AGENDA

- Introduction
- Background
- The 70 m Diameter Antenna
- The Hydrostatic Bearing
- The Radial Bearing
- The Elevation Bearing
- The 34 m Diameter Antenna
- Bearing Possibilities

INTRODUCTION

JPL's Relationship to the US Government

- JPL (www.jpl.nasa.gov) is a Federally Funded Research and Development Center (FFRDC) managed by the California Institute of Technology (Caltech) for the National Aeronautics and Space Administration (NASA). JPL is the only federal laboratory that is not staffed by civil service personnel; JPL personnel are employees of Caltech

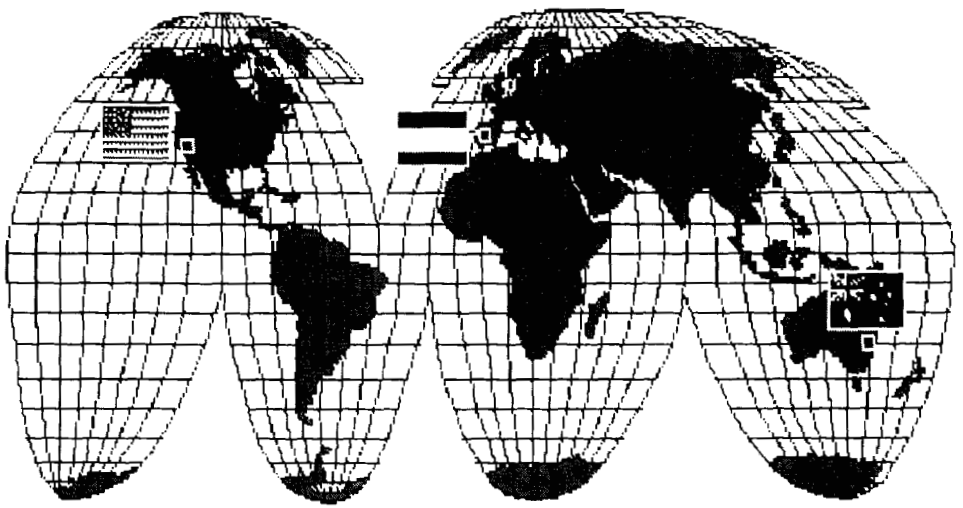
The Deep Space Network

- The Deep Space Network (DSN) (deepspace.jpl.nasa.gov/dsn) is a space communications network funded by NASA and administered by JPL.
- The DSN provides data and communications links between active spacecraft and ground stations. The DSN has been responsible for operating spacecraft missions since its formation in 1958
- The DSN primarily supports unmanned interplanetary spacecraft missions and radio and radar astronomy observations of the solar system and the universe.
- The most important tasks performed by the DSN are driven by 3 types of missions: Near-Earth, Solar System and Deep Space.

BACKGROUND

DSN Operations and Functions

- The DSN operates 3 space tracking complexes, known as Deep Space Communications Complexes (DSCCs). The DSCCs are located near Barstow, California, at Goldstone (GDSCC); near Caberra, Australia, at Tidbinbilla (CDSCC); Near Madrid, Spain, at Robledo de Chavela (MDSCC)
- There are currently 3 operational 70m antennas, one at each complex
- There are total 15 operational antennas in the DSN, in addition to a few antennas for R&D



- The DSN provides communications and data uplink functions between ground stations and spacecraft and satellites on a wide range of space missions
- DSN activities are in operation 24 hours a day, 7 days a week, at the three DSCCs, and at the Network Operations Communications Center (NOCC) located at JPL

THE 70M DIAMETER ANTENNA

The 70-meter (230-foot) diameter antenna is the largest, and therefore most sensitive, DSN antenna. It is capable of tracking a spacecraft traveling more than 16 billion kilometers (10 billion miles) from Earth.

The surface of the 70-meter reflector must remain accurate within a fraction of the signal wavelength, meaning that the precision across the 3,850-square-meter (41,400 sq. ft.) surface is maintained within one centimeter (0.4 in.).

