

RMK TOP - THE NEW AERIAL SURVEY CAMERA SYSTEM FROM CARL ZEISS, OBERKOCHEN

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1. INTRODUCTION

The RMK aerial survey camera system from Carl Zeiss has proven that it is a powerful and reliable camera system for many decades. Continuous improvement kept the system up to date for a long time. The RMK system is still one of the leading systems even today.

Further improvement requests now resulted in a complete redesign. By integrating a microprocessor control unit, Carl Zeiss has designed a completely new camera system, the RMK TOP system. During the design phase it was found that the RMK concept (lens integrated in the camera body, interchangeable film magazines) is still superior to all other concepts even today. So, during the development of the new system, some of the proven solutions have been used and new solutions integrated.

Even though the new RMK TOP system (for Terminal OPerated) differs fundamentally from the existing RMK system, the two systems are compatible at major interfaces. Section 6 contains more details about this. The new RMK TOP 15 wide-angle camera is shown in Fig. 1.

The major new components of the RMK TOP system are:

- RMK TOP 15 and RMK TOP 30
with new handling
- New control system
- New camera bodies
 - New lenses
 - New shutter
 - New filter revolver
 - New auxiliary data recording system
- New film magazine
- New suspension

The major design objectives were:

- Even greater reliability
- Further performance increase
- Easier and flexible handling

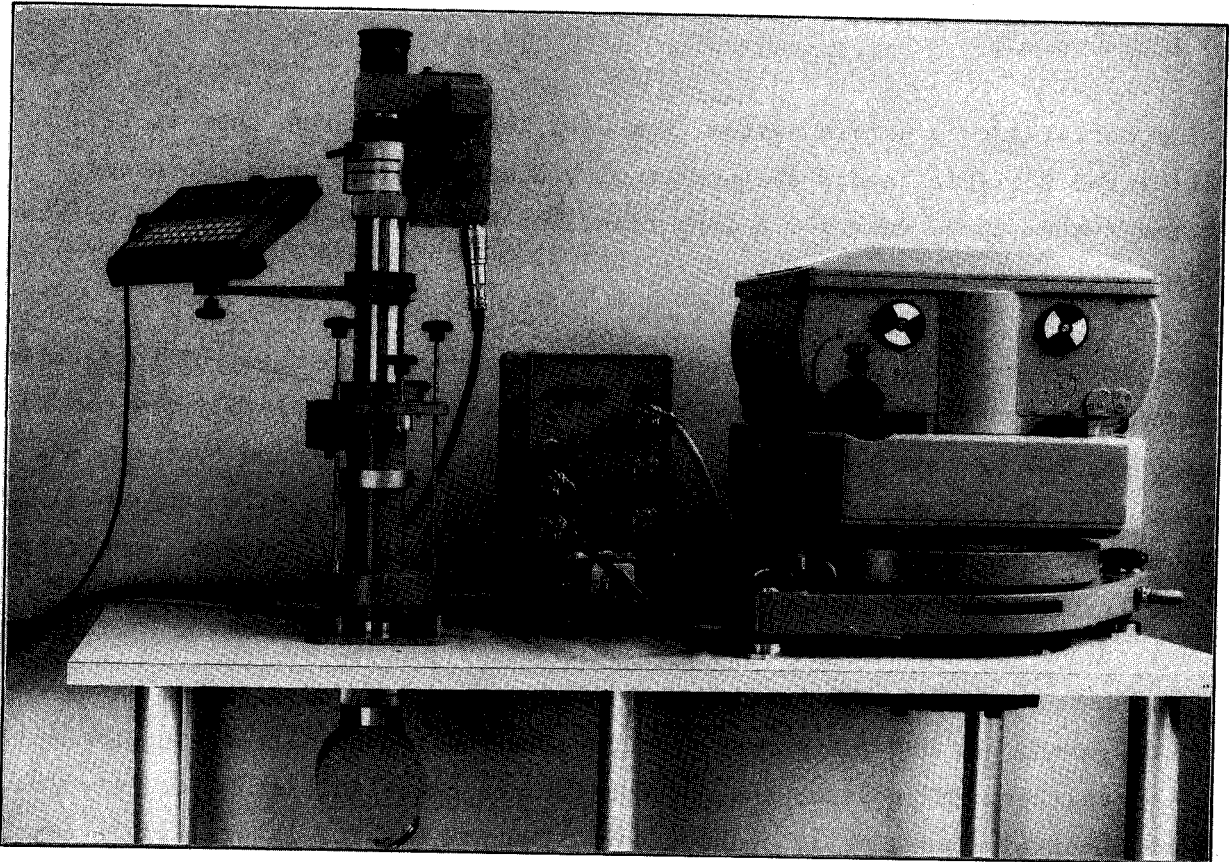


Fig. 1 The new RMK TOP 15 with the T-CU Control Unit and the T-TL Operator Terminal together with the AS2 Suspension and the T-NT Navigation Telescope

