-16.
Black, brown, green, yellow	BS970-120-M36-R, BS2870-NS103-0.
Black, brown, red, black	BS1775-CEW-28, BS2874-CZ114-H.
Black, brown, red, blue	BS1775-CEW-11.
Black, brown, red, brown	HR207, BS1775-CEW-24, BS2871-CZ110-TA.
Black, brown, red, green	BS970-120-M36-S.
Black, brown, red, white	BS1775-CEW-16, BS2870-NS104-½H.
Black, brown, red, yellow	BS970-605-M36-S.
Black, brown, white, black	BS2871-CZ110-M.
Black, brown, white, blue	BS970-605-M36-T.
Black, brown, white, brown	
Black, brown, white, green	BS970-605-M36-U.
Black, brown, white, red	BS970-605-M36-V.
Black, brown, white, yellow	BS2870-NS104-H, DTD5313.
Black, brown, yellow, black	S205, BS2871-CZ119-M.
Black, brown, yellow, blue	BS970-225-M44-S.
Black, brown, yellow, brown	
Black, brown, yellow, green	HR5 (softened sections for forming).
Black, brown, yellow, red	BS2870-NS104-EH, DTD5283.
Black, brown, yellow, white	BS970-070-M20-P.
Black, green, black, blue	BS2056-En 58J (cold drawn).
Black, green, black, brown	BS1554-En 56D (drawn).
Black, green, black, green	BS2056-En 58F (cold drawn), BS3601-HLW-26.
Black, green, black, red	L156 (as rolled), BS2871-CZ119-0.
Black, green, black, white	
Black, green, black, yellow	HR204 (softened and descaled).
Black, green, blue, brown	
Black, green, blue, green	BS970-120-M28 (cold drawn from hot rolled), BS2871-CN102-M.
Black, green, blue, red	HR5 (annealed bar for machining).
Black, green, blue, white	BS970-230-M07 (hot rolled).
Black, green, blue, yellow	BS970-120-M19-R, AMS4900F.
Black, green, brown, blue	BS970-225-M44-T.
Black, green, brown, green	L156-T4, BS2871-CN102-0.
Black, green, brown, red	DTD5303 (annealed).

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COLOURS	SPECIFICATIONS
Black, green, brown, white	HR5 (forging stock).
Black, green, brown, yellow	BS970-605-M30-S.
Black, green, red, black	BS2898-EIE-M.
Black, green, red, blue	L156-T42.
Black, green, red, brown	BS970-605-M30-T.
Black, green, red, green	BS1471-T1B-H8, BS2871-CN107-M.
Black, green, red, white	BS970-605-M30-U.
Black, green, red, yellow	BS970-605-M30-V.
Black, green, white, black	BS970-608-M38-S, BS2870-CZ101-H, BS2871-CN107-0.
Black, green, white, blue	BS970-608-M38-T.
Black, green, white, brown	BS970-608-M38-U, BS2872-CZ115-M.
Black, green, white, green	BS2870-NS106-H.
Black, green, white, red	BS970-608-M38-V, BS2873-CZ106-½H.
Black, green, white, yellow	BS970-530-M40-S.
Black, green, yellow, black	BS970-530-M40-T.
Black, green, yellow, blue	HR601 (cold worked and ground).
Black, green, yellow, brown	BS4360-50B.
Black, green, yellow, green	BS2874-CZ124-H.
Black, green, yellow, red	HR650 (fully heat treated and machined).
Black, green, yellow, white	DTD5032.
Black, red, black, blue	L157-T6, BS2872-CZ116-M.
Black, red, black, brown	
Black, red, black, green	BS3601-EFW-26
Black, red, black, red	BS2874-CZ124-M, DTD5110 (solution treated and controlled stretched).
Black, red, black, white	BS970-526-M50-T.
Black, red, black, yellow	BS970-503-M40 (normalised), BS2872-CZ122-M.
Black, red, blue, brown	DTD5124 (solution treated), AIR9160C-30NCD16 (hardened and tempered - 1080/1230 MPa).
Black, red, blue, green	HR650 (solution treated and machined).
Black, red, blue, red	BS2870-NS106-EH.
Black, red, blue, white	
Black, red, blue, yellow	BS1473-HB30-TF, BS2872-CZ123-M, AIR9160C-30NCD16 (hardened and tempered - 1220/1370 MPa).
Black, red, brown, black	BS970-709-M40-S.
Black, red, brown, blue	
Black, red, brown, green	BS970-709-M40-T.
Black, red, brown, red	BS2870-CZ101-0.
Black, red, brown, white	BS970-709-M40-U.
Black, red, brown, yellow	BS970-709-M40-V, BS2870-NS107.
Black, red, green, blue	BS970-230-M07 (cold drawn).
Black, red, green, brown	L157-T62, BS3602-ERW-23.
Black, red, green, red	BS2870-CZ101-½H, BS3602-ERW-27.
Black, red, green, white	
Black, red, green, yellow	BS970-708-M40-S.
Black, red, white, black	BS970-708-M40-T, BS2872-CA103-M.
Black, red, white, blue	BS970-708-M40-U.
Black, red, white, brown	
Black, red, white, green	
Black, red, white, red	L111 (solution treated).
Black, red, white, yellow	
Black, red, yellow, black	HR206 (softened and descaled), BS2874-C101-0.
Black, red, yellow, blue	BS970-817-M40-U.
Black, red, yellow, brown	BS970-817-M40-V, BS2870-CZ102-0.
Black, red, yellow, green	BS970-817-M40-W.
Black, red, yellow, red	HR403 (cold worked and softened), BS2874-C103-H.
Black, red, yellow, white	BS970-817-M40-X.
Black, white, black, blue	HR240 (annealed and descaled), BS2872-CA104-M.

