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METEOROLOGICAL DATA SOUNDING SYSTEM, AN/UMQ-7(V)

Interim Report

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ARMY MATERIEL COMMAND

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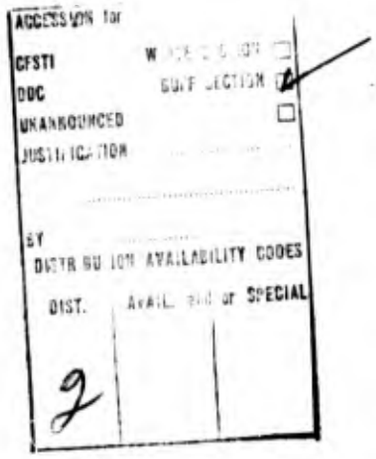

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SUMMARY

This report describes the development of the AN/UMQ-7(V) meteorological data sounding system. Composed of automatic data-processing equipment that tracks and receives meteorological data from atmospheric probes, as well as data from surface stations, the system will provide weather information for artillery weapon systems and target acquisition systems, for forecasting the weather, and for predicting radiological fallout.

RELATED TIR'S

3-68 TIR	9.3.2.2(1)	Mobile Weather Radar Set, AN/TPS-41
____ TIR	33.8.7.4	Fast-Rising High-Altitude Balloon, ML-566/AM
5-68 TIR	33.8.7.12	Meteorological Measuring Set, AN/TMQ-22(XE-3)
5-68 TIR	33.8.7.13	Meteorological Satellite Ground Receiving System
5-68 TIR	33.8.7.15	Hydrogen Generator, ML-536/UM, for Fast-Rising Balloon System
5-68 TIR	33.8.7.16	Automatic Atmospheric Sounding Set, AN/TMQ-19(XE-1)
5-68 TIR	33.8.7.17	Atmospheric Meteorological Probe, AN/AMQ-23(XE-1)

METEOROLOGICAL DATA SOUNDING SYSTEM,

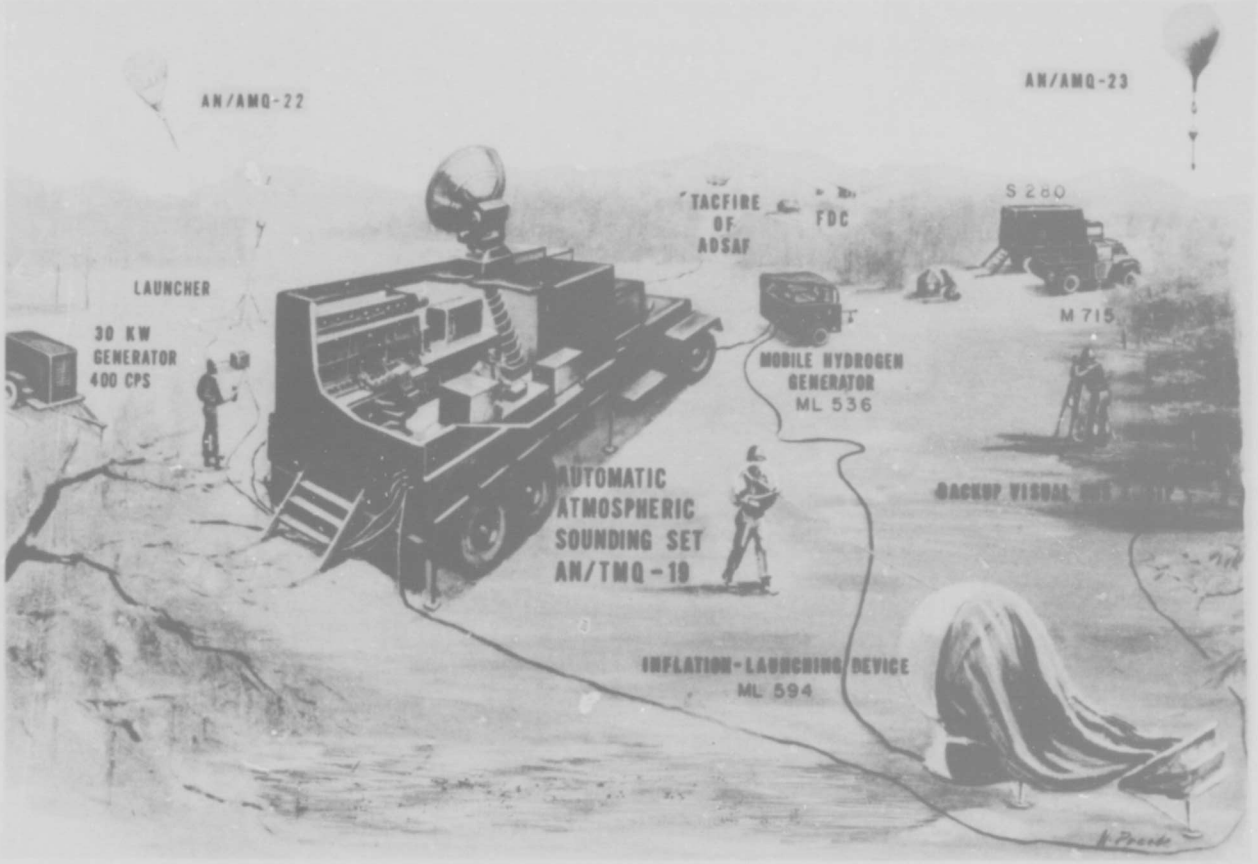
AN/UMQ-7(V)

