

# MI-38 HELICOPTER FLIGHT TEST RESULTS

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## Abstract

This paper describes the results obtained from flight tests of the Mi-38 first prototype. The Mi-38 performance is compared with similar characteristics of the Mi-17 helicopter. In the course of the flight tests, the Mi-38 helicopter with the normal gross mass demonstrated a hovering ceiling exceeding 3,000 m, attained at a level-flight speed of 320 km/h, and with an internal load of 1,000 kgf climbed to an altitude of 8,150 m.

The Mi-38 ranking among other world medium lift helicopters is shown.

## INTRODUCTION

The Mi-38 is a multipurpose medium helicopter, which being dimensionally equal to the world-known Mi-8/Mi-17 helicopter significantly outperforms it by far. In a transport configuration, the helicopter is to carry internal and external loads of up to 5,000 kgf and 7,000 kgf respectively. The Mi-38 helicopter flew its maiden flight on August 25, 2004, and was formally presented and demonstrated (**Figure 1**) at the Kazan Helicopter Plant on October 1 of the same year in front of the aeronautical community and mass media representatives.

Then, and actually after the helicopter had been ferried to Moscow, the phase of its development flight tests began. Practically the entire helicopter consists of new components including main rotor blades and head, swash plate and control system, main gear-box and transmission, engines and fuselage. The helicopter employs new layout solutions. All that called forth a considerable amount of flight testing in which solutions, concerning the strength of all helicopter components, had to be obtained and its performance had to be determined.

### Helicopter Basic Design Features

- Aerodynamic configuration of the fuselage with low parasitic drag;
- A six-bladed main rotor ensuring a low vibration level;
- Main rotor fiberglass blades which aerodynamic configuration uses third-generation airfoils designed by the Central Aerohydrodynamics Institute (TsAGI);
- Main rotor head with elastomeric bearings;
- Energy-efficient and low-noise scissors tail rotor;

- Four-stage multitorque main gear-box;
- Power plant with the PW-127T/S engines arranged aft of the main gear-box;
- Stabilizer controlled by collective pitch;
- Large-area fin unloading the tail rotor at high airspeeds



**Figure 1. Mi-38 in Demonstration Flight. October 1, 2004**

## **DATA COLLECTION AND PROCESSING SYSTEM**

During flight testing of helicopters at the Mil Moscow Helicopter Plant, the use is made of the BSS-500A system as an airborne system for measurement, collection and recording measured analog data in the field of the performance, flight dynamics, strength and vibration, monitoring of the airborne equipment, and integrated systems providing full information on the state of things in flight testing. The system was developed by Aeroprofil Gromov Flight Research Institute branch under the direction of Doctor A.I. Akimov.

Apart from a number of service functions, the BSS-500A system provides for:

- measurement, collection and recording of measured analog data,
- display of characteristics of measured parameters in flight, as well as in the course of check-out and calibration operations.

The system also includes a software system, which comprises:

- software enabling operation of the airborne system,
- software of the ground-based processing system providing for generation of data collection and recording tasks for the airborne system, as well as for post-flight processing of information relating to the focal points of the helicopter flight tests.

The introduction of that system drastically accelerated processing of the test data and enhanced its quality.

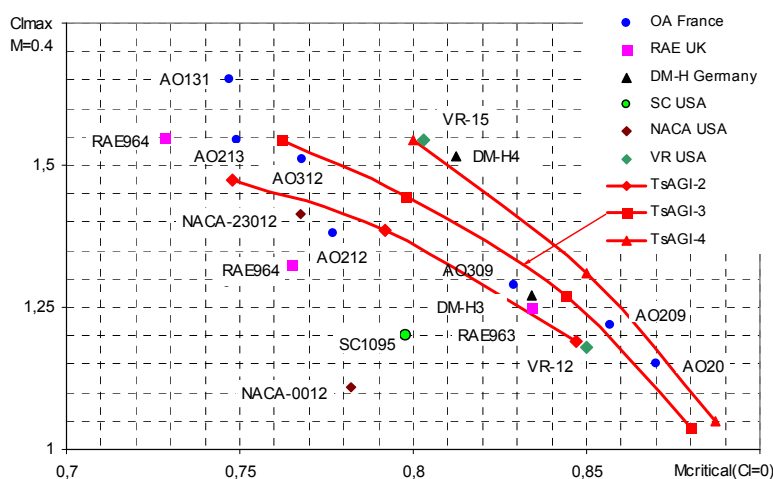
## **HELICOPTER AERODYNAMIC PERFORMANCE**

Prior to installation on the Mi-38 helicopter, the main rotor blades were tested using the Mi-8MTV helicopter acting as a test-bed. It was simple to implement such a possibility thanks to practically equal main rotors diameters and blade chords of the Mi-8 and Mi-38. The tests measured both strength and aerodynamic performance of the blades featuring aerodynamic configuration that differed from the configuration of the Mi-8 production blades

both in geometric twist and in aerofoil sections. Five of the six blades from the set of the Mi-38 helicopter were installed in the main rotor head of the Mi-8 helicopter.

Mil Moscow Helicopter Plant cooperates with the TsAGI in development of aerodynamic configurations of the main rotor blades. Airfoils developed in the institute division under the direction of E.S. Vozhdayev are employed in the configurations of the main rotor blades of the Mi-26 and Mi-28 helicopters and demonstrate sufficiently high efficiency. The Mi-38 helicopter main rotor blades are also made with the use of the TsAGI airfoils which were developed consistent with the customer requirements imposed on the helicopter with respect to the hovering ceiling and temperature range, as well as maximum speed, and with due account of the blade design and manufacturing technology. Furthermore, the designer requests for the airfoil pitch moment were also taken into account.

The requirement for high values of the maximum and cruising speeds motivated application of a thin airfoil at the tip of the blade with a thickness-chord ratio of 9 % featuring a high value of the critical Mach number. This airfoil is employed in the swept blade tip. The main body of the blade, running from  $\bar{r} = 0.5$  to  $\bar{r} = 0.91$ , is formed by the TsAGI-3 airfoil featuring a high lifting capability and a high L/D ratio maintaining them with the thickness-chord ratio varying within the range from  $\bar{c} = 11\%$  to  $\bar{c} = 14\%$ . The NACA230 airfoil is used for the blade root from running  $\bar{r} = 0.2$  to  $\bar{r} = 0.45$ .