COLOURS	SPECIFICATIONS
Black, white, black, brown	BS970-212-M36-Q.
Black, white, black, green	BS2874-C106-M.
Black, white, black, red	BS2989 (Class 1B).
Black, white, black, white	BS2872 - CA106-M.
Black, white, black, yellow	HR402 (cold worked and softened), BS970-503-M40-Q, BS1473-RIB-HS.
Black, white, blue, brown	BS2874-C106-0.
Black, white, blue, green	BS970-817-M40-Z.
Black, white, blue, red	BS970-826-M31-U.
Black, white, blue, white	TA1, BS2872-NS101-M.
Black, white, blue, yellow	HR251 (solution treated and descaled), BS970-826-M31-V.
Black, white, brown, black	BS970-826-M31-W.
Black, white, brown, blue	BS2874-C109-M.
Black, white, brown, green	BS970-826-M31-X.
Black, white, brown, red	HR501 (cold drawn).
Black, white, brown, white	BS970-826-M31-Z.
Black, white, brown, yellow	BS970-040-A12 (as rolled or forged), BS2872-CS101-M.
Black, white, green, blue	BS970-826-M40-V, BS2874-C109-0.
Black, white, green, brown	BS970-826-M40-W.
Black, white, green, red	BS2870-CZ102-H.
Black, white, green, white	BS970-826-M40-X, BS2874-C111-M.
Black, white, green, yellow	HR502 (cold drawn and solution treated), BS2874-C111-0.
Black, white, red, blue	BS970-826-M40-Y.
Black, white, red, brown	BS970-826-M40-Z.
Black, white, red, green	BS970-830-M31-U.
Black, white, red, white	L113 (solution treated), BS2870-CZ102-½H, BS2874-CZ103-M.
Black, white, red, yellow	BS970-830-M31-V.
Black, white, yellow, black	HR503 (cold drawn), BS970-830-M31-W.
Black, white, yellow, blue	
Black, white, yellow, brown	
Black, white, yellow, green	
Black, white, yellow, red	
Black, white, yellow, white	
Black, yellow, black, blue	BS2874-CZ104-M.
Black, yellow, black, brown	BS2870-CZ103-0.
Black, yellow, black, green	BS3601-SFW-26
Black, yellow, black, red	BS2874-CZ106-M.
Black, yellow, black, white	BS2870-CZ103-½H.
Black, yellow, black, yellow	BS970-220-M07 (hot rolled).
Black, yellow, blue, brown	BS2874-CZ113-M.
Black, yellow, blue, green	
Black, yellow, blue, red	
Black, yellow, blue, white	BS2874-CZ116-M.
Black, yellow, blue, yellow	BS2870-CZ103-H.
Black, yellow, brown, blue	BS2898-EIE-½H.
Black, yellow, brown, green	
Black, yellow, brown, red	BS2870-CZ110-M, BS2874-CZ119-M.
Black, yellow, brown, white	
Black, yellow, brown, yellow	BS1470-NS8-H4.
Black, yellow, green, blue	HR601 (cold worked, solution treated and ground or descaled), BS2874-CZ122-M.
Black, yellow, green, brown	
Black, yellow, green, red	
Black, yellow, green, white	BS2874-CA106-M.
Black, yellow, green, yellow	BS1449 - En 2C/A, BS2870-CZ110-0.
Black, yellow, red, blue	BS2874-CA106-0.
Black, yellow, red, brown	
Black, yellow, red, green	

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COLOURS	SPECIFICATIONS
Black, yellow, red, white	HR650 (forging stock).
Black, yellow, red, yellow	
Black, yellow, white, blue	BS970-653-M31-T.
Black, yellow, white, brown	BS970-653-M31-U, BS2874-CS101-M.
Black, yellow, white, green	
Black, yellow, white, red	BS970-817-M40-T, BS2874-NS113-M.
Black, yellow, white, yellow	BS2870-CZ118-½H.
Blue, black, blue, brown	BS2874-CS101-0, BS3601-HFS-22.
Blue, black, blue, green	L164 (as rolled), BS1775-HFS-23.
Blue, black, blue, red	BS3601-HFS-27.
Blue, black, blue, white	
Blue, black, blue, yellow	BS3601-HFS-35.
Blue, black, brown, blue	L164-T4, BS1775-HFS-11, BS2874-NS101-M.
Blue, black, brown, green	BS1775-HFS-13, BS2870-CZ118-H.
Blue, black, brown, red	BS1775-HFS-20.
Blue, black, brown, white	BS1775-HFS-16.
Blue, black, brown, yellow	BS2870-CB101-0.
Blue, black, green, blue	
Blue, black, green, brown	BS2874-NS102-M.
Blue, black, green, red	L164-T42.
Blue, black, green, white	BS2870-CZ118-EH.
Blue, black, red, blue	BS2874-NS111-M.
Blue, black, red, brown	
Blue, black, red, green	BS2874-NS112-M.
Blue, black, red, white	
Blue, black, red, yellow	
Blue, black, white, blue	BS1775-OAW-11, BS2870-CZ119-H.
Blue, black, white, brown	
Blue, black, white, green	
Blue, black, white, red	
Blue, black, white, yellow	
Blue, black, yellow, blue	
Blue, black, yellow, brown	BS970-722-M24-T, BS2870-CZ119-½H.
Blue, black, yellow, green	BS970-722-M24-U.
Blue, black, yellow, red	BS970-905-M31-S, BS1775-EFW-16.
Blue, black, yellow, white	
Blue, brown, black, blue	BS970-905-M39-S
Blue, brown, black, brown	BS970-905-M39-T.
Blue, brown, black, green	BS2870-CZ119-EH.
Blue, brown, black, red	BS970-080-M50-S.
Blue, brown, black, white	BS1775-CDS-23.
Blue, brown, black, yellow	BS1449-CS17A.
Blue, brown, blue, brown	BS1775-HLW-16.
	L168-T6 (3L100, Section 5), BS970-945-M38 (as rolled), BS1449 - En 58D (cold rolled), BS2870-CZ120-½H.
Blue, brown, blue, green	L165-T6, BS1449-En 58E (softened).
Blue, brown, blue, red	BS1449 - En 58E (cold rolled).
Blue, brown, blue, white	BS970-503-A37 (hardened and tempered), BS1449- En 58F (softened), BS2870-CZ120-H.
	BS970-150-M19 (normalised), BS1449 - En 58F (cold rolled), BS1470-HS15-TF.
Blue, brown, blue, yellow	BS1449-CS17B, BS1775-CDS-11.
Blue, brown, green, blue	L165-T62, BS1775-CDS-20.
Blue, brown, green, brown	BS1775-CDS-16.
Blue, brown, green, red	
Blue, brown, green, white	BS2870-CZ120-EH.
Blue, brown, green, yellow	
Blue, brown, red, blue	BS1775-CDS-13.
Blue, brown, red, brown	
Blue, brown, red, green	
Blue, brown, red, white	
Blue, brown, red, yellow	
Blue, brown, white, blue	

