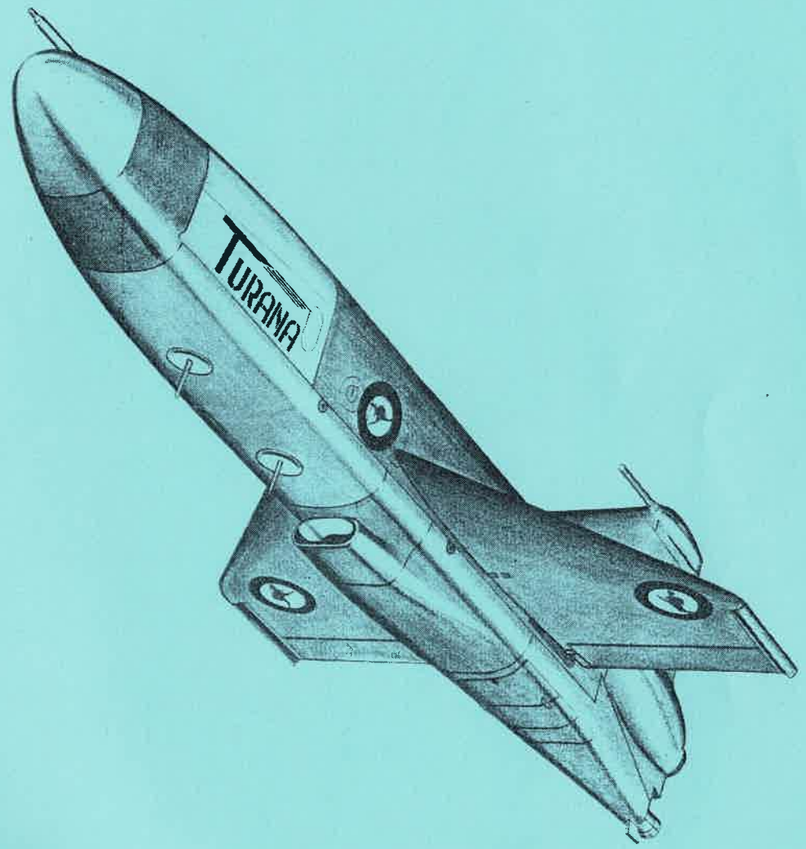
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Publication No.
GAF/19/1

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TURANA



SYSTEM and EQUIPMENT

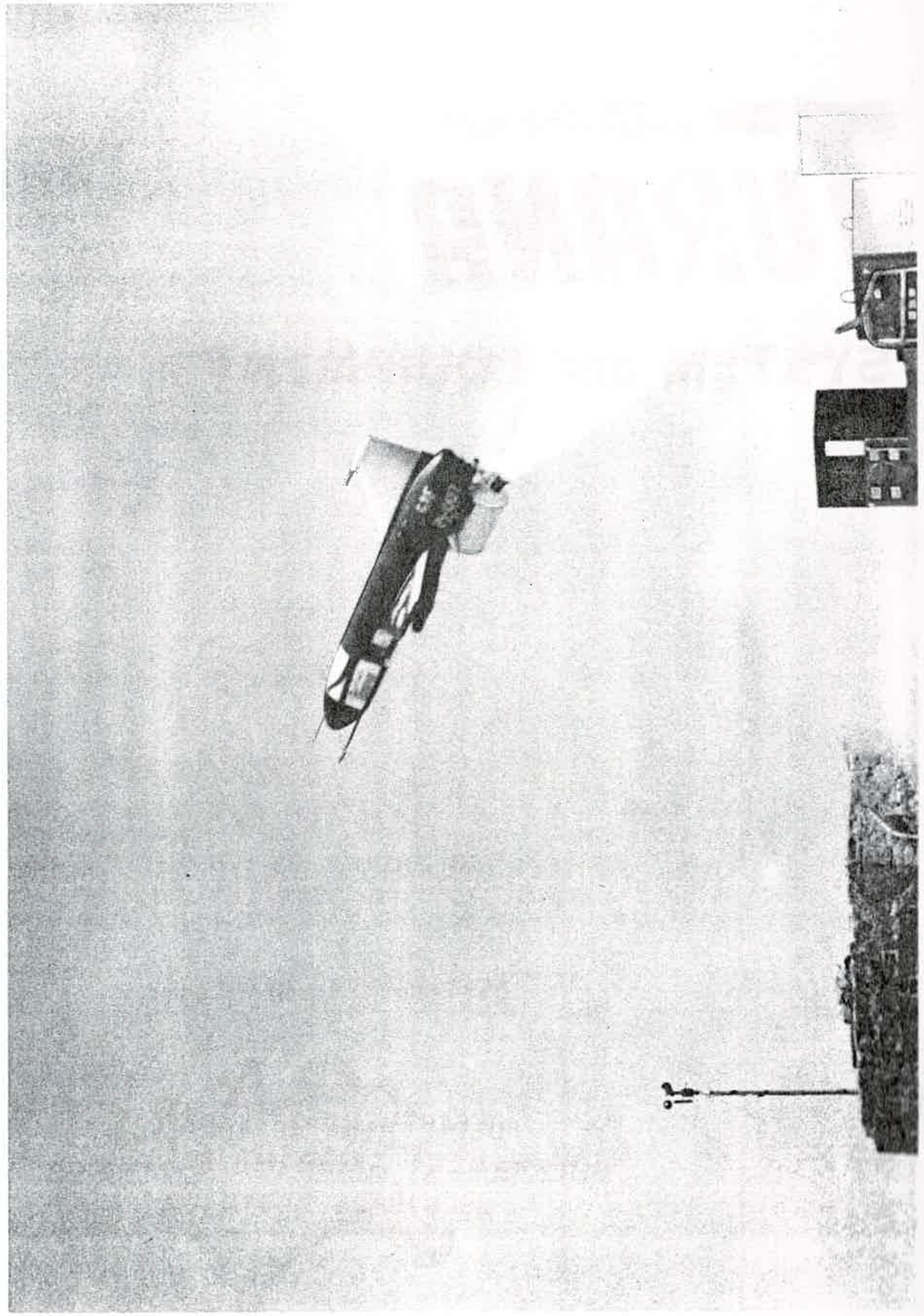
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GAF/19/1

TURANA

SYSTEM and EQUIPMENT

Designed and Developed
by





DEPARTMENT OF SUPPLY
GOVERNMENT AIRCRAFT FACTORIES
MELBOURNE AUSTRALIA

TURANA - SYSTEM AND EQUIPMENT

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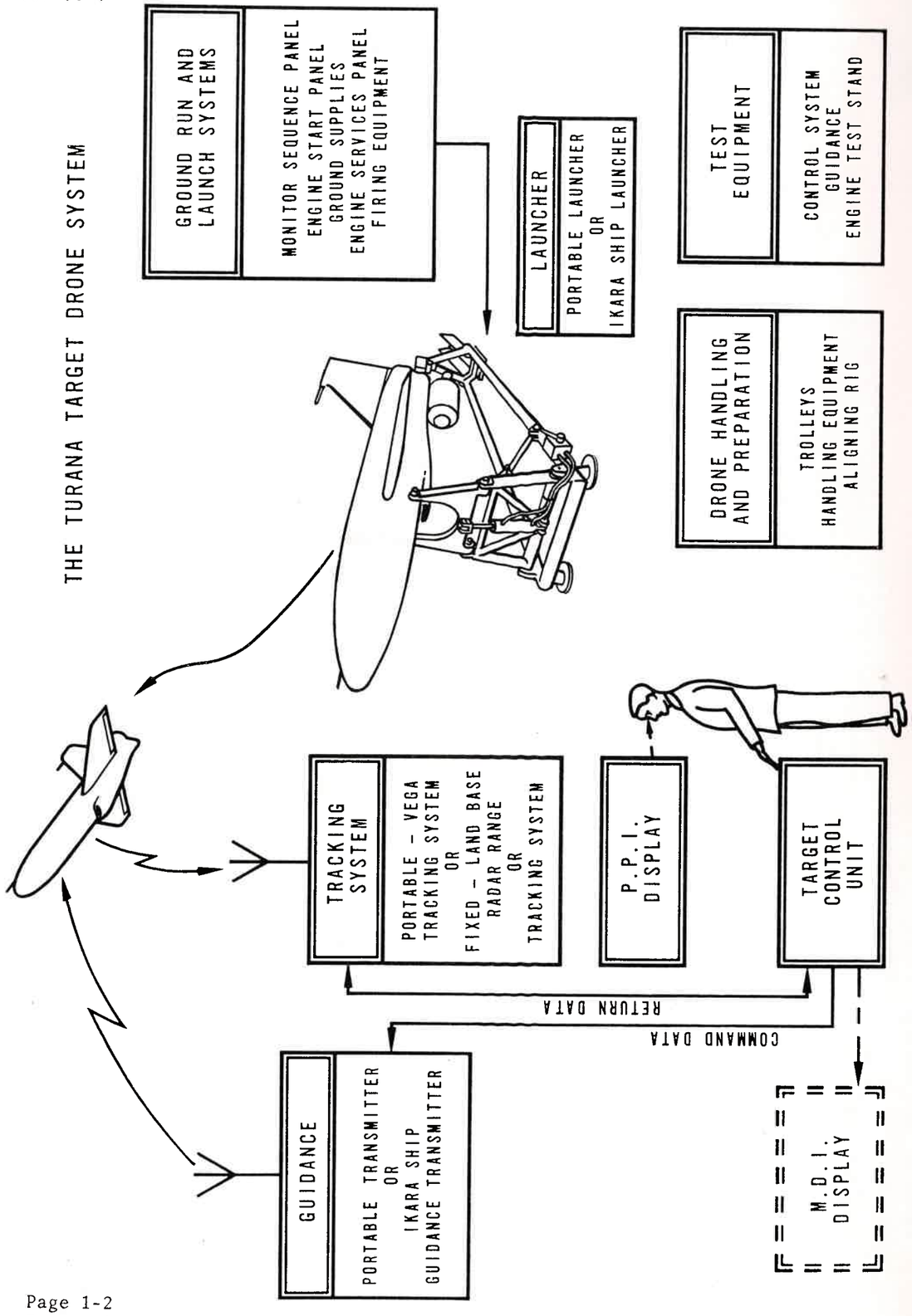
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TURANA - SYSTEM AND EQUIPMENT

SECTION 1

GENERAL INFORMATION

THE TURANA TARGET DRONE SYSTEM



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TURANA - SYSTEM AND EQUIPMENT

SECTION 1 - GENERAL INFORMATION

INTRODUCTION

The Turana Target Drone System was conceived and designed as an adaption of the Ikara Anti-Submarine Weapon System installed in the Royal Australian Navy and Royal Navy ships. A government sponsored programme aimed at meeting a R.A.N. target requirement was approved in mid-1969 and development co-ordinated by Government Aircraft Factories (G.A.F.) is proceeding. Highly successful flight trials have been carried out at the Weapons Research Establishment's Woomera Range and at the R.A.N.'s Jervis Bay Missile Range. Further trials at sea using a complete shipborne installation will complete the basic development programme in mid-1972.

Turana is designed for parachute recovery and all equipments are suitable for at least 20 complete mission cycles including sea water immersion followed by simple refurbishing procedures.

Because of its weapon parentage, Turana achieves high subsonic speeds with little effort. It has a large weight and volumetric capacity for carrying special equipments and possesses exceptional manoeuvring capabilities. These attributes make it an outstanding and versatile target suitable not only for routine service use but also for a wide range of R and D roles.

THE SYSTEM

The Turana System comprises airborne and ground or ship equipments necessary to maintain and operate a target facility. A tracking facility will normally be available in the environment in which Turana will be used and a suitable transponder can be fitted in the target.

The breakdown of the Turana System Hardware is such as to allow the operator a free choice of equipment dispersal. This permits flexible use of equipments normally sited in either the operational or support areas and means that few restrictions are placed on target facility planning.

METHOD OF OPERATION

Turana is launched at a fixed elevation of 22.5^{o}. After burn-out the boost motor is automatically jettisoned and at this point the controller selects the mode of control appropriate to the mission plan.

Control of the drone is effected by open loop demands from the ground and by a closed loop sensing and auto control system in the drone. This system deletes any obligatory need for either telemetered flight information or for highly skilled flight controllers.

Versatility in target operations is effected by providing Turana with these basic flight modes:

LEVEL : A basic level flight, height-keeping mode in which speed may be varied by command via throttle variations. Small changes of height relative to datum may be commanded using a calibrated control.

NON LEVEL : A basic climb or descent speed-keeping mode in which forward speed is set by adjustment of the attitude control. Rate of climb or descent may be varied by setting the throttle control.

HEADING AND TURNS CONTROL : A basic azimuth control which allows demanded heading changes of up to 26^{o} or demanded turns of up to 3g.

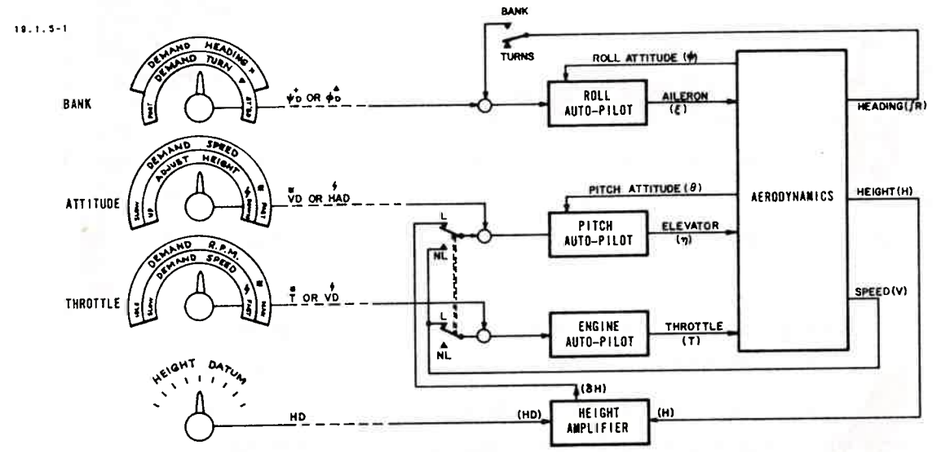
Additional on-off command channels are provided for initiating special equipment operation or for selecting programmes or disturbances for evasive manoeuvres. Turana's Weapon System Origin, where gross weights were considerably greater than any target requirement, permits pitch manoeuvres in excess of 10g to be performed.

A wide variety of flight plans is available to provide realistic simulated attacks allowing both service and R and D Weapons Systems to be exercised and evaluated.

On completion of a sortie and after guidance to an appropriate area, Turana is recovered by parachute and retrieved from the sea close to the launching ship. A land recovery system is also being developed.

Turana's automatic recovery in the event of engine failure, electrical power system failure or command link failure ensures that safety boundaries will not be violated by inadvertent system faults and that the drone will not be lost.

TURANA - SYSTEM AND EQUIPMENT



TURANA BASIC FLIGHT CONTROLS

OPERATING CREW

Turana operation and maintenance has been planned so that recourse to extensive operator training and highly skilled crew is not necessary.

The following special operational crew are required:

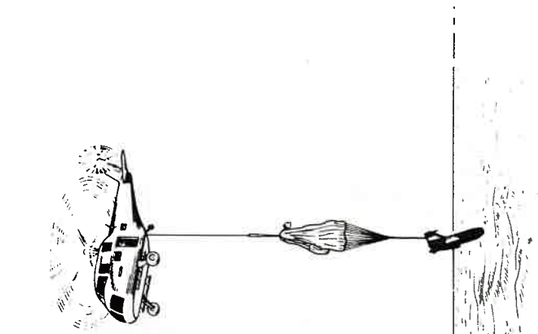
CONTROLLER : The Internal Control System of Turana so simplifies the control task that only a short familiarization period is required to produce a competent controller. It is not necessary for a controller to have previous aeronautical or flying experience.

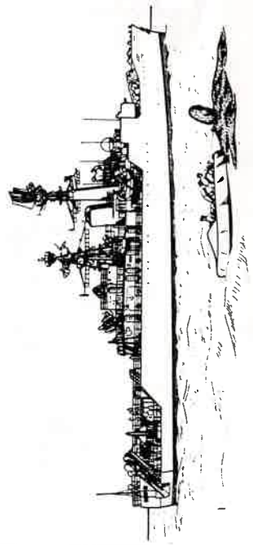
ENGINE TECHNICIAN : To carry out pre flight engine checks and post flight refurbishing.

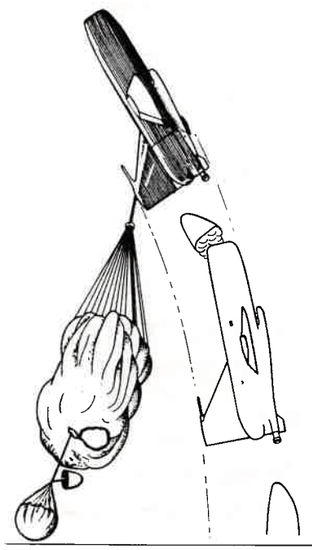
ELECTRICAL TECHNICIAN : To carry out pre flight guidance and control checks.

