DEPARTMENT OF NATURAL RESOURCES
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TO: Interested Parties

FROM: Mary Sexton, DNRC Director
Bob Harrington, DNRC Forestry Division Administrator

DATE: May 11, 2010

RE: Response to recent letter from Billings Flying Service

This memo is in response to a recent letter from Billings Flying Service (BFS) regarding a number of issues related to the DNRC Aviation Program. BFS assertions are bulleted in bold, followed by a response/clarification by the DNRC Fire & Aviation Management Bureau.

- **"The DNRC, set up their own lower safety standards, and are not adhering to the minimum standards set up by the manufacturer, military and approved by the FAA."**

It is true that the FAA has no legal oversight of the DNRC aircraft maintenance program. Although the DNRC is technically exempt it has, in the interest of safety, chosen to meet or exceed the scope and intent of applicable FAA regulations.

Unlike their commercial aircraft, the DNRC MT205 (UH-1H) helicopters have not been certificated under an FAA Type Certificate Data Sheet and therefore, do not hold an Airworthiness Certificate. This certificate is the FAA's legal instrument that ties the aircraft maintenance to specific standards, regulations, Airworthiness Directives, Supplemental Type Certificates (STC) etc. As a result, the MT205 program, procedures, modifications, etc. cannot technically be "FAA Approved" and therefore the DNRC must rely on experienced personnel, industry standards and internal procedures to operate as compliant and safely as possible. Note that the US military fleet operates the same way. They are exempt from the FAR's so they may establish their own standards; utilize their own engineers for modifications etc.

Since operating safely is the DNRC's primary goal, they continually strive to attain the highest standards possible and in fact have been proactive with establishing standards utilized by industry as well as for internal use. The following are some examples of the DNRC's accomplishments reflecting their goal of establishing higher standards both in industry and for internal use:

Ms Sexton's letter

- Participated as a technical representative on the development of the Interagency Committee on Aviation Policy (ICAP) UH-1H Inspection Program. Note the DNRC's UH-1H Inspection Program was the basis for this ICAP program.

- Drafted the National Association of State Foresters Cooperators Aviation Standards for Interagency Fire. This stipulates the aviation standards for cooperating fire agencies including operations, maintenance, equipment etc. Note that the DNRC is expected to be fully compliant with these standards by June of 2010.

- The DNRC has a much higher technician experience requirements than the industry standard and it has acquired the proper facilities, extensive tooling and training which has consistently impressed both industry professionals and FAA representatives.

- It is well known and accepted that the commercial Bell Helicopter205A1 maintenance and inspection program is more appropriate for use, rather than the US Army program, when addressing the concerns related to the repetitive lift events incurred during fire fighting. The MT205 maintenance and inspection program continues the move towards the adoption of the commercial standards:

  - The MT205 inspection program has been revised to include all of the commercial 205A1 inspection items. The revision also includes the inspection items necessary for the continued airworthiness of the modifications incorporated and additional inspection items based on the DNRC's 30 years of experience operating the UH-1 aircraft. The inspection program has been reviewed by an FAA Designated Airworthiness Representative and has been found to be equivalent to an FAA Part 135 Air Taxi Approved Aircraft Inspection Program. Note that this program requires technicians to hold an Inspection Authorization. Meeting the Part 135 standards and the use of IA's for the inspections are both much higher standards than is normally met by industry.

  - The majority of the 205A1 overhaul and retirement requirements have now been implemented. The remaining requirements are scheduled to be implemented in the near future as maintenance functions involve those components.

- Commercial operators are only required to comply with FAA Airworthiness Directives applicable directly to their UH-1H Type Certificate. In the interest of safety, the DNRC has established a policy of reviewing and complying with

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any safety document published by the following which may be applicable to their MT205 configuration: U.S. Army Safety of Flight and Aviation Action Messages, Bell Helicopter 205A1 Alert Service Bulletins, Honeywell T53-L-703 Bulletins, Bell Helicopter UH-1H Alert Bulletins, FAA AD notes applicable to the UH-1H and 205A1 airframes, engines and accessories.

