

# FOUR STROKE OUTBOARD PETROL ENGINE HOMOLOGATION FILE

| International Homologat                    | ion File Number:  | 00540                     |
|--|---|---------------------------|
| Homologation Valid from:                   | 2021  | Expiry: December 31, 2031 |
| Valid for the following classes:           | CIRCUIT<br>Formula 2, S2                                    |                           |
| Manufacturer:                              | Mercury Marine  |                           |
| Engine Model:                              | Mercury Racing<br>200APX                                    |                           |
| Number Manufactured:                       | >1000 V6 engines  |                           |
| At the date:                               | January 1, 2020   |                           |
| Certified by the National<br>Authority of: |   |                           |
| At the date:                               |   |                           |
| UIM Homologation Group<br>Inspector:       | Mikael Lundblad   |                           |
| At the date:                               | July 15, 2021   |                           |
| UIM Certification<br>Approval:             | Union Internationale Mo                                     | tonautique                |
| At the date:                               | July 15, 2021   |                           |
| Running Production Changes                 |   |                           |
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|  | Union Internationale Motonautiqu<br>1, Avenue des Castelans | e                         |

1, Avenue des Castelans 98000 Monaco Tel: +377 92 05 25 22 uim@uim.sport

## PICTURES





## **PICTURES**





#### UIM Homologation File No: 00540

































## MEASUREMENTS

### **ENGINE FUEL**

| Туре:   |           | Gasoline                |                |
|---|-----------|-------------------------|----------------|
| Minimum octane required:  |           | 98                      | RON            |
| ENGINE TYPE   |           |                         |                |
| Number of cylinders:  |           | 6                       | Cylin-<br>ders |
| Cylinder arrangement:   |           | V (64°)                 |                |
| ENGINE BLOCK  | Tolerance | Measurement             | Unit           |
| Bore  | +/- 0.10  | 92.00                   | mm             |
| Stroke  | +/- 0.10  | 86.00                   | mm             |
| Capacity per cylinder   | max       | 573.6                   | cc             |
| Total Capacity  | max       | 3 442                   | cc             |
| Cylinder block material   |           | XK360.2-T5<br>Aluminium |                |
| Cylinder liner material   |           | Grey iron               |                |
| Distance from crankshaft centreline to cylinder block deck face.    | +/- 0.10  | 210.0                   | mm             |
| CYLINDER HEAD   | Tolerance | Measurement             | Unit           |
| Cylinder head material  |           | A356-T6 Aluminiu        | m              |
| Volume of combustion chamber<br>(without volume of spark plug hole) | min       | 51.9                    | сс             |
| Compression ratio   | nom       | 10.9                    |                |
| Thickness of cylinder head  | +/- 0.20  | 96.0                    | mm             |
| Inlet Port:   |           |                         |                |
| Size of port at cylinder head/manifold face                         | max       | 30 x 60                 | mm             |
| Internal diameter of valve seat insert                              | +/- 0.20  | 33.1                    | mm             |
| Surface finish of port  |           | Cast                    |                |
| Exhaust Port:   |           |                         |                |
| Size of port at cylinder head/manifold face                         | max       | N/A                     | mm             |
| Internal diameter of valve seat insert                              | +/- 0.20  | 26.1                    | mm             |
| Surface finish of port  |           | Cast                    |                |

