

QUESTIONNAIRES

In order to facilitate obtaining the technical information required, it is suggested that the leading German technicians listed below be requested to provide detailed written answers to the questions given in the attached questionnaires:-

1. Fuels,
2. Lubricants,
3. Special Products,
4. Industrial Lubricants,

which have already been submitted to Pier, Phil^p/ipovich and Kadmer.

It is suggested that at least the following be asked to supply detailed answers. Each should be warned that at a later date they will be requested to answer more specific questions based on their replies,

Dr. HUNSDORFER	Chief Chemist	DEURAG/NERAG at MISBURG
Dr. HANS BROCHHAUS	Director	do.
Dr. STEGEMAN	Director	RHENANIA - HARBURG
Dr. LEUTKEMEIER	Chemist	RHENANIA - Shell Haus HAMBURG
Prof. ZERBE	Head of Research	do. do.
BRAENDEL	Chief Chemist	RHENANIA - GRASBROOK
KINGEL	President	DEUTSCHE VACUUM <i>Hamburgstr. 9 Hamburg</i> OSLEBSHAUSEN
or Dr. GOETZ	Technical Director	
Dr. ZERLES	See Assessment Report 83 21 Army Group Area	
Dr. BRANDT	Chief Chemist	DVAG - SCHULAU
or Dr. H. WENZEL	do.	DVAG - OLDESLOE
or Dr. K. KEITEL	Chief Res. Chemist	DVAG - SCHULAU
Dr. OSCAR ALBER	Chief Chemist	JULIUS SCHINDLER (See Report 79)
or C.W. BUNDE	Director	do.
A. SPANGENBURG	Manager	DAPG, Hamburg <i>See item</i> (see Report 88)
or EMIL KROPP	Aviation Manager	
J. DODENHOF		ZB Hamburg (See Report 87)
Dr. MÜLLER	Chief Chemist	DEAG (See Report 89)

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HARMSSEN

Director

HARMSSEN - KIEL
(See Report 95)

PAUL SCHNEIDER

or ROSENKRANTZ

See Report 152

von MADEYSKI (of LUENA-I.G.)

at Hamburg with
DEUTSCHE GASOLIN

Three copies of each questionnaire are included in this folder and Mr. Faragher, the party leader, has 12 copies in addition.

To:

Date:

ROAD TESTS WITH MECHANICALLY DRIVEN VEHICLES.

A considerable mass of information has already been supplied by German Technicians regarding the utilisation and performance of fuels and lubricants prior to and during the recent war.

It is understood that you have carried out practical road tests of these materials and have employed various types of vehicles on German roads and autobahns for the purpose of such tests.

You are therefore required to provide as full answers as possible to the following questions and subsequently to hold yourself in readiness to explain any points arising from a consideration of your answers.

1. With which objects in view have road tests been made?
2. When and where were the tests carried out and under which climatic conditions (temperature, altitude, wind, humidity etc.)?
3. What types and makes of vehicles were used; were they standard production models or had they been modified in any way; and were they in new or used condition? Give details of any relevant chassis and engine particulars (weight, horse-power, compression ratio, air, oil or fuel filters used, etc.)
4. What adjustments were made to the engines prior to the tests?
5. What instruments were fitted and what measurements were taken? Have any special instruments been developed?
6. Under what service conditions and in which type of road were the tests carried out?
7. What technique was adopted, how many observers were there per vehicle and what were their duties?
8. What fuel types were used? Give inspection data if possible.

(OVER)

9. What lubricating oil types were used and give inspection data if possible?
10. What was the condition of the engines and lubricating oil after the tests?
11. What methods were used in the analysis of the results?
12. What conclusions were reached as a result of the tests?
13. What laboratory engine, chemical or physical tests were found best to predict the road performance of fuels or lubricants?
14. What detailed reports or publications are there available and where can they be obtained?

QUESTIONNAIRE NO. 1.FUELSAVIATION FUELSFuel Rating Methods.

