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5th Part of Report No. A. & A. E. E. /783, a.

AVIAR/734  
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AEROPLANE AND ARMAMENT EXPERIMENTAL ESTABLISHMENT

BOSCOMBE DOWN.

Kittyhawk II, F.L. 220.

|                             |       |
|-----------------------------|-------|
| (Merlin VI650-1)            | STOCK |
| Engine cooling trials.      |       |
| DATE 6/1/53                 | 10    |
| REDUCED TO 12               |       |
| DATE 6.1.53                 |       |
| Progress of issue of report |       |

This report shall  
with the aircraft  
(or equipment) as  
tested. Action to  
remedy defects or  
decisions to accept  
items not in strict  
compliance with the  
specifications are  
matters for decision  
and action by the  
Ministry of Aircraft  
Production.

A. & A. E. E. Ref:- 4484/1 - A.S. 76/4

M. A. P. Ref:- R.A. 1871

| Report No.                         | Title                                                                  |
|------------------------------------|------------------------------------------------------------------------|
| 1st Part of A. & A. E. E. /783, a. | F.L. 220 - Weights and loading data.                                   |
| 2nd. do.                           | F.L. 220 - Flame damping trials with short stub exhaust flame dampers. |
| 3rd. do.                           | F.L. 220 - Carbon Monoxide contamination tests.                        |
| 4th do.                            | F.L. 220 - Climb and level speed performance and position error.       |

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SUMMARY.

Measurements of oil (engine inlet) and coolant (engine outlet) temperatures have been made on the climb and in cruising level flight at 13,000 ft. in M.S. supercharger gear and 20,000 ft. in F.S. gear. The results show that the temperatures are within requirements for tropical summer conditions, under all conditions

1. Introduction:

Engine cooling tests have been made on Kittyhawk II, F.L. 220. The results have been reported to M.A.P. by letter ref. A.A.E.E./4484/1-AS76/4 dated 3.9.42.

2. Condition of aeroplane relevant to tests made.

The Kittyhawk II is in general layout similar to the Kittyhawk I. The armament consisted of 3 x .5 ins. machine guns in each wing. The muzzles were sealed, but the ejection chutes underneath the wings remained open. The aeroplane incorporated fixtures for bomb racks beneath the wings and under the fuselage, but during the trials, neither bombs nor jettisonable fuel tank were fitted.

Aerials were fitted from each wing to the rudder, with a lead-in from the rudder to the fuselage behind the pilot's hood. In addition I.F.F. aerials were fitted between the sides of the fuselage and the tailplane. There was no

/aerial

aerial mast behind the cockpit.

The exhaust system was six single ejector stub pipes on each side of the aeroplane.

Other details included a camera gun under the starboard wing and a landing lamp on the port wing. The exterior rear-view mirror has been moved slightly to port compared with the Kittyhawk I.

As on the Kittyhawk I the radiator and oil cooler were in a duct under the fuselage. The flow of air through the duct was controlled by gills at the trailing edge of the duct. The gaps between the trailing edge of the gill plates and the undersurface of the fuselage for three positions are:-

| Indicator Reading | Mean Gap Inches |
|-------------------|-----------------|
| Closed            | 0.35            |
| Neutral           | 5.45            |
| Full open.        | 12.30           |

The closed position is used for warming up on the ground; in the neutral position the gills follow approximately the lines of the duct and this position is used for level flight; the full open position is used for climb. The oil cooler was to drawing No. 87-46-925 and the radiator to drawing No. R-502A-42D.

The engine limitations for the Packard Merlin V-1650-1 obtaining at the time of the tests were:-

|                                                                                                                                                                               |                                                                    |                 |                            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|-----------------|----------------------------|
| <u>1. Engine Revolutions.</u>                                                                                                                                                 |                                                                    | <u>M. gear</u>  | <u>S. Gear</u>             |
| (i)                                                                                                                                                                           | Max. for take-off (1000 ft. or 3 mins)                             | 3000            | -                          |
| (ii)                                                                                                                                                                          | Minimum for take-off at max. take-off boost.                       | 2225            | -                          |
| (iii)                                                                                                                                                                         | Max. for climbing (1 hour limit)                                   | 2850            | 2850                       |
| (iv)                                                                                                                                                                          | Max. for emergency climbing above 20,000 ft. (short periods only). | -               | 3000                       |
| (v)                                                                                                                                                                           | Max. for all-out level flight or combat (5 min. limit)             | 3000            | 3000                       |
| (vi)                                                                                                                                                                          | Max. for cruising (rich and weak)                                  | 2650            | 2650                       |
| <u>2. Boost Pressures (in. Hg.)</u>                                                                                                                                           |                                                                    | <u>M. Gear.</u> | <u>S. Gear.</u>            |
| (i)                                                                                                                                                                           | Max. for take-off (1000 ft. or 3 mins)                             | 54              | -                          |
| (ii)                                                                                                                                                                          | Max. for climbing (1 hour limit)                                   | 48              | 48                         |
| (iii)                                                                                                                                                                         | Max. for emergency climbing above 20,000 ft. at 3000 r.p.m.        | -               | 48                         |
| (iv)                                                                                                                                                                          | Max. for all-out level flight or combat (5 min. limit)             | 48              | 48                         |
| (v)                                                                                                                                                                           | Max. for cruising (rich)                                           | 44              | 44                         |
| (vi)                                                                                                                                                                          | Max. for cruising (weak)                                           | 38              | 38                         |
| <u>Note</u> A max. of 54 in. Hg. boost pressure is permitted in M. gear only, for short periods during an emergency. This is obtained by operating the boost control cut out. |                                                                    |                 |                            |
| <u>3. Oil Pressures (lb/sq. in.)</u>                                                                                                                                          |                                                                    |                 |                            |
| (i)                                                                                                                                                                           | Normal minimum.                                                    | 60              |                            |
| (ii)                                                                                                                                                                          | Emergency minimum (5 mins. limit)                                  | 45              |                            |
| <u>4. Oil Temperatures °C. (inlet to engine)</u>                                                                                                                              |                                                                    | <u>Normal.</u>  | <u>Short periods only.</u> |
| (i)                                                                                                                                                                           | Minimum for take-off.                                              | 15              | -                          |
| (ii)                                                                                                                                                                          | Max. for cruising (rich and weak)                                  | 90              | 100                        |
| (iii)                                                                                                                                                                         | Max. for climbing.                                                 | 90*             | 100                        |
| (iv)                                                                                                                                                                          | Emergency maximum (5 min. limit)                                   | -               | 105                        |
| <u>5. Coolant.</u>                                                                                                                                                            |                                                                    |                 |                            |
| (i)                                                                                                                                                                           | Approved type - Pressure liquid (70% water + 30% Ethylene Glycol). |                 |                            |
| (ii)                                                                                                                                                                          | Temperatures °C. (Outlet from engine).                             | <u>Normal.</u>  | <u>Short periods only.</u> |
| (a)                                                                                                                                                                           | Max. for climbing and all-out level flight (1 hour limit)          | 120             | 135                        |
| (b)                                                                                                                                                                           | Max. for cruising (rich and weak)                                  | 100             | 115                        |
| (c)                                                                                                                                                                           | Minimum for take-off.                                              | 60              | -                          |

\* 100°C above 20,000 ft.

The test  
3. Scope of Test  
Temperatures of

The tests were made at a weight of 8910 lb.

3. Scope of Tests. The tests were made in accordance with A.D.M. 464. The temperatures of the coolant at outlet from the engine and the oil at inlet to the engine were measured on two climbs at maximum permitted power and best climbing speed with the radiator duct gills fully open. Similar measurements were made in both rich and weak mixture cruising flight at the respective maximum level speed full throttle heights in M.S. and F.S. supercharger gear, with the radiator duct gills in the neutral position.