| Inlet Valves:   |           |             |         |
|---|-----------|-------------|---------|
| Diameter of stem  | +/- 0.008 | 5.4725      | mm      |
| Diameter of head  | +/- 0.1   | 37.00       | mm      |
| Overall length of inlet valve   | +/- 0.25  | 88.49       | mm      |
| Exhaust Valves:   |           |             |         |
| Diameter of stem  | +/- 0.008 | 5.464       | mm      |
| Diameter of head  | +/- 0.1   | 31.0        |         |
| Overall length of exhaust valve   | +/- 0.25  | 87.67       | mm      |
| Valve Springs:  |           |             |         |
| Diameter of wire  | max       | 2.925       | mm      |
| Inside diameter of coil   | min       | 17.5        | mm      |
| Free length   | +/- 0.5   | 46.1        | mm      |
| Number of working turns   | +/- 0.5   | 6.1         | turns   |
| CAMSHAFT/SHAFTS   | Tolerance | Measurement | Unit    |
| Inlet:  |           |             |         |
| Tappet clearance for checking timing  | +/- 0.050 | 0.175       | mm      |
| Total valve lift (at nominal lash)  | +/- 0.10  | 7.89        | mm      |
| Total (duration) inlet opening angle  |           | 104         | 1       |
| (measured at flywheel in degrees at 1,0 mm valve<br>lift at specified valve lash)   | +/- 5°    | 194         | degrees |
| Duration inlet opening angle 3mm under max valve lift (measured at flywheel in degrees)                                     | +/- 2°    | 122         | degrees |
| Base circle diameter of lobe  | +/- 0.02  | 35.00       | mm      |
| Cam shaft lobe height   | +/- 0.05  | 43.07       | mm      |
| Exhaust:  |           |             |         |
| Tappet clearance for checking timing  | +/- 0.050 | 0.350       | mm      |
| Total valve lift (at nominal lash)  | +/- 0.10  | 8.89        | mm      |
| Total (duration) exhaust opening angle<br>(measured at flywheel in degrees at 1,0 mm valve<br>lift at specified valve lash) | +/- 5°    | 204         | degrees |
| Duration inlet opening angle 3mm under max valve lift (measured at flywheel in degrees)                                     | +/- 2°    | 128         | degrees |
| Base circle diameter of lobe  | +/- 0.02  | 35.00       | mm      |
| Cam shaft lobe height   | +/- 0.05  | 44.24       | mm      |

## PISTONS

| Material of piston  |   | Aluminium            |                |
|---|---|----------------------|----------------|
| Type and thickness of rings   | Square<br>Taper Faced Napier<br>Oil Control | 1.20<br>1.00<br>2.00 | mm<br>mm<br>mm |
| Piston crown depth <i>below</i> head deck at top dead center, edge (a)    | min   | 0.30                 | mm             |
| Piston crown height <i>above</i> head deck at top dead center, center (b) | max   | 0.94                 | mm             |
|   |   |                      |                |

| CONNECTING ROD  | Tolerance | Measurement                         | Unit     |
|---|-----------|-------------------------------------|----------|
| Length of rod from big end to small end<br>(centre to centre) | +/- 0.05  | 140.5                               | mm       |
| CRANKSHAFT  |           | Measurement                         | Unit     |
| Number of main bearing journals                               |           | 4                                   |          |
| Diameter of main bearing journals                             |           | 69.984-70.000                       | mm       |
| Diameter of connecting rod journals                           |           | 53.984-54.000                       | mm       |
| Surface finish of crankshaft                                  |           | Primarily machine<br>some as-forged | ed, with |

### **TYPE OF BEARINGS**

| Piston Pin                |           | Floating        |           |
|---------------------------|-----------|-----------------|-----------|
| Connecting Rod journal    |           | Plain           |           |
| Main journal              |           | Plain           |           |
| FUEL INJECTION            | Tolerance | Measurement     | Unit      |
| Make                      |           | Walbro          |           |
| Type of pump, model no.   |           | Gerotor, FGB-29 |           |
| Fuel pressure at idle     |           | approx 290-340  | kPa       |
| Fuel pressure no running  |           | 340-370         | kPa       |
| Total number of injectors |           | 6               | Injectors |
| Diameter of throttle bore | max       | 64.0            | mm        |

## **COOLING SYSTEM**

| Туре                                 | Raw water<br>cooled                              |    |
|--------------------------------------|--|----|
| Method                               | Thermostat<br>controlled with<br>pressure relief |    |
| Pump                                 | Rubber impeller<br>vane pump                     |    |
| Number of impeller blades            | 6  |    |
| Thermostat start opening temperature | 57-61  | °C |
| Thermostat fully opened              | 77   | °C |