**Figure 2. Airfoil Data for Main Rotor Blades**

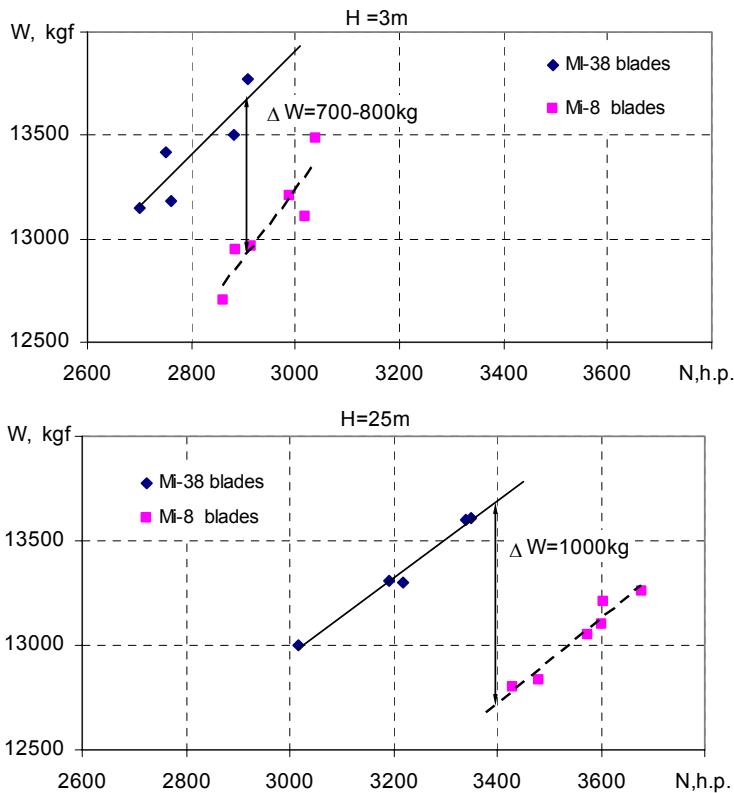
shows at which Mach numbers manifestation of the compressibility signs on the advancing blade becomes apparent.

The airfoils of the TsAGI-3 series employed in the Mi-38 main rotor blades had been developed by the beginning of the helicopter development and at that time, they were the best by the compared parameters. Now even more sophisticated airfoils have been developed both in the TsAGI (TsAGI-4 series) and in French and US laboratories.

The graphs in **Figure 3** present the measurements of the Mi-8MTV helicopter thrust with two types of blades at the wheel height of 3 m, (IGE), and at a height of 25 m (OGE). The tests showed that the helicopter thrust with the Mi-38 blades is by 700 – 800 kgf and 1,000 kgf greater at low hovering height and out of ground effect respectively as compared with the Mi-8 production blades.

The tests aimed at measuring the rotor hover thrust of the Mi-8MTV helicopter equipped with the Mi-38 blades and with the Mi-8MTV production blades were carried out during two consecutive days under identical atmospheric conditions, close to the standard ones ( $P_{amb} = 756$  mm Hg;  $OAT = 11 - 14$  °C), and at a wind speed of  $W = 0 - 3$  m/s.

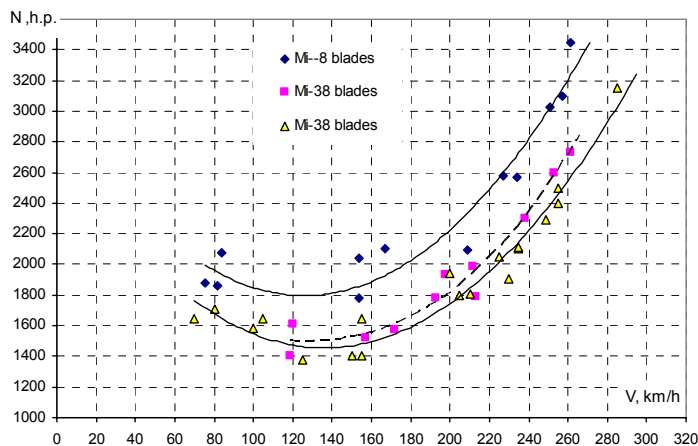
**Figure 2** compares performance of airfoils employed in the main rotor blades of both domestic and foreign helicopters. The critical Mach number at zero lift of the airfoil is laid off on the x-coordinate, and the maximum lift coefficient  $C_l$  at Mach number equal to 0.4 is plotted on the vertical axis. On the one hand this graph describes lifting properties of the airfoils on the side of the rotor disk with the retreating blade, and, on the other hand,



**Figure 3. Results of Measuring Mi-8 Rotor Thrust with Two Sets of Blades**

23% less than that of the helicopter with the production blades.

The advantages of the main rotor with the Mi-38 blades are explained by using new airfoils and their geometric twist (Fig. 5) featuring 1.6 times higher gradient of radial pitch variation than the blade twist of the Mi-8 main rotor.

