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Mi-38 multipurpose helicopter of medium load-carrying capability is developed by Mil Moscow helicopter plant; this is a single-rotor scheme helicopter with tail rotor. The helicopter is powered by two engines, at that engines of two different types can be installed: PW127TS and TV7-117V, Canadian-made and Russian-made respectively. The main components of the fuselage structure are made of aluminum alloys, certain parts and units are made of steel, titanium and composite materials. Advanced design of main rotor with six blades ensures high thrust and low vibrations level. Main rotor (MR) blades are equipped with anti-icing system. X-shaped tail rotor (TR) ensures perfect controllability with low noise level. MR and TR hubs have no units requiring lubrication and can be operated ‘on condition’. Mi-38 helicopter has advanced performance, up-to-date and reliable design of helicopter systems, integrated airborne equipment. Low-consumption engines, advanced helicopter flight structure and high available power ensure efficient operation of the helicopter within wide range of operating conditions, while airborne equipment allows to carry out the flights by day and night in different climatic and geographic conditions.

Spacious cargo cabin, availability of loading and unloading devices and external load system, wide sliding door and easy-to-use ramp allow the helicopter operation for transportation of a variety of loads. Helicopter provides for transportation of loads up to 6,000 kg inside cargo cabin or up to 7,000 kg loads using external load system. Availability of automatically operated helicopter center of gravity (CG) and weight measuring systems, as well as external load weight measuring systems significantly enhance flight safety.

Set of standard and additional equipment ensures multitask capability. Mi-38 helicopter is an optimal platform for creation of special-purpose helicopters.

Helicopter in different application configurations can be used for carrying out the following operations: transportation of cargo, goes inside the cargo cabin and by external sling, medical evacuation (medevac) and search-and–rescue operations, as well as transportation of passengers, including transportation of VIP.

Principal criterion implemented in Mi-38 helicopter design is a maximum level of flight safety. Fuselage layout, dimensions and number of emergency exits, possibility of emergency evacuation through the large windows, energy-absorbing seats and landing gear, capability of main gearbox operation without oil within 30 minutes, triple redundancy of flight control hydraulic system and crashworthy fuel system ensure fulfillment of strictest requirements of international aviation safety standards. Helicopter has a margin of power sufficient to continue takeoff and landing in case of failure of one of the engines. Main and tail rotors location at a considerable height makes helicopter maintenance by ground personnel and other operations on the ground with passengers and cargoes easy and safe.

Installation of removable modular emergency flotation system (EFS) and equipping the helicopter with airborne survival equipment set make possible helicopter ditching and safe evacuation of people. Helicopter features low labour coefficient of technical maintenance. Helicopter operation ‘on condition’, low specific fuel consumption, good indices of components service life (no limitations of blades service life) significantly reduce operational costs.

Minimum number of helicopter crewmembers depending on type of application is 1 or 2 pilots.
Mi-38 MULTIPURPOSE HELICOPTER
The characteristics are given for the standard atmospheric conditions (ISA).

Maximum take-off weight, kg .......................................................... 15,600
Normal take-off weight, kg .............................................................. 14,200
Maximum internal load, kg ............................................................... 7,000
Maximum indicated airspeed of horizontal flight, km/h: .................. 320
Cruising indicated airspeed at altitudes of 0 to 1,000 m, km/h: ............ 290
Minimum indicated airspeed of horizontal flight at altitudes up to 1,000 m, km/h .......................................................... 60
Hovering ceiling:
  out of ground effect, m .............................................................. 3,100
  in ground effect, m ................................................................. 3,460
Service ceiling:
  normal take-off weight, m ........................................................ 6,320
  maximum take-off weight, m ..................................................... 5,600
Maximum flight range:
  main fuel tanks, load 3,655 kg (H=300, ISA), km ......................... 990
  with auxiliary fuel tanks, load 2,500 kg, km ............................... 1,200

General data at maximum take-off weight

Helicopter length:
  without main and tail rotors, mm ........................................... 20,282
  with rotating main and tail rotors, mm ..................................... 25,184

Helicopter height:
  without tail rotor, mm ............................................................ 5,657
  with rotating tail rotor, mm ..................................................... 6,992

Ground clearance, mm ................................................................ 580

Main rotor diameter, mm ............................................................. 21,100
Tail rotor diameter, mm .............................................................. 3,840
Cargo cabin dimensions (L x W x H), m ..................................... 7.00 x 2.36 x 1.84
Cargo cabin capacity, m³ .............................................................. 29.50
Fuselage aperture in the rear part (H x W), mm ............................. 1,840 x 2,343
Cargo cabin sliding door aperture, starboard (H x W), mm ............ 1,655 x 1,432
Entrance stairs/door aperture, portside (H x W), mm ...................... 1,590 x 822
Main landing gear wheel track, mm ............................................ 4,477
Landing gear wheel base, mm ..................................................... 5,408

(L x W x H) – Length x Width x Height
(H x W) – Height x Width
Given in the Tables 1, 2 are cruising speeds depending on helicopter takeoff weight and flight altitude, design data (preliminary) are defined for ISA conditions.

Table 1. Maximum cruising speeds

<table>
<thead>
<tr>
<th>Flight altitude, m</th>
<th>Weight 14,200 kg</th>
<th>Weight 15,600 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$V_{cr, max, indic}$, km/h</td>
<td>$V_{cr, max, true}$, km/h</td>
</tr>
<tr>
<td>0</td>
<td>300</td>
<td>290</td>
</tr>
<tr>
<td>500</td>
<td>300</td>
<td>295</td>
</tr>
<tr>
<td>1000</td>
<td>295</td>
<td>300</td>
</tr>
<tr>
<td>2000</td>
<td>280</td>
<td>300</td>
</tr>
</tbody>
</table>

Table 2. Economic cruising indicated and true flight speeds and corresponding kilometric fuel consumption (q) and fuel consumption per hour (Q).

Helicopter weight is 14,200 kg

<table>
<thead>
<tr>
<th>Flight altitude, m</th>
<th>$V_{cr, ec, indic}$, km/h</th>
<th>$V_{cr, ec, true}$, km/h</th>
<th>q, kg/km</th>
<th>$V_{cr, ec, indic}$, km/h</th>
<th>$V_{cr, ec, true}$, km/h</th>
<th>Q, kg/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>250</td>
<td>242</td>
<td>2.70</td>
<td>150</td>
<td>147</td>
<td>523</td>
</tr>
<tr>
<td>500</td>
<td>250</td>
<td>248</td>
<td>2.60</td>
<td>150</td>
<td>151</td>
<td>510</td>
</tr>
<tr>
<td>1000</td>
<td>240</td>
<td>244</td>
<td>2.50</td>
<td>150</td>
<td>154</td>
<td>497</td>
</tr>
<tr>
<td>2000</td>
<td>230</td>
<td>245</td>
<td>2.34</td>
<td>150</td>
<td>162</td>
<td>479</td>
</tr>
</tbody>
</table>

Helicopter weight is 15,600 kg

<table>
<thead>
<tr>
<th>Flight altitude, m</th>
<th>$V_{cr, ec, indic}$, km/h</th>
<th>$V_{cr, ec, true}$, km/h</th>
<th>q, kg/km</th>
<th>$V_{cr, ec, indic}$, km/h</th>
<th>$V_{cr, ec, true}$, km/h</th>
<th>Q, kg/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>250</td>
<td>242</td>
<td>2.80</td>
<td>150</td>
<td>147</td>
<td>559</td>
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<tr>
<td>500</td>
<td>250</td>
<td>248</td>
<td>2.72</td>
<td>160</td>
<td>160</td>
<td>550</td>
</tr>
<tr>
<td>1000</td>
<td>250</td>
<td>254</td>
<td>2.62</td>
<td>160</td>
<td>164</td>
<td>540</td>
</tr>
<tr>
<td>2000</td>
<td>240</td>
<td>256</td>
<td>2.48</td>
<td>160</td>
<td>172</td>
<td>532</td>
</tr>
</tbody>
</table>
Given in Figure 3 is hovering ceiling-helicopter takeoff weight curve.

