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INTERNAL DOCUMENT

THE STANDARD IOS MK. 4 DEEP SEA CAMERA SYSTEM

by

E.P. COLLINS

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NATURAL ENVIRONMENT RESEARCH COUNCIL

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THE STANDARD IOS MK. 4 DEEP SEA CAMERA

1. INTRODUCTION

This system was developed within the Institute to cover the requirement for a lightweight general purpose 35 mm camera capable of achieving automatic independant operation for periods not exceeding 200 hours at depths of up to 6000 metres. The camera embodies a photographic unit and an electronic flash, these being contained in individual pressure housings together with their associated rechargeable power supplies.

2. THE PHOTOGRAPHIC UNIT

2.1 General Description

The basic unit, which was tailored to fit inside an existing 76 mm internal diameter pressure housing, has an overall length of 410 mm. The small diameter imposes a 15 metre capacity limitation of standard 35 mm perforated film giving a capability of 400 standard 24 x 35 mm format frames per loading which can be increased by almost a factor of two when employing thin base photographic material without degrading the system's performance.

Items embodied in the unit include a fully corrected underwater optical system, a solid state control circuit together with a three digit data display which is back projected onto the relevant frame at the instant of exposure.

The film transport mechanism and drive motor plus gate and data chamber are located between two fixed plates to gain maximum structural rigidity the whole being enclosed in a light proof cover. Power supplies control circuit boards and switches are grouped together in a separate section attached to the rear of the main frame.

2.2 Optical system

All units are equipped with a 38 mm f3.5 Dallmeyer lens designed to cover a spectral range of 450 to 650 nm and to operate through a plane window into seawater having a mean refractive index of 1.343. The camera

is intended to operate at depths in excess of 400 metres where conditions of near total darkness exist and in consequence normal units are not equipped with a shutter mechanism, exposures being controlled by a combination of lens aperture and flash intensity. The lens mount does however embody a spacer tube which can be replaced by a shutter, and a number of units have been modified to incorporate this facility.

2.3 Film transport

Power to operate the film sprocket drive and take-up spool is derived from a type A601 Portescap motor used in conjunction with a 52.5:1 ratio gearbox. A slipping clutch is included in the take-up spool drive to gain constant film tension, the system being designed to cycle at a fixed rate of 12 seconds per frame.

The associated control circuit is triggered by a negative pulse which actuates a self hold timing system. Flash initiation is generated by this pulse and the digital display is energised for approximately 200 ms. Following a 1 second delay the drive motor is powered for one transport cycle. On completion of this sequence of events the circuit is automatically reset and placed on stand-by.

2.4 Control circuits

One of the two circuit boards housed in the photographic units rear compartment contains the C-MOS logic system used to gain selected modes of operation. The output from a crystal controlled oscillator is channelled through a ripple down count binary chain, a selected range of operational frequencies being realised by tapping points in the chain through a bank of 7 switches.

Random single frame operation can also be achieved by incorporating an external trigger switch in the circuit and if required this facility can also be utilized to gain controlled periods of activation at predetermined intervals.

The second card contains decoder and drive circuits required to operate the seven segment L.E.D. display units located in a data chamber directly behind the film gate. The output from this display is optically projected onto the film at the instant of exposure to gain a frame identification number.