- **"..It appears that unsafe and noncompliant modifications have been made."**

  - The DNRC is a safety minded organization and has therefore been proactive in implementing modifications primarily to mitigate the effects of the repetitive lift events and to provide for an adequate safety margin during operations. The DNRC feels that these issues have not been adequately addressed by the UH-1H commercial fleet. As an example, the DNRC installed the right hand tail rotor assembly to address the lack of sufficient tail rotor authority. These tail rotor configurations are from the commercial 205A1 which was implemented about 40 years ago but was never incorporated on the UH-1H.

  - All MT205 alterations/modifications have been reviewed to ensure they have been based on acceptable data that meets the NASF Coop Standards and consistent with the FAR's. Note that there are 35 active modifications on the MT205. All but 4 are based on standard industry data such as Supplemental Type Certificates, previous FAA field approvals, Army Modification Work Orders, Technical Standard Orders, etc. The other 4 are based on data developed by contracted FAA Designated Engineering Representatives (DER). These DER's are very experienced and are retired engineering personnel from Bell Helicopters. Note that these same DER's have designed and approved data for commercial UH-1H operators including Garlick Helicopters (GHI). The GHI Lift Beam STC and their Stainless Steel Vertical Fin Spar STC have been installed on the MT205 fleet. *

- **"The rotor systems on these helicopters have not been modified to accommodate this extra horsepower."**

  - Installation of the T53-L-703 engine was performed in accordance with the DER team mentioned above. The increase in horse power was incorporated on the recommendation of the DER review team. This provides for an additional safety factor should the pilot experience an unplanned requirement for additional power. As a routine requirement with these alterations, the DER team must assess the impact of the proposed modification on the entire aircraft. This includes an engineering review of the rotor system loads, structural loads, flight manual supplements etc. * – Flt manual suppl. Rev A

  - The result of the engineering review of the rotor system loads was the implementation of a limitation on the use of the additional torque/horsepower. The addition torque is restricted to use below 80 knots indicated airspeed and thereby eliminating the need for any rotor system changes. This limitation has *

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Flt manual Suppl Rev A

been included in the new flight manual supplement which was developed as part of the engineering review process.

- There has been an assertion made that the rotor system, specifically the rotor blades and trunnion bolts, were not engineered to withstand the additional horsepower/torque which is being utilized by the DNRC.

  This appears to be an assumption since there was no engineering data cited only a citation to the U.S. Army maintenance manual for the bolts and no citation was made with respect to the blades. This methodology is flawed for a number of reasons and would not normally be acceptable to the FAA in order to make such an engineering decision.

  First of all, the maintenance manual normally contains instructions that do not require engineering approval and hence they are not normally "Approved" data nor does it contain engineering specific information. In addition the manuals contain procedures and instructions that may be driven by other factors such as cost, convenience or a particular maintenance philosophy. There are often stark differences in procedures between the commercial 205A1 and the military UH-1H even though the parts installed may have the same exact part number.

  In this case, the assumption was made that the trunnion bolt was only engineered for a max of 54 psi since the U.S. Army requires replacement of the bolts at that point. In addition another bolt was referenced as being required in order to be capable of withstanding the additional torque. As is often the case with this methodology, the data appears to support a reasonable assumption; however the research was not complete and therefore provides only part of the available data and thereby supports an incorrect conclusion.

  According to the commercial parts manuals, the bolts referenced to were also utilized in the original configurations of the commercial Bell 205A1 and the model 212 helicopters. The UH-1H is limited to 50psi torque however the 205A1 has a normal torque limit of 54psi and the 212 has a 56psi limit which is the same as the DNRC limit. Neither the 205A1 nor the 212 requires replacement of the bolts at any level of over torque. Only the original obsolete -1 bolt requires replacement on the 205A1 not the -3 bolts that are installed on the DNRC helicopters. The larger 212 bolts referred to were incorporated many years later in order to address a service issue with the bolts, not a design limitation. The bolt was installed in conjunction with the stainless steel yoke installation. This yoke was implemented to reduce the risk of cracking of the yoke due to corrosion; however it has not been mandated by the FAA. It was also inferred that the main rotor blades are not capable of withstanding the additional torque. Again this can be disputed using the complete data available as with the trunnion bolts.

In addition to the engineering review of the rotor system, the DNRC has voluntarily implemented the following to mitigate the service issue with the bolts and yoke. **Note that only the** last item is a required item for the UH-1H operators.

- The FAA Airworthiness Directive 81-19-02 against the 205A1 main rotor yoke has been implemented on the MT205. This requires the replacement of the yoke every 3600 hours as compared with the 7200 hour UH-1H requirement.

