**LAA TYPE ACCEPTANCE DATA SHEET**
**TADS E06**
**DH GIPSY MAJOR ENGINE**

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| Issue 1 | Initial issue | Dated 16/09/20 | JP |

This TADS is intended as a summary of available information about the engine type and should be used during the overhaul, operation and permit revalidation phases to help owners and inspectors. Although it is hoped that this document is as complete a summary as possible, other sources contain more complete information, e.g. the manufacturer's (or their representative's) website.

Section 1 contains general information about the engine type and its variants.

Section 2 contains information about the engine type that the LAA considers mandatory and must be complied with.

Section 3 contains advisory information that owners and inspectors should review to help them maintain the engine in an airworthy condition. If due consideration and circumstances suggest that compliance with the requirements in this section can safely be deferred, is not required or not applicable, then this is a permitted judgement call. This section also provides a useful repository for advisory information gathered through defect reports and experience.

## Section 1 Introduction

### 1.1 UK contact

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### 1.2 Description

The de Havilland Gipsy Major is a direct drive, four cylinder, inverted, inline air-cooled engine, that was developed by de Havilland in the early 1930s from the Gipsy III, which was in turn a development of the earlier, upright, Gipsy I and II models.

There are many different engine variants, which differ slightly in specification but the main difference is between the original DH Gipsy Major 1 series of engines (including, for example, the 1C, 1F, 1H, etc, commonly found in Tiger Moths) and the later, more powerful DH Gipsy Major 10 series. These later variants include either the tapered crankshaft 10-1 models (also known as the '10 Mk 1') seen in various post-war Austers, or the later splined crankshaft 10-2 models (also known as the '10 Mk 2'), most commonly found in DHC.1 Chipmunks. Civil conversions of the Gipsy Major Mk 7 and 8 are also found and these were originally built for aircraft such as the military versions of the Auster (Mk 7) and Chipmunk (Mk 8).

Deltair Aerospace Ltd currently hold the Type Responsibility for the Gipsy engine range. In this capacity, they provide the manuals for the type and a compilation of all Technical News Sheets (TNS) to date that are applicable to the type. Separate compilations are provided for the Gipsy Major 1 series and the later Gipsy Major 10 series.

Engine Model Description

| *Engine Model* | *Description* |
|---|---|
| Gipsy Major 1 | Basic model fitted originally to Tiger Moth trainers |
| Gipsy Major 1C | High compression version, accepts leaded fuels |
| Gipsy Major 1D | With fuel pumps, screened ignition, priming system, oil scavenge |
| Gipsy Major 1F | Aluminium cylinder heads to accept leaded fuels |
| Gipsy Major 7 | Military version of 1D, increased RPM |
| Gipsy Major 8 | Sodium cooled exhaust valves, cartridge starter |
| Gipsy Major 10-1 | Similar to 1C & 1D, increased RPM/shorter TBO |
| Gipsy Major 10-2 | Similar to 10-1 but with splined crankshaft |

## Section 2 Mandatory information for owners, operators and inspectors

At all times, responsibility for the maintenance and airworthiness of an aircraft rests with the owner. Condition No 3 of a Permit to Fly requires that: *"the aircraft shall be maintained in an airworthy condition".*

Section 2 of this TADS describes those requirements which an owner must comply with. Declaration of compliance with this TADS means also that the relevant TADS have been consulted and the mandatory requirements described therein have been satisfied.

### 2.1 Lifed Items

LAA Technical Leaflet TL 2.23: Engine Overhaul Life and Operating 'On Condition' summarises the overhaul life of Gipsy Major engines, as specified in TNS G No 15. For ex-military Mk 8 Gipsy engines refer to CAA CAP562 CAAIP Leaflet 70-30.

Depending on the modification state, the crankshaft nose of tapered crank Gipsy Major engines (i.e. all variants other than the 10-2) is subject to specified lives by mandatory Airworthiness Directives (ADs). These specified lives are legally mandatory. In contrast, lifed items specified only by a TNS or by the manufacturer but not mandated by an AD are advisory in strictly legal terms. The owner is responsible for deciding whether to implement these advisory life limits.

### 2.2 Operator's Manual

Operator's Manuals are available, often the manuals being a combined manual including both operational and maintenance data. Deltair Aerospace Ltd list the manuals they hold for reference purposes in the Manuals section of their website.

Other unofficial sources such as Avialogs may provide manuals or access to manuals although these may not be revised to the latest revision available.