A meteorological data sounding system is being developed by the Atmospheric Sciences Laboratory of the US Army Electronics Command that will provide meteorological information for artillery weapon systems and target acquisition systems, for forecasting the weather, and for predicting radiological fallout. Designated AN/UMQ-7(V), the system comprises several measuring, automatic data-processing, computing, and communication devices, all of which are in various stages of development. When completely developed and issued to troops as a system, the AN/UMQ-7(V) will replace the AN/GMD-1(U) and attendant equipment now in use by the field army.

Major components of the AN/UMQ-7(V) system are the AN/AMQ-22(XE-1) rocket-launched atmospheric probe, the AN/AMQ-23(XE-1) and the (XE-2) balloon-borne atmospheric probes, and the AN/TMQ-19(XE-1) automatic atmospheric sounding set. Ancillary equipment includes a rocket launcher, an ML-594/U balloon inflation and launching device, and ML-536/UM hydrogen generator, a 400-hertz power generator, a manual observation set, and the necessary trucks and trailers to transport the equipment.

The AN/AMQ-22(XE-1) atmospheric meteorological probe consists of a radiosonde, radar reflector, and parachute that are borne aloft by a rocket and are ejected at an apogee of 30 kilometers. During its descent, the radiosonde measures temperature, relative humidity, and atmospheric pressure. These data are telemetered to the ground station on a frequency of 1685 (±15) mHz. The rate of descent of the parachute is controlled so that it remains nearly constant below an altitude of 18 kilometers. This control enables the system to make a complete sounding within 30 minutes and determine accurately the direction and speed of the wind.

Although it consists of essentially the same components as the AN/AMQ-22(XE-1), the AN/AMQ-23(XE-1) atmospheric meteorological probe is not packaged for launching by rocket. A fast-rise balloon filled with hydrogen carries the probe aloft to an altitude of about 30 kilometers. Ascent is controlled so that the probe reaches the 30-kilometer apogee in approximately an hour. The AN/AMQ-23(XE-1) is unlike the AN/AMQ-22(XE-1) in that in the former the atmospheric pressure is not measured but is computed by applying the hydrostatic equation to the measured temperature, measured relative humidity, and computed altitude. These data are telemetered to the ground station during the balloon's ascent.



AN/UMQ-7(V) METEOROLOGICAL DATA
SOUNDING SYSTEM

Housed in a modified S-375 shelter, the AN/TMQ-19(XE-1) automatic atmospheric sounding set comprises the major portion of the electronic equipment for the system. Automatically tracking the radiosonde in range, azimuth, and elevation, the AN/TMQ-19(XE-1) receives the meteorological data, converts and processes both the received information and locally generated information into proper form, and computes the meteorological messages for immediate transmission to the user.

A two-frequency system is used, with a 1685-mHz S-band frequency for angular tracking and for receiving meteorological data and an X-band frequency of 9300 mHz for radar ranging. Data are computed by an M18 gun direction computer (FADAC). The digital data terminal set being used for interface matching between the sounding system and the communication system is the AN/TYC-1 digital data terminal, but it will be replaced in the engineering development model of the AN/TMQ-19(XE-1) by the AN/GYC-1 digital data terminal.

The ML-594/U balloon inflation and launching device is a lightweight, trampoline-type device of tubular metal framing that surrounds a nylon-mesh pad. The balloon is filled with hydrogen while attached to the pad and is then launched.

A new process known as steam re-forming is used in the ML-536/UM hydrogen generator. By this method, hydrogen of high purity is produced at a far lower cost than was possible with the old system in which the hydrogen was generated by large quantities of calcium hydride and water. The old process cost 18 cents per cubic foot of hydrogen; the new, only 0.14 cent per cubic foot.

A manual observation set is provided for use in the event that the AN/-TMQ-19(XE-1) is inoperative. Basically a wind-finding set, it consists of a theodolite and pibal balloons, as well as charts and scales. An AN/TMQ-22 meteorological measuring set is also included for measuring surface meteorological data.

The system and its components are being developed with the following twelve performance objectives in mind.

1. The ground station must be able to track the atmospheric meteorological probes at angular rates up to 60° per second with an angular accuracy of ±0.05°, at rates of less than 15° per second, and with a range accuracy of ±16 meters at distances up to 160 kilometers.

2. The probe must measure temperature and relative humidity with accuracies of ±0.5° C and 10%, respectively, at a range of 30 kilometers (pressure will be computed by the balloon-borne probe and measured by the rocket-launched probe).