- The corrosion inspection requirements of the yoke have been incorporated into the MT205 Inspection Program in accordance with FAA Airworthiness Directive 79-20-05. Additional inspections in this area have also been included in the MT205 inspection program.

- The referenced trunnion bolts are replaced at a minimum every 24 months in accordance with FAA Airworthiness Directive 92-23-01.

As demonstrated, the modification process, which includes both engineering and instructions for continued airworthiness, is complicated and must be performed by personnel experienced with the aircraft and modification procedures in order to interpret and respond to the data correctly. The DNRC has the necessary personnel, experience, facilities and resources to accomplish these modifications in a safe and cost effective manner.

HELICOPTER STRUCTURAL DESIGNS

2504 MALLARD CT. KELLER, TX 76248

November 23, 2009

Montana Department of Natural Resources and Conservation.
PO Box 201601
Helena, MT 59620
Attention: Ed Martin

Subject: Alterations incorporated onto the Departments MT205 (Modified UH-1H) Bell Helicopters.

Dear Mr. Martin

As requested; I have completed the engineering reviews for the following alterations incorporated onto the departments MT205 helicopters. The reviews were conducted in accordance with the Federal Aviation Administration's (FAA) procedures with the requirements for certificated aircraft. These reviews were performed by appropriately rated FAA Designated Engineering Representative's (DER's) including a Structures DER, Performance / Analyst DER, Systems DER and a Pilot DER. Refer to the separate acceptance letters from these DER's.

The reviews included any necessary analysis, as would be required by the FAA, for the specific alteration being reviewed including fatigue analysis on airframe and components, structural analysis, operational and performance review, etc. Where needed, individual engineering reports were created which contain any necessary documentation of the analysis, performance charts, engineering drawings, etc. Along with these reports, the DER team assisted the department in the development and review of their Service Instructions (SI) for these alterations. These SI's contain the necessary information to alter, maintain and operate the aircraft including any Instructions for Continued Airworthiness (Airworthiness Limitations, Inspection, Maintenance etc.) and any required Flight Manual Supplements. Results of the individual alterations, including references to the appropriate documents, are summarized below.

word operate above refers to using the Flt Manual Suppl. Rev A.

T53-L-703 Engine

Review and validation of the T53-L-703 engine installation is contained within HSD's report number: HSD-2006-01 Rev A. Engineering data required to manufacture the 90° gear box tail boom casting and the 42° gear box area tail rotor pulley bracket is also provided. Note that the aircraft's configuration, as stated in the report, includes the Bell 212 tail rotor installation along with the required drive line and structural improvements. Refer to the department's service instruction MT-UH1-SI-28 T53-L-703 Engine Installation which also requires compliance with service instruction MT-UH1-SI-27 212 Style Tail Rotor Installation for detailed information.

HELICOPTER STRUCTURAL DESIGNS

TECHNICAL DATA

MODEL	MT205 (PUBLIC SERVICE)

REPORT NO.: HSD-2006-01

TITLE:

PERFORMANCE DATA FOR MONTANA DEPARTMENT
OF NATURAL RESOURCES AND CONSERVATION
MODEL MT205 HELICOPTERS

PREPARED BY:	H. Waldrup / T. L. Walker	DATE:	09/14/06
CHECKED BY:	D. L. Bloom	DATE:	09/14/06
STRUCTURES:	H. Waldrup	DATE:	09/14/06
APPROVED:	Ed Martin	DATE:	09/14/06

ENGINE LOSSES

Engine losses used to calculate engine power available are all based on the original Bell/U. S. Army Qualification Tests (Reference 1 and 2) and are the same as used in the U. S. Army TM 55-1520-210-10 Operators Manual. All tables and charts are for 6600 ERPM (100%) only.

The tabulated losses included in the calculation are as follows:

1. 12 Horsepower Loss for Maximum Generator Extraction
2. 2 Degree Inlet Temperature Rise
3. 2.6% Inlet Pressure Loss
4. 1.6% Customer Bleed
5. 0.0% Tailpipe Change

ENGINE POWER AVAILABLE

Engine power available is that power that can be transmitted to the Engine Drive Shaft connected to the transmission. The power available for the T53-L-703 Shaft Turbine Engine is taken from the charts provided in Reference 3 for each pressure altitude and temperature desired for operation. That power available is then reduced for the Engine Losses listed above and tabulated in Table I and shown on Figure 1. These powers are referred to as Minimum Specification Power Available. These powers are available form a minimum specification engine provided the engine meets the engine Power Assurance Chart and is rigged in accordance with the engine manufacturers instructions for N1 topping.