Maximum speed - helicopter flight altitude – maximum rate of climb curves are given in Figures 4 and 5.

Given in Figure 6 is kilometric fuel consumption-flight speed curve for different helicopter gross masses.
Given in Figures 7, 8, 9 are curves of fuel consumption per ton-kilometer of load transported, possible payload and relative efficiency depending on flight range.

Fig. 7. Ton-kilometer fuel consumption (ISA, sea level, without fuel reserve).

Fig. 8. Transportation capabilities (ISA, flight altitude 300 m, 30-minutes fuel reserve).

Fig. 9. Relative efficiency (ISA, sea level, without fuel reserve).
The helicopter fuselage is a variable section semi-monocoque structure made up of nose and central sections, tail boom, tail boom pylon, stabilizer, as well as power plant cowlings.

The nose section of the fuselage consists of cockpit canopy with windows, side and ceiling panels, cockpit floor and nose fairing. Installed on the floor are pilots’ seats, helicopter controls, pilots’ instrument panel and control panels. Electrical equipment and avionics units, as well as control system units are located in the compartments behind the pilots’ seats and under the cockpit floor. Radar is located in the nose fairing. Windshields are provided with electrical heating and hot air blow-off. Side blisters are sliding, cockpit ceiling is provided with engine and gearbox access hatch. There is a partition with the door between nose and central sections of the fuselage.

Fuselage central section comprises cargo cabin floor, ceiling panel, three-layer honeycomb side panels and tail section, forming a cargo cabin. In the front there is a cargo sliding door located on the starboard and entrance stairs/door located on the port side. Attached to the rear part of cargo cabin floor is loading (cargo) ramp with toe plates, which closes the lower portion of rear cargo door while retracted. Upper portion of cargo door is closed by two panels. On the cargo cabin floor tie-down rings are installed for loads carriage, as well as hoist and hoist boom attachment. In the center section of the floor there is an access door equipped with external load system fittings. Fuel tanks and air conditioning system units are arranged in the cargo cabin floor compartments. Fuel system components, single-point fueling filler neck, hydraulic system units and air conditioner are located in the airborne containers, which are attached at the level of cargo cabin floor both on port side and starboard.

Entrance stairs/door on the port side or loading ramp in the rear part is used to enter the cargo cabin. Cargo cabin is equipped with lighting equipment to provide loading and unloading of cargoes in the nighttime.

Located on the portside and starboard of the fuselage are emergency exits and five rectangular blisters. Emergency exits

---

1. Nose section
2. Nose landing gear
3. Central section
4. Main landing gear
5. Cowling
6. Tail boom
7. Stabilizer
8. Tail boom pylon
9. On-board containers

Fig. 10. Layout of helicopter fuselage.
are also provided in the cargo sliding door and clamshell door. Passenger ramp is also used as emergency exit. All emergency exits are provided with emergency release mechanisms and can be released both from the inside and outside of the helicopter.

Tail boom is all-metal variable section semi-monocoque structure having a flange joint with fuselage central section. There are two strong frames in the rear portion of tail boom, arranged onto which ones are attach fittings of tail rotor pylon, stabilizer, intermediate gearbox and tail bumper. Installed inside the tail boom are emergency flight recorder, radio equipment units, screw mechanism of stabilizer control and intermediate supports, through which ones the tail drive shaft is passed. Tail boom is attached to tail rotor pylon, which has asymmetric aerofoil to relieve loads acting on tail rotor in flight.

Adjustable horizontal stabilizer installed on the tail boom is designed to provide required stability and controllability. Stabilizer setting angle changes depending on collective pitch control lever position. Two-spar vertical stabilizer with its base is attached to the tail boom. Attached to the upper part of vertical stabilizer are tail gearbox and bracket with rollers of tail rotor cable control.

Power plant cowling with separate panels is installed on the ceiling panel of the fuselage central section. Cowling allows carrying out maintenance of engines, main gear box and other units located in the upper part of helicopter without ladders employment.

Helicopter landing gear comprises nose gear, two main gears and tail bumper with hydro-pneumatic shock absorbers. Non-retractable landing gear units shall prevent lateral oscillations of the helicopter during landing, rolling and taxiing to ensure smooth shock absorption. Tail bumper prevents the tail rotor blades from striking against the ground during landing at a high pitch angle.

The main landing gear units are located at the both sides of the fuselage and have wheels provided with a hydraulic block brake.

The nose landing gear has two wheels without brakes. The nose landing gear is a self-oriented, wheel levered-suspension unit.
Power plant of the helicopter consists of two TV7-117V turboshaft engines, manufactured by Russian company “Klimov”, or two PW127TS engines manufactured by Canadian company Pratt & Whitney. Engines transmit torques to main gearbox. Engines are located behind the main gearbox, which reduces the noise level inside the cabin and improves safety in case of emergency landing. Each engine with its front assembly is attached to the spherical joint on main gearbox and with its rear flange it is attached by means of rods to the fittings on the cargo cabin ceiling. Twin engine installation improves safety of helicopter operation and allows continuing flight with one engine inoperative.

Engines have modular design.

TV7-117V engine features:
- compressor – single-stage, mixed-flow;
- combustion chamber – annular, reverse flow;
- compressor turbine – axial-flow, double-stage, with cooled rotor and nozzle blades;
- free power turbine – axial-flow, double-stage, uncooled;

Engine start is provided by the air starter, which rotates compressor and supplied with compressed air from auxiliary power unit (APU) TA14-038.

PW127TS engine has radial-flow double-stage compressor, engine start is electrical.
Engine is provided with automatic control electronic-hydromechanical system.

Electronic portion of automatic control electronic-hydromechanical system is made on the basis of digital computer of FADEC type (Full Authority Digital Engine Control).

While operating in normal mode, hydromechanical portion is acting as actuator of electronic portion. In case of failure of electronic portion hydromechanical portion ensures engine power settings controls according to simplified principles.

Automatic control system provides for engine starting, limitation of engine power settings according to limiting values of engines parameters, including torque, protection against free turbine rotor acceleration, engine anti-surge protection, synchronization of engines operating modes, automatic changeover to power setting higher than takeoff power in case of failure of another engine, automatic recovery of engine power setting in case of spontaneous extinction of combustion chamber etc.

Engine has independent anti-icing system.

Table 3. TV7-117V engine power settings

<table>
<thead>
<tr>
<th>Engine power setting</th>
<th>Temperature, °C</th>
<th>Output shaft power, h.p. (kW)</th>
<th>Specific fuel consumption, g/(h.p.·h) (g/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5-minute power</td>
<td>Up to +15</td>
<td>3,750 (2,760)</td>
<td>-</td>
</tr>
<tr>
<td>30-minute power</td>
<td>Up to +30</td>
<td>3,000 (2,210)</td>
<td>-</td>
</tr>
<tr>
<td>Takeoff (maximum continuous, OEI)</td>
<td>Up to +35</td>
<td>2,800 (2,060)</td>
<td>205 (280)</td>
</tr>
<tr>
<td>Maximum continuous</td>
<td>Up to +40</td>
<td>2,100 (1,545)</td>
<td>-</td>
</tr>
<tr>
<td>Maximum cruise</td>
<td>Up to +40</td>
<td>1,900 (1,400)</td>
<td>222 (300)</td>
</tr>
</tbody>
</table>
Engine oil system consists of inner oil system, being a part of engine design, and outer oil system, being a part of helicopter oil system.