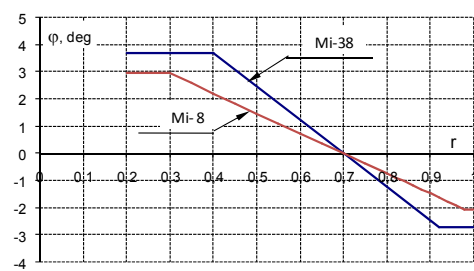


**Figure 4. Power Required for Level Flight of Mi-8 Helicopter with Two Types of Blades**

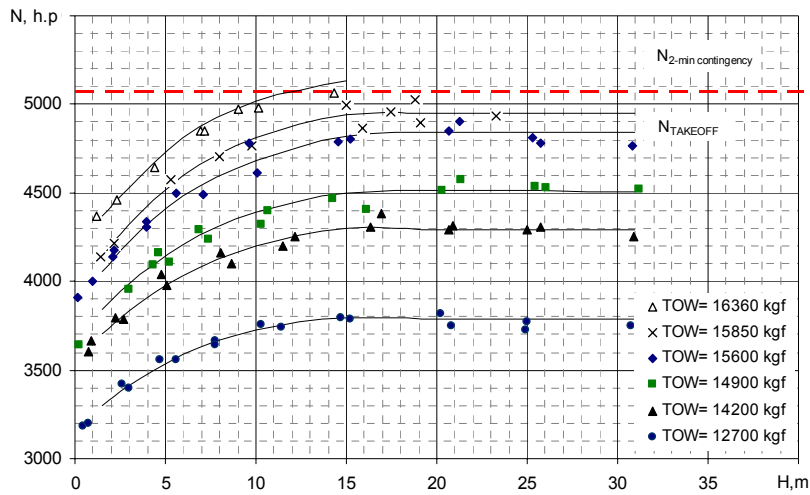
The engine power required versus the hovering height of the helicopter for different values of the helicopter takeoff weight is presented on the graph of Figure 6. The width of the paths of power dispersion values about the line of the mean values determined by the least square method is no more than  $\pm 1.5\%$ .

The advantages of the Mi-38 blades in comparison with the Mi-8 helicopter production blades in level flight proved to be no less impressive.

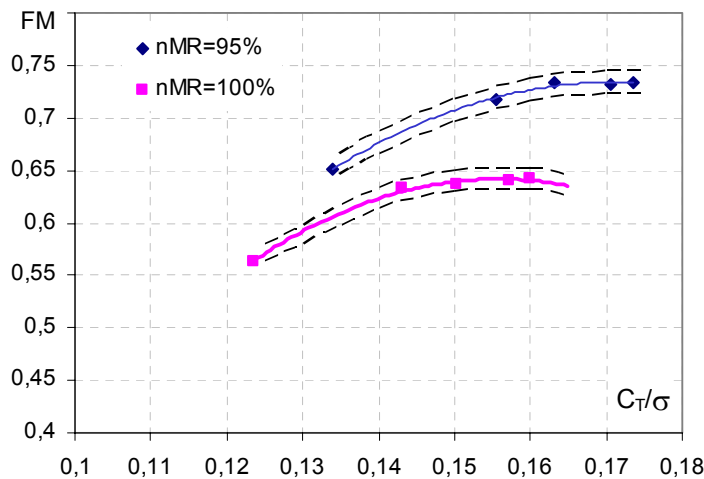
It can be seen from the graph in Figure 4 presenting the relationship between the engine power required for level flight of the Mi-8MTV helicopter with production blades and Mi-38 blades that the power required for the helicopter flight with the Mi-38 blades is less than that required for the helicopter flight with the production blades over the complete range of speeds. For instance, within the range of speeds  $V = 220 - 240$  km/h the power required for level flight of the helicopter with the Mi-38 blades is, respectively, by 19% and



**Figure 5. Geometric Twist of Main Rotor Blades of Mi-8 and Mi-38**



**Figure 6. Engine Power of Mi-38 Helicopter In Hover vs Wheel Heights.**  
 $n_{MR} = 95 \%$



**Figure 7. Mi-38 Main Rotor Figure of Merit vs Rotor Thrust Coefficient**

Figure of Merit of the main rotor, with regard to the width of the dispersion paths of the engine power values, is within the range of  $FM = 0.73-0.75$ , which is a sufficiently high index for single-rotor helicopters.

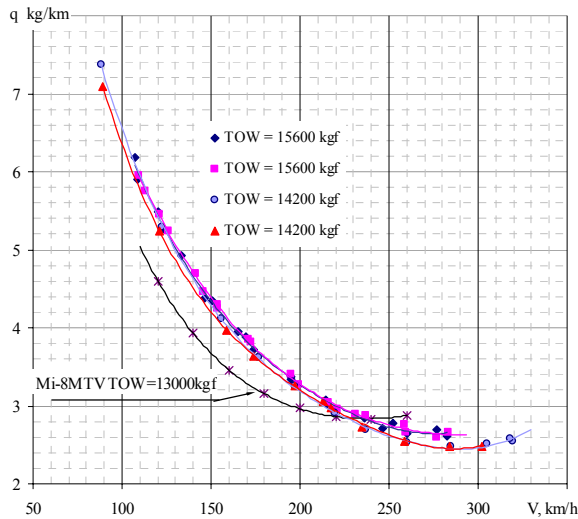
The helicopter fuel consumption per kilometer is equally an essential indicator of the helicopter perfection that defines its economic efficiency. It follows from the graph in **Figure 8** that the minimum values of helicopter fuel consumption per kilometer  $q = 2.49$  kgf/km and  $q = 2.65$  kgf/km for the normal and for the maximum takeoff weights respectively are obtained within the range of flight speeds of  $V = 280-290$  km/h.

In this case the engine power is  $N_{eng} = 3,750-3,850$  h.p. at the normal takeoff weight and  $N_{eng} = 3,950-4,050$  hp at the maximum weight, that conforms to the range of the maximum continuous power which is  $N_{MCP} = 1,900-2,100$  hp. Thus, proceeding from the fuel consumption and required power data obtained, the cruising speed of the helicopter with the normal takeoff weight can be given as  $V = 285$  km/h.

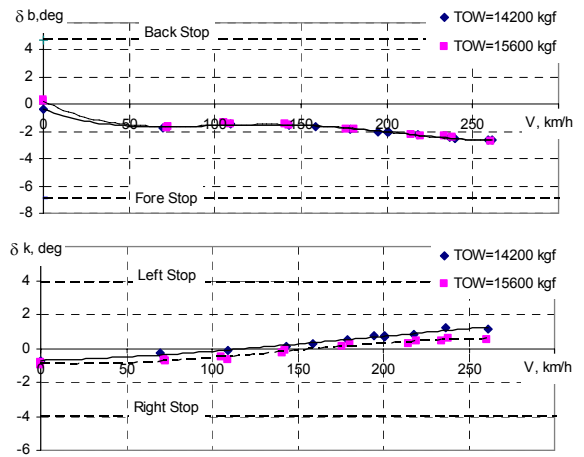
Figure of Merit in hovering is one of the indicators of perfection of the main rotor aerodynamic configuration. The results of the helicopter thrust measurement makes it possible to evaluate the aerodynamic perfection of the main rotor. The graph in **Figure 7** shows the relationship between the Mi-38 main rotor Figure of Merit and its thrust coefficient  $C_T/\sigma$  for two rotor speeds.