ENGINE POWER IN EXCESS OF MINIMUM SPECIFICATION

Bell did this for you but we will not let them use it. →

In discussions with the Montana Department of Natural Resources operation and maintenance personnel it was decided that it would be prudent to allow the use of power available in excess of the minimum specification based on the expectation that the engines would be maintained in a better than normal condition. The engines **must** be capable of producing this excess power and be **checked** to a Power Assurance Chart that provides this extra margin of power. This means the engine must run cooler than a minimum specification engine. Most new or newly overhauled and well maintained engines will run significantly cooler than minimum specification.

Note that this margin has absolutely nothing to do with the mechanical calibration of each engine torque meter, which is accomplished in the engine test cell and stamped on each engine.

It was agreed that an extra 3% could be allowed. This extra power will be referred to as Fleet Average power available and will denote that all helicopters in their (MT DNRC) fleet will meet the +3% Engine Power Assurance Chart. The power assurance charts will be addressed later in this report. The Fleet Power Available is shown in Table II and Figure 2.

→ above min spec

HOVER PERFORMANCE

Hover performance both In-Ground-Effect (HIGE) and Out-Of-Ground- Effect (HOGE) is presented for the UH-1H based on Minimum Specification power and based on Fleet Average power. See Tables III and IV and Figures 3 and 4 for Minimum Specification Power. See Tables V and VI and Figures 5 and 6 for Fleet Average Power. → the min spec is removed from Flt manual

Hover performance for the UH-1H is based on the original Bell/U. S. Army Qualification Tests (Reference 1 and 2) where the rotor thrust coefficients were developed and the relationship of HIGE and HOGE were substantiated. Hover-In-Ground-Effect (HIGE) is based on a 4 foot skid height for the Standard Low Skid Gear equipped helicopter. This is the same skid height used by Bell Helicopter in the FAA Certification of the Bell Model 205A and 205A-1 helicopters. For FAA certification the skid height used for the hover charts sets the basis for performance and the maximum gross weight for certification.

Hover performance is also presented for the MT205 with the Bell Helicopter Model 212 blades installed using Fleet Average power available only. See Tables VII and VIII and Figures 7 and 8. Hover-In-Ground-Effect for the 212 rotor is based on a 5 foot skid height for a Standard Low Skid Gear equipped helicopter. This is the same skid height used by Bell Helicopter in the FAA Certification of the Bell Model 212. This data is from Reference 4.

This configuration with the T53-703 engine and the 212 rotor is essentially the same performance configuration as the 205B that was certified by Bell Helicopter Textron for their Japanese representative, Reference 5. Bell Helicopter at this time has no plans to build the 205B in the United States. The 205B configuration has a number of structural improvements and systems changes. The Model 212 hub assembly used on the Model 205B has different inboard strap fittings which put additional twist in the wire straps to assist in movement of the collective in case of hydraulic system failure. In other words the Model 212 blades have significantly higher pitching moments that would prevent the movement of the collective in the event of a hydraulic system failure. The Model 212 has a dual hydraulic system and actuators that have dual pistons and many other fail safe features that take care of this situation.

POWER ASSURANCE

The Minimum Specification Power Assurance Chart is given in Table IX and the Fleet Average Power Assurance Chart is given in Table X. Each installed engine must produce power at the required Engine Exhaust Temperature given in these charts. The engine Power Assurance check should be done in a stabilized climb at 60kts indicated airspeed and at a power setting as close to take-off power as possible for that altitude and temperature condition.

LIMITATIONS – mandatory to comply with

* → As part of this project to provide improved performance for the MT205 we have established specific limitations and have also assembled a set of limitation charts and figures. Basically we have reproduced the Bell Helicopter limitations for the 205A-1 including the external load configuration. These limitations are shown in the commercial flight manual format rather than the military TM 55-1520-210-10 manual format.

