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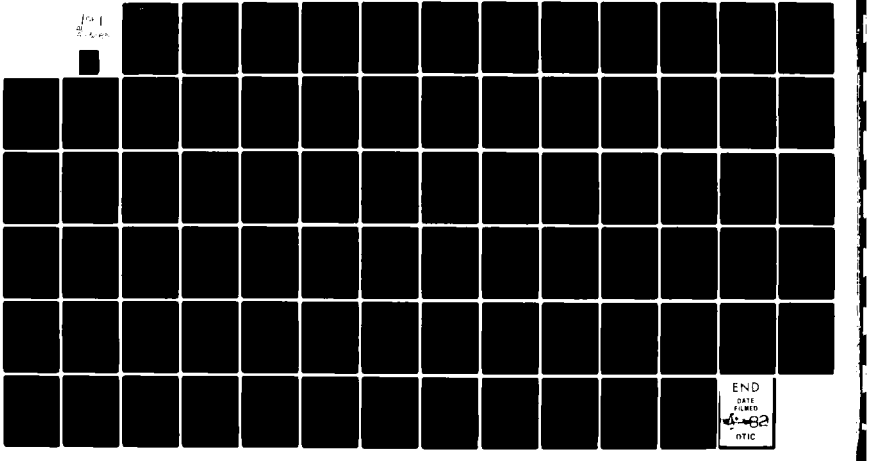

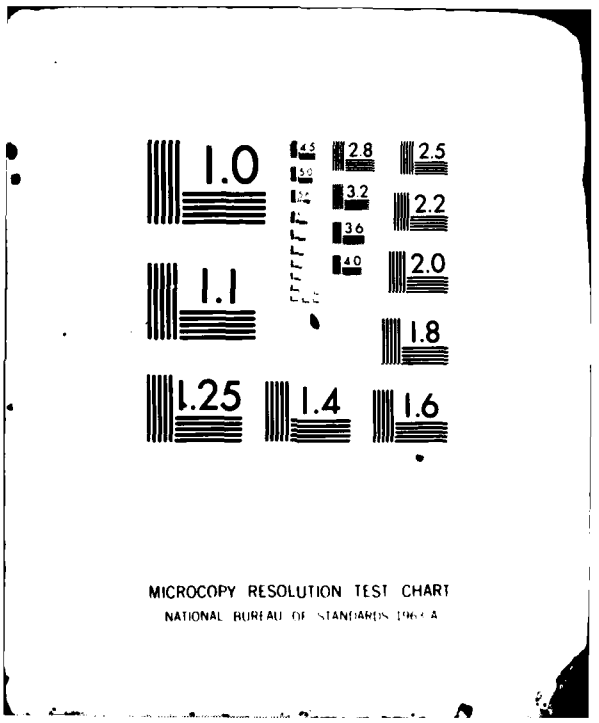
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CONTENTS

PART I — AERONAUTICAL REPORTS

LR-594 **ANALYSIS OF WALL INTERFERENCE EFFECTS ON ONERA CALIBRATION MODELS IN THE NAE 5-FT. X 5-FT. WIND TUNNEL.**

Mokry, M., Galway, R.D., National Aeronautical Establishment, March 1977.

The measurements on three geometrically similar aircraft models by ONERA are used to analyse lift interference effects in the solid and perforated wall test sections of the NAE 5-ft. x 5-ft. test facility. The prediction of the angle of attack correction for both test sections is based on the representation of the model by lifting lines and the solution of the subsonic wall interference problem by the finite difference method. The value of the porosity factor ascribed to the test section with perforated walls is checked by comparing the measured wall pressure distributions with the theoretical ones, predicted by the present method. The lift interference effects on models M1 and M3, having wing span to wind tunnel width ratios of 0.188 and 0.311 respectively, were found to be within the limits of experimental errors. For the M5 model, having a wing span to wind tunnel width ratio of 0.644, the solid and perforated test section measurements, corrected using a uniform angle of attach correction, show good agreement up to lift coefficients of about 0.5. At higher values of the lift coefficient, the effects of the spanwise variation of the angle of attack correction in the solid wall test section become more significant, as demonstrated by measured pressure distributions at three spanwise locations of the wing. Based on the theoretical prediction, the test section with 20.5% perforated walls produces a more uniform distribution of the angle of attack correction along the wing span, and hence should yield more reliable test data than the section with solid walls.

LR-595 **FORGING BEHAVIOUR OF SUPERALLOY COMPACTS AND COMPOSITES.**

Kandeil, A., Immarigeon, J.-P., Wallace, W., National Aeronautical Establishment, February 1978.

The forging behaviour of hot isostatically pressed nickel-base superalloy (Mar M200) compacts, reinforced with 40% volume fraction of tungsten wires, has been examined and compared with that of the non-reinforced alloy matrix by means of isothermal and isostrain-rate compression.

Under identical working conditions, peak flow stresses for the composite specimens are up to 4 times those for the non-reinforced matrix. Furthermore the strain rate sensitivity of the composites is approximately half that of the superplastic matrix. A rationalization of these differences is presented.

Forming limit criteria for the composites are examined. A model is considered which predicts an upper bound forming limit beyond which severe damage is introduced into the composite. In the present case, the maximum strain achievable is predicted and shown to be approximately 0.34. At lower strains, formability is shown to be further limited by void nucleation at the tensile poles of the wires, normal to the loading direction. Means of improving the formability, which is controlled by the strength of the wire/matrix interface relative to that of the matrix, are discussed.

LR-596 **CALCULATION OF THE POTENTIAL FLOW PAST MULTI-COMPONENT AIRFOILS USING A VORTEX PANEL METHOD IN THE COMPLEX PLANE.**

Mokry, M., National Aeronautical Establishment, November 1978.

An efficient algorithm for a vortex panel method in the complex plane is developed to compute the potential flow past multi-component airfoils in free air and a porous-wall wind tunnel. The theoretical foundations of the method — the properties of the source and vortex density functions, the relationship between the exterior and interior flows, and the general Kutta-Joukowski condition for a trailing edge with crossflow — are derived from the theory of the Cauchy type integral. The method utilizes flat panels with linear vortex and source densities, the latter being used to simulate the displacement effect of boundary layers. The airfoil boundary condition is satisfied at all panel midpoints and the overdetermined system of linear algebraic equations solved as a least squares problem, in the L_1 norm, or in the L_∞ norm. The wind tunnel wall interference problem is treated using the concept of the Green's function in the complex plane. Examples are worked out for some theoretical airfoils and extensive tables of exact and computed pressure distributions are given.

LR-597 **THEORETICAL ANALYSIS OF THE TRANSIENT RESPONSE TO NON-STATIONARY BUFFETS LOADS.**

Lee, B.H.K., National Aeronautical Establishment, April 1979.

A method for predicting the response of a wing to non-stationary buffet loads is presented. The wing is treated as a cantilever beam with known mass distribution. Using generalized co-ordinates, the vibration of the wing is governed by the second order mass-spring-damper oscillator equation. The buffet load on the wing is expressed as an integral of the sectional force, which is a function of the spanwise location and time. The non-stationary load is represented as the product of a deterministic time function multiplied by a statistically stationary random function. The time history of the applied load is segmented into a number of time intervals. Analytical expressions for the mean square response of the wing displacement are derived using a power spectral density for the random part of the applied load, similar to that used in the theory of isotropic turbulence. The effects of damping, ratio of the undamped natural frequency of the system to the half power frequency of the power spectral density, length of time segment, and duration of applied load on the response of the wing have been investigated for three examples of the load versus time histories.

LR-598 **A PERTURBATION THEORY OF TWO-DIMENSIONAL TRANSONIC WIND TUNNEL WALL INTERFERENCE.**

Chan, Y.Y., National Aeronautical Establishment, April 1979.

The wind tunnel wall interference in transonic speed is formulated as a perturbation to the basic flow around the airfoil in free air. The perturbation equation is derived from the transonic small disturbance equation and is linear but with variable coefficients containing the non-linear solution of the basic flow. The equation is solved numerically by a direct matrix method using the classical boundary condition for a porous wall. The solution in terms of lift versus angle of attack agrees well with that calculated directly from the small disturbance equation.

LR-599 **APPLICATION OF THE METHOD OF LINES TO THE SOLUTION OF ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS.**

Jones, D.J., South, J.C., Jr., National Aeronautical Establishment, November 1979.

The method of lines is used in this report for solving one linear, two nonlinear elliptic boundary value problems and a linear eigenvalue problem. An analysis of the stability and convergence is made in the linear cases.

LR-600 **A COMPARISON OF METHODS FOR CALIBRATION AND USE OF MULTI-COMPONENT STRAIN GAUGE WIND TUNNEL BALANCES**

Galway, R.D., National Aeronautical Establishment, March 1980.

A method is presented for calibration of strain-gauge balances which does not require that the components can be loaded independently. Applicable to both 'internal' and 'external' types of balance, the procedure uses a single varying calibration load to determine all linear and non-linear calibration coefficients. Constant 'secondary' loads on one or more components are unnecessary, although they may be used if desired.

The usual iterative solution of the second order balance equations is outlined, and an approximate non-iterative scheme is included for completeness, though not recommended. Two methods of accounting for dependency of the calibration coefficients on the signs of the component loads are presented.