COLOURS	SPECIFICATIONS
Blue, brown, white, brown	BS1775-CDS-24, BS2870-CZ123-M.
Blue, brown, white, green	
Blue, brown, white, red	
Blue, brown, white, yellow	BS1775-CDS-28.
Blue, brown, yellow, blue	
Blue, brown, yellow, brown	
Blue, brown, yellow, green	
Blue, brown, yellow, red	BS1775-CDS-35, BS2870-CZ125-0.
Blue, brown, yellow, white	
Blue, green, black, brown	BS1449-CS17C.
Blue, green, black, green	
Blue, green, black, red	
Blue, green, black, white	
Blue, green, black, yellow	BS970-945-M38-S.
Blue, green, blue, black	BS1449 - En 58A (softened).
Blue, green, blue, brown	BS1449 - En 58G (softened)
Blue, green, blue, green	HR1 (softened section for forming), BS1449 - En 58G (cold rolled).
Blue, green, blue, red	BS1449 - En 58H (softened).
Blue, green, blue, white	BS970-503-A42 (hardened and tempered), BS1449 - En58H (cold rolled).
Blue, green, blue, yellow	BS970-150-M19-Q, BS1449 - En 58J (softened).
Blue, green, brown, black	BS970-945-M38-T.
Blue, green, brown, green	BS2870-CN101-M.
Blue, green, brown, red	BS970-945-M38-U.
Blue, green, brown, white	BS970-945-M38-V.
Blue, green, brown, yellow	DTD5232 (bars for forging).
Blue, green, red, blue	BS1449-304-S12 (softened).
Blue, green, red, brown	HR2 (softened section for forming), BS2873-CZ108-½H.
Blue, green, red, green	
Blue, green, red, white	HR3 (heat-treated bar and section for machining), BS1449-HR1, BS1449-HRP1, BS1449-HR11, BS1449-HRP11.
Blue, green, red, yellow	BS1449-HS1.
Blue, green, white, blue	HR3 (softened section for forming), BS1449-HR2, BS1449-HRP2, BS1449-HR12, BS1449-HRP12, BS2870-CN102-M.
Blue, green, white, brown	BS1449-NHR12.
Blue, green, white, green	BS1449-HS2.
Blue, green, white, red	BS1449-CS1.
Blue, green, white, yellow	AIR9160C-30CD12 (annealed), BS1449-CS2.
Blue, green, yellow, blue	TA28, BS1449-HR2-VE.
Blue, green, yellow, brown	HR3 (forging stock), BS1449-CR2/GP.
Blue, green, yellow, green	BS1449-CR2/FF, DTD5232 (bars for machining).
Blue, green, yellow, red	HR6 (annealed bar and section for machining), BS1449-CR2/VE.
Blue, green, yellow, white	
Blue, red, black, brown	HR10 (solution treated bar and section for machining), BS1449-CR1/GP.
Blue, red, black, green	BS1449-CR1/FF.
Blue, red, black, red	BS1449-CR1/VE, BS2870-CN102-0.
Blue, red, black, white	
Blue, red, black, yellow	HR10 (softened section for forming).
Blue, red, blue, brown	BS1449 - En 58J (cold rolled).
Blue, red, blue, green	BS1449 - En 60 (softened).
Blue, red, blue red	BS1449 - En 2A.
Blue, red, blue, white	HR6 (forging stock), BS1449 - En 61 (softened), BS1474-HE9-0.
Blue, red, blue, yellow	
Blue, red, brown, black	BS970-816-M40-T.
Blue, red, brown, blue	BS970-816-M40-U.
Blue, red, brown, green	BS970-816-M40-V.