Figure 9 is the Model 205A-1 Height Velocity Diagram. Figure 10 is the Model 205A-1 H-V Limitations chart. Figure 11 is the Model 205A-1 Weight versus Center of Gravity Limitations chart. This chart shows the C.G. limits including external loads above the 9, 500-pound internal limit. Maximum gross weight for the helicopter is 9500 pounds internal and 10500 pounds external. All weight above 9,500 pounds must be on the external cargo hook. Take-offs and landings cannot be conducted at weights in excess of 9,500 pounds because of skid gear structural limitations and hover in ground effect limitations.

Figure 12 is the Bell 205A-1 Airspeed Limitations Chart except that it has been modified to account for the higher power available at higher altitudes and temperatures than the T53-L13B engine. Airspeed is limited above certain gross weights and altitude combinations. This is required in order to maintain the calculated life limitations of critical flight parts. This limitation does not impose an undue restriction. Airspeed is limited to 80 kts above 89% (50 pounds) torque.

Not IN Flt manual

Figure 13 is what the FAA refers to as the WAT Limit. This is the Weight-Altitude-Temperature for which the helicopter has been substantiated. That includes Handling Qualities, Hover Capabilities, IGE and OGE Control Margins for Forward, Sideward and Aft flight. This chart is the same chart that is used for the Bell Model 205A-1. The MT205 helicopter configuration with the 212-type tail rotor is the same configuration as the 205A-1 except that more power is available at altitude. **It must be noted that the MT205 helicopter will perform in excess of this WAT Limit but has not been substantiated. However, the main rotor is the exact same rotor and autorotation capability has not been improved in any way.**

It also might be noted that the Model 212 rotor is an improvement in rotor and inertia but that rotor was not substantiated for a higher autorotation gross weight because it was not required for certification with the twin-engine configuration. If MT DNRC should decide to incorporate the Model 212 blades, it is imperative that the autorotation capability be substantiated.

The following specific limitations apply:

TORQUE - PERCENT

GRN - 0 To 89 Percent (0 to 50psi) Continuous Operation
YEL - 89 To 100 Percent (50 to 56psi) 5 Minute
RED - 100 Percent Calibrated Torque Maximum.
Note: Maximum indicated torque allowed must be placarded near torque gauge.

TURBINE GAS TEMPERATURE

GRN – 400 C to 820 C Continuous Operation (Normal Power)
YEL – 820 C to 880 C 5 Minute Limit (ECU off above 820 C)
RED – 880 C thru 950 C Transient for Starting and Acceleration (5 sec) 950°C Maximum for Starting

GAS PRODUCER TACHOMETER (N_1)