Air for heating the cockpit is collected in the duct behind the radiator and oil cooler. Since there will be a lower air flow through the duct with the cockpit heating turned off than with heating on, the tests were made with heating off, giving the worst possible condition for oil and coolant cooling.

The tests were made during August 1942.

4. Results of Tests.

These results are given in full in the Appendix in tables I to V and in figures 1 to 3. They are summarised below.

The oil inlet temperatures have been corrected to temperate and tropical summer conditions (of A.D.M. 491), by adding 70% of the difference of the appropriate standard from the observed air temperature.

Radiator suitability is given by

$$\text{Suitability Ratio} = \frac{T_n - T_s}{T_o - T_a} \quad \text{where}$$

- $T_n$  = Normal maximum permissible coolant temperature.
- $T_s$  = Appropriate standard air temperature.
- $T_o$  = Observed engine outlet temperature.
- $T_a$  = Observed air temperature.

(a) Climb.

Radiator duct gills fully open

| Height of Maximum oil inlet Temperature and minimum radiator suitability. | Oil Inlet Temperature °C corrected to - |                            | Radiator Suitability ( $T_n = 125^\circ\text{C}$ ) |                            |
|---------------------------------------------------------------------------|-----------------------------------------|----------------------------|----------------------------------------------------|----------------------------|
|                                                                           | Temperate Summer conditions             | Tropical Summer conditions | Temperate Summer Conditions                        | Tropical Summer Conditions |
| at 2850 rpm. 20,000ft.                                                    | 70                                      | 80                         | 1.11                                               | 1.00                       |
| at 3000 rpm. 33,000ft.                                                    | 83                                      | 93                         | 1.15                                               | 1.05                       |

Max. Permissible oil inlet temperature (below 20,000')  $90^\circ\text{C}$   
(above 20,000')  $100^\circ\text{C}$ .

(b) Cruising level flight at 13,000 ft. in M.S. supercharger gear with radiator duct gills in neutral position.

| Mixture Control | R. P. M. | Boost in. of Hg. | A. S. I. m. p. h. | Oil Inlet Temperature °C corrected to - |                            | Radiator Suitability ( $T_n = 115^\circ\text{C}$ ) |                            |
|-----------------|----------|------------------|-------------------|-----------------------------------------|----------------------------|----------------------------------------------------|----------------------------|
|                 |          |                  |                   | Temperate Summer Conditions.            | Tropical Summer Conditions | Temperate Summer Conditions                        | Tropical Summer Conditions |
| Weak            | 2650     | 38               | 244               | 66                                      | 76                         | 1.22                                               | 1.07                       |
| Rich            | 2650     | 41½              | 256               | 66                                      | 76                         | 1.20                                               | 1.05                       |

Maximum Permissible Oil inlet temperature  $90^\circ\text{C}$ .

(c) Cruising level flight at 20,000 ft. in F.S. supercharger gear with radiator duct gills in neutral position.

| Mixture Control | R. P. M. | Boost in. of Hg. | A. S. I. m. p. h. | Oil Inlet Temperature °C corrected to:- |                             | Radiator Suitability (T <sub>n</sub> = 115°C) |                            |
|-----------------|----------|------------------|-------------------|-----------------------------------------|-----------------------------|-----------------------------------------------|----------------------------|
|                 |          |                  |                   | Temperate Summer Conditions             | Tropical Summer Conditions. | Temperate Summer Conditions                   | Tropical Summer Conditions |
| Weak            | 2650     | 38               | 228               | 65                                      | 75                          | 1.17                                          | 1.04                       |
| Rich            | 2650     | 41               | 240               | 65                                      | 75                          | 1.18                                          | 1.05                       |

5. Conclusions.

1. On the climb using maximum climbing conditions and best climbing speed the oil temperature at inlet to engine and the radiator temperature at outlet from engine, are within requirements for tropical summer conditions, with the gills fully open.

2. Using maximum power for either rich or weak mixture cruising flight, the stabilised oil and coolant temperatures are within requirements in M.S. supercharger gear at 13,000 ft. and in F.S. gear at 20,000 ft., with the gills in the neutral position.

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Chief Technical Officer.

*[Signature]*  
Air Commodore,  
Commanding, A. & A. E. E.,  
Royal Air Force.

DIX.

Kittyhawk II  
 Height Air Feet.  
 Temp. °C.  
 Time  
 Min. Sec.

ation Suitability  
 11500  
 Gear with

APPENDIX.

**TABLE I**  
**OIL COOLING AND RADIATOR SUITABILITY**  
**FULL THROTTLE CLIMB.**

Aeroplane: Kittyhawk II, F.L. 220. Radiator Gills fully open. Cockpit heating off.

| Height Feet. | Air Temp. °C. | Time |      | A. S. I. m.p.h. | R. P. M. | Boost Ins. Hg. | Mix- ture | Oil Temp. INLET °C.                      | Oil Press. MAIN lb/sq. in. | Coolant Engine OUT. C. | Radiator Suitability (T <sub>n</sub> = 125° C) |
|--------------|---------------|------|------|-----------------|----------|----------------|-----------|------------------------------------------|----------------------------|------------------------|------------------------------------------------|
|              |               | Min. | Sec. |                 |          |                |           |                                          |                            |                        |                                                |
| 2000         | 14½           | 0    | 0    | 161             | 2850     | 47.9           | Auto Rich | 65<br>71 <del>x</del><br>81 <del>ø</del> | 88                         | 104                    | 1.14 <del>x</del><br>.985 <del>ø</del>         |
| 4000         | 12            | 1    | 03   | 161             |          | 47.9           |           | 63<br>68 <del>x</del><br>78 <del>ø</del> | 88                         | 102                    | 1.18 <del>x</del><br>1.02 <del>ø</del>         |
| 6000         | 9½            | 2    | 05   | 161             |          | 47.9           |           | 63<br>67 <del>x</del><br>77 <del>ø</del> | 88                         | 104                    | 1.165 <del>x</del><br>1.015 <del>ø</del>       |
| 8000         | 7             | 3    | 04   | 161             |          | 47.9           |           | 64<br>67 <del>x</del><br>77 <del>ø</del> | 88                         | 105                    | 1.165 <del>x</del><br>1.02 <del>ø</del>        |
| 10000        | 3½            | 4    | 07   | 161             |          | 47.7           |           | 64<br>66 <del>x</del><br>76 <del>ø</del> | 88                         | 107                    | 1.14 <del>x</del><br>1.005 <del>ø</del>        |
| 12000        | 0             | 5    | 12   | 161             |          | 44.5           |           | 65<br>67 <del>x</del><br>77 <del>ø</del> | 86                         | 108                    | 1.13 <del>x</del><br>1.000 <del>ø</del>        |
| 14000        | -3½           | 6    | 24   | 161             |          | 47.9           |           | 65<br>67 <del>x</del><br>77 <del>ø</del> | 86                         | 108                    | 1.125 <del>x</del><br>1.000 <del>ø</del>       |
| 16000        | -8            | 7    | 40   | 161             |          | 47.9           |           | 65<br>67 <del>x</del><br>77 <del>ø</del> | 86                         | 108                    | 1.115 <del>x</del><br>0.995 <del>ø</del>       |
| 18000        | -12           | 8    | 56   | 161             |          | 45.5           |           | 65<br>67 <del>x</del><br>77 <del>ø</del> | 86                         | 108                    | 1.11 <del>x</del><br>0.995 <del>ø</del>        |
| 20000        | -16½          | 10   | 28   | 159             |          | 41.9           |           | 67<br>70 <del>x</del><br>80 <del>ø</del> | 86                         | 108                    | 1.105 <del>x</del><br>.99 <del>ø</del>         |
| 22000        | -20           | 11   | 58   | 155             |          | 39.9           |           | 69<br>71 <del>x</del><br>81 <del>ø</del> | 85                         | 107                    | 1.115 <del>x</del><br>1.005 <del>ø</del>       |
| 24000        | -24           | 13   | 36   | 151             | 2990     | 37.9           |           | 72<br>74 <del>x</del><br>84 <del>ø</del> | 85                         | 106                    | 1.12 <del>x</del><br>1.01 <del>ø</del>         |
| 26000        | -28½          | 15   | 43   | 147             |          | 35.5           |           | 74<br>77 <del>x</del><br>87 <del>ø</del> | 85                         | 106                    | 1.11 <del>x</del><br>1.01 <del>ø</del>         |
| 28000        | -33½          | 18   | 18   | 143             |          | 33.0           |           | 75<br>78 <del>x</del><br>88 <del>ø</del> | 82                         | 104                    | 1.115 <del>x</del><br>1.015 <del>ø</del>       |
| 30000        | -38½          | 21   | 50   | 139             |          | 30.4           |           | 76<br>80 <del>x</del><br>90 <del>ø</del> | 82                         | 102                    | 1.12 <del>x</del><br>1.02 <del>ø</del>         |
| 31000        | -41           | 23   | 57   | 137             |          | 29.1           |           | 77<br>82 <del>x</del><br>92 <del>ø</del> | 80                         | 100                    | 1.13 <del>x</del><br>1.03 <del>ø</del>         |
| 32000        | -43½          | 26   | 45   | 135             |          | 28.1           |           | 75<br>80 <del>x</del><br>90 <del>ø</del> | 80                         | 99                     | 1.135 <del>x</del><br>1.035 <del>ø</del>       |
| 33000        | -46           | 30   | 15   | 133             |          | 27.1           |           | 78<br>83 <del>x</del><br>93 <del>ø</del> | 80                         | 97                     | 1.145 <del>x</del><br>1.045 <del>ø</del>       |