A concept of 'buoyancy' is introduced to simplify the application of force balance tares, and a procedure for determining the component outputs for absolute zero load (the 'buoyant' offsets) is given. Balance data at a series of model attitudes are used to define these offsets, and also the coefficients in the equations defining the component load distribution of the tare weight at any attitude.

The topics covered are ideally suited to formulation and solution by matrix methods, which have been used throughout.

LR-601 **A METHOD FOR THE PREDICTION OF WING RESPONSE TO NON-STATIONARY BUFFET LOADS.**

Lee, B.H.K., National Aeronautical Establishment, July 1980.

A method for the prediction of the response of a wing to non-stationary buffet loads is presented. The time history of the applied load is segmented into a number of time intervals. In each time segment, the non-stationary load is represented by the product of a deterministic shaping function and a statistically stationary random function. An approximate modelling of the load on the wing is given. The wing is divided into panels or elements, and the load is computed from measured or estimated pressure fluctuations at the centre of each panel. A series representation, with terms of the correlated noise type, is used to curve fit the experimentally determined complex buffet pressure power spectral densities. Using the correlated noise form of power spectral density for the random part of the applied load, analytic expressions are derived for the mean square displacement and acceleration response of the wing. An illustration using data available for the F-4E aircraft is included.

LR-602 **CONFINED MIXING OF COAXIAL FLOWS**

Tyler, R.A., Williamson, R.G., Division of Mechanical Engineering, October 1980.

An empirical approach is used to correlate the mixing of isothermal incompressible coaxial air flows in straight pipes of constant circular cross-section. An assumed decay function for kinetic momentum is correlated in terms of initial geometry and initial velocities of the mixing streams. The method allows the rapid estimation of quantities of engineering interest including the axial distribution of both static pressure and total momentum. The method has been tested against published data on thrust augmenting ejectors of the parietal type, and found to provide satisfactory reproduction of measured performance as affected by mixing pipe length and area ratio.

LR-603 **FLIGHT-TEST EVALUATION OF STOL CONTROL AND FLIGHT DIRECTOR CONCEPTS IN A POWERED-LIFT AIRCRAFT FLYING CURVED DECELERATING APPROACHES**

Hindson, W.S., Hardy, G.H., Innis, R.C., National Aeronautical Establishment, March 1981. (Also presented as NASA Technical Paper 1641, Ames Research Center, NASA, Moffett Field, Calif. 94035.)

Flight tests were carried out to assess the feasibility of piloted steep, curved, and decelerating-approach profiles in powered-lift STOL aircraft. Several STOL control concepts representative of a variety of aircraft were evaluated in conjunction with suitably designed flight directors. The tests were carried out in a real navigation environment, employed special electronic cockpit displays, and included the development of operational procedures considered appropriate to this class of aircraft. Data are presented describing the performance achieved and the control utilization involved in flying 180° turning, descending, and decelerating-approach profiles to landing. The results suggest that such moderately complex piloted instrument approaches may indeed be feasible from a pilot acceptance point of view, given an acceptable navigation environment. Systems with the capability of those used in this experiment can provide the potential of achieving instrument operations on curved, descending, and decelerating landing approaches to weather minima corresponding to CTOL Category II criteria, while also providing a means of realizing more efficient operations during visual flight conditions.

LR-604 **A KALMAN FILTER APPROACH TO NAVIGATION ON THE NAE CONVAIR 580 AEROMAGNETICS RESEARCH AIRCRAFT.**

Leach, B.W., National Aeronautical Establishment, February 1981.

Doppler radar, compass heading, and VLF communications station phase difference information are combined in an optimal fashion to form an integrated navigation system based on the concepts of Kalman filtering. A ten-state Doppler/VLF Kalman filter navigation algorithm is designed for use onboard the NAE Convair 580 aeromagnetics research aircraft, with simulation studies conducted using computer programs written in FORTRAN for the IBM 3032 TSS operating environment. Results from the studies show the unique features of a Kalman filtering approach to the navigation task. Various contingencies, or anomalous situations, that can arise when handling the VLF data are considered, and solutions are offered in the context of the Kalman filter approach being used. A comparison study involving simulated navigation data demonstrates the superiority of the Kalman filter navigator compared to simpler navigation algorithms, especially when significant bias errors occur in the basic quantities being measured. A further comparison study based on navigation data collected onboard the Convair verifies that the proposed Kalman filter navigation algorithm operates properly when using typical 'real world' data.

LR-605 **THE REJUVENATION OF PROPERTIES IN TURBINE ENGINE HOT SECTION COMPONENTS BY HOT ISOSTATIC PRESSING**

Floyd, P.H., Wallace, W., Immarigeon, J.-P.A., National Aeronautical Establishment, February 1981.

A significant factor in the cost of ownership of industrial, marine and aircraft gas turbine engines is the high price of replacement of parts that have reached the limit of their original design life. Many parts, particularly those operating in the hot sections of gas turbine engines, will be replaced on a routine basis, even though they may have many thousands of safe operating hours remaining. In order to reduce costs, and to conserve materials that are rapidly becoming scarce, a great deal of effort is being expended to develop treatments that allow used parts to be refurbished and their original properties restored by regenerative heat treatments.

A significant development has occurred recently in this area with the introduction of hot isostatic pressing. With hot isostatic pressing it is possible to reheat-treat service exposed parts under pressure so that precipitate structures are restored, and internal defects such as creep voids and cavities are eliminated. As a result, new metal properties can be restored in many cases. However, during hot isostatic pressing there is a tendency for grain growth to occur, for changes in grain boundary structure to occur, and for irreversible changes in carbide morphology and distribution to occur. Consequently, the effective processing of materials requires that careful control of the time, temperature and pressure conditions used in the autoclave be achieved. The particular conditions used must be established for each individual alloy of interest in order to develop the appropriate microstructural features required and thereby obtain the desired improvements in mechanical properties.

This paper will review some of the Canadian work done in this area, with particular reference to a series of precipitation hardenable nickel base superalloys including Inconel alloy X-750, Udimet 500 and IN-738. The limitations of the process will be discussed as well as the successes achieved.

LR-606 **AN INVESTIGATION OF MULTI-AXIS ISOMETRIC SIDE-ARM CONTROLLERS IN A VARIABLE STABILITY HELICOPTER.**

Sinclair, M., Morgan, M., National Aeronautical Establishment, August 1981.

Several helicopter control configurations, each incorporating a pair of multi-axis, isometric side-arm controllers, were evaluated in a flight test program using a variable stability helicopter. The test aircraft was the NAE Airborne Simulator, an extensively modified Bell Model 205A-1, and the evaluation flights encompassed a wide range of demanding tasks from hover manoeuvring and transitions to cruising flight, to nap-of-the-earth flight and precision IFR tracking. The isometric control systems included several two-handed and one-handed configurations with force-pedals for directional control, and one fully-integrated system which provided full control of the helicopter with *either* hand. Evaluations of these unconventional systems were performed by five experienced test pilots.

LR-607 **BRIEF OUTLINE OF AN AERIAL PLANTING CONCEPT FOR FORESTRY APPLICATIONS**

Wood, A.D., National Aeronautical Establishment, October 1981

An aerial planting concept for forestry applications is briefly described and examples are given of the results obtained during biological and flight experiments with a prototype system. In this system newly-developed, seed-containing planting darts are sequentially ejected from several dispensers installed on a light helicopter, which is also fitted with high-accuracy, short-range, navigational-guidance equipment. Continuing development entails further testing in the field and a more detailed examination of manufacturing aspects.

PART II — MECHANICAL ENGINEERING REPORTS

MD-54 THE CUTTING OF ICE WITH WATER JETS.

Coveney, D.B., Brierley, W.H., Division of Mechanical Engineering, November 1977.

A new portable, self-contained facility for investigating the cutting of ice with water jets has been built and tested. Following the initial trials some modifications and improvements to the facility have been recommended.

From current and previous ice cutting tests it has been established that significant cuts in ice can be made over a wide range of conditions. At moderate pressures, that is less than 2,000 psig, and low traverse speeds, it has been possible to cut through ice 28 inches thick. Correlation with previous test results by regression analysis has been made.

MD-55 THE DEVELOPMENT OF A NEW TYPE OF MODEL ICE FOR REFRIGERATED TOWING BASINS.

Timco, G.W., Lane, J.F., Division of Mechanical Engineering, June 1980.

A research program was initiated at the National Research Council of Canada to look for a new type of model ice which would accurately represent sea ice in its mechanical properties over a wide range of scaling factors. The results of this program are outlined in this report. The findings indicate that ice doped with either carbamide (urea) or lithium chloride would be a good model representation for sea ice for tests scaled up to 40:1.

MD-56 TRAWLER ICING — A COMPILATION OF WORK DONE AT N.R.C.

Stallabrass, J.R., Division of Mechanical Engineering, December 1980.

This report collates and reviews the results of an eleven-year project on the icing of fishing trawlers.

Initially the factors causing the icing of ships at sea are presented and some aspects of the physics of the icing process are discussed.

Some simple icing tests on cylinders of various diameters are described. These were made in an icing wind tunnel and demonstrated the effects of air temperature and cylinder size on the resulting ice formations. Later, a number of possible methods for reducing the icing hazard were tested in the wind tunnel and at an outdoor test rig. Of the methods tested the most effective was an inflatable rubber de-icing blanket.