### 2.3 Maintenance Schedule

Regular maintenance is the key to stress free flying. Gipsy Major engines are generally fitted to aircraft that are maintained either in accordance with the CAA Light Aircraft Maintenance

Schedule (LAMS) CAP411 or the LAA Generic Maintenance Schedule. Further details of which can be found in LAA Technical Leaflet TL 2.19: The LAA Generic Maintenance Schedule.

In either case, the schedule should be customized to include the special maintenance activities described in the Gipsy Major Maintenance Manual, as well as the mandatory maintenance actions specified by Airworthiness Directives and recommended maintenance actions specified by TNS's.

Deltair Aerospace Ltd list the manuals they hold for reference in the Manuals section of their website.

More information on maintenance schedules for LAA administered aircraft can be found in the Aircraft Maintenance section of the LAA website.

## 2.4 Airworthiness Directives

Airworthiness Directives (ADs) must be complied with when installed in an aircraft type that was previously certified. In other type installations, ADs should be consulted for any possible useful technical content and complied with and/or taken into consideration in accordance with good maintenance practice.

Gipsy Major ADs are published in CAA CAP747: Mandatory Requirements for Airworthiness, Section 2, Part 1.

The CAA also produces a list on their website of any proposed ADs and ADs awaiting incorporation into CAP 747.

Gipsy Major 1 Series and 10 Series Technical News Sheets Mandated by AD:

| *CAA AD* | *TNS* | *Description* | *Applicability, Compliance and Requirement* |
|---|---|---|---|
| 1768 Pre 80 | GM 424<br>GM 2495<br>GM 2690<br>TNS G No 15 | Modified crankshaft. Crankshaft bearing locating sleeve. Sulphinuz treatment of crankshaft | Compliance required in accordance with TNS G No 8 (Major I) & TNS GM10 No 11 (Major 10 Mark 1) |
| 1772 Pre 80 | TNS G No 8<br>TNS GM10 No 11 | Crankshaft. Inspection of front end for cracks | Applicable to Major 1 Series and Major 10 Mark 1. TNS G No 8 and GM10 No 11 refers. |
| 1776 Pre 80 | TNS G No 77/<br>GM10 No 47 | Pressure test induction manifold heater box | Applicable to early type Gipsy engines TNS G No 77 and Gipsy major engines TNS GM 10 N. 47. An inspection procedure has been devised and published by the engine manufacturer. This requires a pressure test to be made at the following intervals:<br>1. Within 60 days of receipt of the inspection procedure, then,<br>2. Annually, or<br>3. At any time rough running from an otherwise unexplained cause is experienced. |

2.4 Mandatory Permit Directives (CAP 661)

| | | |
|---|---|---|
| MPD 1995-001 R5 | Compliance with ADs | Continued compliance with all ADs and other mandatory requirements applicable when an aircraft/engine was on a Certificate of Airworthiness. |

The CAA MPD Listing should be checked for revisions or amendments to the above list of MPDs.

The LAA website should be checked for MPDs that are non-type specific in LAA Technical Leaflet TL 2.22: Non-Type Specific MPDs.

2.5 Generic Requirements (GR) CAP 747 and Civil Aircraft Airworthiness Information and Procedures (CAAIP) CAP 562

CAA publications CAP747 and CAP562 contain information that may be relevant to LAA administered aircraft and should be checked for applicability.

In particular, for older engines operating beyond the manufacturer's recommended life, CAA CAP747 Generic Requirement No 24: 'Light Aircraft Piston Engine Overhaul Periods' should be read alongside LAA Technical Leaflet TL 2.23: Engine Overhaul Life and Operating 'On Condition'. Generic Requirements can be found in CAP747: Section 2 'Mandatory Information'.

## Section 3 – Advice to owners, operators and inspectors

3.1 General

The Gipsy is a simple and reliable engine but it does need care and attention to perform safely and reliably.

It is suggested that the customised maintenance schedule should include:

1. Every 25 hours change the main engine oil. Lubricate the engine controls at all oiling points provided (not all of them are obvious).
2. Every 50 hours check the contact breaker gaps, clean the fuel filter/s, adjust the tappets, renew the rocker box oil and clean the spark plugs.
3. Annually, clean and inspect the inside of the magneto distributor caps, and clean the brush holders.
4. Periodically, perhaps at least once every 3 years:
    a. Clean the oil jet filter in the magneto oil feed line, and the oil jet itself.
    b. Remove and clean the oil pressure filter, if not being done annually.
5. For gravity feed fuel systems, disconnect the fuel line at the carburettor and turn on the fuel to check the flow. Then turn off the fuel and remove the two jets to check for water or sediment. Before replacing the jets, turn on the fuel briefly to flush the carburettor through. Achieve this flush using the fuel pump priming levers on pumped systems.
6. Consider removing the magnetos to gain access for cleaning the slip rings and 'High Tension' pick-ups.