Inner oil system is of circulating and forced type, it comprises: oil tank, oil pump block, oil filter, fuel-oil heat exchanger, centrifugal filter. Outer oil system of each engine comprises air-to-oil cooler, drain valves, pipelines and metal hoses, interconnected in common manifold.

Fig. 17. Engine oil system layout.

1. Engine with internal oil system
2. Air-to-oil cooler
3. Pipelines and metal hoses
4. Drain valves
ENGINES’ AIR INTAKES, DUST PROTECTION DEVICE AND BYPASS DEVICE

Ambient air is supplied to the engine inlet device through the dust protection device and bypass device (tunnel with flap), with its flap in opened position.

Dust protection device (DPD) of multicyclone type is designed to protect the TV7-117V engines against dust and extraneous objects from the air supplied to the main engines during helicopter taxiing, takeoff and landing. DPD is installed in the opening of rear part of gearbox compartment cowling panel in front of the engine inlet device.

Bypass device is an air intake with air passage to the engine inlet device bypassing the dust protection device, which is provided by opening of turning flap of bypass device. In order to protect against icing bypass channel is heated with hot air bled from the engines.

AUXILIARY POWER UNIT (APU)

Auxiliary power unit (APU) is designed to start main engines using air starters, AC supply to the helicopter power supply system and heating of helicopter cabins when engines are not running. APU TA14-038 is single-shaft gas turbine engine, installed under cowlings on the ceiling panel of fuselage central section. Air is supplied from APU to air starter of each engine and to the heating pipes of cargo cabin through the air line, consisting of pipelines and pipes.

APU start is ensured at ambient air temperatures from minus 50 to plus 45°C, at altitude up to 5000 m, and up to 6500m in flight. Maximum time of continuous operation is 5 hours. Number of air bleeding cycles for the purpose of main engines starting is unlimited.
The helicopter main transmission system is designed for reduction of two gas turbine engines shaft speed and to transmit engine torque to the main and tail rotors, air-cooling system fan and accessories, installed on the main gearbox.

Transmission comprises main gearbox, tail shaft, intermediate and tail gearboxes, main rotor braking system and transmission monitoring devices.

**MAIN GEARBOX**

The VR-382 (VR-38) main gearbox sums up the powers of both engines, reduces rotational speed and transmits torque from engines to the main and tail rotors, fan, two generators, three hydraulic pumps.

Engine with its front end bears on spherical joint of main gearbox (MGB). Engines power is transmitted to MGB through the freewheeling clutches, which automatically disconnect gearbox from one or both engines in case of their failure.

MGB is attached to strong frames of fuselage central section by means of gearbox mounting frame.

Oil system of MGB ensures pressure feed of oil to gears and bearings, as well as their lubrication, cooling and wear particles removal from gearbox.

MGB oil system comprises air-to-oil cooler, pipelines and fittings, oil temperature and pressure sensors, chip detectors.

**INTERMEDIATE GEARBOX**

Intermediate gearbox is designed to transmit torque from main gearbox to tail gearbox, as well as to change the tail rotor drive shaft tilt angle and its rotational speed.

The intermediate gearbox lubrication system is of splash type.

---

Fig. 21. Transmission layout.

1. Air cooling system fan
2. Fan drive shaft
3. Main gearbox with accessories
4. Main rotor brake
5. Tail shaft
6. Intermediate gearbox
7. Tilted part of tail rotor drive shaft
8. Tail gearbox
9. Tail shaft bearing supports
TAIL GEARBOX

Tail gearbox is designed to transmit torque from transmission tail shaft to tail rotor with rotational frequency and position of its rotation axis changing.

Lubrication system is of splash type.

TAIL DRIVE SHAFT

Tail drive shaft is designed to transmit torque from main gearbox to tail rotor. Shaft consists of horizontal and tilted parts.

MAIN ROTOR BRAKE

Main rotor brake is intended to reduce the time taken by the main rotor stoppage after engines shutdown, also for locking the transmission during helicopter parking.

CHECKING INSTRUMENTS

Transmission checking instruments permit to measure oil pressure in main gearbox, also oil temperature in intermediate and tail gearboxes, as well as to detect metal particles in oil, monitor main rotor and engines free turbines rotors RPM.
MAIN ROTOR
In order to generate aerodynamic lift and trust required for the flight, helicopter is equipped with six-blade main rotor. Owing to then action of the swash plate to the rotor blades setting helicopter control relative to the longitudinal and lateral axes is realized.

- Number of blades: 6
- Rotor diameter: 21.1 m
- Rotor disc area: 349.5 m²
- Direction of rotation, viewed from above, - clockwise

MAIN ROTOR BLADES
Main rotor blades are made of composite materials and equipped with electrical anti-icing system.

Each blade consists of nose section, tail sections, fairings and swept-back tip. Blade nose section is shaped by aerofoil and consists of spar, electro-thermal ant-icing strip, wiring harness, counterweight and anti-abrasive protection strips. Tail sections are filled with polymer honeycomb plastic. Spar of D-shaped cross section is main strong element of blade. Butt portion of spar is reinforced with combined packs. Each blade is attached with two bolts to main rotor hub, provided with elastomeric bearings.

Rotor blade tip light is mounted in blade tip fairing.

MAIN ROTOR HUB
Main rotor hub is installed on the main gearbox shaft and designed to transmit torque from main gearbox shaft to blades. During flight MR hub takes and transmits to the fuselage aerodynamic forces and moments, generated on main rotor blades.

Elastomeric bearing is applied in the MR hub design for the purpose of blade attachment to hub. Elastomeric spherical bearing is spring element, in which one thin layers of rubber are alternating with metal spherical plates. Such bearing takes not only centrifugal forces from blades, but also ensures blade hinging owing to the fact that all plates of bearing rotate with respect to one center. Elastomeric bearing is free from rolling motion, sliding and wear, which are typical for normal bearings. In addition to elastomeric bearings, metal-fluoroplastic and fabric bearings are used in other hinges and thanks to that MR hub is free from lubrication points.

Main rotor hub has combined flapping hinges, drag hinges and feathering hinges.

Main rotor hub is provided with hydraulic dampers to damp blade oscillation in the plane of MR rotation and flapping compensator, ensuring blades setting angle changing during flapping.

Centrifugal blade droop stops are arranged in the main rotor hub to reduce the blade droop and create necessary clearance between rotor blades and tail boom when the main rotor does not operate or operates at low RPM.
SWASH PLATE

Swash plate is a mechanism that varies the amount and direction of the resultant aerodynamic forces of main rotor (propeller thrust).

Main rotor thrust changing in value is effected with simultaneous decrease or increase of all blades setting angles by means of swash plates moving with spherical joint along the guide. Direction of main rotor thrust is changing by means of upper rotating swash plate tilting, resulting in cyclic changing of blades setting angles. Swash plate is controlled by means of three hydraulic amplifiers.

Swash plate is mounted on the main gear box by means of collective pitch sleeve guide, which is attached to the main gearbox flange.

TAIL ROTOR

The tail rotor is installed to compensate the main rotor torque and to provide directional control of the helicopter. Tail rotor is a four-blade pusher propeller, X-shaped, two-row, with in-flight variable pitch. Tail rotor blades are made of composite materials and equipped with electrical anti-icing system.

The blades are attached to the tail rotor hub, mounted on the flange of the tail rotor gearbox.

- Number of blades: 4
- Rotor diameter: 3.84 m
- Sense of rotation, viewed from tail rotor side, - counterclockwise
7. FLIGHT CONTROL SYSTEM

Helicopter control in flight is effected by means of variation of main and tail rotors’ thrust direction and value. Control system is mechanical, power-operated, comprises longitudinal, lateral, directional and main rotor collective pitch control, as well as engines control. Helicopter control is dual. Main controls are arranged in the cockpit.