- (1) How are aviation fuels rated in (a) small scale engines?
(b) full scale s.c. aero engines?
(b) Multicylinder main engines?
- (2) What relative importance is attached to rich mixture and weak mixture performance?
- (3) How is rich mixture performance measured?
- (4) How is weak mixture performance measured?
- (5) What work is in hand for the development of fuels having improved weak mixture characteristics?
- (6) To what extent is the C.F.R. Research, or similar method used, and why?
- (7) What degree of inter-correlation is obtained between small scale engines, single cylinder full scale aero engines, and multicylinder main engines?
- (8) What flight tests have been carried out to assess the antiknock requirements of fuels?
- (10) What reference fuels are used (a) under 100 octane number, or corresponding rating?
(b) over 100 octane number?

German Aviation Fuels

- (1) To what specifications are C-3, B-4, and A-3 fuels produced?
- (2) What is the reason for the high aromatic content of the German C-3 fuel, and for its excessive margin of rich mixture performance? For what planes is this type of fuel specified?
- (3) From what components are C-3 fuels blended at the blending points?
- (4) What trouble has been experienced with fuels containing small amounts of water?
- (5) What difficulties have been experienced with highly aromatic fuels? (Effect on synthetic rubber, etc.).
- (6) How important is gum stability considered? What gum inhibitors are used?
- (8) What trouble has been experienced with vapour lock due to excessive fuel volatility, and also to dissolved air? How were these troubles overcome?
- (9) To what extent are cracked fuels used for aviation purposes?
- (10) What work has been done on the development of safety type fuels?
- (11) What engine studies have been carried out on the effect of engine factors, such as valve overlap, etc., on fuel performance, particularly at weak mixtures?
- (12) What general methods are used for cold starting, and to what extent were special priming fuels used, and of what components did these consist?
- (13) To what extent was "run-out" fuel used in an effort to combat cold corrosion?

Anti-Knock Additives

- (1) What factors decided the amount of lead to be incorporated in aviation fuels?
- (2) What attempts have been made to increase the amount of TEL beyond the present amount?
- (3) What experience has been obtained on spark plug fouling, exhaust valve corrosion, etc.? What effect has TEL on overhaul periods? Has any connection been found between type of oil, and cylinder head deposits?
- (4) What difficulties have been experienced with lead deposition in storage and what inhibitors, if any were developed to cure this? Was any special test devised to evaluate lead stability?
- (5) What laboratory methods are used to determine lead content of a fuel?
- (6) What work has been carried out on alternative anti-knock agents?
- (7) What work has been done on the development of new lead evacuants, and in what percentage of theoretical are they used?
- (8) What experience has been obtained with water injection, or other supplementary booster fuel?
- (9) Has any trouble been experienced due to cold corrosion as a result of the use of leaded fuels, and what steps were taken to combat such effects?

Detonation Research

- (1) What work has been done, and is n hand on the rationalisation of factors controlling detonation, and on the fundamentals of combustion, e.g. Muhlner experiments?
- (2) What experimental work has been carried out on pure hydrocarbons?
- (3) What work has been done to investigate pre-ignition, and on the development of pre-ignition ratings of fuels?

Gas Turbine Fuels

- (1) What specifications are laid down for (a) Gas Turbine Fuels
(b) Flying bomb fuels
(c) Rocket fuels,
- (2) What special requirements are necessary for these fuels and how have these requirements been met?
- (3) What developments are under way in connection with fuels for these types of engine?