2. CONTROL UNIT

The control unit of an aerial survey camera consists of the control electronics for the camera functions, the operator controls, and of peripheral navigation instruments that control serial exposure. In the RMK TOP system the control unit and the handling are characterized by the use of a central microprocessor and an operator terminal. The reliability of the overall system is ensured by numerous BITE (built-in test equipment) functions which, if applicable, display detailed error messages on the terminal screen.

- The Microprocessor Control Unit

The microprocessor control unit is the electronic heart of the control system. It is called T-CU Control Unit and contains, apart from the microprocessor, the major part of the control and power electronics. The service-friendly integration of the electronics in a separate module also has a beneficial effect on the system cost when replacing a camera body.

The block diagram in Fig. 2 shows that all components are connected with cables to the T-CU Control Unit.

- The Operator Terminal

The T-TL Operator Terminal is a completely new component. A complete alphanumeric keyboard, programmable special function keys, and a large, high-resolution LCD display afford centralized operator control of the system. Convenient menus and the special function keys facilitate preparatory settings (overlap, automatic exposure control etc.) checks and inflight control. No settings have to be made at the camera body, and no readings taken. The terminal should be mounted preferably at the navigation telescope or in another convenient location where the camera operator can see and reach it.

- The Navigation Instruments

The T-NT Navigation Telescope is an improved version of the existing NT 2 Navigation Telescope. Error messages that may appear on the operator terminal display are indicated in the eyepiece of the navigation telescope by the flashing of the sprocket chain. Overlap control (now also in the rear-oriented telescope), drift and camera release have not been changed.

The existing navigation instruments NS 1, NT 1 and NT 2 can also be used with the RMK TOP system.

Modern position determination systems like GPS can be included by means of the external data interface (see Fig. 2). The data can be used for navigation and for camera release, but can also be stored in the operator terminal computer for later analysis.