Cyclic pitch control stick is used for cyclic change in the main rotor blade setting in different azimuths, resulting in main rotor thrust resultant force direction changes.

MR collective pitch control lever is used for simultaneous changing of MR blades setting angles by the same value, that results in MR thrust variation. At the same time with MR collective pitch variation there is a variation of engines power settings and stabilizer setting angle.

Directional control is realized by the pedals by means of changing tail rotor thrust direction and value.

Double-chamber hydraulic actuators are installed in the helicopter control linkages, consisting of rods, bellcranks and cables.

Three MR control hydraulic actuators are installed on the main gearbox. When the rods of two of three hydraulic actuators are moving, swash plate tilt angle is changing in longitudinal direction, when the third rod is moving - swash plate tilt angle is changing in lateral direction. MR collective pitch changes in case of simultaneous displacement of rods of all three hydraulic actuators for the same travel. Required ratio of all three hydraulic actuators rods travels is provided by summator (mechanical mixing unit).

Directional control hydraulic actuator is installed on the ceiling panel of cargo cabin.

Helicopter is equipped with integrated flight system that provides flight control, stability and piloting safety augmentation.

Engines shutdown, main rotor brake and main landing gear wheels brake control is provided.

1. Directional control pedals
2. Cyclic pitch control stick
3. Collective pitch control lever
4. Pull rods of longitudinal, lateral, directional and MR collective pitch control
5. Summator
6. Directional control actuator
7. Longitudinal control and MR collective pitch control actuator
8. Lateral control and MR collective pitch control actuator
9. Swash plate
10. Directional control linkage
11. Stabilizer control linkage
12. Engine control rod

Fig. 27. Flight control system layout.
Helicopter hydraulic system is designed to supply hydraulic fluid under operating pressure to units and accessories being consumers of hydraulic power.

Helicopter hydraulic system consists of three independent hydraulic systems. Each hydraulic system comprises: hydraulic unit, variable flow pump, air-to-oil cooler, valves, pipelines, connecting fittings and other components.

Hydraulic system 1 ensures hydraulic fluid supply to the first chambers of double-chamber hydraulic actuators of helicopter control system. Hydraulic system 2 ensures hydraulic fluid supply to the second chambers of double-chamber hydraulic actuators. Hydraulic system 3 ensures hydraulic fluid supply to the following consumers: landing gear wheels braking system, loading ramp and panels control system, variable hydraulic stop of longitudinal control and hydraulic damper of directional control, engines air intakes' flaps control, external load system control, cockpit windshield spraying system pump, as well as hydraulic fluid supply to the first and second chambers of hydraulic actuators in case of failure of hydraulic system 1 or 2.

Each hydraulic system comprises: separate hydraulic unit with hydraulic tank, hydraulic accumulator, filters, sensors and indicators; hydraulic fluid variable flow plunger pump, installed on the main gearbox, used as hydraulic power source; air-to-oil cooler; onboard valves; pipelines; connecting fittings and other components. Hand pump is installed in hydraulic system 3 for the purpose of loading ramp, panel and wheels braking system control on the ground when engines are not running. Servicing panel with injection, suction and filling valves for every of three hydraulic systems is installed in the helicopter for the purpose of ground hydraulic unit connection. Ground test of hydraulic system is provided in the helicopter without engines starting:
- for helicopter with ТV7-117V engines – from pumping unit;
- for helicopter with PW127TS engines – from hydraulic system 3 pump, operating in power unit mode.

Information about hydraulic system operation is supplied to the multifunctional displays.

Fig. 28. Hydraulic system layout.
Helicopter fuel system is designed for necessary fuel reserve accommodation and storage on board of the helicopter, ensuring the established sequence of fuel usage, service tanks refuelling, main engines and auxiliary power unit feeding with fuel during all operative modes under different working conditions.

Fuel system is made as two independent symmetrical systems of each engine feeding with fuel with a possibility of automatic cross feeding. Fuel is placed in six soft fuel tanks located in the containers under cargo cabin floor and combined into two groups, each having three tanks, - forward (fuel tanks 1, 2, 4) and aft (fuel tanks 3, 5, 6), with one service tank in each group for left and right engines respectively.

Fuel is supplied to engines and auxiliary power unit from service tanks using electrically driven booster pumps. Fuel usage by means of fuel transfer to service tanks from first fuel consumed tanks of forward and aft groups is effected using ejector pumps. Fuel transfer from one service tank to another is effected using reversible pump, that allows to transfer fuel from one group of tanks to another in case of failure of one of booster pumps, as well as to control uneven use of fuel from tanks. Installed in gearbox compartment are two engines fuel feed units, which are equipped with shut-off valves, pressure switches, cross-feed valves, ensuring automatic engines feeding with fuel from one pump in case of failure of another pump in any of service tanks.

Fuel tanks are interconnected by means of flow pipes and valves, ensuring both fueling and even fuel level in service tanks at different helicopter attitudes, as well as fuel usage from first fuel consumed tanks in case of failure of booster pumps.

Total capacity of fuel tanks is 3,955 l.

Fuel usage sequence monitoring and fuel flow metering is effected by fuel flow and quantity indicating system, which comprises measuring transmitters installed in each tank. These transmitters supply signals to multifunctional displays in the cockpit.

Each group of fuel tanks is provided with filler neck for gravity fueling, single-point fueling connection is used for simultaneous fueling of both groups of tanks.

Russian fuel TS-1 or RT, or equivalent is used.

Fig. 29. Layout of main components of the helicopter fuel system.
Air cooling system is designed for cooling the air-to-oil coolers of engines and main gear box oil systems, hydraulic system, as well as for cooling generators of alternate current. At the same time air cooling system is used to maintain optimum temperature of the accessories, located from the front in the space under cowlings and in the gearbox compartment.

Hydraulic system, engine and main gear box oil cooling is realized by fan blowing of the air through the air-to-oil coolers. Heated air is discharged overboard, out of gearbox cowling.

Fan unit is single-stage blower with inlet guide vanes. It is installed on top, in the space under cowling and connected with main gearbox by drive shaft.

Generators’ cooling is effected by outboard air, which is supplied for blowing through the pipes and flexible air ducts.
The fire protection system in the helicopter is designed to detect fire spots in due time, fire warning and fire suppression in fire-hazardous compartments and helicopter cargo cabin.

Fire-hazardous compartments are left and right engines compartments, as well as APU compartment. Fire-extinguishing equipment ensures fire extinguishing both in manual and automatic mode of operation.

Helicopter fire-extinguishing equipment comprises stationary and portable fire extinguishing system, fire warning system and smoke generation warning system.

Undercowling space compartments, accommodating engines, main gearbox and APU, are separated from each other and from the other compartments by means of fire partitions. Each fire-hazardous compartment is equipped with group of fire detectors, as well as pipelines and sprayers, through which one’s extinguishant is supplied to fire area.

In case of fire or smoke generation respective signal is supplied in order to actuate pyrocartridge, which opens pipeline of fire extinguishant supply from first (automatic) discharge bottle into compartment, from which the fire signal was supplied. Second discharge is actuated by pilot’s decision by means of pressing the manual actuation button. In addition, in case of failure of automatic actuation, manual actuation of first discharge is provided.

Two portable carbon-dioxide fire extinguishers of OU type are intended for fire extinguishing in cockpit and cargo cabin.

Fire shut-off valves are provided in fuel system on the pipelines of fuel supply to the engines fuel pumps.

Fig. 31. Fire protection system layout.
The heating, ventilation and air conditioning system is designed to create and maintain comfortable temperature conditions in the helicopter cabins with engines running.

This system has two areas of air distribution and air supply adjustment:
- cockpit;
- cargo cabin.