*Remington*MOTOR FUELS

- (1) What specifications were adhered to for military purposes, particularly in respect of knock rating, gum content and stability, vapour pressure, and what methods of test were applied. What changes in specification have occurred during the war, with dates of such changes?
- (2) Were any difficulties experienced when vehicles were operated on fuels with the higher lead concentration, such as the new tank fuel which was introduced towards the end of 1944 (2 1/2 - 2-3/4 mg. /I.G.)? Was there any reason for eliminating entirely added aromatics from some of these blends? Was any change made either in composition or proportion of lead evacuants added to the Ethyl mix?
- (3) What was the compositions of the various types of automotive gasolines, and on the main basic components? What happened to the Fischer-Tropsch gasoline, and what was the source of the large quantities of unsaturates normally included in the blended gasoline?
- (4) What effect did the cessation of Roumanian supplies have on the general position for motor spirit, and to what extent was Roumanian gasoline used in motor and aviation fuels?
- (5) Was the general idea to work to a given octane number in blending these fuels, using Benzol and/or TEL as the adjusting agents, reducing the latter when more Benzol was available?
- (6) To what extent has Methanol and Ethanol been used as a blending agent for internal civilian consumption, for use in non-military vehicles in occupied territories, and for military purposes? What factors have lead to the small use made of these blending agents for the latter purpose?
- (7) What quality of Aromatic blended component was used, i.e. was all the toluene extracted from the Benzol, and what happened to the higher aromatics?
- (8) What disposal arrangements were made for Estonian shale gasoline, and was any difficulty experienced in its use as a motor gasoline constituent? What test, if any, were made to establish its suitability as a flying bomb fuel, particularly from the point of view of corrosion?
- (9) To what extent have alternative fuels such as producer gas, acetylene, etc. been used for civilian and military purposes? What technique has been employed with these fuels.

- (10) What methods, if any, are used to determine road octane number, and how do the results correlate with test engine data?
- (11) What bench tests are carried out on fuels and lubricants performance, and what type of operation (e.g. full power continuous, or cyclic) is found to correlate best with actual operation?
- (12) How is wear in an engine measured?

Review Review Pollman

DIESEL FUELS (AUTOMOTIVE, AVIATION, & MARINE)

- (1) What is the status of research on aircraft diesel engines?
- (2) What specifications are laid down for aviation diesel fuels, and why?
- (3) What work is in hand on special fuels for aviation diesels?
- (4) From what components and how is K.I fuel made?
- (5) To what extent is the cetane number considered an adequate measure of ignition qualities? How are they measured? What is the cetane number requirements of average aviation, automotive, and marine diesel engines?
- (6) What work has been done on combustion and ignition accelerators, and to what extent are they used?
- (7) What work has been done on cold starting aids, and what is the normal cold starting procedure?
- (8) What filtering systems are used for diesel fuels?
- (9) How is low pour point obtained, especially in conjunction with high cetane number?
- (10) What general research has been carried out on combustion in diesel engines?
- (11) What types of diesel fuels are used in
 - (a) submarines
 - (b) motor ships of all types
 - (c) land vehicles.
- (12) What is the composition of the type of submarine fuel heavier than water?
- (13) What is the reason for use of very light diesel fuels, almost in the kerosine range, for some types of small motor vessels?
- (14) What importance is attached to boiling range, and has any relationship been worked out between specific gravity, aniline point and boiling range, with cetane number? What importance is attached to aniline point?
- (15) To what extent are diesel fuels from petroleum, brown coal, shale, and Fischer-Tropsch processes used?
- (16) What is the significance of the phenol content present in some diesel oils?

FUEL OILS

- (1) What types and to what specifications are used for {a} heavy industrial?
 {b} light industrial?
 {c} Marine?
- (2) What experimental work has been carried out on combustion of fuels under boilers?
- (3) What main types of fuel oil burners are used?
- (4) To what extent are fuels of non-petroleum origin used?
- (5) Are coal suspensions used to any extent?
- (6) Has any difficulty been experienced on the compatibility of the various fuel oils from different sources?
- (7) Has any trouble been experienced due to the entrainment of gases in fuel oils?