~~x~~ Corrected to temperate summer conditions. )  
~~ø~~ Corrected to tropical summer conditions ) of A.D.M. 491.

R.P.M. changed from 2850 to 2990 at 23,000 ft,  
 Supercharger gear changed at 13,000 ft.

/TABLE II.

APPENDIX

APPENDIX

TABLE II  
OIL COOLING AND RADIATOR SUITABILITY  
FULL THROTTLE CLIMB (REPEAT)

Aeroplane: Kittyhawk II, F.L. 220. Radiator gills fully open. Cockpit heating OFF

| Height Feet. | Air Temp. °C. | Time Min. Sec. | A. S. I. m.p.h. | R. P. M. | Boost Ins. Hg. | Mixture   | Oil Temp. INLET °C. | Oil Press. MAIN lb/sq" | Coolant Engine OUT °C. | Radiator Suitability (T <sub>n</sub> = 125°C) |
|--------------|---------------|----------------|-----------------|----------|----------------|-----------|---------------------|------------------------|------------------------|-----------------------------------------------|
| 2000         | +15           | 0 00           | 161             | 2850     | 47.9           | Auto Rich | 56<br>62x<br>72ø    | 90                     | 100                    | 1.20 x<br>1.04 ø                              |
| 4000         | +12           | 1 03           |                 |          | 47.9           |           | 59<br>64x<br>74ø    | 90                     | 100                    | 1.20 x<br>1.05 ø                              |
| 6000         | +9½           | 2 02           |                 |          | 47.9           |           | 62<br>66x<br>76ø    | 86                     | 103                    | 1.18 x<br>1.03 ø                              |
| 8000         | +7            | 3 03           |                 |          | 47.9           |           | 63<br>66x<br>76ø    | 86                     | 104                    | 1.18 x<br>1.03 ø                              |
| 10000        | +4            | 4 06           |                 |          | 47.4           |           | 64<br>66x<br>76ø    | 86                     | 105                    | 1.17 x<br>1.03 ø                              |
| 12000        | 0             | 5 10           |                 |          | 44.0           |           | 64<br>66x<br>76ø    | 86                     | 106                    | 1.15 x<br>1.02 ø                              |
| 14000        | -4            | 6 23           |                 |          | 47.9           |           | 64<br>66x<br>76ø    | 86                     | 106                    | 1.14 x<br>1.02 ø                              |
| 16000        | -8            | 7 40           |                 |          | 47.9           |           | 65<br>67x<br>77ø    | 86                     | 107                    | 1.13 x<br>1.00 ø                              |
| 18000        | -12           | 9 02           |                 |          | 45.0           |           | 65<br>67x<br>77ø    | 86                     | 107                    | 1.12 x<br>1.00 ø                              |
| 20000        | -16           | 10 38          | 159             |          | 42.0           |           | 65<br>67x<br>77ø    | 86                     | 107                    | 1.12 x<br>1.00 ø                              |
| 22000        | -20           | 12 24          | 157             |          | 38.9           |           | 67<br>69x<br>79ø    | 84                     | 106                    | 1.12 x<br>1.01 ø                              |
| 24000        | -24           | 14 29          | 153             | 2960     | 38.4           |           | 71<br>73x<br>83ø    | 82                     | 105                    | 1.13 x<br>1.02 ø                              |
| 26000        | -28½          | 16 47          | 149             |          | 35.5           |           | 72<br>75x<br>85ø    | 82                     | 103                    | 1.14 x<br>1.03 ø                              |
| 27000        | -31           | 17 58          | 147             |          | 34             |           | 73<br>76x<br>86ø    | 82                     | 102                    | 1.14 x<br>1.03 ø                              |
| 28000        | -33½          | 19 28          | 143             |          | 32.5           |           | 75<br>78x<br>88ø    | 82                     | 101                    | 1.14 x<br>1.04 ø                              |
| 30000        | -39           | 23 23          | 141             |          | 30.6           |           | 75<br>79x<br>89ø    | 82                     | 100                    | 1.13 x<br>1.03 ø                              |

x Corrected to temperate summer conditions } of A. D. M. 491  
ø " " tropical " " }

R. P. M. changed from 2850 to 2960 at 23,000 ft.  
Supercharger changed at 13,000 ft.

/TABLE III.

Cockpit heating OFF  
Radiator  
Suitability

APPENDIX

TABLE III  
OIL COOLING AND RADIATOR SUITABILITY  
CRUISING FLIGHT

M. S. Supercharger gear - Hight - 13,000 ft. Radiator Gills in neutral position  
Aeroplane: Kittyhawk II. F.L. 220. Cockpit Heating OFF.