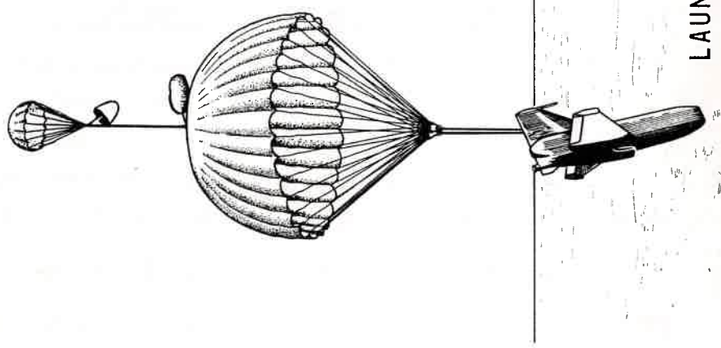
A small semi-skilled crew is also required on-site and at the depot for general handling assistance.

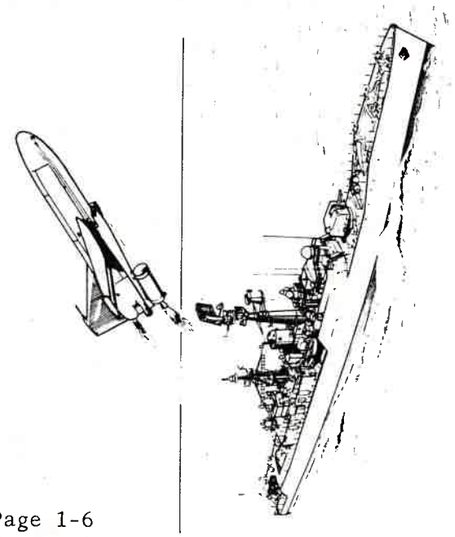
G.A.F. can provide simulator training and supervision of early flights at the customer's range.

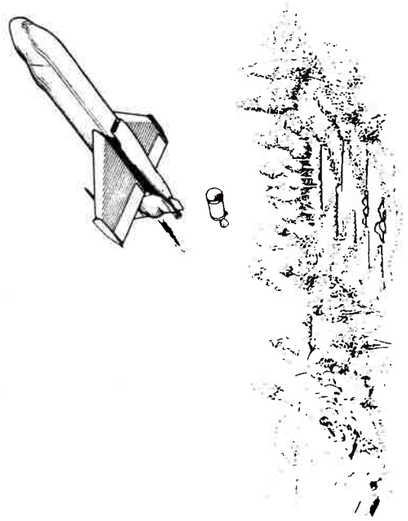












LAUNCH AND RECOVERY

19.1.4-1

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TURANA - SYSTEM AND EQUIPMENT

LAUNCH AND CONTROL FACILITIES

Turana may be launched from an Ikara ship launcher or from a simple, portable, lightweight unit on board ship or on the ground. In the case of an Ikara-fitted ship, the missile handling equipment is used for insertion of the drone into the launcher. For non-Ikara operations, the ground handling equipment and launcher may be combined in a simple trolley/launcher or manual handling cradles can be supplied for use in confined launching areas.

All engine starting, power systems control and sequencing and monitoring are carried out using a special umbilical attached to the port side of the fuselage. Special ground based units, connected via the umbilical, are provided for activation and control of all drone functions prior to launch.

The drone is controlled in flight by means of the target control unit which is connected to either the Ikara guidance system or, in the case of non-Ikara based operations, directly to a command transmitter. Return data facilities are available, although not essential. If used, flight information is presented to the controller on the target control unit. A small remote control panel which provides azimuth and recovery control may be used in conjunction with the target control unit for use in the visual tracking mode.

Navigation is effected by the controller using a plot or P.P.I. display which is fed by either the Ikara tracking system or by any suitable radar. Space and power are available in the drone for fitting tracking transponders to suit any particular customer requirement.

After recovery, the target is washed out with fresh water, dried thoroughly and given a short engine run. A replacement parapack and boost motor are fitted and after check-out Turana may be re-used immediately.

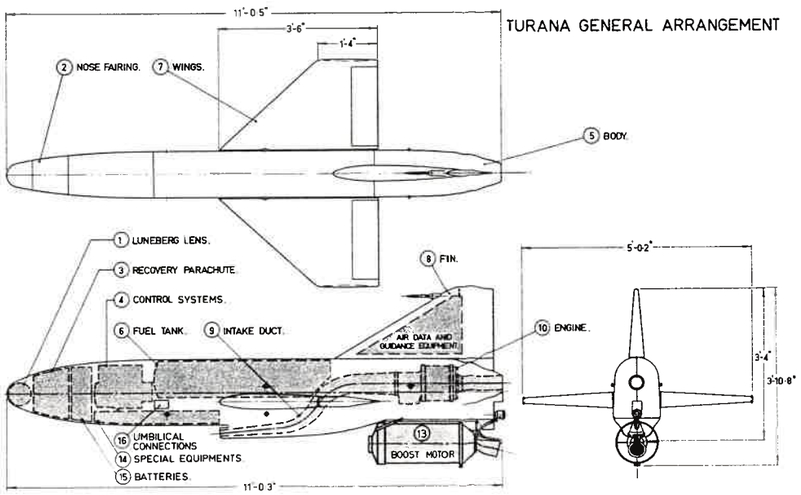
SECTION 2

THE DRONE

TURANA LEADING PARTICULARS

DIMENSIONS:	LENGTH	11' 0.5"	(3.37 m)
	HEIGHT (CLEAN)	3' 4"	(1.01 m)
	HEIGHT (BOOSTED)	3' 10.8"	(1.19 m)
	WING SPAN	5' 0.2"	(1.53 m)
WEIGHTS:	DRY	364 lb	(165.1 kg)
	MAX. ALL UP WEIGHT (LESS BOOST)	555 lb	(251.7 kg)
	FUEL CAPACITY	91 lb	(41.3 kg)
BOOST:	TYPE	SOLID PROPELLANT, DETACHABLE	
	ACCELERATION	10 g (NOMINAL)	
	END OF BOOST SPEED	560 ft/sec	(170 m/sec)
POWER PLANT:	MICROTURBO 022 COUGUAR	GAS TURBINE	
	THRUST	176 lb	(80 kg)
PAYLOAD CAPACITY:	WEIGHT	ABOVE 100 lb	(45.5 kg)
	VOLUME	1 CUBIC FOOT	(0.028 cub m)

TURANA GENERAL ARRANGEMENT



TURANA - SYSTEM AND EQUIPMENT

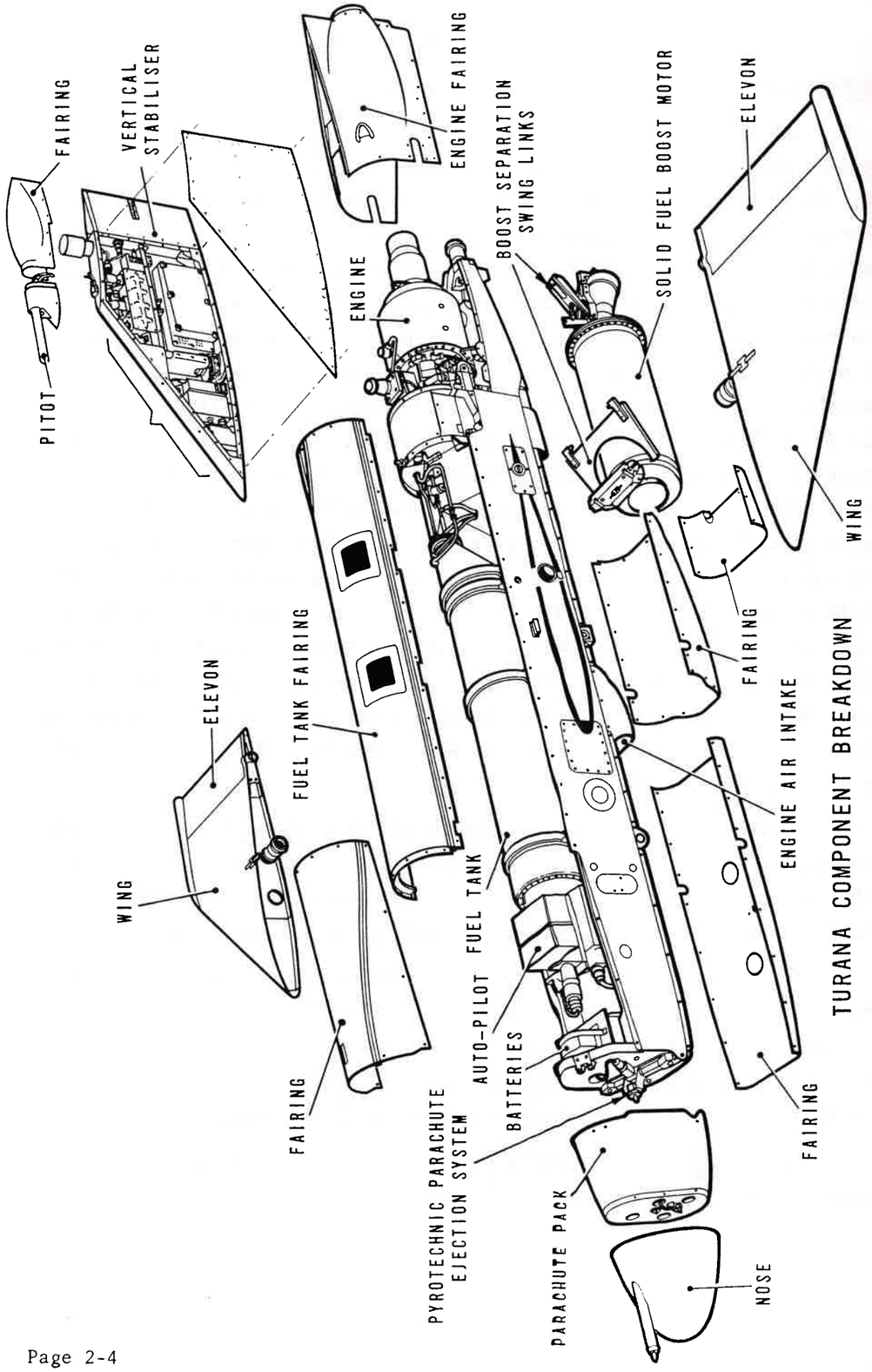
DESCRIPTION OF THE DRONE

The Drone Fuselage (5), is a composite metal-fibreglass structure containing the Microturbo Cougar -022 Turbojet Engine (10), the Fuel Tank (6), Control System (4), Battery Power Supplies (15) and the Recovery System. The Turbojet Engine, which is housed in the rear fuselage is supplied with ram air through a Ventral Intake and Duct (9). The Control and electrical power systems are housed in the front fuselage, ahead of the tank. The Fibreglass nose of the Drone (2) is ejectable on command by means of a pyrotechnic charge. The nose which is connected to the parachute by a lanyard contains a 7½ in. (190mm) diameter Luneberg Lens (1) for forward looking, passive radar augmentation and a Recovery Parachute (3). The main structural member of the body is comprised of a light alloy H-section structure made of chemically milled side-skins, light alloy bulkheads and forgings and a light alloy bottom diaphragm. The easily attachable steel fuel tank also contributes to the structural stiffness of the fuselage. The Fin (8), which contains all the airborne guidance equipment and air data unit, and the Wings (7), are also composite structures and are quickly attachable, interchangeable components. The Boost Motor (13), is attached to the main structure by means of swivelling links and two explosive bolts and is automatically jettisoned at the end of the launching phase.

A breakout fitting is situated at the rear of the Drone to provide restraint in the launcher until the boost thrust reaches a nominated level. Umbilical Connections (16), on the port side ahead of the wings provide starting, power, and monitoring connections prior to launching.

A removable bottom fairing, positioned between the ejectable nose and the intake, provides access to special Trials Equipments (14), and telemetry which the user may wish to carry for particular trials. The telemetry unit is a locally developed 465 MHz 48-Channel Sub-Miniature System which provides some 40 usable information channels.

Flotation is provided by a combination of sealed equipment compartments and integral light foam sections.



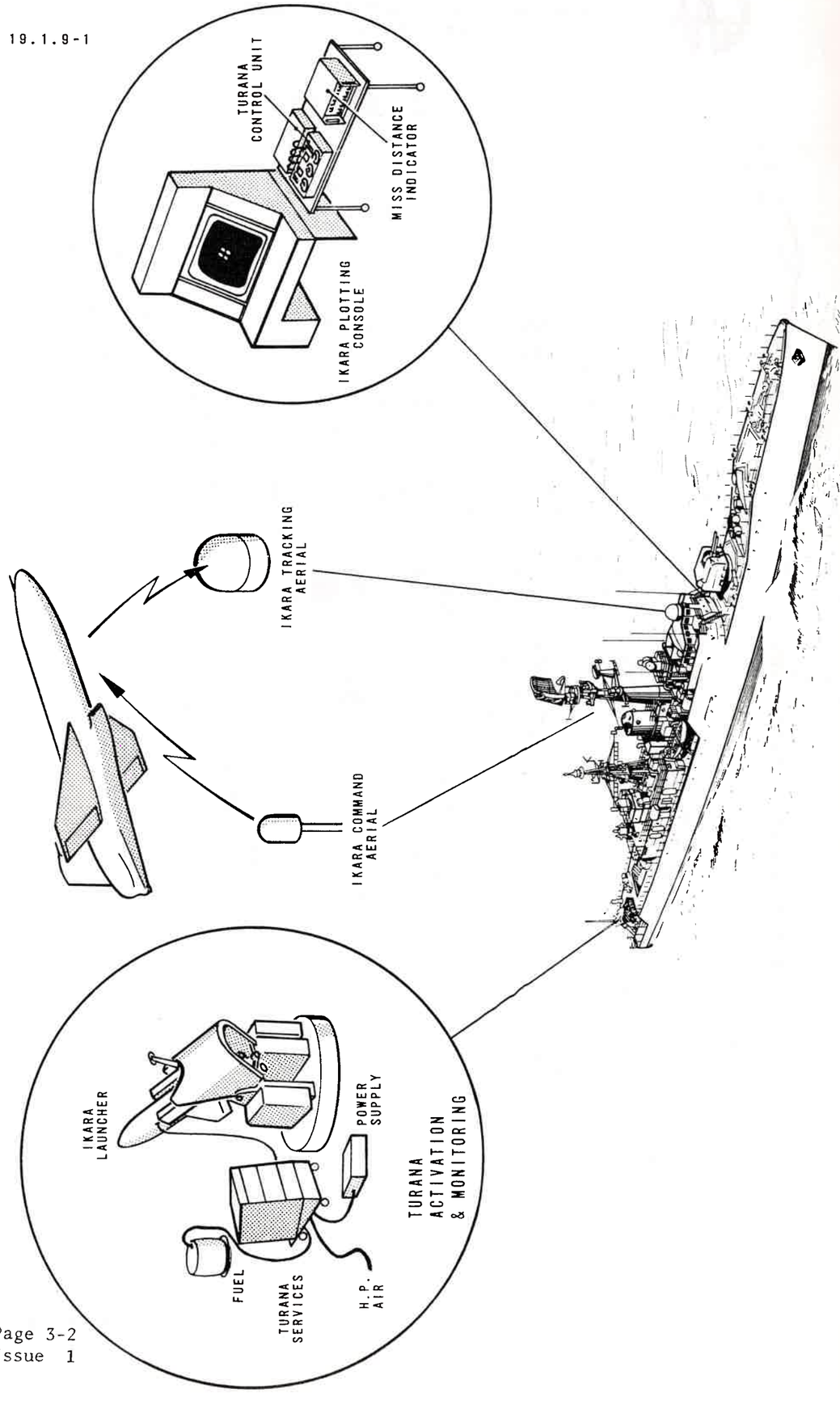
TURANA COMPONENT BREAKDOWN

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TURANA - SYSTEM AND EQUIPMENT

SECTION 3

LAUNCH VARIATIONS



SHIPBOARD LAUNCHING
IKARA BASED

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TURANA - SYSTEM AND EQUIPMENT

SHIPBOARD LAUNCHING: IKARA BASED

Users of the Ikara weapons system can readily perform Turana drone launchings without the necessity of extensive modifications as the drone is designed to use Ikara equipment wherever possible. The tracking system, command aerials and handling equipment in the magazine and missile assembly room are suitable for Turana operation without alteration. Equipment requiring minor modification for Turana use is listed below:

a. Guidance Equipment Console - addition of a change-over switch IKARA/TURANA to permit the GEC to accept signals from the T.C.U.

b. New computer program required to enable the Ikara Attack Console to present the Turana display

c. Launcher - a Turana switch added to launcher to ensure that the vehicle is armed at the instant of fire.