When calculating the main rotor Figure of Merit using the measured values of the engine power and takeoff weights of the helicopter, it was assumed that the thrust losses for the flow about the fuselage are 2.6 %, and the utilization factor of the engine power with an account of the transmission and tail rotor power losses was  $k = 0.824$ .

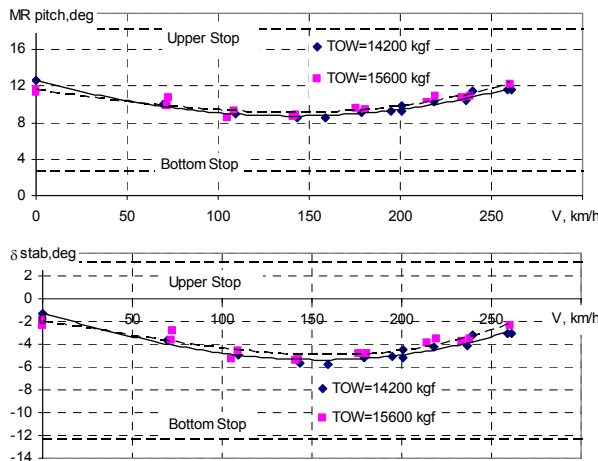
It can be seen from the graph that the peak



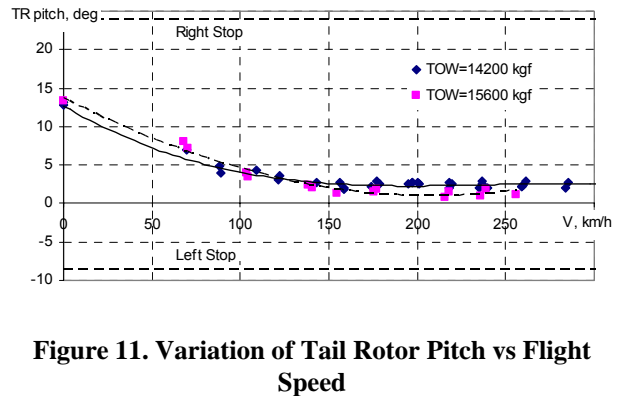
**Figure 8. Kilometric Fuel Consumption vs Flight Speed**



**Figure 9. Pitch ( $\delta_b$ ) and Roll ( $\delta_k$ ) Swash Plate Tilts vs Flight Speed.  $X_{CG}$ -middle**



**Figure 10. Main Rotor Collective Pitch and Angle of Stabilizer Setting ( $\delta_{stab}$ ) vs Flight Speed.  $X_{CG}$ -middle**



**Figure 11. Variation of Tail Rotor Pitch vs Flight Speed**

The airspeed trim curves of the Mi-38 helicopter, as can be seen from the graphs in **Figs 9, 10 and 11**, are typical for the Mil helicopters, however, as a merit, it is important to note that a "duck-in" in the longitudinal trim, intrinsic to the Mi-8 helicopter, is practically none in the Mi-38 helicopter (**Figure 9**). The longitudinal trim curve of the helicopter  $\delta_b(V)$  is practically neutral with respect to the flight speed within the range of speeds from 50 to 150 km/h.

Within the range of speeds of over 150 km/h, the gradient curve of the longitudinal trim  $\delta_b(V)$  conforms to the helicopter stability with the flight speed.

For the Mi-38 helicopter, the variation of the stabilizer setting angle is structurally linked with the variation of the collective pitch angle of the main rotor. This relationship can be plainly traced on the graphs in **Figure 10**.

On account of the helicopter having a large-area vertical stabilizer which assumes a considerable proportion of balancing of the torque reaction of the main rotor the pilot does not need to move the pedals at flight speeds of over 150 km/h, which makes helicopter piloting more comfortable as can be seen from the graph in **Figure 11**.

The values of hovering and service ceilings, as well as the value of the maximum airspeed of the helicopter characterize its power-to-weight ratio and aerodynamic cleanness.



The hovering ceiling of the helicopter with the normal gross weight of 14,200 kgf determined practically under standard atmospheric conditions was 3,100m.

The maximum indicated airspeed of the Mi-38 helicopter measured in one of the flights with the normal gross weight at a height of 500 m was 320 km/h.

In the course of the flight tests, the helicopter flew to determine the service ceiling and the maximum altitude. Table 1 specifies the values of service ceilings reduced to standard atmospheric conditions and time to climb thereto obtained in flights with the normal and maximum takeoff weights.

**Table 1**

TOW, kgf	H <sub>service</sub> , m	t <sub>climb</sub> , min	W <sub>gross</sub> , kgf
14,200	6,050	27.6	13,800
15,600	5,460	23.6	15,200

In flight to the maximum altitude, the helicopter climbed to 8,150 m with the gross weight being 10,600 kgf. The post-flight weight analysis showed that the helicopter carried 1,000 kgf of load which included the test equipment and an excess of fuel upon attainment of 8,150 m.

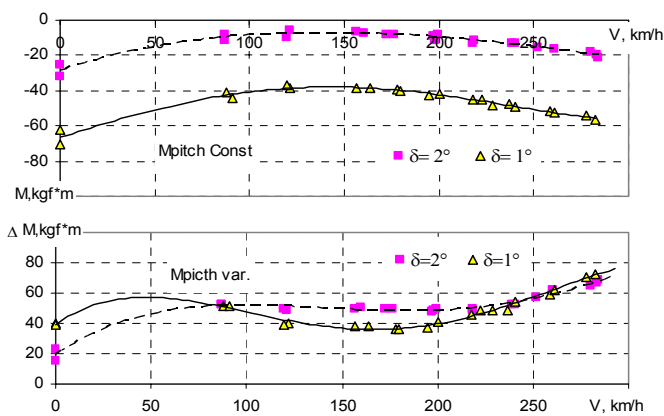
## OPTIMIZATION OF LOADS IN HELICOPTER COMPONENTS

One of the objectives of the flight tests is measurement of loads applied to the helicopter components and, in particular, to the control system units. There are situations when, due to various reasons, the maximum permissible load levels can be achieved before the helicopter has attained maximum allowable flight conditions. In these cases, it is necessary to seek ways to decrease the values of the attained maximum permissible load levels under critical flight conditions, even through at the cost of an increase of load levels under the flight conditions where loads are far from maximum permissible values. Such an effort to optimize the load levels in the helicopter control system is made during testing of practically every new type of a helicopter. The purpose of this work is to reduce loads under all flight conditions, including maneuvers, to the designer-prescribed limitations on the levels of loads applied to the components.