Throughout the project, icing report forms were distributed to vessels operating out of Canadian east coast ports. The data obtained by this means has helped to establish the types of weather systems responsible for icing conditions, the geographical extent of the occurrence of icing, and statistics on the severity of icing encounters in the study area.

Appendices present simplified formulae for the droplet collection efficiency of cylinders and rectangular bodies, the derivation of an analytical expression for the rate of ice build-up on fishing trawlers, and a bibliography of ship icing.

MD-57 CUTTING ICE WITH "HIGH" PRESSURE WATER JETS.

Coveney, D.B., Division of Mechanical Engineering, July 1981.

The potential of "high" pressure water jets to cut slots in an ice sheet, primarily for possible use as an assist to ice breaking, has been under investigation by the Division of Mechanical Engineering of the National Research Council of Canada.

In the field, slots have been cut into and through fresh water ice, about 0.7 m thick with water jets applying up to about 260 kW of power to the ice. Each ice sheet consisted of a clear bottom layer and multiple upper layers of opaque white ice. The ice temperature just below the top surface ranged from -21°C to 0°C. In the laboratory, cuts to more than 17 cm were made in artificially grown, essentially clear, fresh water ice, and cuts to almost 25 cm were made in a simulated sea ice. Up to 50 kW was applied to the fresh water ice and up to 31 kW was applied to the simulated sea ice.

This report describes the ice cutting performance of small to moderate scale water jets. The majority of cuts produced a narrow, clean kerf, indicative of erosion in a ductile material, while other cuts produced a wide spalled trench, indicative of spalling in a brittle material. Still others produced a combination of the two modes of cutting, with a wide, shallow trench and a narrow, deep kerf below the trench. In many cases the ice was also crazed extensively by the water jet. The causes and the effects of these characteristics on ice cutting performance are discussed, along with the effects of jet traverse speed, nozzle diameter, nozzle pressure, nozzle stand-off, ice characteristics and the overall scale of the system. An empirical relationship, derived by regression analysis, is presented correlating the jet penetration to the power in the jet, the jet traverse speed, the nozzle stand-off and the estimated ice temperature.

ME-245 OVERLAND AND AMPHIBIOUS ACV DESIGN DATA RELATING TO PERFORMANCE.

Fowler, H.S., Division of Mechanical Engineering, April 1979.

This handbook of data endeavours to collect and present in practical form such design data relating to performance as are currently publicly available.

The art is at present in an early stage of its development, and many of the data given are tentative or incomplete, and are hedged around by ill-defined boundary conditions.

We shall attempt to keep up with the ever-shifting frontiers of ignorance by issuing amendments to this handbook as exploration proceeds.

Finally one must remember that he who lives strictly by the rules, stagnates. Progress is attained only by knowing the rules and then living dangerously beyond them.

ME-246 ON THE LIFT-AIR REQUIREMENTS OF AIR CUSHION VEHICLES AND ITS RELATION TO THE TERRAIN AND OPERATIONAL MODE

Fowler, H.S., Division of Mechanical Engineering, May 1979.

The optimization of installed power in a low-speed overland ACV is shown to depend heavily on the minimization of skirt/terrain interaction drag, which is in turn shown to depend critically upon lift-air supply.

The influence of hoverheight, terrain roughness and porosity, vegetation, and vehicle speed on drag is examined in the light of data from the CASPAR vehicles. An analysis is proposed by which the data can be reduced to give a lift airflow applicable to any vehicle having a segmented skirt, operating over a range of specified terrains.

Tentative values for these flow coefficients, together with associated drag coefficients, are given.

ME-247 URBAN TRAFFIC SIGNAL CONTROL FOR FUEL ECONOMY

Messenger, G.S., Richardson, D.B., Graefe, P.W.U., Mufti, I.H., Division of Mechanical Engineering, January 1980.

The Metropolitan Toronto Roads and Traffic Department and the Engine Laboratory of the Division of Mechanical Engineering at the National Research Council of Canada have completed a study to determine the influence of two computer-controlled traffic signal timing plans over a given route. The two plans are the existing plan based on SIGRID (SIgnal GRid Design program) and TRANSYT (TRAffic Network StudY Tool).

The results show that under the TRANSYT timing plan, vehicles encountered fewer stops, saved time and used a slightly smaller amount of fuel than under the existing timing plan.

Vehicle fuel consumption was computed using a computer model of a vehicle which used velocity profiles obtained from an instrumented "floating" car. Single and multiple linear regression analyses were used to determine the relationship between the fuel consumption and the relatively easy-to-measure and statistically stable quantities such as trip time, number of stops and delay time.

It was found that fuel consumption could be expressed adequately as a linear combination of trip time, number of stops and delay time. Using only two independent variables showed a combination of delay time and stops to be equally as good as a combination of travel time and stops. When restricted to a single independent variable, any one of them could be used for predicting fuel consumption.

ME-248 THE INFLUENCE OF BLADE PROFILE AND SLOTS ON THE PERFORMANCE OF A CENTRIFUGAL IMPELLER.

Fowler, H.S., Division of Mechanical Engineering, January 1980.

As part of the program of studies on centrifugal impellers, the problem of instability at low flows was investigated. The major cause was found to be flow detachment from the impeller vanes.

Slotted blades were found to be the most effective means of delaying this detachment, and extending the working range of the blower.

Low speed studies were confirmed by a test program on a high speed machine, where it was demonstrated that the improved flow range was accompanied by a general increase of efficiency.

The design and placement of the slots is discussed.

ME-249 URBAN TRAFFIC SIGNAL CONTROL FOR FUEL ECONOMY
PART 2: EXTENSION TO SMALL CARS

Messenger, G.S. Division of Mechanical Engineering, November 1981.

Use of a small car's characteristics in a simulation program utilizing velocity profiles obtained in a traffic study by the Metropolitan Toronto Roads and Traffic Department and the Engine Laboratory at the National Research Council Canada has shown that trends shown in fuel consumption in NRC, Division of Mechanical Engineering Report No. ME-247 are similar for a small-engined vehicle.

NRC, DME Report No. ME-247 showed that under the TRANSYT timing plan, vehicles encountered fewer stops, saved time and used a slightly smaller amount of fuel than under the existing timing plan. In the above mentioned report a large vehicle's fuel consumption was calculated using a computer model of the vehicle which used velocity profiles obtained from an instrumented "floating" car.

MH-111 WAVE LOADS ON LARGE CIRCULAR CYLINDERS: A DESIGN METHOD

Mogridge, G.R. and Jamieson, W.W., Division of Mechanical Engineering, December 1976.

The forces and overturning moments exerted by waves on large vertical circular cylinders have been measured in the laboratory. Two rigid cylinders, 12 in. and 26.5 in. in diameter, extending from the bottom of a wave flume through the water surface, were tested in varying depths of water, for a range of wave periods and wave heights up to the point of breaking. A digital computer was used for the acquisition, processing, plotting and storage of the experimental data.

In addition to the experimental work, a design method is presented which allows the wave loads on large circular cylinders to be estimated by means of a simple desk calculation. The experimental data shows that this simple method of calculation, based on the linear diffraction theory of MacCamy and Fuchs, is accurate over a wide range of wave conditions and cylinder sizes.

MI-839 A PERFORMANCE EVALUATION OF A LONG LOAD STEERING TRI-AXLE DOLLY ON THE ALASKA HIGHWAY, 1981

Woodrooffe, J.H.F., Division of Mechanical Engineering, July 1981.

A road test has been conducted on a highway transporter designed to carry three, 80-foot lengths of 48-inch diameter steel pipe on the Alaska Highway. The transporter uses a tri-axle forced steering dolly which has shown the capacity of significantly reducing the off tracking of the vehicle during curving.

The curving dynamics of the vehicle, as they relate to off tracking, are discussed and the processed data from the test are presented.

MK-29 DYNAMICS OF MULTI-BODY SYSTEMS.

Mufti, I.H., Division of Mechanical Engineering, November 1979.

The dynamic equations of multi-body systems in the form of open chains are derived by applying the principles of linear and angular momentum to each individual member in the chain. This results in the appearance of constraint forces and torques in the dynamic equations. Using more or less classical approach these unknown forces and torques can be eliminated. Another approach is to approximate these forces by elastic and viscous forces by allowing small violations of the constraints. The well-known elimination procedure leads to a small densely coupled system of equations while the lesser-known procedure of approximating the constraint forces and torques yields a large but less densely coupled system. Both these procedures are first explained in the context of a single rigid body and then applied to a system of rigid bodies in an open chain where each body is coupled directly to at most two neighbours.

ML-6 THE NRC STRESSALYSER: A GENERAL-PURPOSE PURSUIT TRACKING TASK FOR FIELD AND LABORATORY STUDIES.

Buck, Leslie, Leonardo, R., Hyde, F., Division of Mechanical Engineering, June 1978.

The stressalyser is a step-input, subject-paced, pursuit tracking task developed in the Control Systems and Human Engineering Laboratory of the Division of Mechanical Engineering for use in measuring performance impairment under adverse conditions, and in studying motor control. The instrument produces measures of several aspects of the subject's performance following stress. Results of published studies are briefly reviewed and some new potential applications are indicated.