The special equipments required for Turana operation from an Ikara installation are:

a. Target Control Unit

b. Drone Activation and Monitoring Equipment

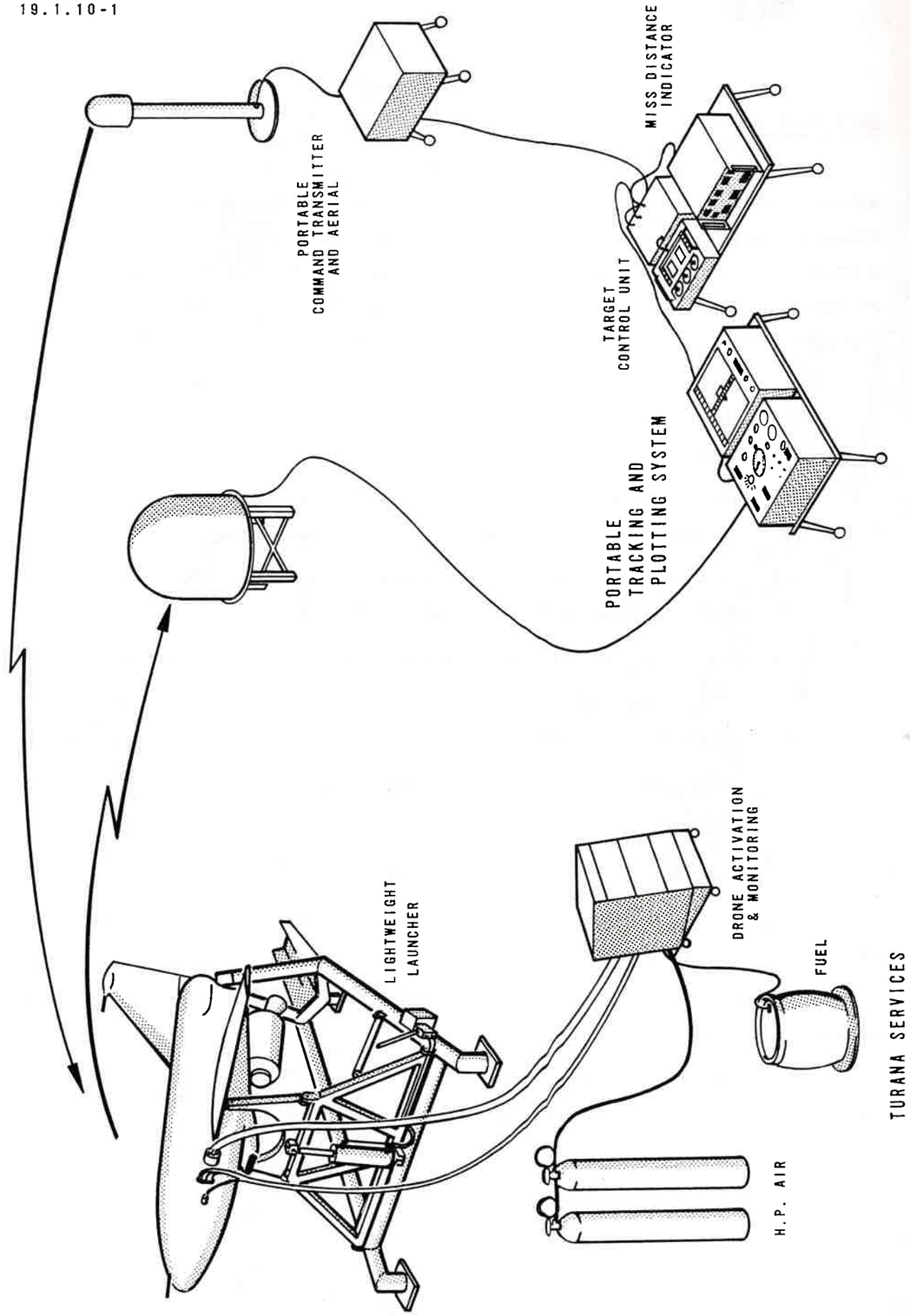
c. Refurbishing Stand

d. Fuel Supply

All of these equipments are readily portable and occupy a minimum of space.

If immediate re-use is required without recourse to Shore facilities a battery charger is required.

If gunnery operations are to be carried out, acoustic MDI equipment is fitted to Turana, and an MDI scorer carried.



TURANA SERVICES EQUIPMENTS FOR NON IKARA BASED OPERATIONS

TURANA - SYSTEM AND EQUIPMENT

SHIPBOARD LAUNCHING - NON IKARA BASED

The Turana drone can be launched on board ship from the portable lightweight launcher. The launcher is secured to the deck by flexible lashings and a boost blast deflector incorporated in the rear of the launcher prevents the boost motor efflux from damaging deck surfaces.

The equipment required for Turana operation from on board ship is listed below:

a. Portable Lightweight Launcher
b. Drone Activation and Monitoring Equipment
c. Target Control Unit
d. Portable Command Transmitter and Aerial
e. Portable Radar Tracking System and Aerial
   NOTE: If the ship has a satisfactory tracking system available the portable radar tracking system is not required.
f. Drone Handling Equipment
g. Refurbishing Stand
h. MDI Indicator)
j. Battery Charger) Options

A brief description of the above equipment is contained in later sections of this handbook.

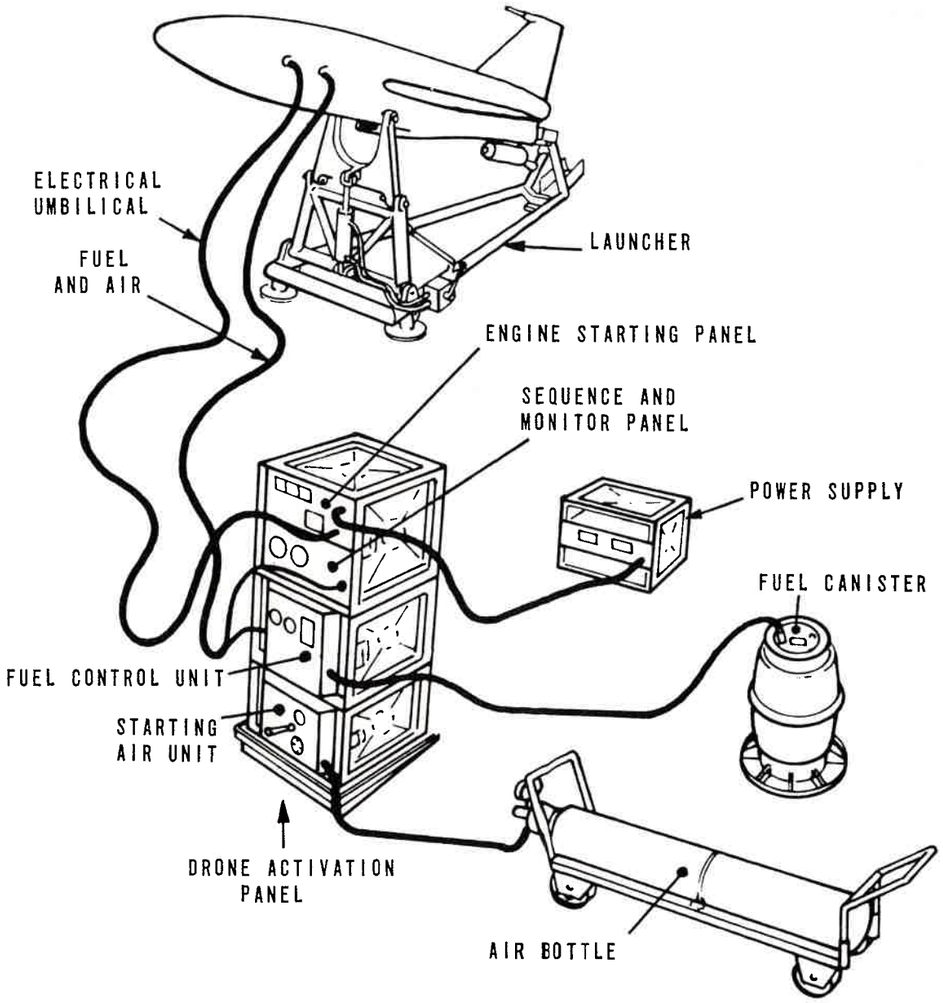
All equipments are readily portable and occupy a minimum of space, and those which may be used or transported on deck are suitable for extended exposure periods.

LAND LAUNCHING

The equipment required for land launching is the same as that required for non-Ikara shipboard launchings. Because of its compactness and comparatively light weight, the control equipment, tracking system and drone activation and monitoring equipment could be mounted in a medium sized van or trailer. For mobile operations, the drone may be fired from the portable lightweight launcher mounted on an open tray truck or similar vehicle; thus, with a suitable mobile power supply, the Turana system can be used as a completely self-contained transportable target facility.

SECTION 4

LAUNCHING EQUIPMENT



DRONE ACTIVATION AND MONITORING EQUIPMENT

TURANA - SYSTEM AND EQUIPMENT

DRONE ACTIVATION PANEL

The Drone Activation Panel (DAP) is used at the launch site, or during testing, for the following purposes:

a. To fuel the drone and provide the engine starting sequence

b. Activation of the drone electrical system

c. Monitoring the control surface position during the pre-launch check-out

d. Engine shut-down

e. Drone de-fueling

f. Engine refurbishing.

To facilitate transport and storage the DAP is contained in three separate interlocking units. The three units are:

a. Engine Starting Panel and Sequence and Monitor Panel (Top Unit)
b. Fuel Control Unit (Centre Unit)
c. Starting Air Unit (Bottom Unit).

Attachment and lashing points for securing the DAP to a mobile land vehicle or shipboard are incorporated in the base.

Power Supply

Power for the DAP is derived from a separate power supply which may, if required, be located remotely from the DAP

Air Supply

The air for engine starting can be supplied from an air bottle, maximum pressure 3600 p.s.i. (254 kg/cm^2) or from a similar existing supply. Low pressure air at 160 p.s.i. (11.2 kg/cm^2) is also suitable providing a flow rate of 0.16 lb/sec (0.07 kg/sec) is available.

Fuel Supply

The fuel is contained in an 18-gallon (82 l) canister and supplied to the drone's fuel tank via the Fuel Control Unit.

Equipment Dimensions and Power Supply Requirements

DAP complete (Three Units and Base)

Size	:	58ins x 21ins x 20ins (1.473m x 533mm x 508mm)
Weight	:	240 pounds (109 kg)
Power	:	Provided by separate power supply

Engine Starting Panel and Sequence and Monitor Panel

Size	:	21ins x 18ins x 20ins (533mm x 457mm x 508mm)
Weight	:	55 pounds (25 kg)
Power	:	from power supply

Fuel Control Unit

Size	:	21ins x 14ins x 17ins (533mm x 355mm x 432mm)
Weight	:	80 pounds (36 kg)
Power	:	from Engine Starting Panel

Starting Air Unit

Size	:	21ins x 11ins x 17ins (533mm x 279mm x 432mm)
Weight	:	75 pounds (34 kg)
Power	:	from Engine Starting Panel
Input Pressure	:	3600 p.s.i. (254 kg/cm^2) from air bottle or alternatively to suit customer's supply
Output Pressure	:	160 p.s.i. (11.2 kg/cm^2) - Starting 100 p.s.i. (7.0 kg/cm^2) - Refurbishing
Flow Rate	:	0.16 lb/sec (0.07 kg/sec)

Power Supply

Size	:	21ins x 14ins x 17ins (533mm x 355mm x 432mm)
Weight	:	120 pounds (54 kg)
Power	:	115V, 60 Hz or 240V, 50 Hz
Output	:	24/28V dc, 20 amps

Fuel Canister

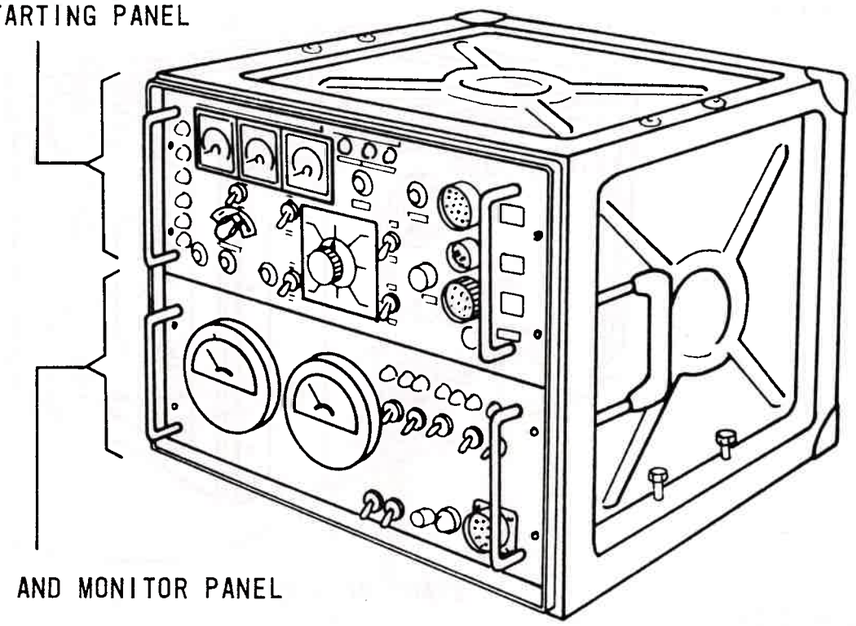
Size	:	27ins x 18ins diameter (685mm x 457mm diameter)
Weight (full)	:	180 pounds (82 kg)
Capacity	:	18 gallons (82 l)

Air Bottle (optional) - Maximum Pressure 3600 p.s.i. (254 kg/cm^2)

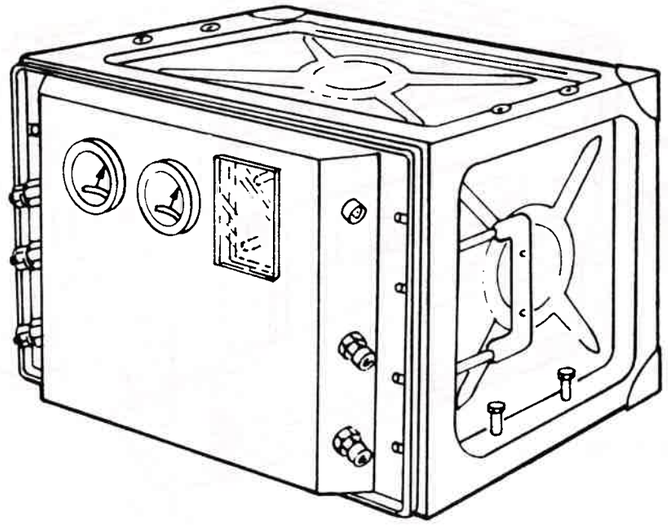
Size	:	72ins x 10ins diameter (1.829m x 254mm diameter)
Weight	:	150 pounds (approx.)

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ENGINE STARTING PANEL

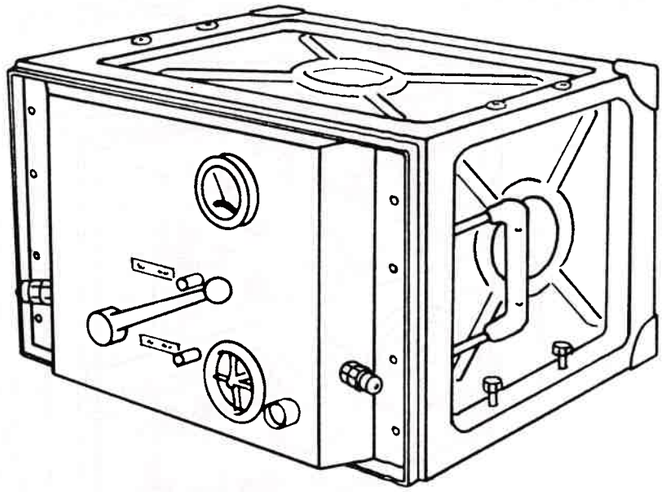


SEQUENCE AND MONITOR PANEL

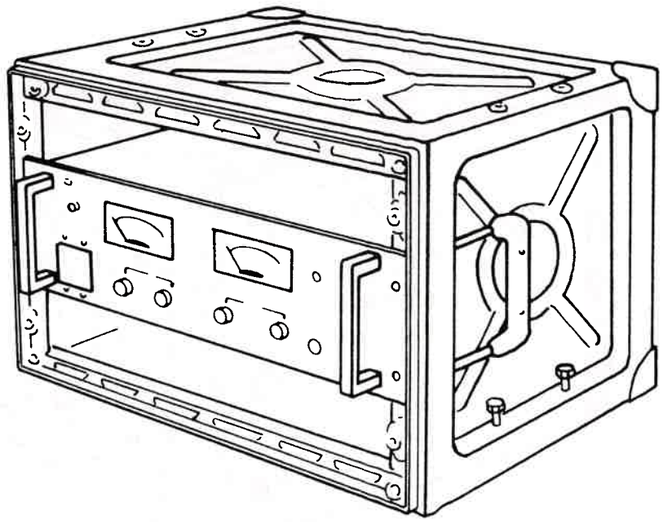


FUEL CONTROL UNIT

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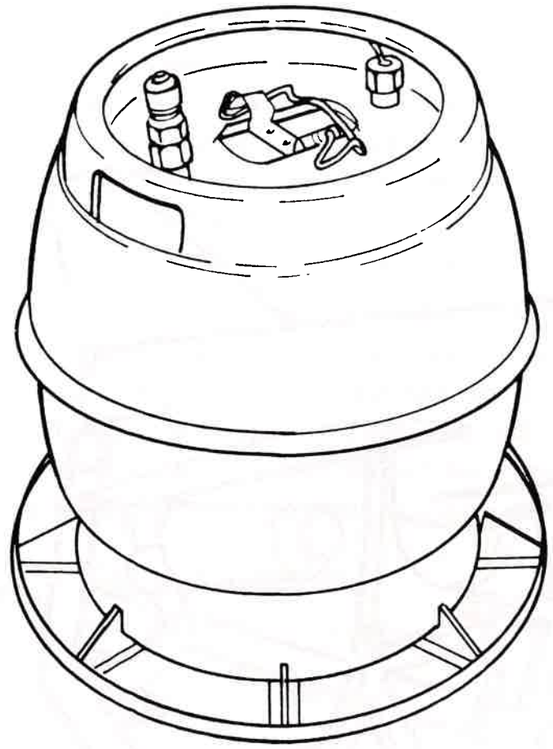