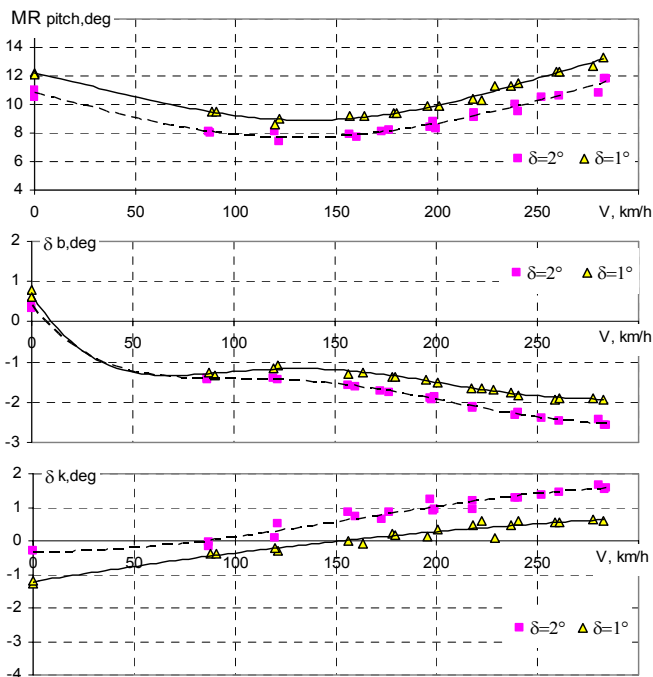
The TsAGI-3 series airfoils of the main rotor blades of the Mi-38 helicopter have trailing edge flap tabs. For the first sets of the main rotor blades, these flap tabs were manufactured in a way enabling the variation of their setting angle relative to the airfoil chord and thus affecting the values of the blades pitch moments and, hence, the levels of loads applied to the swash plate and hydraulic actuators of the control system.

In the course of the helicopter testing under non-maneuvering flight conditions it was found that a satisfactory load level under all level flight conditions is obtained at the flap tab bending angle equal to 2° up from the airfoil chord on the main rotor blades. However, under flight conditions where normal load factor  $n_y$  exceeded unit, to attain the value of normal load factor  $n_y = 2$ , in particular, in zoom, loads applied to some components of the control system reached the specified limits. Therefore, proceeding from the results of the flight data analysis, the flap tab bending angles were altered and set equal to  $\delta = 1^\circ$ .

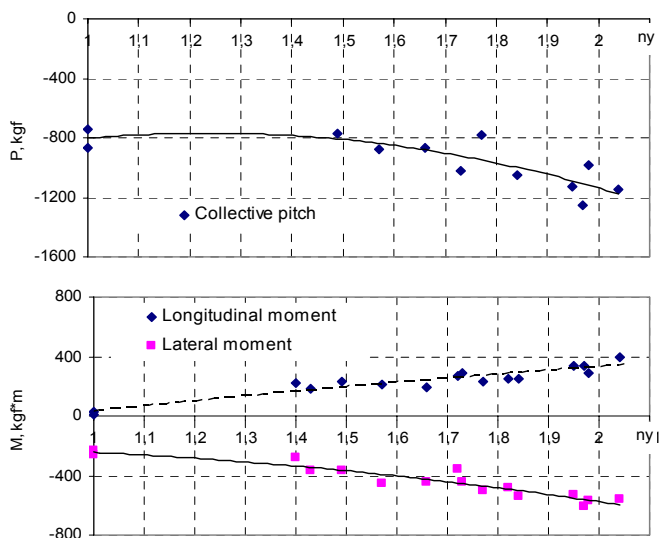
It can be seen from the graph in **Figure 12** that as a result of the flap tab bending angle change by one degree the constant component of the blade pitch moment curve versus the flight speed dropped by 35–40 kgm. In this case, the value of the variable component of the pitch moment at high speeds remained practically unchanged, and somewhat decreased within the range of average flight speeds.



**Figure 12. Variation of Pitch Moment Components of Main Rotor Blade vs Flight Speed**



**Figure 13. Effect of Main Rotor Blade Flap Resetting on Trim Curves**



**Figure 14. Loads on Swash Plate vs Normal Load Factor**

A decrease in the flap tab bending angle also effected the helicopter flight speed trim curves, with respect to the flight speed which is shown on the graphs in **Figure 13**.

Redistribution of the swash plate longitudinal and lateral moment components of the forces on the hydraulic actuators of the control system as a result of changing the flap tab bending angle made it possible to obtain considerably a much higher value of the normal load factor during flying under maneuvering conditions.

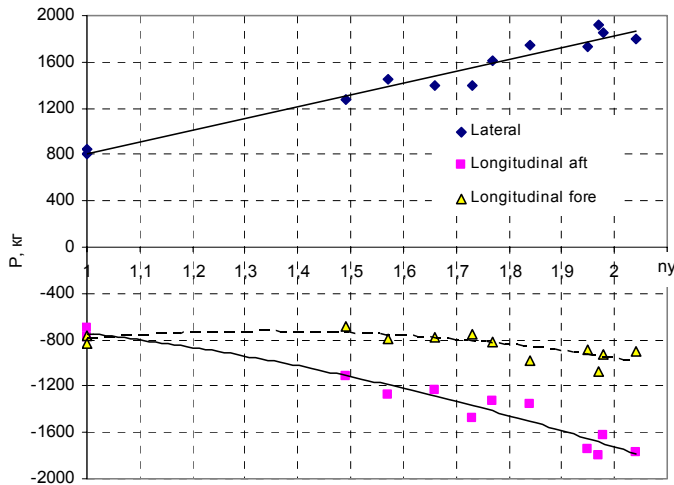
The maximum normal load factor  $n_y$  attained on entry into zoom was 2.0.

