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Jap/NAK/45/1674

# PACMIRS
# AIR TRANSLATIONS

NUMBER 5

25 JUNE 1945





Jap/3027

ISSUED BY THE MILITARY INTELLIGENCE DIVISION, U.S. WAR DEPARTMENT,
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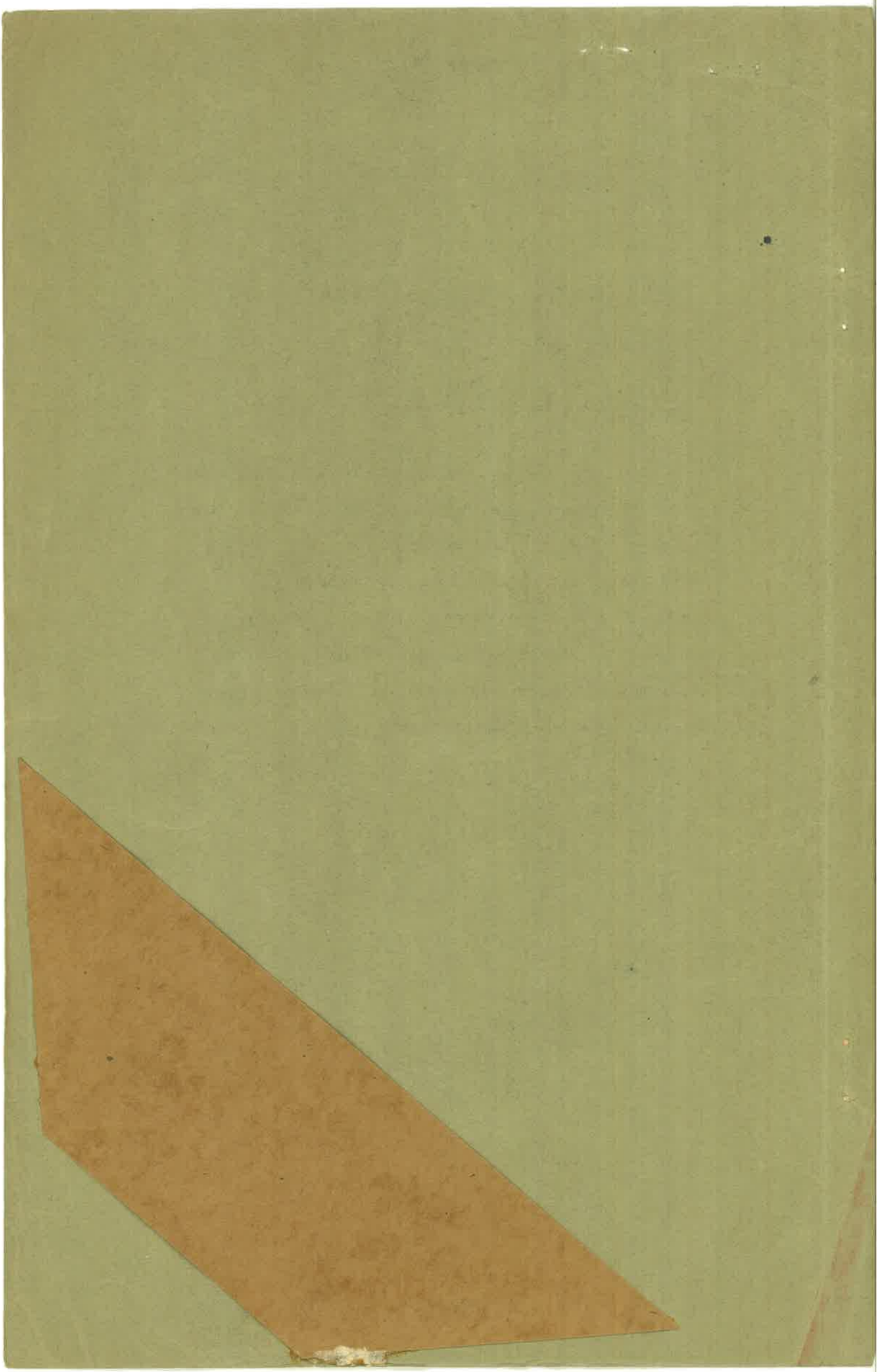

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Nakajima

TECHNICAL MANUAL ON B6N2 /JILL 12/
(PACMIRS Doc 1674)

A full translation of the technical manual, including reproduction of illustrative drawings, appears here, with the exception of the final subsection which was missing from the original document. The contents comprise: outline of design; dimensions, construction, equipment and materials of cowling and engine mount; power equipment; power equipment maintenance; maintenance of water-methanol injection system; the handling of water-methanol.

Pages 1 - 39.

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COMPLETE TRANSLATION

(TN: with exception of final subsection, which was missing from original document)

# TECHNICAL MANUAL ON B6N2 [ JILL 12 ]

[Author and authority unknown]

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## Section I. OUTLINE OF DESIGN

### A. Essentials of Design

General Statement:

This plane [JILL 12] is based on the specifications for JILL 11, with the following additional features:

1. A different engine. JILL 12 is equipped with the KASEI 25 engine (reduction gear ratio 0.625)

2. Change in over-all height. This change was held to a minimum by utilizing the B6-P propeller, which has a diameter of 3,400 meters.

3. An over-all fuselage length of 10.800 meters, to place the center of gravity toward the nose of the airplane as much as possible.

4. Provision for the greatest possible field of vision for landing on aircraft carriers.

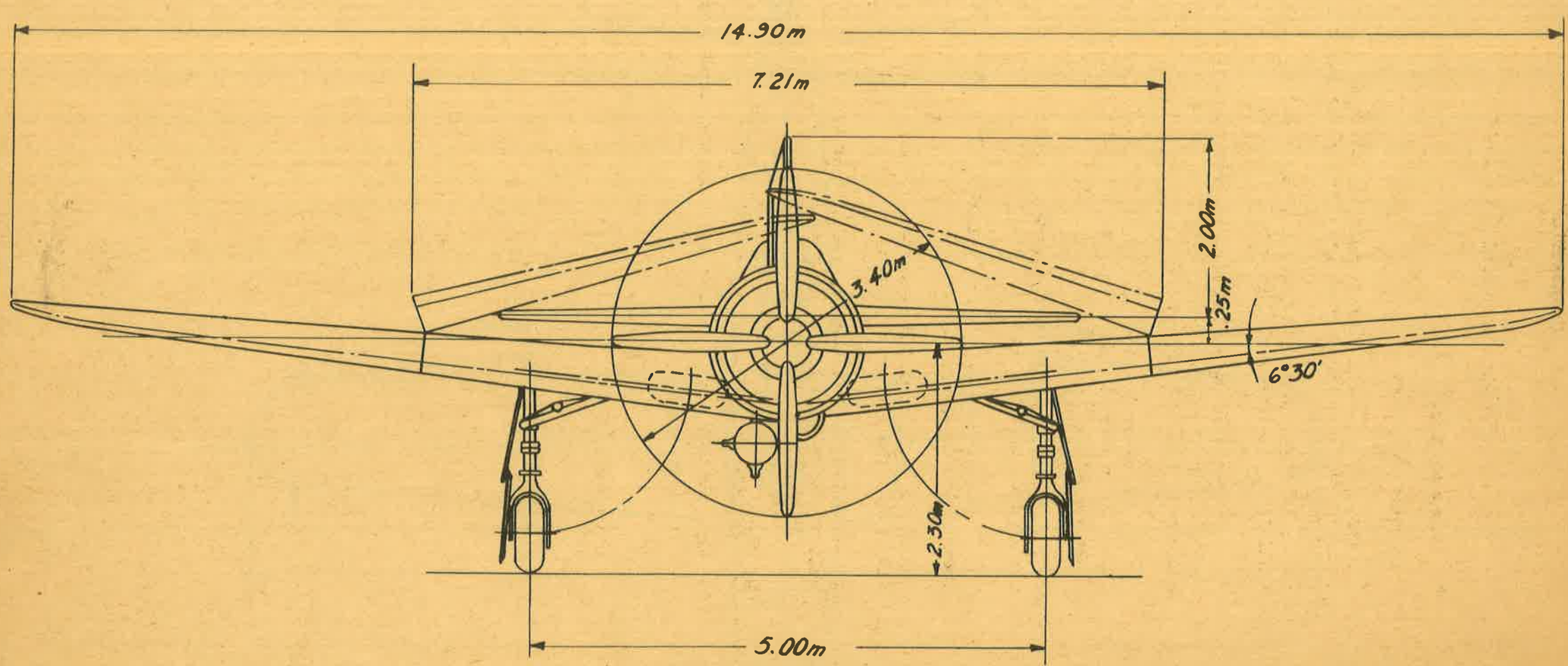
5. A water-methanol supply lasting 30 minutes at full speed. (Capacity: 95 liters)

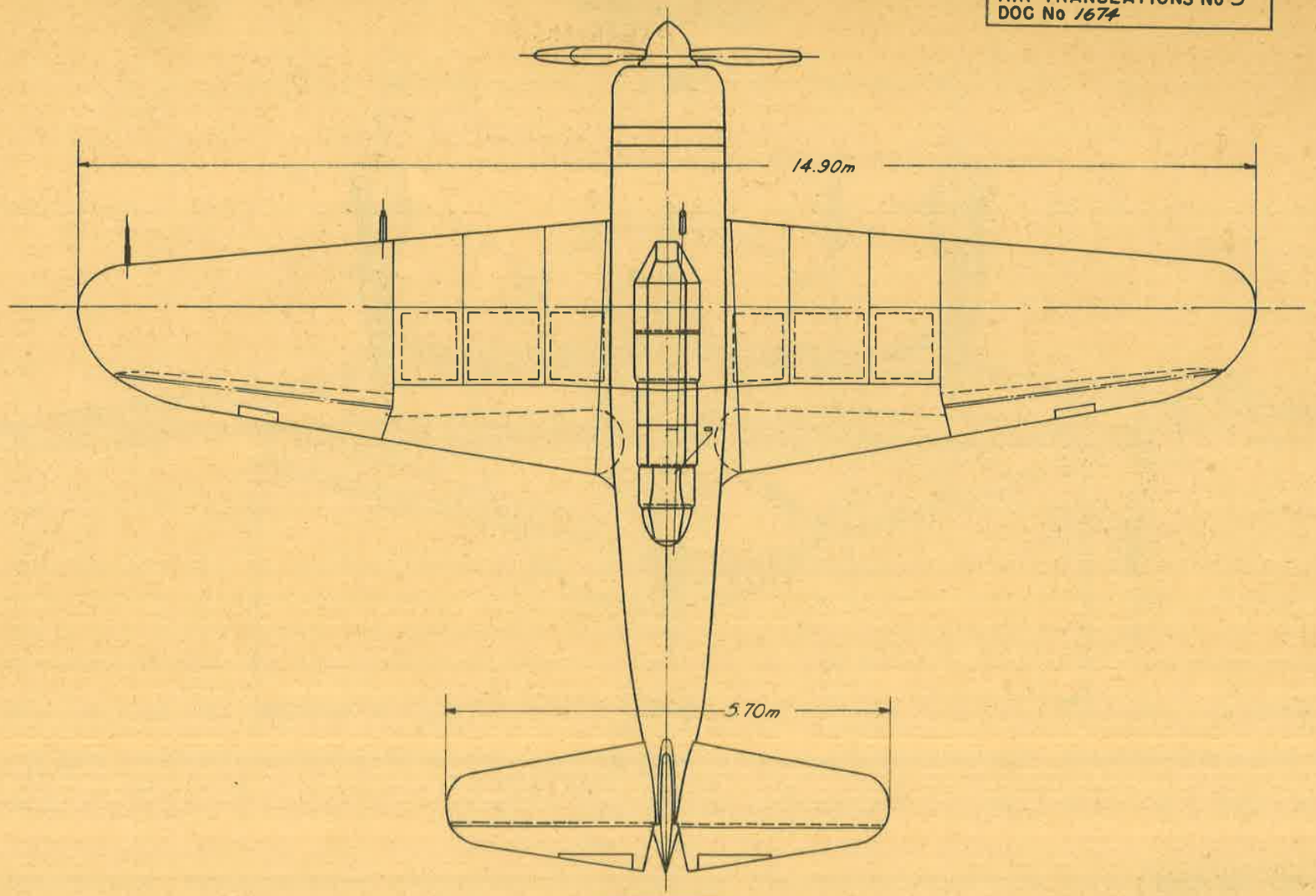
6. Use of Model 115 generator and Model 22 storage battery in the electric system.

