HOSPITAL ENGINEERING

May 1977

The Journal of the Institute of Hospital Engineering

Successful Annual Conference

The most systematic attack on cross infection since sterilization itself

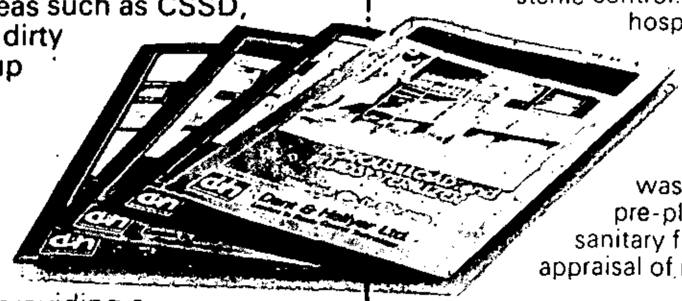
Nowadays, controlling cross infection is more than a hygiene problem.

With increasing demands on hospital resources it also presents a difficult management problem.

Sterile equipment must get into the right hands fast, involving as few "hands" as possible on the way, at the lowest possible cost.

At Dent & Hellyer we recognise what the real problems are. Quality equipment including sterilizers, bed pan washers and sanitary units are only part of our solution.

The essence of it is our ability to piece them all together into fully cost-effective packages for key areas such as CSSD, TSSU, sluice room, dirty utility room, scrub up area, pharmacy and laboratory.

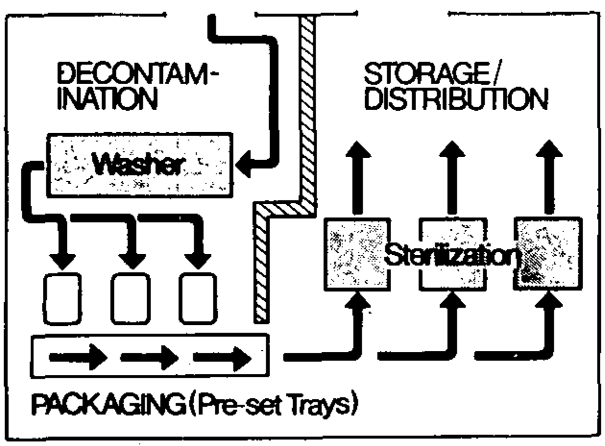


For maximum efficiency you have to plan for efficiency. This is precisely what we can do for you, providing a comprehensive service including feasibility studies, planning, equipping, commissioning, staff training and worldwide after-sales support. You also reap the benefits of a Sterile Control Technology that's based on years of experience and backed up by a comprehensive research and development programme.

For example, we have now developed an improved low temperature steam and formaldehyde process for sterilizing heat sensitive loads. We can equip your sterile supply units with a unique combination of both sterilizers and automatic surgical instrument washers. Very soon we'll be able to supply a new range of table top sterilizers.

Dent & Hellyer's concept of sterile control is of vital importance to everyone concerned with world health care.

If you'd like to know how we can assist you, please send us the coupon or contact us about your project (if you're in London you're welcome to visit our permanent display at the British Hospital Equipment Display Centre, 22 Newman Street, W.1).



Please give me details of your work in sterile control. I'm interested in:
hospital and laboratory sterilizers and autoclaves ☐
surgical instrument washers ☐ bed pan and urine bottle washers and disinfectors ☐
pre-plumbed sanitary units/ sanitary fittings ☐ a free appraisal of my existing facilities ☐
(Tick as applicable)

Name ____________________

Position ____________________

Authority/Hospital/Company ____________________

Address ____________________

____

____

____

Dent & Hellyer Limited, Walworth Road, Andover, Hampshire, SP10 5AA
Tel. Andover (0264) 62111
Telex 47430 Cables: Dents Andover.
A member of the InterMed Group.

HE5/77

d+h ESTABLISHED 1730 Dent & Hellyer

Dent & Hellyer Limited, Walworth Road, Andover, Hampshire, SP10 5AA
Telephone: Andover (0264) 62111

'Hospital Engineering' is published monthly, except in January and August, by Earlsport Publications

Printed by JB Offset Printers
(Marks Tey) Ltd.
Station Approach, North Lane,
Marks Tey, Colchester, Essex

Individual copies cost
£1.70 U.K. postage paid

The annual subscription is UK: £14.50
Overseas: £17.50 Americas: $40

Average circulation per issue
(January-December 1976): 2228

ABC

Editor
Christopher Tanous

Art Editor
Bob Rixon

Advertisement Manager
Sue Cartwright

All correspondence relating to the Journal should be addressed to:
'Hospital Engineering',
Earlsport Publications
33 Ludgate Hill,
London EC4, England
Telephone: 01-248 0148/9

UK ISSN 0309-7498

The Institute of Hospital Engineering,
20 Landport Terrace,
Southsea, Hants. PO1 2RG, England
Telephone:
Portsmouth 23186 (STD 0705 23186)

Secretary
J. E. Furness, VRD

HOSPITAL ENGINEERING

May 1977 **Vol. 31 No. 4**

The Journal of the Institute of Hospital Engineering

Contents

Institute News

The Institute submitted evidence to the Royal Commission in April. It is reproduced in full below.

The Royal Commission on the NHS

The Institute's Evidence

The objects for which the Institute of Hospital Engineering was established are outlined in the Memorandum of Association attached hereto. But for immediate consideration the first two objects are:

a. To promote the science of Hospital Engineering involving the design, construction, employment and maintenance of plant, equipment, machinery and apparatus used in the engineering and associated services of hospitals, clinics and laboratories, and the maintenance of vehicles.

b. To promote advance and assist in the education of students in the profession of Hospital Engineering and technology in all its branches by every expedient means and, in particular, by conducting appropriate examinations to test the suitability of candidates for admission to membership of the Institute.

The Institute does not engage itself in political activities, neither does it provide to its membership those services usual within the orbit of a Trade Union or such other body taking part in negotiations for salaries etc.

Membership of the Institute is not confined to those engineers who are employed in the Health Service. Indeed quite a proportion of the membership is drawn from consulting engineers and those who follow their profession in companies manufacturing and providing hospital equipment. In addition many companies producing goods and materials used within the Health Service have affiliate membership.

Because of this such observations as are made will be confined to those aspects of the Health Service workings and organisation which it is considered should be investigated and possibly modified in order to provide the best back-up to the human endeavour made for the benefit of patients by

(i) the provision of the most efficient engineering installations and systems, and

(ii) the type of training and career structure which could, as far as possible, ensure that there are enough engineers and other associated professions and trades within the service to design, operate and maintain those installations and systems previously mentioned.

Engineering installations

In February 1962 the then Minister of Health, Mr. Enoch Powell, speaking at the dinner of the Institution of Engineers, said:

"Physically speaking the modern hospital should not be imagined as a solid box into which the necessary services and facilities can be filled or fitted. It is much nearer the truth to think of it as being essentially a central core of ducts and channels carrying the engineering services. To this central core are attached all the wards and departments which depend on those services for their life; with an outer case round everything. Perhaps I am exaggerating a little, but not much. Certainly I am exaggerating in the direction toward which we ought to lean in our hospital thinking and planning today.

For too long we have thought of our hospitals almost like ancient monuments, imposing in their solidity, durable and inflexible in their plan. As medical knowledge and methods have been transformed and as medical needs have changed, we have had to try to squeeze the new services, appliances and departments into a rigid and resistant framework. The old hospital was built to last. The new hospital must be built to change. That means it must be so designed as to give the utmost freedom to regroup and modify the layout around the central nervous system of the engineering services.

These services are thus the key to the physical planning of the hospitals of the future. But they are the key to more than that. I said that in the past we tended to think of hospitals as boxes into which patients were put, along with the due proportion of doctors and nurses. This idea we must discard. Instead, we have to think of the hospital as a great piece of equipment placed at the disposal of highly trained staff, to do specific jobs within the service of patients."

There is no need to add to this statement which so succinctly describes the engineering involvement in a hospital, except to say that in the 15 years since it was made there has been an enormous increase in the extent and sophistication of installations and equipment in hospitals. Unfortunately during this same period there has been little or no impact upon the renewal of engineering installations which have reached the end of their useful life in an already aging stock of hospital buildings.

These installations attract to themselves a massive running cost through the use of energy in the form of coal, oil, gas or electricity and also recurring maintenance costs. The inability of the Health Service to provide sufficient funds to enable engineering installations to be operated at a level of high efficiency, or to be modified to take account of technical advancement, means that we are spending an increasing sum to meet the rising cost of energy and maintenance; the incidence of breakdown is greater as installations become older.

Preliminary investigations undertaken not only in the engineering division of the Department of Health, but also at Regions and Areas, show that the return on investment, if there were a more rational approach to the replacement of engineering installations, would in itself generate more funds to improve patient care.

The Institute would therefore recommend that a more critical assessment of the engineering state should be made in the terms of the Estmancode[1] philosophy in order that

(i) the capital investment can be preserved at the most economic state of efficiency, and

(ii) the revenue expenditure related to operation and maintenance brought down to an efficient minimum in order that a maximum of monies can be allocated for direct use to the patient.

Engineers

Although engineering makes a vital contribution to patient care the number of engineers of all types and grades employed is comparatively few when measured against the complete

[1]Estmancode is the name given to a set of guidance notes developed by DHSS/NHS working parties to set down the principles and practices of good estate management for the NHS.

Health Service labour force. Each engineer needs to be as efficient as possible, well trained and receiving that degree of job satisfaction which will enable him to work within the demanding conditions that a 24-hour day, seven days a week, working environment demands. Although not labour intensive, the engineering function in hospitals is necessarily high compared with other health care support activities. When related to the total 'Estate Management' function it generates a significant proportion of the total expenditure on health services.

Very broadly the engineering effort can be divided into two distinct categories:

a. design and build;

b. operation and maintenance.

The maximum design effort is at Region, the maximum operation and maintenance, at District, with an intermingling of these two operations at Area.

Because of the wide implications and effect of engineering and estate management on all aspects of health care and the consequent expenditure that it generates, it is essential to provide authoritative estate management input at the higher level of management decisions in each tier of the total organisation. At present this applies only at Region and more recently at the DHSS, but it does not apply at Area and District where the greatest proportion of the total NHS budget is spent and where the health services are more directly discharged.

Prior to the re-organisation there seemed to be a sharp division between the activities of Regions and Hospital Management Committees which in engineering function terms meant between design and build on the one hand and operation and maintenance on the other. This was a functional division which was not intended to create an atmosphere where there were two separate types of engineers, each with their own career prospects and attainments with no cross-over points, but in fact the situation of separation pertained. In many people's view this was encouraged because of the way in which the Whitley machinery was organised in respect of negotiations for the conditions governing the engagement and employment of the engineers working at both Regional and Management Committee level. There were, in fact, two quite separate committees and the impression was that they were in complete isolation with no regard to the fact that the two groups of engineers they were discussing were following their profession within the same overall organisation. It was hoped that the re-organisation would overcome this anomalous situation and create a career structure working through all parts of the organisation, from the Department of Health, to Region, to Area, to District, to Hospital so that there could be set up training and career opportunities which would attract the best and most suitable people to the Service. Unfortunately this hope has not been realised. Indeed the original situation still pertains and consequently there is a very large barrier to the realisation of this total career structure which the Institute feels is so necessary if the best of engineering and engineers is to be available.

The Institute therefore recommends very strongly that an immediate effort should be made to rationalise the regulations covering the conditions of engagement and service of all engineers employed in the Health Service, with particular reference to training, qualifications and related responsibilities.

Although this statement relates primarily to professional engineers, technician engineers and technicians it applies equally to other professions and artisan staff associated with estate management.

Associated hospital engineering endeavour

In the introduction mention was made of the membership within the Institution of consultants and manufacturers and suppliers who are engaged in the field of export, using the Health Service as a base load for their operations. This is an activity which must not, and cannot, be ignored, particularly as the Department of Health is encouraging the sale of Health Service expertise to foreign countries. It has been extremely encouraging to note the real interest shown in, for instance, building systems developed — these included Best Buy, Harness and Nucleus. The potential for the sale of this commodity is almost limitless but its development is wholly dependent upon an on-going programme of capital building in the UK. The case here is based on the same philosophy which is stated in relation to our fields of export endeavour, namely that a thriving export industry is wholly dependent upon a well established and viable home industry.

The Institute therefore recommends that the effect of the engineering effort in the UK Health Service as related to the export of goods and expertise should be more fully realised and more account taken of it.

Summary

The Institute of Hospital Engineering therefore makes the following recommendations:

(i) that there should be a carefully considered capital investment programme for the replacement of engineering installations, thereby minimising maintenance and operation costs, coupled with greater recognition of the need to effectively maintain and effectively operate the physical assets of the Service;

(ii) that there should be a complete career structure for all engineers in the Health Service, giving particular attention to training, qualifications and related responsibilities;

(iii) that the effect of the engineering effort in the UK Health Service in relation to the export of goods and expertise should be more fully realised and more account taken of it.

Howorth Air Engineering win Design Award

A fitting end to the Presidential term of Mr. F. H. Howorth, who handed over the reins of the Presidency of the Institute to Mr. Richard Harrison at Pitlochry on April 29, will take place in a few weeks.

The Duke of Edinburgh will be presenting Mr. Howorth's company, Howorth Air Engineering Limited, with one of the coveted Design Council Awards for 1977.

The Award has been made by the Design Council for the Charnley-Howorth Sterile Operating Unit, designed by Mr. Howorth in association with Sir John Charnley CBE, Professor of Orthopaedic Surgery, and Director of Research at Wrightington Hospital, Wigan.

The Award has been given for the latest model of the Charnley-Howorth Operating Unit, an air handling device which provides a substantial downward and outward flow pattern of contamination-free air over members of the surgical team and the patient. The system was described in an article by Mr. Howorth, in *Hospital Engineering* for November 1976.

The Design Council judges considered the Unit to be a 'good piece of British innovation simply executed'. They also said that 'this operating theatre demonstrates outstanding successful collaboration between doctors and engineers'. Units of this type are already installed in hospitals in 21 different countries, and another 39 are already earmarked for export, since they were demonstrated recently at the Royal Festival Hall at the 6th Combined Orthopaedic Meeting of the English Speaking World.

North Western Branch

The Annual General Meeting of the above branch was held on Thursday, March 24 1977 at the Bolton Medical Institute. The Committee for 1977/78 was elected as follows:

Chairman	W. J. Smith
Vice-Chairman	R. Richards
Hon. Secretary/Treas.	D. H. Mellows
Assistant Secretary	J. E. Burton
Committee Members	D. Cunliffe
	T. Hardacre
	A. Juliff
	A. Millington
	A. W. Schaffel
	J. Sunderland

The Chairman's Annual Report contained a summary of the year's events, including the highly successful Annual Dinner Dance, which this year had been held at the Worsley Court House. The report also expressed the hope that Branch Meetings would continue to be joint events, open to members of The Institute of Plant Engineers and the CIBS.