STARTING AIR UNIT

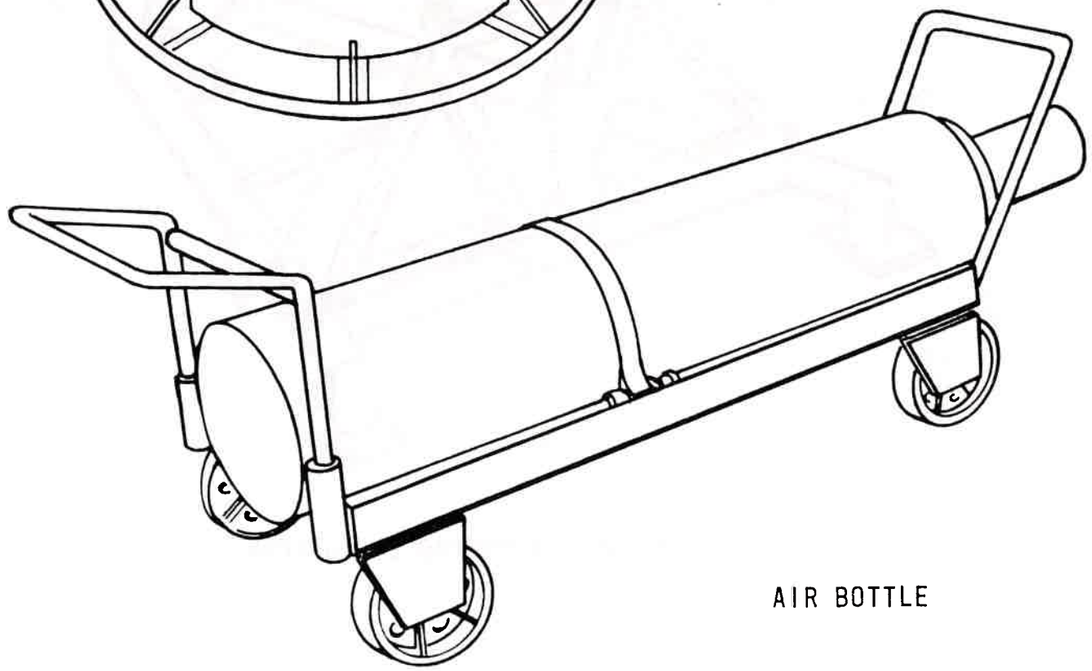


POWER SUPPLY

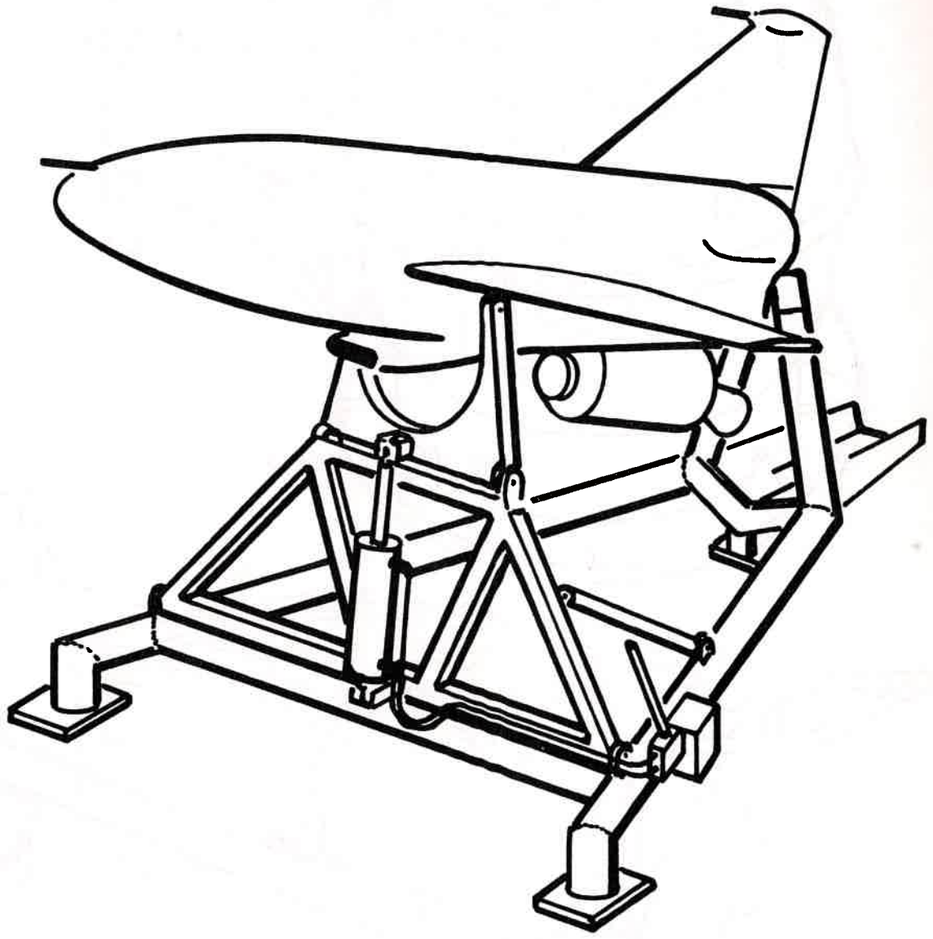
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FUEL CANISTER



AIR BOTTLE



TURANA ON PORTABLE LAUNCHER

DEPARTMENT OF SUPPLY
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TURANA - SYSTEM AND EQUIPMENT

PORTABLE LIGHTWEIGHT LAUNCHER

The lightweight portable launcher is an all welded tubular steel construction that may be used for land or shipboard launchings. The launcher is secured, at the launch area by flexible lashings and does not require any external power supplies. When collapsed the launcher measures 7 ft x 5 ft x 2 ft (2.134 m x 1.524 m x 0.609 m) and is easily man portable. Protective treatment permits the launcher to be stowed as deck cargo.

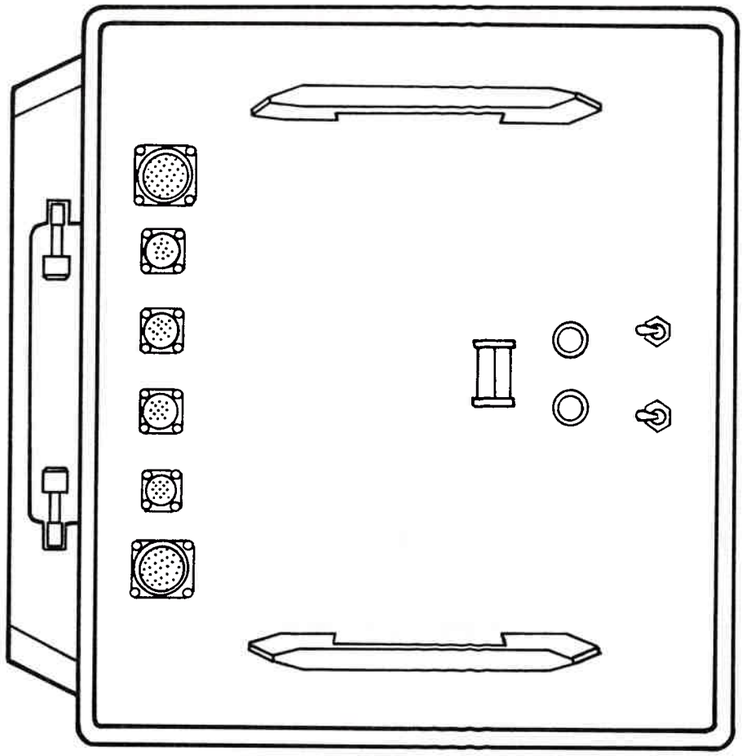
In use the drone, less wings, fin, boost motor and fuel, is loaded onto the launcher with the launcher in the horizontal position; the wings, fin and boost motor are fitted and the launcher is elevated, by means of the integral hydraulic hand pump and jack, to the launch angle. A blast deflector incorporated in rear of the launcher deflects the boost motor efflux to prevent damage to the launch site.

Equipment Dimensions

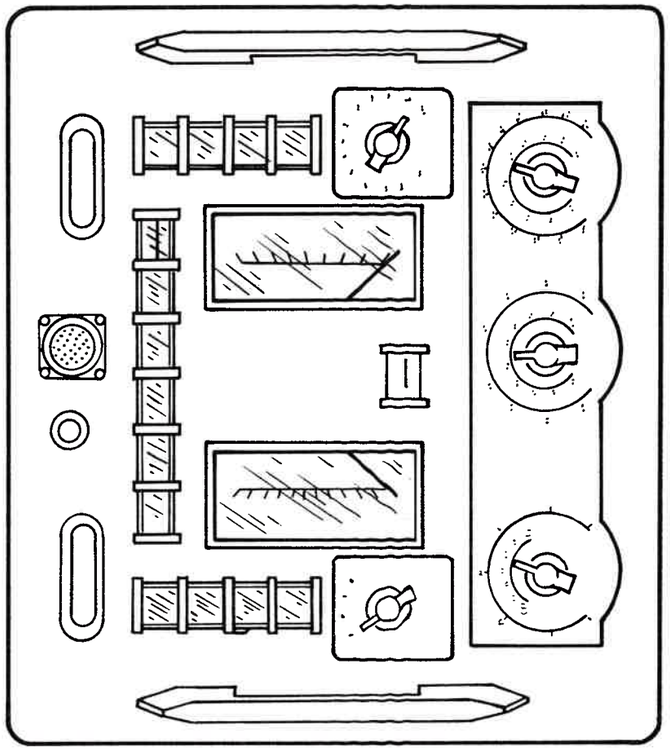
Size	:	Collapsed	7 ft x 5 ft x 2 ft (2.134 m x 1.524 m x 0.609 m)
		Erected	9 ft x 5 ft x 4 ft 2 in (2.743 m x 1.524 m x 1.270 m)
Weight	:		450 pounds (204 kg)

SECTION 5

CONTROL EQUIPMENT



LOGIC ASSEMBLY



CONTROL AND DISPLAY ASSEMBLY
FRONT PANEL

TARGET CONTROL UNIT

19.1.16-1

TURANA - SYSTEM AND EQUIPMENT

TARGET CONTROL UNIT

The Target Control Unit (T.C.U.) comprises two units, the Control and Display Assembly and the Logic Assembly. Interconnection between the two units is made by a 9 ft (2.75 m) long cable assembly. The two units fit together as a suitcase for transportation and can be carried by one man.

The drone's entire flight pattern is governed by the flight controller from the T.C.U. Ten commands are available for varying the flight pattern and for the execution of manoeuvres. The manually selected commands are digitally encoded and transmitted by RF carrier to the drone. A return RF link from the drone provides return data for decoding, within the T.C.U., to give visual indication of actual airspeed and altitude on the control and display assembly; shell miss distance information is relayed to the miss distance indicator display unit via the T.C.U.

The control and display assembly also incorporates two digital timers, one for interval time, which may be used by the flight controller to time the duration of a particular flight manoeuvre etc., and the other for total elapsed flight time. The elapsed flight timer is automatically started at drone IOM but must be manually stopped at the end of the flight.

The logic assembly houses the printed circuit boards for the logic circuit and T.C.U. power supplies and also provides the interface between the two T.C.U. assemblies, the remote T.C.U., and MDI display unit and the command transmitter.

Equipment Dimensions and Power Supply Requirements

T.C.U. - Transit condition

Size	:	17 in x 17 in x 8 in (432 mm x 432 mm x 203 mm)
Weight	:	48 lbs (21.8 kg)

Control and Display Assembly

Size	:	17 in x 17 in x 3½ in (432 mm x 432 mm x 89 mm)
Weight	:	19 lbs (8.6 kg)
Power	:	From Logic assembly

Logic Assembly

Size	:	17 in x 17 in x 4½ in (432 mm x 432 mm x 114 mm)
Weight	:	29 lbs (13.1 kg)
Power	:	240 Volts 50 Hz or 115 Volts 60 Hz

TURANA - SYSTEM AND EQUIPMENT

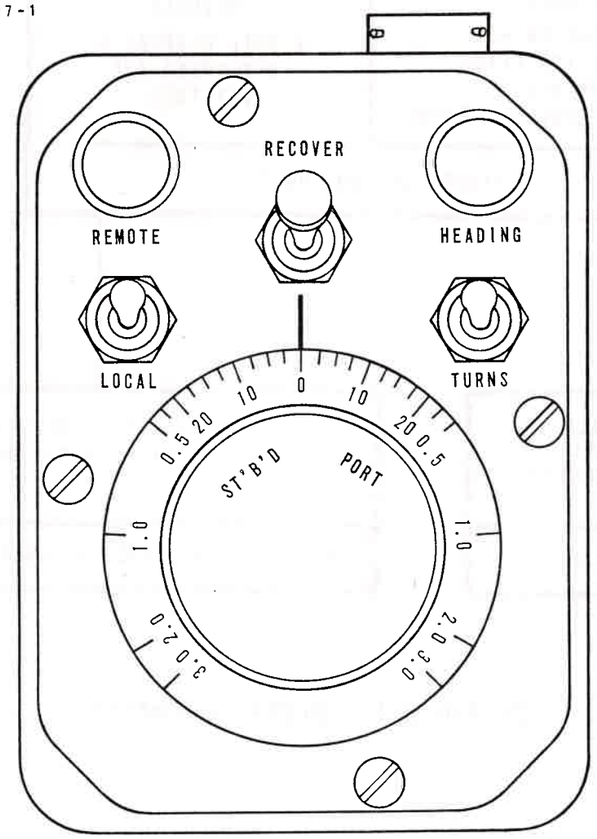
REMOTE TARGET CONTROL UNIT

The remote target control unit is a small portable unit that operates, via the T.C.U., to give limited control over the drone's flight. From the remote target control unit only azimuth control and command recover are available.

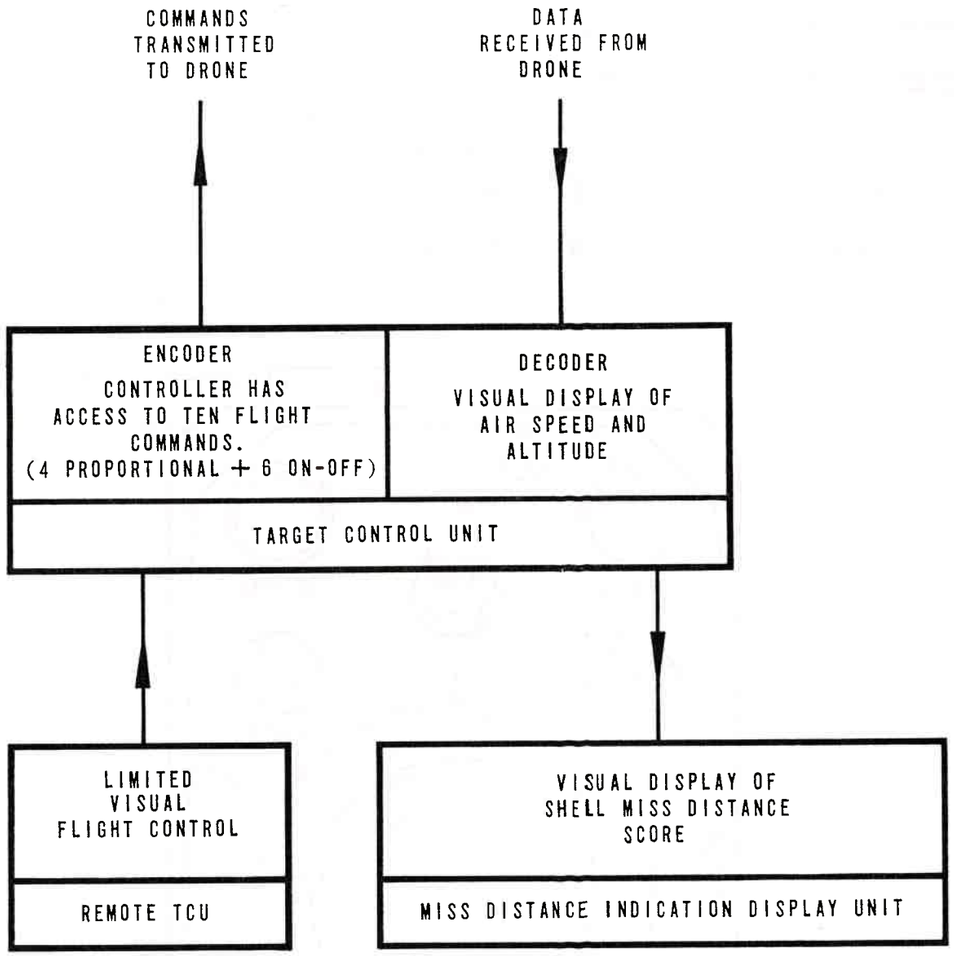
Equipment Dimensions and Power Supplies

Size	:	6 in x 4 in x 4 in (152 mm x 102 mm x 102 mm)
Weight	:	2 lb (.9 kg)
Power	:	From the T.C.U.

19.1.17-1



REMOTE TARGET CONTROL UNIT
FRONT PANEL



TCU AND MDI : BLOCK SCHEMATIC

19.1.18-1

TURANA - SYSTEM AND EQUIPMENT

COMMAND TRANSMITTER

Details of the Command Transmitter will be included in a later issue of this handbook.