| Condition     | Boost ins. Hg. | R. P. M. | A. S. I. M. P. H. |
|---------------|----------------|----------|-------------------|
| Weak Cruising | 38             | 2650     | 238               |
| Rich cruising | 42             | 2650     | 254               |
| Full throttle | 47½            | 3000     | 269½              |

| Time from commencement of flight. mins. | Air Temp. °C. | Mixture | Oil Pressure lb/sq. in. MAIN | Oil Temperature INLET °C. | Coolant Temperature Engine OUT °C. | Radiator Suitability (T <sub>n</sub> = 115°C) |
|-----------------------------------------|---------------|---------|------------------------------|---------------------------|------------------------------------|-----------------------------------------------|
| 0                                       | -½            | Weak    | 84                           | 64<br>65X<br>75Ø<br>61    | 100                                | 1.135 X<br>.995 Ø                             |
| 2                                       | ↓             | ↓       | ↓                            | 62X<br>72Ø<br>60          | 94                                 | 1.205 X<br>1.06 Ø                             |
| 4 to 12                                 | ↓             | ↓       | ↓                            | 61X<br>71Ø                | 92                                 | 1.235 X<br>1.08 Ø                             |
| 5 Minutes full throttle                 |               |         |                              |                           |                                    |                                               |
| 0                                       | -½            | Weak    | 85                           | 62<br>63X<br>73Ø<br>61    | 97                                 | 1.17 X<br>1.025 Ø                             |
| 2                                       | ↓             | ↓       | ↓                            | 62X<br>72Ø<br>60          | 96                                 | 1.18 X<br>1.035 Ø                             |
| 4                                       | ↓             | ↓       | ↓                            | 61X<br>71Ø<br>60          | 96                                 | 1.18 X<br>1.035 Ø                             |
| 6                                       | ↓             | ↓       | ↓                            | 61X<br>71Ø<br>60          | 95                                 | 1.195 X<br>1.045 Ø                            |
| 8 to 14                                 | ↓             | ↓       | ↓                            | 61X<br>71Ø                | 94                                 | 1.205 X<br>1.06 Ø                             |
| 5 Minutes full throttle                 |               |         |                              |                           |                                    |                                               |
| 0                                       | -½            | Rich    | 85                           | 61<br>62X<br>72Ø<br>60    | 97                                 | 1.17 X<br>1.025 Ø                             |
| 2                                       | ↓             | ↓       | ↓                            | 61X<br>71Ø<br>60          | 96                                 | 1.18 X<br>1.035 Ø                             |
| 4                                       | ↓             | ↓       | ↓                            | 61X<br>71Ø<br>60          | 95                                 | 1.195 X<br>1.045 Ø                            |
| 6 to 8                                  | ↓             | ↓       | ↓                            | 61X<br>71Ø<br>60          | 96                                 | 1.18 X<br>1.035 Ø                             |
| 10 to 12                                | ↓             | ↓       | ↓                            | 61X<br>71Ø                | 95                                 | 1.195 X<br>1.045 Ø                            |

X Corrected to temperate summer conditions. } of A. D. M. 491,  
Ø " " tropical " " }

APPENDIX

TABLE IV  
OIL COOLING AND RADIATOR SUITABILITY  
CRUISING FLIGHT (REPEAT)

M. S. Supercharger gear. Height - 13,000 ft. Radiator gills in neutral position.  
Aeroplane:- Kittyhawk II. F.L. 220. Cockpit heating OFF.

| Conditions    | Boost ins. of Hg. | R.P.M. | A. S. I. m. p. h. |
|---------------|-------------------|--------|-------------------|
| Weak cruising | 38                | 2650   | 244               |
| Rich cruising | 41½               | 2650   | 256               |
| Full throttle | 48                | 2980   | 272               |

| Time from commencement of flight. mins. | Air Temp. °C. | Mixture | Oil Pressure lb/sq. in. MAIN | Oil Temperature INLET °C.                      | Coolant Temperature Engine OUT °C. | Radiator Suitability (T <sub>n</sub> = 115°C) |
|-----------------------------------------|---------------|---------|------------------------------|------------------------------------------------|------------------------------------|-----------------------------------------------|
| 0                                       | -9½           | Weak    | 85                           | 63<br>70 <del>X</del><br>80 <del>Ø</del><br>63 | 85                                 | 1.205 <del>X</del><br>1.06 <del>Ø</del>       |
| 4                                       | ↓             | ↓       | ↓                            | 70 <del>X</del><br>80 <del>Ø</del><br>64       | 84                                 | 1.220 <del>X</del><br>1.07 <del>Ø</del>       |
| 8                                       | ↓             | ↓       | ↓                            | 71 <del>X</del><br>81 <del>Ø</del><br>65       | 84                                 | 1.220 <del>X</del><br>1.07 <del>Ø</del>       |
| 10                                      | ↓             | ↓       | ↓                            | 72 <del>X</del><br>82 <del>Ø</del><br>65       | 83                                 | 1.23 <del>X</del><br>1.08 <del>Ø</del>        |
| 12                                      | ↓             | ↓       | ↓                            | 72 <del>X</del><br>82 <del>Ø</del><br>65       | 83                                 | 1.23 <del>X</del><br>1.08 <del>Ø</del>        |
| 14 to 16                                | ↓             | ↓       | ↓                            | 72 <del>X</del><br>82 <del>Ø</del>             | 84                                 | 1.22 <del>X</del><br>1.07 <del>Ø</del>        |
| 5 Minutes at full throttle              |               |         |                              |                                                |                                    |                                               |
| 0                                       | -9½           | Weak    | 85                           | 63<br>70 <del>X</del><br>80 <del>Ø</del><br>63 | 89                                 | 1.155 <del>X</del><br>1.015 <del>Ø</del>      |
| 4 to 10                                 | ↓             | ↓       | ↓                            | 70 <del>X</del><br>80 <del>Ø</del>             | 84                                 | 1.22 <del>X</del><br>1.07 <del>Ø</del>        |
| 5 Minutes at full throttle              |               |         |                              |                                                |                                    |                                               |
| 0                                       | -9½           | Rich    | 85                           | 63<br>70 <del>X</del><br>80 <del>Ø</del><br>62 | 88                                 | 1.17 <del>X</del><br>1.025 <del>Ø</del>       |
| 4                                       | ↓             | ↓       | ↓                            | 69 <del>X</del><br>79 <del>Ø</del><br>63       | 85                                 | 1.205 <del>X</del><br>1.06 <del>Ø</del>       |
| 8 to 12                                 | ↓             | ↓       | ↓                            | 70 <del>X</del><br>80 <del>Ø</del>             | 85                                 | 1.205 <del>X</del><br>1.06 <del>Ø</del>       |

~~X~~ Corrected to Temperate summer conditions } of A. D. M. 491.  
~~Ø~~ Corrected to tropical summer conditions }

/TABLE V.

F. S. Supercharger gear  
Aeroplane:- Kittyhawk

INDIA



neutral position.

APPENDIX.

TABLE V  
OIL COOLING AND RADIATOR SUITABILITY  
CRUISING FLIGHT.

F.S. Supercharger gear. Height: 20,000 ft. Radiator gills in neutral position.  
Aeroplane:- Kittyhawk II. F.L. 220. Cockpit heating OFF.

| Conditions.   | Boost ins. of Hg. | R. P. M. | A. S. I. m. p. h. |
|---------------|-------------------|----------|-------------------|
| Weak cruising | 38                | 2650     | 228               |
| Rich cruising | 41                | 2650     | 240               |
| Full throttle | 43                | 3000     | 253               |