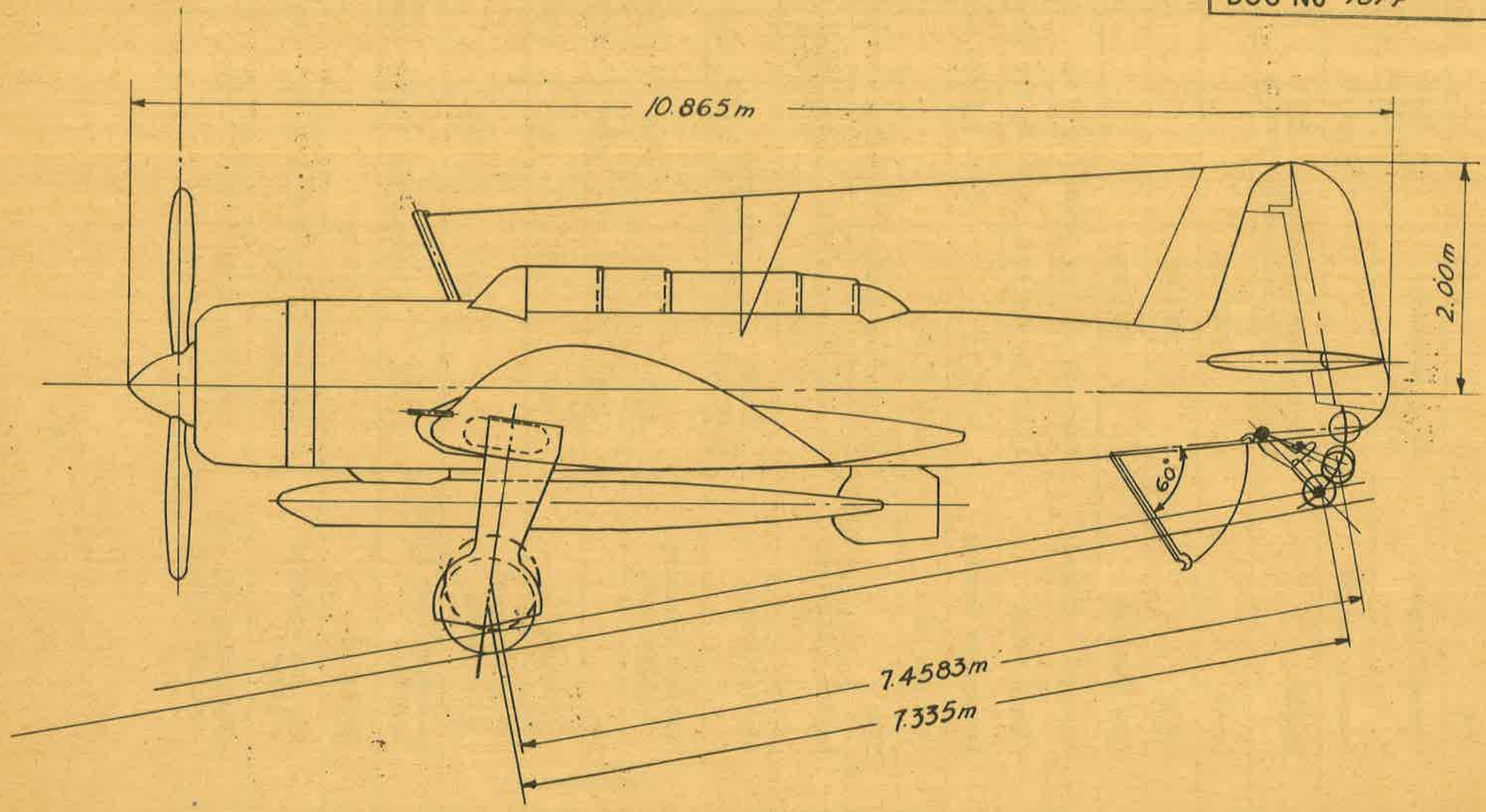
7. Changes in accessories and liner behind the fire wall to be made as little as possible.

### B. Principal Items

1. Frontal, top and side views of the airplane follow:







2. General Data

| | | | | | | |
|---|---|---|---|---|---|---|
| Name | | | Provisional name TENZAN 12 | | | |
| Type | | | Low wing monoplane, single engine & retractable landing gear | | | |
| Crew | | | 3 | | | |
| Dimensions | Over-all Span | | Fully extended: 14.894 m<br>Folded: 7.193 m | | | |
| | Over-all Length | | 10.808 m | | | |
| | Height | | Landing gear extended: 4.323 m<br>Landing gear retracted: 3.820 m | | | |
| Weight | Gross | | 5200 kg | | | |
| | Empty | | 3083 kg | | | |
| | Load Capacity | | 2117 kg | | | |
| | Approved Overload | | Take-off 650 kg; Landing 5200 kg | | | |
| Load | Wing Loading | | 139.78 kg per sq m (5200 kg per 37.202 sq m) | | | |
| | Horsepower Loading | | 3.095 kg (5200 kg/1680 hp) | | | |
| Engine | Name and No | | KASEI 25 x 1 | | | |
| | Type | | 14 cylinder double-row radial air-cooled | | | |
| | Critical Altitude | | Supercharger 1st speed 2100 m | | Supercharger 2d speed 5500 m | |
| | Performance | Classification | Normal (1st speed) | Military 1st speed | Military 2d speed | Take-off |
| | | Manifold Pressure (Millimeters) | +150 | +300 | +300 | +450 |
| | | RPM | 2300 | 2500 | 2500 | 2600 |
| | | Horsepower Ground | 1240 | 1570 | 1300 | 1850 |
| | | Horsepower At Critical Altitude | | 1680 | 1540 | |
| | Reduction Gear Ratio and Type | | 0.625 Planetary flat gear type | | | |
| | Dry Weight | | 760 kg | | | |
| | Fuel and Specific Gravity | | Aviation 87 gasoline x 0.735 water-methanol x 0.9 | | | |
| | Lubricating Oil and Specific Grevity | | Aviation mineral oil x 0.885 | | | |

2. General Data (Contd)

| | | |
|---|---|---|
| Propeller | Title Type | 4035 - 100A (Constant speed) |
| | Diameter | 3.400 m |
| | Pitch | High 43° Low 23° |
| | Weight | 234.30 kg |
| Fuel Capacity (Liters) | No 1 Tank | Left and right 260 l x 2 |
| | No 2 Tank | Left and right 310 l x 2 |
| | No 3 Tank | Left and right 200 l x 2 |
| | Water-Methanol Tank | 85 l |
| | Total | 1625 l |
| | Lubricating Oil Capacity | 70 l |
| Wing | Span | 14.894 m |
| | Chord | 3.500 m |
| | Area (Fuselage and Aileron) | 37.202 sq m |
| | Angle of Incidence | Left and right 2° 30' |
| | Dihedral Angle | Left and right 6° 30' |
| | Angle of Sweep-Back | 0 |
| Flaps | Length | 2.925 m |
| | Width | Inner joint 0.780 m<br>Outer edge 0.260 m |
| | Area | 1.627 sq m x 2 |
| | Flap Angle | Take-off 20° Landing 38° |
| Aileron | Length | 3.475 m |
| | Width | Inner joint 0.260 m<br>Outer edge 0.070 m |
| | Area (including Trim Tabs) | 1.500 sq m x 2 |
| | Balance Ratio | 27% |
| | Angular Range | 23° Up 20° Down |

2. General Data (Contd)

| | | | |
|---|---|---|---|
| Empennage | Horizontal Stabilizer | Length | 5.705 m |
| | | Area | 4.735 sq m |
| | | Setting Angle | +0° 30' |
| | Elevator | Length | 5.626 m |
| | | Width | 0.626 m |
| | | Area (including Trim Tab) | 1.112 sq m x 2 |
| | | Balance Ratio | 50% |
| | | Angular Range | 29° 50' Up 18° 0' Down |
| | Vertical Stabilizer | Height | 1.595 m |
| | | Width | 0.870 m |
| | | Area | 1.230 sq m |
| | | Angle of Incidence | Left 2° 10' |
| | Rudder | Height | 2.182 m |
| | | Width | 0.600 m |
| | | Area (including Trim Tab) | 1.108 sq m |
| | | Balance Ratio | 25% |
| | | Angular Range | Right 22° 40' Left 25° 0' |
| Fuselage | Length (Includes Engine Mount) | | 8.390 m |
| | Width (Maximum) | | 1.450 m |
| | Height (Maximum) | | 1.450 m |
| | Maximum Cross Section Area | | 1.650 sq m |
| Landing Gears | Main Wheel | Type | High-pressure brake wheel |
| | | Dimension | 800 mm x 280 mm |
| | | Tread | 5.007 m |
| | | Brake | OKAMOTO T hydraulic oil pressure |
| | Tail Wheel | Type | OKAMOTO T solid tire |
| | | Dimension | 200 x 75 mm |
| | 3-Point Landing Angle | | Approx: 10° 20' |

C. WEIGHT AND CENTER OF GRAVITY

1. Standard Load and Weight [in kg except where otherwise specified]

| | Classification / Number | Load | Normal | Overload | Reconnaissance |
|---|---|---|---|---|---|
| | Empty Weight | | 3083.0 | 3083.0 | 3083.0 |
| | Crew (including Parachutes) | 3 | 235.0 | 235.0 | 235.0 |
| Armament | T97 M3 Modification 2 7.7-mm Fixed MG | | 12.8 | 12.8 | 12.8 |
| | Ammunition Box for the above-mentioned MG | | 14.0 | 14.0 | 14.0 |
| | T92 Modification 1 7.7-mm Flexible MG (Top) | 1 | 8.0 | 8.0 | 8.0 |
| | Magazines and Ammunition Boxes for the above-mentioned MG | 6 | 24.72 | 24.72 | 24.72 |
| | T92 Modification 1 7.7-mm Flexible MG (Bottom) | 1 | 8.0 | 8.0 | 8.0 |
| | Magazines and Ammunition Boxes for the above-mentioned MG | 5 | 20.6 | 20.6 | 20.6 |
| | Sight for T92 Modification 1 7.7-mm Flexible MG (Reflector Type) | | 0.28 | 0.28 | 0.28 |
| | Fixed and Flexible MG Mounts | | Included in Empty Weight | Included in Empty Weight | Included in Empty Weight |
| | Subtotal | | 88.4 | 88.4 | 88.4 |
| Torpedo Equipment | T91 Modification 3 Torpedo | | 854.0 | 854.0 | |
| | Torpedo Sight | | 0.48 | 0.48 | |
| | T1 Torpedo Release | | 13.49 | 13.49 | |
| | Depth and Tilt Control Regulator | | 2.0 | 2.0 | |
| | Subtotal | | 869.97 | 869.97 | |

1. Standard Load and Weight (Contd)

| Classification | Number / Load | Normal | Overload | Reconnaissance |
|---|---|---|---|---|
| Radio Equipment | T96 Aero Mark 3 Radio Set | 1 | 53.58 | 53.58 | 53.58 |
| | T1 Aero Mark 3 Command Set | 1 | 27.8 | 27.8 | 27.8 |
| | TK Aero Mark 3 Homing Device and Ratio Direction-Finder | 1 | 28.35 | 28.35 | 28.35 |
| | T99 Frequency Meter | | 6.0 | 6.0 | 6.0 |
| | Rectifier and Antenna Switch | | 2.3 | 2.3 | 2.3 |
| | Radio Reserve Supply | | 5.0 | 5.0 | 5.0 |
| | Radio Support and Antenna Secondary Battery | | Included in Empty Weight | Included in Empty Weight | Included in Empty Weight |
| | Subtotal | | 123.03 | 123.03 | 123.03 |
| Aerial Navigation Equipment | T97 Mark 1 Drift Meter | 1 | 6.5 | 6.5 | 6.5 |
| | Target Course Marker Lights and Flares | | 12.75 | 12.75 | 12.75 |
| | Navigation Chart Panel | | 2.3 | 2.3 | 2.3 |
| | Target Course Indicator | | 0.45 | 0.45 | 0.45 |
| | Reconnaissance Equipment Bag | | 5.0 | 5.0 | 5.0 |
| | Subtotal | | 27.0 | 27.0 | 27.0 |
| Signal and Illumination Equipment | T90 M1 Flare | 6 | 6.6 | 6.6 | 6.6 |
| | M2 Modification 1 Flare | 1 | 4.6 | 4.6 | 4.6 |
| | Portable Electric Signal Lamp | | 0.9 | 0.9 | 0.9 |
| | Landing Light | | 2.0 | 2.0 | 2.0 |
| | Subtotal | | 14.1 | 14.1 | 14.1 |