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COLOURS	SPECIFICATIONS
Blue, red, brown, red	BS2870-CN103-0.
Blue, red, brown, white	BS970-640-M40-S.
Blue, red, brown, yellow	BS970-640-M40-T.
Blue, red, green, black	BS970-640-M40-U.
Blue, red, green, blue	HR10 (forging stock).
Blue, red, green, brown	QQ-B-637A-485-½H.
Blue, red, green, white	
Blue, red, green, yellow	BS2870-NS104-0.
Blue, red, white, blue	
Blue, red, white, brown	BS1449-HR3, BS1449-HRP3, BS1449-HR13, BS1449-HRP13, BS2870-NS109-0.
Blue, red, white, green	
Blue, red, white, red	BS1474-NE5-0.
Blue, red, white, yellow	HR11 (solution treated bar and section for machining), BS1449-HR3/VE.
	BS1449-NHR13, BS2870-NS105-½H.
Blue, red, yellow, blue	HR11 (softened section for forming), BS1449-HS3.
Blue, red, yellow, brown	BS2870-NS109-½H.
Blue, red, yellow, green	L513.
Blue, red, yellow, red	BS2874-CZ115-M (hot worked).
Blue, red, yellow, white	BS1449-CS3, BS2870-NS105H.
Blue, white, black, brown	
Blue, white, black, green	BS970-080-A27 (as rolled or forged), BS2870-NS109-H.
Blue, white, black, red	
Blue, white, black, white	BS970-080-A42 (as rolled or forged), BS2870-NS105-0.
Blue, white, black, yellow	BS970-080-M40-Q.
Blue, white, blue, black	BS970-150-M28 (normalised), BS1449-CR3-GP, BS3601-CDS22.
Blue, white, blue, brown	BS970-150-M36-Q, BS1449-CR3-FF, BS2870-NS105-EH.
	BS970-120-M36-Q, BS1449-CR3-VE, BS3601-CDS27.
Blue, white, blue, green	BS2870-NS109-EH, DTD5101.
Blue, white, blue, red	BS970-605-M36-R, BS3601-CDS35, BS2874-CZ115-M(C&SR).
Blue, white, blue, white	BS970-080-A32 (as rolled or forged).
Blue, white, blue, yellow	BS970-080-M40 (as rolled or forged).
Blue, white, brown, green	L515.
Blue, white, brown, red	BS970-605-M36 (as rolled).
Blue, white, brown, white	BS970-503-M40 (as rolled).
Blue, white, brown, yellow	BS970-608-M38 (as rolled), BS1449 - En 2B/B, BS2870-NS108-0.
Blue, white, green, brown	BS1449-HR4, BS1449-HRP4, BS1449-HR14, BS1449-HRP14.
Blue, white, green, red	BS970-530-M40 (as rolled), BS1449-HR4-VE.
	BS970-835-M30 (as rolled), BS2870-NS108-½H.
Blue, white, green, white	BS1449-NHR14.
Blue, white, green, yellow	BS1449-HS4A.
Blue, white, red, brown	BS970-080-M15 (as rolled or forged and bright bars), BS1449-CS4 (annealed).
Blue, white, red, green	L514, BS1449-HS4B, BS2870-NS108-H.
Blue, white, red, white	BS970-220-M07 (cold drawn), BS1449-CR4-GP.
Blue, white, red, yellow	BS1449-CR4-FF.
	BS1449-CR4-VE.
Blue, white, yellow, blue	BS1449-CS4 (skin passed).
Blue, white, yellow, brown	BS1449-CS4-¼H.
Blue, white, yellow, green	BS970-817-M40 (as rolled), BS1449-CS4-½H, BS2870-NS108-EH.
Blue, white, yellow, red	BS970-826-M31 (as rolled), BS1449-CS4-H.
Blue, white, yellow, white	BS970-080-A30 (as rolled or forged).
Blue, yellow, black, brown	
Blue, yellow, black, green	BS970-216-M36-R.
	BS1449 - En 2B.
Blue, yellow, black, red	BS970-695-A32 (hardened and tempered).
Blue, yellow, black, white	BS970-605-A37 (hardened and tempered).
Blue, yellow, black, yellow	
Blue, yellow, blue, brown	
Blue, yellow, blue, green	
Blue, yellow, blue, red	
Blue, yellow, blue, white	