The business meeting was followed by an illustrated talk on Gas Distribution Networks, given by Mr. Maynard, assisted by Mr. Partington, both of North West Gas. The talk and the associated slides proved to be of great interest to members and described the methods of, and problems associated with distribution of natural gas, compared with town gas.

The meeting ended with a lengthy and lively exchange of views and opinions.

East Anglian AGM

The Annual General Meeting was held at Addenbrooke's Hospital, Cambridge, on Saturday, March 5 1977. Mr. J. A. Parker, Chairman of the Branch, presided.

Giving his annual report, Mr. Parker stated that 1976 had not been a very good year for the Institute. Members were still suffering from lack of morale following re-organisation of the Health Service. The movement of staff throughout the service had slowed down and the Branches were now becoming re-established and undergoing an increase in the active membership. Mr. Parker felt that members should do everything possible to encourage Engineers and particularly the younger staff, to apply for membership of the Institute.

The highlight of the year for the Branch had been the 1976 Annual Conference which had been held in Norwich and Mr. Parker thanked all members of the Branch for the support which had made the conference one of the most successful ever held.

He went on to thank the Secretary for his services and also Mr. Blackburn and Mr. Turnbull for the work they performed in co-ordinating the secretarial duties for much of the year. Mr. Parker then handed over the Chair to Mr. R. G. Kidsley.

Mr. Kidsley thanked Mr. Parker for his services to the Branch and, in particular, the work he had personally put into the 1976 Annual Conference. Mr. Kidsley also thanked Mr. Blackburn, Mr. Turnbull and Mr. Brooke for their services as Branch Secretaries.

Following the request for nominations for Branch Officers, it was not necessary to hold a ballot. The Branch Officers for 1977 will be as below.

Mr. R. G. Freestone is to continue as Area Member of Council.

1977 Five-Branch Meeting

The Secretary advised the Committee that the Meeting will take place at the Middlesex Hospital on Saturday, May 21 1977. Further details will be circulated as soon as these are received from the organisers.

The programme of Meetings for 1977 was agreed as below:

Chairman	R. C. Kidsley	District Works Officer, Bury St. Edmunds Health District
Vice-Chairman	F. D. Blackburn	District Works Officer, Norwich Health District
Hon. Secretary and Treasurer	M. Brooke	District Works Officer, Gt. Yarmouth and Waveney Health District
Committee Members		R. G. Freestone, J. A. Parker, C. P. Le Breton, G. G. S. Turnbull

May 21 1977	Five-Branch Meeting	Middlesex Hospital, London
July 2 1977	Factory Visit	Great Yarmouth
September 24 1977	Subject to be arranged	Bury St. Edmunds
November 5 1977	Factory Visit	Norwich
January 7 1978	Subject to be arranged	Cambridge
March 4 1978	Annual General Meeting	Bury St. Edmunds

Letter to the Editor

Dear Sir,

May I say how much I enjoyed Mr. Fletcher's article 'Boiler and Feed Water Treatment' in the April 1977 issue of *Hospital Engineering*.

Under the general heading of Fire Side Corrosion, the subject of water dewpoint corrosion in LTHW boilers is raised. As Mr. Fletcher clearly points out, it is essential to raise the return water temperature above 48°C as quickly as possible.

However, whilst internal boiler arrangements can play a big part, it is also imperative in most cases that means of recirculating water through the boiler are provided — particularly on cold starts.

My own company are very involved with minimising the effects of water dewpoint fire-side corrosion attack by the use of our Sarco 58 three-port control. It is widely used for this purpose throughout the UK on such projects as schools, offices etc. where intermittent operation is practised.

Indeed, we have produced a technical booklet on the subject entitled 'Fire-Side Corrosion in Low Temperature Hot Water Boilers', which is freely available on request.

I am taking the liberty of enclosing a copy for your interest and look forward to the next series of 'Students' Pages'.

A. J. Graver
Manager Heating Department
Spirax-Sarco Ltd.,
Charlton House,
Cheltenham GL53 8ER.

The Institute of Hospital Engineering – Library 1977

It was November 1974 when a full index of books held in the Library was last published in the Journal, therefore it is now felt that an up-dated press announcement would be helpful.

Members may obtain on loan for one month any of the following books, journals and catalogues on application to the Institute Honorary Librarian, R. G. Smith, Kewstoke, Primrose Lane, Oversley Green, Alcester, Warwickshire B49 6LG.

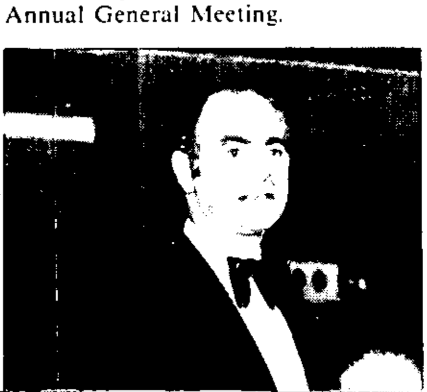
Title	Author	Publishers
Hospital Henri Mondor	Administration Générale De L'Assistance Publique à Paris	
Hospital Planning Requirements	ALDIS, Gary	*Pitman 1959*
Fire Safety Training in Health Care Institutions	American Hospital Association	
Proceedings of the International Conference on Nosocomial Infections	American Hospital Association	
Boiler Management, Maintenance and Inspection	ARMSTRONG, H. C., LEWIS, C. V.	*Charles Griffiths & Co.*
Practical Boiler Firing	ARMSTRONG, H. C., LEWIS, C. V.	*Charles Griffiths & Co.*
Estudios sobre Hospitals	Asociacion Para el Desarrolo Hospitalario	*Jacint Goday — No. 53 1972*
Domestic Heating and Hot Water Supply	BARTON, J. J.	*MacLaren & Sons*
Estimating for Heating and Ventilating	BARTON, J. J.	*George Newnes Ltd. (London)*
Fundamentals of Industrial Ventilation (Third enlarged edition)	BATURIN, V. V.	*N. S. Billington, E. Owner*
Evaluating New Hospital Buildings	BAYNES, Ken, LANGSLOW, Brian, WADE, Courtanay C.	*King Edward's Hospital Fund for London — 1969*
Transformation of Scientists and Engineers into Managers	BAYTON and CHAPMAN	*National Aeronautics and Space Admin.*
Supervisory Studies — second edition	BETTS, P. W.	*MacDonald & Evans Ltd.*
Lighting Design in Buildings	BOUD, John	*Peter Peregrinus Ltd.*
The Principles and Practice of Management	BRECH, E. F. L.	*Longman*
Pump Users' Handbook	British Pump Manufacturers' Association	*Trade and Technical Press Ltd.*
Annual Report 1970-1971	British Standards Institution	*BSI*
Valves for the control of fluids, technical reference book — second edition	British Valve Manufacturers' Association	*Pergamon Press*
BSI Yearbook 1971 and 1972	British Standards Institution	*BSI*
BSI News 1973 and 1974	British Standards Institution	*BSI*
A Complete Public Speaking Course	CARSON, Herber N.	*The Efficiency Magazine*
Walmsley's Rural Estate Management	CHAPMAN, D. H.	*The Estates Gazette Ltd.*
Workshop Technology Part 1 — an Introductory Course	CHAPMAN, W. A. J.	*Edward Arnold & Co.*
Manual of Maintenance Engineering	CLEMENTS, Richard and PARKER, Dennis	*Business Publications Limited*
News Sheets	Clwyd and Deeside HMC	*Clwyd and Deeside Aug. and Nov. 1970*
European Development Aid	Commission of European Communities	
Copper Flashings and Weatherings — A Practical Handbook	Copper Development Association	*Copper Development Association — 1944*
The Cockroach — Vol. 1	CORNWELL, P. B.	*Hutchinsons — 1968*
Planning, Design and Construction of Hospital Buildings for the National Health Service	CRUIKSHANK, H. J.	*DHSS*
Work Study	CURRIE, R. M.	*Pitman Publishing — 1972*
Alphabetical Classification Index	Department of Health and Social Security	*DHSS*
Buildings for Mentally Handicapped People	Department of Health and Social Security	*HMSO — 1971*
Guide to Good Practices in Hospital Administration (Management Services)	Department of Health and Social Security	*HMSO — 1970*
Hospital Building Maintenance (Report of the Committee — 1968-70)	Department of Health and Social Security	*HMSO — 1970*
Hospital Service Engineering Data Sheets: Regional Engineers, England and Wales	Department of Health and Social Security	*DHSS*
Hospital Service Engineering (January 1974)	Department of Health and Social Security	*DHSS*
Hospital Service Engineering Nos. 12, 13, 14, 18, 19, 20	Department of Health and Social Security	*DHSS*
Hospital Technical Memorandum Nos. 1, 2, 6, 8, 10, 21, 22, 23	Department of Health and Social Security	*DHSS*
An Introduction to Present Worth Techniques	Department of Health and Social Security	*DHSS*
Maintenance Manual Mechanical PMG/13	Department of Health and Social Security	*DHSS*
Present Worth Approach to Decision Taking	Department of Health and Social Security	*DHSS*
The Proceedings of the Second International Congress of Hospital Engineering, held in June 1972, in London.	Department of Health and Social Security	*DHSS*

Title	Author	Publishers
Noise and Vibration Control for Industrialists	PETRUSEWICZ, S. A., LONGMORE, D. K.	*Paul-Elek (Scientific Books) Ltd.*
Practical Boiler Water Treatment (Including Air Conditioning Systems)	PINCUS, L. I.	*McGraw-Hill Book Co.*
Handbook of Heating Ventilating and Air Conditioning — 7th Edition	PORGES, J. revised by PORGES, F.	*Newnes-Butterworths*
Hospital Building Maintenance (Comments on the Woodbine Parish Report)	Regional Engineers' Association	*Regional Engineers' Association (August 1970)*
The Future Structure of the National Health Service (Comments on Second Green Paper)	Regional Engineers' Association	*Regional Engineers' Association — 1970*
Free Monies	Research Committee of Association of Hospital Treasurers	*Research Committee of Association of Hospital Treasurers — 1966*
L'Assistenza Ospedaliera 4 and 6	Rivista Dei Segretari Generali E Dei Dirigenti Ospedalieri	
Finance for the Non-Accountant	ROCKLEY, L. E.	*Business Books Ltd.*
Design and Equipment of Hospitals	ROLAND, W.	*Baillie, Tindall & Cox*
Strength of Materials	RYDER, G. H.	*Cleaver-Hume Press Ltd.*
Theory of Machines through Worked Examples	RYDER, G. H.	*Cleaver-Hume Press Ltd.*
Electrical Earthing and Accident Prevention	SAY, M. G.	*George Newnes Ltd.*
Managing Large Systems	SAYLES, L. R., CHANDLER, M. K.	*Harper and Row*
The Commercial Management of Engineering Contracts	SCOTT, P.	*Gower-Press*
Organisation and Design of Out Patient Departments (Hospital Planning Note 6)	Scottish Home and Health Department	*HMSO — 1967*
Industrial Oil Fuel Delivery, Storage and Handling	Shell Mex and BP Ltd.	*Shell Mex and BP Ltd.*
Productivity and Training	SMITH, D.	*King Edward's Hospital Fund for London — 1969*
Spon's Architects' and Builders' Price Book 1974 (99th Edition)		*E. and F. N. Spon Ltd.*
Spon's Mechanical and Electrical Services Price Book 1974		*E. and F. N. Spon Ltd.*
Plant Engineering Handbook — Second Edition	STANIAR, William	*McGraw-Hill Book Company*
The Law of Smoke Nuisances	STEER, HORNBY, W. R.	*National Smoke Abatement Society — 1948*
Steam Pipe Installations		*Stewarts and Lloyds Ltd.*
Handbook of Environmental Control — Vol. V	STRAUB, Conrad P.	*CRC Press Inc.*
An Introduction to Heat Pumps	SUMNER, J. A.	*Prism Press*
Techniques for Production Efficiency	SWANN, K.	*MacMillan Handbooks in Industrial Management*
Het Koningin Juliana Ziekenhuis	TE HENGELO, (O.)	*Plattegronden Van*
Electrics 72/73: Electrical Services in Buildings	The Electricity Council	*The Electricity Council*
Modern Oilhydraulic Engineering	THOMA, Jean	*Trade and Technical Press*
Redgraves Factories, Truck and Shops Acts	THOMPSON, J., ROGERS, H. R.	*Butterworth & Co.*
Design of Loadbearing Brickwork in SI and Imperial Units	THORLEY, W.	*William Heinemann Ltd.*
Principles of Estate Management	THORNCROFT, M.	*The Estates Gazette Ltd.*
A Guide to Sanitary Engineering Services	THOMSON, T. A.	*MacDonald and Evans Ltd.*
Water Supply — 2nd Edition	TWORT, A. C., HOATHER, R. C. and LAW, F. M.	*Edward Arnold — 1974*
Basic Electronics in Six Parts (The New Model Illustrated Course of Elementary Technician Training)	Van Valkenburgh: Nooger and Neville Inc.	*The Technical Press Ltd.*
Industrial Boiler House Efficiency	WADE, Charles F.	*Crosby, Lockwood and Son*
Royal Aircraft Establishment Bibliography on Laser Radiation Hazards	WADSWORTH, Jill	*Royal Aircraft Est.*
Electronic Equipment and Accessories	WALKER, R. C.	*George Newnes Limited*
Heat Engineering	WALSHAW, A. C.	*Longmans, Green & Co.*
Marine Electrical Practice	WATSON, G. O.	*George Newnes Ltd.*
Hospital Infection, Causes and Prevention	WILLIAMS, R. E. O., BLOWERS, R., GARROD, L. P., SHORTER, R. A.	*Lloyd Luke (Medical Books) Ltd.*
Boiler House Practice	WILLIAMS, S. N.	*George Allen and Unwin Ltd.*
Management in Hospitals	Working Party set up by the IHE (Midland Branch)	*Institute of Hospital Engineers (Midland Branch) — 1969*
Costing Matters for Managers	WOOD, E. G.	*Business Books Ltd.*
Modern Health Administration	WREN, George R.	*University of Georgia Press, Athens*
Technical College Series Commerce Vol. 1 — An Introduction to Commerce	WRIGHT, F. S.	*English University Press*
Technical College Series Commerce Vol. 2 — The Commercial System	WRIGHT, F. S.	*English University Press*
Materials of Construction for Steam Power Plant	WYATT, L. M.	*Applied Science Publishers Ltd.*

Annual Conference-First Report

The 33rd Annual Conference of the Institute was held successfully at Pitlochry in Scotland from April 27 to 29. Members enjoyed a pleasant mixture of working sessions and social events. The ladies joined in the latter with enthusiasm, and spent their days riding around in coaches to various places of local interest. Our front cover picture shows them setting out from the hotel one morning.