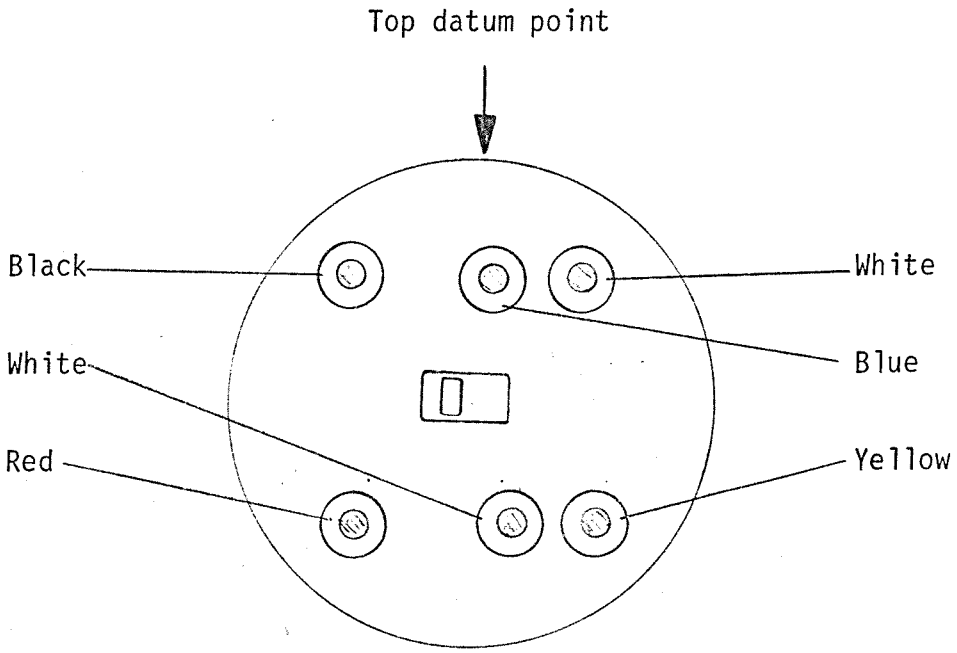
Both display and timing circuits embody a reset facility triggered by the master switch to gain a zero read-out on initiation. For more detailed circuit information reference should be made to IOS 5229 drawings.

2.5 Power supply

The unit is equipped with five 1.25 volt 0.75 Ah rechargeable nickel-cadmium cells which are located between the two circuit boards in the rear compartment. Excluding external demands these cells contain sufficient power to operate the unit for a maximum period of 200 hours.

2.6 Camera orientation

Orientation of the camera is a critical factor during operation and in view of the circular form of the photographic unit difficulty may be experienced in establishing the top datum point of this unit. When doubt exists reference should be made to the following sketch.



Rear view of standard Mk. 4 unit

It must be emphasised however that this information applies only to standard 24 mm x 36 mm format Mk. 4 systems.

3. THE FLASH UNIT

Basically this is a commercial unit modified to operate inside a small diameter pressure housing. The flash incorporates a thyristor controlled output level system gaining a duration of between 1/2000 and 1/30000 secs and a colour temperature of 5.500°K. The unit has a designed guide number of 18 (m at ISO 100) and is powered by four 1.25 volt 4 Ah rechargeable nickel-cadmium cells giving the system an operational capability of approximately 2000 cycles this figure being wholly dependent on the frequency of operation in all standard units.

4. PRESSURE HOUSINGS

The flash and photographic units are mounted in light alloy tubes having an external diameter of 103 mm and a wall thickness of 14 mm both being closed off by removable end caps equipped with 'O' ring seals. The whole system is designed to withstand pressures of 680 kg/cm^2.

In the flash housing the associated flash head assembly is located in a glass dome mounted in one end cap which also incorporates a small conical window to facilitate operation of the light level detector.

An 83 mm x 30 mm thick chemically toughened plane glass window and electrical outlets are accommodated in caps on the second case. To eliminate problems with links between the photographic unit and associated cable looms this unit plugs directly into an electrical connector mounted on the end caps inner face, the two rotating as a whole when the latter is screwed into position, a lubber line on the external face then indicating the system's orientation.

The protective finish on all housing components is resistive to corrosion but very prone to physical damage and therefore must be handled with extreme care.

Following immersion in the sea casings should be thoroughly washed in fresh water to flush off salt deposits and all seals cleaned and regreased at regular intervals.

5. ELECTRICAL CONNECTORS

Pressure housings are equipped with Electro Products Series B53 female bulkhead connectors. A non-conducting film will rapidly form on all electrical contacts when these are exposed to a corrosive atmosphere and must therefore be protected from contamination at all times. The relevant surfaces should also be coated with silicone grease or alternatives to gain added immunity and to ease insertion.

Corroded surfaces can be cleaned with fine emery paper or a 0.22 calibre rifle bore brush.

External connectors not required in operation must be equipped with dummy blanking plugs to protect both internal circuits and contact surfaces.

6. OPERATIONAL DATA

6.1 Camera control

The control circuit board on the photographic unit carries an eight-way selector switch which is used to gain the various operational modes available as detailed below.

(a) Single frame sequences via an external switch.

To achieve conventional single shot operation via an external trigger select switch 1 only.

(b) Operation at preselected intervals.