3.2 Manufacturer's Information (including Service Bulletins, Service Letters, etc)

Manufacturer's information takes the form of a Gipsy Major combined 'Maintenance, Operation and Overhaul Manual' and the accumulated Technical News Sheets (TNS). TNSs were originally published by de Havilland then by Rolls Royce and latterly promulgated by Deltair Aerospace Ltd. All are available from Deltair Aerospace Ltd in compilations specific either to the Series 1 or Series 10 engine, as requested.

In the absence of any over-riding LAA classification, inspections and modifications published in the TNSs should be satisfied according to the recommendations therein. It is the owner's responsibility to be aware of and supply such information to their inspector.

The following Gipsy Major engine inspection Technical News Sheets are not Mandated by AD:

| *TNS* | *Description* | *Applicability, Compliance, Requirement* |
|---|---|---|
| TNS G No 80<br>TNS GM10 No 50 | Examination of oil jet and filter to the magneto driving spiral gear | Involves annual inspection of filter for contamination and removing jet to check for blockage. |
| TNS G No 79 | Propeller hub nut, vernier lockplate | Only applicable to engines with propeller hub p/n 43787 and vernier lockplate p/n 38535 or 2100-5 (Pre-Mod 2144). Involves dye-penetrant crack checks at 300 hr intervals. |
| TNS GM10 No 51 | Examination of oil suction filter to oil scavenge pump (pipe p/n 35342) | Examine suction pipe for proper fit, cracks or poor brazing. Applicable to 10 series engines DH Moth TNS CT (Moth) 27 (withdrawn) also referred. |

3.3 Special Inspection Points

See also the points raised above in Sections 3.1 and 3.2.

The combined Gipsy Major Maintenance, Operation and Overhaul Manual and compilation of TNSs (both as applicable to the Gipsy Major 1 or Series 10 as appropriate) provide details of many special inspection points applicable to the type, derived from many years of experience with it in service.

1. Hobson Carburettor

The Hobson carburettor fitted to the Gipsy gives very little trouble if properly overhauled at the commencement of engine life. Over time the dope coating on the float can develop cracks allowing the cork to absorb fuel and become heavy. The first sign of this is usually a flooding carburettor, over-rich running, or poor throttle response after a glide. In a different case, a bubbled float coating can jam against the sides of the float chamber. If using Mogas, different additives in the fuel may affect the dope coating.

2. Cylinder Heads

The potential weakness of a Gipsy is the cylinder heads. The Gipsy engine will usually run its full overhaul period but the top end (or the bottom end as it is upside down) needs regular attention and probably one or two intermediate top overhauls.

A likely problem is the exhaust valves, depending on the fuels used. If you have the so called 'Trainer valves' (part no. 1902-23) in your engine, they have a history of the valve heads separating from the stem after a relatively short life, causes major damage to the engine, not to mention the airframe if it happens over the wrong terrain for a successful

forced landing. Trainer valves were produced in great numbers and so they are easy to get hold of and are approved in the Major 1 engine, but are not durable with leaded fuels. They generally run satisfactorily for about 300 hours on 100LL before they give trouble, so replacement at 250 hours is recommended. Inlet valves, on the other hand seldom give any trouble.

3. Fuel Type

These engines were designed to run on low-octane unleaded fuels. These days, UL 91 fuel is ideal. Leaded high-octane fuels such as 100LL can cause problems. The type of fuel that you can use will depend on the model and modification state of the engine. Only Gipsy engines with aluminium alloy heads such as the 1C, 1F and 10-series engines (or other models fitted retrospectively with aluminium alloy heads) are designed to handle the levels of Tetra-ethyl lead in 100LL Avgas.

The Gipsy Major 1 with bronze heads must not be operated on leaded fuels because the lead eats away at the bronze especially at the exhaust valve seats. Modifications that fit steel valve seats into bronze heads (a feature of the Major 1H) are only a partial solution as the bronze heads still erode slowly in the adjacent areas. The use of Avgas may also be detrimental to exhaust valve life, perhaps because Avgas burns slowly and is still burning when the valve is opening.

4. BTH Magnetos

An area that tends to be neglected and misunderstood is the BTH magnetos. Most fundamentally, the magnetos must be timed to the engine at full advance.