3. The ground station must be able automatically to acquire, track, convert, and compute the received data into NATO, Computer, Fallout, Air Weather Service, Zone Wind, Sound Ranging, and Refractivity message formats and transmit the messages over conventional communication channels.

4. Housed in a shelter transportable by a 2 1/2-ton truck, the ground station must also be transportable by C-130 aircraft.

5. The system must become operational within 40 minutes after emplacement.

6. With the use of a modification kit, the system must be operable at temperatures ranging from -50° to 120° F.

7. All equipment must be operable in relative humidities as high as 100% at temperatures ranging from 0° to 85° F; in relative humidities equivalent to 13 grains of moisture per cubic foot at all temperatures between 85° and 120° F.

8. During a rainfall of up to 12 inches, the equipment must operate for a minimum of 12 hours.

9. Components of the system must be able to withstand snow loads up to 20 pounds per square foot.

10. Tracking accuracies must be maintainable in winds up to 60 mph and tracking at reduced accuracy must be possible in 80-mph winds with gusts up to 120 mph.

11. Dismantled and packed for transport, the system components must be capable of traversing rough terrain without damage.

12. The minimum system reliability must be 96% for a 1.5-hour mission.

Many of the design criteria of the system and its components have been met, but several problems remain to be solved. Although the fast-rising balloon has an average ascension rate of 520 meters per minute in daytime (sufficiently fast to complete a sounding within the required 60 minutes), at night the balloon can reach a height of from 20 to 30 kilometers at an ascension rate of 490 meters per minute only 70% of the time. Therefore, efforts are being made to design a balloon for both day and night use that will meet the ascension rate requirements.

Because combat efficiency necessitates that the time for a sounding be reduced to 30 minutes, a rocket-borne probe, designated the AN/AMQ-22, is being developed. This probe will consist of a radiosonde to measure temperature,

pressure, and humidity; a radar reflector for ranging; and a descent vehicle that will lower the radiosonde at a constant rate of 915 meters per minute from an altitude of 20 kilometers. This is the highest rate at which the assembly can be tracked with a wind-measuring accuracy of ±1 knot. Between altitudes of 30 and 20 kilometers, however, descent can be faster because less wind-tracking accuracy is necessary.

At present, the digital data terminals connect the computer and tape to conventional telephone lines. Plans have been made to transmit data by radio by adding a 3/4-ton vehicle and a radio equipment shelter to the system.

Manual data processing will supplement the automatic data-processing equipment of the AN/TMQ-19(XE-1). Geometric and raw meteorological data from the radiosonde data processor will have to be printed out from the paper-tape output. Therefore, an integrated computational slide rule and charts will be developed.

The computed power requirement is 21 kilowatts. It is planned to use a 30-kw military standard three-phase 400-hertz generator now under development.

The present status of development of the components of the system follow:

Exploratory Development Model

Atmospheric Meteorological Probe, AN/AMQ-22 (no hardware as yet)
Atmospheric Meteorological Probe, AN/AMQ-23 (XE-1) and (XE-2)
Automatic Atmospheric Sounding Set, AN/TMQ-19(XE-1)
Rocket and Rocket Launcher (no hardware as yet)

Advanced Development Model

Hydrogen Generator, ML-536/UM
Fast-Rising High-Altitude Balloon, ML-566/AM

Engineering Development Model

Meteorological Measuring Set, AN/TMQ-22

Standard A

Inflation and Launching Device, ML-594/U

In view of the wide disparity in the stage of development of the various components, no principal characteristics are listed. For the same reason, type classification dates have not been established.

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY Research & Development Directorate Army Materiel Command

13. ABSTRACT

The AN/UMQ-7(V) meteorological data sounding system is being developed to supply meteorological information to combat units for calculating artillery-projectile trajectories, acquiring data for target acquisition systems, forecasting the weather, and predicting radiological fallout. Rocket-launched and balloon-borne atmospheric probes collect meteorological data and transmit them to a ground station. This ground station tracks the probes in range on an X-band radar-ranging frequency and receives the meteorological data and tracks the probes in azimuth and elevation on an S-band frequency. These data are fed to an M18 (FADAC) gun direction computer, are automatically processed, and are then transmitted by digital data terminals over conventional communication channels to user units. Locally acquired surface data are also processed and distributed. Major components of the system include the AN/AMQ-22 and AN/AMQ-23 atmospheric radiosonde probes, the AN/TMQ-19(XE-1) automatic atmospheric sounding set, the AN/TMQ-22 meteorological measuring set, the ML-566/AM fast-rising balloon, the ML-536/UM hydrogen generator, and the ML-594/U inflation and launching device. In addition, the AN/UMQ-7(V) system includes manual instruments and computing devices for use if the automatic equipment becomes inoperable.

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14. KEY WORDS	LINK A		LINK B		LINK C	
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*Meteorological data acquisition, *Meteorological data sounding, Automatic atmospheric sounding, Meteorological probes, Missile trajectory calculations, Balloon-borne radiosondes, Rocket-launched radiosondes, Atmospheric humidity sensing, Atmospheric temperature sensing, Radiosonde tracking, Mobile weather radars						

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