QUESTIONNAIRE NO. 2.LUBRICANTSA. Aviation - *Rising*

- (1) What general types of aviation oils are used, from what sources are they obtained, and why were these sources chosen?
- (2) What refining methods are used for aviation oils? To what extent are solvent refined oils incorporated in aviation oils?
- (3) To what extent are synthetic oils used in the blending of aviation oils, and what advantages, if any, result?
- (4) To what extent is Voltol used in aviation oils? What are the reasons why it is or is not extensively used? What effect has Voltol on V.I. or pole height?
- (5) Are the advantages of the incorporation of detergent type additives recognised, and have these additives been developed for use in aviation oils?
- (6) Are viscosity-temperature susceptibility improvers of the Oppanol-Gemisch polyisobutene type used in aviation oils?
- (7) Have additives of any other type been used in aviation oils, if so, what are they, and what results are obtained by their use?
- (8) What troubles have been experienced with (a) oil frothing (b) ring sticking (c) bearing corrosion. and what remedies have been found?
- (9) Have any particular combinations of bearing metals given trouble with any particular oils, and if so, how were the troubles overcome?
- (10) What engine tests are carried out on an oil before it is accepted for aviation use, and by what methods are the merits of a given oil assessed? If small scale engines are used for oil testing, how do they correlate with main engine performance.
- (11) Has any connection been found between condition of valves and spark plugs on leaded fuels, and type of oil?

A. Aviation (contd.)

- (12) What laboratory tests are considered most important, and has any laboratory procedure been evolved which ties in closely with actual behaviour in an engine?
- (13) How many hours running are normally carried out between overhauls?
- (14) To what extent are oil filters and/or centrifuges used on aircraft engines, and what types are used.
- (15) Has any trouble been experienced with sludge deposition in oilways, etc., and if so, what remedies have been applied?
- (16) Has any trouble been experienced with scuffing of reduction gears and what remedies have been applied?
- (17) What lubrication system and lubricant are used on the flying bomb, including ancillary equipment, gyros, etc.?
- (18) What type of aviation oils are used in jet propelled aircraft, I.G. turbines, rocket propelled missiles, etc., and what special properties are required? What temperature extremes are met in such devices? By what methods are low pour point oils obtained, if required? Is more than one lubricant necessary?
- (19) Are diluents employed with aviation oils, if so, to what extent, and why? What diluents are used?

B. Automotive. *Rumple*

- (1) To what specifications are lubricants for petrol engines and high speed diesel engines produced, and what relative importance is assigned to the various properties.
- (2) What are the chief sources of motor oils? What crudes are used, what refining methods, and to what extent are synthetic oils incorporated?
- (3) Are engine tests carried out before approval, and if so, what are they?
- (4) What laboratory oxidation tests, or sludge tests are used and how do they correlate with performance in an engine?
- (5) To what extent is Voltol used in motor oils? Is it more commonly used in motor oils than aviation oils, and if so why? What particular advantages in engine cleanliness, viscosity index, etc., have been found with Voltol?
- (6) Are detergents other than Voltol used in (a) petrol engines
(b) diesel engines
- (7) Is trouble experienced with ring-sticking in diesel engines, and if so what palliatives are used?
- (8) What type of filters are used in mechanically propelled vehicles? If chemical type filters are used, is any trouble experienced with them?
- (9) What mileage is normally recommended between sump drainings?
- (10) What inspections are carried out on used oils, and how do the various types of oil compare on used oil condition?
- (11) What additives are used as pour point depressors, V.I. improvers, anti-oxidants, antiwear additives, anti-corrosion additives, and film strength improvers?
- (12) To what extent are fatty oils used in motor lubricants? What kind of fatty oils are used, and what advantage have they?
- (13) Were any lubrication difficulties experienced with producer gas equipment (both wood and coal types), bottled gas, or acetylene driven vehicles?

(14)

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C. Marine

Follow-up spec.

- (1) What lubricating oils are specified for use with marine diesel equipment?
- (2) What oils are used in steam turbine driven vessels? Are additives of any kind incorporated (anti-corrosion etc.).
- (3) To what extent are compounded cylinder oils used, and what are the compounding agents employed?
- (4) To what specifications are stern-tube greases manufactured, and what compounding agents are employed?
- (5) For what uses are aqueous emulsions of oil, with the addition of montan wax employed?