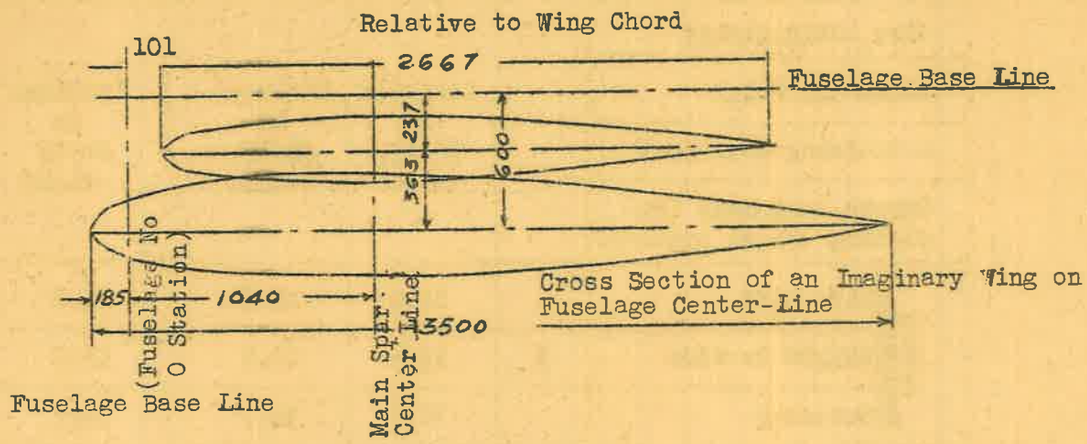
1. Standard Load and Weight (Contd)

| Classification \ Load | | | Normal | Overload | Reconnaissance |
|---|---|---|---|---|---|
| Fire Extinguisher | | | Included in Empty Weight | Included in Empty Weight | Included in Empty Weight |
| Automatic Pilot | | | | | |
| Anti-Icing Equipment | | | | | |
| Oxygen Equipment (excluding Oxygen Bottles) | | | | | |
| Safety Equipment | Life Raft | 1 | 11.2 | 11.2 | 11.2 |
| | Oxygen Bottles | 3 | 19.5 | 19.5 | 19.5 |
| | Subtotal | | 30.7 | 30.7 | 30.7 |
| Fuel | Methanol Tank | 85 l | 85 l<br>76.5 | 85 l<br>76.5 | 85 l<br>76.5 |
| | Wing Tanks: No 1 Tank | 260 l x 2 | 520.1<br>382.2 | 520.1<br>382.2 | 520.1<br>382.2 |
| | Wing Tanks: No 2 Tank | 310 l x 2 | 283 l<br>208.0 | 620 l<br>455.7 | 620 l<br>455.7 |
| | Wing Tanks: No 3 Tank | 200 l x 2 | | 276 l<br>202.86 | 400 l<br>294.0 |
| | Subtotal | | 666.7 | 1117.26 | 1208.4 |
| Lubricating Oil | | 70 l | 61.95 | 61.95 | 61.95 |
| Total Weight | | | 5199.85 | 5650.41 | 4871.58 |

2. Weight and Center of Gravity

| Classification \ Load | | Empty | Normal | Over-loaded | Reconnaissance |
|---|---|---|---|---|---|
| Weight Kg | Empty Weight | 3083.0 | 3083.0 | 3083.0 | 3083.0 |
| | Load Capacity | | 2116.85 | 2567.41 | 1788.58 |
| | Total Weight | 3083.0 | 5199.85 | 5650.41 | 4871.58 |
| Center of Gravity | Millimeters Aft of C station | 422 | 806 | 865 | 892 |
| | Millimeters Below Fuselage Base Line | 235 | | | |
| | Percentage relative to Equivalent Wing Chord | 12.03 | 26.43 | 28.65 | 29.66 |

3. Limitation on the Movement of Center of Gravity Relative to Equivalent Wing Chord




Center of gravity relative to wing chord should generally be within 25 to 32 percent. (Dimensions expressed in millimeters).

4. Calculation of Center of Gravity

| | | Weight (kilograms) | Distance (meters) (Aft of O Sta) | Moment of Force (kilograms meters) |
|---|---|---|---|---|
| Empty Weight | | 3083.0 | 0.422 | 1301.026 |
| Crew Gear (including Life-Saving Equipment and Oxygen Bottles) | | 265.7 | 2.202 | 584.972 |
| Fuel — Methanol Tank | 85 l | 76.5 | 0.341 | 26.100 |
| Fuel Wing — No 1 Tank | 520 l | 382.2 | 1.570 | 600.054 |
| Fuel Wing — No 2 Tank | 283 l | 208.0 | 1.550 | 322.408 |
| Lubricating Oil | 70 l | 61.95 | 0.392 | 24.284 |
| Complete Torpedo Attack Equipment | | 869.97 | 0.786 | 683.776 |
| Complete Fire Control Equipment | | 88.40 | 2.917 | 257.838 |
| Complete Radio Equipment | | 123.03 | 2.692 | 331.252 |
| Complete Navigation Equipment | | 27.0 | 1.875 | 50.623 |
| Complete Signal Equipment | | 14.1 | 4.025 | 56.750 |
| Total Weight | | 5199.85 | 0.806 | 4190.515 |

Relative to Equivalent Wing Chord:

$$\frac{0.806 - 0.101}{2.667} \times 100 = 26.43\%$$

D. Performance

| Item | | Performance |
|---|---|---|
| Maximum Speed | | Low blower full open 2500 m 255 knots<br>High blower full open 4900 m 260 knots |
| Climb | | Up to 3000 m 5 min 34 sec<br>Up to 5000 m 10 min 24 sec<br>Up to 7000 m 17 min 45 sec<br>Service ceiling 9040 m<br>40 min 40 sec |
| Take-Off Distance (Use Flap at 25° Angle) | Normal Torpedo Attack Weight of 5200 kg | Manifold pressure + 300 mm at military hp<br>No wind 5m/sec (wind) 12m/sec (wind)<br>259 m 191 m 117 m |
| | | Take-off manifold pressure + 400 mm<br>No wind 5m/sec (wind) 12m/sec (wind)<br>245 m 181 m 111 m |
| Landing Speed | Normal Torpedo Attack Weight | 71.5 knots |
| Flying Radius (Altitude 4000 m, RPM 1800) | Normal Torpedo Attack Weight<br>Fuel 803 l | 180 knots x 5.18 hrs = 934 nautical mi |
| | Torpedo Attack in Overloaded Condition<br>Fuel 1416 l | 180 knots x 9.14 hrs = 1644 nautical mi |
| | Reconnaissance<br>Fuel 1540 l | 180 knots x 11.0 hrs = 1980 nautical mi |

## Section II. DIMENSIONS, CONSTRUCTION, EQUIPMENT AND MATERIALS OF COWLING AND ENGINE MOUNT

### A. Position and Dimensions

1. The engine /KASEI 25/ is mounted in the same manner as the MAMORU engine/on JILL 11/, except for a difference in length, the KASEI 25 being 420 millimeters longer than the MAMORU. The engine center line is 15 millimeters lower than the fuselage center line.

2. Measured from the fire wall frontal surface to the propeller tip, the JILL 12 is 290 millimeters longer than an airplane installed with the MAMORU 11.

3. The engine cowling forms the frontal section of the fuselage. The maximum outside diameter at the cowling flaps is 1.420 meters, and at the fire wall it is 1.450 meters.

4. Engine, engine mount, exhaust pipes, oil tank, oil cooler and water-methanol tank are installed within the engine cowling.

### B. Engine Mount

In shape, diameter of pipes, etc., the engine mount of JILL 12 is the same as that of JILL 11. In JILL 12 the dimension from fire wall to engine has been lengthened 420 millimeters.

### C. Engine Cover

The component parts of the engine cover are the front ring cowl, engine cowl, and cowl flaps. Its shape is the same as the engine cover installed on the No 8 plane of JILL 11.

### D. Fire Wall

The fire wall is the same as that of JILL 11, but the accessory drive housing is no longer in use. (TN: AMORU Accessory Drive) For the installation of the engine controls, the fire wall has been strengthened as in JILL 11.

### E. Materials for Engine Mount and Cowling

Materials used for the engine mount and cowling are the same as those used in JILL 11. They are listed in the following chart.

| Name of Part | Materials | Remarks |
|---|---|---|
| Engine Mount | KUROMORI Steel Pipe (EA 202) | |
| Engine Cowl | SDCH Plate | |
| Cowl Flaps | SDCH Plate | |
| Engine Diaphragm | Rust-Proof Steel Plate | |
| Fire Wall | Rust-Proof Steel Plate | |
| Fire Wall Reinforcement | SDCH Plate | |

## Section III. POWER EQUIPMENT

### A. Engine and Propeller

1. The engine installed in this airplane is a KASEI 25. General engine data are given in tables on the next pages.

2. General Propeller Data

| | | |
|---|---|---|
| Type | | 4-Blade Constant Speed Propeller (B6N2 - P) |
| Blade Shape | | 4035 - 100A |
| Diameter | Meters | 3.400 |
| Pitch | High | 43° |
| (Normal Use) | Low | 23° |

## AIRCRAFT ENGINE DATA

| | | | |
|---|---|---|---|
| Type<br>Number of Cylinders | | Twin Row Radial<br>14 Cylimders | |
| Cooling Method | | Air cooled | |
| Cylinder | Bore; Stroke; Compression Ratio | 150mm; 170mm; 6.5 | |
| | Swept Volume | Per Cylinder - 3 l<br>Total 42.0 l | |
| Performance | Supercharger | 1st Speed | 2d Speed |
| | Military Horsepower at Critical Altitude | 1680 | 1540 |
| | Military Hp/L (Displ | 40.0 | 36.7 |
| | Kg/Military Hp | 0.446 | 0.487 |
| | Critical Altitude | 2100 | 5500 |
| | Military Hp at Sea Level | 1570 | 1300 |
| | Rpm @ Military hp | 2500 | 2500 |
| | Manifold Press @ Military hp | +300 | +300 |
| Take-Off | Horsepower | 1850 | |
| | Hp/L (Displ) | 44.1 | |
| | Kg/Hp | 0.411(Kg) | |
| | Rpm | 2600 | |
| | Manifold Pressure | +450 | |
| Normal hp | At Full Throttle Altitude | 1370 | 1260 |
| | At Sea Level | 1230 | 1000 |
| | Full Throttle Altitude | 3100 | 6200 |
| | Rpm | 2300 | 2300 |
| | Manifold Pressure | +150 | +150 |
| Fuel Consumption Rate — Standard | Military | G630 290g<br>M160 94g | G600 335g<br>M160 113g |
| | Take-off | G700 300g<br>M220 110g | |
| | Normal | G532 310g | G484 350g |
| Economic | 7/10 Military | 280g | 325g |
| | 6/10 Military | 250g | 290g |
| | 4/10 Military | 210g | 230g |
| Oil Consumption Rate | Military | 11.2 l/hr<br>6/hp | |
| | Normal | 6.9 l/hr<br>5/hp | |

| | | | | | |
|---|---|---|---|---|---|
| Limitation on Usage | Maximum Rpm | 2750 | | | |
| | Classification According to Use | Maximum Approved | 30 Minutes Approved | Continuous Approved | Opn Minimum Approved |
| | Cylinder Temperature (at Outlet) | 260° C | 230° C | 200° C | 100° C |
| | Oil Temperature (at Inlet) | 90° C | 85° C | 70° C | 40° C |
| | | Maximum | Standard Minimum | | |
| | Fuel Pressure | | 0.3-0.35 kg/sq cm | | |
| | Oil Pressure | | 6.0 kg/sq | | |
| | Supercharger Speed-shift Oil Pressure | | 15 kg/sq cm | | |

| | |
|---|---|
| Fuel Tube Used and Specific Gravity | Aviation 87G + Water-methanol (0.723 x 0.92) |
| Lubricating Oil to Be Used and Specific Gravity | Aviation Mineral Oil 120 x 0.89 |