| Time from commence of flight. mins. | Air Temp. °C. | Mixture | Oil Pressure lb/sq. in. MAIN | Oil Temperature INLET °C.                      | Coolant Temperature Engine. OUT °C. | Radiator Suitability (T <sub>n</sub> = 115°C) |
|-------------------------------------|---------------|---------|------------------------------|------------------------------------------------|-------------------------------------|-----------------------------------------------|
| 0                                   | -14           | Weak    | 85                           | 65<br>66 <del>X</del><br>76 <del>Ø</del><br>64 | 99                                  | 1.13 <del>X</del><br>1.00 <del>Ø</del>        |
| 4                                   | ↓             | ↓       | 83                           | 65 <del>X</del><br>75 <del>Ø</del><br>64       | 98                                  | 1.14 <del>X</del><br>1.01 <del>Ø</del>        |
| 8 to 12                             | ↓             | ↓       | 83                           | 65 <del>X</del><br>75 <del>Ø</del>             | 95                                  | 1.17 <del>X</del><br>1.04 <del>Ø</del>        |
| 5 Minutes full throttle             |               |         |                              |                                                |                                     |                                               |
| 0                                   | -14           | Weak    | 84                           | 67<br>60 <del>X</del><br>73 <del>Ø</del><br>65 | 96                                  | 1.16 <del>X</del><br>1.03 <del>Ø</del>        |
| 4                                   | ↓             | ↓       | 83                           | 66 <del>X</del><br>76 <del>Ø</del><br>64       | 97                                  | 1.15 <del>X</del><br>1.02 <del>Ø</del>        |
| 8                                   | ↓             | ↓       | ↓                            | 65 <del>X</del><br>75 <del>Ø</del><br>64       | 96                                  | 1.16 <del>X</del><br>1.03 <del>Ø</del>        |
| 10 - 14                             | ↓             | ↓       | ↓                            | 65 <del>X</del><br>75 <del>Ø</del>             | 95                                  | 1.17 <del>X</del><br>1.04 <del>Ø</del>        |
| 5 Minutes full throttle             |               |         |                              |                                                |                                     |                                               |
| 0                                   | -14           | Rich    | 83                           | 64<br>65 <del>X</del><br>75 <del>Ø</del><br>64 | 95                                  | 1.17 <del>X</del><br>1.04 <del>Ø</del>        |
| 4 - 10                              | ↓             | ↓       | 83                           | 65 <del>X</del><br>75 <del>Ø</del>             | 94                                  | 1.18 <del>X</del><br>1.05 <del>Ø</del>        |

~~X~~ Corrected to temperate summer conditions } of A.D.M. 491.  
~~Ø~~ Corrected to tropical summer conditions. }

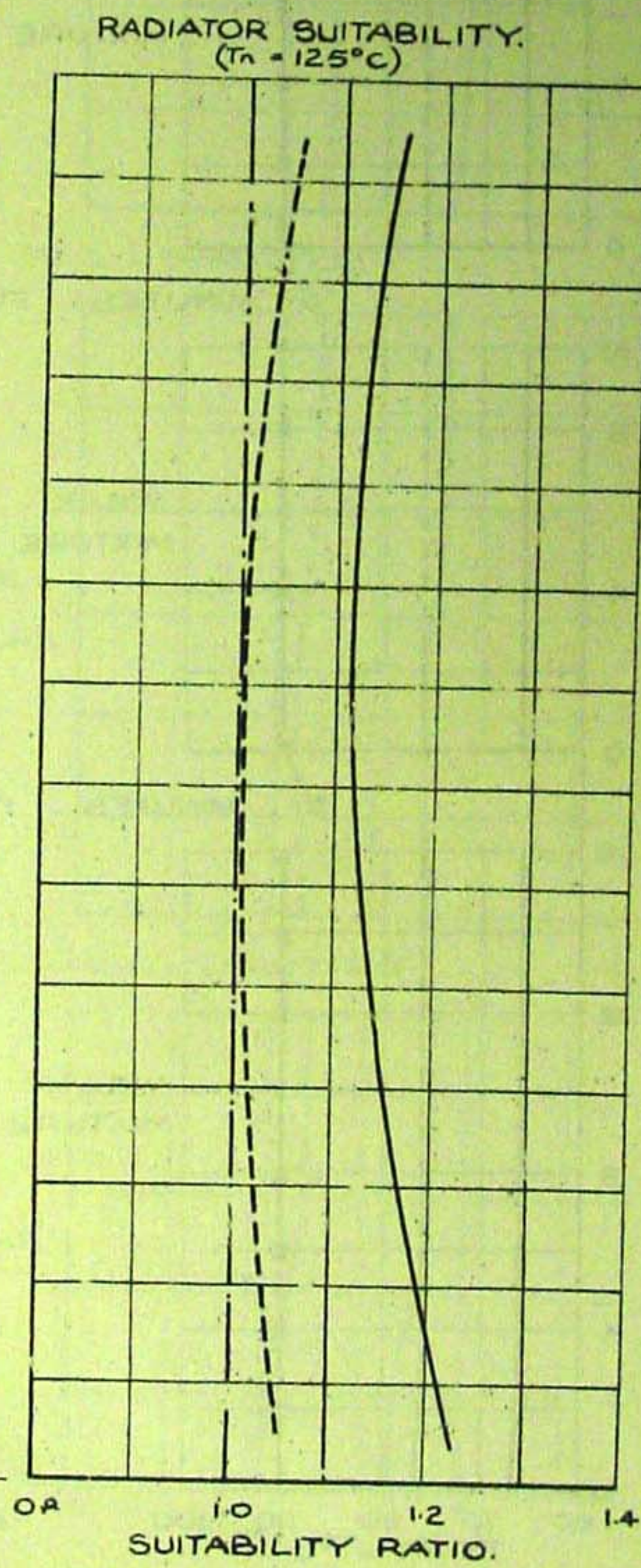
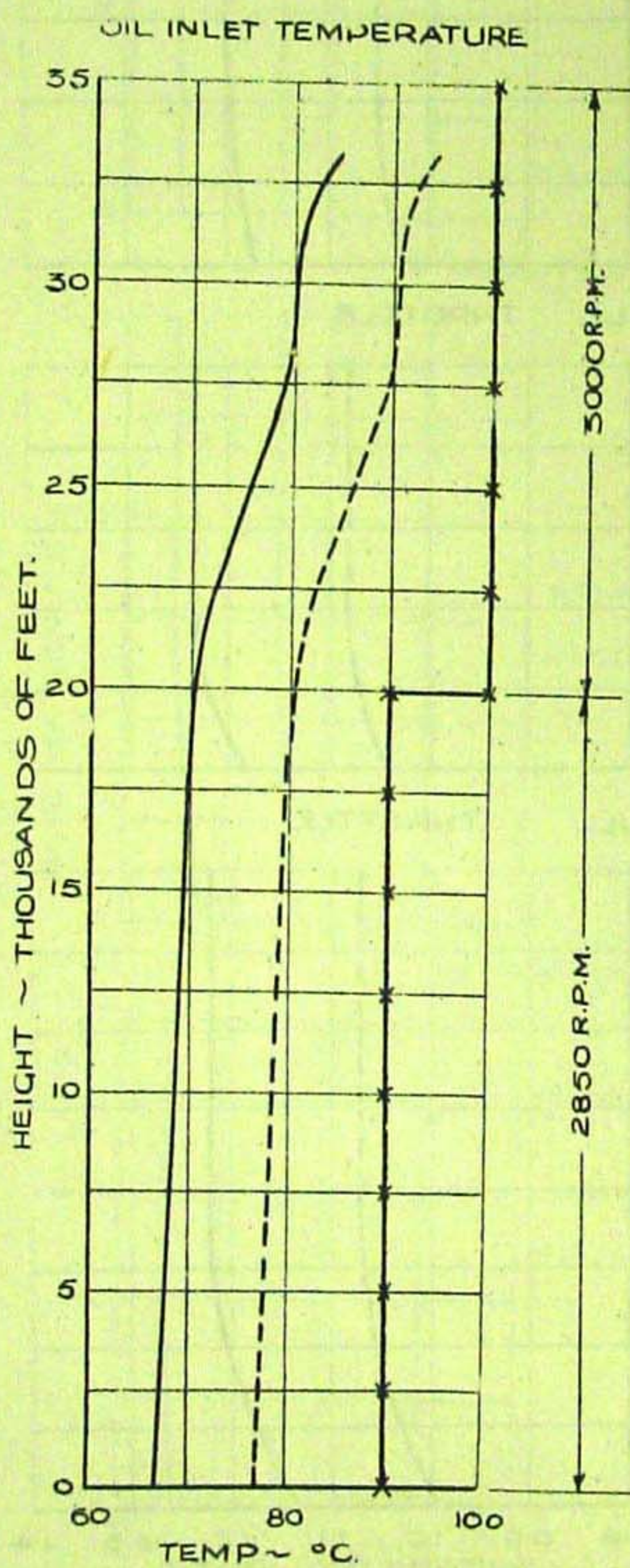
FIG 1.