The graphs in **Figure 14** present loads on the swash plate versus the attained normal load factor. The loads applied in level flight at a speed of 240 km/h prior to entry into zoom are shown on the graphs at  $n_y = 1$ .

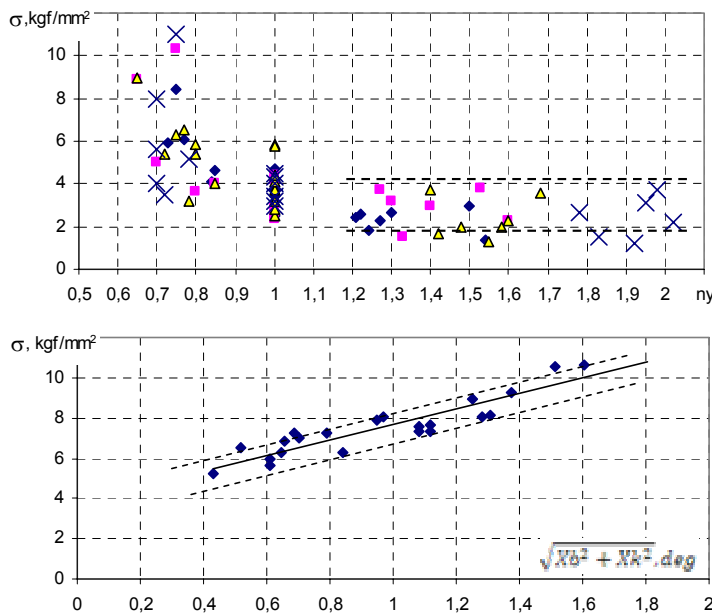
One of the objectives of flying under maneuvering conditions with attainment of load factor  $n_y = 2$  was measurement of loads applied to the hydraulic actuators of the control system under such conditions and their correlation with the values of maximum forces generated by the hydraulic actuators. The graph in **Figure 15** shows variation of forces applied to the hydraulic actuators of the control system versus the attained load factor on entry into zoom.

The test results have shown that under maneuvering conditions with attainment of load factor  $n_y = 2$  the margin of the constant component of the hydraulic actuator forces is at least 63% during normal operation of two hydraulic systems of the helicopter, and 25% in case either of them fails.





**Figure 15. Hydraulic Actuators Loads on Entry into Zoom**



**Figure 16. Main Rotor Mast Bending Stresses in Zoom**

the analysis of the records of the helicopter motion parameters and displacement of the controls, at the cyclic pitch control stick travels greater in magnitude than on entry into zoom.

The lower graph in the same figure testifies that the maximum semi-ranges of bending stresses in the main rotor mast depend on the total angle of the swash plate tilt. The total tilt angle refers to the angle of the swash plate tilt in the longitudinal and lateral directions from the position in which the first harmonic bending stresses in the mast are near-zero.

A rather interesting result was obtained from the analysis of recorded bending stresses arising in the main rotor mast during the execution of the zoom maneuver. Flying under maneuvering conditions, particularly in zoom, with attainment of considerable load factor levels involves displacement of the cyclic pitch control stick, swash plate, and associated with vectoring of the rotor thrust, both in longitudinal and lateral directions, and changing the value of the rotor head moment.

The upper graph in **Figure 16** shows the maximum semi-ranges of bending stresses in the lower cross-section of the main rotor mast achieved at maximum and minimum load factors in zoom. Plotted on the same graph are magnitudes of acceleration stresses at  $n_y = 1.0$  on the steady-state flight leg prior to entry into zoom.

It can be seen that the bending stresses have no tendency to grow with the maximum acceleration. In contrast, the greatest magnitudes of stresses were achieved during recovery from zoom, at load factors less than unity and, as evidenced by

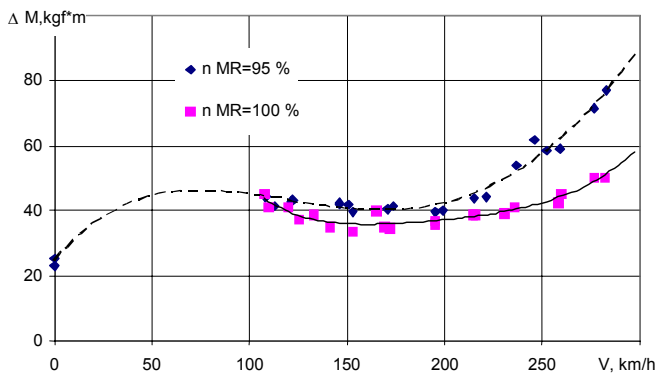
## EFFECT OF MAIN ROTOR SPEED ON CONTROL SYSTEM LOADS

The Mi-38 helicopter is provided with two operating values of the main rotor speed enabling level flight, 95 % and 100 %. The main rotor speed is increased to 100 % at a flight altitude of over 2,000 m to put off the main rotor blade stall boundary with speed which is characterized by the beginning of an intensive growth of loads in the helicopter control system. To determine the actual reduction of the load level as a result of the main rotor speed-up, a flight with the maximum takeoff weight at 15,600 kgf was carried out at two rotational speeds within the whole range of level-flight speeds. It can be seen from the graph in **Figure 17** that the speed-up to 100 % resulted in a 60 % decrease of the variable component of the pitch moment at a speed of 280 km/h.