## KASEI Engine M25

| | | | |
|---|---|---|---|
| Superchargers | Classification | 1st Speed | 2d Speed / 3d Speed |
| | Type | | |
| | Drive System | Centrifugal Gear Change-over | |
| | Impeller Diameter | 320 | 320 |
| | Gear Ratio | 7.00 | 9.12 |
| Propeller Shaft | Shaft Coupling | No 95 | |
| | (Pitch) Governor | Installation impossible | |
| | Reduction Ratio and Direction of Rotation | 0.625 Right | |
| | Type of Reduction Gear | Planetary flat gear type | |
| Major Dimensions | Height | 1.340 m | |
| | Over-all Width or Diameter | 1.340 m | |
| | Over-all Length | 1.705 m | |
| Weight | Dry Weight | 760 kg (- 15) | |
| | Oil Capacity and Coolant Capacity | 4 kg. --kg | |
| | Propeller Boss | 26.6 kg | |
| | Cylinder Baffle Plates | 11.5 g | |
| Position of the Center of Gravity | | 280 mm in front of engine attachment surface<br>0 mm above or below propeller shaft center | |
| Moment of Inertia | Rotation of Propeller Shaft I. | kg cm/sec | |
| | Lateral Moment | kg cm/sec | |
| | Vertical Moment | kg cm/sec | |

| | | | | |
|---|---|---|---|---|
| Cooling | Cylinder — Amount of Radiant Heat | kg cal/min | At C° | Rated Operation at Sea Level |
| | Volume of Air and Amount of Fluid in Circulation | sq m/min or l/min | At C° | |
| | Differential in Air Pressure | Column of water in mm | | |
| | Equivalent Jet | sq m | | |
| | Lubricating Oil — Amount of Radiant Heat | 9.00 kg cal/min | At C° | |
| | Amount of Oil in circulation | 45 l/min | | |

| | | | |
|---|---|---|---|
| Valve Timing | Opening & Closing — During Opn — Intake | Open - 20° Before TDC | Close - 77° After TDC |
| | Exhaust | Open - 76° Before TDC | Close - 21° After TDC |
| | Cold Condition — Intake | Open - | Close - |
| | Exhaust | Open - | Close - |
| | Valve Clearance — During Opn — Intake | 1.9 mm | |
| | Exhaust | 1.9 mm | |
| | Cold Condition — Intake | Front Row 0.4 mm<br>Rear Row 0.1 mm | |
| | Exhaust | Front Row 0.4 mm<br>Rear Row 0.1 mm | |
| Ignition Angle | Front | 20° before TDC | |
| | Rear | 20° before TDC | |

Firing Order: R 1 3 5 7 2 4 6 / F 2 4 6 1 3 5 7

Master Rod (Cylinder)

| | | |
|---|---|---|
| Experiment | Date | |
| | Location | Navy Air Technical Arsenal Engine Section |
| Magneto | Type, Weight and Number of Magnetos | Air Arsenal 14 CF 2L - 1 Magneto (MKS2 14AF2L domestic type) |
| | Ratio and Direction | 7/8 Left |
| Type, Weight and Number of Spark Plugs | | AICHI-A1A 28 Spark Plugs |
| Carburetor or Injection Pump | Type and Number | DS4 - 85D1 1 |
| | Throat Tube Diameter x Number | 72 mm x 4 |
| | Main Nozzle | Diameter 3.8 x 4 or scale 3.4 x 2 4.5 x 2 — Period of 520 l, Flow 204 l 304 l |
| | Idling Nozzle | Diameter or scale 1.5 mm x 4 — Period of Flow 64 l |
| | Economizer Operation Period | Manifold pressure 50 mm |
| Fuel Pump | Type, Weight and Number | M26G; 1.8 kg l fuel pump |
| | Rotation Ratio and Direction | 1.31; Right |
| Oil Pump | Type and Number | Gear type; 1 |
| | Oil Pump | Main Lubrication — 1/min — 1/min — 1/min |
| | Output (Rated) | 58 l/min — 1/min — 1/min — 1/min |
| | Oil Scavenger Pump | Main oil drainage |
| | Output (Rated) | 80 l/min<br>58 l/min — 1/min — 1/min — 1/min |
| Water Pump | Type and Number | Installation possible; 1 |
| | Rotation Ratio and Direction | 1.31; Right |
| | Output (Rated) | 15 l/min |

| | | |
|---|---|---|
| • Starter | Type, Weight and Number | M1 Electric Inertia Starter;<br>1 Electrically operated 18.5 kg<br>Hand operated 10.2 kg |
| | Rotation Ratio and Direction | 1; left |
| • MG Drive | Type, Weight and Number | Installation impossible |
| | Rotation Ratio and Direction | |
| • Propeller Governor (Speed) | Type, Weight and Number | |
| | Rotation Ratio and Direction | |
| • Generator | Type, Weight and Number | M15; 1 generator |
| | Ratio, Direction, FU and SU (TN: Symbols For Flange and Spline Nos. Resp.) | 2.438; left |
| • Vacuum Pump | Type, Weight and Number | M2; 2.33; 1 |
| | Ratio, Direction FU, SU | 1.31; right |
| • High Pressure Oil Pump | Type, Weight and Number | M12; 2 |
| | Ratio, Direction FU, SU | 1.31; right |
| • | Type, Weight and Number | |
| | Ratio, Direction FU, SU | |
| • | Type, Weight and Number | |

Remarks

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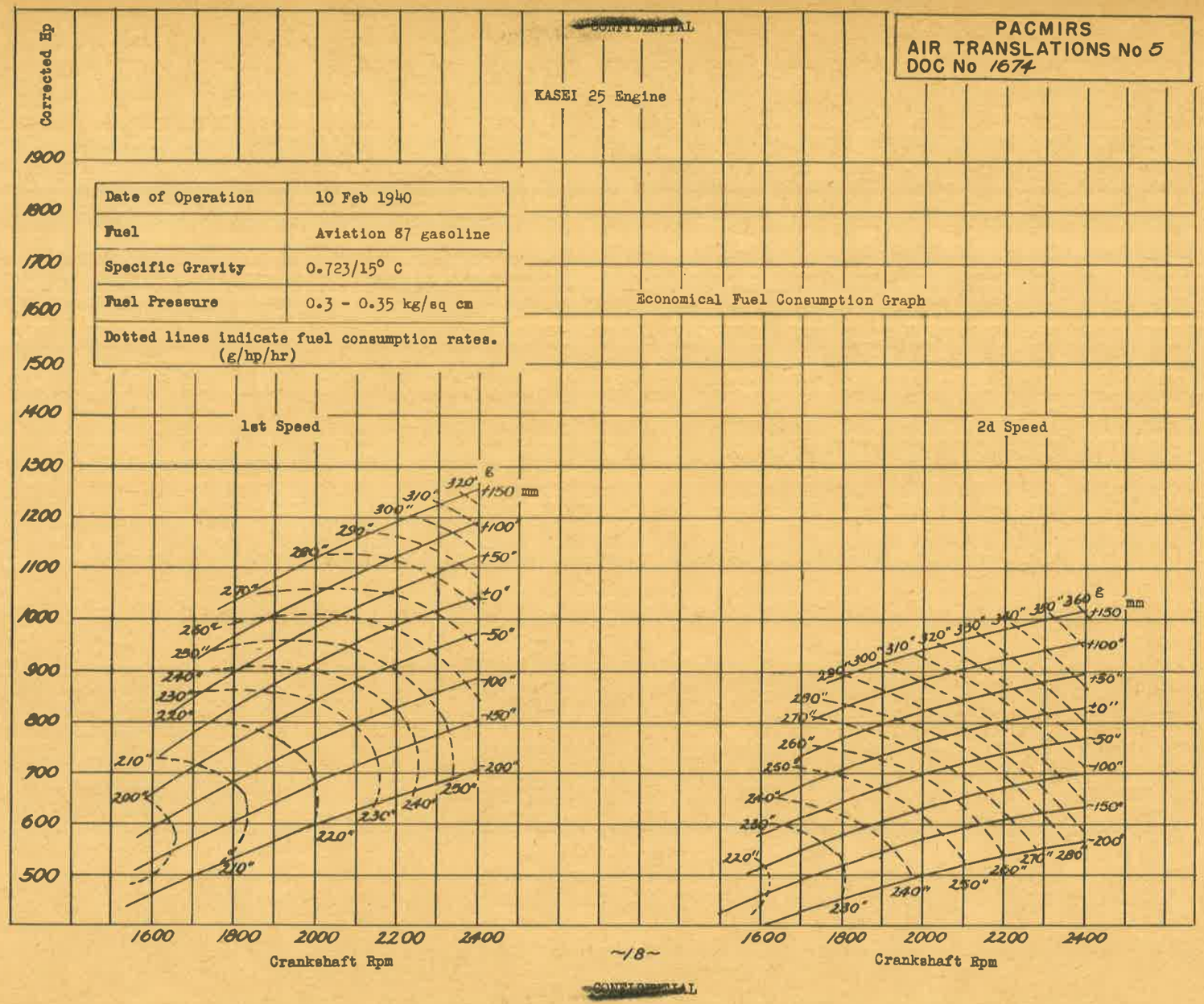
KASEI 25 Engine

Economical Fuel Consumption Graph

| | |
|---|---|
| Date of Operation | 10 Feb 1940 |
| Fuel | Aviation 87 gasoline |
| Specific Gravity | 0.723/15° C |
| Fuel Pressure | 0.3 - 0.35 kg/sq cm |
| Dotted lines indicate fuel consumption rates. (g/hp/hr) | |