# KITTYHAWK II FL220

OIL COOLING AND RADIATOR SUITABILITY  
FULL THROTTLE CLIMB.

\_\_\_\_\_ CORRECTED TO TEMPERATE SUMMER CONDITIONS } OF A.D.M.  
 - - - - - " " TROPICAL " " } 491.  
 \* \* \* \* \* MAX PERMISSIBLE OIL INLET TEMPERATURE

SUPERCHARGER GEAR CHANGED AT 13,000 FT.  
RADIATOR DUCT GILLS FULLY OPEN.



5<sup>th</sup> PART OF REPORT N° A6AEE / 785a | CURVE N° 4349 | TRACED. W.L. Loop. | DATE OF TEST. AUG. 1942. | CHECKED. S.A.L. | APPROVED. A.F.C.

KIT  
OIL CO

# KITTYHAWK II FL-220

## OIL COOLING AND RADIATOR SUITABILITY IN CRUISING FLIGHT.

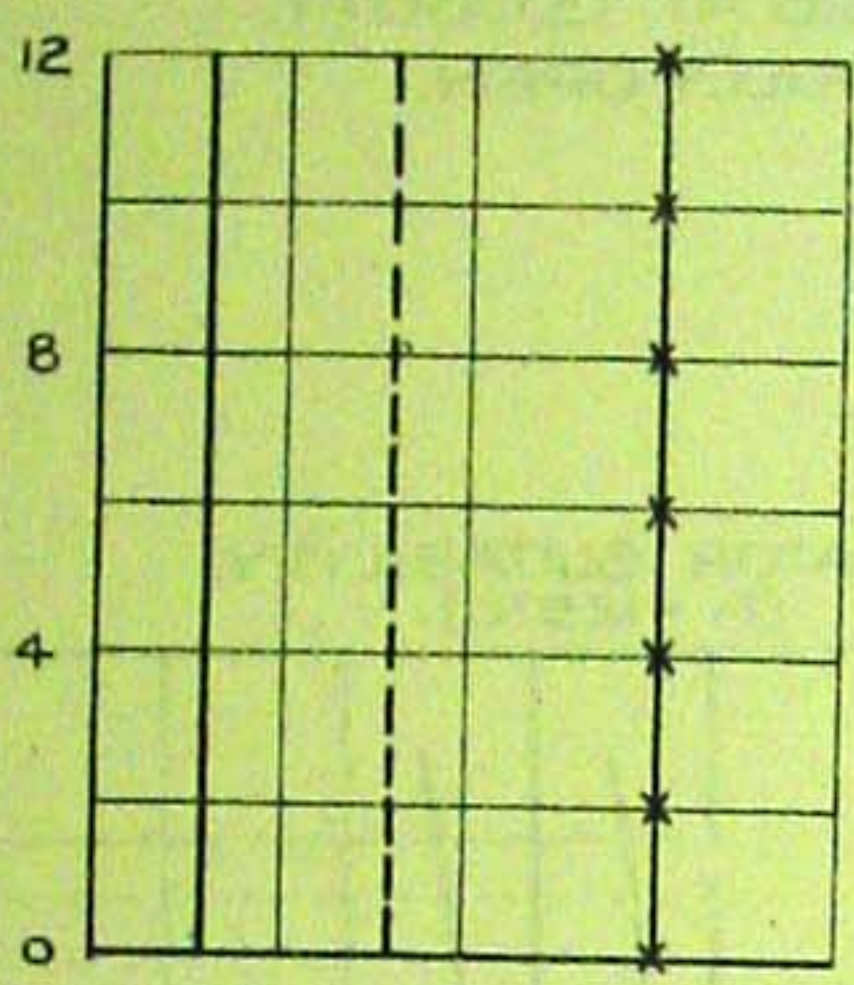
HEIGHT ~ 13,000 FT.  
M.S. SUPERCHARGER GEAR

— CORRECTED TO TEMPERATE SUMMER CONDITIONS } OF A.D.M.  
 - - - " " TROPICAL " " } 491.  
 \* \* \* \* \* MAX. PERMISSIBLE OIL INLET TEMPERATURE  
 IN CRUISING FLIGHT ~ 90°C.

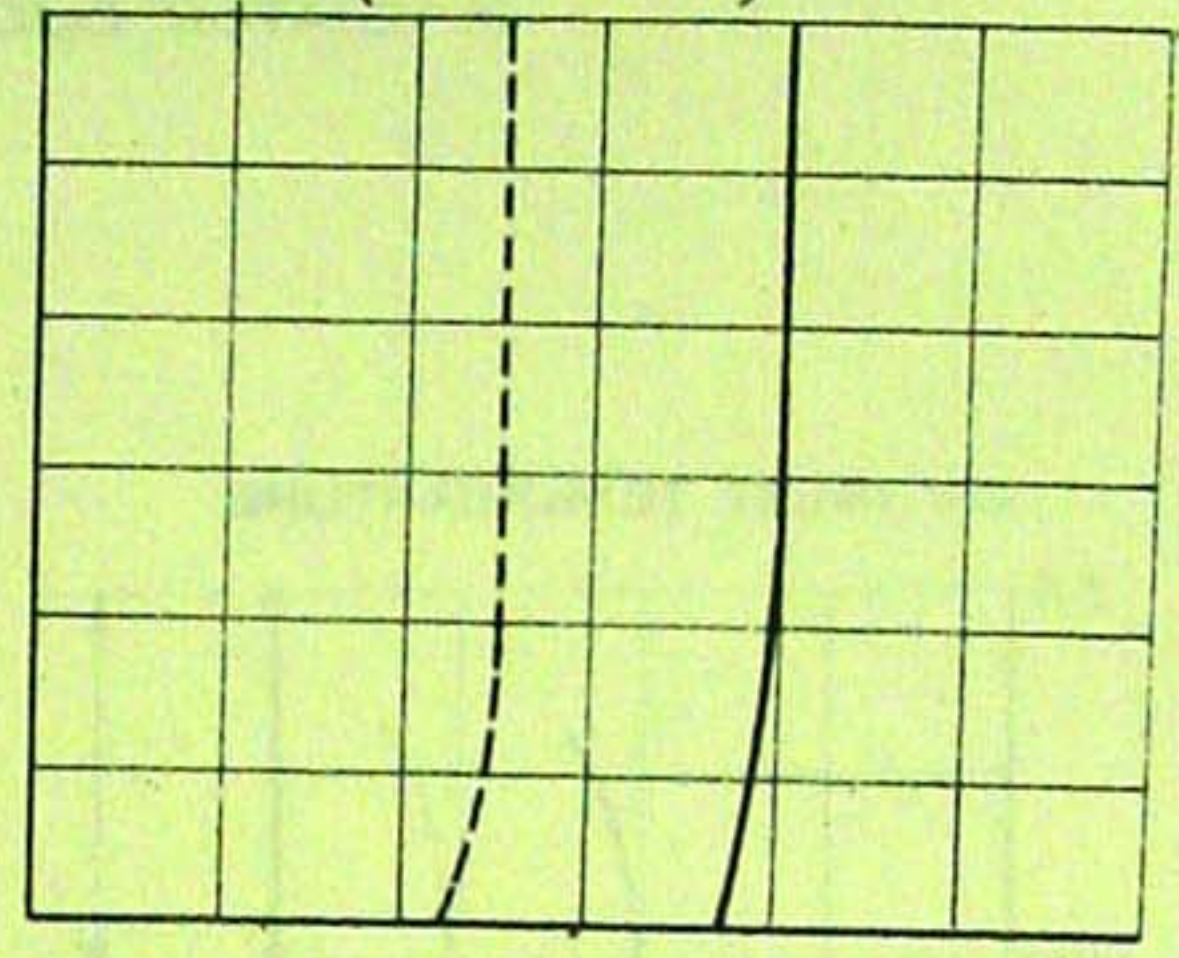
RADIATOR DUCT GILLS IN NEUTRAL POSITION.