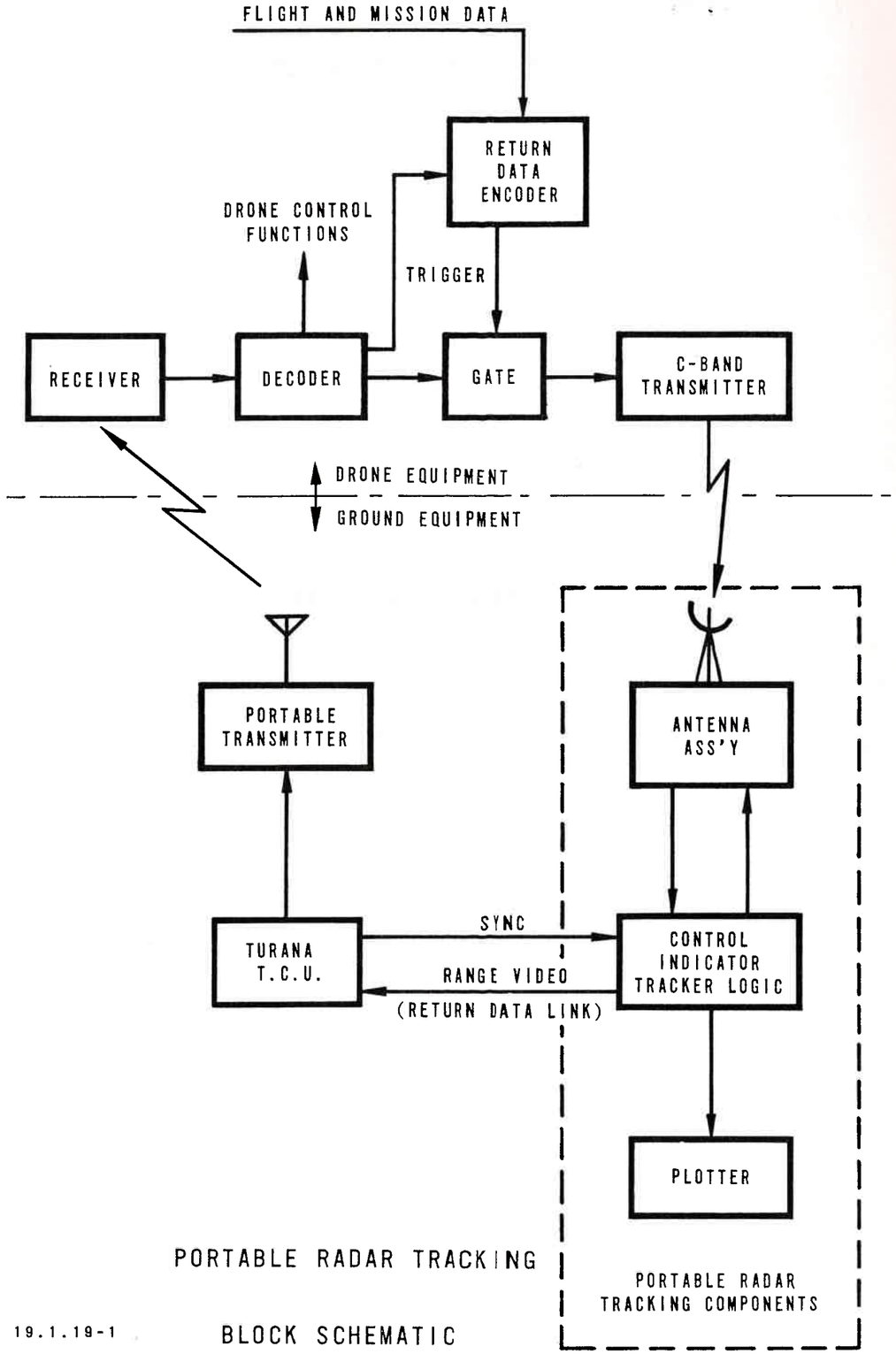
Equipment Dimensions and Power Supply (Approx.)

Size	:	22 in x 20 in x 9½ in (559 mm x 508 mm x 241 mm)
Weight	:	80 pounds (36.3 kg)
Power Supply	:	115V, 60 Hz.

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SECTION 6

TRACKING EQUIPMENT



19.1.19-1

BLOCK SCHEMATIC

DEPARTMENT OF SUPPLY
GOVERNMENT AIRCRAFT FACTORIES
MELBOURNE AUSTRALIA

TURANA - SYSTEM AND EQUIPMENT

PORTABLE RADAR TRACKING SYSTEM

To enable Turana operation in areas where a suitable tracking facility is not available, a Portable Radar Tracking System, capable of operating from a mobile land vehicle or shipboard, can be supplied.

As an example, A Vega Model 626C with minor modifications is compatible with the Turana/Ikara microwave link and provides range and bearing data. The link is also used for the manual Turana return data. The ground-based tracker package comprises an Antenna Assembly, a Control Indicator Tracker Logic Assembly and a Display Assembly incorporating a 11 in x 17 in (279 mm x 431 mm) X-Y plotter.

System Performance

Slant Range	0 to 100,000 yards (0 to 91,440 m)
Slant Range Resolution	10 yards (9.14 m)
Slant Range Accuracy	± 20 yards (± 18.3 m)
Azimuth Angular Coverage	360° continuous
Azimuth Angular Accuracy	± 1%
Azimuth Tracking Rate	20°/sec. maximum
Azimuth Acceleration Rate	10°/sec.^{2} maximum
Azimuth Slew Rate	32°/sec. maximum
Elevation Tracking Rate	Unlimited
Acquisition	Automatic full azimuth sector scan ± 16°
Re-acquisition	Range Modified Sector Scan 0-16 N.M.: ±8° 16-32 N.M.: ±4° 32-50 N.M.: ±2°
Readout - Display	Range, Bearing
Readout - Plotter	Range, Bearing on 10 in x 15 in X-Y Plotting Paper
Plotter - Range Scales	A Range Scales - 1K yds, 2K yds, 4K yds, 8K yds per inch

Range Gate	Automatic Sweep for Requisition and Tracking
Frequency	5.4 to 5.9 GHz (tunable)
AGC	Meter Display for Signal Strength

Operators Controls

Transmitter ON - OFF
Antenna Slew
Antenna Lockout
Range Select
Transmitter Code Setting
Transponder Fixed Delay Setting

Equipment Dimensions and Power Supply Requirements

Antenna Assembly

Size : 30 ins diameter x 41 ins (762 mm diameter x 1.041 mm)
Weight: 87 pounds (39.5 kg)
Power : 115 Volts, 60 Hz

Control Indicator Tracker Logic

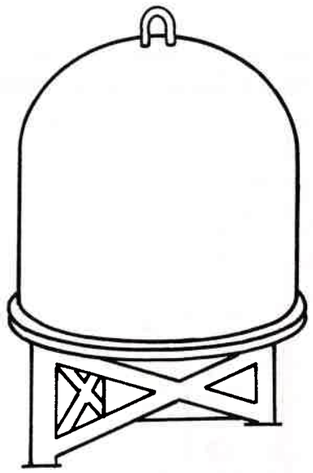
Size : 17 ins x 14½ ins x 13 7/8 ins (432 mm x 368 mm x 352 mm)
Weight: 70 pounds (32 kg)
Power : 115 Volts, 60 Hz

Display Assembly

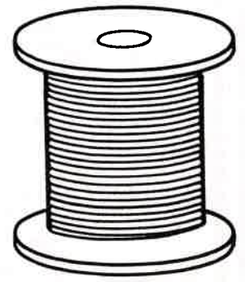
Size : 20½ ins x 16 7/8 ins x 7½ ins (520 mm x 429 mm x 191 mm)
Weight: 40 pounds (18 kg)
Power : 115 Volts, 60 Hz

Single Axis Mounting Stand

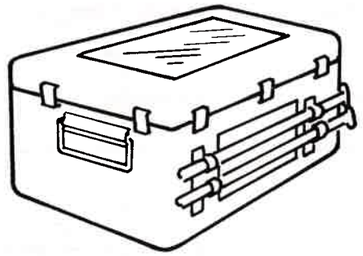
Size : 5 ft long x 2 ft wide x 2 ft high (1.524 m x 584 mm x 584 mm) (folds for shipping)
Weight: 25 pounds (11.3 kg)



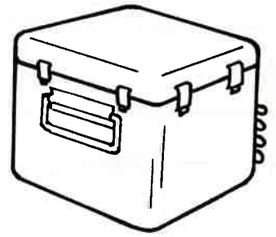
ANTENNA ASSEMBLY



INTERCONNECTING CABLE



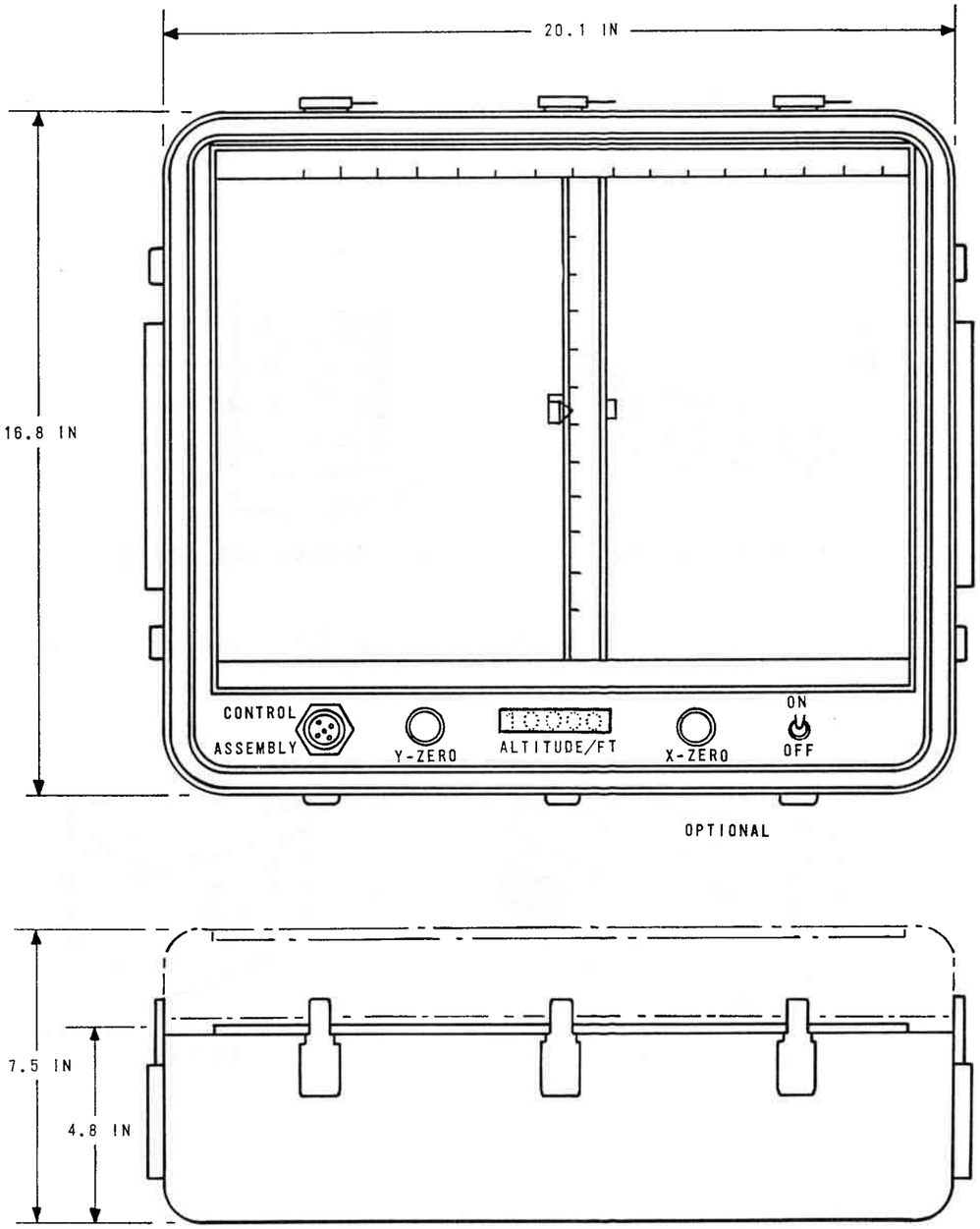
REMOTE PLOTTING UNIT



CONTROL INDICATOR TRACKER LOGIC

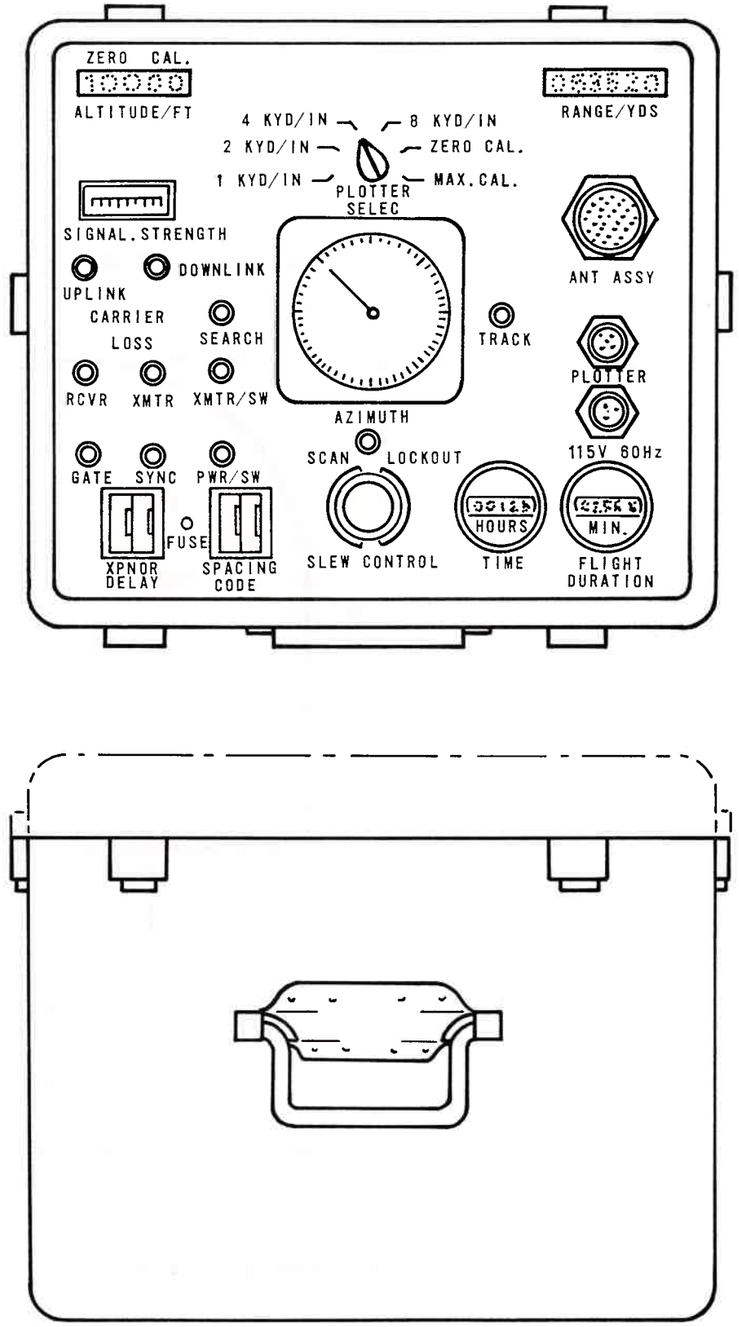
PORTABLE TRACKING SYSTEM, TRANSIT CONDITION