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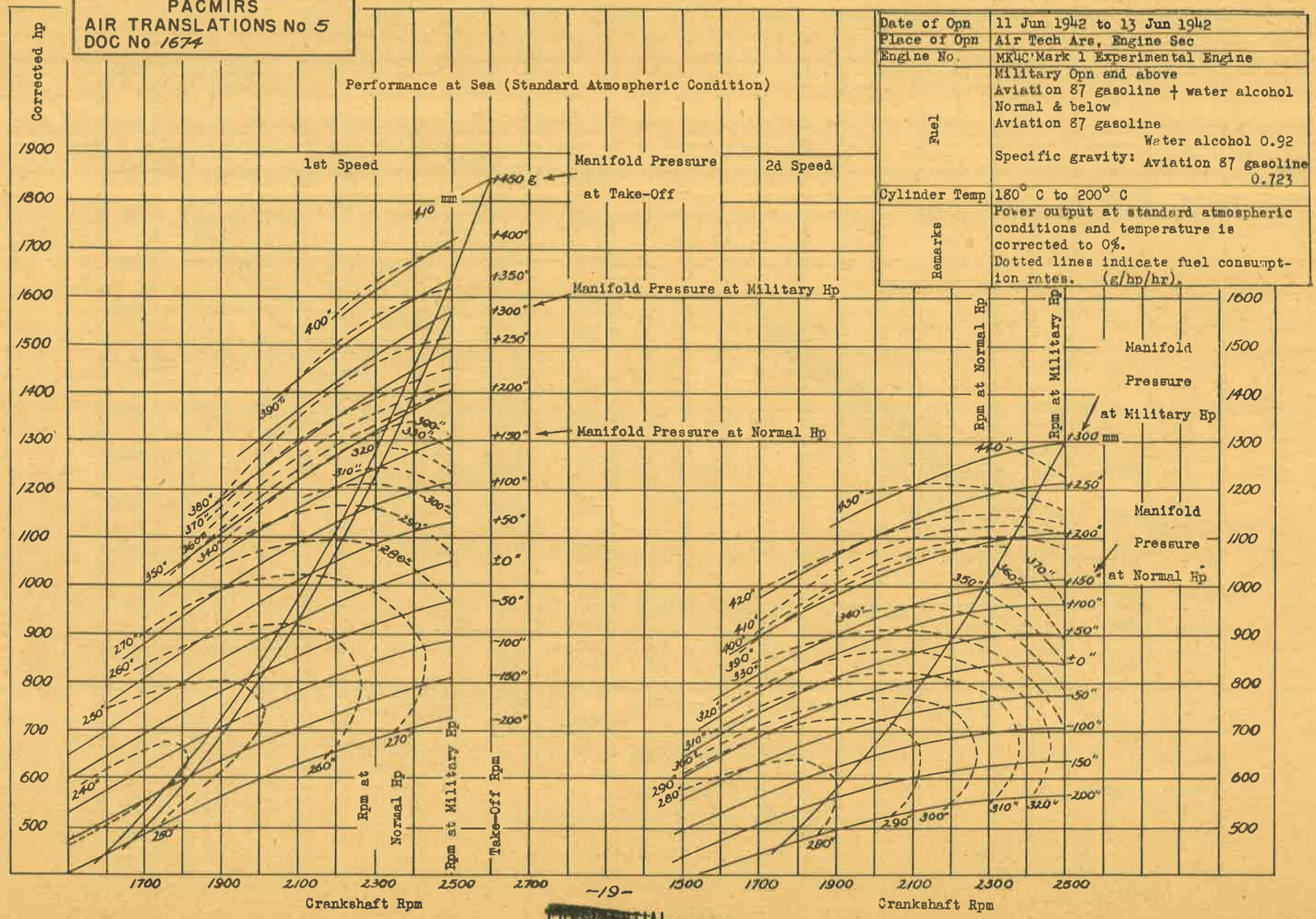
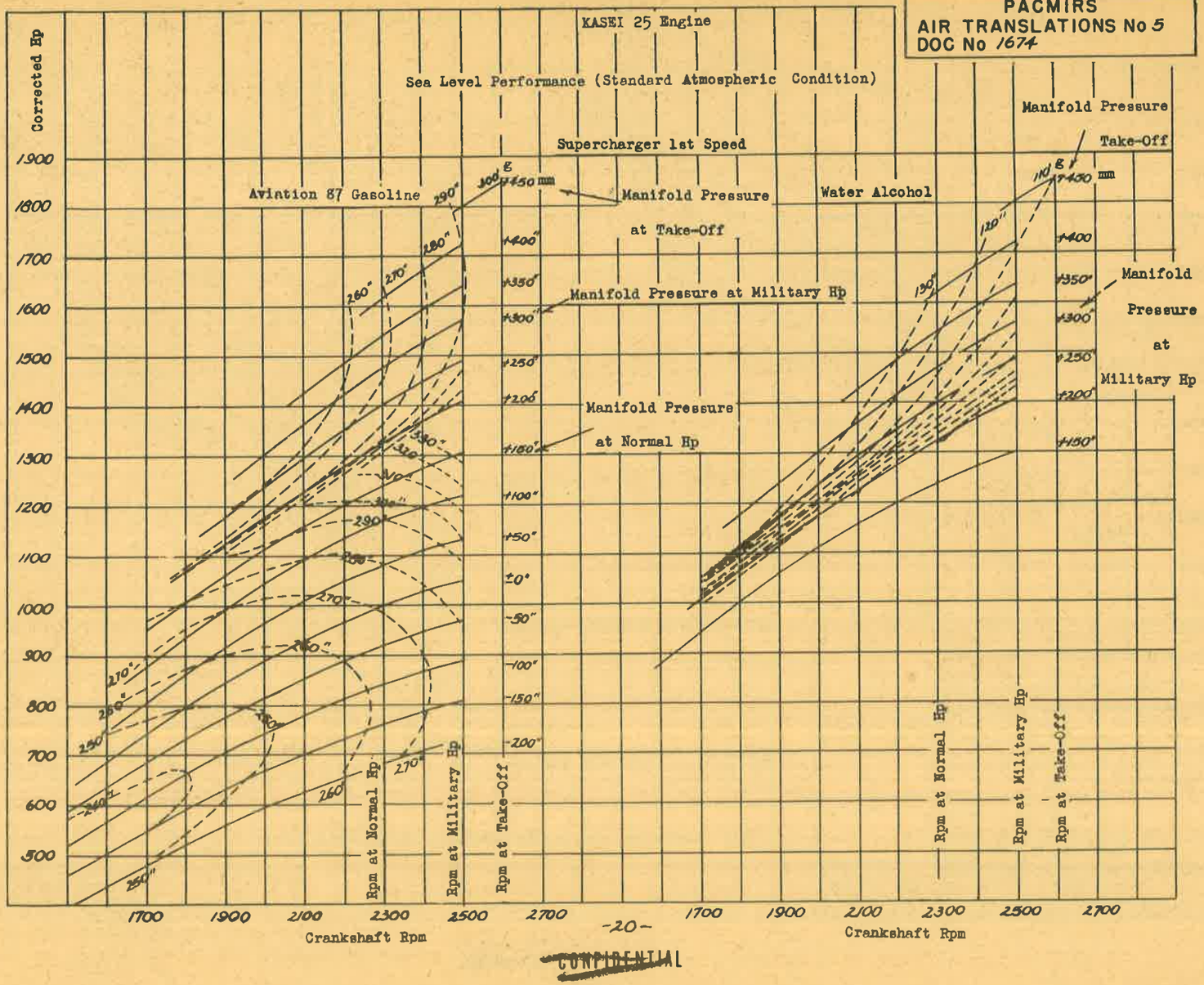



| | |
|---|---|
| Date of Opn | 11 Jun 1942 to 13 Jun 1942 |
| Place of Opn | Air Tech Ars, Engine Sec |
| Engine No. | MK4C'Mark 1 Experimental Engine |
| Fuel | Military Opn and above<br>Aviation 87 gasoline + water alcohol<br>Normal & below<br>Aviation 87 gasoline<br>Water alcohol 0.92<br>Specific gravity: Aviation 87 gasoline 0.723 |
| Cylinder Temp | 180° C to 200° C |
| Remarks | Power output at standard atmospheric conditions and temperature is corrected to 0%.<br>Dotted lines indicate fuel consumption rates. (g/hp/hr). |



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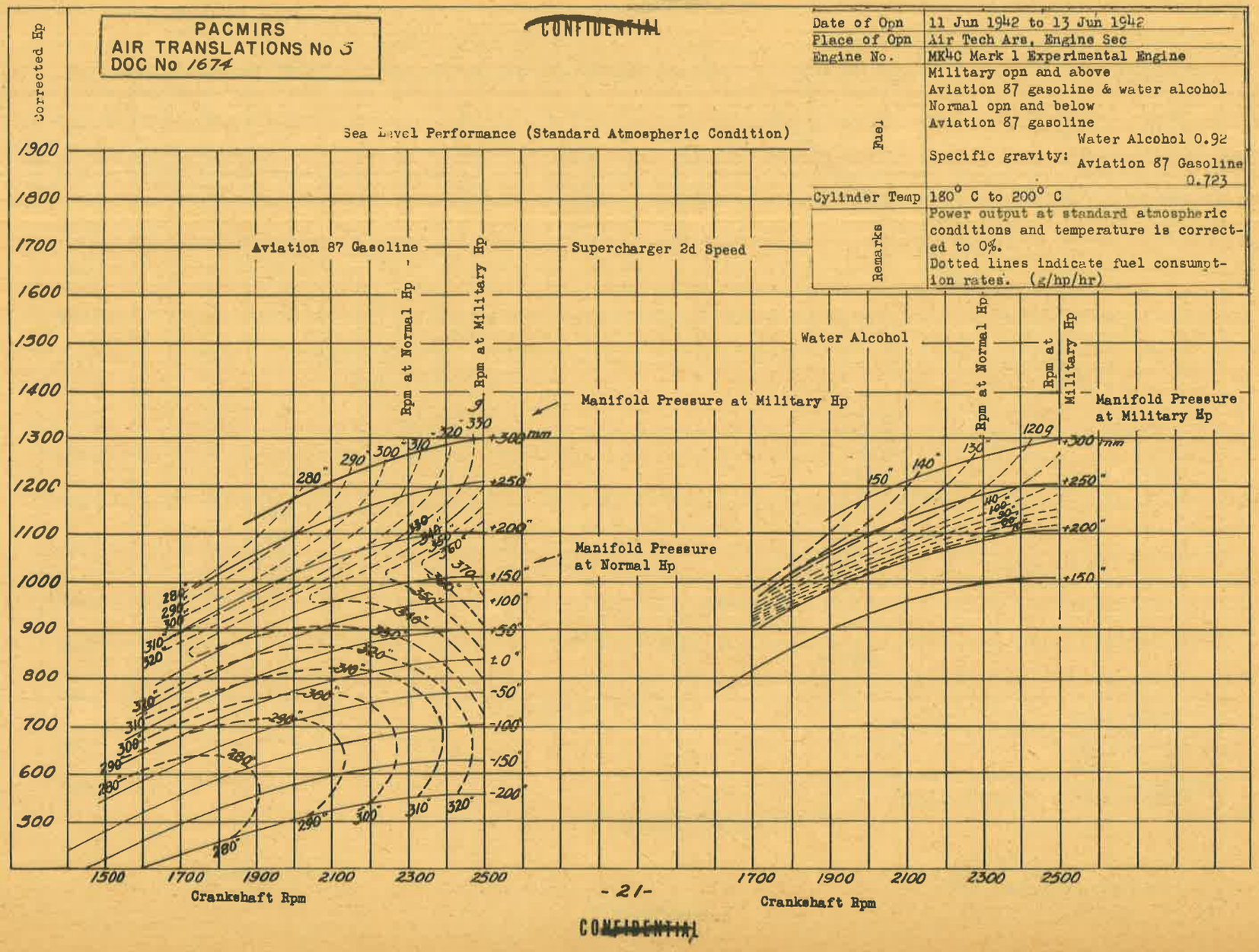
| | |
|---|---|
| Date of Opn | 11 Jun 1942 to 13 Jun 1942 |
| Place of Opn | Air Tech Ars, Engine Sec |
| Engine No. | MK4C Mark 1 Experimental Engine |
| Fuel | Military opn and above<br>Aviation 87 gasoline & water alcohol<br>Normal opn and below<br>Aviation 87 gasoline<br>Specific gravity: Water Alcohol 0.92<br>Aviation 87 Gasoline 0.723 |
| Cylinder Temp | 180° C to 200° C |
| Remarks | Power output at standard atmospheric conditions and temperature is corrected to 0%.<br>Dotted lines indicate fuel consumption rates. (g/hp/hr) |

Sea Level Performance (Standard Atmospheric Condition)