MP-73 **PROPERTIES OF REGULAR AND SUPER UNLEADED AUTOMOTIVE GASOLINES (Ottawa/Hull Area — Winter, 1978-79)**

Strigner, P.L., Moroz, G., Sabourin, R., Burton, G., Bailey, T., Division of Mechanical Engineering, June 1979.

Unleaded, automotive, winter grade gasolines, both regular (type 2) and super (type 1), sold in the Ottawa/Hull area by the major oil companies are all excellent in quality, meeting requirements of CGSB* Standards 3-GP-5 and 3-GP-5Ma for Unleaded Automotive Gasoline.

All the tested gasolines have nil or negligible lead and phosphorus contents indicating excellent protection against catalyst poisoning. Most gasolines have manganese, probably as the methylcyclopentadienyl manganese tricarbonyl antiknock agent.

* Canadian Government Specifications Board

MP-74 **PROPERTIES OF REGULAR AND SUPER UNLEADED AUTOMOTIVE GASOLINES (Ottawa/Hull Area — Summer, 1979)**

Moroz, G., Kallio, N.N., Bailey, T., Smith, S.A., DesBrisay, C., Division of Mechanical Engineering, September 1979.

Unleaded, automotive, summer grade gasolines, both regular (type 2) and super (type 1), sold in the Ottawa/Hull area by the major oil companies are all excellent in quality. They meet requirements of CGSB* Standards 3-GP-5 and 3-GP-5Ma for Unleaded Automotive Gasoline, except for some Reid vapour pressure values and one lead content that marginally exceed limits.

The tested gasolines have nil or negligible lead and phosphorus contents indicating excellent protection against catalyst poisoning. Most gasolines have manganese, probably as the methylcyclopentadienyl manganese tricarbonyl antiknock agent.

* Canadian Government Specifications Board

MP-75 **PROPERTIES OF BASE STOCKS OBTAINED FROM USED ENGINE OILS BY ACID/CLAY RE-REFINING.**

Strigner, P.L., Moroz, G., Sabourin, R., Burton, G., Bailey, T., Division of Mechanical Engineering, September 1980.

For more than 10 years the Fuels and Lubricants Laboratory of the Division of Mechanical Engineering has been examining the properties of base stocks, used oil feedstocks and re-refined engine oils of Canadian re-refiners. Over 20 samples of base stocks from six Canadian re-refiners have been examined. Data are presented and compared with virgin base stock data. In addition, tables of suggested specification limits for base stocks and batch-to-batch consistency ranges are given. Finally, data are given for a number of samples obtained from a re-refiner in India.

As shown, when well re-refined, the base stocks have excellent properties including a good response to anti-oxidants and a high degree of cleanliness.

MS-139 A PARAMETRIC STUDY ON HIGHWAY CABLE BARRIER PERFORMANCE AND ITS EFFECT ON VEHICLE REDIRECTION DYNAMICS

Basso, G.L., National Aeronautical Establishment, February 1977.

A parametric study of the highway cable barrier system and its effect on vehicle redirection has been carried out using the NRC barrier analysis, as programmed for digital simulation in conjunction with an existing analysis of the vehicle-terrain system. Component data sets were obtained from barrier experimental measurements and a vehicle parameter study.

A two-part study was performed. The initial phase dealt with barrier response. An evaluation of the effect of design parameters on design response variables was conducted. The importance of post parameters was highlighted. A means of using these characteristics to improve performance was considered. A brief extension of the analysis to other tension barrier systems has also been included.

The second phase considered vehicle interaction with cable barriers, straight and curved, over level and sloping terrain. To do this, system components were chosen so as to represent typical upper and lower bound combinations for the private passenger class of automobile. A number of computer tests were performed with the object of evaluating vehicle response performance as affected by critical barrier and terrain parameters. Correlation with such parameters was established for purposes of mapping bounds of acceptable vehicle performance. The most dominant instability found to occur was a vehicle roll-over condition.

MS-140 A SYSTEMS ENGINEERING STUDY OF NIGHT VISIBILITY WITH AUTOMOBILE HEADLIGHTING

Pinkney, H.F.L., Ayad, A.A., Huculak, P., Harrison, A.L., National Aeronautical Establishment, August 1977.

The question of night visibility with automobile headlighting is studied using a systems approach.

A methodology has been developed to isolate all the independent variables affecting night driving visibility such as sources, reflective surfaces, transmission media and observer.

It is shown that correlation was achieved between the results obtained from field experiments for the unopposed roadway obstacle detection task and corresponding calculations based on accurate field illumination engineering data and observer laboratory visual performance data.

Using the luminance difference method developed during the visual performance studies, the report demonstrates how the illuminance characteristics of the source interacting with the scene luminance factors can affect the luminance difference signal *available* for detection (ΔL_A) with respect to the luminance difference signal *required* by the observer (ΔL_R).

Examples of the application of this type of approach are also given to analyze the unopposed case and the interaction with other sources of illuminance such as moonlight, dusk skylight and opposing headlights. By means of these examples the sensitivity of visibility to the field, source and task parameters is also shown.

Extension of the methodology to statistical population performance evaluations is outlined and current research in progress for obtaining a statistical measure of the parameters affecting headlamp population behaviour is briefly outlined.

MS-141 A VISIBILITY ANALYSIS OF OBSTACLE DETECTION EXPERIMENTATION IN UNOPPOSED AUTOMOTIVE HEADLIGHTING

Huculak, P., National Aeronautical Establishment, May 1978.

This report is concerned with the description and analysis of a series of unopposed automobile headlighting experiments. The study emphasizes the phenomena involved in the detection of dark obstacle targets simulating the hazardous objects encountered during night driving.

In the detection experiment, the visibility levels are established for the observer-driver by retracting the visual targets at predetermined distances from the test vehicle. This luminance difference signal at or near the threshold of detection defines the visual task. Laboratory work measured observer visual potential in luminance difference discrimination in order to supplement the field studies.

The influences of atmospheric luminance, dynamic vehicle pitch, target shadow enhancement, foreground luminance and fixation duration are included in the analysis of the field detection trials. Several different measures of target visibility are employed. It is shown that a centroidal value of target luminance difference can be used as an index of the detection of dark hazard-like objects of concern in night driving.

One-to-one correspondence was established between laboratory measurements of visual potential and roadway detection trials showing that a comprehensive treatment of the detection processes associated with night driving is possible.

MS-142 THE INFLUENCE OF GLARE ON THE DETECTION OF HAZARDOUS OBJECTS IN AUTOMOBILE NIGHT DRIVING

Huculak, P., National Aeronautical Establishment, June 1978.

This study consists of the visibility calculations for a series of automobile headlight experiments employing retractable detection targets under opposing glare. The present work is the natural continuation of the unopposed target experiments published earlier.

With the addition of opposing glare, attention is directed to describing the glare levels, eye movements, and the spatial adaptation levels associated with the visual task. The transient adaptation states consisting of both dark-to-light and light-to-dark transitions are then determined.

It is shown that one-to-one correspondence is possible between field detection trials and predictions based on laboratory visual potential.

MS-143 FAILURE ANALYSIS OF SOME ORTHOPEDIC IMPLANTS

Holt, R.T., Wallace, W., National Aeronautical Establishment, May 1980.

The latest information indicates that over 2500 orthopedic implant malfunctions may occur each year in Canada.

Several orthopedic implants which failed in service have been examined in the Structures and Materials Laboratory, National Aeronautical Establishment, National Research Council of Canada. Two classes of material were studied, wrought stainless steel, type 316L and a cast Co-Cr-Mo alloy. In each case where fracture of the device occurred, fatigue striations were detected, indicating that fatigue was a primary mechanism of failure. Other problems were detected in each class of material; corrosion in the stainless steel and porosity in the cobalt-based alloy.

MS-143 FAILURE ANALYSIS OF SOME ORTHOPEDIC IMPLANTS (Cont'd)

Due to problems with corrosion, it is recommended that type 316L stainless steel should not be used when there is a possibility of the implant remaining in the body for an extended period of time (say over 18 months).

Also, there should be some control over the allowable porosity levels in cast cobalt-base alloys. It is shown, for example, that the porosity levels can be dramatically reduced by controlling the cooling rate during the casting process.

Recent trends in orthopedic implant technology are briefly described, particularly the processing of metal powders which gives a uniform microstructure resulting in better strength and fatigue resistance.

At the end of the report, a bibliography of over 240 papers in nine different categories covers the properties and performance of metals and alloys used as orthopedic implants.

MS-144 AN ANHYDRIDE-ACID COMPOUND FOR CROSS-LINKING EPOXY RESIN SYSTEMS.

McLean, P.D., Scott, R.F., National Aeronautical Establishment, January 1981.

Modified dicarboxylic acid anhydride compounds have been made which contain free carboxylic acid groups. These compounds cross-link with epoxy resins giving low exotherms, longer working times and produce strong ductile plastics. The modified compound is made by adding water to the liquid dicarboxylic acid anhydride methyl tetrahydrophthalic anhydride with a small amount of catalyst and heating. The amount of water added is selected to obtain the desired anhydride to acid ratio.