A complete report will be given in our next issue. The photographs on this page show the outgoing President, Mr. F. H. Howorth opening a session (above); Mr. Harry Ewing MP, Parliamentary Under Secretary of State at the Scottish Office, speaking at the Dinner Dance; and (right) the new President, Mr. J. R. Harrison, making his first speech to members at the Annual General Meeting.



BS 5266: Pt. 1: 1975, Code of practice for the emergency lighting of premises, *published nearly two years ago, was heralded as the panacea for the ambiguity and confusion which had previously reigned. It has had some success in its aim of encouraging rationalistion of the requirements of a considerable list of legislation, together with many specific bye-laws, covering various types of premises.*

The author is a director of Poselco Ltd., of Walmgate Road, Perivale, Middlesex.

Emergency Lighting - Progress and Practice

HUGH J. OGUS BA MIllumES

Before the Code of Practice was published, the standard of installed systems depended largely upon specifications issued by certain Local Authorities, and the competence of individual Fire Officers struggling to work effectively despite lack of official guidance. Since publication, a concerted effort has been made by manufacturers and enforcement authorities to agree their interpretation of the recommendations and to apply them in a sensible and practical manner. Fire Officers have worked very hard to increase their understanding of lighting technicalities, and the manufacturers have responded with the right equipment for the job. Seminars, arranged jointly by LIF, BEAMA and BSI, have made a considerable contribution to clarifying the issues by providing forums for frank exchanges of views between Suppliers, Consultants, Architects, Contractors, and officials with responsibility for enforcement.

Hospital Engineers may feel, and with some justification, that the confusion has never applied to their premises. Hospitals have always benefited from special research and guidance, and indeed BS 5266, whilst including them in the broad classification of *Premises used as sleeping accommodation,* recognises in a footnote:

"Hospital Technical Memorandum No. 11 'Emergency Electrical Services', gives guidance on the provision of all emergency electrical services in hospitals, and compliance with the recommendations of this memorandum may, at the discretion of the enforcing authority, supplement or replace the recommendations of this code."

Nevertheless, many hospitals contain a hotch-potch of systems and equipment, perhaps not so much through a lack of knowledge as through a lack of adequate funds. Since financial stringency is a continuing fact of life, consideration of the prime needs for emergency lighting with a comparison of types of equipment will help selection of systems which offer the best value for money for given circumstances.

Statutory requirements

The primary requirement for emergency lighting is the provision of the most reliable method of illuminating an escape route to a level which will permit safe evacuation of a building in the case of failure of the normal lighting system. Additionally, the lighting must permit the immediate location and operation of fire alarms and fire fighting equipment, and reduce the risk of panic in enclosed spaces such as lifts.

Photometric data

IES Technical Report No. 12, 'Hospital Lighting', will shortly be re-issued after revision. Reference to Emergency Lighting will be in line with the advice of the IES Code for Interior Lighting and BS 5266. The lighting level recommended in these latter two documents is a minimum of 0.2 lux at floor level. There seems to be serious misunderstanding of this recommendation, and it must be stressed that the figure of 0.2 lux is a *minimum* level, approximating to bright moonlight. The misunderstanding arises because lighting calculations are normally based, of course, on average levels. Average illuminance in emergency conditions is relatively unimportant, and indeed may be considered of academic interest only when the permitted uniformity ratio is as great as 40 : 1.

The most practical way of designing a scheme is to follow the specific recommendation of the Code that luminaires are placed at all changes in level and direction on an escape route, such as on stairways, intersections or bends in corridors, and on either side of fire doors. Furthermore, fire fighting equipment and any obstructions or hazards must be illuminated. Once these essential points have been identified, additional luminaires may be

Figure 1

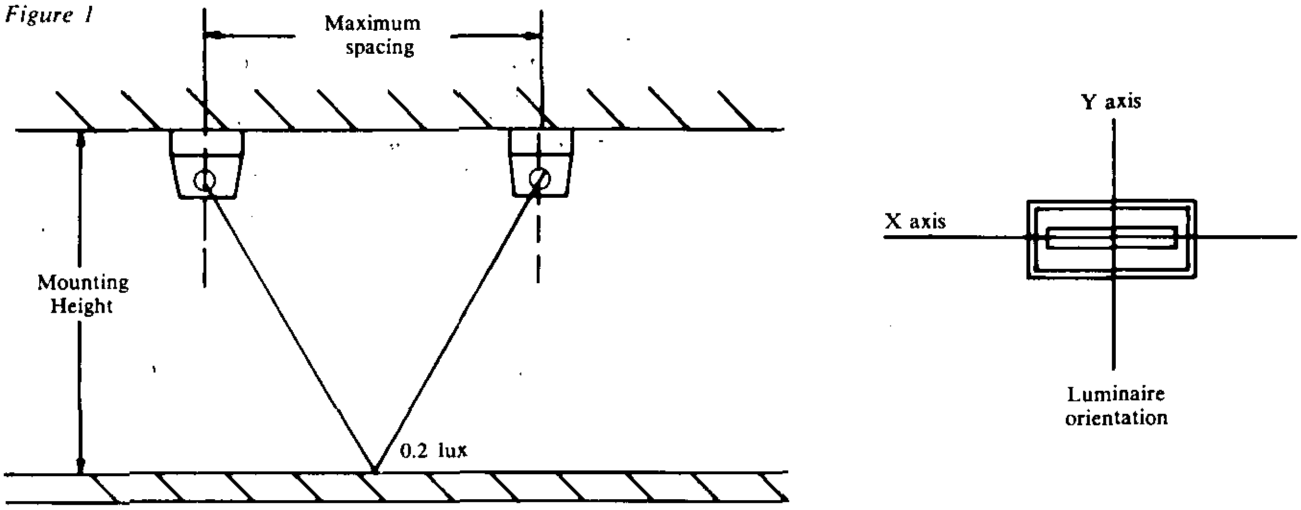


Table 1 shows typical mounting data for 4W self-contained luminaire as illustrated in Figure 1 *above.*

required to comply with the minimum illuminance and uniformity clauses. At these levels, it is best to discount the benefit of reflection from walls, ceilings and furniture, so apart from ensuring that the luminaires are not mounted in such a position that they can cause disability glare, or can be interfered with, the scheme in many cases is simply a matter of mounting height and spacing.

Thus the required photometric data can be simply presented in tabular form, giving the maximum spacing at various mounting heights to ensure 0.2 lux minimum. *Table 1* illustrates such a presentation. This method cannot be applied so simply for wall-mounted luminaires, particularly 'exit' signs where the light can make a definite contribution to the scheme, and isolux diagrams are useful for these cases.

Deterioration of the performance of luminaires due to dust and discolouration of the reflectors and diffusers must not be overlooked, and an initial target illumination with a minimum of 0.4 to 0.5 lux should be considered. Certain areas, in any case, will probably need to have a greater designed illumination because of their use or the amount of traffic.

Public areas

Public areas, particularly out-patients' departments and reception rooms, will contain many people unfamiliar with the geography of the building and the lighting levels chosen must allow for this, especially where there may be obstructions such as seating or mobile equipment, or where the exit route is complex.

Spacing/height ratio for 0.2 lux minimum

Mounting height (Metres)	*Spacing (Metres)*		*Average Illuminance (Lux)*		*Uniformity ratio*
	X	Y	X	Y	
2	8.3	11.4	1.00	1.16	12.5 : 1
3	9.0	14.6	.39	.66	5.6 : 1
4	9.6	12.4	.39	.43	3.1 : 1

Table 1

Table 2

Self-contained luminaires

Advantages

(a) Each luminaire is independent and therefore any malfunction of the equipment in any one luminaire will not affect the correct operation of any of the other luminaires.

(b) Any damage due to fire or corrosive atmosphere will affect only the section of emergency lighting in the immediate vicinity of the disturbances. Essential emergency lighting, illuminating escape routes away from the affected section will still function normally.

(c) No routine maintenance is required for the batteries.

(d) Simple connection to mains makes special wiring unnecessary, thus giving lower initial cost where only a few lighting points are required or special wiring runs would be expensive.

Disadvantages

(a) High ambient temperatures may have an adverse effect on the life of the nickel cadmium cells. The available capacity will fall if the ambient temperature exceeds 30°C.

(b) A number of cells and auxiliary equipment must be accommodated within the luminaires which places limitations on their size relative to their light output.

Central systems

Advantages	Disadvantages
(a) The batteries have a very high capacity and are very robust in construction. Lead/acid types are the cheapest and can be maintained from a simple and relatively inexpensive charging circuit.	(a) It is necessary to install special cables, although the cost of this may be minimised by using higher voltage supplies and smaller diameter cable.
(b) Batteries can be operated under ideal conditions since they are housed in specially constructed areas. Longer battery life can thus be assumed, subject to correct maintenance.	(b) The battery system requires frequent supervision and maintenance. If the premises have no regular maintenance staff available, central systems operated basically from lead/acid batteries *should not be employed.*
(c) The condition of the power source can continually be monitored, by measurement of both the specific gravity of the electrolyte and the battery voltage.	(c) A break in the luminaire supply line, a short circuit on a luminaire supply line, or a fire in, or close to, the battery room, could render part, or the whole of the system, inoperative.
(d) Only one charging circuit is required per battery room.	(d) Failure of a mains subcircuit in one area of a building only would not necessarily trigger the emergency circuit.
(e) The luminaires can be of minimal volume relating directly to the power they are required to dissipate.	
(f) Despite special wiring, initial cost can be lower where a large number of lighting points are required.	

Table 3

Wards

Other than at visiting times, wards do not normally have milling crowds, but the choice of emergency lighting level must include consideration of location, the type of patient, and the effect of disorientation due to unfamiliarity with adjacent corridors. For Geriatric Wards and the like, a lighting level of up to 10-lux may be needed.

Operating theatres

In theatres the prime consideration is for standby lighting rather than merely escape lighting. Supplying the operating lamp by means of its own power pack is one solution, where the lamp is fed through a transformer under normal conditions and is automatically switched to battery on mains failure. The same battery can be used to supply other essential local lighting.

Ancillary areas

These may also require standby rather than escape lighting.

Light sources and gear

The most efficient light source, at the present time, remains the hot cathode fluorescent tube and there is yet no indication of a superior source for this application, where high efficiency, minimal warm-up time, predictable performance and long life are all major factors. Fluorescent tubes require an AC supply for operation and this is usually obtained from small individual transistor ballasts. The international specification, IEC 458: 1974, demands a very high standard of quality and performance.

The fluorescent tubes normally used are from the miniature range of nominal 4W, 6W, 8W or 13W ratings. Where the capacity of the power supplies is limited, or the required illumination level is relatively low, these miniature tubes have the advantage of low current drain. Where power supplies are more substantial, and a high illumination level is needed for standby use, normal fluorescent tubes up to 40W can be operated. The actual performance of the tube depends significantly on the transistor ballast which operates it, and the nominal rating and light output should be ignored; the light output which is declared on the ballast label (which is a recommendation of both the Code of Practice and IEC 458: 1974), should be used for any comparison or calculation.

Another light source in common use is the miniature gas filled incandescent lamp and the most efficient of these is the 3.6W Krypton filled lamp with a life in the order of 100 hours, and a light output of 41 lumens. However, only about 2W of fluorescent lamp power would be required to achieve the same light output.

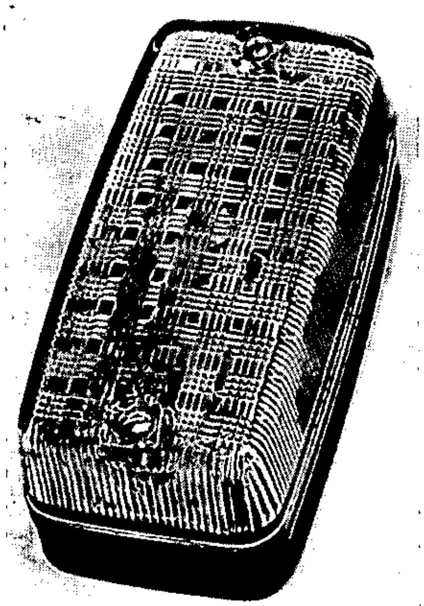


Figure 1
Self-contained, non-maintained bulkhead, for one 4W miniature fluorescent tube. (Poselco Ltd.).

The usual durations of operation from the secondary (battery) source are of one hour and three hours, recharging fully within 24 hours. One hour duration is recommended only for those installations which have a generator fitted, and the three hour duration is recommended for those applications which have no alternative power provision. Standby generators as a secondary supply source are outside the scope of this article. However, even where these are installed and are self-starting, there is a strong case for short duration battery operated lamps in particular positions or even a full supplementary battery system. The few seconds delay between mains failure and the generator running up could be critical, whether in an operating theatre or on a staircase.

Terminology

A full glossary of terms can be found in BS 5266 and in explanatory literature produced by several manufacturers. However, there are three terms describing circuits which continue to cause confusion, and which could usefully be elaborated:

Non-maintained
Applies to a system or to individual luminaires where the lamps are in operation only when the normal lighting fails.

Maintained
Applies to a system or to individual luminaires where the same light source is illuminated at all material times, either by normal mains supply or by the battery on mains failure.

Sustained
Applies only to luminaires containing two (or more) lamps, arranged so that the unit sustains lighting at all times. One lamp operates only when the normal lighting fails (ie its circuit is non-maintained) while the other lamp provides lighting from the normal supply.

Confusion tends to arise between 'maintained' and 'sustained', since either term is being used somewhat arbitrarily in specifications which do not necessarily intend to dictate the circuit conditions but do require the emergency luminaires to provide lighting normally as well as on mains failure. The BS Code of Practice recognises both systems without expressing any partiality.