COLOURS	SPECIFICATIONS
Blue, yellow, blue, yellow	
Blue, yellow, brown, green	BS970-665-M17 (as rolled or forged and bright bars).
Blue, yellow, brown, red	
Blue, yellow, brown, white	BS2056 - En 58A (cold drawn).
Blue, yellow, brown, yellow	
Blue, yellow, green, brown	
Blue, yellow, green, red	
Blue, yellow, green, white	
Blue, yellow, green, yellow	
Blue, yellow, red, brown	
Blue, yellow, red, green	BS970-735-A50 (as rolled or forged).
Blue, yellow, red, white	
Blue, yellow, red, yellow	
Blue, yellow, white, brown	
Blue, yellow, white, green	BS970-080-M30 (as rolled or forged).
Blue, yellow, white, red	
Blue, yellow, white, yellow	HR202 (softened and descaled).
Brown, black, blue, brown	
Brown, black, blue, green	BS970-503-A37 (as rolled).
Brown, black, blue, red	BS970-503-A42 (as rolled).
Brown, black, blue, white	BS970-785-M19 (as rolled).
Brown, black, blue, yellow	BS970-150-M19 (as rolled or forged).
Brown, black, brown, green	L158 (as rolled), BS970-150-M28-Q.
Brown, black, brown, red	BS970-605-M30-R.
Brown, black, brown, white	BS970-606-M36-R.
Brown, black, brown, yellow	BS970-608-M38-R.
Brown, black, green, brown	BS970-240-M07 (cold drawn), BS1470-NS4-M, BS1475-NG4-M.
Brown, black, green, red	L158-T42, BS970-709-M40 (as rolled).
Brown, black, green, white	BS970-708-M40 (as rolled).
Brown, black, green, yellow	BS970-708-A37 (as rolled), BS1470-NS4-H3.
Brown, black, red, brown	L158-T4.
Brown, black, red, green	
Brown, black, red, white	
Brown, black, red, yellow	
Brown, black, white, brown	
Brown, black, white, green	BS970-905-M39 (as rolled).
Brown, black, white, red	BS970-080-M50 (as rolled or forged).
Brown, black, white, yellow	BS970-080-M50 (cold drawn from normalised).
Brown, black, yellow, brown	HR202 (solution treated).
Brown, black, yellow, green	
Brown, black, yellow, red	
Brown, black, yellow, white	
Brown, blue, black, green	BS970-080-M40 (cold drawn from hot rolled), BS2873-C101-0.
Brown, blue, black, red	BS970-080-A35 (as rolled or forged).
Brown, blue, black, white	BS970-080-A37 (as rolled or forged).
Brown, blue, black, yellow	BS970-080-A40 (as rolled or forged).
Brown, blue, brown, black	BS970-530-M40-R.
Brown, blue, brown, green	BS970-530-A32 (hardened and tempered), BS2873-C102-H.
Brown, blue, brown, red	L159-T6, BS970-530-A36 (hardened and tempered).
Brown, blue, brown, white	BS970-530-A40 (hardened and tempered).
Brown, blue, brown, yellow	BS970-709-M40-R, BS2873-C103.
Brown, blue, green, brown	BS2873-C106.
Brown, blue, green, red	BS970-708-A42 (as rolled).
Brown, blue, green, white	
Brown, blue, green, yellow	L159-T62.
Brown, blue, red, brown	
Brown, blue, red, green	BS2873-C108-H.
Brown, blue, red, white	
Brown, blue, red, yellow	BS970-534-A99 (as rolled).

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COLOURS	SPECIFICATIONS
Brown, blue, white, brown	BS2873-CZ101-0.
Brown, blue, white, green	BS970-080-A47 (as rolled or forged).
Brown, blue, white, red	BS970-080-A52 (PART 1 - as rolled or forged), BS1475-HG9-M.
Brown, blue, white, yellow	TA22, BS1470-SIA-M.
Brown, blue, yellow, brown	BS2873-CZ101-½H.
Brown, blue, yellow, green	
Brown, blue, yellow, red	HR11 (forging stock).
Brown, blue, yellow, white	BS1554-En 56A (drawn).
Brown, green, black, green	BS1554-En 56B (drawn), BS2873-CZ101-H.
Brown, green, black, red	BS970-212-M36 (as rolled or forged), BS1554-En 56C (drawn).
Brown, green, black, white	L168-T6511 (3L.100, Section 5), BS1470-NS4-H6.
Brown, green, black, yellow	L168-T6510 (3L.100, Section 5), BS970-150-M28 (as rolled or forged), BS2873-CZ102-0.
Brown, green, blue, green	
Brown, green, blue, red	BS970-150-M36 (as rolled or forged).
Brown, green, blue, white	BS970-708-M40-R.
Brown, green, blue, yellow	BS970-708-A37 (hardened and tempered).
Brown, green, brown, black	BS970-240-M07 (hot rolled), BS1474-HE9-TE, BS2873-CZ102-½H.
Brown, green, brown, blue	QQ-S-766C-301 sheet (full hard).
Brown, green, brown, green	BS970-708-A42 (hardened and tempered).
Brown, green, brown, red	TA21.
Brown, green, brown, white	L168-T6510 (3L.100, Section 6), BS2873-CZ102-H.
Brown, green, brown, yellow	L168-T6511 (3L.100, Section 6), BS1471-HT20-H4.
Brown, green, red, brown	
Brown, green, red, green	BS2873-CZ103-0.
Brown, green, red, white	BS1449-En 44D (hot rolled or normalised).
Brown, green, red, yellow	
Brown, green, white, brown	
Brown, green, white, green	
Brown, green, white, red	BS1449-HS20, BS2873-CZ103-½H.
Brown, green, white, yellow	BS970-212-M36 (cold drawn from hot rolled), BS2873-CZ103-H.
Brown, green, yellow, brown	
Brown, green, yellow, green	BS1449-CS30.
Brown, green, yellow, red	BS970-212-A37 (as rolled or forged), BS2873-CZ106-0.
Brown, green, yellow, white	BS970-216-M36 (as rolled or forged), BS1449-CS40.
Brown, red, black, green	BS1449-En 2D.
	BS970-120-M36 (as rolled or forged), BS2873-CZ106-H.
Brown, red, black, red	
Brown, red, black, white	TA11.
Brown, red, black, yellow	DTD5100.
Brown, red, blue, green	
Brown, red, blue, red	BS970-653-M31-S, BS1449-CS50.
Brown, red, blue, white	BS970-653-M31 (as rolled).
Brown, red, blue, yellow	BS2873-CZ107-0, QQ-A-200/8D-T6511 (as supplied).
Brown, red, brown, green	BS1449-HS40.
Brown, red, brown, red	BS1449-CS60.
Brown, red, brown, white	BS3602-HFS-23.
Brown, red, brown, yellow	BS970-080-A62 (as rolled or forged), BS2873-CZ107-½H.
Brown, red, green, brown	BS1449-En 5, BS3602-HFS-27.
Brown, red, green, red	BS970-080-A67 (PART 1 - as rolled or forged), BS3602-HFS-35.
Brown, red, green, white	
Brown, red, green, yellow	
Brown, red, white, brown	
Brown, red, white, green	
Brown, red, white, red	
Brown, red, white, yellow	