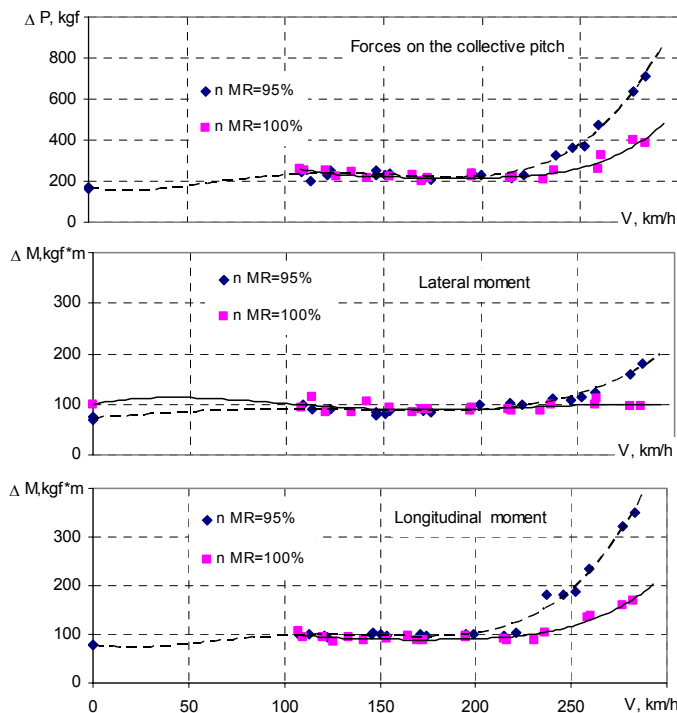
Reduction of the level of variable components of pitch moments occurred, principally, at the cost of the reduced first harmonic component. Constant components of the pitch moments in this case changed slightly.

Changes in variable components of the blade pitch moments caused considerable changes in the levels of variable loads applied to the swash plate. The graph in **Figure 18** presents the forces acting on the collective pitch slider, as well as the lateral and longitudinal moments as a function of the flight speed.

It can be seen from the graphs, that as a result of the main rotor speed-up to 100 % forces applied to the collective pitch slider decreased by 75 % at a speed of 280 km/h, and no intensive growth of variable components of the lateral moment with the flight speed was observed, up to and including  $V=280$  km/h, whereas at the main rotor speed of 95 % the moment began to grow at a speed of 240 km/h. Semi-ranges of the lateral moment at a speed of 280 km/h decreased by more than 40 %. Semi-ranges of the variable component of the longitudinal moment at a flight speed of 280 km/h reduced almost by half.



**Figure 17. Variable Component of MR Blade Pitch Moment vs Flight Speed**



**Figure 18. Variable Components of Forces on Collective Pitch Slider and Longitudinal and Lateral Moments of Swash Plate vs Flight Speed**

## HELICOPTER VIBRATION STATE

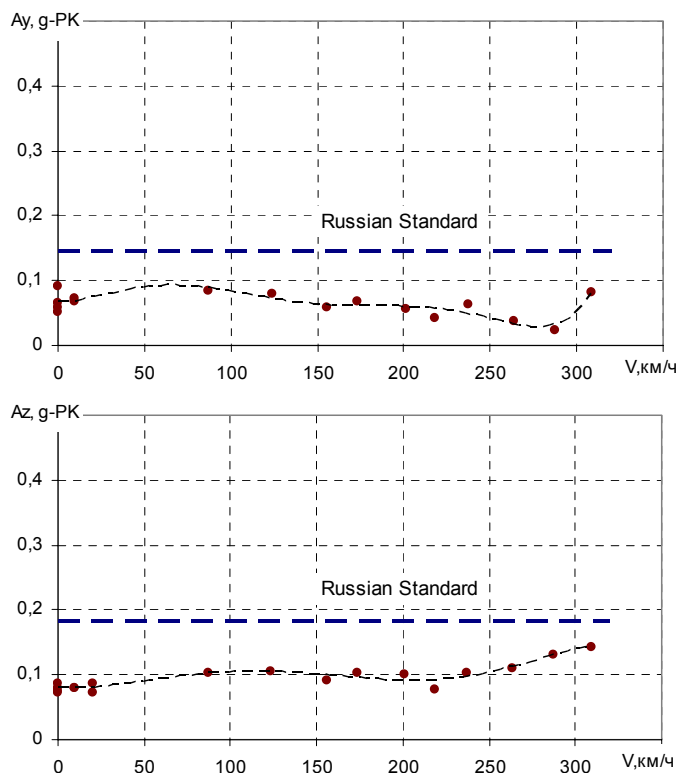
During development of the helicopter, much attention was given to the problem of how many blades the main rotor should have. It is common knowledge that a primary reason for excessive vibration of single-rotor helicopters is the existence, within the range of operating speeds, of a so called “pylon” resonance of the main rotor with a frequency equal to the product of the number of the blades by the main rotor speed. This problem in the helicopters is solved either by vibration isolation or by installation of special vibration dampers, as, for example, in the Mi-8 helicopters. One of the valid methods of the pylon resonance removal from the range of operating speeds of the main rotor is a rational choice of the number of blades, and that was done at the Mi-38 helicopter design stage. All the pros and cons considered, it was determined that the main rotor of the helicopter should have 6 blades, and not 5, like the Mi-8.

This has made it possible, first, due to an increase of the transfer harmonic frequency, to obtain the desired value of dynamic stiffness of the fuselage pylon and to exclude the pylon resonance from the range of operating speeds, second, to bring down the level of the main rotor aerodynamic excitation by raising the number of the transfer harmonic of forces and, third, not to increase the chord of the blades, in comparison with the Mi-8 helicopter blades, which allowed to ensure continuity and affected favorably the level of loads applied both to the main rotor head and to the control system units.

The results of vibration measurements during the flight tests confirmed the correctness of the decisions adopted at the design stage. Vibration level with the transfer harmonic

frequency proved to be low, and a comfortable ride in the Mi-38 helicopter meets the applicable requirements of the Russian standards without employment of any special means of vibration reduction. The graph in **Figure 19** presents the values of vibration acceleration observed on the flight compartment floor of the Mi-38 helicopter in level flight with the normal gross weight.

According to subjective estimation of the pilots who flew the Mi-38 helicopter, its vibration state is the same, or even somewhat better, than that of the Mi-8 helicopter furnished with vibration dampers.