In practice, subject to space for the components being available, the sustained system is preferable. It is true that, in a maintained circuit, the operation of certain parts is constantly monitored, but the state of charge of the battery is not being proved any more than in a non-maintained circuit. Furthermore, with all batteries and electrical components, reliability and life are a function of temperature, and invariably a non-maintained circuit is cooler and therefore has better reliability and life. Yet more important is the effect on the light source itself. The limited life of a tungsten lamp of any kind, plus the probability of its failure without warning, should eliminate it from

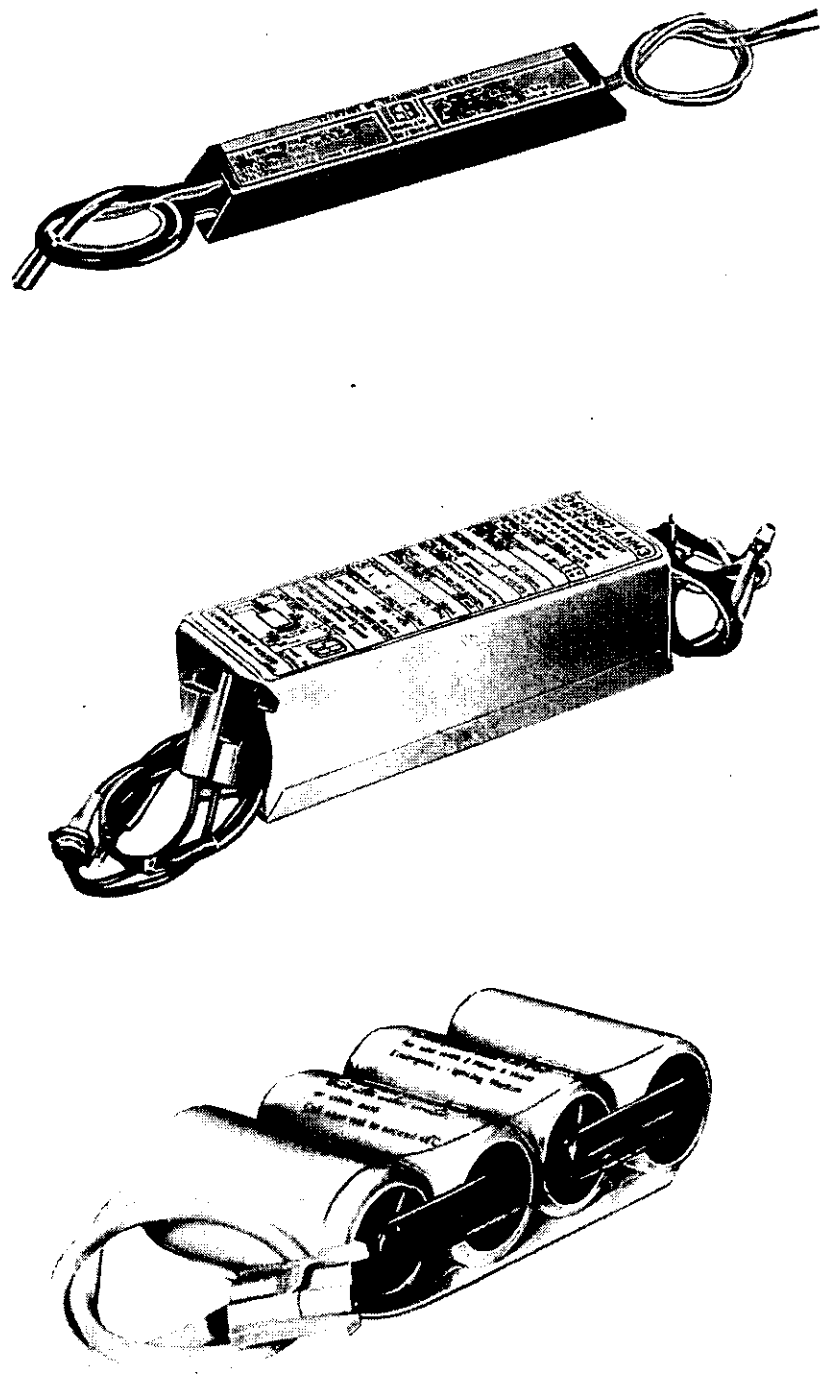


Figure 2
(Top)
Transistor ballast (to IEC 458) for use in luminaires. (Smart & Brown Lighting Ltd.).
(Centre)
Self-contained 'module' for use in luminaires. This unit contains a transistor ballast, trickle charger and solid-state mains hold-off circuit. (Smart & Brown Lighting Ltd.).
(Bottom)
Battery pack of sealed nickel/cadmium cells for use in conjunction with the 'module'.

consideration for maintained use. Fluorescent tubes do not suffer this drawback, but their light output does depreciate constantly throughout life and quite rapidly over the first few hundred hours. Battery limitations already restrict the amount of light available for emergency situations, so it would seem logical to take advantage of the relatively high initial lumen output of the tubes by using them in non-maintained circuits. Over an average five-year period, with regular testing, they would only burn for about fifty hours, and could then be replaced. This would not be wasteful as the tubes removed could be used up in normal mains circuits.

Two further terms which are fundamental to the understanding of emergency lighting relate to the power supply, which is *self-contained* or *central system*.

Self-contained systems

These use independent luminaires which contain their own secondary power supplies, generally consisting of a number of nickel/cadmium rechargeable cells, or sealed gel type lead/acid batteries, together with an integral charger and switching circuit so that only conventional mains wiring is required. The cylindrical nickel/cadmium cells are similar in appearance to normal torch batteries, having dimensions which are internationally standardised so that replacements are obtainable anywhere in the world. The major factors affecting the battery performance are *temperature* and *charge conditions*. The nominal battery capacity must be down rated, first of all because it is normally declared at the five hour rate (that is, all of the available capacity is taken over five hours), whereas for emergency lighting in the UK normal use will discharge them fully in one to three hours. A further downward rating must be applied for ambient temperatures in the vicinity of the battery exceeding 30°C. Yet another reduction should be made for loss of capacity through life. After these allowances, one would expect typically a 25% drop from the nominal to the real effective capacity in a non-maintained luminaire, and slightly more in a maintained or sustained luminaire because of increased ambient temperatures. A similar down-rating exercise on the sealed lead acid battery results in an even lower effective capacity, although the initial cost is cheaper.

The re-charge rate is very critical; too high a rate of continuous trickle charge will seriously reduce the life and too low a rate will not give the 24-hour recovery required by the Code of Practice. The charge rate required for 14 hours' recovery is too great for continuous trickle charge, but that needed for 24 hours is acceptable.

Due to limited power from batteries small enough to be incorporated in luminaires, the self-contained system is restricted to miniature fluorescent tubes or Krypton lamps.

Central systems

These provide a secondary power supply feeding more than one luminaire, where a central cubicle holds the battery, together with its charging and changeover circuit. Batteries used in this type of application are commonly of the vented nickel cadmium or of the higher quality lead acid types such as the Planté cell.

The static batteries are grouped to give the current and voltage required for a particular arrangement. Where wiring from the battery room is long, it is wise to connect the batteries in series to increase the available potential and decrease the current flow, thus minimising the power drop in the wiring. In addition to making better use of the power available, the cables may be of a smaller diameter and installation costs lower.

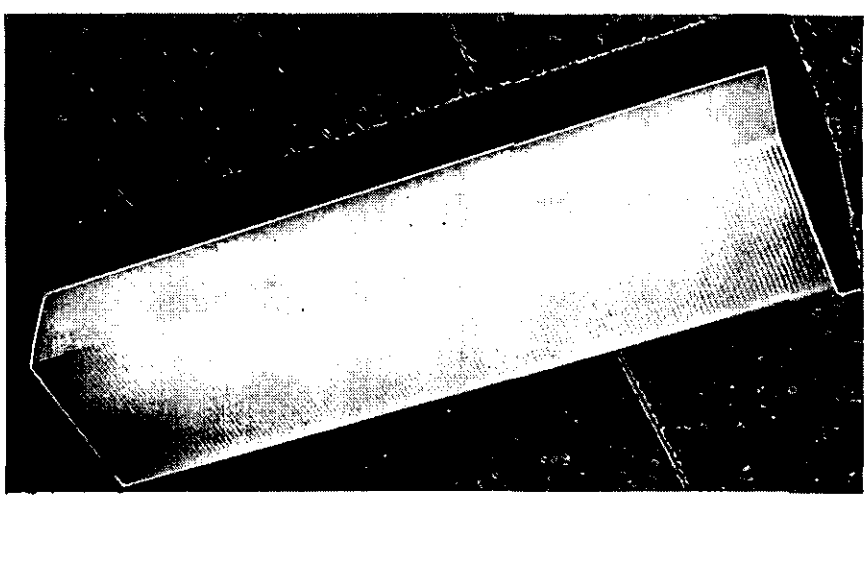
In large buildings it is advisable to include monitoring circuits from all the mains lighting sub-circuits, so that in the event of failure in one location only, as distinct from total failure, the emergency lighting for that area will come into operation. Alternatively, a technique increasingly being adopted is the use of compact power packs, usually 24 volts, sited one per floor or other readily defined area to control the emergency lighting only within those limits.

Sometimes a bulk inverter with a 50Hz 240V output is used with a central system, although it is normally uneconomical to have an inverter for a lighting load only. They come into their own where there is a mixed load of equipment to supply. In theory, savings can be made by using existing standard fluorescent fittings to provide emergency lighting from the bulk inverter. In practice, however, the load presented by conventional mains fluorescent circuits with shunt-connected power factor correction capacitors is not matched to the output impedance of the inverters, resulting in low overall efficiency, and sometimes affecting the output frequency. The match can be improved, but the manufacturers of the inverters and the luminaires should be consulted before equipment is specified.

Testing

Since no part of most emergency lighting systems function in normal conditions it is important to ascertain that they will function when called upon. Regular testing of the system — for the full rated running period at least once every six months and switching to the emergency system for short periods once a month, or even

Figure 3
Sustained luminaire for corridors and stairways incorporating one 20W fluorescent tube, mains operated, plus one 8W miniature tube with self-contained 'module' and batteries for emergency use. (Poselco Ltd.).



more frequently if convenient — is strongly recommended as an essential maintenance schedule for this type of installation. Nickel cadmium batteries, when employed, should be replaced after a period of five years, or as specified by the battery manufacturer, irrespective of their apparent condition.

Product standards

While British Standard Specifications for luminaires, components, lamps etc. are applicable, there is not yet a product standard exclusively for the manufacture of Emergency Lighting Equipment, complementary to BS 5266. However, the Lighting Industry Federation and BEAMA trade organisations are well advanced with the preparation of an Industry Product Recommendation, with the intention of providing a sound specification which will be used by their members manufacturing this equipment.

Luminaires

Because of the relatively high price of the batteries, it is most important that high efficiency is achieved for the luminaire, the light source, the batteries and the circuitry. Now that a standard lighting level is recommended, it is far more important to consider overall the most economic way to produce this lighting level than to look only at the cost per luminaire. For instance, a single good quality 8W self-contained fluorescent luminaire may well emit more light than five 3.6-watt incandescent lamps at a much lower installed cost. Similarly an 8W tube supplied from a 24-volt central battery, through an inverter meeting the IES 458 requirements, can be compared in light output to a 25W tungsten lamp of the same voltage. But the life of the two light sources does not bear comparison and neither does the current consumption — 1.0 amps for the tungsten lamp against 0.4 amps for the fluorescent.

Details of particular luminaires are available from the manufacturers, and summaries and comparisons are published from time to time by various journals, in the form of Buyers' Guides. Certain types, such as signs or bulkheads, are purely functional, and are clearly recognisable as being separate from the normal lighting installation. Other luminaires, whilst still being solely for emergency use, have decorative features which will blend with the overall appearance of

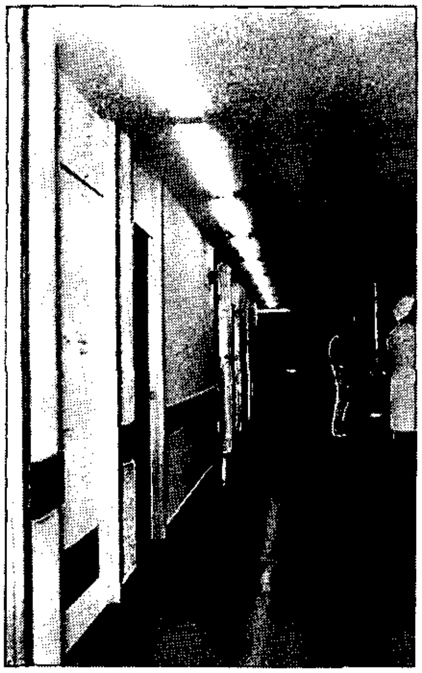


Figure 4a
Recessed fluorescent fittings of a design which can incorporate additional lamps for emergency purposes where required.

the lighting scheme. For complete unobtrusiveness, the emergency units can sometimes be incorporated within the main lighting fittings. Since the design of most lighting schemes must satisfy the user both functionally and aesthetically, a combination of all these types provides choice and flexibility.

Signs

The total lighting scheme should include sufficient signs to direct safe passage for escape from any part of the building by the quickest route. These will read 'Exit' or 'Emergency Exit' and may include a direction arrow, with lettering according to BS 2560 or BS 5266.

Various self luminous signs, which require no power supply whatsoever, are on the market. Externally lit signs are also widely used but the most popular current design is the box type with internal lamps. For the highest efficiency, box signs use miniature fluorescent tubes, and ideally have sustained or maintained circuits so that they are permanently illuminated, either from the mains or from the central or self-contained batteries. A particular advantage of this type is that they give sufficient illumination to be usable in calculating floor illuminance, and can incorporate a diffuser panel in the base to increase the downward distribution.

Bulkheads

These general purpose units are suitable for interior or exterior use, and many are constructed to resist vandalism. The miniature fluorescent types are normally non-maintained, as they have insufficient space for both mains and emergency gear. The latest self-contained units employ 150mm/4W tubes with nickel cadmium cells for one-hour or three-hour duration.

Figure 4b
Interior view of a luminaire of the type shown in 4a. The miniature fluorescent tube, operated from a 24V central battery emergency system, can be seen between the mains tubes. (Poselco Ltd. for Modular Support Systems).

General purpose luminaires

There is a wide and varied range of small fittings of glass, metal, or plastic, often based on standard decorative and commercial tungsten units, and using Krypton lamps, low-voltage tungsten lamps, or miniature fluorescent tubes as the light sources. Sustained and maintained types are available, but the majority are non-maintained for self-contained or central battery operation.

Standard fluorescent luminaires

Sustained installations can be achieved by incorporating additional lamps for emergency purposes in standard mains luminaires. It has long been the practice in hospitals to include additional lamps for secondary use as emergency and also night lighting, but this has often meant no more than a BC or SBC holder in some convenient position. The principle has not changed but modern techniques bring the advantage of improved appearance and, more important, higher light output for lower battery drain.

Miniature fluorescent tubes can be fitted alongside the mains lamps in a variety of luminaires from battens to recessed modules. Such arrangements complicate the fittings' design, and testing and proving become critical. Particular fittings are not necessarily suitable just because the physical space exists for the extra tube and gear. Central battery circuits permit the greatest flexibility, where the inverter is less likely to be affected by heat from the mains gear. Many enclosed luminaires are unsuitable for incorporating self-contained batteries, as the high ambient temperatures caused by the mains tube and control gear exceeds the permissible limits for the batteries.

There are many luminaires in which these problems can be resolved satisfactorily, and the combination of normal and emergency light sources in the same enclosure makes it possible to reduce installation costs, while simultaneously achieving functional and aesthetic improvements. It is a reasonable assumption that the lighting will be correctly sited for normal occupation of a building, and this will include identifiable key points for safe passage out of the building which will be the same for normal or emergency conditions.

Conclusion

The Hospital Engineer has to coordinate many disciplines; it would be presumptuous for a lighting specialist to tell him his job, yet the HE must rely on guidance from specialists to keep him up-to-date in their particular fields. The magnitude of the subject makes it inevitable that this paper remains only a general study but the author hopes that particular aspects have been clarified or sufficient stimulus has been given for further advice to be sought.