RED - 106 Percent Maximum

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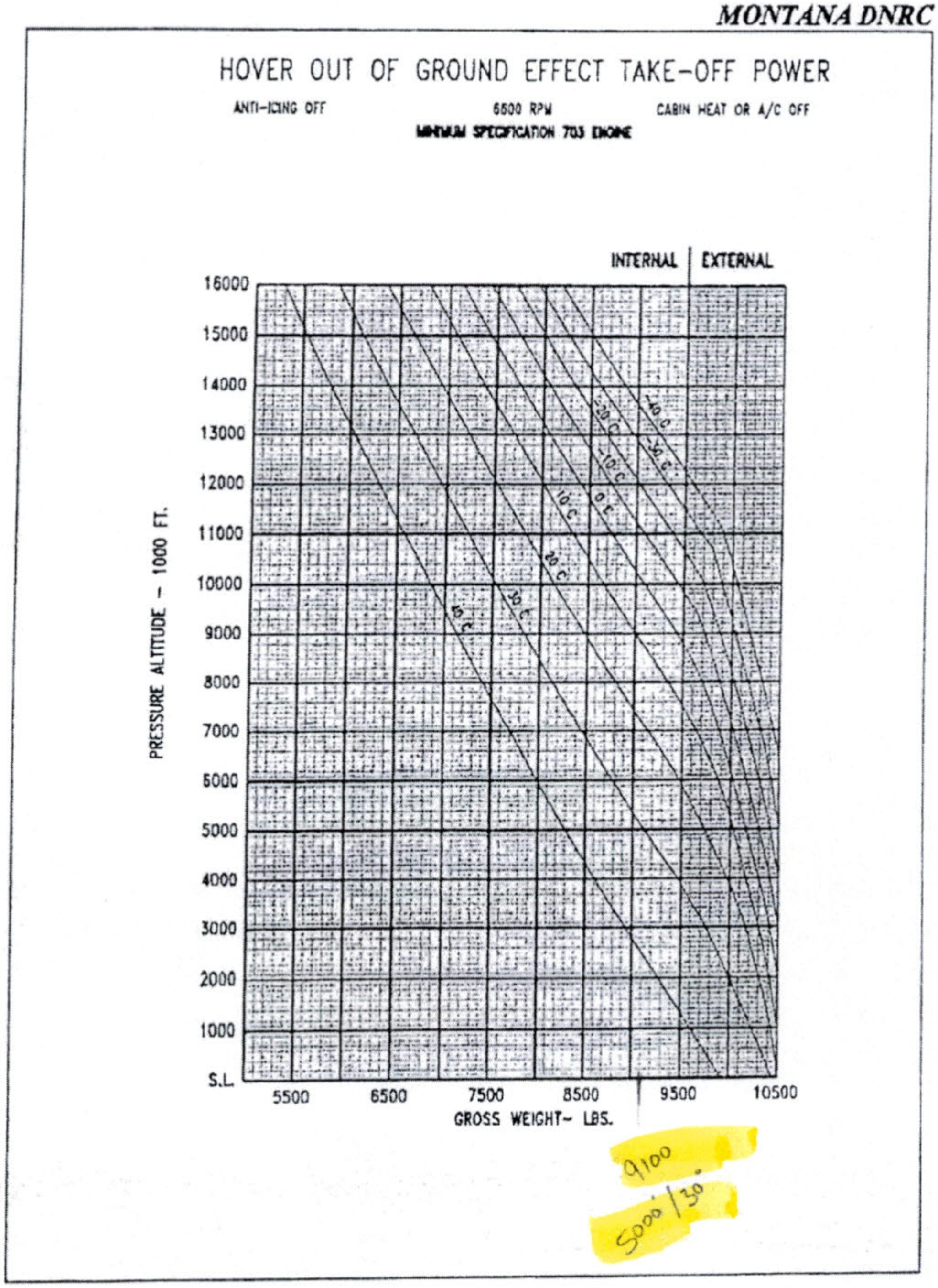