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D. Transmission Lubricants*Benjamin*

- (1) What lubricants are recommended and specified for tank gear boxes, and car and truck gear boxes of normal and synchromesh types?
- (2) To what extent are Voltolised oils and compounded oils used for tank gear boxes? What compounding agents are employed?
- (3) To what extent are additives of the nitrogen type, chlorine type, etc., used in oils for gear boxes?
- (4) In what proportion are straight tooth, spiral bevel, Hypoid, and worm gears used in rear axles, and what oils are specified in each type?
- (5) What additives are used in extreme pressure oils?
- (6) To what extent are compounded oils (fatty oil compounded) used for rear axle lubrication?
- (7) What type of oil seals are used?
- (8) What temperature extremes are encountered in the different types of axle?

E. Hydraulic, Recoil and Buffer Oils

- (1) To what extent are pure mineral oils used for this purpose? What specifications apply with particular reference to V.I., pour point, etc.? From what crudes are they made and by what refining methods?
- (2) To what extent are non-mineral oils used for this purpose? How much castor oil is used for this purpose?
- (3) What solvents such as diacetone alcohol, methyl carbinol, etc. are used?
- (4) To what extent are water and glycerol used in hydraulic fluids?
- (5) What work has been done on non-inflammable hydraulic oils?
- (6) What oils seals are used, and has any trouble been experienced as a result of interaction between seals and fluids?
- (7) To what extent are compounded mineral oils used, and why?

F. Railroad Lubricants

- (1) What oils are used for steam cylinder lubrication (satd. and superheat) valves, axle boxes, etc., and what compounding agents are used, and why?
- (2) What type of crudes are preferred for this purpose? What asphaltene content is usual in such oils?
- (3) Are any special oils used in the lubrication of diesel locomotives, and what additives, if any, are employed?

G. Industrial Lubricants

*Revised
Rumpf*

- (1) What types of oil are used in steam turbine lubrication? Are any troubles experienced with corrosion, emulsification, and if so, how are they combatted? What additives are used, if any? What is the average life of a steam turbine oil?
- (2) What types of oils are used for transformers? What electrical tests, if any, are carried out? Are any additives employed?
- (3) To what extent are mineral, non-mineral, compounded oils, and aqueous emulsions used in quenching? What types are preferred for small and large objects?
- (4) What types of cutting oils are used? To what extent are sulphurised and compounded oils used? Are corrosion inhibitors added, and if so, what are they?
- (5) What types of slushing oils are used? What additives are employed to give anti-corrosion properties?
- (6) From what sources are textile oils refined? What research has been done on carcinogenicity?
- (7) What oils are used for clock and instrument lubrication, especially for aviation use. What compounding agents are used?
- (8) What is "Radiol" and for what uses is it employed?
- (9) What is the composition of compounded light machine oils?

H. Greases *- See also*

- lithium
- (1) To what extent are barium/and aluminium soap greases used?
 - (2) What fats are used for greases, and what substitutes have been employed?
 - (3) To what extent are waxes, especially montan wax used in grease manufacture?
 - (4) What types of greases are used for high temperature applications?
 - (5) For what reason and to what extent are greases used in shock absorbers for aeroplane landing gear?
 - (6) What material is employed for ship launching purposes?

General *- Bureau*

- (1) To what extent are aqueous emulsions used in industrial lubrication?
- (2) Has this type of lubricant ever been employed in engines of any type?
- (3) By what processes is Voltol made?

End of 1st Div. Oct 3.

QUESTIONNAIRE No. 3.

SPECIAL PRODUCTS.

BITUMENS

- (1) To what extent are bitumens of petroleum origin used in road construction, and to what extent are hot application, cut-back, and bituminous emulsion application used?
- (2) What advances, if any, have been made in bitumen emulsion manufacture, and what crude sources are preferred for this purpose?
- (3) Are emulsions of any other pitch residues used for any purpose?
- (4) What work has been done on soil stabilisation, and to what extent has this process been used for airfield runways, etc.? What types of emulsion have been found most suitable, and how are they made?
- (5) To what extent are bitumens and other residues used for:-

- (a) Paper impregnation?
- (b) Roofing?
- (c) Insulating?
- (d) Paint applications?

What fillers, if any are used?