## VALVE INSPECTION

#### Intake valve

| Intake Valve Specifications |  |                  |  |
|-----------------------------|--|------------------|--|
| Intake valve                | Height (a)   | 88.49 ± 0.25 mm  |  |
|                             | Valve stem diameter (e)                                  | 5.4645-5.4805 mm |  |
|                             | Valve face angle   | 45°              |  |
|                             | Outside diameter (d)                                     | 37.0 ± 0.1 mm    |  |
|                             | Valve margin width (c)                                   | 0.875 ± 0.2 mm   |  |
|                             | Valve stem service limit runout (measured at valve face) | 0.030 mm         |  |



Exhaust valve

| Exhaust Valve Specifications |  |                  |  |
|------------------------------|--|------------------|--|
| Exhaust valve                | Height (a)   | 87.667 ± 0.25 mm |  |
|                              | Valve stem diameter (e)                                  | 5.456-5.472 mm   |  |
|                              | Valve face angle   | 46*              |  |
|                              | Outside diameter (d)                                     | 31.0 ± 0.1 mm    |  |
|                              | Valve margin width (c)                                   | 1.331 ± 0.2 mm   |  |
|                              | Valve stem service limit runout (measured at valve face) | 0.030 mm         |  |



| Intake Valve Seat Specifications  |                                   |                 |  |
|-----------------------------------|-----------------------------------|-----------------|--|
| Valve Seat                        | Surface (a) angle from valve axis | 20°± 1°         |  |
|                                   | Surface (b) angle from valve axis | 30°±1°          |  |
| Surface (c) angle from valve axis |                                   | 44°± 0.25°      |  |
| Surface (d) angle from valve axis |                                   | 60°±1°          |  |
| Surface (b) width                 |                                   | 1 ± 0.2 mm      |  |
|                                   | Surface (c) width                 | 1 ± 0.1 mm      |  |
|                                   | Diameter (e)                      | Ø36.45 ± 0.1 mm |  |





| Exhaust Valve Seat Specifications   |                                   |                |  |
|-------------------------------------|-----------------------------------|----------------|--|
| Valve Seat                          | Surface (a) angle from valve axis | 20°± 1°        |  |
|                                     | Surface (b) angle from valve axis | 35°± 1°        |  |
|                                     | Surface (c) angle from valve axis | 44°± 0.25°     |  |
| Surface (d) angle from valve axis 5 |                                   | 55°±1°         |  |
|                                     | Surface (b) width                 | 1.2 ± 0.2 mm   |  |
|                                     | Surface (c) width                 | 1.2 ± 0.1 mm   |  |
|                                     | Diameter (e)                      | Ø30.4 ± 0.1 mm |  |



## SENSOR TESTS

Cylinderblock coolant sensor

| Meter T              | est Leads           | Temperature    | Reading (nominal) |
|----------------------|---------------------|----------------|-------------------|
| Red                  | Black               |                |                   |
| Pin A (black/orange) | Pin B (brown/black) | 0 °C (32 °F)   | 32.6 kΩ           |
|                      |                     | 20 °C (68 °F)  | 12.5 kΩ           |
|                      |                     | 40 °C (104 °F) | 5.3 kΩ            |
|                      |                     | 65 °C (150 °F) | 2.1 kΩ            |
|                      |                     | 95 °C (203 °F) | 786 Ω             |

#### Manifold Absolute Pressure Sensor

| Manifold Absolute Pressure (MAP) Sensor Readings |                     |  |  |
|--|---------------------|--|--|
| At idle (neutral)                                | 35-48 kPa (5-7 psi) |  |  |
| At wide-open throttle                            | Within 15% of BARO  |  |  |