THE HYDROSTATIC BEARING

Functions of the hydrostatic bearing

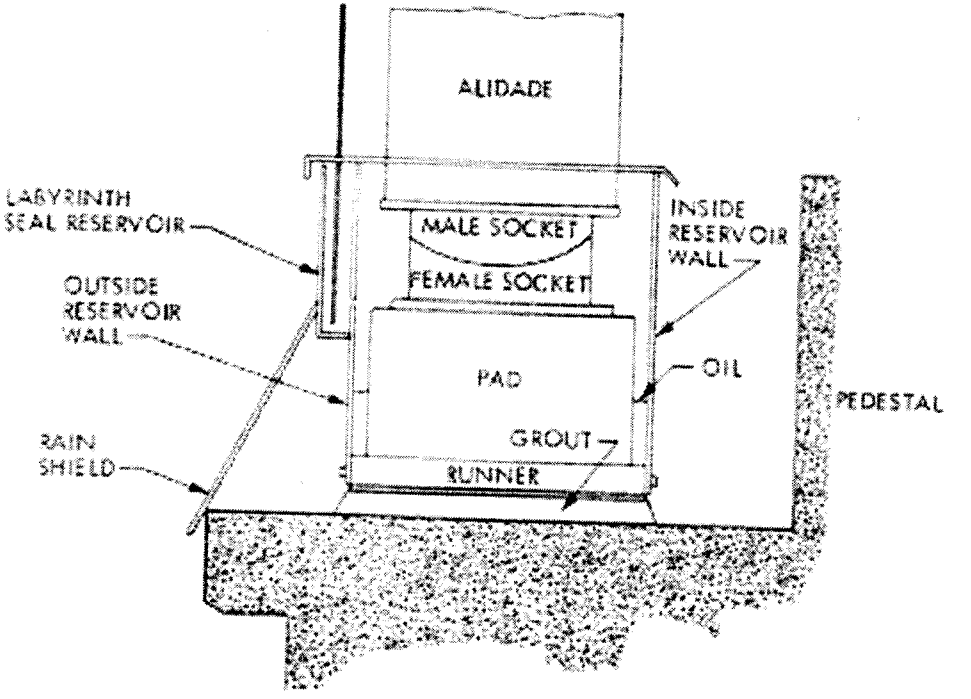
- The hydrostatic bearing is used to support the antenna rotating structure

Existing configuration requirements

- Dead weight of antenna is 9,000,000 lbs
- Provide film height of 0.005" to 0.008"
- Oil flow of 60 GPM per pad
- Operating pressure of 1,200-1,350 psi

Bearing Components

- Azimuth Runner (11 pieces)
- 3 Bearing pads (with 6 recesses each)
- Hydraulic system for hydrostatic bearing
  (Pre-charge pumps; Oil conditioning --Filters, heaters, heat exchanger; High pressure skid -- pumps, filters; etc.)
- Oil reservoir



Cross section of hydrostatic bearing and pad

THE RADIAL BEARING

Functions of the azimuth radial bearing

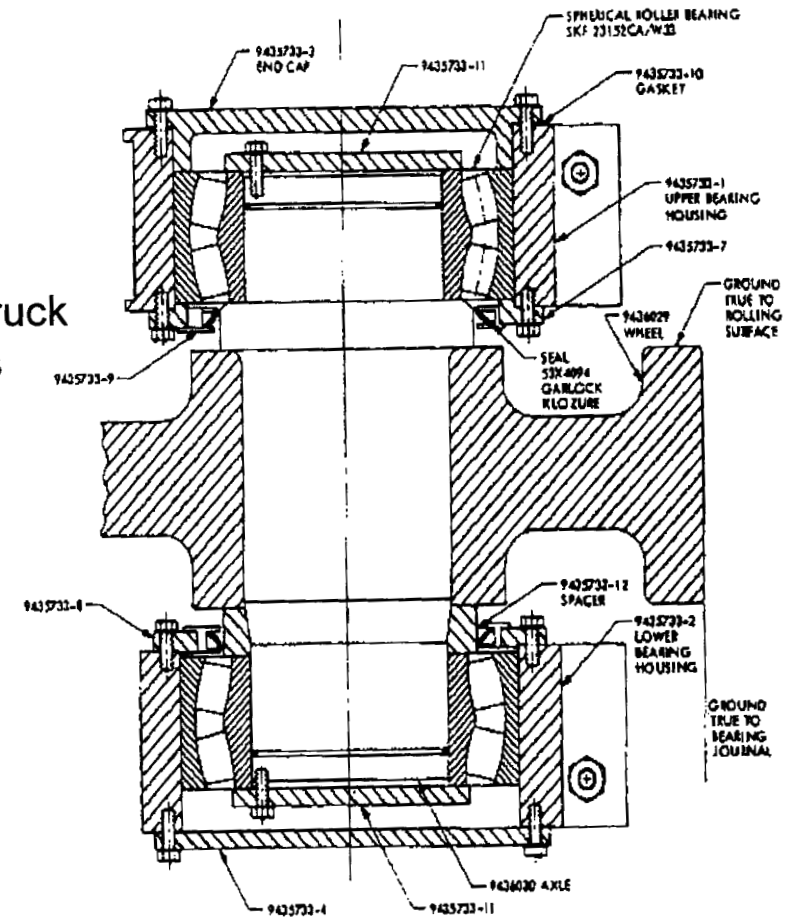
- The radial bearing is used to help maintain the pointing accuracy and stability of the antenna