EXTRACTS AND POLYMERS *20*

- (1) Are lubricating oil extracts produced by either acid treatment or solvent extraction being used as substitutes for:

- (a) Linseed oil in paints and putties?
- (b) Plasticisers in rubbers and P.V.C. compositions?

Are they being used for any other purposes? What are the user requirements?

- (2) To what use are the phenol extracts from solvent extraction or lubricating oils put?
- (3) How are olefine polymers such as those of ethylene, propylene and particularly of butenes and butadiene being utilised?
- (4) To what extent are polymers being used in the manufacture of lubricants?

WAXES *20*

- (1) To what uses are waxes produced from petroleum, brown coal oils, and Fischer Tropsch processes being applied, and what particular properties are demanded by the user?
- (2) What types of waxes (with specifications) are used in candle manufacture, paper impregnation, insulating, etc.
- (3) To what extent is slack wax from solvent dewaxing processed into a usable wax, and how is this done? What proportion is used as a cracking stock?
- (4) What results have been obtained with the use of montan wax, and synthetic substitutes in grease manufacture?
- (5) What work has been done on micro-crystalline waxes?

RUST PREVENTIVES

- (1) What rust preventives of the solvent type, suitable for spray application are used, and what is their composition, with particular reference to corrosion inhibitors?
- (2) What corrosion preventives of the petrolatum type for brush or swab application, of the transparent hard drying type, and of the permanent aluminium paint type are used? Are any special additives used? What solvents are employed?
- (3) Are "fly-away" corrosion preventive oils used, and what is their composition?
- (4) Have any special compounds been produced to combat cold corrosion in stored engines?
- (5) Are any corrosion preventive additives manufactured for addition to turbine oils, transformer oils, etc.?

CABLE OILS

- (1) To what extent are oil filled cables used; what oil specifications are laid down; what are the best sources for oils of this type?
- (2) Are any blending agents or additives employed (e.g. resins)?
- (3) To what extent are oil impregnated insulated types used? What oils are used, and what specifications have been laid down?
- (4) What methods of test are used to determine dielectric strength, and s.i.c. for such oils?

Specific inductive capacity

Rising
COOLANTS AND DE-ICING FLUIDS

- (1) What coolants are used in automotive engines, both for normal operation and low temperature, and in aviation engines? Are corrosion inhibitors added? Are soluble oil emulsions ever employed?
- (2) What fluids or compounds have been developed for de-icing of aircraft, and what additives are used? For what purposes are lithium and potassium soaps added to these compounds?

MISCELLANEOUS

- (1) Have detergents of the ester salts type been developed, and how are they made? *Sub*
- (2) What developments have been made in products used for pest control? *2nd*

QUESTIONNAIRE No.4.INDUSTRIAL LUBRICANTS.1. TURBINE OILS. *Bunker*

- (a) What type of oil has been used for this purpose, and from what raw materials?
- (b) What changes have been made in this type of product during the War and for what reason?
- (c) What inhibitors and/or additives have been used in these oils?
- (d) What troubles have been experienced in their use?
- (e) What length of service has been common without oil change, and what limits in deterioration are allowed before an oil change is considered necessary?
- (f) What specifications exist for these oils?

2. RAILWAY OILS. *Bunker*Steam Cylinder Oils.

- (a) What oils have been used for this purpose?
- (b) What changes have been made in quality during the war and for what reason?
- (c) What troubles were experienced in the use of these oils?
- (d) What specifications exist covering these types of oil?
- (e) What inhibitors and/or additives have been used in these products?

Axle Oils or Greases.

- (a) What products have been used for this purpose?
- (b) What specifications have been used covering these products?
- (c) What changes have been made in these products during the war and for what reason?
- (d) What troubles were experienced in the use of these oils and greases?
- (e) What additives have been used in these products?

Railway Diesel Oils.

- (a) What oils and fuels have been used for this purpose?
- (b) To what specifications were they manufactured?
- (c) What changes in quality have occurred during the war?
- (d) What troubles were experienced in their use?
- (e) Have additives been used in these products:—such as ignition promoters in the fuel and detergents in the oil?
- (f) What operating times were common between oil drainage periods? Were these influenced by the quality of the products?