Figure 5 - Hover OGE With Take-Off Power (Minimum Specification)

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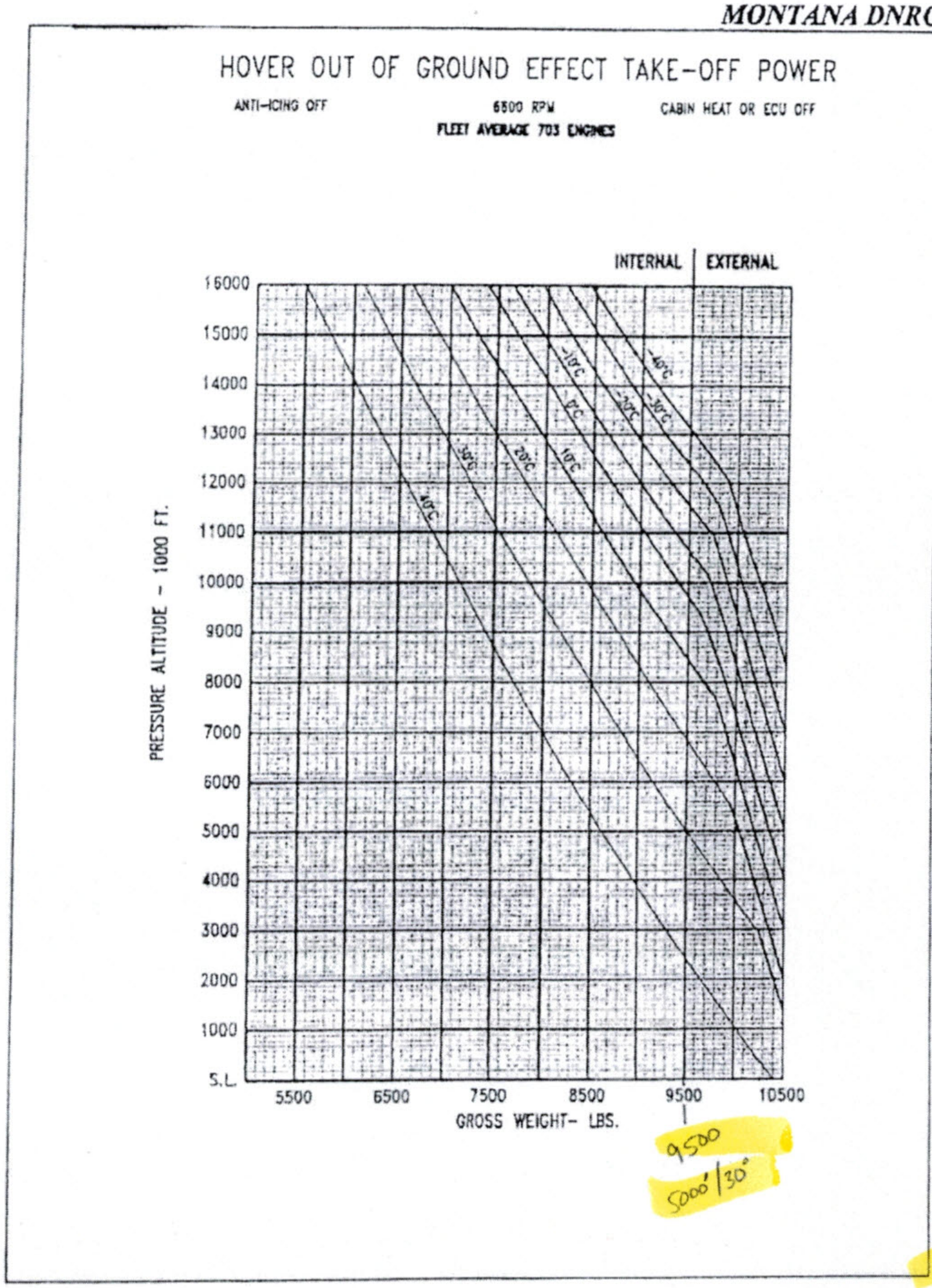