### Manifold Air Temperature Sensor

| Meter Test Leads |                      | Temperature     | Reading (nominal) |
|------------------|----------------------|-----------------|-------------------|
| Red              | Black                |                 |                   |
| Pin A (tan)      | Pin B (black/orange) | 0 °C (32 °F)    | 6.5 kΩ            |
|                  |                      | 15 °C (59 °F)   | 3.2 kΩ            |
|                  |                      | 25 °C (77 °F)   | 2.1 kΩ            |
|                  |                      | 100 °C (212 °F) | 150 Ω             |

| SPARK PLUG |          |  |
|------------|----------|--|
| Brand      | NGK      |  |
| Model      | LKAR7C-9 |  |

## **ENGINE GRAPHCIS**

The color of graphic items (1) and (2) may be modified as desired. All other graphics and components must remain as shown. Pattern files for items (1) and (2) are available from Mercury Racing upon request.



| WEIGHTS                                  | Tolerance | Measurement      | Unit       |
|--|-----------|------------------|------------|
| Inlet valve (bare)                       | min       | 47               | g          |
| Exhaust valve (bare)                     | min       | 36               | g          |
| Valve spring                             | min       | 23.5             | g          |
| Inlet camshaft (port and stbd)           | min       | 770              | g          |
| Exhaust camshaft (port and stbd)         | min       | 1 055            | g          |
| Piston (with rings)                      | min       | 305              | g          |
| Piston Pin                               | min       | 66.5             | g          |
| Connecting Rod (with bearings and bolts) | min       | 440              | g          |
| Crankshaft                               | min       | 16 880           | g          |
| Flywheel (bare)                          | min       | 3 000            | g          |
| <b>OVERDRIVE RATIOS</b>                  | Pinion    | Driven Gear Over | rall Ratio |
| 0.818                                    | 22        | 18               | 0.927      |

#### **UNDERWATER UNIT** OB IV SSM

|   | Tolerance | Measurement  | Unit |
|---|-----------|--------------|------|
| Gear Ratio  |           | 1.13 (15/17) |      |
| P Longtitudinal length of gearcase torpedo (B)                  | max       | 450          | mm   |
| Q Longtitudinal dimension of gearcase including propeller shaft | max       | 575          | mm   |
| R Transverse dimension of gearcase                              | min       | 64.5         | mm   |
| S Thickness of strut  | min       | 40.0         | mm   |
| Z1 Skeg chord length, 25mm above bottom                         | +/- 5 mm  | 111          | mm   |
| Z3 Skeg chord length, 75mm abobe bottom                         | +/- 5 mm  | 145          | mm   |
| W1 Distance from propeller shaft to upper flange                | +/- 2 mm  | 238          | mm   |
| Y1 Thickness of skeg, 25mm above bottom*                        | min       | 5.3          | mm   |
| Y3 Thickness of skeg, 75mm above bottom*                        | min       | 6.8          | mm   |
| Y Skeg depth from propeller shaft*                              | +/-       | 190          | mm   |

\*Gearcase skeg must conform to Mercury skeg template, part number 91-840671



#### FOUR STROKE OUTBOARD PETROL ENGINE

#### NOTES

Inspection of ECM

| Model                       | 200APX        |
|-----------------------------|---------------|
| ECM over speed limiter*     | 6800 rpm      |
| ECM software version        | BRZ19_AAD_004 |
| ECM calibration part number | 8M0177128     |

\*Note, over speed limiter indicates speed at which individual cylinders are cut. At 7,100 rpm all cylinders are cut. Instantaneous spikes over 7,100 rpm are possible if the prop completely exits the water (e.g. wave jump).