A detailed technical handbook of Emergency Lighting (produced by Smart & Brown Lighting Ltd.), can be supplied on application to the author.

The following paper was given at the Institute's symposium on March 2 1977 on Transport in the Health Service. Mr. Peters is the Regional Automotive Engineer for the South West Thames Regional Health Authority.

Transport Engineering - Legal and Operational Implications

Nigel E. H. PETERS CEng FIMechE MCITMIRTE

Background

If one is to define transport in the Health Service context one must include a few heavy goods vehicles, many ambulance vehicles and a vast number of light commercial vehicles including those operated within hospital grounds. The adjectives 'few', 'many' and 'vast' are used because as yet I have not established the precise numbers. One source claims 6,0C0 ambulances within a fleet of some 20,000 vehicles. Preference is given to the figures unearthed by Bill Gage that there are seven categories of vehicles, including 6,600 ambulances in a fleet of 15,500 vehicles, engaged in the carriage of persons. There are others carrying goods. In other words, we have a mixture of some of the functions of the National Bus Company and the National Freight Corporation.

The size of the ambulance fleet operation is illustrated by the following extracts from a table of comparative costs and statistics for 1975/76:

Table 1

	Surrey	*Hants.*	*Kent*	*Essex*	*Lancs.*	*London*	*Total*
No. of vehicles	127	148	251	160	223	1,050	1,959
Total miles	4.58m	5.35m	4.70m	4.33m	3.73m	11.92m	34.6m

If one projects these figures to the Health Service ambulance fleet of 6,600 vehicles the approximate miles would be 116.6m. If they are run at a cost of 8.32 pence per mile, and we include cost of fuel, oil, tyres and maintenance of vehicles with carrying capacities of 1½ tons, the cost of running ambulance vehicles alone would be in the region of £9.7m, at 1976 prices.

The value of the running cost figure is intended to illustrate the size of the Health Service commitment in terms of its ambulance fleet — please project the cost indicated to the other 8,900 vehicles in the Health Service. Whilst the total figure is indeed small when compared to the annual NHS bill it indicates areas in which Engineers can effect considerable savings.

From studies in some depth of the transport management in four Regions and in four Areas, it is clear that some Regions have transport expertise in the form of technician engineers, that the strength of management is varied, and that maintenance and repair facilities vary from very good to none at all. In the latter case total reliance is placed on outside contractors with varying degrees of success. The profit orientated retail garage trade employ tradesmen working to a bonus scheme linked to standard times for set tasks, which exclude many tasks normally done by tradesmen in a fleet user's workshop.

Definition

When related to the sphere of 'transport' in the Health Service, the Engineer has a role quite different from the role of Engineers in the spheres of hospitals, shipping or heavy engineering industry, where the design and development aspects are totally divorced from the maintenance role. It is intended in this paper to indicate the need, not for a maintenance engineer but for a manager with transport engineering as a basis — in other words a Transport Engineering Manager.

Objectives

To ensure that the operational needs are satisfied in terms of availability;
to ensure that operational staff have the right vehicles for their different tasks;
to ensure reliability of vehicles;
to ensure that so far as condition is concerned the vehicles are operated within the law and are safe;
to obtain the greatest benefit from limited resources.

To ensure operational needs are satisfied in terms of availability

In the year ending March 31 1976 the following extracts from the London Ambulance Statistics are important:

Table 2

No. of patient carrying vehicles	1,050
Mileage	11,915,402
Stretcher carrying patients	491,450
Chairs and walking wounded	2,256,908
Daily average	
Stretcher carrying patients	1,346[1]
Chairs and walking wounded	6,183

1It is understood that since March 31 1976 this figure has risen to about 1,500 per day.

If the daily operational requirements remain fairly constant it is relatively easy to plan one's fleet utilisation, but since operational demands vary considerably it is necessary to add a further dimension to availability, which is defined as the total number of vehicles in the fleet minus the number of vehicles:
on operational standby;
in workshops for planned preventive maintenance;
undergoing major repairs;
out of service because of major accidents.

The Engineer can influence all but the first and last requirements. His greatest influence is on the ratio of operational vehicles to maintenance spares. In a large fleet of some 230 goods vehicles of gross vehicle weights of around 7.3 tonnes, it was possible to achieve a ratio of ten operational vehicles to one maintenance spare, remembering that the night shift was mainly concerned with first line preventive maintenance and attention to complaints.

In the London Ambulance Service the Workshop Supervisors and Station Officers are constantly juggling.

The Workshop Supervisor juggles to achieve his objective in completing his planned preventive maintenance programme by the end of each month in spite of extraneous diversions.

The Station Officer juggles to cope with the demands made on him by Control to convey patients in chairs and the walking wounded to hospitals and then back home.

The ratio of operational vehicles to maintenance spares varies considerably, ranging from 8 to 15 : 1. The redeeming feature is that operational vehicles not in use because of staff holidays or sickness are pounced upon for preventive maintenance. Opportunities are taken to work on sitting case vehicles on Saturday mornings when the operational demand for them is low.

Ensure that operational staff have the right vehicle for their different tasks

In the bread world two main types of vehicles were evolved:
for wholesale deliveries;
for retail sales.

In the gas world three main types of vehicles were evolved:
tankers for liquid oxygen;
tankers for liquid nitrogen;
cylinders for hydrogen gases.

Collection and delivery of laundry calls for one type of vehicle to accommodate linen in bags or baskets plus towels on trolleys.

The ambulance world calls for greater variety:
emergency front line ambulances capable of carrying two recumbent patients or a maximum of eight seated walking wounded;
sitting case vehicles to accommodate eight or ten walking wounded;
sitting case vehicles fitted with a tail-lift to assist up to 11 walking wounded;
limousine type ambulances for long journeys which are necessary because the introduction of open-plan railway carriages makes it difficult for an attendant to look after his patient properly on an ambulance/train/ambulance journey;
emergency control vehicles equipped with sophisticated telecommunications equipment;
trailers with accommodation for equipment required at major disaster scenes;
other miscellaneous vehicles.

In producing a new vehicle it is important that there is a meeting of the minds of the Transport Engineering Manager and his operational counterpart to develop a 'performance specification' which is then translated by the Engineer into an engineering specification telling the contractor in specific terms the exact requirements, and incorporating features which simplify valeting and reduce maintenance.

The London Ambulance Service philosophy is to make substantial improvements in each new batch of vehicles, rather than to resort to expensive retrospective action.

The Engineer's specification and drawing will be his yardstick when exercising quality control at the following stages:
the mounting of structural members of the body to the chassis;
after the outer shell is in position but before the inner lining is attached;
on completion, water test for leaks, road test for vibrations and final arrangement of internal furniture and contents.

Once the standard is set inspections thereafter are at random intervals.

With quality control in mind the Engineer's guidance must be sought when adjudicating on the tenders returned. It has never been the author's philosophy that cheapest is best. The Engineer's experience and his cost consciousness will indicate that revenue expenditure outside the warranty period diminishes the difference between the lowest tender and a higher one from a supplier of proven quality. Another financial consideration is the cost in terms of time and money involved in carrying out at least three quality control inspections on the contractors' premises. There is a strong argument for selecting a contractor within, say, 100 miles of one's operating base rather than one at the other end of the country.

When a new vehicle is delivered to the user, another set of problems arises, because experience proves that the chassis/cowl is parked in the open

both at the vehicle manufacturer's premises for fairly lengthy periods, and again at the body manufacturer's prior to the building of the body. The following faults are predictable:
inner heater controls seized because of rust;
rust on the faces of drive pulleys causing premature belt failure;
corrosion on brake wheel cylinders;
lower fulcrum arm bolts not modified;
corrosion on the 12 way fuse box — a big problem;
corrosion on indicator switches;
corrosion within ignition switches and door locks;
headlights badly out of adjustment.

In making a radical change attention must be given not only to the benefits of making the change but its effect on other parts of the vehicle. For example the introduction of the long wheelbase ambulance provided an excellent opportunity to stow ambulance equipment in specially built cupboards at the rear, and thus to eliminate the need for the bulkhead cupboard, with the added advantage of more headroom in the cab. However, it was not at the time realised that the bulkhead cupboard provided a form of insulation against the noise from the motor in the blue beacon and the compressor motor of the two tone horns. The net result was that the driver and attendant could not easily speak to each other when on an emergency call, neither could they easily communicate with Control over their radio. Additional insulation was hurriedly improvised.

It is virtually impossible to produce a complex vehicle, ambulance or otherwise, to please everybody, hence the creation, within LAS, of a Working Party on vehicles and equipment. The Automotive Engineer chairs the Working Party, consisting of one Divisional Ambulance Officer and one 'Staff Side' representative from each of the four Divisions. The Working Party was created almost a year ago and has met six times in an atmosphere free of the 'them' and 'us' attitude — working instead on the philosophy that 'we' want the best from limited resources.

To ensure reliability of vehicles

When one thinks of reliability of vehicles operated within the Health Service, one must think of the many derivatives of the heavier end of the manufacturer's car range. One must also accept that this type of vehicle will be driven harder by more people, and operated for longer periods over greater distances than the normal large car.

Reliability can be measured in terms of failures resulting in breakdowns or complaints and is related to:
their frequency (vehicle or component);
time the vehicle is out of service;
cost incurred (time, mileage and parts).

A breakdown is defined as a failure which takes a vehicle out of service for more than 15 minutes.

Within the Greater London Area the nearest of the 22 ambulance workshops will, during normal working hours, attend to a breakdown of *any* ambulance vehicle. The London Ambulance Service now have an excellent understanding with the Automobile Association who attend to breakdowns during the 'silent' hours of the ambulance workshops. In arriving at this satisfactory understanding it was necessary to exchange information to establish that the AA knew all that was expected of them and the LAS knew the limitations of the service the AA could provide.

Whilst it is as yet not possible to relate timely planned preventive maintenance to the incidence of breakdowns, there is ample proof to substantiate the claim that regular analysis of breakdowns by the Automotive Engineer, Area and Workshop Supervisors, reflects in a higher standard of maintenance. Monitoring the planned preventive maintenance progress on a weekly basis ensures that routine maintenance is carried out on time. The obvious must be stated — the better the preventive maintenance, the fewer the breakdowns.

To ensure operation of vehicles within the law and with due regard to safety

Jonathan Lawton (*The Legal Responsibilities of Operating a Fleet of Vehicles* — paper given at the same symposium, reprinted in *Hospital Engineering* April 1977) is so right to lay emphasis on the two major areas of legal responsibility. It is imperative to exert one's professionalism by ensuring that:
the vehicle being constructed will when finished comply with every aspect of the Construction and Use regulations;
when loaded the manufacturer's maximum axle weights are not exceeded;
a maintenance system is of a sufficiently high standard that when the vehicle leaves a workshop it is legal in all respects and capable of satisfying its operational demands;
a system exists for drivers to report complaints in between periods of preventive maintenance. This will be referred to again under maintenance;
tyre pressures are shown on the vehicle to avoid the 'I didn't know' claim. All LAS vehicle pressures are indicated by two small numerals on the side of the body immediately above each wheel;
interpretation of the law is not left to drivers or the engineering staff. One such interpretation recently concerned abnormal shoulder wear on front tyres of vehicles fitted with independent front suspension. One school of thought interpreted the 1mm minimum tread depth over three quarters of the breadth of the tyre to include the shoulders in the 'breadth'. Recently an Appeal Court ruled that the breadth of the tyre was that part normally in contact with the road (Law Reports, *The Times*, December 15 1976);
constant attention to Statutory Instruments and numerous publications, to be aware of impending legislation and its effect on the fleet.

To obtain the greatest benefit from limited resources

In 1975/76 the National Health Service spent some £2,500m, and in the same period it cost just over £15m to run the London Ambulance Service, of which £0.85m was spent on maintenance and on repair of the ambulance fleet. The 'why bother' view has been heard based on '£15m is only 0.6% of £2,500m and £0.85m is only 0.034% of the total'. This muddled thinking is totally unacceptable.

Instead of moralising the Engineer must establish for himself the areas of high expenditure. In the long term it is imperative to get down to the root cause of high expenditure, but in the short term because of limited technical assistance, the author had to ask the following questions before making commercial judgements relative to engines, torque converters and gearboxes:
What is the incidence of unit replacements?

What is the cost?
Can the same item be purchased for less?
Can a better item be purchased for the same amount?
Can the same item at the same price be got with better service?

This type of thinking has produced benefits for the London Ambulance Service which can be summarised as shown in *Table 3*.

If the warranty is used as a yardstick, it can justifiably be claimed that in these three areas alone better quality units are being purchased for lesser amounts. It is estimated that in the year ending March 31 1977 the saving to the London Ambulance Service is in the region of £20,000 per annum.

Having stated the objectives it is necessary to define the Engineer's responsibilities.

Responsibilities

In carrying out his objectives the Engineer is concerned with money, machines and men, and is constantly making decisions at two levels bearing in mind that decisions at one level could affect decisions at the other.

Primary

The capital cost of new vehicles (bearing in mind the vehicle's life expectancy);
the purchase of the correct type of vehicle and equipment;
the capital cost of building and equipping new repair workshops;
the budget for maintenance in terms of labour and material;
the recruitment of skilled personnel;
the training of engineering personnel in new vehicles and workshop equipment;
the achievement of transport engineering objectives.