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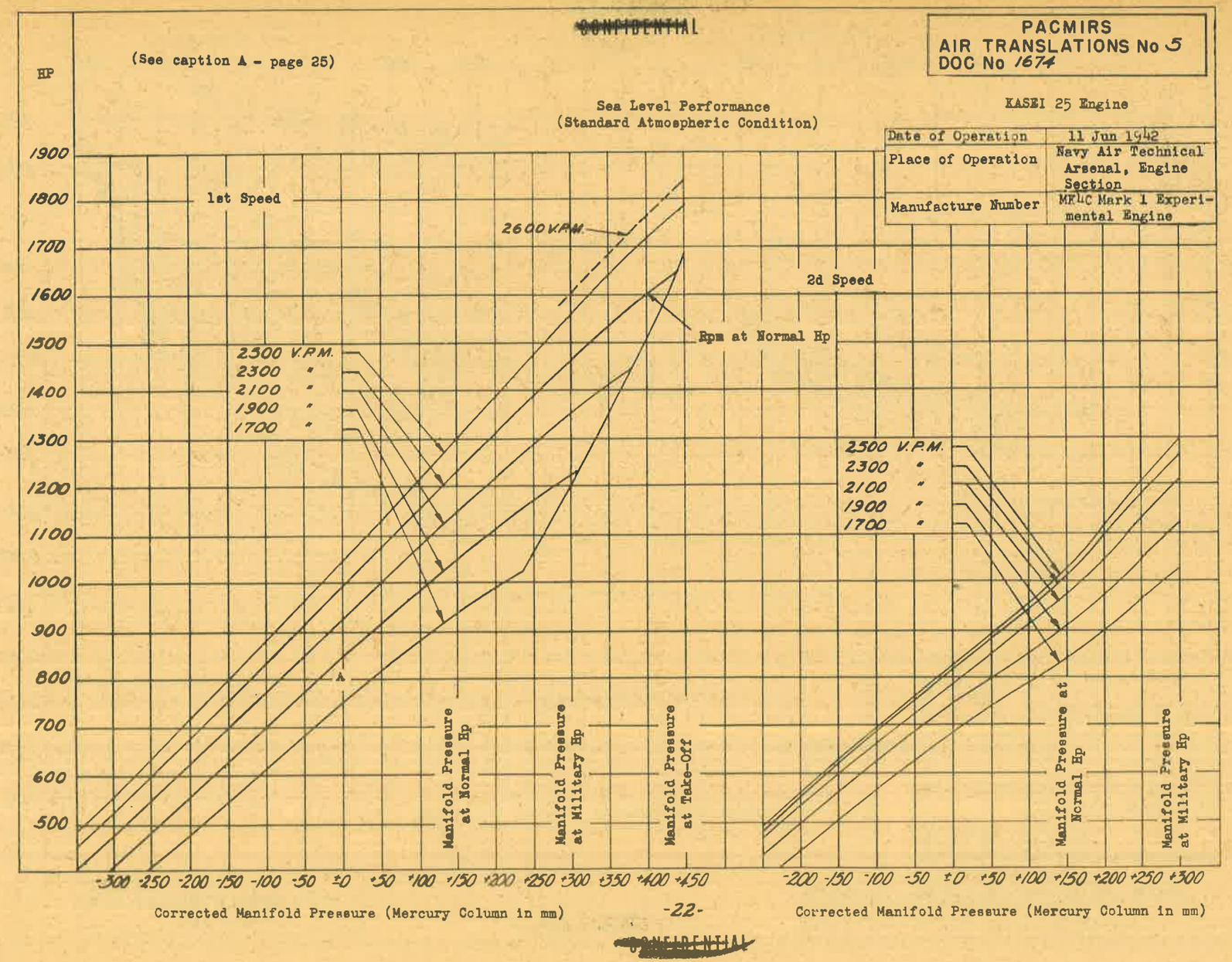
(See caption A - page 25)

Sea Level Performance
(Standard Atmospheric Condition)

KASEI 25 Engine

| | |
|---|---|
| Date of Operation | 11 Jun 1942 |
| Place of Operation | Navy Air Technical Arsenal, Engine Section |
| Manufacture Number | MK4C Mark 1 Experimental Engine |



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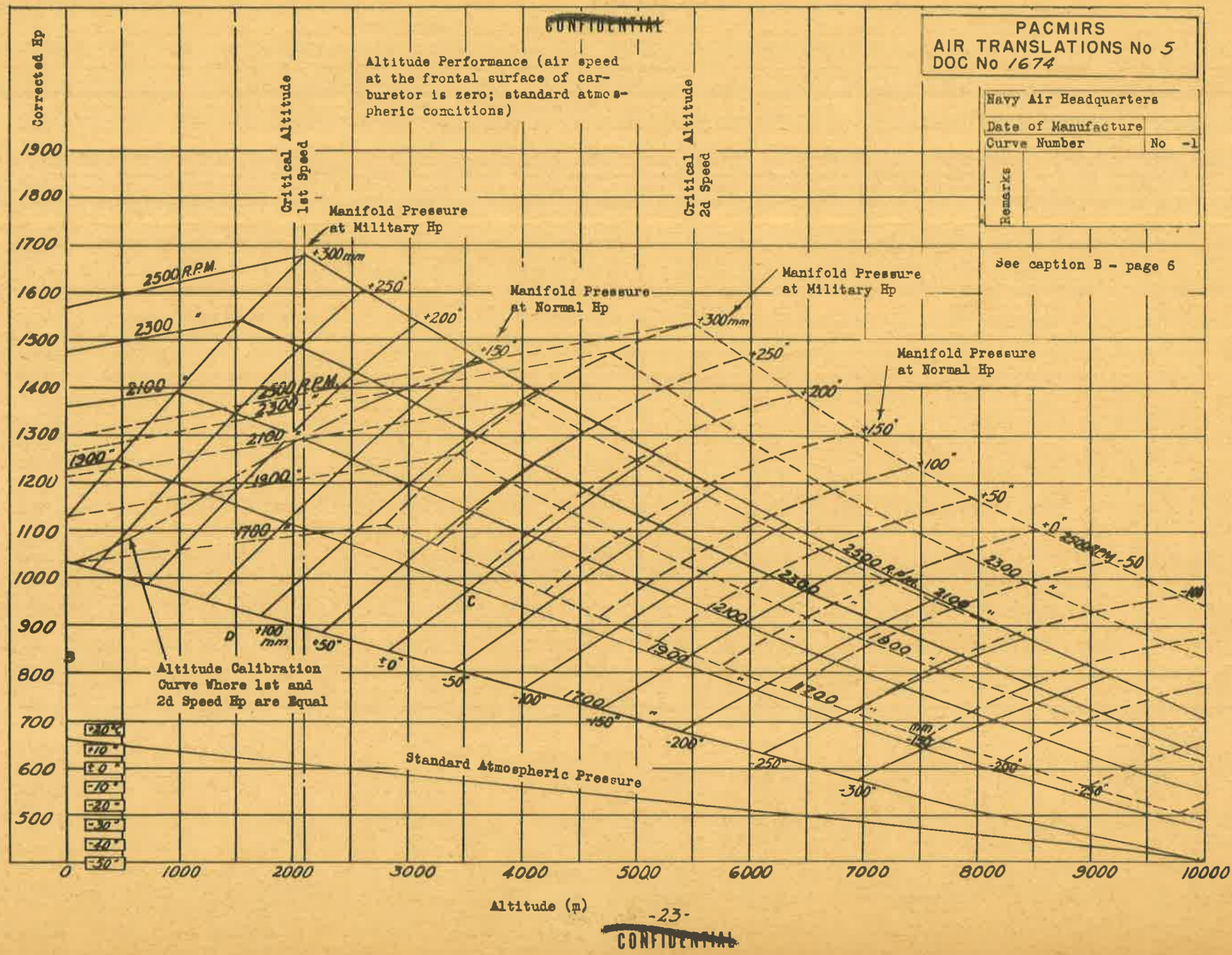
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AIR TRANSLATIONS No 5
DOC No 1674
Navy Air Headquarters
Date of Manufacture
Curve Number
No -1
Remarks
See caption B - page 6
Altitude Performance (air speed at the frontal surface of carburetor is zero; standard atmospheric conditions)
Corrected Hp
Critical Altitude 1st Speed
Critical Altitude 2d Speed
Manifold Pressure at Military Hp
Manifold Pressure at Normal Hp
Manifold Pressure at Military Hp
Manifold Pressure at Normal Hp
2500 R.P.M.
2300
2100
1900
1700
Altitude Calibration Curve Where 1st and 2d Speed Hp are Equal
Standard Atmospheric Pressure
Altitude (m)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
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Caption A

Method of Obtaining Bhp during Flight:

First, take the instrument readings for manifold pressure, rpm, altitude, and air intake temperature (ta). [Then:]

1. Obtain Point A on the sea level calibration curve from the manifold pressure and rpm reading, then move horizontally to Point B. In the same manner, obtain Point C on the altitude calibration curve from the same manifold pressure and rpm reading. Connect Points B and C with a straight line; obtain Point D, which corresponds to indicated altitude. This (Point D) then gives horsepower corrected for that altitude.

2. By referring to the standard atmospheric temperature curve, obtain the standard atmospheric temperature ($t_s$) for that altitude.

Brake Horsepower = Brake Horsepower corrected for Altitude x $\sqrt{\frac{273 + t_s}{273 + ta}}$

Method of Obtaining Brake Horsepower at Sea Level:

First, take the instrument readings for manifold pressure, rpm, humidity, atmospheric temperature and air intake temperature (ta).

Corrected manifold pressure = manifold pressure (reading on manifold pressure gauge) minus vapor pressure (obtained from table of humidity and atmospheric temperature).

Obtain corrected brake horsepower at sea level from corrected manifold pressure and rpm reading.

Brake Horsepower = corrected Brake Horsepower at Sea Level

$$x \sqrt{\frac{288}{273+ta}}$$

Caption B

| KASEI 25 Engine | | | |
|---|---|---|---|
| | | 1st Speed | 2d Speed |
| Rpm at Military Hp | | 2500 per minute | |
| Manifold Pressure at Military Hp | | + 300 millimeters | + 300 millimeters |
| Critical Altitude | | 2100 meters | 5500 meters |
| Military Horsepower at Critical Altitude | | 1680 | 1540 |
| Military Horsepower at Sea Level | | 1570 | 1300 |
| Rpm at Take-Off | | 2600 | |
| Manifold Pressure at Take-Off | | + 450 millimeters | |
| Maximum Horsepower at Take-Off | | 1850 | |
| Minimum Rpm at Take-Off | | 1850 | |
| Maximum at Normal Rpm | | 2300 | |
| Manifold Pressure at Normal Hp | | + 150 | |
| Maximum Rpm | | 2750 | |
| Reduction Ratio | | 0.625 | |
| Compression Ratio | | 6.5 | |
| Supercharger Ratio | 1st Speed | 7.0 | |
| | 2d Speed | 9.12 | |
| Impeller Diameter | | 320 millimeters | |
| Carburetor | | MITSUBISHI $DS_4$ - 85D | |
| Fuel | Military Hp and Above | Aviation 87 gasoline + water alcohol | |
| | Normal Hp and Below | Aviation 87 gasoline | |

B. Engine Controls

The angle of the handle which operates the supercharger in the KASEI 25 engine was changed from 60 degrees to 40 degrees. Other than that, controls for operation of this engine remain the same as those of Model 11 /JILL 11/

C. Fuel System

1. General Remarks

a. Three fuel tanks are installed in both the port and starboard wings, as well as one below the pilot's seat and one above the engine mount in front of the fire wall.

b. Aviation 87 gasoline is carried in both port and starboard wing tanks; water-methanol is carried in the tanks below the pilot's seat and above the engine mount.

c. Fuel Tanks in the port and starboard wings are connected to the left and right valves respectively, and the lines from each are joined at a three-way coupling. From there, they pass as one line through a three-way valve, then through the fuel pump, in which are installed the fuel by-pass and pressure relief valves. Finally the line passes to the carburetor.

The tank above the engine mount is connected with the tank below the pilot's seat.

d. Water-methanol, travelling in a line separate from that of the aviation 87 gasoline, is pumped by the water injection pump from the tank below the pilot's seat, through the filter and regulator to the engine supercharger section.

e. Installation of fuel pressure and fuel quantity gauges is the same as in Model 11. However, in connection with the methanol system, a methanol pressure gauge and a methanol pressure warning light have been installed on the line running from the water pump outlet through the methanol pressure warning transmitter.