19.1.20-1



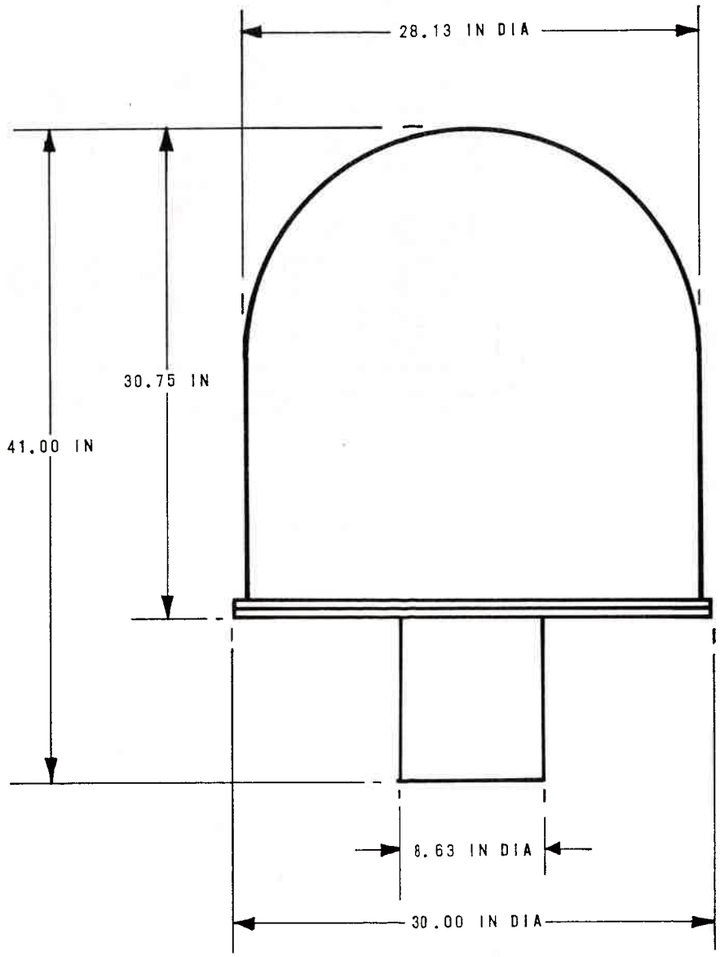
REMOTE PLOTTING UNIT

19.1.21-1



CONTROL INDICATOR TRACKER LOGIC

19.1.22-1

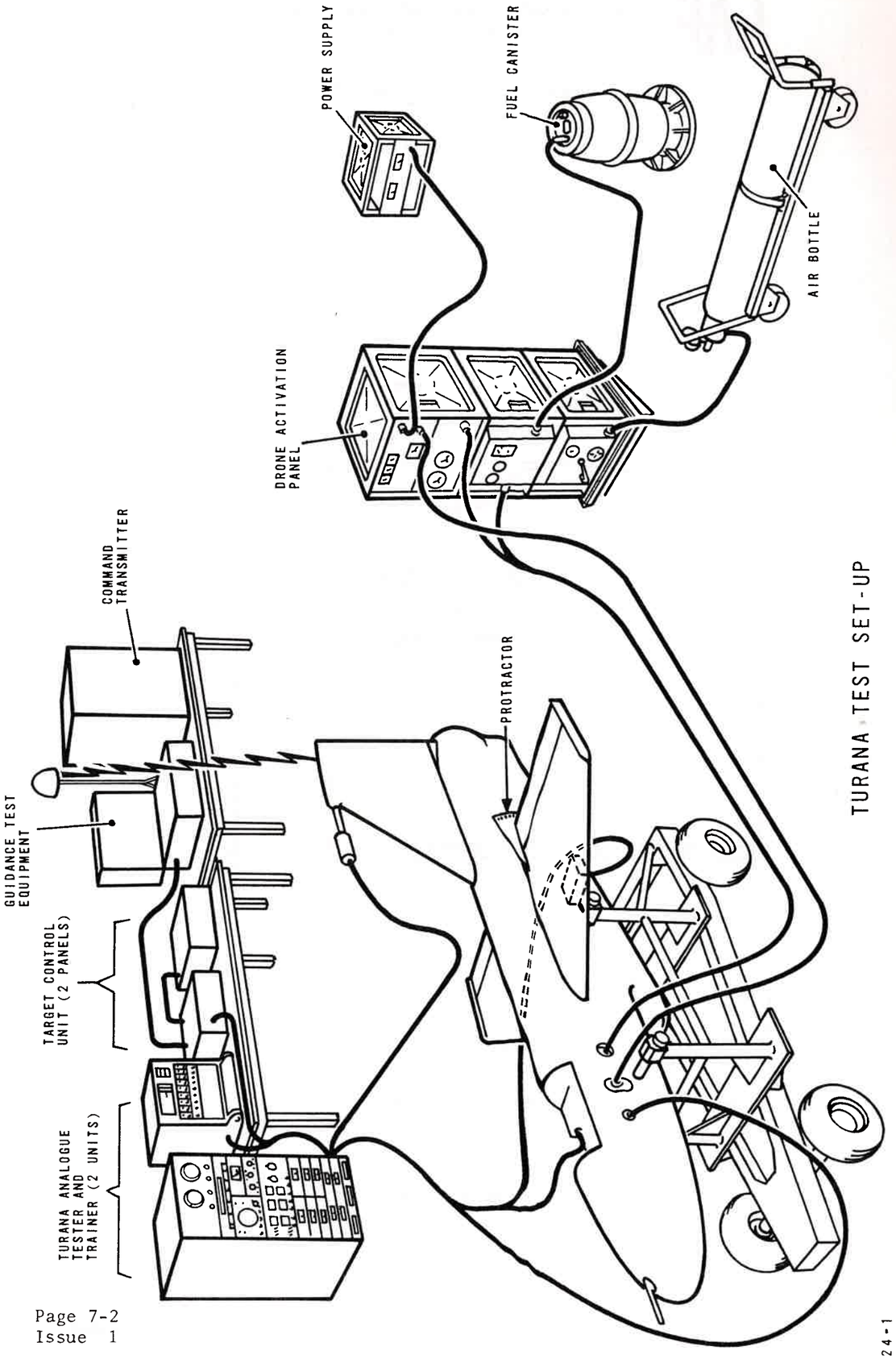


ANTENNA ASSEMBLY

19.1.23-1

SECTION 7

SUPPORT EQUIPMENT
AND
HANDLING GEAR



TURANA TEST SET-UP

19.1.24-1

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TURANA - SYSTEM AND EQUIPMENT

TURANA ANALOGUE TESTER AND TRAINER

The Turana Analogue Tester and Trainer (T.A.T.T.) system performs three basic functions; these are :

a. Turana System Testing
b. Controller Training
c. Flight Plan Proving.

A brief description of these functions follows:

Turana System Testing

The T.A.T.T. system provides pre-flight, in-flight and post-flight tests and checks.

(i) Pre-flight

A pre-flight operator sequence activates the Turana electrical system and the voltage levels throughout the system are read and recorded by T.A.T.T. The satisfactory completion of this test signifies the serviceability, to the pre-IOM stage, of the command link, the drone activation system and the autopilot system.

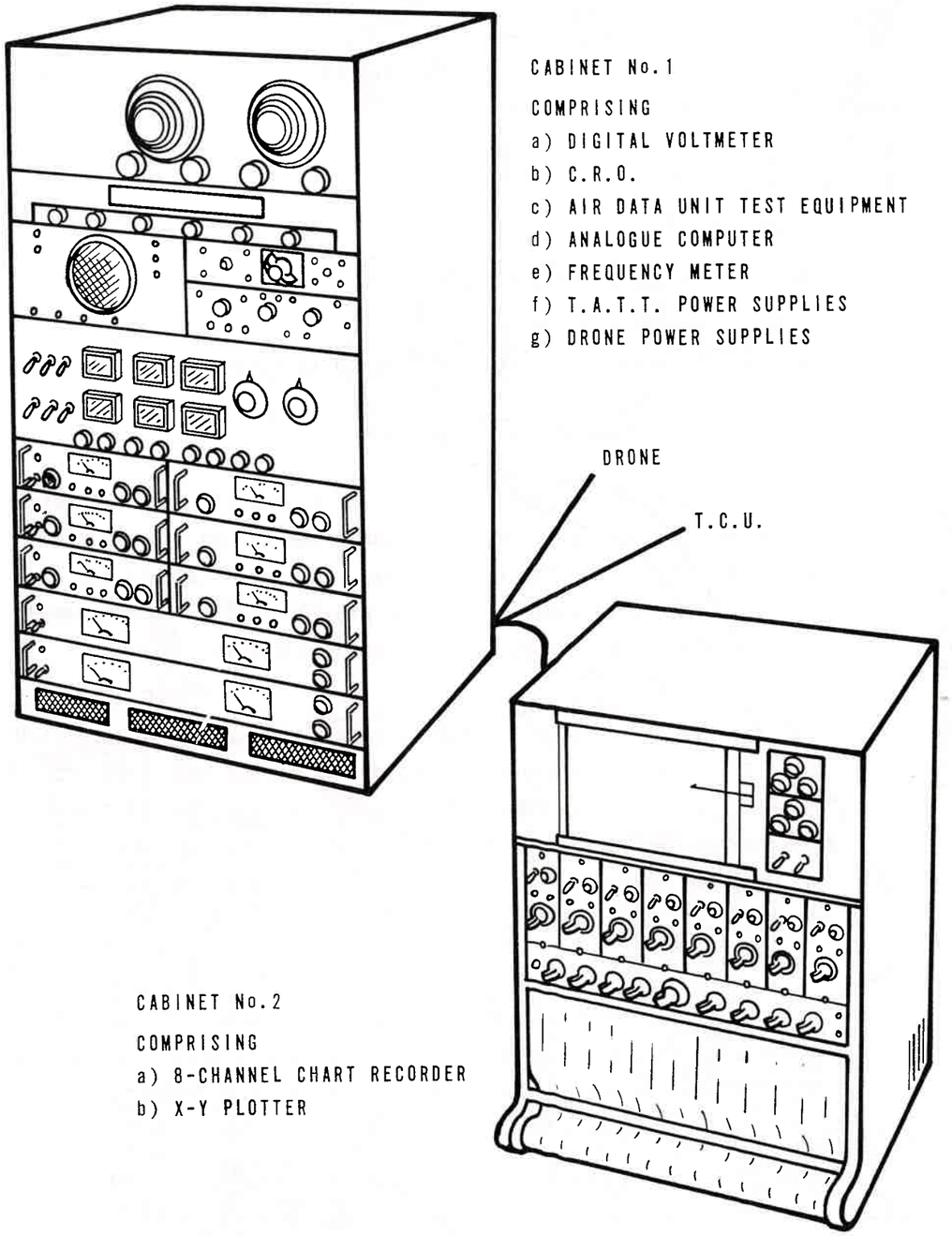
(ii) In-flight

To test the drone for serviceability under flight conditions, T.A.T.T. subjects the drone to a simulated flight and checks the drone's response to a number of commands. A selection of these commands and responses is recorded, on the 8-channel recorder, and compared to a recorder trace overlay to determine the drone's acceptability for flight.

(iii) Post-flight

The post-flight tests check the basic logic statements for a complete permutation of the drone's states and flight conditions, also the performance of the associated units, e.g. P.S.U., Pitot, A.D.U. etc., that have not been previously checked.

During any of the pre-flight, in-flight or post-flight tests the Guidance Test Equipment or Turana Transmitter may be used as well as the drone's engine or engine simulator.



CABINET No.1

COMPRISING

a) DIGITAL VOLTMETER
b) C.R.O.
c) AIR DATA UNIT TEST EQUIPMENT
d) ANALOGUE COMPUTER
e) FREQUENCY METER
f) T.A.T.T. POWER SUPPLIES
g) DRONE POWER SUPPLIES

CABINET No.2

COMPRISING

a) 8-CHANNEL CHART RECORDER
b) X-Y PLOTTER

TURANA ANALOGUE TESTER AND TRAINER

19.1.25-1

TURANA - SYSTEM AND EQUIPMENT

Controller Training

The T.A.T.T. system makes controller training possible by simulating the pre-flight sequence and in-flight conditions. During simulated pre-flight and flight the controller experiences identical feed-back links to those of a drone launch and flight. The feedback links are altitude, indicated airspeed and X-Y plot of the flight track (simulated radar). A series of commands and responses may be recorded during the training exercise to enable the trainee controller to gain a clearer understanding of the sensitivities and limitations of the drone control system.

Flight Planning

Proposed flight plans may be flown on T.A.T.T. and checked for fuel consumption, height and airspeed attainment. Fuel flow rates may also be displayed on the recorder thus leading to a better understanding of fuel usage and providing a guide for alterations to the flight plan.

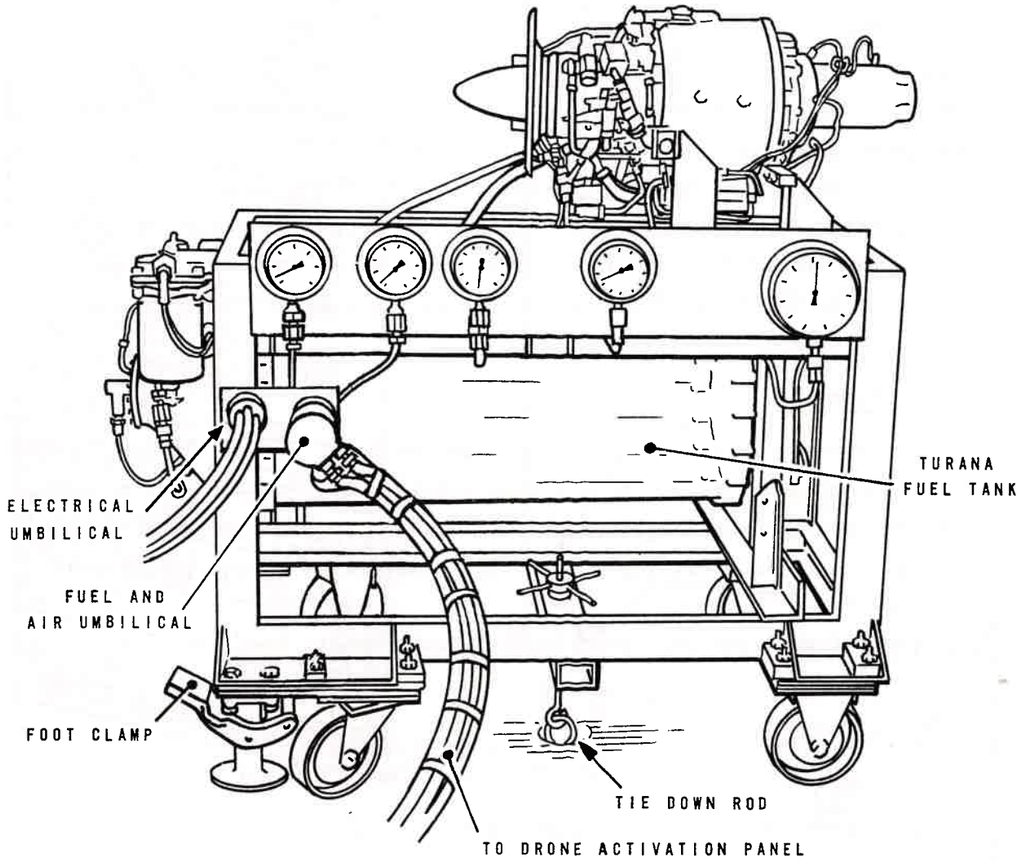
Equipment Dimensions and Power Supply Requirements

T.A.T.T. Cabinet 1

Size	:	50 ins x 19 ins x 24 ins (1.270 m x 483 mm x 610 mm)
Weight	:	550 pounds (250 kg)
Power	:	240 Volts 50 Hz

T.A.T.T. Cabinet 2

Size	:	30 ins x 19 ins x 24 ins (762 mm x 484 mm x 610 mm)
Weight	:	160 pounds (73 kg)
Power	:	240 Volts 50 Hz



ENGINE TEST STAND

19.1.26-1

TURANA - SYSTEM AND EQUIPMENT

ENGINE TEST STAND

The engine test stand is used for acceptance testing and bench testing after engine overhaul. The test stand frame is an all-welded construction mounted on wheels for easy handling and mobility; this permits the engine to be mounted on the test stand and engine run preparation completed in a protected area prior to moving the test stand to the engine run site.

The test stand fuel tank and fuel system are identical to those of the Turana, thus ensuring that engine performance under test or under flight conditions is similar. A series of gauges mounted on the stand shows starting air pressure, compressor bleed pressure and fuel system pressures. The engine test monitor panel indicates engine R.P.M., thrust and jet pipe temperature.

Engine starting and control is performed by the D.A.P. and all fuel and air connections between the D.A.P. and test stand are made with an umbilical connector identical to that used for the drone.

Engine Test Monitor Panel

The engine test monitor panel comprises three digital meters and is used during engine runs to monitor engine R.P.M., thrust and jet pipe temperature.

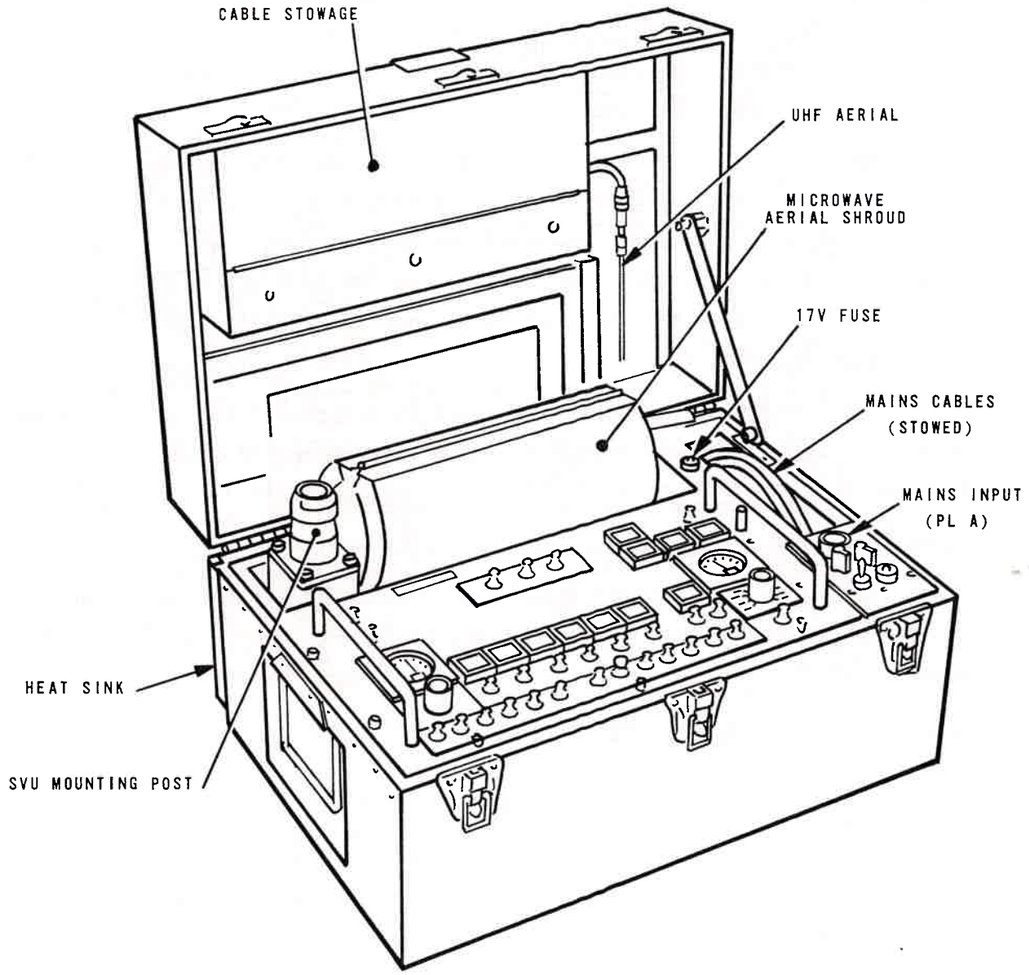
Equipment Dimensions and Power Supply Requirements

Engine Test Stand

Size	:	54 in x 33 in x 48 in high (1.372 m x 838 mm x 1.219 m)
Weight	:	Approx. 450 pounds (204 kg) less fuel
Power	:	Supplied from D.A.P.