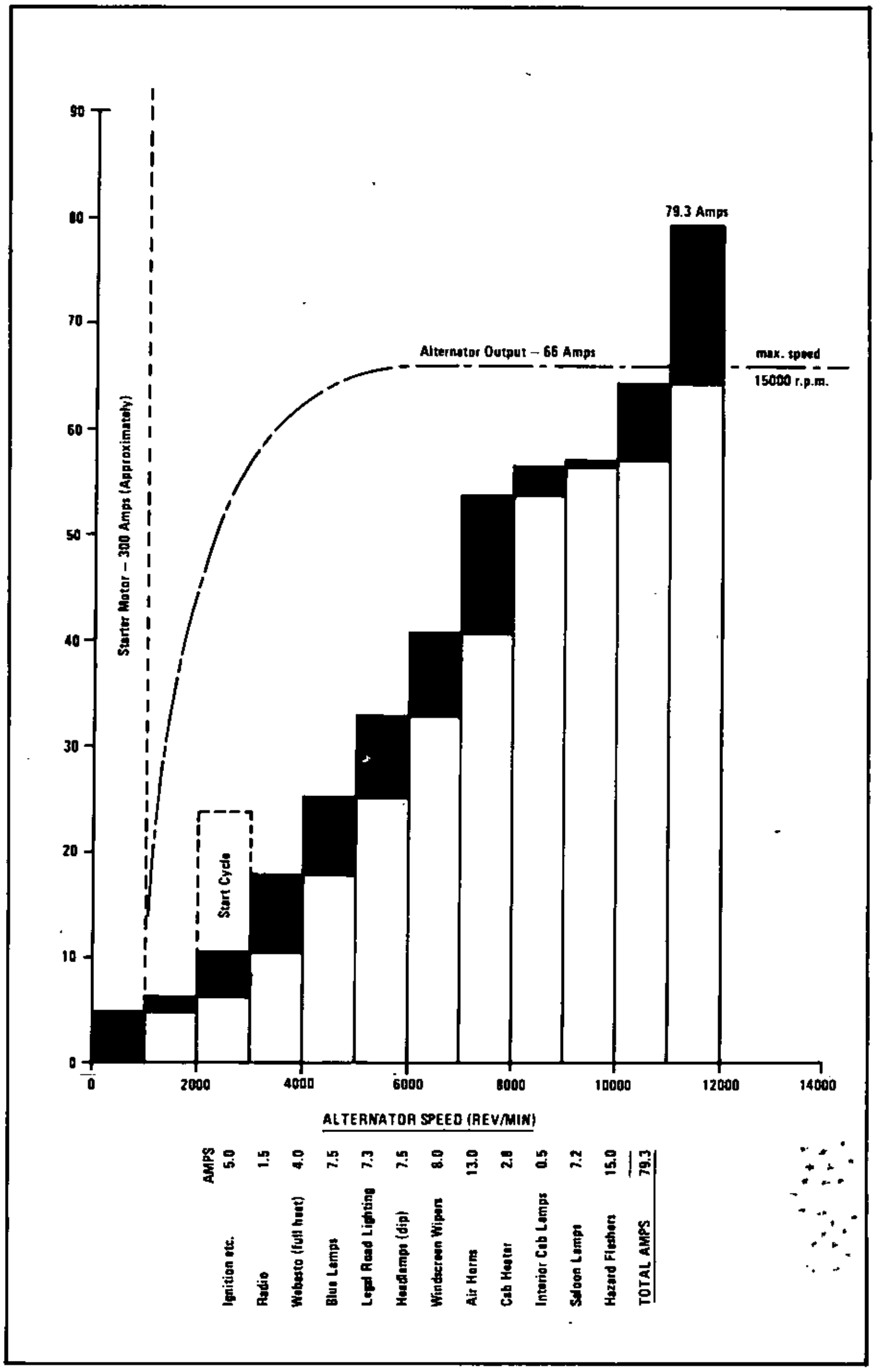
Secondary

the proper use of all repair facilities and equipment;
agreement with the operational side to ensure vehicles are maintained to the correct standard at the correct time;
constant vigil of maintenance and major repair expenditure, regardless of whether the work is carried out in own workshops or on a contractor's premises. At present a workshop supervisor cannot exceed £50 per repair without reference to an Area Supervisor whose own limit is £100; above this figure the Automotive Engineer is consulted.

Table 3

Source	*Engine*	*Gearbox*	*Torque Convertor*	*Warranty*
'A'	£269	£210	£88	6 months or 6,000 miles
Other than 'A'	£125	£75	£34	12 months or 12,000 miles
Betterment	53.5%	64.4%	61.4%	Twice as good

Figure 1
Electrical supply and demand — the graph plots the 66-amp output of the alternator at 1500 rpm.



Decisions in the secondary category can be important, as will be seen when related to items of major expenditure.

It has been stated that failure of engines and gearboxes have resulted in the short term in commercial judgements, and the root cause of early failure has yet to be technically explored. Meanwhile, observations can be made on operational behaviour likely to have a detrimental effect on the major units.

Operationally one is aware that crews engaged on front line emergency work are conscious of activation time and response time, and are motivated by a sense of urgency. All these considerations produce conditions the engine, gearbox and vehicle designers never envisaged. If a tachograph were fitted, it would show a slight ripple after a cold engine is started, immediately followed by a very quick build-up of engine revs whilst the vehicle, in low gear, races up to near maximum speed which cannot be maintained for long, because of traffic conditions, hence a drop in speed due to fierce braking, followed by another burst of speed, and so on.

The net result of demands of this kind clearly indicates that an ambulance engine will not last as long as a similar one fitted to a car or another light commercial vehicle. Recently, reconditioned units have been fitted at around 60,000 miles — an engine life the author considers to be too low; hence further analysis and investigations are necessary.

Regrettably, the fate of the three speed automatic gearbox is only marginally better, and on investigation it has been established that failure is of mechanical nature rather than of the hydraulics.

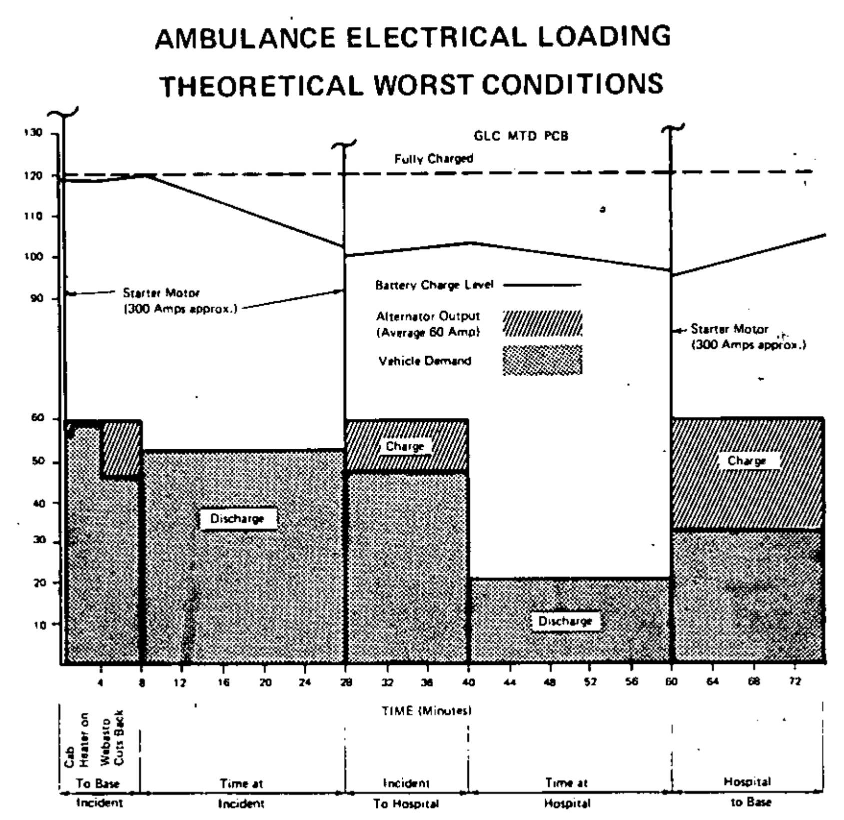
Experience has shown that when fitting a reconditioned engine an examination of the gearbox oil must be made to establish its condition and hence an indication of the condition of the gearbox. If the colour is dark and has particles of foreign bodies the gearbox is opened for a further detailed examination and corrective action varies from replacing parts to reconditioning the unit.

The condition of the gearbox oil will also govern the fate of the torque convertor. If heavy deposits of foreign bodies exist in the oil a decision is made to fit a reconditioned unit because it is virtually impossible to flush thoroughly the insides of a torque convertor. There is no point in fitting a reconditioned gearbox with fresh lubricating oil, because it will undoubtedly be contaminated in a brief period.

One further stage is vital — the hydraulic line from the gearbox to the oil cooler and the return line to the gearbox must be flushed to extract any foreign matter. Flushing in itself is not easy if the oil cooler is external to the vehicle radiator, and if the oil cooler is fixed into the bottom tank of the radiator flushing is extremely difficult. A conscious decision has been made to replace the internal cooler with an external type. This has the added advantage that the external cooler relies on fins to dissipate heat to the atmosphere. With the internal cooler it is always possible for the coolant in the radiator to enter the gearbox, with disastrous results — one such incident occurred recently.

The author makes no apology for wandering away from the main theme of this article. Consideration must be

Figure 2
Ambulance electrical loading showing the theoretically worst conditions.



Items	Items	Items	Items	Items
1	2	1	2	1
2	10	2	10	2
3 (10)	4	10	5	10
4	5	4	9	5
5	6	5	12	6
6	8	6		7
7	11	7		9
8	12	8		
9	13	9		
		12		

	Items	Amps		Items *	Amps
1	Ignition etc.	5.0	8	* Air Horns	3.0
2	Radio	1.5	9	Cab Heater	2.8
3	Webasto (Start Cycle)	17.5	10	Webasto (Full Heat)	4.0
4	Blue Lights	7.5	11	Cab Lamp	0.5
5	Side, Tail & No. Plate	7.3	12	Saloon Lights	7.2
6	Headlights (Dipped)	7.5	13	Hazard Flasher	15.0
7	Windscreen Wiper	8.0			

* Air Horns 13.0 Amps but 25% usage

given to these units because of the important part they play in one's maintenance expenditure and on vehicle availability.

One other technical influence on availability is the demand made by the 12 constituent parts of an ambulance's electrical system. *Figure 1* plots the 66 amp output of the alternator at 1500 rpm and indicates that the output cannot cope with prolonged stretches of maximum demand. *Figure 2* assumes a time scale of an ambulance on an emergency call and plots it against output of and demand on the alternator and the battery charge level, on the assumption that the battery was at its fully charged condition of 120 ampère hours at the commencement of this exercise.

In view of this study one realises why so many flat batteries occur during darkness in the autumn and winter. Having fitted the largest capacity batteries and an alternator with the greatest output, the Engineer feels helpless because there is not much else he can do, apart from ensuring that battery condition on an emergency ambulance is good. In the London Ambulance Service the policy is to fit a new battery to an emergency ambulance, and after two years to relegate this battery to a sitting case vehicle with less arduous duties.

Figure 3
Maintenance check list for London ambulances servicing.

LONDON AMBULANCE SERVICE VEHICLE MAINTENANCE LA 81

MAKE .... TYPE .... FLEET No .... MILAGE NOW ....

DATE NOW .... SERVICE ...... REPAIR .... MILAGE LAST SERVICE ....

Road test only if less than 500 miles since last service but in all cases, a full service is required if more than two months since last service, irrespective of milage covered.

	A	B	C	
1				Check steering box and joints and check wheel bearings
2				Check fan belt adjustment and condition of belt
3				Check pins and swivel
4				Check road springs and shackles
5				Check gear change linkage
6				Check hand and foot brake linkages
7				Check clutch linkage
8				Check exhaust system
9				Check brake hoses and hydraulic lines
10				Check engine mountings
11				Check oil fuel and water leaks
12				Check and top up dampers
13				Check propshaft
14				Check road spring 'U' bolts (front) + lower fulcrum bolts
15				Drain engine oil
16				Change oil filter
17				Change gearbox oil (manual)
18				Top up gearbox (manual)
19				Top up rear axle
20				Clean Webasto fuel filter
21				Lubricate grease nipples
22				Check tyres
23				Remove wheels, drums, front hubs
24				Check linings, wheel cylinders, hub races (Record % worn)
25				Change all wheel cylinders at 40,000 max. or sooner if unserviceable
26				Change brake hoses and bridge pipes 40,000 max.
27				Change master cylinder 40,000 max.
28				Flush brake and clutch systems and top up 40,000 max.
29				Adjust hand and foot brakes
30				Tighten rear 'U' bolts
31				Spray penetrating oil to items 5,6,7 8 except CF automatics
32				Check wheel nuts and tyre pressure
33				Top up/refill engine oil
34				Lubricate and check door lock and hinges
35				Check window winders
36				Check stretcher trolleys
37				Check seat belts
38				Check rear view mirrors
39				Check air horn reservoir
40				Check ambulance floor and bodywork
41				Check rear steps
42				Check fire extinguisher
43				Full discharge battery test
44				Top up batteries hydrometer test
45				Clean and 'no corrode' Battery terminals
46				Top up steering box (FG/LD) and check rack for leak (CF)
47				Top up brake and clutch reservoirs
48				Top up screen washer check jets

	A	B	C	
49				Check screen wipers and blades
50				Fit new wiper blades
51				Check electrical system (lights, horn, wipers, ammeter) visual
52				Check cab heaters and cables
53				Check clutch pedal clearances
54				Check brake pedal clearances
55				Check and top up radiator, check radiator cap
56				Clean and adjust spark plugs
57				Check C.B. points (Dwell meter all services)
58				Lubricate distributor cam and weights
59				Adjust tappets
60				Clean carburettor bowl
61				Clean petrol pump filter
62				Check water pump
63				Check all water hoses and pressure test
64				Tighten manifold bolts (except CF)
65				Check sealed breather system (CF)
66				Clean air cleaner
67				Change water hoses (top and bottom) when renewing anti freeze, flush cooling system, check radiator and radiator cap
68				Lubricate throttle linkage
69				Lubricate handbrake linkage
70				Top up automatic gearbox
71				Set carburettor slow running
72				Top up, operate and check tail lift.

ROAD TEST AND REPORT
Check wheel nuts and tyre pressure
Check all instruments and warning devices
Test Sec./handbrake (Tapley) %
Test Ser./footbrake (Tapley) %
Test hand brake
Check transmission noise
Check steering behaviour
Run and check Webasto heater
Check general performance

REPAIRS ACTION NOW

REPAIRS OUTSTANDING

Fitters signature .... Chargehands signature ....

Involvement

Whilst the author has indicated the objectives and areas of responsibility of the Engineer, he has yet to state the Engineer's total involvement, which must inevitably be a case of 'cradle to the grave' in that the Engineer is:

involved in a performance specification;

responsible for delivering to the user a vehicle which complies with the agreed engineering specification;

responsible for the maintenance of the vehicle whilst in service;

involved in the disposal of the vehicle.

The first two involvements have already been dealt with at some length.

Maintenance plays a very large part in the Engineer's involvement over the whole period the vehicle remains in service.

The author's philosophy has always been that vehicles should be maintained economically but above the minimum standard required by law. Two aspects are pertinent:

at an inquest held on October 11 1974 into the death of an ambulance driver the verdict was accidental death, and the jury added a rider: "We consider that the servicing of emergency vehicles should be maintained at an impeccably high standard consistent with the requirements of their duties".

The operative words "consistent with the requirements of their duties" will apply to some other vehicles, for example the carriage of LOX and LIN, as it does to ambulances; although the Health Service is free from the rigours of the 'O' licence system, and to a certain extent shielded by the fact that the vehicles operated are Crown owned, those responsible are still liable in the eyes of the law for complying with all legal requirements.

Table 4 shows the results of checks carried out and reported in *Commercial Motor* on November 12 1976.

Table 4

Years	*Vehicles checked*	*No. found defective*	*%*
69/70	598707	179761	30
74/75	905552	177675	19.62
75/76	904384	174000	19.24

These results are staggering.

There is evidence that vehicle condition, because of the very large part the vehicle plays whilst in service, can be directly related to the discipline exercised by management and to the morale of the men or women making up a unit. For example in an Area Health Authority it was recently established that the best ambulance in the fleet was one driven by a limited number of drivers.