Catalysis of the systems is accomplished by either precatalysis of the resin, by additions of a conventional catalyst or by addition of a suitable catalyst during the manufacture of the modified dicarboxylic acid anhydride compound.

Strengths of 14000-15000 psi with elongations of 7-9% have been obtained using a cure schedule of 100°C for six hours and 160°C for eight hours. When stoichiometric quantities of phthalic anhydride were included in the composition, strengths up to 17000 psi have been obtained.

The use of the anhydride-acid compound results in generally lower heat deflection temperatures than nadic methyl anhydride.

Parts have been made using DGEBA, Novolac or alicyclic epoxy resin systems, by filament winding, wet lay up and preimpregnation, each using vacuum and pressure curing technique.

PART III — FEATURE ARTICLES FROM QUARTERLY BULLETINS

THE HOT WORKING BEHAVIOUR OF MAR M200 SUPERALLOY COMPACTS, by J.-P.A. Immarigeon, W. Wallace and G. Van Drunen. Reprint from DME/NAE Quarterly Bulletin 1977(1), April 1977.

MATTE ALLOCATION IN A COPPER SMELTER, by L.K. Nenonen, U. Graefe, M.V. Neimanis and C.M. Woodside. Reprint from DME/NAE Quarterly Bulletin 1977(1), April 1977.

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MODE VERSUS AVERAGE IN CANADIAN CO-OPERATIVE FUELS AND LUBRICANTS EXCHANGES, by P.L. Strigner. Reprint from DME/NAE Quarterly Bulletin 1977(2), July 1977.

HYBRID COMPUTER MODELS AS AN AID IN DESIGN OF GAS TURBINE CONTROL SYSTEMS FOR HELICOPTERS, by R. Langton, R.M. Evans, B.D. MacIsaac. Reprint from DME/NAE Quarterly Bulletin 1977(3), October 1977.

ON THE INVESTIGATION OF THE RAM AIR EFFECTS ON THE AIR SIDE COOLING SYSTEM PERFORMANCE OF A NORTH AMERICAN CAR, by U.W. Schaub. Reprint from DME/NAE Quarterly Bulletin 1977(3), October 1977.

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A MAJOR REFURBISHING PROGRAM FOR THE NAE 5-Ft. X 5-Ft. BLOWDOWN WIND TUNNEL, by L.H. Ohman. Reprint from DME/NAE Quarterly Bulletin 1978(1), April 1978.

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YACHT RESEARCH AT NRC, by D.C. Murdey. Reprint from DME/NAE Quarterly Bulletin 1978(3), October 1978.

A REAL TIME PROCESSOR FOR RAILWAY CAR AXLE YAW-SIGNALS, by C.M.G. Zwarts. Reprint from DME/NAE Quarterly Bulletin 1978(3), October 1978.

THE USE OF SHOCK TUBE AND SHOCK WAVE CONCEPTS IN THE PHYSICS OF ELECTRICAL AND OPTICAL GAS DISCHARGES, by M.M. Kekez, A.H. Makomaski, P. Savic. Reprint from DME/NAE Quarterly Bulletin 1978 (3), October 1978.

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SEDIMENT LOAD UNDER WAVES AND CURRENTS, by D.H. Willis. Reprint from DME/NAE Quarterly Bulletin 1979(3), October 1979.

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PART IV — LABORATORY TECHNICAL REPORTS

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LTR-FR-57 Tests of a Reverse Flow Outside Air Temperature Probe for Use on Cloud Physics Research Aircraft, by D.F. Daw, January 1977.

LTR-FR-58 Additional High Speed Icing Wind Tunnel Tests of Outside Air Temperature Probes for Use on NAE Cloud Physics Research Aircraft, by D.F. Daw, May 1977.

LTR-FR-59 Effects of Aerodynamic Interference on the Atmospheric Environment Service Particle Measuring Devices Mounted on the NAE Twin Otter, by A.M. Drummond, February 1977.

LTR-FR-60 A Cumulus Cloud Seeding Experiment for Forest Fire Control — NAE Participation and Results for 1976, by J.I. MacPherson, August 1977.

LTR-FR-62 Wind Tunnel and Flight Tests of Temperature Probes Used on the NAE T-33 and Twin Otter Atmospheric Research Aircraft, by J.I. MacPherson, January 1978.

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LTR-FR-67 A Cumulus Cloud Seeding Experiment for Forest Fire Control — NAE Participation and Results for 1977, by J.I. MacPherson, June 1978.

LTR-FR-69 Automatic Aeromagnetic Compensation, by B.W. Leach, March 1979.

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LTR-FR-77 Canadian Participation in Hiplex 1979 (AES Internal Report No. APRB 110 P 34), by J.I. MacPherson, (R.S. Schemenauer, G.A. Isaac, J.W. Strapp) AES, October 1980.

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LTR-HA-32 Results of Flow Measurements made in the Settling Chamber and in the Transonic Test Section of the NAE 5ftx5ft Trisonic Blowdown Wind Tunnel in February-March, 1976 (prior to the refurbishing of the settling chamber), by D. Brown, September 1980.

LTR-HA-39 A Description of the NAE Two-Dimensional Transonic Small Disturbance Computer Method, by D.J. Jones and R.G. Dickinson (summer student), January 1980.

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LTR-HA-47 Boundary Layer Development on Perforated Walls in Transonic Wind Tunnels, by Y.Y. Chan, February 1980.

LTR-HA-51 Evaluation of Three-Dimensional Wall Interference Corrections from Boundary Pressure Measurements, by M. Mokry, October 1980.

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LTR-HA-53 On the Representation of Axisymmetric Bodies by Sources along the Axis, by D.J. Jones, February 1981.

LTR-HA-54 A Computer Program for Prediction of Aerodynamic Characteristics for Slender Bodies at Angles of Attack, by Y.Y. Chan, September 1981.

LTR-HA-55 A Review of CANADAIR's Analytical Method for the Prediction of Flutter Characteristics of CF-5 Aircraft, by B.H.K. Lee, April 1981.

LTR-HA-56 Analysis of Flutter Flight Test Data for LAU-5003/A Configurations on the CF-5 Aircraft, by B.H.K. Lee, September 1981.

LTR-HA-57 Computation of Transonic Flow Field about Slender Aircraft, by Y.Y. Chan, M. Provencher (summer student), October 1981.

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LTR-LA-211 The Effect of a Passing Vehicle and an Ambient Crosswind on a Triangular Roadside Warning Device, by C.D. Williams, February 1979.

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LTR-LA-213 A Wind Tunnel Investigation of Smoke Stack Performance for the Polar VII Icebreaker, by C.D. Williams and R.L. Wardlaw, February 1977.

LTR-LA-214 Wind Tunnel Measurements of the Aerodynamic Forces and Surface Pressures on a Submerged Drilling Pipe Fairing, by M.G. Savage, A.J. Bowen and K.R. Cooper, July 1977.

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LTR-LA-222 Correction of Distortion in Fluctuating Pressure Measurements, by H.P.A.H. Irwin, K.R. Cooper, February 1980.

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LTR-LA-225 Wind Tunnel Tests on the La Prade Heavy Water Plant Flare Tower, by K.R. Cooper, July 1978.

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LTR-LA-228 A Wind Tunnel Investigation of the Montreal Olympic Stadium Roof, by H.P.A.H. Irwin, R.L. Wardlaw, K.N. Wood, K.W. Bateman, May 1979.

LTR-LA-229 A Wind Tunnel Investigation of Wind Velocity in Air Terminal Doorways, by M.G. Savage, D. Muir, H.P.A.H. Irwin, R.L. Wardlaw, January 1979.

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LTR-ST-971 SFSYNTHS: Computer Programs for Creating Mean Surface and Deviation Maps for Groups of Headlamp Intensity Maps, by A. Harrison, February 1978.

LTR-ST-972 The Ratio Map: A Technique for Headlamp Comparison, by A. Harrison, February 1978.

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LTR-ST-982 Electron Microprobe Examination of MAR-M200 Superalloy — Tungsten Wire Composite, by A.Y. Kandeil and R.T. Holt, March 1978.

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LTR-ST-1115 Vehicle Installation and Photometrically-Determined Aim for Certain Headlamps. Part (3) — Headlamps Mounted in Cart 5, by A. Harrison, October 1979.

LTR-ST-1116 Vehicle Installation and Photometrically-Determined Aim for Certain Headlamps. Part (4) — Headlamps Mounted in the Test Cars, by A. Harrison, October 1979.

LTR-ST-1117 Vehicle Installation and Photometrically-Determined Aim for Certain Headlamps. Part (5) — Replacement Headlamps of Meteor 2 (1974) and Revised Aim for Headlamps of Cart 5/ S.A.E. (1975), by A. Harrison, October 1979.

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LTR-LT-111 Field Trial of Prototype "Cyclone Switch Heater" on CP Rail Switch at Sturgeon Falls, Ontario, by D.B. Coveney, December 1979.

LTR-LT-112 Traction Motor Suspension Bearing Leakage Tests — Phase IV. Migration of Water Vapour into Bearing Reservoirs, by J.F. Lane and D.E. Morris, January 1980.

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LTR-LT-119 Saline Ice for Direct Contact Cooling of Fish, by D.B. Coveney, January 1981.