Automatic cycling at fixed predetermined intervals from 'switch on' can be achieved as follows:

Preselect switch 2 to gain 15 sec intervals
Preselect switch 3 to gain 30 sec intervals
Preselect switch 4 to gain 1 min intervals
Preselect switch 5 to gain 4 min intervals
Preselect switch 6 to gain 8 min intervals
Preselect switch 7 to gain 16 min intervals
Preselect switch 8 to gain 32 min intervals

The time interval for switch 8 can be increased by a link change to gain 64 or 128 minutes if required.

(c) External initiation of automatic operation.

To conserve film it is possible to control operational periods at preselected intervals by an external switch. To achieve this functional mode select switch 1 in addition to those detailed in section (b).

Energising the master switch will reset the timing sequence and frame count but cycling will only occur following operation of the external trip.

6.2 Data display

A further 2-way switch is provided on the control circuit board to control data output levels to cover either medium speed mono or colour film material.

7. POWER SUPPLY

As already stated both the photographic unit and flash are equipped with rechargeable nickel-cadmium cells and following long periods of inactivity these should be fully charged prior to use.

(a) 1.25 volt 0.75 Ah cells in the photographic unit require a 12 hour charge at 75 mA.

(b) The 1.25 volt 4 Ah cells located in the flash unit require a 12 hour charge period at 500 mA.

Following completion of operations, units should be subjected to a topping up charge at the above rates for a period approximately 1.5 times the length of stations covered up to a maximum of 12 hours. Caution should be exercised at all times as serious overcharging at high rates will damage the cells. If in doubt trickle charge at lower rates for longer periods of time. Connect charger to 'Red' and 'Black' terminals in both units.

8. LENS ADJUSTMENT

All current IOS flash systems have a controlled level output and it is threfore possible to accurately determine the correct aperture, when operating between 1 and 3 metres from subject matter, to suit any type of photographic material selected by reference to the attached graph.

9. GENERAL SPECIFICATION

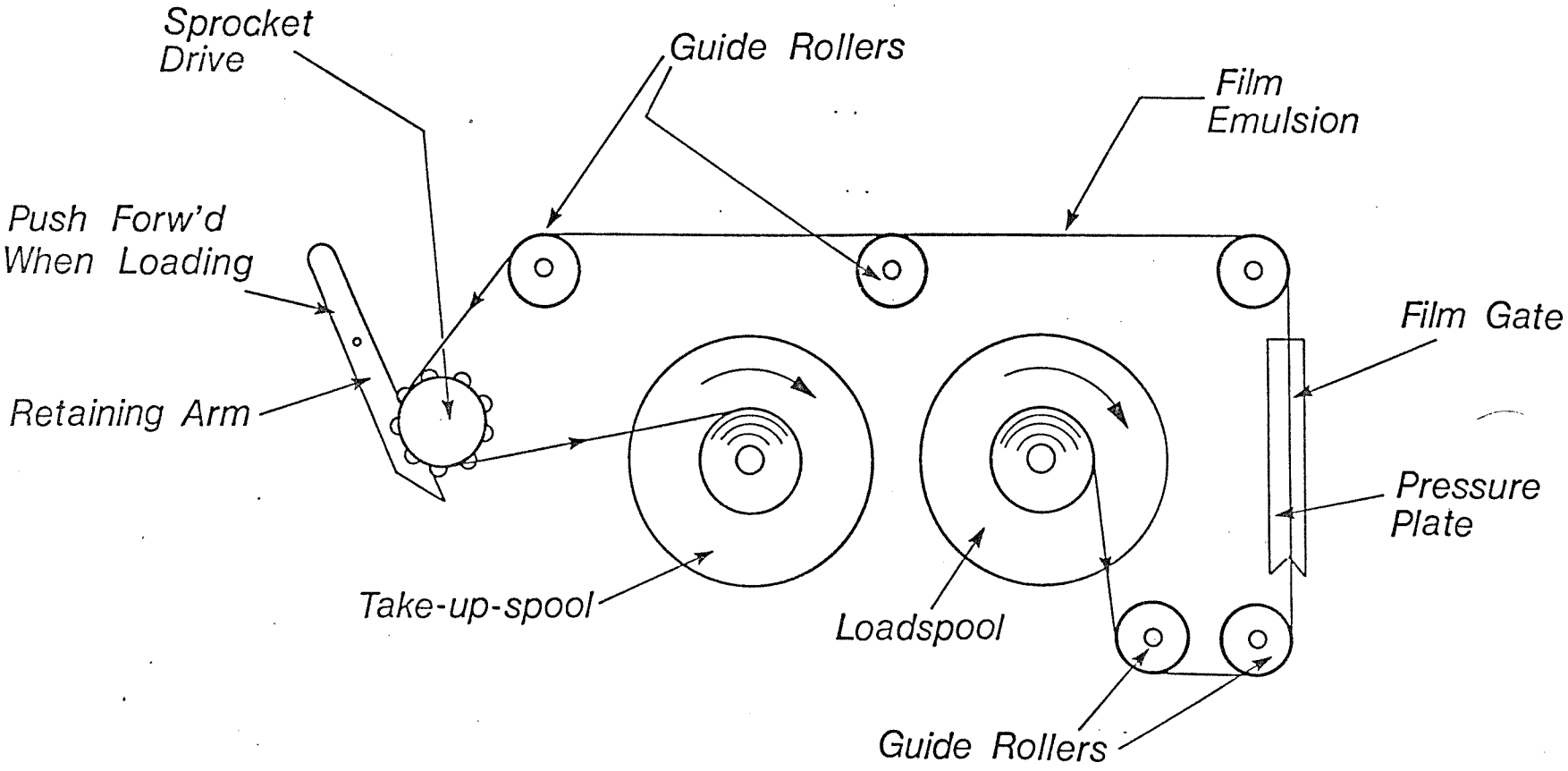
Film format	24 x 36 mm
Film capacity	400 exposures on 14 metres of standard film or 750 exposures on 25 metres of thin base material
Optics	Dallmeyer 38mm f3.5 underwater lens operating through a plane window
Power supplies	Nickel-Cadmium rechargeable cells throughout
Maximum duration	Approximately 200 hours
Operational modes	Single shot operation or a range of seven preselected intervals of between 15 seconds and 128 minutes
Data imprint	Frame count only
Housing material	Light alloy
Depth rating	6000 metres
External connector	Electro Products Type 53