Existing configuration requirements

- Compression loads of minimum 330,000 lbs per truck between cantilevered truck and runner at all times

Bearing Components

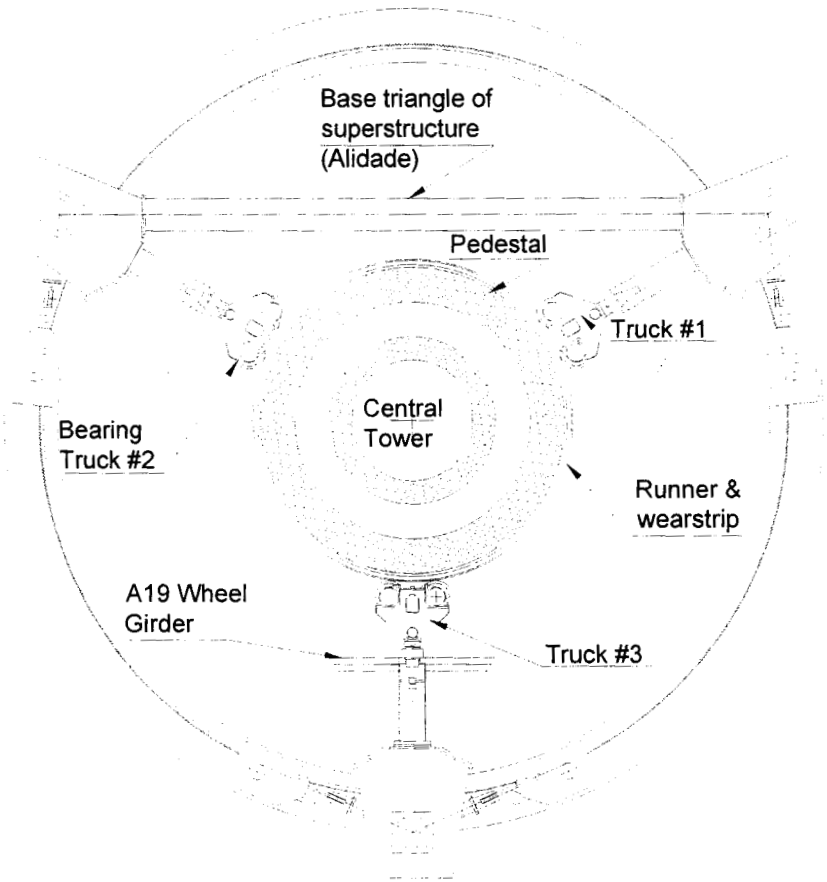
- Bearing truck attached to rotating structure
  - Wheel, bearings, seals, shafts, load pin with sensors, etc.
- Runner and wear strips
- Grout

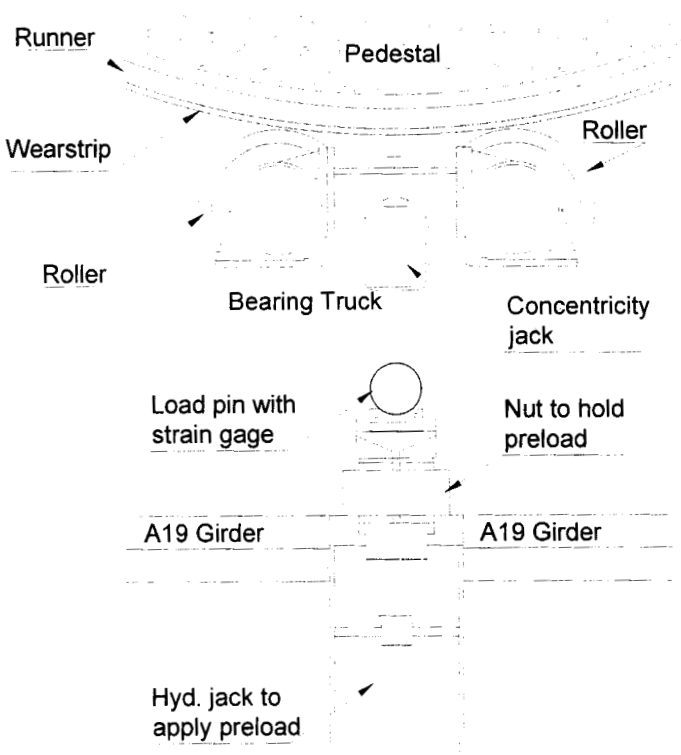


Wheel and bearing assembly

THE RADIAL BEARING (Cont'd)