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LTR-LT-124 Traction Motor Snow Ingestion Problems — Exhaust Temperature of Traction Motor Cooling Air, by J.R. Stallabrass and P.F. Hearty, May 1981.

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LTR-WE-1 NCEDIT, by K.G. Whale, January 1977.

LTR-WE-2 Lab Assessment of Glass Filled PTFE as Bearing Pad Material for Diversion Gates (BC Hydro), by H. Hawthorne, February 1977.

LTR-WE-3 Marine Hydraulic Steering Gear Component Testing (Teleflex), by H. Hawthorne, February 1977.

LTR-WE-4 Instrument Package for Automatic Detection of Avalanche Impact Pressures Rogers Pass, B.C., by W.E. Gervais, August 1977.

LTR-WE-5 An RS-232/C Serial Interface for Use with the Interdata Model 4 Minicomputer, by K.G. Whale, November 1977.

LTR-WE-6 Brittle Coating and Strain Gauging Test on "Rotary Vane R 2.5" (Wagner), by J. Kalousek, February 1978.

LTR-WE-7 An Experimental Study of the Leakage Paths in a Rotary Vane Marine Steering Gear (Wagner), by C. Dayson, R. Lau, February 1978.

LTR-WE-9 NC Machining of Graphite Molds, by D. Dark, March 1978.

LTR-WE-10 The Lubricity of Methanol (interim), by H. Hawthorne, July 1978.

LTR-WE-11 Instrument Package for the Automatic Detection and Recording of Impact Pressures and Seismic Signals of Snow Avalanches, 77-78 Season, by W.E. Gervais, July 1978.

LTR-WE-12 Interdata 4/Kennedy System 8000 — Magnetic Tape Controller, by D. Russo, K. Whale, August 1978.

LTR-WE-13 Friction & Wear Behaviour of some High Temperature Bearing Alloys at 760°C (1400°F) (Westinghouse), by H. Hawthorne, J. Lowe, September 1978.

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LTR-WE-16 A Densitometer for Reading Optical Densities of Ferrograph Slides, by P.A.B. Robinson, June 1979.

LTR-WE-17 Comparative Galling Resistance of Various Metal Couples, (BC Hydro), by H. Hawthorne, R. Lau, September 1979.

LTR-WE-18 Upload/Download Utilities for the Apple II (Users Manual), by R.D. Lambert and K.G. Whale, September 1980.

LTR-WE-19 Effectiveness of Locomotive Traction Motor Bearing Wick Lubricators at -35°C Ambient Temperature, by C. Dayson, R. Lau, September 1980.

LTR-WE-20 Laboratory Measurements of the Friction and Wear of Thordon SXL Material Sliding Against 304 Stainless Steel, (B.C. Hydro & Power Auth.) by H. Hawthorne, B. Bennett, October 1980.

LTR-WE-21 Wear in Fuel Pumps Pumping Methanol and its Reduction by Vegetable Oil Additives, by H. Hawthorne, J. Lowe, May 1981.

LTR-WE-22 A Proposed Specification for a Micro Computer Assisted N/C Programming System with Interface Graphics, by K.G. Whale, May 1981.

LTR-WE-25 A Tricycle Aid for Harvesting Strawberries, by C. Dayson, December 1981.

LTR-WE-26 Comparison of Spent Automotive Engine Oil by Ferrography, by J. Lowe, H. Hawthorne, December 1981.

LTR-WE-27 Lubrication Tests on a Close-fitting Wick for Locomotive Traction Motor Bearings, by C. Dayson, December 1981.

LTR-WE-30 Friction Between Steel and Various Dry and Greased Bearing Materials, by H.M. Hawthorne, J. Lowe, March 1980.

PART V — NEWSLETTERS

Division of Mechanical Engineering

TRANSPORTATION

Volume 1

No. 1	—	Oct. 1969	Vertical Take-off and Landing Aircraft (VTOL) for Commercial Air Transportation in the Period 1975 and Beyond. A.S. Jackson.

Volume 2

No. 1	—	Apr. 1970	Rail Engineering Research Facilities. C.A.M. Smith, Instrument Laboratory.
No. 2	—	Apr. 1970	Engine Laboratory Facilities. H.S. Fowler, Engine Laboratory.
No. 3	—	Apr. 1970	Fuels and Lubricants Research Facilities Assist Canadian Industry. R.B. Whyte, Fuels and Lubricants Laboratory.
No. 4	—	Apr. 1970	Vertical Take-off and Landing Aircraft (VTOL) (Out of Print). D.C. MacPhail, Director.

Volume 3

No. 1	—	Jan. 1971	Activities and Facilities of the Fuels and Lubricants Laboratory in the Field of Friction, Wear and Lubrication. C. Dayson, Fuels and Lubricants Laboratory.
No. 2	—	Jan. 1971	Diesel Engines. (No author indicated).
No. 3	—	Jan. 1971	Diesel Engine Oil and Filter Change Project. P.L. Strigner, Fuels and Lubricants Laboratory.
No. 4	—	Jan. 1971	Low Temperature Flow Properties of Distillate Fuels. P.L. Strigner, Fuels and Lubricants Laboratory.
No. 5	—	Jan. 1971	St. Lawrence River Development. Hydraulics Laboratory.

No. 6	—	Jan. 1971	*Ship Laboratory Marine Dynamics.* (No author indicated).
No. 7	—	Jan 1971	Engineering Environmental Simulation Facilities. T.R. Ringer, Low Temperature Laboratory.
No. 8	—	May 1971	Rail Developments in Canadian Railway Operations. (No author indicated).
No. 9	—	May 1971	Rail Track Switches. Low Temperature Laboratory.
No. 10	—	Sep. 1971	Manoeuvring Pond. M. Miles, Marine Dynamics and Ship Laboratory.
No. 11	—	Sept. 1971	The Ship Model Towing Tank. J.T. Tothill, Marine Dynamics and Ship Laboratory.

Volume 4

No. 1	—	Jan. 1972	Numerical Simulation. D. Prandle & N.L. Crookshank, Hydraulics Laboratory.
No. 2	—	Mar. 1972	Cavitation Water Tunnel Assists Shipping Industry. J.T. Tothill, Marine Dynamics and Ship Laboratory.
No. 3	—	Nov. 1972	A Transmission Line Wave Height Transducer. C.M.G. Zwarts, Instruments Laboratory.

Volume 5

No. 1	—	Jan. 1973	Vertical Take-off and Landing Aircraft (VTOL) — Proposals to Meet Future Aircraft Needs in Canada as a Supplement to STOL Development. (No author indicated).
No. 2	—	Jul. 1973	Fan Noise Research Activities and Facilities. G. Krishnappa, Engine Laboratory.
No. 3	—	Sept. 1973	Newsprint Protection in Boxcars. C.A.M. Smith, Instruments Laboratory.

Volume 6

No. 1	—	Jan. 1974	Air Cushion Vehicles — Heavy Transport for Weak Ground. H.S. Fowler, Engine Laboratory.
No. 2	—	Jan. 1974	Research on Water Waves due to Wind. J. Ploeg, Hydraulics Laboratory.
No. 3	—	Jan. 1974	Wave Forces on Marine Structures. G.R. Mogridge & W.W. Jamieson, Hydraulics Laboratory.

Addendum No. 1 Summary of discussions Apr. 1974		Vertical Take-off and Landing Aircraft (VTOL) — Proposals to Meet Future Aircraft Needs in Canada as a Supplement to STOL Development. Vol. 5, No. 1 — Jan. 1973. (No author indicated).
No. 4 —	May 1974	Transportation Research in the National Research Council of Canada. A.S. Jackson.
No. 5 —	Jun 1974	VTOL Research Activities: Fan-in-wing Experiments. U.W. Schaub, Engine Laboratory.
No. 6 —	Nov. 1974	Predicting the Behaviour of Ships in Rough Water. D.C. Murdey, Marine Dynamics and Ship Laboratory.
No. 7 —	Dec. 1974	A Pulse Jet Railway Track Switch Heater. J.F. Lane, Low Temperature Laboratory.
Volume 7		
No. 1 —	Feb. 1975	Skirt/Terrain Interaction Research for Air Cushion Transports — The "CASPAR" Programme. H.S. Fowler, Engine Laboratory.
No. 2 —	Jul. 1975	Miramichi Channel Study. D.H. Willis, Hydraulics Laboratory
No. 3 —	Sept. 1975	Railway Laboratory. S.H.G. Connock, C.A.M. Smith, F.B. Blader, Railway Laboratory.
Volume 8		
No. 1 —	Mar. 1976	Automotive Engines and Fuels. R.B. Whyte, Fuels and Lubricants Laboratory.
No. 2 —	Jul. 1976	Directional Anemometer for Near-Ground Aircraft Vortex Wake Detection. H.G. Tucker, Control Systems and Human Engineering Laboratory.
Volume 9		
No. 1 —	Jan. 1977	Canadian Activities in the Development of Heavy Air Cushion Vehicles. A.S. Jackson.
No. 2 —	Jan. 1977	Marine Dynamics and Ship Laboratory. (Public Information Branch Brochure).
No. 3 —	May 1977	Jet Engine Thrust Measurement. M.S. Chappell, Engine Laboratory.
No. 4 —	Jul. 1977	Ice, Icing and Ice Breaking. Low Temperature Laboratory Staff.