OIL INLET TEMPERATURE.

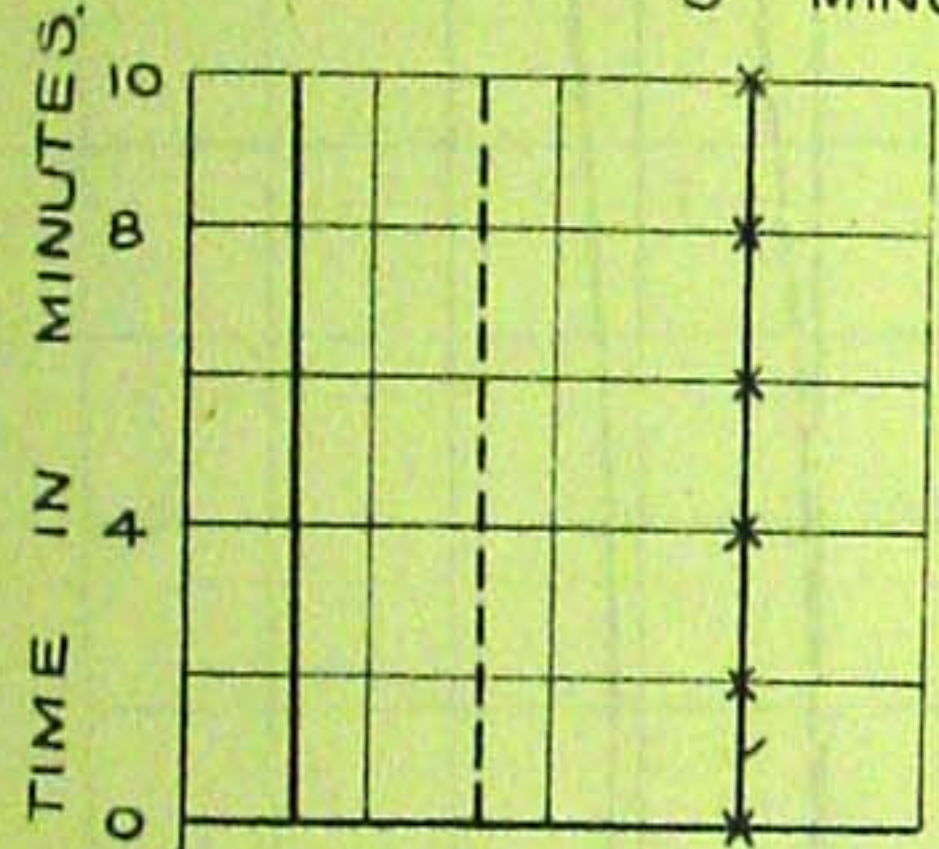
RADIATOR SUITABILITY  
( $T_n = 115^\circ\text{C}$ )