3. CUTTING OILS. *Burster*

Neat Cutting Oils.

- What type of products (with formulae) have been used for this work showing the different types used for different machining operations on different types of metal, including non-ferrous?
- Were these made to specification and, if so, what?
- What changes have been made during the war either voluntarily or due to lack of the required raw materials?
- Were these materials satisfactory or could they have been improved?
- Were sulphur, phosphorus and chlorine additives used in these products as well as fatty oils?
- Have substitutes been employed for fatty oils?
- Were any troubles encountered in their use?

Soluble Oils.

- Show, with formulae, the changes made in these products during the war.
- Were they used to a greater extent than pre-war as a measure of economy?
- Did the shortage of petroleum sulphonates greatly affect the properties of these products?
- What troubles were experienced in their use?
- Were these products made to company or outside specifications: give details of these?
- What additives were used to impart outstanding qualities, such as E.P., anti-rust, anti-foaming, etc?
- Indicate what operations they were used on and for what metals.

4. DRAWING OILS. *Burster*

Metal Drawing.

- What materials were used for this purpose?
- To what specifications were they manufactured?
- What changes have been made during the war and why have they been made?
- Were any special materials developed for deep drawing?
- What troubles have been experienced?
- What additives have been used and for why?

Wire Drawing.

- What products were used for this purpose for the different types of wire?
- What were the specifications?
- What changes were made during the war?

Wire Drawing (Contd.)

- (d) What troubles were encountered in their use?
- (e) What additives were used in these products to impart special properties?

5. ROLLING OILS.

- (a) What products, with formulae, were used for metal rolling and for the different types of metal?
- (b) What specifications existed for this type of product?
- (c) What changes have been made in these products during the war and for what reason?
- (d) What troubles were encountered in their use?
- (e) What was used as a substitute for palm oil?
- (f) What additives were used to impart special properties?

6. QUENCHING OILS.

- (a) What were the types of product used and their mode of application?
- (b) To what specification were they made?
- (c) What changes in their composition have been during the war and for what reason?
- (d) Have these products always been satisfactory, and, if not, why not?
- (e) Have any additives been used in these products and for what purpose?
- (f) Were different products used according to the size of the part being quenched or was a different technique used?

7. CORE OILS.

- (a) What products were used for this purpose?
- (b) To what specification were they made?
- (c) What changes have been made in their composition and the reason?
- (d) Was any trouble encountered in the use of substitute materials?
- (e) Were any additives used to impart special properties?

8. RUST PREVENTATIVES.

- (a) What products have been used for this purpose, indicating the application for each type of material?
- (b) Which of these were peculiar to your company?
- (c) To what specification were they made?
- (d) What changes have been made during the war giving the reason?

RUST PREVENTATIVES (Contd.)

- (e) Did the use of substitute materials improve or degrade the properties?
- (f) What troubles have been experienced in their use?
- (g) What special materials were added to give increased effectiveness?

9. SLUSHING OILS. - *Bunker*

- (a) To what extent were they used and what was the type of product?
- (b) What changes have been made during the war and for what reason?
- (c) What specification governed the type of product used?
- (d) What troubles were encountered in their use?
- (e) What additions were made to impart special properties?

10. INK OILS. - *Leak*

- (a) What products were used for this application, and from what raw materials were they made?
- (b) What specifications existed governing this type of product?
- (c) What changes were made in their composition and for what reason?
- (d) What troubles were experienced in their use?
- (e) What additions were made to give special properties, such as easy flow, easy wetting of the pigment, etc?
- (f) To what extent were refining extracts such as those from solvent refining used and/or sludges from synthetic oil manufacture?

11. TEXTILE OILS. - *Leak*Wool and Cloth Oils.

- (a) What products were used for this purpose, giving their composition?
- (b) What specifications existed for this type of product?
- (c) What changes have been made during the war and for what reason?
- (d) How was the shortage of fatty oils overcome?
- (e) What troubles have been experienced in their use?
- (f) What additives have been employed to improve scouring, etc., or to impart special properties?