**Figure 19. Variation of Vibration Acceleration Loads in Flight Compartment vs Flight Speed**

## Mi-38 AMONG OTHER MEDIUM LIFT TRANSPORT HELICOPTERS

The results of flight tests confirmed that the flight performance of the Mi-38 helicopter was the same as that of the predicted one at the helicopter development stage, and in some cases exceeded it. **Table 2** compares basic specifications of some medium helicopters. Helicopter performance is given for the maximum takeoff weight.

**Table 2**

	<b>EC-225</b>	<b>S-92</b>	<b>EH-101UT</b>	<b>Mi-171</b>	<b>Mi-38</b>
<b>Maximum takeoff weight, kgf</b>					
with internal load	10,400	11,861	15,600	13,000	15,600
with external load	11,200	12,837	15,600	13,000	15,600
<b>Maximum load weight, kgf</b>					
internal	–	–	–	4,000	5,000
external	5,000	4,536	4,536	4,000	7,000
<b>Helicopter operational empty weight, kgf</b>	5,335	7,279	9,350	7,250	8,570
<b>Fuel quantity, liters</b>					
with main tanks fuel	2,609	2,877	4,303	2,615	3,942
with main and auxiliary tanks fuel	5,305	4,277	4,952	4,445	6,022
<b>Number x type of engines</b>	2 x Makila 2A	2 x CT7-8A	3 x CT7-8E	2 x TV3-117VM	2 x PW-127
<b>Engine power, hp</b>					
30-s contingency	2,448	2,740	–	–	3,900
2 (2.5)-min contingency	2,264	2,523	n/d	2,200	3,600
30-min contingency	2,198	2,498	n/d	2,000	2,700
takeoff	2,129	2,520	2,560	2,000	2,500
maximum continuous	1,897	2,043	2,068	1,700	2,000
<b>Speed (ISA, sea level), km/h</b>					
never-exceed	324	306	n/a	233	300
maximum cruising	276	284	278	219	275
economic cruising	276	258	230	219	255
<b>OGE hovering ceiling (ISA), m</b>	2,084	2,172	1,460	1,500	1,500
<b>Service ceiling (ISA), m</b>	5,530	4,572	n/d	4,800	5,450
<b>Range with main tanks full (ISA, sea level, no reserves), km</b>	870	940	1,040	700	965

The cost-efficiency of the helicopters can be characterized in terms of many parameters, but since such an economic analysis is beyond the scope of this paper, let us consider two parameters only that describe the Mi-38 economic efficiency.

One of these parameters is the load weight that can be carried by the helicopter over a desired distance. The graph in **Figure 20** shows the weight of the load carried versus the range under the ISA conditions at sea level with the main fuel tanks full with an allowance for the fuel reserve for 125 kilometers of flight.

The characteristic curves were obtained for helicopters with a maximum takeoff weight. As can be seen, the Mi-38 helicopter has an edge over other helicopters of its class with respect to this parameter up to a flight range of 850 km.

The other important parameter is fuel efficiency of the helicopter. The graph in **Figure 21** presents fuel consumption per tonne-kilometer for a carried load for the medium helicopters being compared. In this parameter, the Mi-38 helicopter outperforms both domestic and similar foreign countertypes.

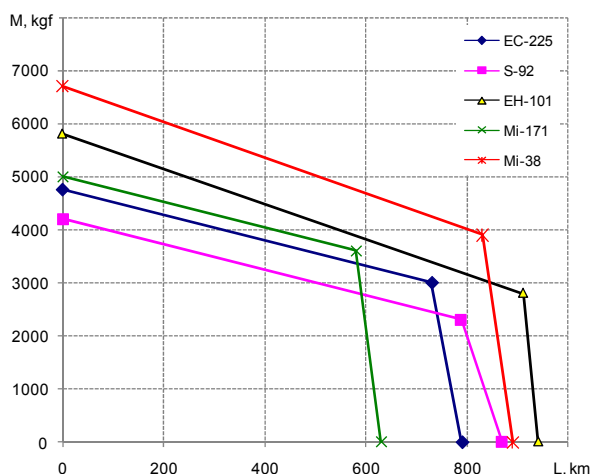


Figure 20. Weight of Carried Load vs Helicopter Range

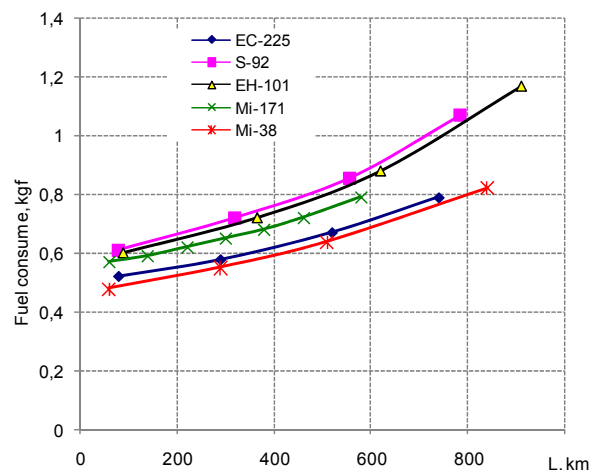


Figure 21. Fuel Consumption per Ton-Kilometer of Carried Load vs Helicopter Range

## CONCLUSIONS

- The flight tests of the Mi-38 helicopter confirmed, and in some instances, exceeded the claimed performance:
  - hovering ceiling with the normal takeoff weight – 3,100 m
  - service ceiling with the normal takeoff weight – 5,900 m
  - service ceiling with a maximum takeoff weight – 5,450 m
  - maximum flight altitude with 1000 kgf load – 8,150 m
  - maximum indicated airspeed with the normal takeoff weight – 320 km/h
  - maximum helicopter thrust in hover (OGE) – 15,900 kgf
  - maximum maneuvering normal load factor at the normal takeoff weight – 2.0
- Levels of vibration in the pilot cabin of the Mi-38 helicopter meet the Russian comfort requirements.
- The shape of the main rotor blade airfoil has been refined providing optimum levels of loads in the helicopter control system.
- Data obtained enable manufacturing of the second prototype of the helicopter as a standard construction for carrying out the certification tests.
- As for its economic efficiency, the Mi-38 helicopter can compete with aircraft of foreign manufacture.