# Attachment 1 - Camlift measurement

| Valve Lift Table (in Cam angle) at Nominal Lash |                        |           |                 |
|---|------------------------|-----------|-----------------|
| INTAKE  |                        | EΣ        | CHAUST          |
| (INT#   | (INT#1 Lobe Index      |           | 1 Lobe Index    |
| Timing @ Max Lift: 110                          |                        | Timing (d | ) Max Lift: 110 |
| degrees in                                      | degrees in Crank ATDC) |           | n Crank BTDC)   |
| Cam Angle                                       | Valve Lift [mm]        | Cam Angle | Valve Lift [mm] |
| -70   | 0.053                  | -64       | 0.007           |
| -68   | 0.087                  | -62       | 0.041           |
| -66   | 0.121                  | -60       | 0.075           |
| -64   | 0.155                  | -58       | 0.121           |
| -62   | 0.189                  | -56       | 0.224           |
| -60   | 0.223                  | -54       | 0.431           |
| -58   | 0.257                  | -52       | 0.759           |
| -56   | 0.291                  | -50       | 1.184           |
| -54   | 0.336                  | -48       | 1.667           |
| -52   | 0.433                  | -46       | 2.170           |
| -50   | 0.627                  | -44       | 2.674           |
| -48   | 0.932                  | -42       | 3.176           |
| -46   | 1.328                  | -40       | 3.673           |
| -44   | 1.778                  | -38       | 4.160           |
| -42   | 2.246                  | -36       | 4.631           |
| -40   | 2.715                  | -34       | 5.082           |
| -38   | 3.182                  | -32       | 5.510           |
| -36   | 3.639                  | -30       | 5.913           |
| -34   | 4.081                  | -28       | 6.292           |
| -32   | 4.501                  | -26       | 6.646           |
| -30   | 4.899                  | -24       | 6.975           |
| -28   | 5.273                  | -22       | 7.278           |
| -26   | 5.624                  | -20       | 7.556           |
| -24   | 5.950                  | -18       | 7.808           |
| -22   | 6.252                  | -16       | 8.033           |
| -20   | 6.529                  | -14       | 8.233           |
| -18   | 6.781                  | -12       | 8.406           |
| -16   | 7.007                  | -10       | 8.553           |

| -14 | 7.208 | -8 | 8.673 |
|-----|-------|----|-------|
| -12 | 7.384 | -6 | 8.766 |
| -10 | 7.533 | -4 | 8.833 |
| -8  | 7.656 | -2 | 8.873 |
| -6  | 7.754 | 0  | 8.887 |
| -4  | 7.825 | 2  | 8.873 |
| -2  | 7.871 | 4  | 8.833 |
| 0   | 7.890 | 6  | 8.766 |
| 2   | 7.884 | 8  | 8.673 |
| 4   | 7.851 | 10 | 8.553 |
| 6   | 7.793 | 12 | 8.406 |
| 8   | 7.708 | 14 | 8.233 |
| 10  | 7.598 | 16 | 8.033 |
| 12  | 7.461 | 18 | 7.808 |
| 14  | 7.299 | 20 | 7.556 |
| 16  | 7.111 | 22 | 7.278 |
| 18  | 6.897 | 24 | 6.975 |
| 20  | 6.658 | 26 | 6.646 |
| 22  | 6.394 | 28 | 6.292 |
| 24  | 6.104 | 30 | 5.913 |
| 26  | 5.790 | 32 | 5.510 |
| 28  | 5.452 | 34 | 5.082 |
| 30  | 5.089 | 36 | 4.631 |
| 32  | 4.703 | 38 | 4.160 |
| 34  | 4.294 | 40 | 3.673 |
| 36  | 3.862 | 42 | 3.176 |
| 38  | 3.412 | 44 | 2.674 |
| 40  | 2.949 | 46 | 2.170 |
| 42  | 2.481 | 48 | 1.667 |
| 44  | 2.011 | 50 | 1.184 |
| 46  | 1.548 | 52 | 0.759 |
| 48  | 1.120 | 54 | 0.431 |
| 50  | 0.766 | 56 | 0.224 |
| 52  | 0.516 | 58 | 0.121 |
| 54  | 0.375 | 60 | 0.075 |
| 56  | 0.310 | 62 | 0.041 |
| 58  | 0.274 | 64 | 0.007 |
| 60  | 0.240 |    |       |
| 62  | 0.206 |    |       |
| 64  | 0.172 |    |       |
| 66  | 0.138 |    |       |
| 68  | 0.104 |    |       |
| 70  | 0.070 |    |       |
| 72  | 0.036 |    |       |

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