Weights:

Photographic unit	4 kg wet	8.2 kg dry
Flash	2 kg wet	4 kg dry

Overall housing dimensions:

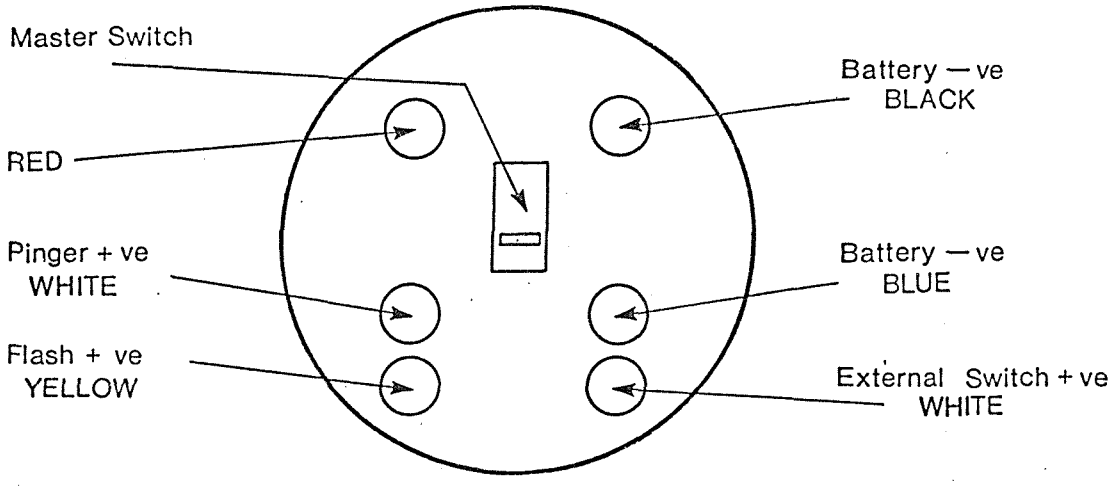
Photographic unit	Length	530 mm
	Diameter	103 mm
Flash	Length	480 mm
	Diameter	103 mm