Engine Test Monitor Panel

Size	:	20 in x 18 in x 10 in (508 mm x 457 mm x 254 mm)
Weight	:	25 pounds (11.3 kg)
Power	:	240 Volts 50 Hz



GUIDANCE TEST EQUIPMENT

19.1.27-1

TURANA - SYSTEM AND EQUIPMENT

GUIDANCE TEST EQUIPMENT

The Guidance Test Equipment (GTE) provides the power supplies and UHF signal required to test the airborne guidance equipment contained in the Turana Fin. The UHF signal is modulated, by the TCU, to give pulses in the Turana command code format; outputs from the fin are monitored by the GTE which gives pass or fail indications. The fin outputs are connected to sockets on the GTE to facilitate the connection of external test equipment if more precise measurements of equipment operation are required. During base testing the GTE is used to transmit guidance commands in lieu of the command transmitter.

In use, the lid of the GTE is raised where it automatically locks in position. A UHF transmitting aerial is positioned in the lid of the case so that the aerial is adjacent to the receiving aerial of the fin under test.

The dimensions included below are for the GTE in the transit condition; when operating the equipment the following factors govern the space requirements:

a. The fin on test projects 17 in beyond the left hand side of the case

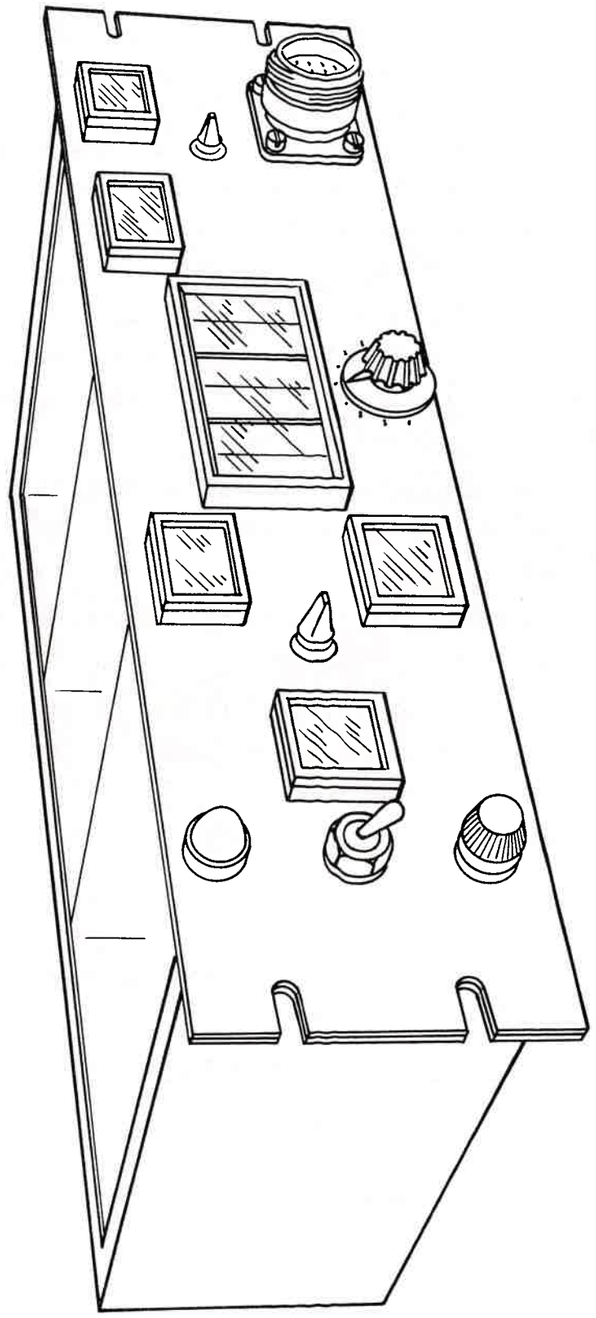
b. Overall height with the lid open is 27 in; a further 4 in above this height must be allowed for lowering the fin on to the mounting post

c. With the lid open the overall depth is increased to 23 in

d. The heat sink, on the rear of the case, is at earth potential when the equipment is operating, but several inches around the heat sink should be kept clear to allow for heat dissipation.

Equipment Dimensions and Power Supply Requirements

Size	:	27 in x 20 in x 14 in (686 mm x 508 mm x 356 mm)
Weight	:	101 pounds (46 kg)
Power	:	240V, 50 Hz or 115V, 60 Hz



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TURANA - SYSTEM AND EQUIPMENT

BATTERY CHARGER

The battery charger is a constant current type having two separate charging circuits (one 56V for the +28V, 0, -28V battery section and one 18V for the 18V battery section) and incorporating automatic switching, via voltage comparators, for terminating the charging current when the battery voltage reaches a predetermined level. Constant current discharging facilities are also incorporated to permit battery discharging after flight and prior to storage.

The following functions are performed using the battery charger:

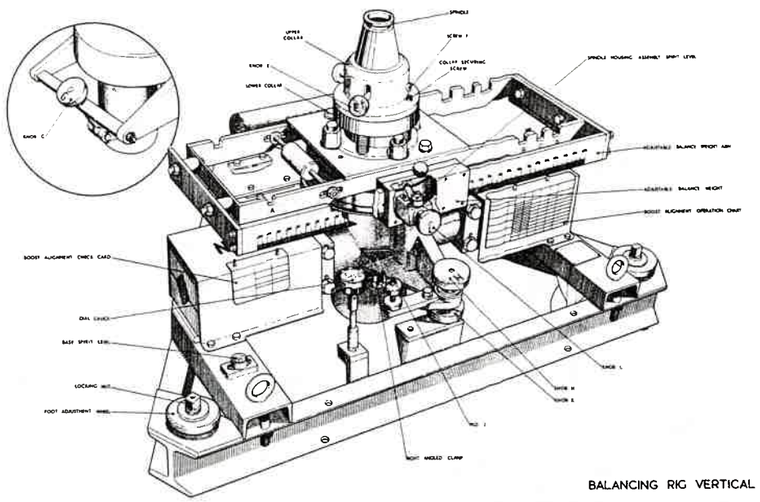
a. Formation charging
b. Discharging the battery after flight and prior to storage
c. Battery charging prior to flight.

Because of battery characteristics, the specialized battery charger is necessary to ensure that the drone battery operates efficiently for the maximum possible number of charge/discharge cycles.

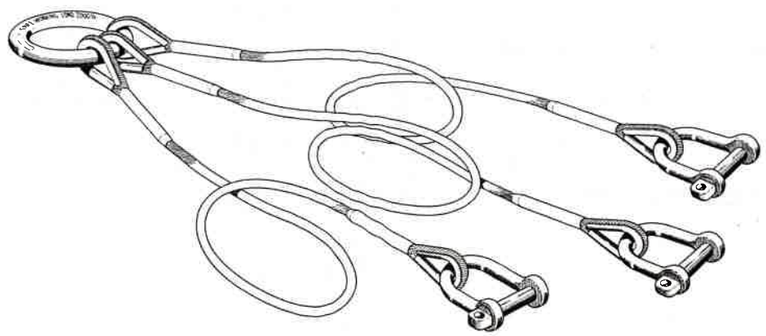
The battery charger is carried in an equipment case but may be removed and mounted in a standard 19 inch rack.

Equipment Dimensions and Power Supply Requirements

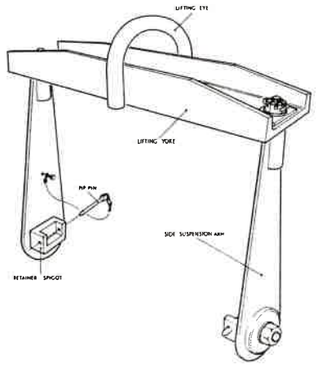
Size	:	21 in x 17 in x 7 in (533 mm x 432 mm x 178 mm)
Weight	:	30 pounds (13.6 kg)
Power Supply:		115V, 60 Hz or 240V, 50 Hz



BALANCING RIG VERTICAL



SLING, BOOST ALIGNMENT RIG



BALANCING SLING

TURANA - SYSTEM AND EQUIPMENT

BALANCING AND BOOST ALIGNMENT RIG

The balancing and boost alignment rig enables the boost motor mean thrust line of each drone to be correctly positioned relative to the centre of gravity to ensure that the drone describes the required boost trajectory.

The balancing operation is based on a null reading principle and uses balance weights to provide an equivalent opposite offset moment to measure the position of the centre of gravity. The drone's boost thrust line is adjusted by moving the boost motor forward-end mounting jacks to provide the desired thrust line/C.G. offset.

Because of the sensitivity of the rig to vibrations, it is essential that boost alignment is carried out in a draught-free area, remote from any vehicular traffic or other causes of vibration.

Additional Equipment Required

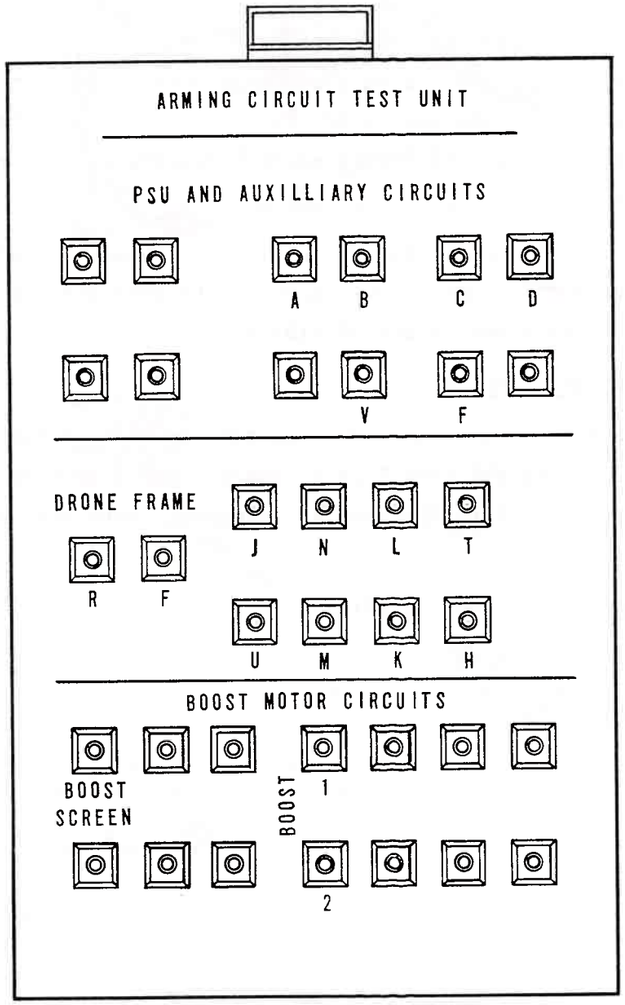
a. Overhead crane with a descent rate of ½ in/sec or less, under load, over the last 3 in of travel, and fine control of 'inching', i.e. starting and stopping, over the last ½ in of travel

b. Boost alignment rig sling

c. Balancing sling.

Equipment Dimensions

Size	:	52 in x 45 in x 34 in (1.330 m x 1.143 m x 864 mm)
Weight	:	Approx. 725 pounds (329 kg)



ARMING CIRCUIT TEST UNIT
FRONT PANEL

TURANA - SYSTEM AND EQUIPMENT

ARMING CIRCUIT TEST UNIT

The arming circuit test unit is designed to accept a test lead from either the arming plug or the boost motor firing circuits and provides grouped test points to which measuring instruments can be connected when it is required to test the electrical continuity of the pyrotechnic fittings and boost motor firing circuits.

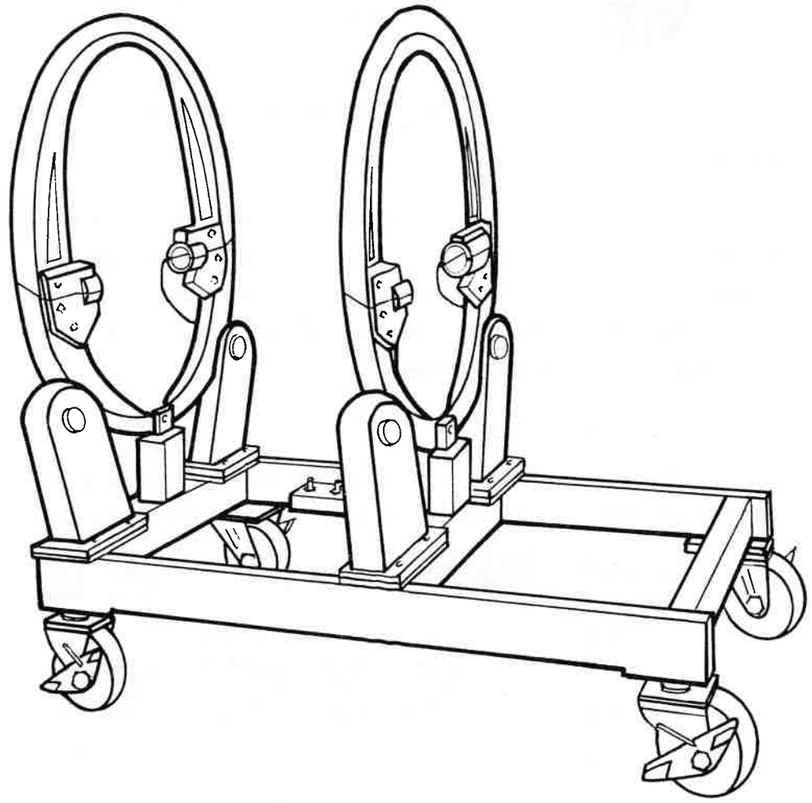
Test Connectors

Two test connectors are used with the arming circuit test unit, either of them connecting in turn to the plug on the unit.