Hot air supplied from engines and compressors is used in heating system. Hot air is mixed with cabin air and through the distribution system is supplied into cabins, including for blowing of windshields and blisters in cockpit. Distributing pipelines with cooling ejectors located along the portside and starboard are used for air supply into cargo cabin. For the purpose of individual ventilation and heating there are connections installed on both sides of cockpit. These connections are provided with twist knob intended for adjustment of amount and direction of air flow. Crewmembers’ legs blowing with warm air is effected through the holes in shutters installed over the cabin floor in the area of legs location. When engines are out-of-operation, hot air could be supplied from APU compressor.

Functional control and monitoring is effected using control unit and air temperature sensors with the help of system control panel located in cockpit.

Heating system could be operated in both automatic and manual modes and is able to maintain air temperature of 15°C minimum inside the cabins at outside air temperature of minus 50°C. In summer period cabin ventilation with atmospheric air is effected by dynamic pressure. Besides, pilots’ stations are provided with individual blowing fans. Installation of additional air conditioner for the purpose of air cooling in cargo/transport cabin is possible.

Fig. 32. Layout of heating, ventilation and air conditioning system.
Helicopter ice protection system is designed to protect against icing main and tail rotors’ blades, cockpit windshields, Pitot tubes and engines compressors inlet devices.

Helicopter ice protection system comprises: ice protection system of main and tail rotors, ice protection system of engines and dust protection system bypass device, heating of cockpit windshields, heaters automatic temperature control unit, windshield spraying system and windshield wipers.

Main and tail rotors blades are provided with heating elements of electrothermal type. Windshield ice protection system comprises both hot air blowing (air bled from engines compressors) and electrical heating. Windshield wipers and washing fluid spraying system are installed for the purpose of cockpit windshield cleaning. Pitot tube ice protection system is of electrothermal and automatic type.

Bypass channel of dust protection device is heated by hot air bled from engines. Components of compressors inlet devices are heated with hot oil taken from engines. Installation of metal screen onto the engines inlet devices ensures ice removal as its formation.

Heaters automatic temperature control unit provides icing warning and automatic ON/OFF of main and tail rotors ice protection system.

Visual ice detector is a probe installed on the right blister in pilot’s field of view, which serves as means of icing detection.

Oxygen equipment shall be installed in the helicopter to supply with oxygen the crewmembers and passengers during flight at the altitudes more than 2,000 m and to protect from smoke, carbon dioxide and other toxic gases that can appear in emergency.

Helicopter oxygen and smoke protection equipment includes:
- two sets of easy removable oxygen equipment (KKO-LS2) for individual use to supply each crewmember with oxygen (including pure oxygen);
- one set of portable smoke protection oxygen equipment with smoke protecting oxygen mask and oxygen supply unit for using when detecting fire points and smoke sources in cargo cabin;
- additional sets of oxygen equipment in cargo cabin for passengers.
15. ELECTRICAL POWER SUPPLY SYSTEM

Electrical power supply system is designed to supply electrical power to the helicopter equipment both in flight and on ground.

Electrical power supply system includes 400 Hz 115/200 V three-phase A.C. generation system, 27V DC generation system, electrical power distribution system, as well as emergency electrical power supply system. Each AC and DC generation system has two independent channels.

The power sources of the helicopter primary electrical power supply system, i.e. 400 Hz 115/200 V three-phase A.C. generation system, are two generators ГТ60ПЧ8Б installed on the accessory gearbox of main gearbox.

Generator rated at 30 kVA, installed on auxiliary power unit, is independent power supply source of 400 Hz 115/200 V three-phase A.C. on the ground, when engines are not running and ground power source is not available, for example, in case of stand-alone location or emergency flight with two main generators failed.

When APU generator is out of operation, single-phase static inverter connected with category 1 loads is used as emergency electrical power source.

Power supply of the helicopter equipment during parking in airfield conditions is realized by ground power source of 400 Hz 115/200 V three-phase A.C. connected with helicopter electrical power system through the external power connector.

DC generation system is a secondary electrical power supply system designed for supplying the loads with 27V DC power. DC generation system is supplied with power from primary three-phase AC electrical power supply system by rectifiers. Primary power sources in this system are rectifiers, which convert 400 Hz 200V three-phase AC into 27VDC. Two storage batteries are emergency power supply sources in this system. Possibility of connection of ground 27VDC power source is provided in DC generation system.

Information about system functioning and failures is supplied to pilots and displayed in data frame on multifunctional displays in analog form and in the form of text messages. Electrical power supply system controls are located on the switching panel in the cockpit.
Adequate lighting equipment is installed in the helicopter to provide for its flying and ground servicing under all weather conditions, at day and night.

According to its intended purpose lighting equipment is subdivided into:
- interior and exterior lighting equipment;
- interior and exterior light indication-warning equipment.

Helicopter interior lighting equipment is a set of lights ensuring lighting of cabins, compartments and equipment located in these compartments.

Exterior lighting equipment is intended for lighting the space around the helicopter. Exterior lighting includes two search-and-landing lights and two lights for hoist boom and external load system lighting.

Helicopter exterior light indication-warning equipment is a set of lights used for light warning and transmission of various information to airfield ground personnel, as well as to flight crews of other aircrafts in order to ensure flight safety and helicopter light designation at parking and during taxiing. Helicopter exterior light indication-warning equipment includes navigation lights, rotor blade tip lights – for marking the contour of the rotor disk plane, and two anti-collision flash beacons.

Interior light indication-warning equipment is installed in the cockpit and intended for crewmembers informing in form of light text messages about various parameters and flight conditions, operation and failure of certain components and systems. Interior light warning is effected using warning and caution annunciator lights.

Helicopter can be equipped with additional lighting equipment.

All lighting equipment can be adapted for night vision goggles.
Navigation, radio navigation, radio communication and common Mi-38 helicopter equipment, having data communication channels, is combined into Integrated Avionics System (IBKO-38) by means of data exchange management, information management and integrated data processing.

Integrated Avionics System is designed to provide helicopter crew with necessary flight and navigation information, centralized monitoring and control of airborne, radio navigation and radio communication equipment. Integration allows to reduce crew’s workload during flight and simplify piloting.

IBKO-38 Integrated Avionics System ensures:
- organization of cockpit integrated information-management field and ensuring of optimum interaction between crew and equipment;
- organization of computerized testing of helicopter systems, accessories, units and equipment both on ground and in flight with output of their status indication to helicopter crew;
- generation and output of alarm and warning signals on common helicopter equipment, flight limitations, prompts and recommendations about crew’s actions in contingency;
- creation of flight plans of any complexity and manoeuvres using navigation databases and user waypoints databases;
- automatic and director control at different flight stages, as well as enhancement of helicopter stability and controllability parameters;
- air track flights and out of air track flights, as well as international air track flights, VFR and IFR flights;
- ILS precision approaches;
- generation and output to display current helicopter location coordinates, spatial orientation and helicopter flight parameters;
- detection of moisture targets in airspace;
- redundancy of data sensors, computer aids and interface channels according to the requirements of AP-29, FAR-29, CS-29 aviation regulations;
- record of flight parameters and equipment performances;
- adaptation for night vision goggles;
- open structure, possibility of equipment and current tasks upgrading;
- output of necessary information for line and periodic maintenance.

Integrated Avionics System comprises:
- two flight management computers;
- information-management field units;
- flight-navigation equipment;
- radio communication equipment;
- airborne monitoring system;
- flight data and cockpit voice recorder.

Standby equipment is used to complete flight in case of failure of IBKO-38 system.

Standby equipment includes:
- standby equipment integrated system (ISRP-4) intended for measurement, computation and output to displays flight altitude and speed parameters, as well as helicopter attitude position;
- magnetic compass;
- mechanical clock.
The VC-3 Flight Management Computer is intended for the implementation of the following tasks:
- control of reception and output of information to adjacent systems via digital and analog interfaces;
- control of Integrated Avionics System (IAS) and constituent systems operating modes according to the flight stage and IAS operating mode, as well as signals supplied from cockpit information-management field controls;
- preprocessing and integrated data processing;
- current in-flight monitoring of IAS equipment, generation and output to display IAS status signals;
- ground preparation and extended ground monitoring of IAS;
- generation of warning signals according to flight parameters;
- IAS reconfiguration control.