Volume 10

No. 1	—	Jun. 1978	Welland Canal Ship and Lock Model Studies. R.P. Browne, Marine Dynamics and Ship Laboratory.
No. 2	—	Oct. 1978	Analysis of Exhaust Gas Emissions. G. Moon, Fuels and Lubricants Laboratory.

Volume 11

No. 1	—	Mar. 1979	The Concentration of Falling Snow and its Relation to Visibility. J.R. Stallabrass, Low Temperature Laboratory.

Volume 12

No. 1	—	Aug. 1980	Facilities at NRCC for the Railway Vehicle Designer. C.A.M. Smith & E.H. Bowler, Railway Laboratory.
No. 2	—	Sept. 1980	NRC Propulsion Wind Tunnel. R.G. Williamson, Gas Dynamics Laboratory.
No. 3	—	Nov. 1980	CCGS Franklin Icebreaking Probes I&II into Lake Melville Labrador in Jan. & March 1980. M. Michailidis, Arctic Vessel and Marine Research Institute.

Volume 13

No. 1	—	Jul. 1981	Rail/Wheel Testing Facility. J. Kalousek, Western Laboratory.

MANUFACTURING DEVELOPMENTS

Volume 1

No. 1	—	Oct. 1969	Experimental Shops. (No author indicated).
No. 2	—	Oct. 1969	Electrochemical Machining. Experimental Shops.
No. 3	—	Oct. 1969	Modernizing Precision Machine Tools (Out of Print). (No author indicated).
No. 4	—	Oct. 1969	MAAG HSS 360 Gear Tooth Grinder Precise Measurements. Experimental Shops.

Volume 2

No. 1	—	Apr. 1970	Cutting with High Speed Water Jets. H.D. Harris, Gas Dynamics Laboratory.

Volume 3

No. 1	—	Jan. 1971	Power Saw Exhaust System. J.K.S. Wong, Fuels and Lubricants Laboratory.
No. 2	—	May 1971	Improvement of Machine Tool Techniques and Productivity. (No author indicated).
No. 3	—	Sept. 1971	Numerically Controlled Turret Machining Centre. E.S. Moore, Manufacturing Technology Centre.

Volume 4

No. 1	—	Mar. 1972	Centrifugal Compressor Research. H.S. Fowler, Engine Laboratory
No. 2	—	Jun. 1972	Putting Water Jets to Work. H.D. Harris & W.H. Brierley, Gas Dynamics Laboratory.
No. 3	—	Jun. 1972	Water Jet Cutting Technology. (Out of Print). H.D. Harris, Gas Dynamics Laboratory.
No. 4	—	Jun. 1972	Gas Bearings. E.H. Dudgeon & I.R.G. Lowe.

Volume 5

No. 1	—	Jul. 1973	Electron Beam Welding. E.S. Moore, Manufacturing Technology Centre.
No. 2	—	Sept. 1973	Electrochemical Machining. E.S. Moore, Manufacturing Technology Centre.

Volume 6

No. 1	—	Jun. 1974	Progress in Water Jet Cutting. H.D. Harris, Gas Dynamics Laboratory
No. 2	—	Jun. 1974	Removing Rock with a Rotating High Speed Water Jet. H.D. Harris & W.H. Brierley, Gas Dynamics Laboratory.
No. 3	—	Nov. 1974	Increased Productivity via Numerical Control. E.S. Moore, Manufacturing Technology Centre.

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No. 1	—	Sept. 1975	Used Oil Re-refining. P.L. Strigner, Fuels and Lubricants Laboratory.

Volume 8

No. 1	—	Apr. 1977	Summary of Proceedings at the Cost Effectiveness of Industrial Tribology Seminar June 1976. T. Maloney, Fuels and Lubricants Laboratory.

No. 2	—	Apr. 1977	Deburring and End Rounding of Internal and External Gear Teeth. E.S. Moore, Manufacturing Technology Centre.

Volume 9

No. 1	—	Mar. 1978	NC and the Small Shop. D. Dark, Western Laboratory (Vancouver).
No. 2	—	Apr. 1978	Stability of a Gaseous Fuel Mixture. J.K. S. Wong, Fuels and Lubricants Laboratory.
No. 3	—	Jul. 1978	Sheet Metal Forming Technique for Repairs, Prototypes and Small Batch Lots. E.S. Moore, Manufacturing Technology Centre.

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No. 1	—	Mar. 1980	Machinery Noise Source Identification. G. Krishnappa, Engine Laboratory.
No. 2	—	Mar. 1980	The Use of Heat Pipes to Control Temperature in Electronic Systems. B. Larkin, Gas Dynamics Laboratory.
No. 3	—	Apr. 1980	Industrial Combustor Development Facilities. K. Depooter, Gas Dynamics Laboratory.

Volume 11

No. 1	—	Jan. 1981	Hot Machining. E.S. Moore, Manufacturing and Technology Centre.
No. 2	—	Jun. 1981	High Pressure Liquid Jets and their Potential Applications. M.M. Vijay, W.H. Brierley, Gas Dynamics Laboratory.

COMPUTERS

Volume 1

No. 1	—	Jan. 1971	General Facilities in the Analysis Laboratory. R.E. Gagne, Analysis Laboratory.

Volume 2

No. 1	—	Mar. 1972	Computer-Aided Design of Boiler Controls. R.E. Gagne, Analysis Laboratory.
No. 2	—	Nov. 1972	Studies of Pattern Recognition. R. Kasvand, Control Systems Laboratory.

Volume 3

No. 1	—	Apr. 1973	Computer-Aided Design of Engines. R.E. Gagne, Analysis Laboratory.
No. 2	—	Sept. 1973	Computer-Aided Study of Ship Controls. R.E. Gagne, Analysis Laboratory.
No. 3	—	Sept. 1973	Study of Scheduling in a Copper Smelter. L.K. Nenonen, Control Systems Laboratory and P.W.U. Graefe, Analysis Laboratory.

Volume 4

No. 1	—	Jan. 1974	Computer-Aided Design of Steam Plants. J.R. Amyot, Analysis Laboratory.
No. 2	—	Jun. 1974	Computer-Aided Design of Gas Pipeline Compressor Stations. R.E. Gagne, Analysis Laboratory.
No. 3	—	Oct. 1974	Computer-Aided Study of an Urban Transit Vehicle. R.E. Gagne, Analysis Laboratory

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No. 1	—	Jul. 1975	Computer-Aided Study of Gas Turbines. B.D. MacIsaac, Analysis Laboratory.

Volume 6

No. 1	—	Jul. 1976	Computer-Aided Study of the Scheduling of a BOF Shop. (No author indicated).
No. 2	—	Jul. 1976	Computer-Aided Design of a Satellite Attitude Control System. (No author indicated).

Volume 7

No. 1	—	Jan. 1978	Computer-Aided Operations Study of an Intermediate Capacity Transit System. P.W.U. Graefe, Analysis Laboratory.
No. 2	—	Jan. 1978	A Printing Press Order Sequencing Aid. A.W. Chan, Analysis Laboratory.

Volume 8

No. 1	—	Nov. 1979	Computer-Aided Study of an Electric Steel Making Shop. L.K. Nenonen, Control Systems and Human Engineering Laboratory.

Volume 9

No. 1 — 1980 — Distributed Process Control — A New Opportunity for Canada?
R.W. Gellie, Control Systems and Human Engineering Laboratory.

Volume 10

No. 1 — Jan. 1981 — Computer-Aided Study of Truck Dispatching in an Open Pit Mine.
L.K. Nenonen, P.W.U. Graefe, A.W. Chan, Control Systems Laboratory, Analysis Laboratory.

No. 2 — 1981 — Computer Model of Heave in Hovercraft HEX 5.
R. Amyot, Analysis Laboratory.

ENGINEERING AND BIOLOGICAL CONTROL SYSTEMS

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No. 1 — May 1971 — Research Activities of the Control Systems Laboratory.
J.A. Tanner.

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No. 1 — Jan. 1972 — Control and Sensing with Fluidics.
W. Hayes, Control Systems Laboratory.

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No. 1 — Apr. 1973 — The NRC Stressalyser and Studies of Human Performance.
L.J. Buck, Control Systems Laboratory.

Volume 4

No. 1 — Jan. 1974 — Pneumatic Control Apparatus for Specialised Applications.
W.F. Hayes, Control Systems Laboratory.

CONTROL SYSTEMS AND HUMAN ENGINEERING
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Volume 5

No. 1 — Jun. 1975 — CAMAC — An International Standard for Process Control Systems.
R.W. Gellie, Control Systems Laboratory.

STANDARDS AND STANDARDIZATION IN THE ENGINEERING INDUSTRIES

Volume 1

No. 1	—	Jan. 1972	Fuel Cleanliness. L. Gardner, Fuels and Lubricants Laboratory.
No. 2	—	Jan. 1972	Wear in Shot Gun Barrels. C. Dayson & T. Maloney, Fuels and Lubricants Laboratory.
No. 3	—	Jan. 1972	Practical Lubrication. (Out of Print). J.L. Bordeleau, Fuels and Lubricants Laboratory.
No. 4	—	Mar. 1972	Aircraft Engine Anti-icing. (Out of Print — see revised edition dated October 1978). M.S. Chappell & W. Grabe, Engine Laboratory.
No. 5	—	Nov. 1972	Lubrication and Wear (tribology). C. Dayson, Fuels and Lubricants Laboratory.