In many areas of the Health Service where utilisation is unpredictable, it is advisable to base planned preventive maintenance on a time frequency closely related to optimum utilisation. In a minority of cases this philosophy can be considered expensive because some vehicles will be over-maintained. A cost benefit exercise will show that this limited luxury is acceptable to ensure that a 'service' is not missed and to ensure an even workload in the vehicle workshops.

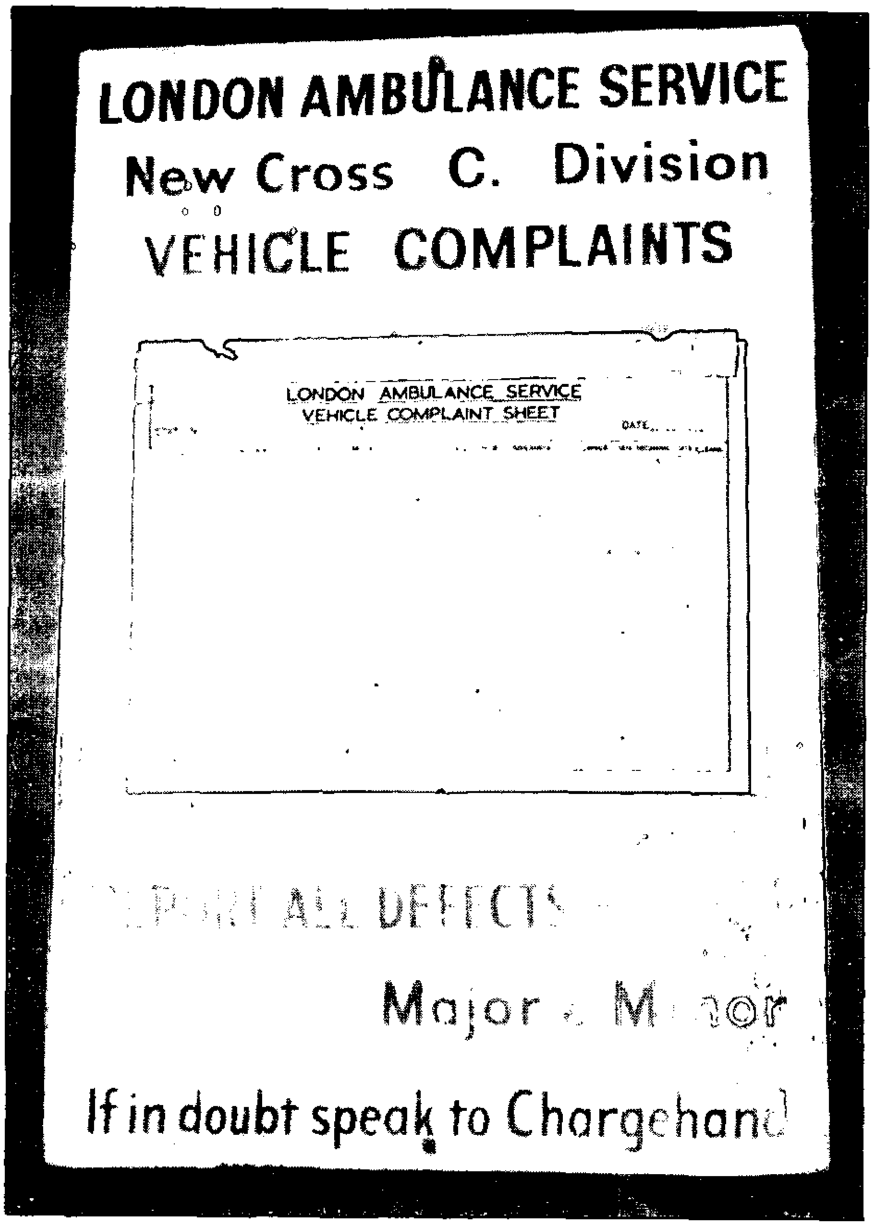


Figure 4
A planned prevention sheet or tick list accessible to all concerned.

A planned preventive sheet or tick list (*Figure 4*) recently produced and, as yet, not used by all the 22 ambulance workshops in the London Ambulance Service, indicates a schedule based on:

an A service each month (c 3,000 miles);

a B service every alternate month (c 6,000 miles);

a C service carried out annually (c 12,000 miles).

It need hardly be said that, regardless of the thoroughness of the preventive maintenance programme, faults can develop in between periods of regular servicing. It is imperative that the operational staff be given an opportunity to report complaints relative to the vehicle. At each London Ambulance Service main station a complaints board is prominently located, plus a Vehicle Complaint Sheet which is monitored several times a day and corrective action, described in a previous section of this paper, is taken.

All information regarding preventive maintenance and repair on a vehicle is recorded on its history card (*Figure 5*) and retained at the ambulance workshop responsible for the vehicle. The history card first introduced by the author in January 1965 records basic information pertinent to the vehicle plus entries as follows:

Date
Odometer reading
Details of work —
Preventive maintenance in green;
work on brakes and/or steering in red;
any other work in blue or black.

Vehicle workshops are manned at an approximate ratio of one unit of staff to 15 ambulance vehicles to cope with an optimum load, within the following limitations:

space;
specialisation in terms of skill;
equipment.

In the last 14 months limited resources have been expended in improving three establishments in

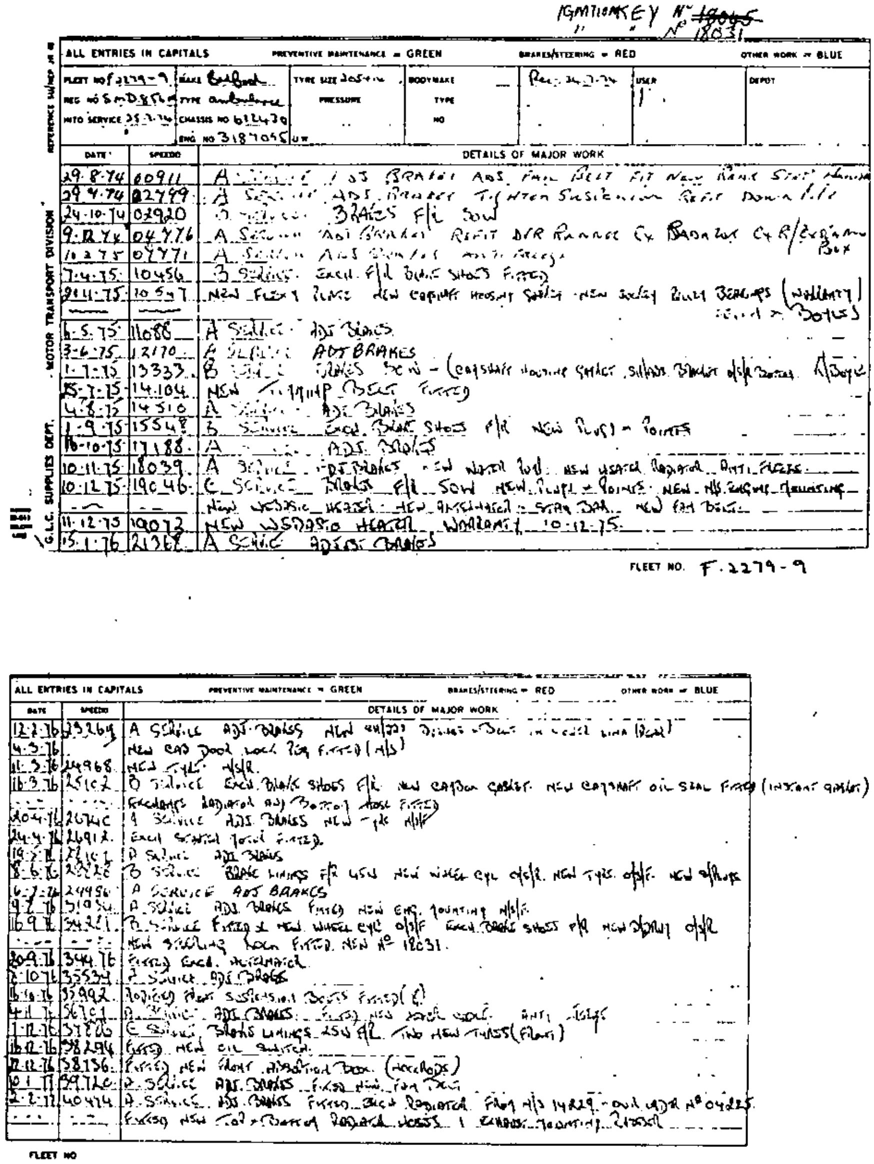


Figure 5
The history card of maintenance and repair on a vehicle.

terms of space and equipment. Specialist courses have been arranged. These factors, coupled with judicious purchasing plus repair agreements, have shown substantial decrease in expenditure in the first nine months of the current financial year when compared to the same period last year.

Further inroads into the revenue budget are possible by:

continued improvement of ambulance premises;

introduction of diagnostic equipment to reduce servicing times;

regular technical training of tradesmen;

managerial training of Workshop Supervisors and Area Supervisors;

increase of Area Supervisors to ensure control of ambulance workshops in considerably more depth;

the introduction of Inspectors to carry out engineering audits with direct access to the Engineer.

The author has spent a great deal of effort with the three major manufacturers with the objective of:

improving parts availability;

eliminating recurring problems in service;

introducing improvements and developments likely to affect operation and maintenance;

holding regular meetings with the manufacturer's service organisation on failures of a repetitive nature;

introducing regular tyre inspections by a tyre manufacturer's experienced Service Engineers (Reports on these monthly tyre inspections are regularly submitted to the Automotive Engineer with the following basic information:

fleet number;

uneven tread wear;

all tyre treads 2mm or less in depth;

all tyre pressures below or above 5lb/sq in relative to recommended pressures;

damage to interior or exterior side walls).

Side wall damage and illegal tread depths are acted upon immediately, firstly to avoid prosecution and secondly as an audit of planned preventive maintenance.

The final ritual in the vehicle's life is to denude it of all signs, letters, numerals and all ambulance fittings, such as blue lights, two-tone horns, the bell, and the two trolley beds. These items are used on a new batch of vehicles.

At one time it was the practice to spray the white exterior of the ambulance grey to make it look as unlike an ambulance as possible.

The most satisfactory way of disposing of unwanted vehicles has been by public auction. One London firm displayed old ambulances for sale with price tags showing almost twice the auction price. Someone must have informed the firm of the existence of the Trades Description Act, because a prominent sign on the windscreen, which read 'one owner only', has now been removed.

Summary

Transport in the Health Service presents a fantastic challenge for the Engineering Manager when his role is defined in the wider context.

The objective of the Engineering Manager is to provide a complete transport service compatible with operational needs and acceptable levels of capital and revenue expenditure, without sacrificing reliability.

The Engineering Manager will make decisions at two levels (primary and secondary) knowing that decisions at one level can affect decisions at the other.

The involvement of the Engineering Manager is total, insofar as he must be concerned right at the start in discussing the performance specification, translating it into engineering terms, ensuring that the vehicle eventually purchased is the vehicle specified, and then in caring for it through its operational life, in making a conscious decision to end its useful life and finally, in arranging disposal.

NEW CASS HIGH-SPEED ELECTRONIC WATCHMAN

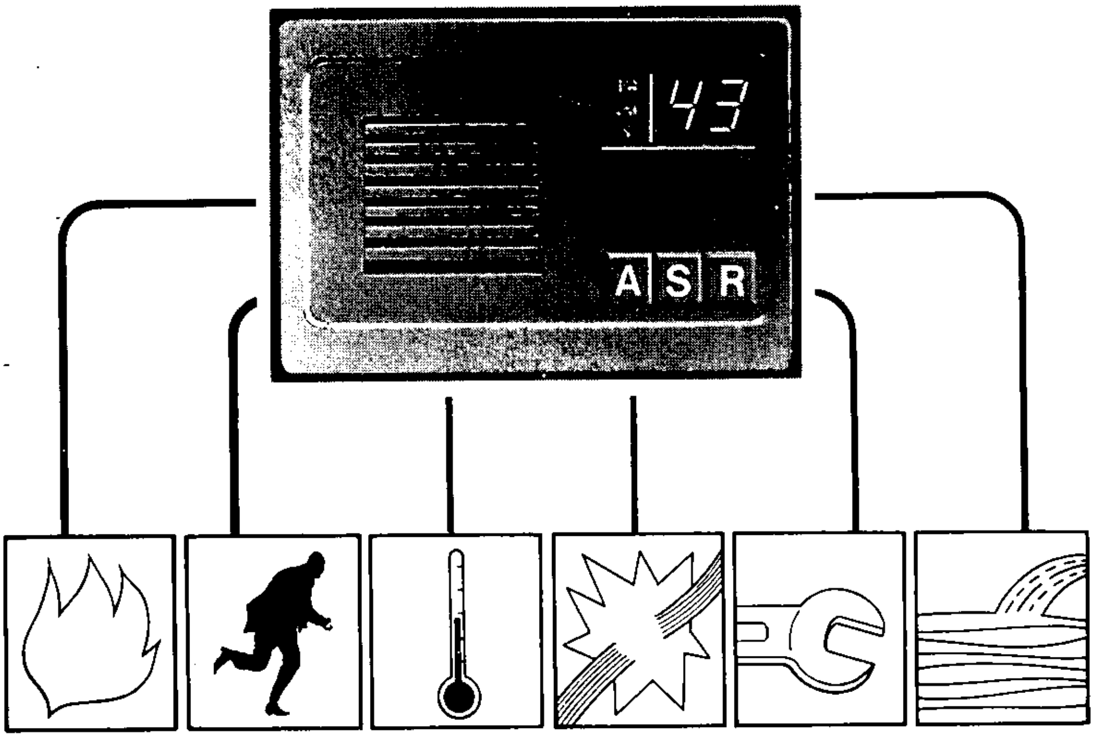
MINISCAN

SURVEILLANCE AND SUPERVISION

Miniscan is a high speed surveillance system checking alarm points and providing information in digital form. The modular design enables connections to be madė for measuring control or automatic programmes.

THE CONTROL UNIT

The compact desk unit is easy to read and operate. Built around the scanner it is expandable from 25 to 999 points. Alarm calls activate a buzzer or a TELE-TRACER Pocket Paging signal until the accept key is pressed. The identity of any alarm is shown on the digital display.



FIRE
Automatic detection or break glass system.

CRIME
Perimeter, vault, safe and hold up alarm.

TEMPERATURE VARIATION
Heating, ventilating, air conditioning, boiler failures.

POWER FAILURES
Day and night protection.

BREAKDOWN
Automatic signal of failures for freezers, cold store.

FLOODING
Level variations, water seepage in buildings or tunnels.

CASS

Cass Electronics Limited
FIRE AND SECURITY DIVISION
CRABTREE ROAD, THORPE, SURREY TW20 8RN
TELEPHONE EGHAM 6266 TELEX 934593

This paper was given to members of the London Branch on Tuesday, September 28 1976 under the chairmanship of Mr. K. J. Eatwell.