Information-management field units. Instrument panel and control panels

Information-management filed of Integrated Avionics System comprises five multifunctional displays (TDS-12), two multipurpose control and display units (MFPU-1), flight-navigation and radio communication equipment control panels and units. Arrangement of information-management filed units on instrument panel is...
1. Multifunctional display -5 pcs.
2. Annunciators
3. Aircraft clock
4. Light
5. TDC-17M control panel
6. TDC-17N control panel
7. AH5-3000 №1 attitude and heading reference system control panel
8. FLIGHT-NAVIGATION switches
9. IM-33 multifunctional display from ISRP-4 set
10. UMD-3 dynamic microphone unit
11. AH5-3000 №2 attitude and heading reference system control panel
12. ADF RT-600
13. Control panel of radio station Prima-KV B7-PrK unit
14. SO-96 transponder control panel
15. Remote control panel from ARM-406P set
16. Unit B8-38
17. MFPU-1 Multipurpose Control and Display Unit
18. APU and DPD control panel
19. Ice protection system annunciators
20. Fire protection system control panel
21. PU-38 control panel from helicopter integrated flight system PKV-38 set
22. Terrain Awareness and Warning System (TAWS) TTA-12H
23. Cursor position control panel TCCD
24. Left and right engines starting control panel
25. Engines monitoring control panel (under cover)

Fig. 37. Layout of equipment on pilots’ instrument panel and center console.
Instruments shown in Figure. Some of controls of helicopter equipment are located on cyclic pitch control stick and collective pitch control lever.

Multifunctional displays are subdivided as follows: two flight displays, two navigation and one common helicopter equipment display. In case of necessity each navigation multifunctional display could be operated in flight mode.

Flight multifunctional displays are intended for display of flight and navigation information supplied from systems of Integrated Avionics System and equipment, operating in conjunction with Integrated Avionics System in ROUTE, LANDING, and HOVERING modes.

Navigation multifunctional displays are intended for display of digital map, radar image, messages and terrain relief image from Terrain Awareness and Warning System (TAWS), information about current enroute flight, information about parameters and status of common helicopter equipment. Video image could be also displayed.

Central multifunctional display of common helicopter equipment is intended for displaying information about parameters and status of common helicopter equipment.

Each display provides for displaying of warning and caution messages relating to flight-navigation information, information about failures of systems integrated in IAS and adjacent equipment, as well as additional reference information, required for crew and maintenance personnel in flight and during preparation on ground respectively.

Each pair of multifunctional displays simultaneously receives information from two sets of attitude and heading reference systems and two air data computers. Automatic selection and operation with serviceable system is realized in multifunctional displays.
Multipurpose Control and Display Unit MFPU-1 is used for attitude and heading reference systems and radio communication equipment operating modes control, including activation of ground monitoring of the whole Integrated Avionics System and individual systems integrated in IAS, as well as adjacent equipment.

Pilots’ instrument panel and control panels are provided with lighting system and inscriptions, lights or integral lighting.

Combined standby instrument ISRP-4 is standby means of measurement and displaying of flight data.

**FLIGHT-NAVIGATION EQUIPMENT**

Flight-navigation equipment of Integrated Avionics System includes:
- strapdown attitude and heading reference system (AHS-3000 – 2 pcs) intended for measurement and output information (in digital format) about angles and speeds of heading, roll, pitch changing, as well as information about accelerations and G-forces values;
- altitude-speed data system (IKVSP-38);
- radio altimeter (A-053 – 2 pcs);
- digital map computer (TMG-17);
- Terrain Awareness and Warning System (TAWS) (TTA-12H);
- weather navigation radar (38A813);
- distance measuring equipment (DME-4000);
- receiver of VOR/ILS instrument landing system and ADF (NAV-4000 – 2 pcs);
- helicopter integrated flight system (PKV-38) intended for augmentation of stability, controllability and piloting safety in manual, automatic, director and combined helicopter control modes;
- Doppler system (DISS -32).
Radio communication equipment set comprises:
- VHF radio station (VHF-4000 – 2 pcs);
- HF radio station (Prima-KV);
- emergency locator transmitter (ARM-406AS1);
- portable emergency locator transmitter (ARM-406P1);
- radio direction finder (RT-600A), intended for search and rescue operations fulfillment;
- transponder (SO-96), intended for operation with secondary radars of air traffic control systems, for transmission of helicopter coordinates code signals, registration number, altitude, fuel reserve etc;
- combined unit of intercommunication system and voice information reporting system (B27-MS2);
- aircraft “friend or foe” identification.

Fig. 43. Data frame of multifunctional display in the BSK-38 extended monitoring activation mode.

Fig. 42. Helicopter cockpit equipment.
AIRBORNE MONITORING SYSTEM

Airborne monitoring system (BSK-38) is intended to fulfill the following tasks:
- reception and conversion of analog signals and event signals from power plant and common helicopter equipment sensors to digital code;
- reception of information from airborne equipment via code communication line;
- information output to adjacent systems via code communication line;
- self-test for proper functioning in flight and on ground.

FLIGHT DATA AND COCKPIT VOICE RECORDER

Flight data and cockpit voice recorder (RPI-2-03) is intended for collection, recording and safe keeping of flight parameters and crewmembers' talks, as well as marking of recorder unit location in case of falling into water.

WARNING AND CAUTION SYSTEM

Warning and caution system (SAS-4M-39) is provided in the helicopter. Annunciators are located on pilots' instrument panel and center console.
To provide safety flight over water surface emergency floatation system (EFS) can be installed on the helicopter. This removable modular system provides buoyancy within the time that is sufficient for setting up the rafts, and for leaving the helicopter by the passengers and the crew.

Equipping the helicopter with EFS provides helicopter landing on water surface in autorotation mode at water surface roughness
up to 4 points. As in this case landing on water is carried out with certain forward speed, to exclude heavy shock loads action on the floats and, respectively, decrease in mass of EFS, starting of system of floats unfolding is automatic on a signal from water sensors located on the bottom of fuselage at the time of helicopter contact with water surface. Also, standby activation of system manually by pilot is provided. In addition to floats of EFS fuel tanks are also participating in creation of buoyancy.

Possibility of safe people evacuation is provided by equipping the helicopter with survival equipment set.

TECHNICAL CHARACTERISTICS OF EMERGENCY FLOATATION SYSTEM (EFS) OF MI-38 HELICOPTER

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum take-off weight, kg</td>
<td>15,600 kg</td>
</tr>
<tr>
<td>Water temperature, ºC</td>
<td>4…30 ºC</td>
</tr>
<tr>
<td>EFS survivability temperature range, ºC</td>
<td>-50…+50 ºC</td>
</tr>
<tr>
<td>Water surface roughness, points</td>
<td>4 points</td>
</tr>
<tr>
<td>Water surface roughness, at which helicopter floatability is ensured, with one damaged float, points</td>
<td>2 points</td>
</tr>
<tr>
<td>Time of floats unfolding from the moment of signal supplying, s</td>
<td>5 maximum</td>
</tr>
<tr>
<td>Mode of EFS unfolding</td>
<td>automatically from water sensors / manually - standby</td>
</tr>
<tr>
<td>Number of water sensors, pc</td>
<td>2 pc</td>
</tr>
<tr>
<td>Floats reserve of buoyancy at maximum takeoff weight, %</td>
<td>25 %</td>
</tr>
<tr>
<td>Floatability time, min.</td>
<td>no less than 30</td>
</tr>
<tr>
<td>Number of floats, pc</td>
<td>8 pc</td>
</tr>
<tr>
<td>Float volume, m³</td>
<td>1.6 m³</td>
</tr>
<tr>
<td>Weight of EFS, kg</td>
<td>150 kg</td>
</tr>
<tr>
<td>Assigned service life (service time), h (years)</td>
<td>18,000 (20) years</td>
</tr>
</tbody>
</table>
Equipment installed on the helicopter permits to operate it in the following main versions:
- transport;
- search-and-rescue;
- medevac;
- passenger;
- VIP cabin.