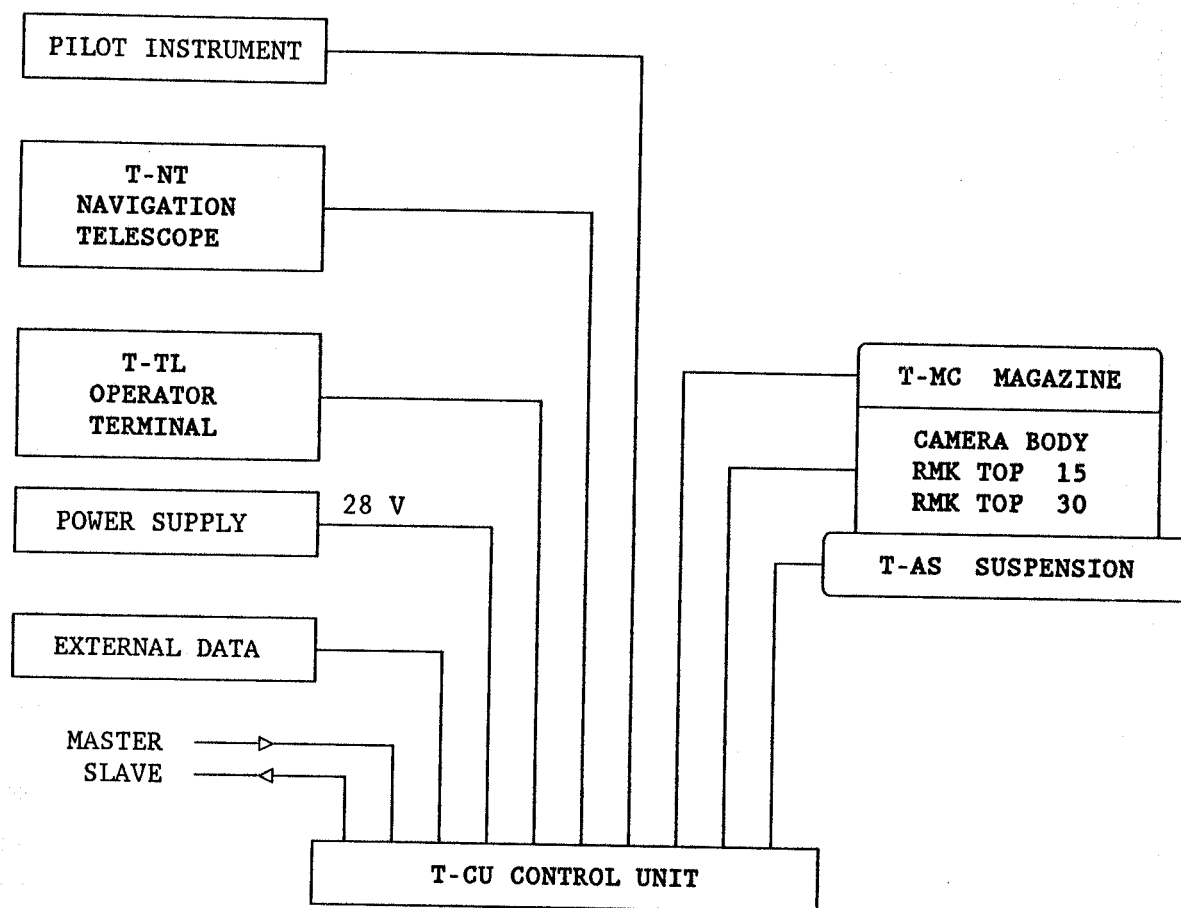


Fig. 2 Block Diagram of the RMK TOP System

3. CAMERA BODY

The new, neatly designed camera body is smaller than the existing one to facilitate camera installation. Different camera bodies, the RMK TOP 15 and the RMK TOP 30, are required for the wide-angle and the normal-angle versions because of the differing lens sizes.

The major expandable items of the existing RMK system, e.g. the friction wheel and the carbon brushes, have been replaced by non-wearing parts to improve the maintainability and the reliability. Despite these changes, the RMK TOP system is compatible with the existing RMK system.

• Lenses

Two new, completely redesigned lenses are available for the RMK TOP system:

Topar A3 5.6/305 for the RMK TOP 30 and

Pleogon A3 4/153 for the RMK TOP 15.

Even though the imaging performance of the existing RMK lenses Topar A1 5.6/305 and Pleogon A2 4/153 was considered unsurpassed, the performance of the new lenses was increased considerably.

The area weighted average modulation (AWAR) is an indication of aerial lens performance. For the spatial frequency of 60 lines per millimeter, for example, the AWAR value was increased from 20 % for the Topar A1 to 30 % for the Topar A3; the Pleogon values are 15 % for the Pleogon A2 compared to 34 % for the Pleogon A3. Especially increases at high spatial frequencies are of particular significance for the use of high-resolution films.

- Shutter

The proven rotating disk shutter has been redesigned for the RMK TOP system. The new design enables the so-called pulsed mode, a type of intermittent operation. The main advantage of this pulsed shutter is the constant access time of about 50 msec. This is the time period between the release signal and the actual camera release.

With continuously operating rotating disk shutters a constant access time is theoretically not possible because there are fixed instants which recur at certain intervals at which a release is possible. Since the shutter release signals arrive at times that are independent of these fixed instants, the access time must vary. The longer the exposure time, the longer the access time in unfavorable cases. These access time variations adversely affect the overlap precision in particular at high flying speeds.

This restricted the use of the longer exposure times that are required for high-resolution films and are enabled by forward motion compensation. The modern, high-resolution films make longer exposure times (up to 1/50 sec.) more relevant than shorter ones.

At the midpoint of the exposure time, the shutter control supplies a signal that serves to imprint the fiducial marks. This signal is also supplied to the control program and can therefore be used at the operator terminal and for auxiliary data recording (for details refer to the Auxiliary Data section).

- Filters

Antivignetting filters, color filters (often gelatine filters) and cut-off filters (e.g. yellow or orange filters) are generally used with aerial survey cameras. The antivignetting filter must be placed in front of the lens.

Gelatine filters are individually matched to the film and the processing method. Therefore they must be easily accessible. A suitable location is again in front of the lens. Cut-off filters, on the other hand, may be located in the lens. This solution has been implemented in the new RMK TOP lenses. A filter revolver near the iris diaphragm offers space for four different internal filters. The internal filters can be changed at the operator terminal. The filter factors are allowed for automatically. The following standard filter assignments are used: KL = neutral, A2 = haze, B = yellow, C = orange. Custom assignments are optional.