Figure 6 - Hover OGE With Take-Off Power (Fleet Average)

Performance Line 7b load calc
FHA 9500
9100
400 diff

MONTANA DNRC

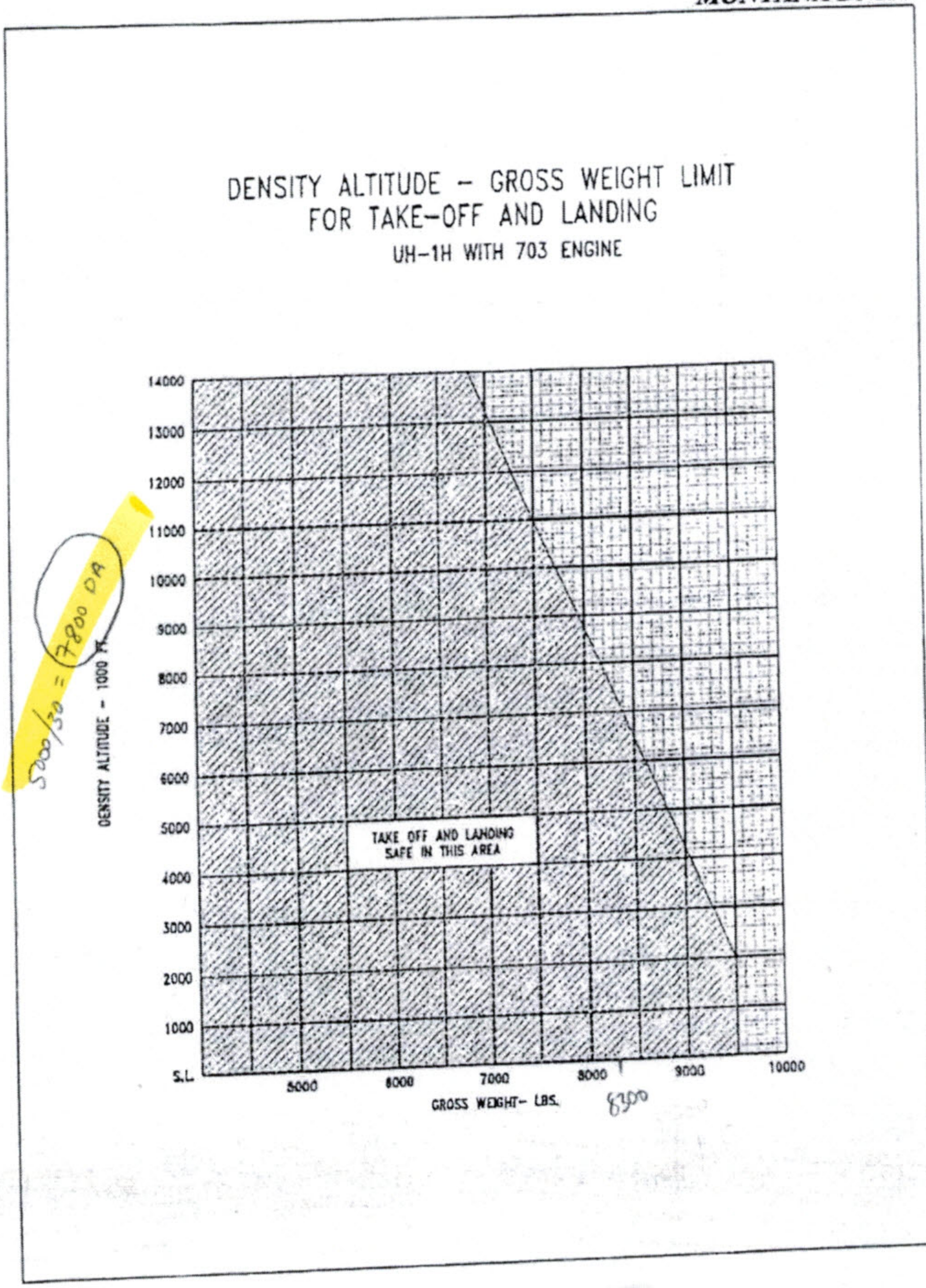

Figure 10 - Height Velocity Limitation

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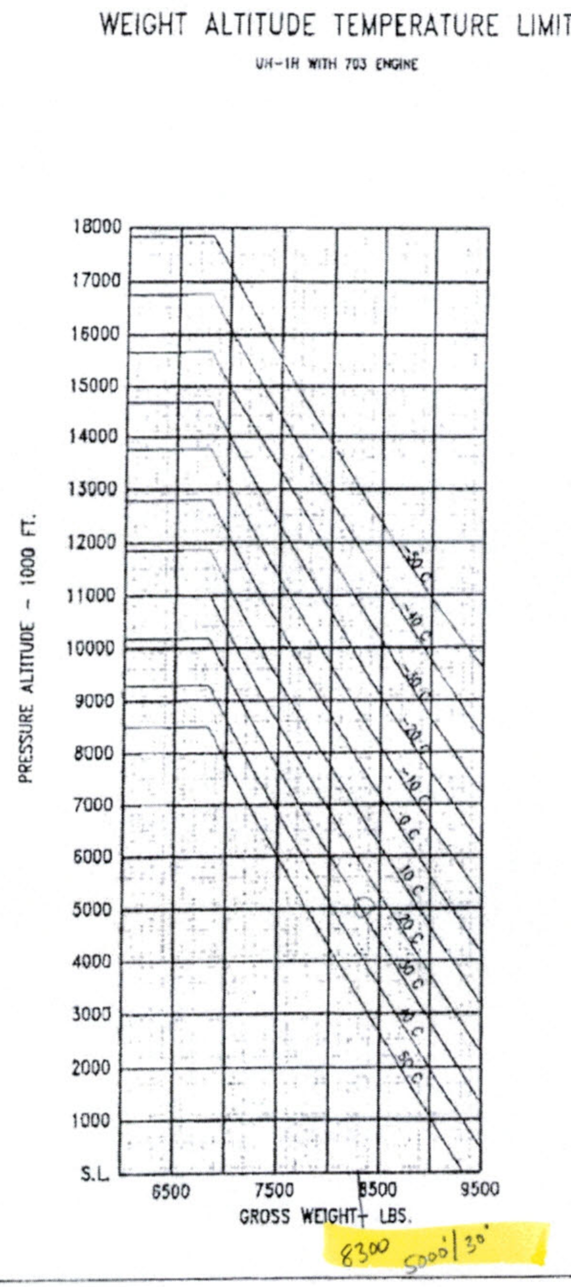

Figure 13 - Weight Altitude Temperature Limitation (WAT Limit) Not in Flt manual