Dr. Burman is not a medical practitioner but a bacteriologist concerned with the quality of water for some seven million London consumers, and in his capacity as Manager of the Metropolitan Water Laboratories for the Thames Water Authority, he is supported by a total staff of approximately 100. Mr. Tabor is Senior Supplies Engineer with the Authority.

Dr. Burman stressed that although his experience in the water industry spanned some 31 years he would only refer specifically to the water treatment practices and problems associated with the Metropolitan Water Division.

Problems in Water Treatment and Distribution

Dr. N. P. BURMAN PhD FIBIOL FIMLS
Mr. R. TABOR CEng MICE MIWES

Basically, all raw river water received for treatment is derived from two main sources — the River Thames and the River Lee, and pumped to large open storage reservoirs. During storage suspended solids, and other impurities tended to 'settle' and fall to the bottom. This storage period can be anything from one month to over a year, depending mainly on engineering and hydraulic management requirements and to some extent on quality requirements, particularly factors related to growth of green algae. Improvement in quality usually occurs, resulting from the dying out of polluting micro-organisms, and oxidative changes in the dissolved organic matter.

The next stage in the purification process is that the water flows under gravity to primary filters of the rapid sand or micro screen type, which remove the larger particulate matter including much of the algae growth. The water then continues its journey under gravity to secondary slow sand filters which reduce considerably the presence of micro-organisms. Filtration through a sand bed two feet deep reduces bacteria by 80 to 99%, especially the polluting intestinal bacteria. Water turbidity, taste and colour undergo distinct changes. The water is finally treated with chlorine, and pumped into a contact tank to enable the chlorine to complete its disinfecting action and its chemical oxidation of organic matter. Finally the treated water is pumped to covered service reservoirs, generally situated at high level, from whence the water supply gravitates to the consumer.

Besides drinking water, water is of course also used for many different applications including domestic, industrial and agricultural uses, food preparation, beverages, pharmaceuticals etc. Treated water should be colourless, tasteless, odourless, non-corrosive, contain no pathogenic organisms, biological forms, chemicals or metals, and not be harmful.

A wide variety of living organisms — algae, bacteria (aerobic and anaerobic), moulds and fungi are all frequently encountered in the treatment of river water. Algae, which are distinctively green or blue-green in colour, require a light source for their metabolism and are usually found in open water surfaces. Dead algae tend to fall and settle, creating objectionable odours. Moulds also cause unpleasant smells.

Limnological observation towers, fitted with instruments for measuring water temperatures and dissolved oxygen differences, are now very acceptable 'tools' in the newest storage reservoirs. They record results automatically and visually at the 'works' laboratory for observation, and in cases of emergency an audible signal is given. The principle of the micro-strainer is of special interest. It is basically a cylindrical rotating screen usually covered with 496 wires by 76 double wires to the inch, giving approximately 80,000 apertures per square inch — the inner size of the apertures being 35 microns. The periphery of one side of the drum is provided with a ring of teeth which engage with those of an electrically driven gear which imparts linear drum speeds of 20, 35 or 50 feet per minute, as desired. One end of the drum is open and revolves against a matching inlet opening in the end frame, which is built into a reinforced concrete wall of the tank containing the screen, and which divides the unfiltered water from the filtered.

The down stream end of the drum is blanked off, and rotates against the other end frame which stands in the filtered water compartment. As the sediment is entrapped it is washed away by a series of high pressure water jets spanning the length of the drum as the strainer slowly revolves.

In conclusion it is suggested that the use of any substances which support or encourage microbial growth should not be allowed to come in contact with potable water. Careful consideration should be given, for example, to the exclusion of all jointing materials based on linseed oils, on any other vegetable oil, or on shellac, and of most grease type fluxes. However, PTFE tape and PTFE-based materials and all silicone products can be expected to be micro-biologically inert, provided that they do not contain other substances in their compounding which support growth. Plasticised PVC flexible anti-splash tap nozzles, found unfortunately in many homes, should be discarded immediately as potential bacteria 'carriers'.

The importance of regular river water examination is fundamental. For example, largely during mild winters, which favour the breakdown of organic matter in the soil coupled with low rainfall and low river flows, the nitrate concentration can increase to such an extent that the Water Authority will order the discontinuation of water extraction from the river source, and rely upon its reservoirs until such times as the nitrate content falls to an acceptable level.

High nitrate concentration if allowed to go unchecked could be harmful, particularly to bottle-fed babies. At no time has the level in the London area exceeded 11.3 mg/litre (measured as nitrogen) which is the level at which the WHO recommends that the local health authorities should be notified. At twice this level alternative sources of water should be made available.

The Metropolitan Water Division supplies engineers are always available to Hospital Authorities for advice on correct plumbing system methods and on leakage, which is a serious problem. Constant vigilance is essential.

Portugal '78

5th International Congress of Hospital Engineering Lisbon May 28 - June 2 1978

Call for papers

The next International Congress will be held in Portugal in summer 1978. There are a number of subjects on which papers have been invited by the organisers, and a detailed summary of around 500 words, or of course the full paper, should be submitted in duplicate *before July 1 1977*. A selection committee will inform authors of acceptance of papers by August 31 1977; full papers must then be submitted by November 30 1977. The subjects are as shown:

Organisation

The 5th Congress is sponsored by the International Federation of Hospital Engineering, the Ministry of Health and the Ministry of Public Works. It is organised in conjunction with the Associação Portuguesa de Engineering Hospitalar. It will take place from Sunday, May 28 to Friday, June 2 1978 at Calouste Gulbenkian Foundation. All enquiries should be addressed to: Comissão Organizadora do 5 Congresso Associação Portuguesa de Engineering Hospitalar, Av. Miguel Bombarda, N° 133, 5°-B Lisboa, 1 Portugal.

SUBJECT 1 — **Hospital planning and programming**
a. National and regional hospital planning. Emergency planning in a large city
b. Hospital size
c. Centralised supply and service systems in hospitals
d. Hospital site. Security of the hospital
e. Hospital, department and service programming

SUBJECT 2 — **Modern hospital construction**
a. The shape of a hospital
b. Hospital and nursing unit standardisation
c. Industrial building applied to hospitals
d. Hospital design and project management
e. Capital and operating costs in hospitals

SUBJECT 3 — **Industry and hospital equipment**
a. Bio-engineering
b. Medical engineering and equipment
c. Sterilisation equipment
d. Laundry equipment
e. Kitchen equipment
f. Incineration equipment. Plastics disposal

SUBJECT 4 — **Hospital engineering services**
a. Technical plants
b. Air conditioning
c. Emergency services
d. Medical gases
e. The hospital sewage system

SUBJECT 5 — **Safety and comfort**
a. Safety precautions and regulations in hospitals
b. Comfort for patients and personnel
c. The environment and the patient
d. Public health engineering

SUBJECT 6 — **Hospital maintenance**
a. Preventive maintenance
b. Maintenance costs
c. The hospital and its own maintenance service

SUBJECT 7 — **Hospital engineers inside the hospital. Hospital engineer training**
a. Engineers and the other personnel in a hospital
b. Hospital engineering and administration
c. Hospital engineering training, nationally and internationally

Classified Advertisements

APPOINTMENTS AND SITUATIONS VACANT

South West Thames
Regional Health Authority

Engineering Clerk of Works

To work within the Engineering Division of the Authority supervising engineering work at various sites within the region, which covers the following area — Surrey, West Sussex and the south-west corner of London. Initially the officer will be based at Guildford, but this could vary depending upon the location of the particular sites to be supervised.

Applicants (male or female) must have served an apprenticeship in mechanical or electrical engineering and have not had less than five years' experience supervising site installations employing trades associated mechanical or electrical building services.

Salary scale: £3,345-£4,251 per annum plus £141 per annum London Weighting. Commencing salary according to experience.

Application forms from Personnel Officer (S2), 40 Eastbourne Terrace, Paddington W2 3QR.

Completed forms to be returned by May 27 1977.

QUEEN MARY COLLEGE (University of London)
MAINTENANCE DEPARTMENT

DEPUTY SERVICES SUPERVISOR

required to assist the Mechanical Services Supervisor with the maintenance and inspection of installed equipment. The person concerned must have served a recognised apprenticeship and be prepared to carry out practical work. It is essential that he/she has sound practical experience regarding the repair and maintenance of oil and gas-fired steam and MTHW boilers, air compressors, air conditioning equipment, laboratory and plumbing services, heating and ventilating control equipment, together with knowledge of water, gas and drainage systems and the preparation of boilers and pressure vessels for inspection by insurance surveyors. Wages £69.36 per week, plus additional supplement under Stage II of the Government's pay code. Five-day week, forty-hour week. Three weeks' annual leave plus a week at Christmas and Easter which includes the public holidays. Pension scheme.

Letters only to Assistant Secretary (Establishment) M/DSS, Queen Mary College, Mile End Road, London E1 4NS, stating age, experience and qualifications. Closing date: May 18 1977.

NORTH YORKSHIRE AREA HEALTH AUTHORITY
HARROGATE HEALTH DISTRICT

Applications are invited for the post of

ASSISTANT ENGINEER

(£3,063-£3,507 per annum plus non-enhanceable pay supplement)

based at the Royal Bath Hospital, Harrogate

The successful applicant will be responsible to an Acting Deputy Group Engineer for the day-to-day engineering functions of the above hospital and associated properties.

Applicants must have completed an apprenticeship in mechanical or electrical engineering or have otherwise acquired a thorough practical training as appropriate to the duties and responsibilities of the post which include direct supervision of a coal-fired steam boiler plant.

Applicants must hold an ONC in electrical or mechanical engineering or an alternative qualification acceptable to the Secretary of State.

Applications stating age, qualifications, full details of previous experience together with names and addresses of two referees to: District Works Officer, Harrogate Health District, Windsor House, Cornwall Road, Harrogate. Closing date May 27 1977.

CROYDON AREA HEALTH AUTHORITY Area Engineering Services

ASSISTANT ENGINEER

(Male or Female)

for duties on an Area basis, initially based at Warlingham Park Hospital (626 beds, psychiatric). Applicants should possess ONC in Engineering or an equivalent qualification.

Salary scale £3,063 p.a. rising to £3,507.

Suitably qualified and experienced candidate may commence at £3,285. London Weighting of £354 and supplementary allowance of £291 p.a. is also paid plus five per cent supplement — minimum £130 p.a., maximum £208 p.a.

This post offers excellent training for Engineers wishing to make a career in the hospital service.

Applications, stating age, qualifications/apprenticeships, full details of previous experience together with names and addresses of two referees (current/previous employers preferred) who will be contacted if called for interview, to Area Personnel Officer, General Hospital, London Road, Croydon, quoting reference: AW015.

Closing date for applications: May 30.

Surrey Area Health Authority
South West Surrey District

ASSISTANT HOSPITAL ENGINEER

required for New District General Hospital, Guildford, to be responsible to the Hospital Engineer for implementing District Works policies.

Applicants must have completed an approved apprenticeship or similar practical training and possess qualifications to ONC grade or acceptable alternative.

Salary on scale: £3,063-£3,507 plus £141 Outer London Weighting plus £291 Supplement plus additional Supplement of £174.

For application form please apply to Staff Officer, St. Luke's Hospital, Guildford, Surrey. Tel. Guildford 71122, ext. 469.

Closing date: May 25 1977.

To place an advertisement in the next issue of

HOSPITAL ENGINEERING

appearing on

JUNE 3 1977,

please contact:

Sue Cartwright

EARLSPORT LIMITED,

33 Ludgate Hill, London EC4. Tel. 01-248 0148

by **May 24 1977** latest

Devon Area Health Authority
Torbay Health District

HOSPITAL ENGINEER

Required to be responsible to the District Engineer for the operation and maintenance of Health Service properties, Hospitals, Health Centres, etc. within the northern Sector. Qualifications and experience as PTB Circular 261.

Salary scale: £3,351 to £3,942 plus £291 annual supplement and £72 responsibility allowance.

Job description available until Friday, May 27 1977, from the District Engineer, Newton Abbot Hospital, East Street, Newton Abbot TQ12 4PT.

HILLINGDON HOSPITAL
Uxbridge, Middlesex

HOSPITAL ENGINEER

Specialising in preventive maintenance and energy conservation. Must have previous hospital engineering experience and DHSS approved qualifications. Salary £3,996-£4,587.

Application forms from Sector Personnel Officer.

Closing date June 3 1977.

CLASSIFIED ADVERTISEMENTS
— continued from previous page

APPOINTMENTS AND SITUATIONS VACANT

THE NATIONAL HOSPITAL
Queen Square, London WC1N 3BG

HOSPITAL ENGINEER

The Hospital Engineer is responsible to the Group Engineer for the services at the main hospital in Queen Square and two branch hospitals at Maida Vale and Finchley, plus laboratory buildings, staff homes, etc.

We require someone who will have served an engineering apprenticeship and have a sound knowledge of mechanical and engineering plant and its maintenance and who also possesses one of the following qualifications or an alternative qualification acceptable to the Secretary of State:

(a) HNC in Mechanical Engineering together with certificates of a technical college or a college of further education in Electrical Engineering and Industrial Administration if these were not taken as subjects of the course.

(b) City and Guilds Mechanical Engineering Technician's Certificate (No. 293 or 255) Part III Plant Engineering, together with an Industrial Administration Certificate or City and Guilds Electrical Technician's Technological Certificate (No. 57 or 281) plus certificates of endorsement in Applied Heat, Applied Mechanics and Industrial Administration.

Salary £3,351-£3,942 per annum, plus a responsibility allowance of £147 per annum; plus supplements of £312 and 5% (maximum £208) per annum, plus London Weighting Allowance of £354 per annum.

For application form and job description please write to Mrs. J. Andrews, Personnel Officer, at the above address or telephone 01-837 3611, extension 65.

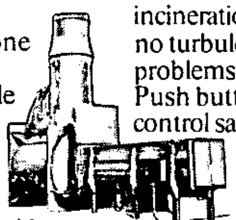
Closing date June 3 1977.

'Consumat – the sweet smell of success in waste disposal.'

Miss N. Ostril

The clean, clinical destruction of hospital waste calls for much more than a fire and a chimney. The smoke and residue alone present a serious potential health hazard – unacceptable under the terms of current anti-pollution legislation.

That's why over 3,000 Consumat incinerators are installed throughout the world, reducing all types of waste to a sterile ash – simply, safely and automatically.



The Consumat "starved-air" incineration system has no grate, no turbulence, no smoke, and no problems. Push button operation and easy control saves operator time and cuts running costs.

It's the finest and most reliable incineration system in the world.

Ask for full details.

Robert Jenkins Systems Limited

Registered Office:
Wortley Road, Rotherham, South Yorkshire S61 1LT, England Telephone: Rotherham 76701 (5 lines) and 64201 (STD Code 0709)
Grams: Jenkins Rotherham Telex: 54111