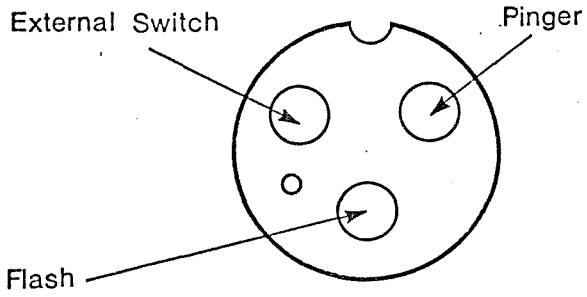
FILM LOADING GUIDE

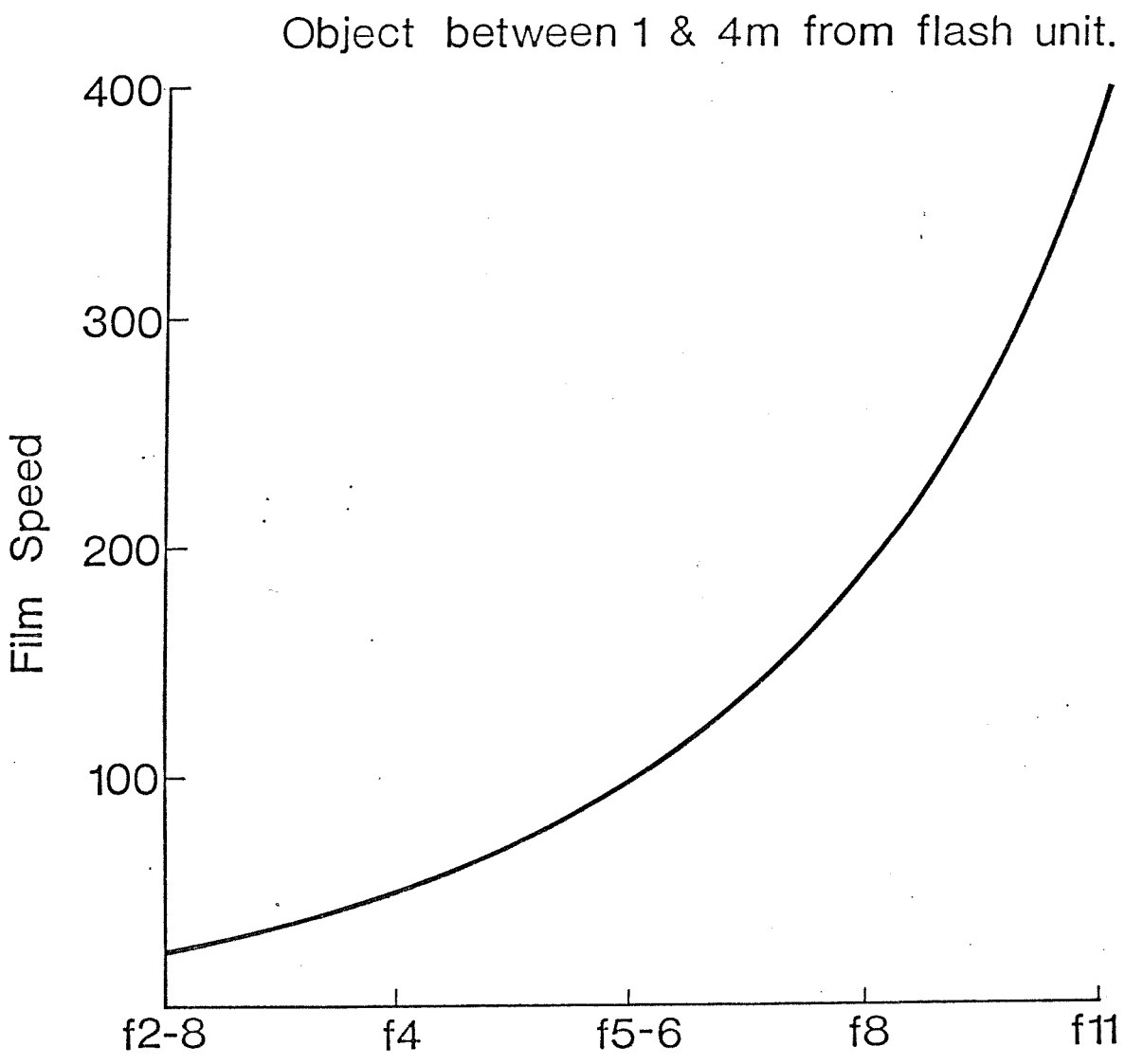
Electrical Connection

Connections on the rear panel of the photographic unit are as shown below:



The six-way Oceanics connector fitted to the pressure housing is designed to accept three two-way jack plugs, the position of these being illustrated below:





FLASH UNIT AUTO EXPOSURE GUIDE