As compared with another helicopters of the same class Mi-38 helicopter features more spacious cargo cabin and higher load-carrying capacity, that makes it optimum platform for creation of another special application modifications.

**TRANSPORT**

Mi-38 transport version helicopter is designed for cargo transportation inside the cargo cabin and by means of external sling, transportation of personnel (35-37 people on folding seats), as well as erection operations performing.

Mi-38 helicopter has spacious cargo cabin with capacity of 31 m³, this is maximum capacity in this class of helicopters. Rear cargo door is provided with loading (cargo) ramp with hydraulic actuator, side door with wide sliding door is provided on the starboard. Loading ramp is adapted for quick loading-unloading, including loading-unloading of self-propelled wheeled and caterpillar vehicles. Cargoes tie-down is effected using standard tie-down equipment: tie-down cables, straps and cargo net. In order to protect cargo cabin floor surface against damages from transported cargoes installation of removable deck is provided. Tie-down fittings are used for removable deck attachment.

Hoist boom mounted on the helicopter is intended for loading-unloading operations carrying out through the door opening in the cargo cabin starboard, as well as for lifting people on-board during rescue operations. Hoist SLG-300М mounted on hoist boom is also intended for loading and unloading wheeled non-self-propelled vehicles through the rear cargo door.

- Hoist boom load-carrying capability 300 kg
- Maximum altitude of cargo lifting 46 m

Loading of cargoes through the side opening is possible when the helicopter is on the ground or in hovering. Hoist boom has a turning function with and without cargo.

External load sling system is used for transportation of large-size cargoes up to 7 tons. External load system is equipped with
tactical and emergency cargo release systems, as well as sling pull-up device. Besides, helicopter equipped with external load sling system can be used for rescue operations and erection works performance. External load sling system is installed in the cargo cabin floor access hatch. Hatch is provided with guard with operator’s seat.
SEARCH AND RESCUE (SAR)

Helicopter in search-and-rescue version is intended for application in emergency conditions, requiring fast response for rescue of people and elimination of the consequences of the accident, including areas remote for another search and rescue means.

The search and rescue version of the Mi-38 helicopter provides: transportation of special divisions of the rescuers equipped with the rescue and medical equipment to an area of search and rescue works; carrying out survey and situation investigation around an emergency situation; search and evacuation of victims, including evacuation by means of hoist boom while in hovering; rendering medical care to injured persons in scope of the first medical care; delivery to a place of an emergency situation of necessary cargoes and equipment; possibility of free dropping and paradropping of cargoes and survival kits to people in distress through the side and rear cargo doors.

For the purpose of search and rescue operations carrying out, transportation of rescuers to the area of emergency situation and evacuation of victims and injured persons helicopter cargo cabin is equipped with: 15 folding energy-absorbing seats (8 on starboard and 7 on port side); 2 berth-stretchers for critically injured persons; rack with medical equipment for rendering medical care, containers with ambulance equipment and oxygen apparatuses; furnishings rack; container with survival equipment sets, attached to cargo floor tie-down fittings; removable hoist boom with cargo hoist system SLG-300M and set of devices for lift and descent of cargo up to 300 kg or people on-board both from land and sea. To ensure good field of view when performing in-flight observing the necessary number of blisters can be installed in cargo cabin instead of standard windows. In case of need removable modular emergency flotation system can be installed in the helicopter. Appropriate converters are provided in the helicopter for the purpose of electrical power supply to special medical equipment.
The IBKO-38 Integrated avionics system in the search-and-rescue helicopter includes the following additional equipment:
- gyrostabilized system of optical observation with thermal imaging and television channels;
- searchlight;
- loudhailer;
- aircraft location monitoring satellite system;
- night vision goggles;
- search ADF.

Helicopter applications

1. Hoist boom with cargo hoist system
2. Entrance stairs/door
3. Folding seats
4. Blister
5. Survival kit
6. Rack with medical equipment
7. Berth-stretcher
8. Furnishings
9. Stretcher for operation with hoist boom
10. Basket for operation with hoist boom

Fig. 50. Layout of search-and-rescue helicopter.
MEDEVAC

Mi-38 medevac helicopter is intended for evacuation of 8 lying-down cases (or 12 sitting injured persons) and three medical attendants in special medical institutions for rendering them qualified specialized medical care; rendering to injured persons medical care in scope of the first medical care with elements of qualified medical care by life-saving indications.

One of the features of medevac version of the helicopter is power-driven transportation of stretcher cases, allowing quickly and safely and with the minimum labor costs of medical staff to load/unload injured persons and arrange them in the helicopter.

Helicopter cargo cabin is subdivided into three compartments: forward vestibule, main compartment and rear compartment. Installed in the forward vestibule are shock-absorbing seats with seat belts for two medical attendants. Four cardiorespiratory monitors are installed at senior medical attendant’s station.

Eight double-deck berth-stretchers and racks with medical, ambulance equipment and furnishings are installed on both sides of main compartment. Located under the berth-stretchers of bottom level are drawers for medical equipment and furnishings. Medical attendant call buttons and oxygen masks, connected to centralized system, are provided next to each berth-stretcher. Oxygen system bottles are installed in lengthened landing gear fairing on the starboard. Bottom-level berth-stretchers are used for transportation of sitting injured persons, at that three persons are accommodated on each berth-stretcher. In this case top level berth-stretchers are placed in vertical position.

Rack with medical equipment is located on starboard of central section of main compartment; rack with furnishings is located on port side of central section of main compartment. Located on starboard in the rear part of main compartment is medical attendant’s station, located on port side is chemical toilet. Racks with ambulance equipment are located over loading ramp on both sides.

Appropriate power converters are provided in the helicopter for the purpose of special medical equipment power supply.

Lifting-and-carrying device is used in the helicopter for the purpose of mechanical (power-driven) putting of berth-stretchers with injured persons in their places inside the helicopter. Lifting-and-carrying device is moving along the fuselage on rails mounted
on the cargo cabin floor; placing of berth-stretchers on the onboard brackets with retainers is effected by means of lateral motion of carriage of lifting-and-carrying device. Lifting-and-carrying device is provided with independent drive ensuring lifting of berth-stretcher with injured person up to top level of its arrangement. For the purpose of loading/unloading of injured persons lifting-and-carrying device is moved to the ramp set to horizontal position. In stowed position lifting-and-carrying device is fixed on closed ramp.

Fig. 52. Layout of medevac helicopter.

1. Senior medical attendant’s seat
2. Entrance stairs/door
3. Oxygen bottles
4. Medical attendant’s seat
5. Ambulance equipment
6. Ambulance equipment and furnishings
7. Berth-stretcher
8. Rack with medical equipment
9. Lavatory
10. Lifting-and-transportation device
Mi-38 helicopter in passenger version is intended for transportation of 29 passengers and one flight attendant. Set of passenger’s equipment and furnishings ensures the economy class level of transportation.