- Auxiliary Data

The auxiliary data recording system was redesigned: eight numbered fiducial marks are flashed on at the midpoint of the exposure time. The FMC mark is new. It indicates the amount of forward motion compensation that occurred during the exposure. The four-digit photo number retains its location in the corner.

When a new film magazine (see section 4) is used, the number of the pressure plate is also imprinted next to each photo. All other data known from the RMK system (altimeter, level, camera number and focal length, clock, data card) have been replaced by two lines with 48 alphanumeric characters each. The text imprinted next to the photo can be formatted freely, e.g. mission number, strip number, photo scale, overlap, camera number, focal length, date, time, filter, aperture, exposure time, v/h value etc.).

4. FILM MAGAZINE

The T-MC Magazine is an improved version of the proven RMK CC24 Magazine. Forward motion compensation has been expanded to a film speed of up to 64 mm/sec. A differential pressure sensor has been installed for film flattening control. Any lack of vacuum is displayed at the operator terminal.

The film supply has so far been indicated mechanically by a disk at the magazine cover. Following the concept of centralized operator control, the mechanical indicator has been supplemented by an electronic film supply indication at the operator terminal. As already mentioned above, the serial number of the pressure plate is also recorded as a separate item of auxiliary data.

5. SUSPENSION

Forward motion compensation (FMC) compensates the image motion caused by the forward movement of the plane.

However, airplane pitch and roll reduce the definition if a conventional suspension is used. The new T-AS Suspension compensates these airplane motions to a large extent in ω and φ by means of an active stabilizer.

6. COMPATIBILITY BETWEEN RMK TOP AND EXISTING RMK SYSTEM

RMK TOP is a new aerial survey camera system with increased reliability and performance and with centralized operator control. The functions of the individual components: RMK TOP 15 or RMK TOP 30 Camera Body, T-MC Magazine, T-AS Suspension, T-TL Operator Terminal and T-NT Navigation Telescope have been matched precisely. The advantages of the new system can all be used only if all components of the new RMK TOP system are used.

Even so combining existing RMK components with new RMK TOP components may make sense. This is why complete compatibility has been ensured at the major interfaces (camera body/suspension, camera body/magazine, and navigation instrument connection). This means that the RMK TOP camera (together with the T-CU Control Unit and the T-TL Operator Terminal) can also be used with the existing AS2 and AS5 suspensions and the existing FK24 and CC24 magazines and/or with the existing NS1, NT1 or NT2 Navigation Instruments.

7. PRACTICAL ADVANTAGES

The improvements of the individual components described in the preceding sections intermesh closely. The performance increase of the complete system is decisive. The first step was taken some years ago already with the introduction of forward motion compensation (FMC). FMC allows longer exposure times and thus the use of high-resolution film also in unfavorable lighting conditions. However, this increases the lack of definition caused by airplane pitch and roll and the overlap errors due to the random access time of the rotating disk shutter.

Both problems have been solved perfectly in the RMK TOP system by the stabilized suspension and the pulsed shutter. Now longer exposure times can be used without drawbacks so that modern high-resolution films can be used. In line with these improvements, the RMK TOP lenses have been improved considerably especially in the high spatial frequency range in order to make the use of the resolving power of these films possible for the first time.

The interaction of improved lenses, pulsed shutter, stabilized suspension and convenient handling brings about the enormous performance increase of the complete RMK TOP system.

ABSTRACT

Carl Zeiss presents the new RMK TOP aerial survey camera system. Major redesigned or completely new components are the operator terminal as central operator control unit, new lenses with an even higher resolution, the pulsed shutter with constant access time and the stabilized suspension. The performance and reliability have been increased considerably and operator control has become more convenient.

RMK TOP, DAS NEUE LUFTBILDKAMMERSYSTEM VON CARL ZEISS, OBERKOCHEN

ZUSAMMENFASSUNG

Carl Zeiss stellt ein neues Luftbildkammersystem RMK TOP vor. Die wichtigsten, völlig neu konzipierten Komponenten sind: Die zentrale Bedienung mittels Terminal (TOP = TERMINAL OPERATED), die neuen Objektive mit noch höherem Auflösungsvermögen, der gepulste Verschluss mit konstanter Zugriffszeit und die stabilisierte Aufhängung. Damit konnten Leistung und Zuverlässigkeit wesentlich gesteigert und die Handhabung bequemer gemacht werden.

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