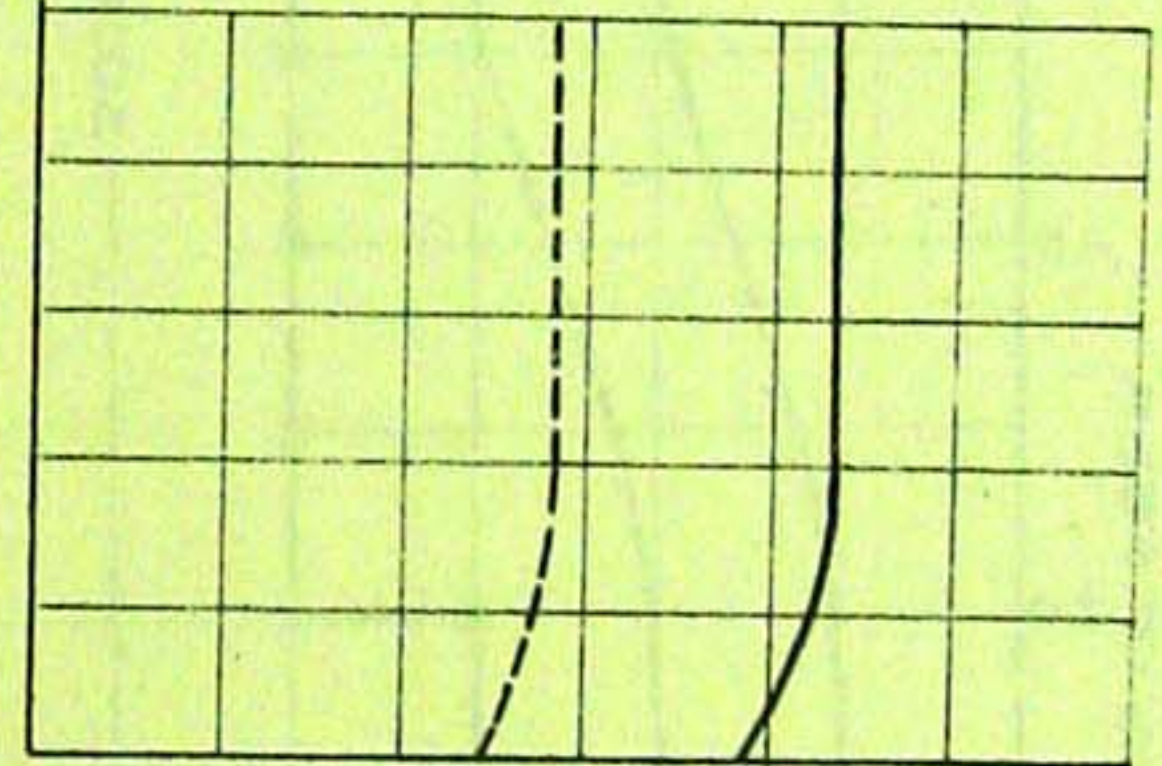
RICH  
MIXTURE



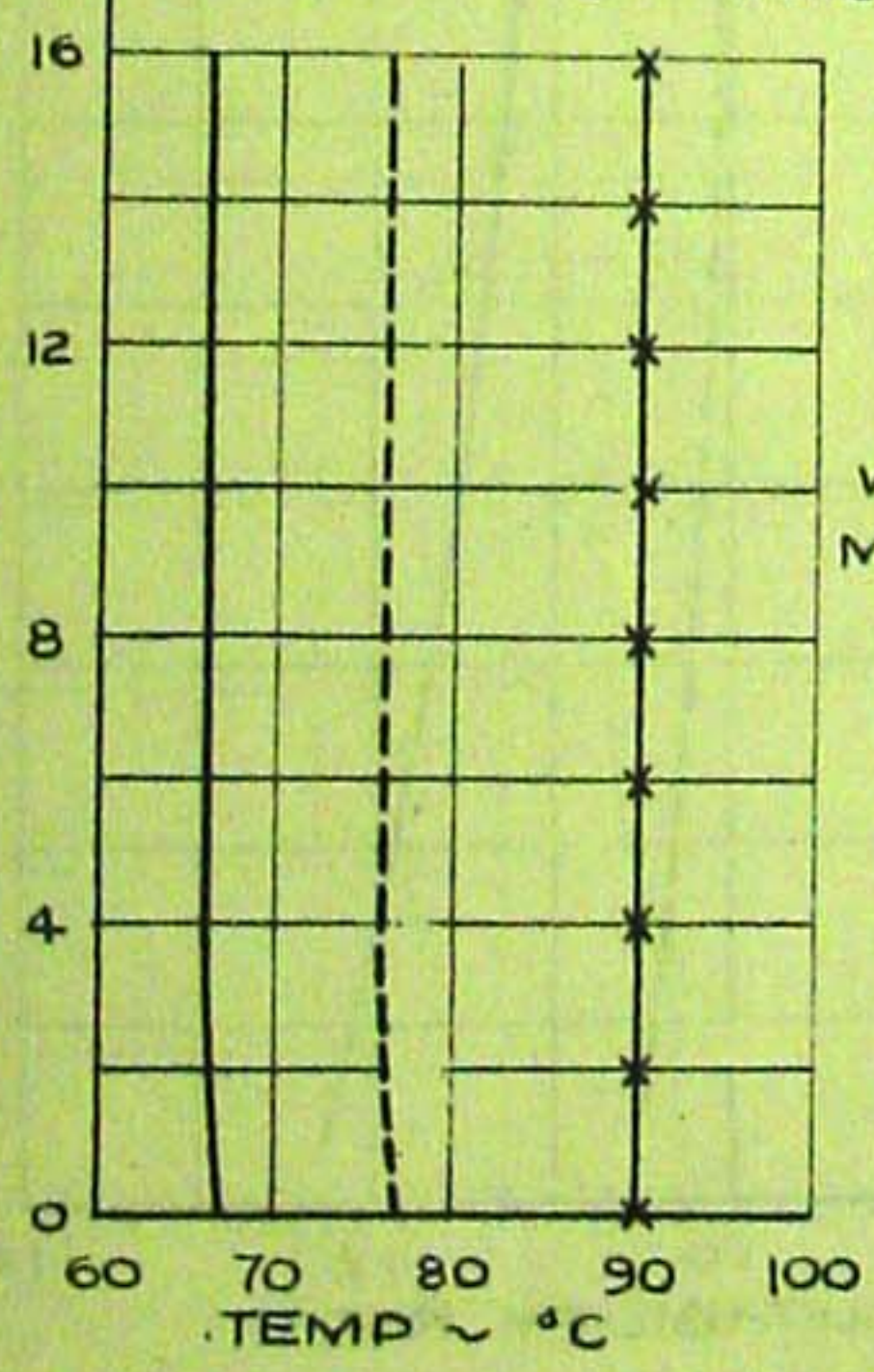
5 MINUTES FULL THROTTLE



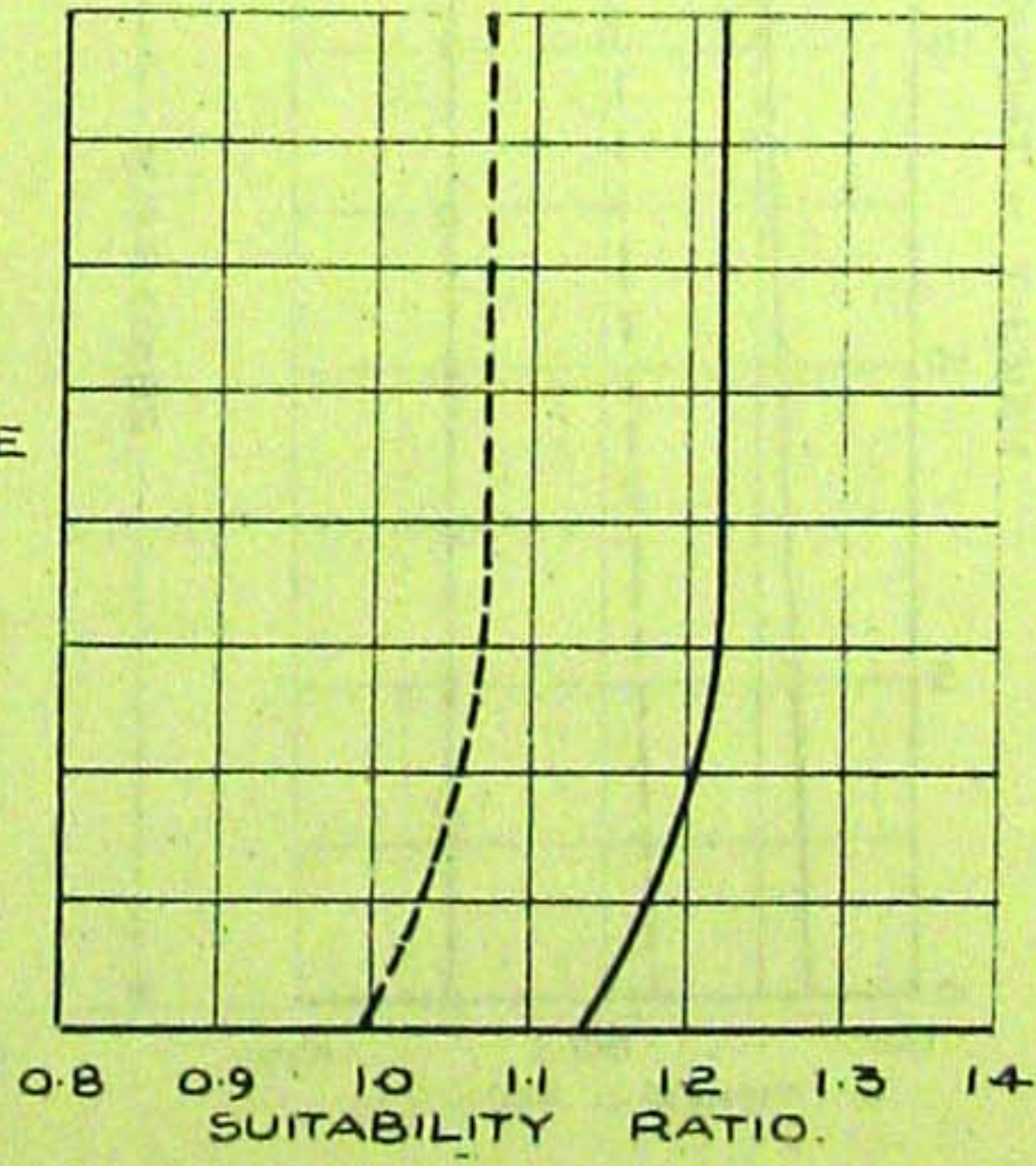
WEAK  
MIXTURE



5 MINUTES FULL THROTTLE



WEAK  
MIXTURE



5<sup>th</sup> PART OF REPORT No A 8 AEE / 783 a. CURVE No 4350. TRACED. DATE OF TEST: AUG 1942. CHECKED: D. A. G. APPROVED: A. T. G.

TEMP ~ °C

SUITABILITY RATIO.

5<sup>th</sup> PART OF REPORT NO A&AEE/783w. CURVE NO. 4351. TRACED. G. J. WOOD. DATE OF TEST. AUG. 1942. CHECKED. S. A. S. APPROVED.

# KITT YHAWK II FL-220 FIG 3

## OIL COOLING AND RADIATOR SUITABILITY IN CRUISING FLIGHT

HEIGHT ~ 20,000 FT.  
FS SUPERCHARGER GEAR.

————— CORRECTED TO TEMPERATE SUMMER CONDITIONS } OF A.D.M.  
 - - - - - " " TROPICAL " " " } 491.  
 \* \* \* \* \* MAX. PERMISSIBLE OIL INLET TEMPERATURE  
 IN CRUISING FLIGHT. ~ 90°C.  
 RADIATOR DUCT GILLS IN NEUTRAL POSITION.