2. Fuel Tanks

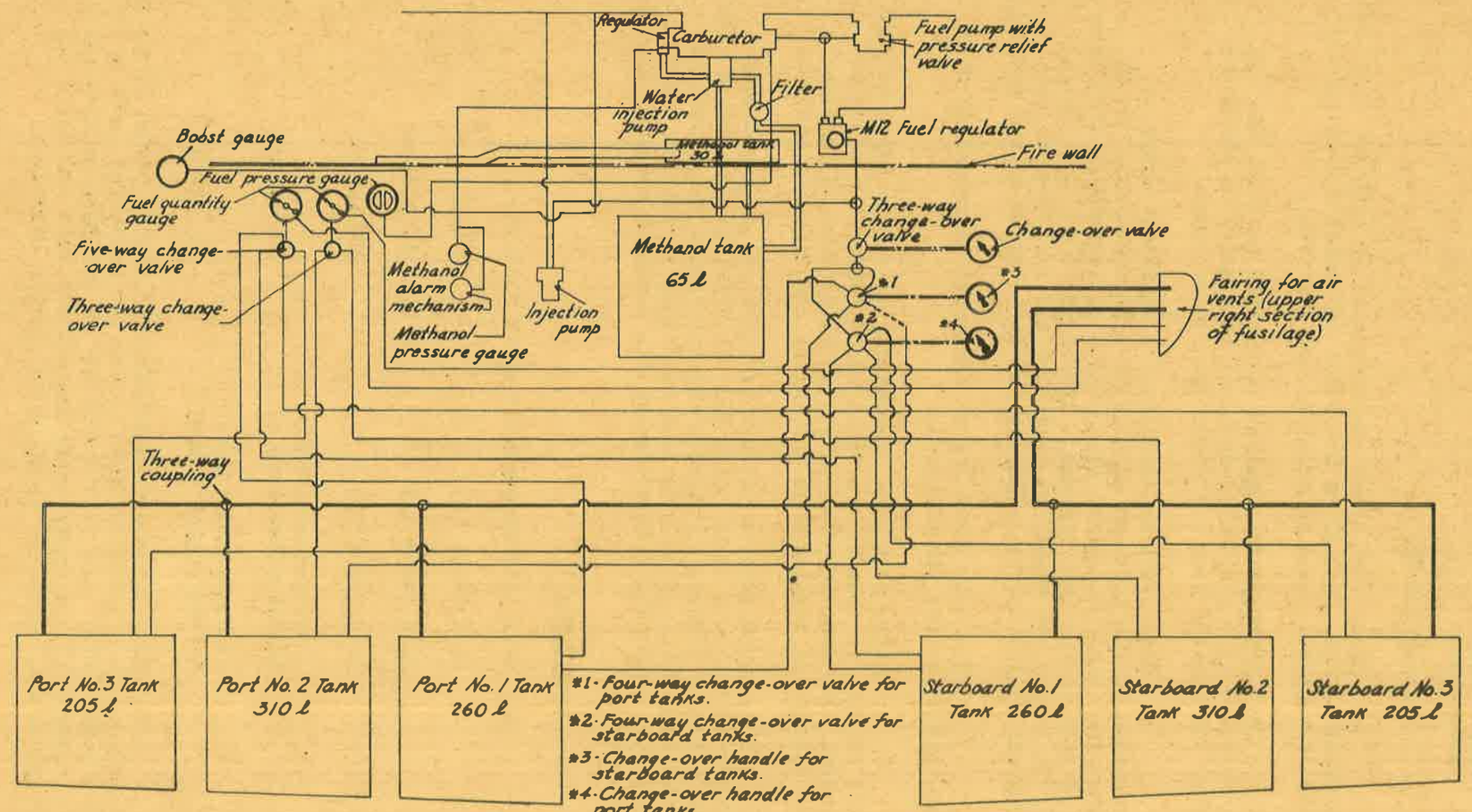
a. Fuel tank capacities are as follows:

| | |
|---|---|
| No 1 Tanks (2) | 264 liters |
| No 2 Tanks (2) | 310 liters |
| No 3 Tanks (2) | 208 liters |
| Water-Methanol Tank (below pilot's seat) | 65 liters |
| Water-Methanol Tank (above engine mount) | 30 liters |

b. Wing tanks are installed with filter ports, 90 mm in diameter. Fuel emergency dump valves are installed on No 1 and No 2 tanks only. Air vent materials are the same as those in Model 11, except for the tanks below the pilot's seat and above the engine mount, which are aluminum to prevent corrosion.

3. Fuel valves, fuel emergency dump valves, hand pump, injection pump, etc. in the KASEI 25 engine are the same as those in Model 11.

# ILLUSTRATIVE DRAWING OF FUEL SYSTEM




#1 - Four-way change-over valve for port tanks.
#2 - Four-way change-over valve for starboard tanks.
#3 - Change-over handle for starboard tanks.
#4 - Change-over handle for port tanks

## D. Lubrication System

### 1. Lubricating Oil Lines

The lubricating oil lines of the KaSEI 25 engine are the same as those of Model 11. Oil from the oil tank reaches the oil pump through the filter via the oil drain valve. It lubricates all parts of the engine and preheats the carburetor. Then, through the return oil line and the oil cooler, the oil returns to the upper section of the oil tank. (See diagram at end of this subsection)

### 2. Lubricating Oil Tank

The capacity and installation of the oil tank are the same as that for Model 11. Only the outer shape is different.

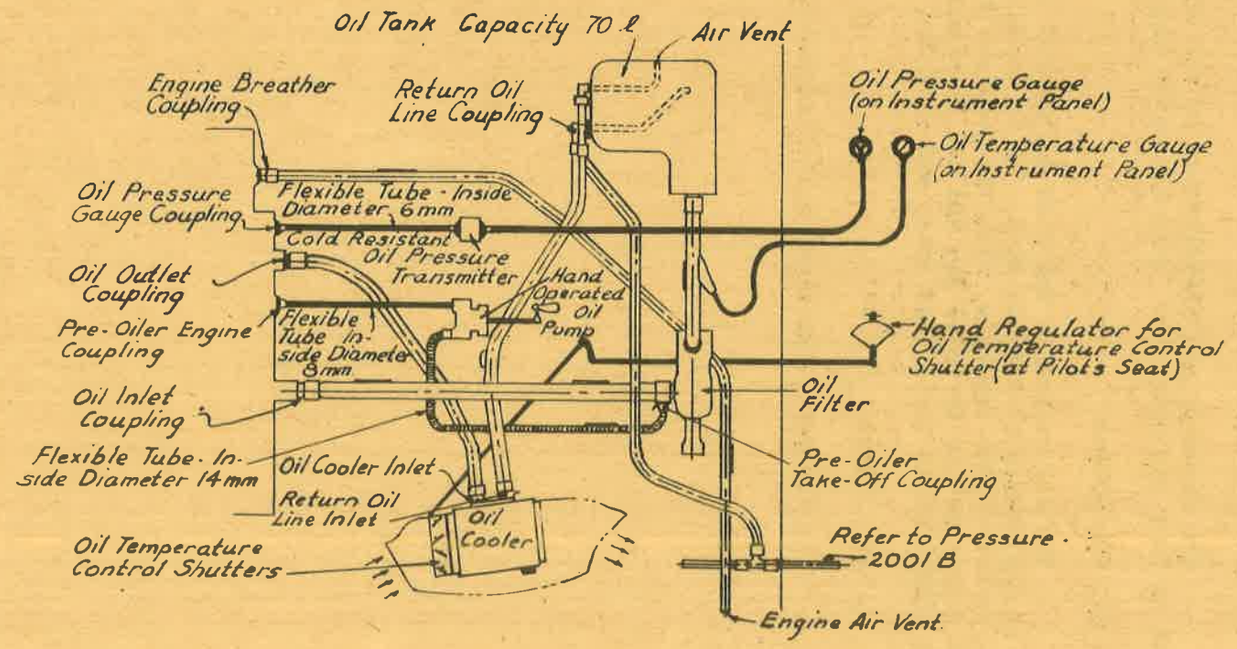
### 3. Oil Cooler

The oil cooler is the same as that of Model 11, and so is the method of installation. It is installed close to the center of the fuselage, with the rear section faired into the fuselage. As in Model 11, the oil temperature shutters are installed in the cooler scoop and operated by hand.

### 4. Oil Filter

The filter is the same as that of Model 11.

## DRAWING OF LUBRICATING OIL SYSTEM



E. Starting System

The starter mechanism in this engine is a Model 11 Electric Inertia Starter, supplemented by a hand operated inertia starter.

F. High-Pressure Oil System

Two Model 13 High-Pressure Oil Pumps are directly connected to the engine and supply oil at high pressure. The high-pressure oil line is the same as that of Model 11.

G. Exhaust and Air Intake Manifolds

1. Single Exhaust Stacks

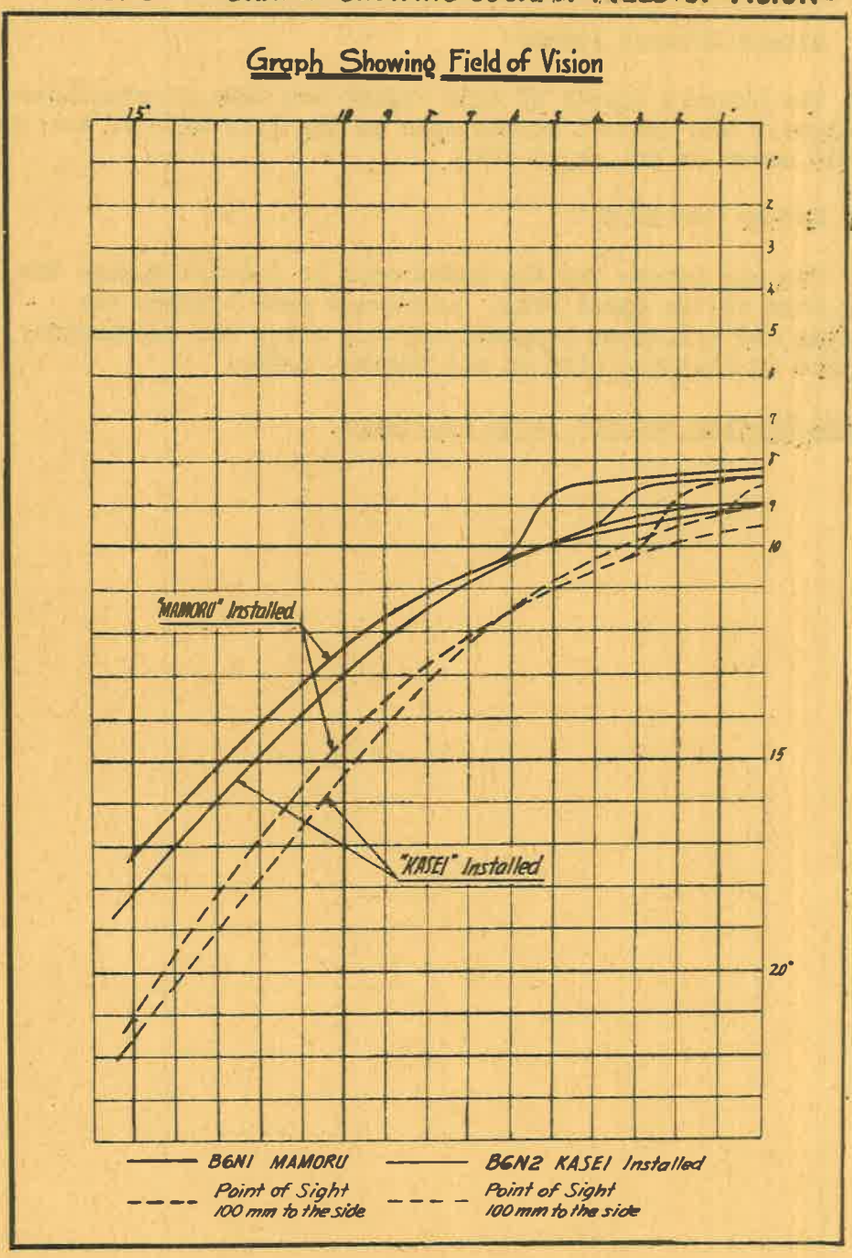
The exhaust stacks of this engine are made of stainless-steel plate. Six exhaust stacks open on the left side of the fuselage, and seven on the right side.

2. Intake Manifold

The air intake for the carburetor is located inside the leading edge of the speed ring. Air ducts pass between the speed ring and cylinders respectively and enter the carburetor. The engine is equipped with an air intake heater.