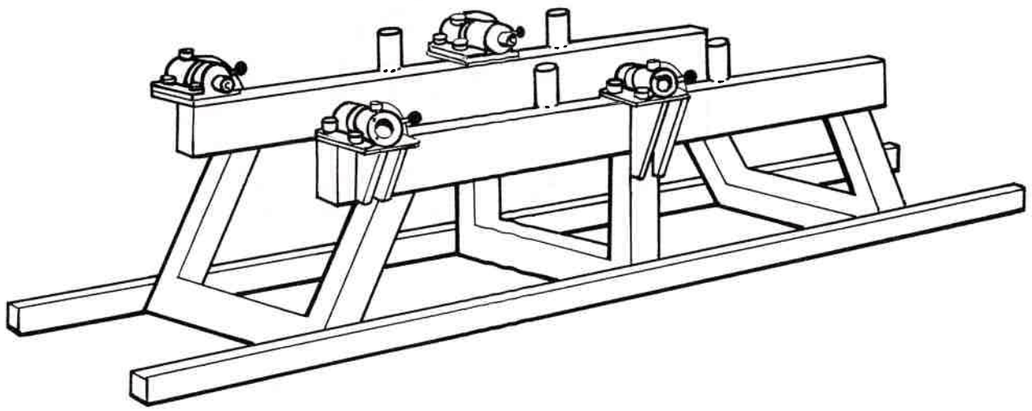
Equipment Dimensions

Size	:	10 in x 8 in x 4 in (254 mm x 203 mm x 102 mm)
Weight	:	5 pounds (2.26 kg)
Power	:	-

19.1.31-1

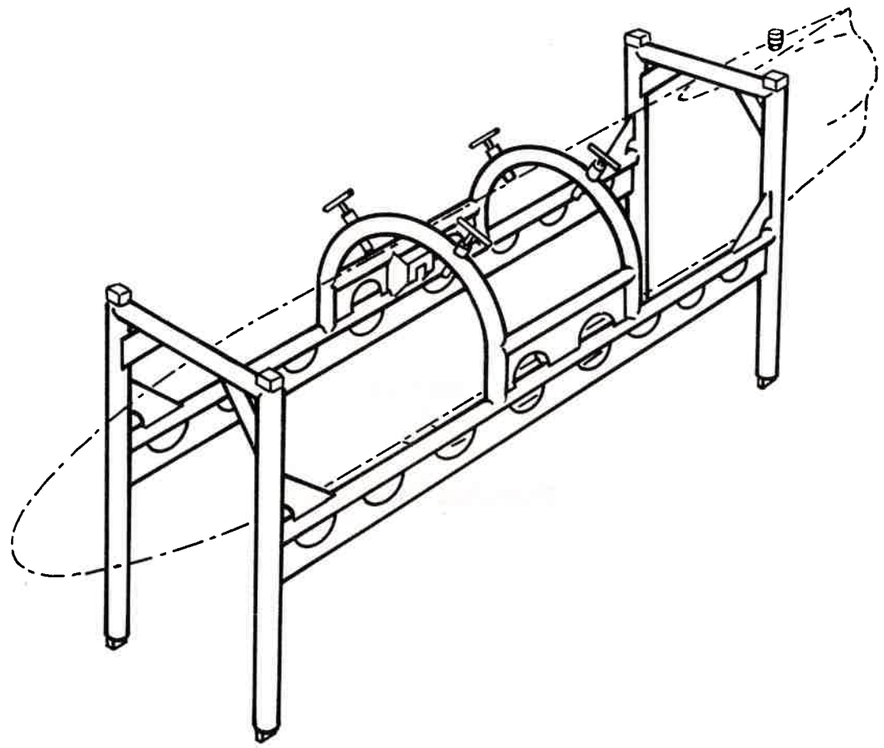


TURNOVER TROLLEY



REFURBISH STAND

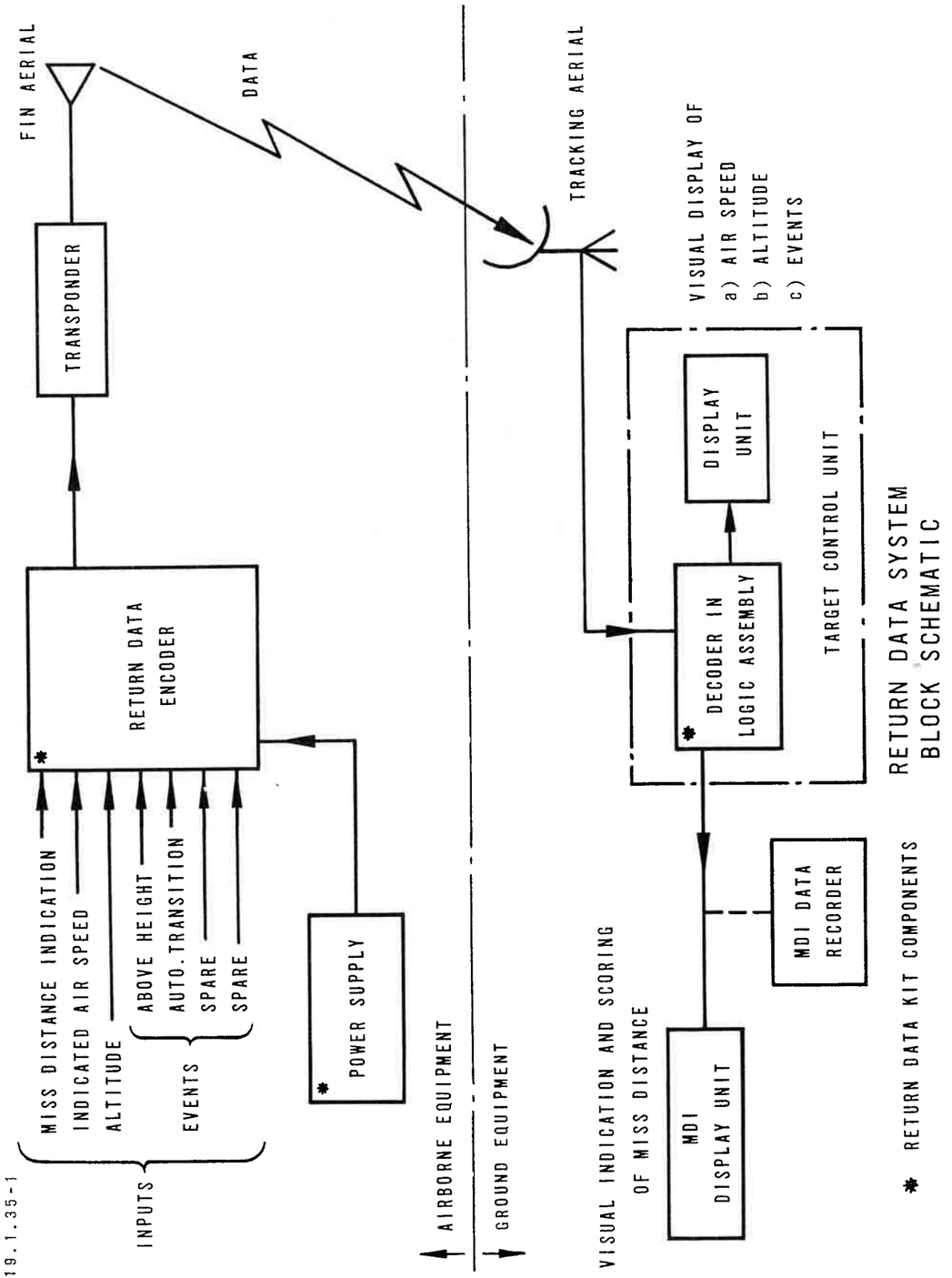
19.1.32-1



HANDLING TROLLEY

SECTION 8

OPTIONAL EQUIPMENT



TURANA - SYSTEM AND EQUIPMENT

RETURN DATA KIT

The return data kit comprises a Return Data Encoder (RDE), a Power Supply and two printed circuit board assemblies. The RDE and power supply are mounted on the drone autopilot chassis and the two printed circuit boards are fitted into the logic assembly of the TCU. The permanent wiring requirements for the return data installation are fitted to the drone and TCU as standard equipment.

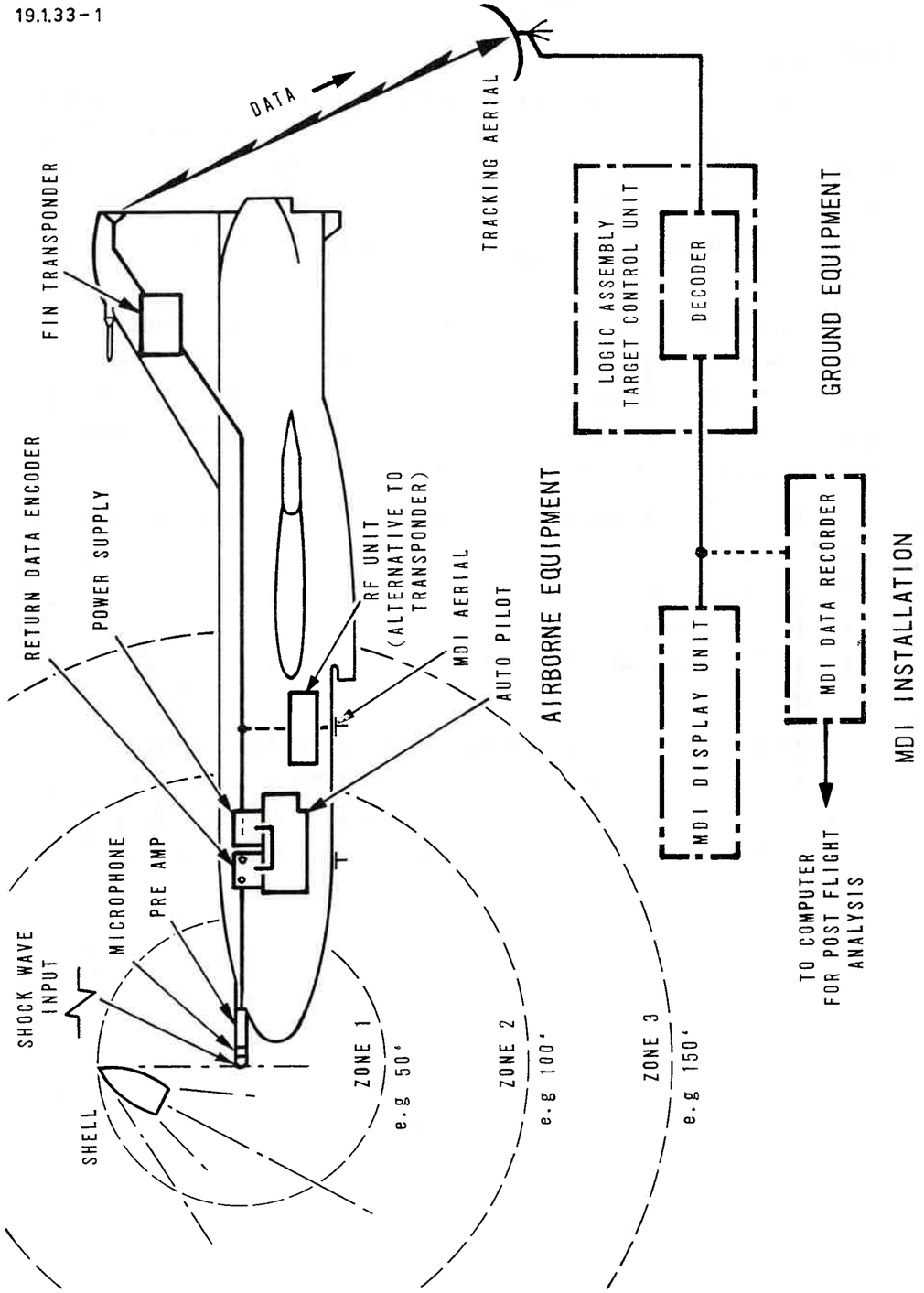
The RDE modulates the transponder reply pulses to a predetermined pattern and this encoded information is received back at the control position. The two return data printed circuit boards, fitted in the TCU logic assembly, decode the information for display on the TCU Control and Display Assembly and the MDI Display Unit.

The information transmitted back to the control position is :

(a) Altitude
(b) Air speed
(c) Miss distance indication
(d) Events.

Altitude and indicated air speed information is sent back alternately, however, if MDI information is present it takes precedence over both. 'Event' channels are also available in the RDE; two are used as controller aids, for Above Height and Auto Transition events and the remaining two may be used for Customer requirements.

19.1.33-1



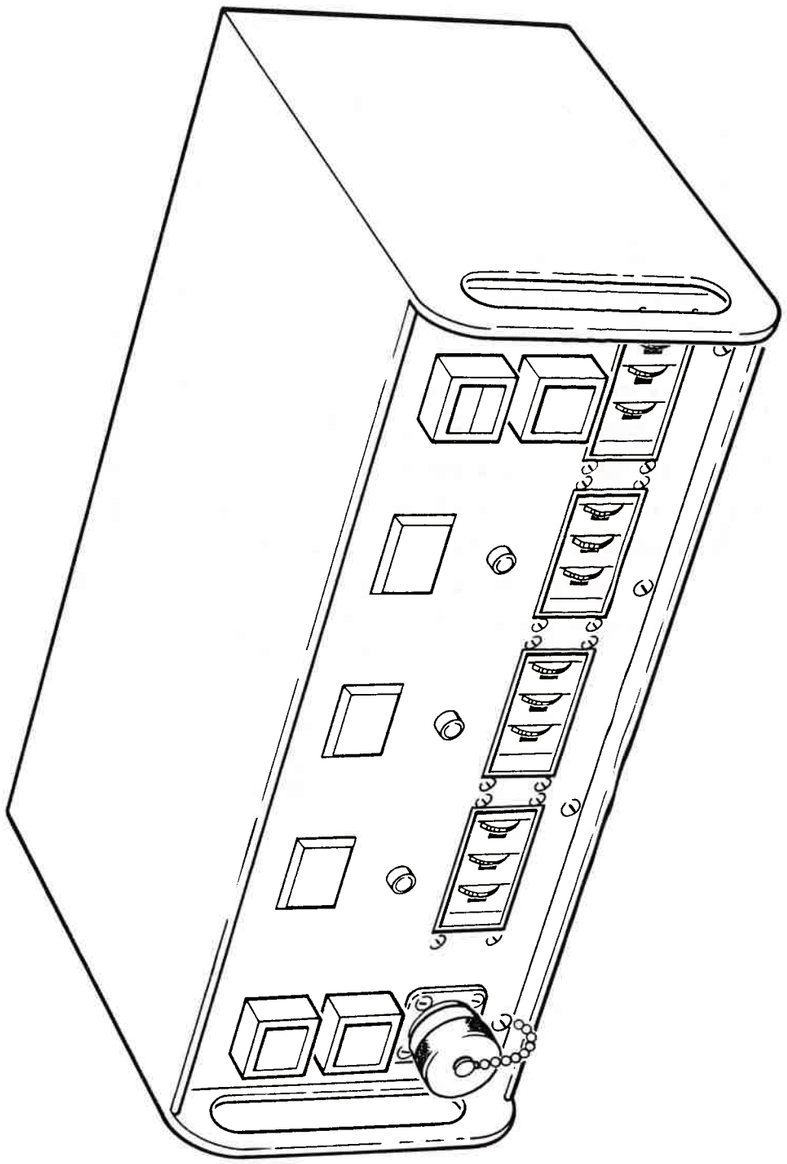
TURANA - SYSTEM AND EQUIPMENT

MISS DISTANCE INDICATION

The Miss Distance Indication (MDI) equipment permits the Turana System to measure the relative proximity of a passing shell.

The magnitude of the shock wave from a passing shell is acoustically detected and, depending on the miss distance, a particular signal level is established. This signal is fed to a digital encoder and the information transmitted, via an RF link, back to the T.C.U. The decoded miss distance is transferred to the MDI display unit where it is registered in one of three possible socring zones on the MDI display panel. The zone boundaries are defined by manual selection on the MDI display panel; a hit in one of these zones causes the respective zone score to advance by one count.

The power supply is provided as an integral part of the return data encoder system and the transponder and permanent MDI wiring requirements are fitted to the drone as standard equipment. To convert the drone for MDI, the return data system must be fitted and a microphone and pre-amplifier assembly is plugged into the forward probe. For non-Ikara based flights, a separate RF link and MDI aerial are used to transmit the MDI information back to the ground display and recording equipment.



MISS DISTANCE INDICATOR DISPLAY UNIT

19.1.34-1

TURANA - SYSTEM AND EQUIPMENT

MDI DISPLAY UNIT

The MDI display unit operates in conjunction with the T.C.U. to indicate and record the proximity of a passing shell to the drone.

Three scorers, one for each zone, are fitted to the front panel of the MDI display unit; a hit in any one zone illuminates in indicator above the respective zone scorer and causes the scorer to advance by one count.

In-built test facilities permit the operation of the MDI display unit to be checked without disconnecting it from the system or isolating the unit from possible incoming MDI data. To check the unit the test mode is selected and a 'test shot' fired into a predetermined zone; if, during testing, additional MDI data arrives the unit automatically resets and recalls the previous MDI scores.

Equipment Dimensions and Power Supply Requirements

Size	:	13 in x 8 in x 5 in (330 mm x 203 mm x 127 mm)
Weight	:	14 lb (6.3 kg)
Power	:	From T.C.U. Logic Assembly

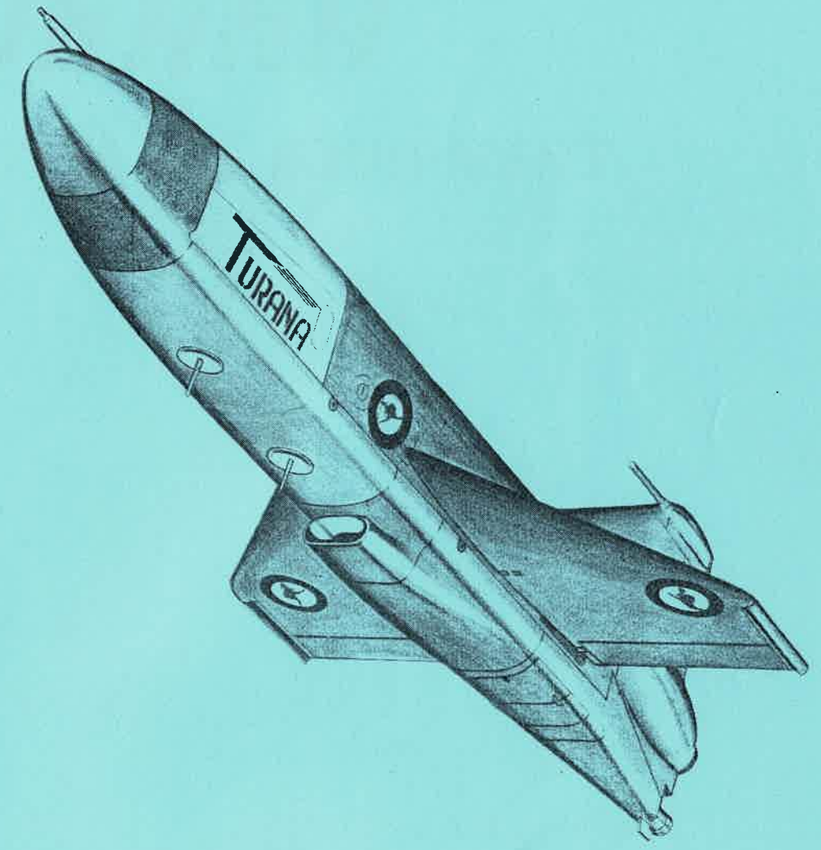
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TURANA



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