The following is installed in passenger cabin:
- 15 dual energy-absorbing seats arranged as follows: 2+2, spacing 762 mm (30’’), longitudinal aisle 508 mm in width. Flight attendant’s seat is installed in direction opposite to direction of flight, on the starboard, and ensures good view of passenger cabin;
- baggage compartment and coat room for passengers’ and crewmembers’ outerwear in the forward section of passenger cabin;
- luggage racks along both sides of passenger cabin for passengers’ hand luggage are provided with covers and locks;
- furnishings compartment in rear part of passenger cabin used to provide passengers and crewmembers with meals, including boiler, oven and compartment for food keeping;
- isolated lavatory with chemical toilet, tanks with pure and used water, lavatory basin with mixer tap, water heater, mirror etc. Lavatory is equipped with exhaust fan;
- blinds on windows;
- additional heat and sound insulation;
- panels of individual lighting and ventilation;
- hand fire extinguisher;
- loudhailer with self-contained power supply;
- first aid kit.

Passenger cabin is equipped with air heating and ventilation systems.
Installation of oxygen units BKP-3-2-210 is provided.
Windows in cabin are replaced with double-glass windows in order to reduce noise and improve comfort.
To fulfill requirements of AP-29 aviation regulations helicopter is equipped with five emergency exits:
- emergency exits of type II and III on starboard;
- emergency exits of type I (jettisonable entrance stairs/door) and type III on port side;
- emergency exit of type III in the rear section of fuselage.
In order to provide free access to emergency exits of type III spacing between seats in the area of door location is increased.

Fig. 54. Layout of passenger helicopter.

1. Coat room and baggage compartment
2. Entrance stairs/door
3. Flight attendant’s seat
4. Passenger seats
5. Furnishings and baggage compartment
6. Lavatory

Fig. 54. Layout of passenger helicopter.
Helicopter in this version is intended for transportation of 12 passengers of “VIP” class, one attendant and one flight attendant. Cabin is divided into 3 compartments: forward vestibule, VIP cabin and rear compartment. Compartments are separated from each other by partitions with folding doors.

Arranged in the forward vestibule are:
- attendant’s seat installed near the entrance stairs/door;
- coat room for crewmembers’ outerwear;
- isolated lavatory with chemical toilet, tanks with pure and used water, lavatory basin with mixer tap, water heater, mirror etc. Lavatory is equipped with exhaust fan.

Arranged in VIP cabin are:
- 4 VIP seats, provided with seat belts, height adjustable headrests, reclining seat backs, foot rests, swinging mechanisms. Tables are installed between seats;
- coat room for passengers’ outerwear;
- table-cabinet for arrangement of onboard entertainment equipment, including DVD-player, amplifier etc., bar;
- two four-place divans provided with seat belts. Provided in the bottom portions of divans are compartments for storage of plaid, cases etc;
- 2 LCD displays per each side (port side and starboard), loudspeaker systems;
- additional heat and sound insulation;
- double-glass windows to reduce noise level;
- blinds on windows.

Area with divans installed could be separated by curtain. All places in VIP cabin are equipped with panels of individual ventilation and lighting, flight attendant call buttons. Satellite phones are installed next to the seats of main VIPs. All applicable finishing materials conform to requirements of AP-29 regulations.
Arranged in the rear compartment are:
- flight attendant’s seat;
- baggage compartment;
- galley, consisting of worktable with sink and cabinet. Mounted on the worktable are water heater and tank for used water. Coffee machine is installed on the table top. Arranged in the cabinet are refrigerator, oven, tank with pure water, compartments for food and tableware keeping.

In addition to standard heating and ventilation system of passenger cabin helicopter in this version of application is equipped with air conditioning system to create comfortable conditions in cabin. Air conditioning unit is installed in lengthened landing gear fairing on the starboard.

To fulfill requirements of AP-29 aviation regulations helicopter is equipped with four emergency exits:
- emergency exit of type III on starboard;
- emergency exits of type I (jettisonable entrance stairs/door) and type III on port side;
- emergency exit of type III in the rear section of fuselage.

Backrests of divans can be folded in order to provide an access to emergency exits of type III on fuselage sides.
Helicopter airframe service life/service time till discarded, as well as overhaul life are not specified. Helicopter is operated “on condition”, i.e. helicopter technical condition is periodically evaluated in the course of operation by means of carrying out scheduled maintenance operations and repair, as well as replacement of components with expired service life. According to the results of repair operations statement on helicopter serviceable condition and airworthiness or statement on necessity to perform additional works to restore helicopter airworthiness is issued. When reaching operation time of 18,000 flight hours/20 years operator addresses its request to helicopter developer to define any additional works required for continued airworthiness of the helicopter.

The helicopter design makes possible to carry out high-quality maintenance and repair in the course of helicopter operation at minimum labour consumption. The helicopter assemblies and units are made ready accessible, easy removable and interchangeable.

During the Mi-38 helicopter operation the following types of helicopter maintenance are provided: on-line maintenance, periodic maintenance, helicopter maintenance during storage, temporal maintenance, extra work maintenance, inspection and repair maintenance.

- Total unit man-hours of technical maintenance and repair – no more than 4 man-hours per one flight hour.
- Total unit duration of technical maintenance and repair – no more than 0.95 man-hours per one flight hour.

21. SERVICE LIFE AND OVERHAUL FREQUENCY

At the beginning of operation initial service life of helicopter is specified and increases step by step in the course of operation up to total service life of the whole fleet of serial helicopters, at that individual increase in service life and service time of the helicopter is allowed. Helicopter service time till discarded is confirmed step by step in the course of operation.

Within the limits of assigned service life (service time) helicopter is operated “on condition” (without overhaul life and time between overhauls).
Table 4  Service life and service time of helicopter and main components

<table>
<thead>
<tr>
<th>Description</th>
<th>Service life, h/service time, years</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial</td>
<td>Service life</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Assigned</td>
<td>Life to first overhaul</td>
<td>Life between overhauls</td>
</tr>
<tr>
<td>Helicopter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airworthiness limitation 2, 000/5</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>18,000/20 (36,000 landings)</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>TV7-117V engine, h</td>
<td>2,000</td>
<td>1,000</td>
<td>-</td>
</tr>
<tr>
<td>PW-127T/S engine</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TA14-038 engine (operating time, h)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Main gearbox BP-38</td>
<td>2,000/3</td>
<td>1,000/3</td>
<td>-</td>
</tr>
<tr>
<td>Transmission (shaft, tail gearbox, interm. gearbox)</td>
<td>2,000/3</td>
<td>1,000/3</td>
<td>-</td>
</tr>
<tr>
<td>Rotor system (MR blades, MR hub, tail rotor, swash plate)</td>
<td>1,000/3</td>
<td>1,000/3</td>
<td>-</td>
</tr>
<tr>
<td>Hydraulic pump HP-137M-1</td>
<td>2,000/5</td>
<td>2,000/10</td>
<td>-</td>
</tr>
<tr>
<td>Hydraulic actuators P11-10A, P11-15A</td>
<td>1,000/3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Nose and main landing gears, tail bumper shock absorber</td>
<td>2,000 take-offs-landings</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Air conditioning and ventilation system</td>
<td>1,000/3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Fan</td>
<td>1,000/6</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
22. DELIVERY, GUARANTEE AND TECHNICAL SUPPORT

Standard delivery conditions of new helicopter comprise:
- guarantee according to the contract requirements (usually 12 months);
- individual kit of spare parts, tools and equipment;
- maintenance kit, contained spare parts and equipment set;
- technical documentation.

Helicopter delivery to the Customer is carried out on agreement - by sea or air, also it is possible helicopter direct ferry flight.

Helicopter manufacturer provides a wide range of services related to the helicopter operation, such as:
- full technical support during helicopters operation;
- guaranteed spare parts supply under AOG requirements during the whole period of helicopter operation;
- helicopter modernization;
- helicopter overhaul both at Kazan Helicopters or Customer’s premises;
- flight and maintenance personnel training in Kazan Helicopters training center or at the Customer’s base.

Fig. 59. Mi-38 helicopter shipment by truck.
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