COLOURS	SPECIFICATIONS
Brown, red, yellow, brown	BS1449-CS70, BS2873-CZ107-H.
Brown, red, yellow, green	
Brown, red, yellow, red	
Brown, red, yellow, white	
Brown, white, black, green	BS970-212-A42 (as rolled or forged), BS2873-CZ107-EH, BS3603-HFS-27-LT30.
Brown, white, black, red	BS3603-HFS-27-LT50.
Brown, white, black, white	BS3603-HFS-503-LT100.
Brown, white, black, yellow	BS1449-CS80 (annealed).
Brown, white, blue, brown	BS970-695-A32 (as rolled).
Brown, white, blue, green	BS970-605-A37 (as rolled).
Brown, white, blue, red	BS970-605-M30 (as rolled), BS2873-CZ108-0.
Brown, white, blue, white	DTD5056 (wire).
Brown, white, blue, yellow	BS970-606-M36 (as rolled).
Brown, white, brown, blue	BS970-826-M31-T.
Brown, white, brown, green	BS970-826-M40-U, BS1449-CS90.
Brown, white, brown, red	BS970-830-M31-T, BS2873-CZ108-EH.
Brown, white, brown, white	BS970-070-M20 (as rolled or normalised).
Brown, white, brown, yellow	
Brown, white, green, brown	BS970-826-M40 (as rolled).
Brown, white, green, red	
Brown, white, green, white	
Brown, white, green, yellow	BS970-830-M31 (as rolled), BS1449-CS100.
Brown, white, red, green	BS2873-CZ119-0.
Brown, white, red, white	
Brown, white, red, yellow	BS970-722-M24 (as rolled).
Brown, white, yellow, brown	BS1449-HS12B, BS2873-CZ119-½H.
Brown, white, yellow, green	
Brown, white, yellow, red	
Brown, white, yellow, white	
Brown, yellow, black, green	BS2873-CZ119-H, BS3604-HF-620.
Brown, yellow, black, red	
Brown, yellow, black, white	BS3604-HF-621, BS970-526-M60 (as rolled).
Brown, yellow, black, yellow	
Brown, yellow, blue, brown	BS970-530-A30 (as rolled).
Brown, yellow, blue, green	BS970-530-A32 (as rolled), BS1449-HS12C.
Brown, yellow, blue, red	BS970-530-A36 (as rolled), BS2873-CB101-W, BS3604-HF-622/27.
Brown, yellow, blue, white	BS970-530-A40 (as rolled).
Brown, yellow, blue, yellow	BS2873-CB101-W(H), BS3604-HF-622/35
Brown, yellow, brown, green	BS3604-HF-625.
Brown, yellow, brown, red	BS1449-En 2, BS2873-CB101.
Brown, yellow, brown, white	
Brown, yellow, brown, yellow	BS2873-NS103-0.
Brown, yellow, green, red	BS1449-HS22A.
Brown, yellow, green, white	
Brown, yellow, green, yellow	BS1449-HS12A.
Brown, yellow, red, brown	BS970-897-M39 (as rolled).
Brown, yellow, red, green	BS2873-NS103-½H, BS3604-HF-660.
Brown, yellow, red, white	BS970-905-M31 (as rolled).

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COLOURS	SPECIFICATIONS
Brown, yellow, red, yellow	BS1449-HS17B.
Brown, yellow, white, green	BS1449-HS17A, BS1474-HE30-0.
Brown, yellow, white, red	BS2873-NS103-H.
Brown, yellow, white, yellow	
Green, black, blue, green	BS2873-NS104-0.
Green, black, blue, red	HR40 (annealed bar and section for machining), BS1471-T1C-H8.
Green, black, blue, white	HR40 (forging stock).
Green, black, blue, yellow	HR53 (annealed bar and section for machining).
Green, black, brown, green	
Green, black, brown, red	HR51 (annealed bar and section for machining), BS2873-NS104-½H.
Green, black, brown, white	HR51 (forging stock).
Green, black, brown, yellow	TA12.
Green, black, green, blue	BS970-045-M10 (as rolled or forged and bright bars), BS-1449-En 42E (as cold rolled).
Green, black, green, brown	BS1449-En 42E (hot rolled or normalised).
Green, black, green, red	HR52 (annealed bar and section for machining), BS1449-En 42F (as cold rolled), BS1471-T1B-H4.
Green, black, green, white	BS970-210-M15 (as rolled or forged and bright bars), BS2873-NS104-H.
Green, black, green, yellow	HR52 (forging stock), BS1449-En 42F (hot rolled or normalised), BS1475-NG4-H8.
Green, black, red, green	
Green, black, red, white	TA16.
Green, black, red, yellow	BS2873-NS105-0.
Green, black, white, green	
Green, black, white, red	HR53 (forging stock), BS2873-NS105-½H.
Green, black, white, yellow	TA19.
Green, black, yellow, green	L114 (annealed).
Green, black, yellow, red	L114 (solution treated).
Green, black, yellow, white	TA8.
Green, blue, black, green	BS970-431-S29 (softened).
Green, blue, black, red	BS2873-NS105-H.
Green, blue, black, white	
Green, blue, black, yellow	
Green, blue, brown, green	L167-T6, TA7, BS2873-NS106-0.
Green, blue, brown, red	
Green, blue, brown, white	
Green, blue, brown, yellow	BS2873-NS106-H.
Green, blue, green, black	BS1449-En 42G (as cold rolled).
Green, blue, green, brown	BS970-665-M23 (as rolled or forged and bright bars), BS1449-En 42G (hot rolled or normalised).
Green, blue, green, red	BS970-665-A22 (as rolled or forged and bright bars), BS1449-En 42J (as cold rolled).
Green, blue, green, white	BS970-665-A24 (as rolled or forged and bright bars), BS2873-NS106-½H.
Green, blue, green, yellow	BS970-640-A35 (as rolled), BS1449-En 42J (hot rolled or normalised).
Green, blue, red, green	TA6, BS2873-NS107-0.
Green, blue, red, white	
Green, blue, red, yellow	L167-T62.
Green, blue, white, green	
Green, blue, white, red	AIR9160C-30CD12 (hardened and tempered - 1080/1270 MPa).
Green, blue, white, yellow	BS2873-NS107-½H.
Green, blue, yellow, green	
Green, blue, yellow, red	AIR9160C-30CD12 (hardened and tempered - 930/1080 MPa).
Green, blue, yellow, white	BS4300/5-TF.
Green, brown, black, red	BS2873-NS107-H.