H. Graph Showing Cockpit Field of Vision

## NO. 8 GRAPH SHOWING COCKPIT FIELD OF VISION



No 9

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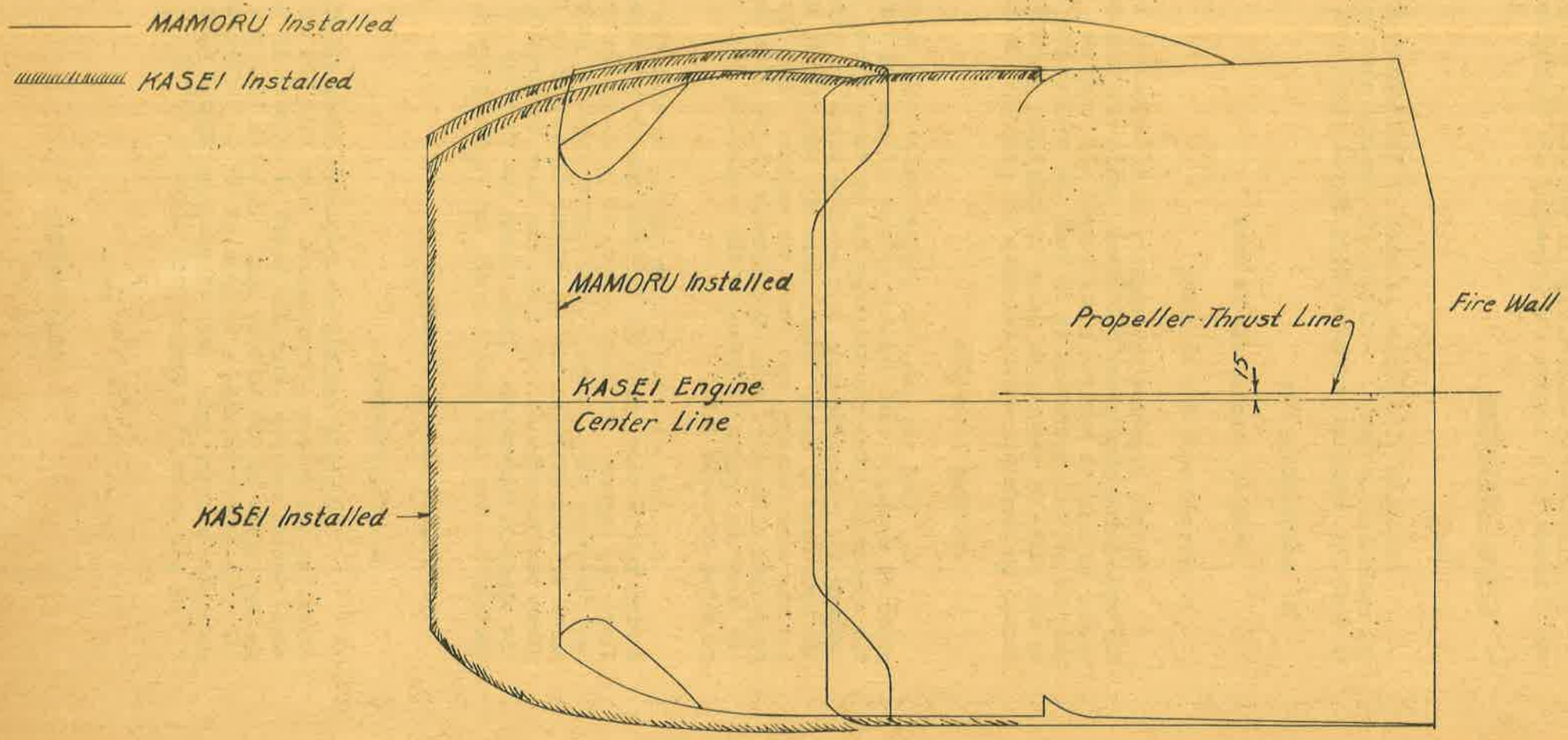
# ENGINE COWLING COMPARISON CHART



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## Section IV. POWER EQUIPMENT MAINTENANCE

### A. Engine and Propeller Assembly and Disassembly

The differences between JILL 11 and JILL 12 in assembly and disassembly of engine and propeller are negligible.

### B. Engine Maintenance

#### 1. Fuel

Aviation 87 gasoline is used at manifold pressure for normal operation or below. Aviation 87 gasoline plus water-methanol is used for manifold pressure above normal operation.

#### 2. Lubricating Oil

Aviation mineral oil is used

#### 3. Preparation for Starting

Before starting the engine, it is necessary to work the pre-oiling pump about 200 times, while rotating the propeller by hand to achieve a sufficient oil pressure. The purpose of this operation is to send the lubricating oil to all parts of the engine prior to starting; therefore, it should be performed while rotating the propeller by hand.

#### 4. Starting Procedure

a. When starting the engine during cold weather, in order to supply a satisfactory mixture of air and fuel to the cylinders, pump the throttle two or three times, while working the pre-oiler pump four or five times and rotating the propeller by hand. Then, place the throttle in approximately 1.8 per cent position and start the engine. When the throttle is pumped violently, some fuel remains in the FIR5 manifold, and there is danger of damaging the connecting rod. Care must be taken to avoid this.

b. When starting a warm engine, or starting an engine during hot weather, pump the throttle one or two times and start the engine. In these cases, it is advisable not to use pre-oiler pump. When a warm engine fails to start after three or four attempts and the engine appears to be flooded, place the throttle at wide open, and turn the propeller in the opposite direction. Then, place the throttle at approximately 2.0 per cent position and try starting again.

#### 5. Engine Warm-Up Procedure

a. Oil pressure

Several seconds are required after starting to establish the proper oil pressure. When this oil pressure is established, set the propeller pitch at extreme low and warm up the engine at 900 to 1000 rpm. Maintain this rpm until the oil temperature reaches a minimum of 40° C. After this, increase to rated rpm. The oil pressure should then be 6.0 - 6.5 kg per sq cm at a temperature close to 60° C.

b. Cylinder temperature

Because the cylinder temperature is likely to rise during ground test runs, special care must be taken to keep it from exceeding 200° C. Even when performing a special run, the temperature should not exceed 230° C. The cylinder temperature thermocouple is installed in the rear No 3 cylinder where the temperature is highest.

c. Oil temperature

The oil temperature gauge is installed in the oil inlet to the engine. Unless there is extremely warm weather, the oil cooler shutter should be placed at Full Hot, in order to shorten the time required to warm up the engine. The ideal oil temperature is 60° to 70° C.

d. Exhaust air temperature

The exhaust air temperature is highest when the manifold pressure is approximately ± 0 mm; at standard fuel consumption, the exhaust air temperature registers 750°-770°C. The exhaust air temperature thermometer is installed on the front row No 5 cylinder exhaust stock.

6. Ground operation record

a. For ground operation, the propeller pitch should be adjusted to 23 degrees, the manifold pressure to + 300 mm and the engine rpm to 2500.

| Manifold Pressure | Rpm | Fuel Pressure | Oil Pressure | Oil Temperature | Cylinder Temperature | Exhaust Temperature | Methanol Pressure |
|---|---|---|---|---|---|---|---|
| -250 | 1720 | 0.30 | 6.5 | 50 | 195 | 670 | |
| -200 | 1880 | " | " | " | 205 | 700 | |
| -100 | 2120 | 0.38 | " | " | 200 | 740 | |
| ± 0 | 2240 | " | 7.0 | 60 | 215 | 760 | |
| + 100 | 2360 | 0.31 | 7.2 | " | 220 | 740 | |
| + 200 | 2450 | 0.30 | 7.0 | " | " | 730 | 0.40 |
| + 300 | 2500 | " | " | 65 | " | 740 | 0.85 |

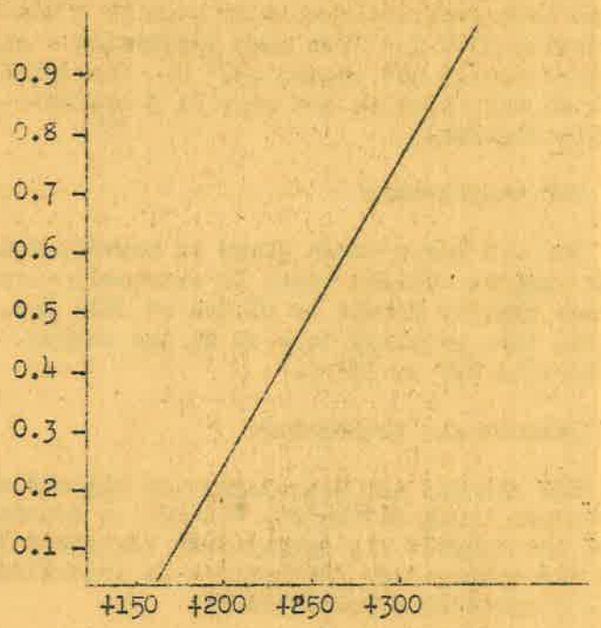
7. Magneto Check for Rpm Loss

Advance the engine rpm to 1800. Throw the magneto switch from "Both" to "Left" and from "Both" to "Right". A loss of 30 to 40 rpm on either side is normal. If this loss is exceeded, the cause is frequently a faulty ignition system and an inspection should be made.

8. Special Operation Precautions

Water-methanol is injected into the engine when the manifold pressure is over + 160 mm; therefore it is essential to observe carefully the injection pressure gauge, and confirm the rise in manifold pressure. The relation between the manifold

and injection pressure is shown in the following chart:




When the relation between injection pressure and manifold pressure is improperly adjusted, frequently black smoke will pour out. This occurs after the water-methanol has begun to flow, the manifold pressure having reached +230 to +250 mm. However, if the carburetor is adjusted as recommended, operating conditions will then be satisfactory.

## Section V. MAINTENANCE OF WATER-METHANOL INJECTION SYSTEM

The engine installed in this plane has water-methanol injection equipment which requires care in handling. The following points must be strictly observed:

### A. Water-Methanol Tank and Filter

The water-methanol tank and line must be carefully washed with clean water. The filter in the water-methanol line should be cleaned often so that not even small dust particles will collect.

### B. Regulating Valve

Because the operation of the water-methanol sleeve type regulator valve is rendered impossible by adhesion of even small dust particles, cleaning must be done with care.

### C. Servicing of Water-Methanol System

A filter is used when filling the water-methanol tank. Usually water-methanol is filled to full tank capacity.

### D. Injection Pressure and Pressure Warning Light

During operation of the engine, attention must be paid to the water-methanol pressure warning light and injection pressure gauge. If these do not operate, stop the engine immediately and determine the cause.

The standard water-methanol injection pressure is 0.8 to 0.9 kg per sq cm when the manifold pressure is +300 mm. In this case the pump pressure is 1.2 to 1.3 kg per sq cm. The water-methanol warning light should be adjusted so that it will light when the pump pressure is below 1.1 kg per sq cm.

Supplement THE HANDLING OF WATER-METHANOL

A. Effect of Injection

Water-methanol injection has the following advantages:

1. The manifold pressure increases because of the greater anti-knock qualtities of water-methanol injection.

2. Low grade fuels can be used (for example, engines which /normally/ require 100 octane fuel will operate satisfactorily with 87 octane fuel).

3. With the same manifold pressure and rpm the power output increases (because of the increased volumetric efficiency).

4. Gasoline consumption is reduced by the amount of water-methanol injected.

5. Water-methanol injection decreases the maximum combustion temperature in the cylinder.

B. Types of Water-Methanol

1. Methanol "A"

50% Water 50% Methanol

2. Methanol "B" (for use in cold areas)

25% Water 75% Methanol

3. For both A and B types, 10 grams of potassium chromate are added to 100 liters of the mixed liquid before use. Water with the purity of service water should be used.

C. Corrosive Properties of Water-Methanol

1. Water-Methanol Tank

a. Use a welded tank made either from CHI 421 (MO) or from CHI 021. The bulkheads are CHI 232, and the rivets are made of CHI 181 which has been given an electric anti-corrosion treatment (the latter should be done at the last possible stage).

b. Riveted tanks will not be used at present until leak-proof compcunds have been perfected.

2. Flexible Line

The water-methanol flexible line will be provisionally specified "99 Flexible Line" with the inside grounding wire removed. The metal couplings for the line will not be treated for corrosion.

3. General Remarks Concerning Principal Materials

a. The steel used should be as rust-proof as possible. Materials other than steel should be chromium-plated.

b. Although copper alloys turn a black-brown color, they are in general serviceable except for sliding surfaces, where corrosion must be at a minimum.

c. Although aluminum alloys will corrode, aluminum-magnesium alloy (HIDROMARIUMU) is satisfactory when given an alemite anti-corrosion treatment.

(TN: Remainder of document missing)



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