Volume 2

No. 1	—	Apr. 1973	Carburetor Icing. L. Gardner, Fuels and Lubricants Laboratory.
No. 2	—	Apr. 1973	Acceleration Level Counter. E.H. Bowler & W.S. Blaney, Instruments Laboratory.
		Oct. 1978	Aircraft Engine Anti-icing — Revised edition of Vol. 1, No. 4, March 1972. M.S. Chappell, Energy Projects Office and W. Grabe, Engine Laboratory.

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Volume 1

No. 1	—	Apr. 1970	Engineering Developments for Medical and Surgical Use — Brain Cooling Equipment (Out of Print). T.R. Ringer, Low Temperature Laboratory.
No. 2	—	Apr. 1970	Engineering Developments for Medical and Surgical Use — Vascular Suturing Instruments. S.H.G. Connock, Instruments Laboratory.

Volume 2

No. 1	—	Nov. 1972	Equipment for the Preservation of Kidneys and other Organs. N.D. Durie, Low Temperature Laboratory.
No. 2	—	Nov. 1972	Mechanical Aids to Surgery, Surgical Tatooing Instrument. S.H.G. Connock, Instruments Laboratory.

Volume 3

No. 1 —	Jun. 1976	The NRC Hospital Air Bed Program. U.W. Schaub, Engine Laboratory.
No. 2 —	Jun. 1976	A Page Turner for the Physically Handicapped. C.A.M. Smith, Instruments Laboratory.

GENERAL

Volume 1

No. 1 —	Apr. 1973	Assisting a Small Manufacturer: A Co-operative Applied Research Project. R. Fielding, Industrial Engineer, Technical Information Service, L.K. Nenonen, Control Systems Laboratory, Division of Mechanical Engineering.
No. 2 —	Jul. 1973	Vancouver Laboratory. (No author indicated).

Volume 2

No. 1 —	Sept. 1975	Western Laboratory Activities. S.H.G. Connock, Vancouver Laboratory.
No. 2 —	Sept. 1975	(NOT TO BE PUBLISHED).
No. 3 —	Sept. 1975	The Engine Laboratory — Ten Years of Research. (No author indicated).

Volume 3

No. 1 —	Apr. 1977	Research and Development Services for Western Industry. C. Dayson, Western Laboratory (Vancouver).

Volume 4

No. 1 —	Aug. 1979	The Division of Mechanical Engineering — NRC Organization and Functions. (No author indicated).

Volume 5

No. 1 —	Oct. 1981	Revised Edition of Vol. 4, No. 1, Aug. 1979.

ENERGY

Volume 1

No. 1 —	Mar. 1975	Thermosiphon Heat Exchanger Applications. B.S. Larkin, Gas Dynamics Laboratory.

No. 2	—	Jun. 1975	An Energy-Conserving Railway Switch Protector. T.R. Ringer, Low Temperature Laboratory.
No. 3	—	Nov. 1975	High Temperature Gases — Progress Towards Nuclear Fusion Energy. P. Savic, Gas Dynamics Laboratory.

Volume 2

No. 1	—	May 1976	Sewer Gas as Automotive Fuel. J.K.S. Wong, Fuels and Lubricants Laboratory.
No. 2	—	Aug. 1976	Short Term Industry Related Energy Programs. A.J. Bachmeier, Gas Dynamics Laboratory.

Volume 3

No. 1	—	Jun. 1981	Gas Dynamics of Electrical and Optical Discharges in Gases. M.M. Kekez, Gas Dynamics Laboratory.
No. 2	—	Jun. 1981	Measurement of Droplet Sizes in Liquid Sprays. J. Lau, K. Depooter, Gas Dynamics Laboratory.

PART VI — MISCELLANEOUS PAPERS

National Aeronautical Establishment

PRESENTATION OF FLIGHT RECORDER INFORMATION FROM INCIDENTS AND ACCIDENTS, by B. Caiger. Paper presented at 34th International Air Safety Seminar, Acapulco, Mexico, 9-12 November 1981.

THE CHALLENGES OF DIGITAL FLIGHT DATA RECORDER READ-OUT AND ANALYSIS, by B. Caiger. Paper presented at ISASI Annual Seminar, Montreal, September 1979.

EXPERIMENTS ON VORTEX MOTION AND SPRAY DEPOSITION, by A.M. Drummond. Paper presented at Symposium on Long Distance Drift, U. of N.B., Fredericton, N.B., February 12-14, 1979. Published in Proceedings. (New Brunswick Task Force on Spray Dispersion).

FLIGHT EXPERIENCE WITH ADVANCED CONTROLS AND DISPLAYS DURING PILOTED CURVED DECELERATING APPROACHES IN A POWERED-LIFT STOL AIRCRAFT, by W.S. Hindson. Paper presented at AGARD Stability and Control Flight Mechanics Symposium, Ottawa, September 25-28, 1978. NASA Technical Memorandum 78527, September 1978.

EVALUATION OF IRF HANDLING QUALITIES OF HELICOPTERS USING THE NAE AIRBORNE V/STOL SIMULATOR, by S. Kereliuk (Co-Author M. Sinclair). Paper presented at Atlantic Aeronautical Conference (AIAA, RAeS/CASI/AAAF), held at Williamsburg, VA., March 26-28, 1979. AIAA Paper No. 79-0702.

AN AIRBORNE SIMULATION STUDY OF THE RECOVERY FROM AN ENGINE FAILURE DURING APPROACH IN A TWIN-ENGINE AUGMENTOR WING AIRCRAFT, by S. Kereliuk (Co-Authors M. Sinclair, D.E. Sattler, R. Fowler (DHC)). Paper presented at CASI Flight Test Symposium, Ottawa, March 25-26, 1980. NAE Misc. 55.

AN EVALUATION OF IFR HANDLING QUALITIES OF HELICOPTERS USING THE NAE AIRBORNE SIMULATOR, by S. Kereliuk (Co-author M. Sinclair). Presented at the CASI Flight Test Symposium, CFB Cold Lake, Medley, Alberta, 1 April 1981.

AEROMAGNETIC COMPENSATION AS A LINEAR REGRESSION PROBLEM, by B.W. Leach. Paper presented at Second Annual Workshop on Information Linkage between Applied Mathematics and Industry, Monterey, California, February 10-24, 1979. Published in Proceedings. (Also presented at Conference 'Optimization Days 1979', McGill Univ., Montreal, May 23-25, 1979).

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PRELIMINARY TESTS OF A CUMULUS CLOUD SEEDING TECHNIQUE, by J.I. MacPherson, (Co-authors — AES — G.A. Isaac, R.S. Schemenauer, C.L. Crozier, A.J. Chisholm, — NRC — N.R. Bobbitt, — CFS — L.G. MacHattie. Journal of Applied Meteorology, Vol. 16, No. 9, September 1977, pp. 949-958.

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HANDLING QUALITIES OF A SIMULATED STOL AIRCRAFT IN NATURAL AND COMPUTER-GENERATED TURBULENCE AND SHEAR, by S.R.M. Sinclair. (Co-author LTC T.C. West, FAA). Paper presented at AGARD FMP Specialists Meeting on Piloted Aircraft Environment Simulation Techniques. Brussels, Belgium, 24-27 April 1978. (NAE Misc. 54).

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A NEW DROPLET GENERATOR, by Slack, W.E. Paper presented at International Colloquium on Drops and Bubbles, Monterey, California, 19-21 November 1981.

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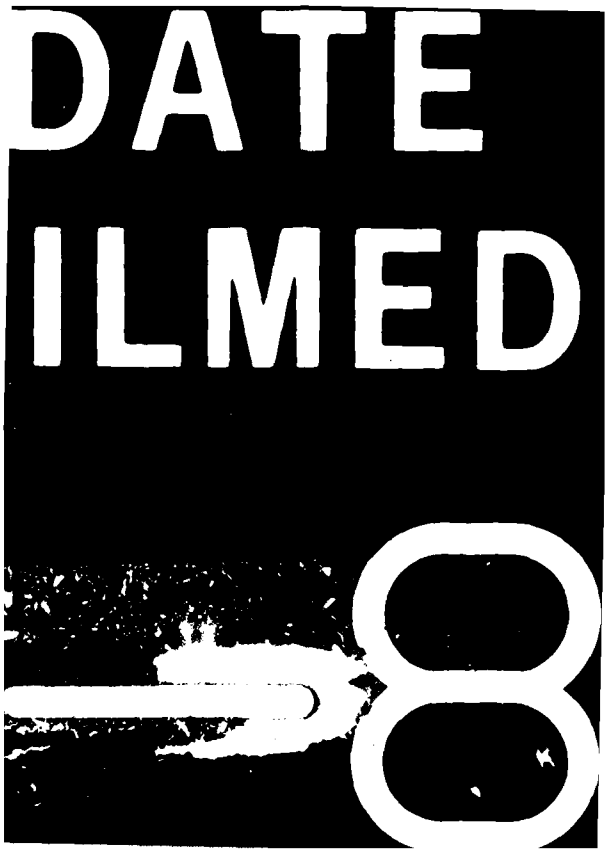
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