COLOURS	SPECIFICATIONS
Green, brown, black, white	BS1449-CS12C.
Green, brown, black, yellow	BS2873-NS108-0.
Green, brown, blue, red	T76.
Green, brown, blue, white	L166-T42.
Green, brown, blue, yellow	BS970-640-A35 (hardened and tempered), BS1449-En 43G (as cold rolled).
Green, brown, green, black	L166 (as rolled), BS1449-En 43G (hot rolled or normalised), BS2873-NS108-½H.
Green, brown, green, red	BS970-130-M15 (as rolled or forged and bright bars).
Green, brown, green, white	BS970-214-M15 (as rolled or forged and bright bars), BS1449-En 43J (as cold rolled).
Green, brown, green, yellow	TA3, BS1449-En 2D/A, BS2873-NS108-H.
Green, brown, red, green	BS1449-HS23A.
Green, brown, red, white	S132 (fully heat treated - not nitrided).
Green, brown, red, yellow	DTD5212 (bars for forging).
Green, brown, white, green	BS2873-NS109-0.
Green, brown, white, red	TA4.
Green, brown, white, yellow	L166-T4.
Green, brown, yellow, green	BS2873-NS109-½H.
Green, brown, yellow, red	BS2873-NS109-H, DTD5212 (bars for machining).
Green, brown, yellow, white	BS2873-PB101-0.
Green, red, black, red	BS1449-HS23B.
Green, red, black, white	BS970-070-M55 (cold drawn from normalised).
Green, red, black, yellow	BS3602-CDS-23.
Green, red, blue, red	BS970-080-M46 (cold drawn from hot rolled), BS2873-PB101-½H.
Green, red, blue, white	BS970-070-M55-R, BS1449-HR6C, BS1449-HRP6C, BS1449-HR17C, BS1449-HRP17C.
Green, red, blue, yellow	BS970-523-A14 (as rolled or forged and bright bars), BS1449-En 43J (hot rolled or normalised).
Green, red, brown, red	BS970-527-A19 (as rolled or forged and bright bars), BS1449-En 44D (as cold rolled).
Green, red, brown, white	BS970-040-A04 (as rolled or forged), BS2873-PB101-H.
Green, red, brown, yellow	BS970-635-M15 (as rolled or forged and bright bars).
Green, red, green, black	BS970-637-M17 (as rolled or forged and bright bars).
Green, red, green, blue	BS2873-PB101-EH.
Green, red, green, red	BS1449-En 14A, BS3602-CDS-27.
Green, red, green, white	BS970-070-M55 (as rolled or forged), BS3602-CDS-35.
Green, red, green, yellow	BS1449-HR6B, BS1449-HRP6B, BS1449-HR17B, BS1449-HRP17B, BS2873-PB103-0, DTD5202 (normalised).
Green, red, white, green	BS2871-CZ127-M.
Green, red, white, red	BS970-070-M55-S, BS2873-PB103-½H.
Green, red, white, yellow	HR201 (softened and descaled), HR401 (cold worked and softened).
Green, red, yellow, green	BS970-816-M40 (as rolled), BS1449-CS80 (hardened and tempered), BS2873-PB103-H.
Green, red, yellow, red	BS3076-NA18 (cold worked and precipitated).
Green, red, yellow, white	BS2873-PB103-EH.
Green, white, black, red	BS3076-NA18 (cold worked, solution treated and precipitated).
Green, white, black, white	BS2871-CZ127-0.
Green, white, black, yellow	BS970-080-M50-T, BS4109-C102-H.
Green, white, blue, red	BS970-815-M17 (as rolled or forged and bright bars), BS1449-En 44E (as cold rolled).
Green, white, blue, white	
Green, white, blue, yellow	
Green, white, brown, red	
Green, white, brown, white	
Green, white, brown, yellow	
Green, white, green, black	