Textile Mill Lubricants.

- (a) What products have been used for these purposes?
- (b) To what specifications were they manufactured?
- (c) What changes have been made in their composition during the war and for what reason?
- (d) What troubles were encountered?
- (e) What additions were made to impart special properties?

12. LEATHER OILS. *Under*

- (a) What products have been used for this purpose?
- (b) To what specification were they manufactured?
- (c) What changes have been made in their composition during war and for what reason?
- (d) Did the use of substitute materials result in a decrease in quality in the finished leather?
- (e) To what extent were synthetic wetting agents used (indicate their type)?
- (f) What troubles were experienced in their use?
- (g) What additions were made to impart special properties?

13. CABLE OILS. *Beverly*

- (a) What type of oils were used for both the light and heavy types of cable oil?
- (b) To what specifications were they manufactured?
- (c) What changes in composition had to be made during the war?
- (d) What troubles were experienced?
- (e) Were any additions made to increase dielectric properties or to stop hydrogen formation?
- (f) Were any additions made to impart special properties?

14. MARINE OILS. *Beverly*

- (a) Turbine oils should have been covered under No. 1
- (b) What products were used for this purpose?
- (c) To what specifications were they produced?
- (d) Were Voltol products used in these oils?
- (e) What changes have been made in their composition during the war and for what reason?
- (f) What difficulties were experienced in their use?
- (g) Were any additions made to impart special properties?

15. REFRIGERATION OILS. *Beverly*

- (a) What products, and from what sources, were used for this application, either for SO_2 , CO_2 , NH_3 , Freon, etc?
- (b) To what specifications were they produced?
- (c) What changes in composition have been necessary during the war and for what reason?
- (d) What troubles have been experienced in their use?
- (e) What additions have been used to overcome sludging and/or corrosion?

16. INSULATING OILS. *Beverly*

- (a) What products, and from what sources, were used for this application?
- (b) To what specification were they produced?

INSULATING OILS (Contd.)

- (c) What changes in composition have been necessary during the war and for what reason?
- (d) What troubles have been experienced in their use?
- (e) What additives, e.g. anti-oxidants or metal passifiers have been used?
- (f) Have any non-petroleum products been used for this purpose?

17. SPECIALTIES. *all*

- (a) Have any oils been developed for high temperature lubrication? If so, describe them fully as outlined in the above question.
- (b) Describe the uses of Wire Rope Lubricants, their composition etc. Have refinery extracts found application in this field?
- (c) What oils have been used as Mold Lubricants? Describe their use, composition, etc., as outlined above.
- (d) What products have been used as Air Tool Lubricants? Describe their use, changes in composition as outlined in the above question.
- (e) What type of products have been used as General Machinery Oils and Black Oils? Describe their use, composition, etc. To what extent have oils been replaced by emulsions in the former case and to what extent have solvent extracts been used in the latter?

18. GREASES. *Greases*

- (a) What type of products have been used, with their compositions, for the following purposes?
 - (i) Ball and roller bearing greases, for high and low speed, high and low temperature and for heavily loaded applications.
 - (ii) General lubrication greases.
 - (iii) Block greases for steel mills, paper machinery, crushers, etc.
 - (iv) Greases or oils for open gears.
 - (v) Greases for Marine applications.
 - (vi) Any other types of greases.
 - (vii) Extreme pressure greases.
- (b) With each of the above give the relevant specification.
- (c) What changes have been made in composition during the war and for what reason?
- (d) What troubles have been experienced in their use?
- (e) What additions have been made for special purposes?

19. RESEARCH AND DEVELOPMENT. - *Tests*

For Items 1-18 inclusive indicate any research or development work which has been carried out, particularly of a more fundamental nature to elucidate properties, etc.

20. CONTROL TESTS. - *Tests*

For Items 1-18 inclusive give the Control Tests carried out to ensure uniformity of manufacture. Where these are of a special nature, give full details.