5. Ignition Timing

Ignition timings vary according to the engine variant and the crankshaft type in question, so refer to the Manual or engine dataplate for details. Special techniques apply to the 10 Mk 2 engine which usually lacks any timing marks on the propeller hub.

6. Sticking Impulse

The problem with sticking impulse magneto pawls is well known, often caused by failing to lubricate the impulse in the manner described in the manual, or by an accumulation of oil sludge in the impulse drive. If the impulse isn't heard to click when the prop is swung, the engine won't start however hard you swing it. Tapping the impulse will usually free it but is no substitution for proper lubrication in the first place.

It's a good idea to carry a spare contact breaker spring in the aircraft as they occasionally break, but are easily replaced in the field. You will also need to carry a 3 BA spanner or a 1/8" Allen key to remove the contact breaker for this.

Don't forget that with the contact breaker cap off, the mag is likely to be live, as the P lead connects via the contact breaker cover. The exception is when the 'safety-type cut-out' is fitted in the magneto contact breaker and earthing cap.

7. Earthing Cap

A potentially lethal issue is failure to appreciate the incompatibility between different standards of contact breaker and magneto earthing cap. An overhauled magneto should be installed as a unit, complete with earthing cap (and also distributor cap).

8. Gear Teeth

Another source of problems is with the gear teeth stripping on the magneto's phenolic half speed wheel, especially when the half speed wheel is of the type with small gear teeth. Watch for accumulations of dust in the distributor which may indicate that the gear teeth are wearing. Also, prevent the engine kicking back on stopping by use of the idle cut-off (if fitted) or by correct throttle technique.

9. Slick Magneto STC

Even with careful attention to all the above it pays to have a spare pair of mags available. These are best stored in a dry sealed container in a warm, dry location such as a cabinet above a domestic radiator. An STC exists for substituting Slick magnetos on Gipsy engines, using a custom adaptor bracket, which is simple to install and has been accepted by the LAA on one installation, but does not provide for variable advance and retard of ignition timing.

10. Oil Type

Many operators use a straight oil in the belief that that is what the engine was designed for. With newly-overhauled engines it is desirable to switch to the appropriate ashless dispersant detergent oil immediately after 'running-in' (approximately 50 hours) because straight oil has more tendency to form sludge. Sludge gums up the piston rings and the small holes in the piston ring grooves, stopping the rings working effectively and leading to increased oil consumption and reduced performance.

Straight oils also do not have the beneficial corrosion inhibiting additives that are in modern detergent oils, so some maintain that harmful corrosion is more likely to set in when using straight oils. This is a particular problem with aircraft that are used infrequently or have long periods of disuse without being inhibited. It is best not to delay the running-in period unduly - the sooner an overhauled engine can transfer to a more protective oil, the better. All this said, there is some empirical evidence that a grimy black film on the engine internals may be a helpful protective layer against corrosion!

With an engine that has been using straight oil for a long time, transferring to detergent oil should be approached with care as a great deal of deposited sludge can be freed at once, potentially clogging the narrow oil ways. Change the first filling of detergent oil promptly, and flush the oil filters to remove the contamination.

11. Oil Consumption

There are various 'ring mods' that have been approved which attempt to reduce the Gipsy's oil consumption. There are some concerns that these ring mods may also lead to more rapid cylinder wear and/or an increased risk of internal corrosion due to thinner oil film and lesser seep-down while static. Only Mod No. G.4014 was approved and tested by an engine Design Authority.

12. Spark Plugs

Many Gipsy Major 1 series owners use unscreened 12mm automotive spark plugs type NGK D6HA rather than the much more expensive aviation type RC50R. For the Gipsy Major 10 series engines 14mm plugs are used such as the RS9-1R or Champion REL37B. Beware that the excellent long-life SBS-1 14mm spark plugs, used at one time by the MoD, require compatible ignition harnesses.

## 3.4 Operational Issues

1. Reference Documents and Manuals
   Refer to the Gipsy Major combined Maintenance, Operation and Overhaul Manual applicable to the Series 1 or Series 10 as appropriate.

2. Start-Up Fires

   Over the years there has been several instances of start-up fires with DH Rapide aircraft and one DHC.1 Chipmunk in which a combination of flame and unburnt fuel emitted from the exhaust pipe has set fire to the aircraft's fabric covering have

highlighted the importance of following correct starting procedures, ie not over-priming. They have also raised the possibility that the more lightweight modern synthetic fabrics that are commonly substituted nowadays may have lesser thermal mass than traditional cotton and linen fabrics and consequently may be more easily ignited by a short exposure to flame.

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*Please report any errors or omissions to LAA Engineering*: engineering@laa.uk.com