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COLOURS	SPECIFICATIONS
Green, white, green, blue	BS970-820-M17 (as rolled or forged and bright bars).
Green, white, green, brown	BS970-822-M17 (as rolled or forged and bright bars).
Green, white, green, red	BS970-805-M17 (as rolled or forged and bright bars), BS1449-HR17/1
Green, white, green, white	BS970-050-A20 (as rolled or forged), BS4109-C102-0.
Green, white, green, yellow	BS970-805-M20 (as rolled or forged and bright bars), BS1408-C (Range 3), BS3072-NA13 (cold rolled and annealed).
Green, white, red, white	
Green, white, red, yellow	
Green, white, yellow, green	BS1449-HS100, BS3603-CDS-27-LT30, DTD5192 (softened).
Green, white, yellow, red	BS3076-NA18 (hot worked and precipitated), BS3603-CDS-27-LT50, BS4109-C101-H.
Green, white, yellow, white	BS3603-CDS-503-LT100.
Green, yellow, black, red	BS3604-CD-620, BS4109-C103-0.
Green, yellow, black, white	BS3076-NA18 (hot worked, solution treated and precipitated), BS3604-CD-621.
Green, yellow, black, yellow	BS4109-C101-0.
Green, yellow, blue, red	BS970-070-M55 (normalised), BS1449-HR6A, BS1449-HRP6A, BS1449-HR17A, BS1449-HRP17A, BS3604-CD-622/27, BS4109-C103-H.
Green, yellow, blue, white	BS970-070-M55-T, BS1449-NHR23.
Green, yellow, blue, yellow	BS1472-HF16-M, BS3604-CD-622/35.
Green, yellow, brown, green	BS1449-En 2D/B.
Green, yellow, brown, red	BS970-060-A57 (as rolled or forged), BS3604-CD-625.
Green, yellow, brown, white	TA23.
Green, yellow, brown, yellow	
Green, yellow, green, black	BS970-805-M25 (as rolled or forged and bright bars), BS1449-En 44E (hot rolled or normalised).
Green, yellow, green, brown	BS970-530-A30 (hardened and tempered).
Green, yellow, green, red	BS1470-NS8-M.
Green, yellow, green, white	BS1449-HR7A, BS1449-HRP7A.
Green, yellow, green, yellow	DTD5091 (soft).
Green, yellow, red, white	BS970-080-A57 (as rolled or forged), BS1449-HS80, BS3604-CD-660.
Green, yellow, red, yellow	
Green, yellow, white, red	BS970-060-A62 (as rolled or forged), BS1449-HS22C.
Green, yellow, white, yellow	BS1449-HR7B, BS1449-HRP7B.
Red, black, blue, red	
Red, black, blue, white	BS970-060-A67 (as rolled or forged), BS1554-En 58E (softened), BS3601-ERW-410.
Red, black, blue, yellow	BS1554-En 58F (softened).
Red, black, brown, red	S201.
Red, black, brown, white	BS970-060-A72 (as rolled or forged), BS3601-BW-320.
Red, black, brown, yellow	BS970-070-A72 (PART 1 - as rolled or forged), BS3601-ERW-360
Red, black, green, red	BS970-080-A72 (as rolled or forged).
Red, black, green, white	BS970-945-A40 (as rolled), BS3601-ERW-320.
Red, black, green, yellow	BS970-060-A78 (as rolled or forged), BS1449-CS12B.
Red, black, red, brown	BS970-640-M40 (as rolled).
Red, black, red, white	BS3839-½H.
Red, black, red, yellow	
Red, black, white, red	BS970-070-A78 (PART 1 - as rolled or forged).
Red, black, white, yellow	BS970-080-A78 (as rolled or forged), BS3601-SAW-410.
Red, black, yellow, red	BS1449-En 2C.
Red, black, yellow, white	BS970-060-A83 (as rolled or forged).
Red, blue, black, red	BS1554-En 56A (softened).
Red, blue, black, white	BS970-080-A83 (as rolled or forged), BS1449-CS12A, BS1554-En 56B (softened).
Red, blue, black, yellow	TA18, TA25, BS3601-S-410, BS1554-En 56C (softened).
Red, blue, brown, white	BS970-050-A86 (as rolled or forged), BS1449-HS22B.

Issue 1

June, 1985

APPENDIX IV TO LEAFLET BL/2-2

HANDWRITTEN AMENDMENTS

The following handwritten amendments have been included in MOD Leaflet QTR 7/AQD and should be incorporated in CAA CAIP Leaflet BL/2-2, Appendix I.

(a) APPENDIX I

PAGE	DESCRIPTION	COLOUR
7	Under 'BS 1473' amend 'HB2C-TH' to read 'HB20-TH'	
12	Under 'BS2871' delete 'NT8-M' and all details	
13	Under BS2873 amend colour codes for NS106-.5H to read	'Green, blue, green, white'
16	Under HR650 amend colour code against 'solution treated and machined' to read	'Black, red, blue, green'
18	Change colour code for TA26 to	'White, green, blue, yellow'
20	Amend S15(B) to read 'S15 B & D'	
21	Amend S61B to read 'S61 B & D'	
21	Against 'S93A'... 'bars for forging' delete '(normalised)'	
22	Amend 'S114' to read 'S114 B & D', and include black bars in the description	
22	Amend S131 so that S131 B & D appear against 'bars for machining'	
24	Under S517 delete all' the part beginning '(40-ton 0.1 per cent proof stress)' as this part appears correctly against S518	

BL/2-2 APP. IV

PAGE	DESCRIPTION	COLOUR
29	Against colour code RED BLACK WHITE RED, amend '060 A78' to read '070 A78'	
31	Amend colour code against 530 A30 'as rolled' to read	'Brown, yellow, blue, brown'
33	Change colour code for 785 M19, Q condition, to	'Black, blue, brown, white'
34	Change colour code against 945 A40 'as rolled' to	'Red, black, green, white'
38	Amend colour code against 352 S54 to read	'Brown, black, white, black, brown'
41	Change colour code against En 44D 'Hot rolled or normalized' to	'Brown, green, white, red'
42	Enter at beginning of DESCRIPTION and COLOUR lists of BS 1449 1962, 'EN 2A/1	Red, brown, red, yellow'
42	Enter after 'HS30': 'En 2D/1	Red, white, red, blue'
43	Amend 'HR14, HRP24' to read 'HR14, HRP14'	
43	Enter after 'HS12B', 'En 2C/1	Red, green, red, brown'
45	Insert under BS 2056, against the first entry, 'En 56A'	