Radial Bearing Configuration:





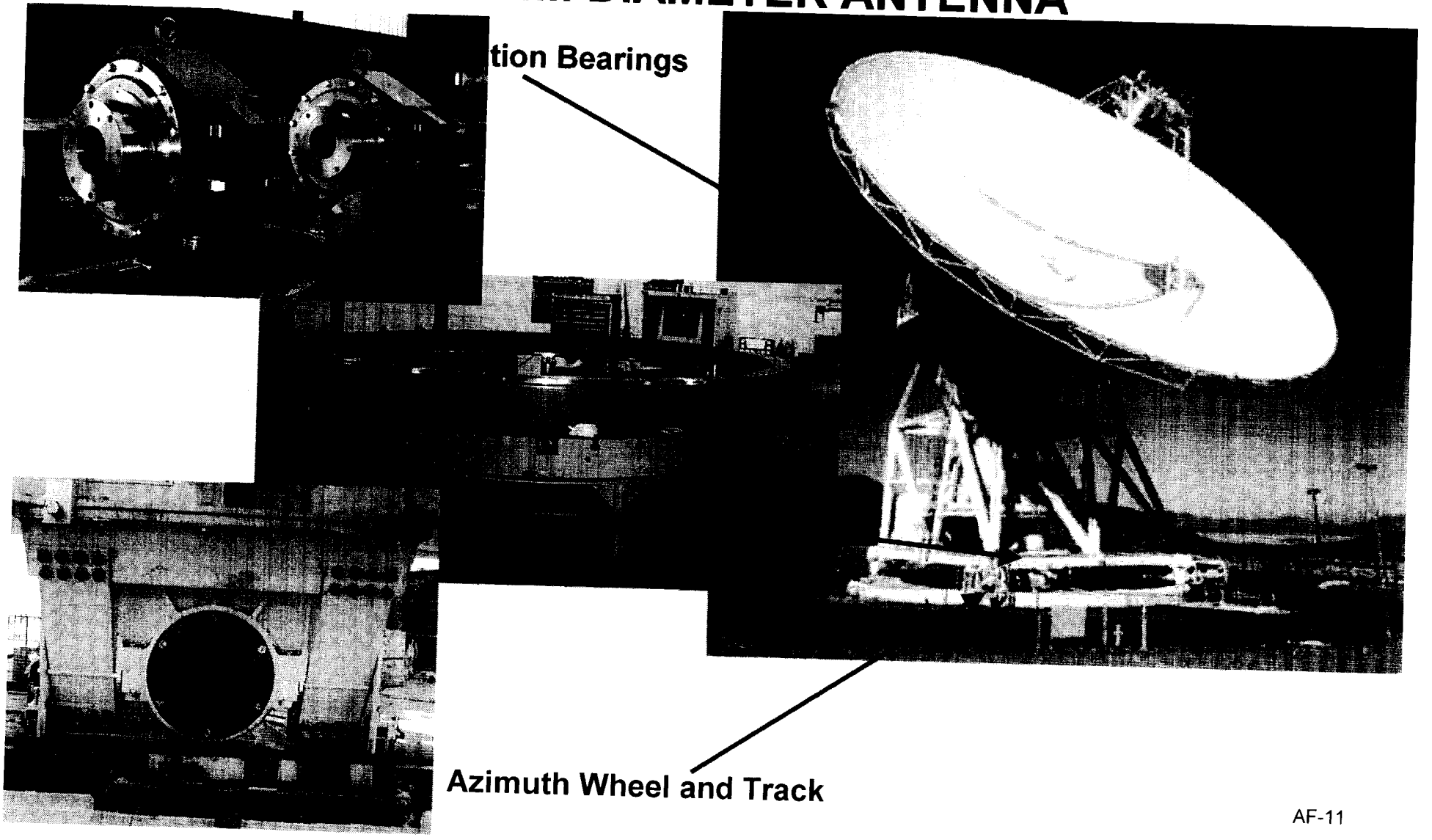
THE ELEVATION BEARINGS

- The dead weight on elevation axis is about 4.5 million pounds, plus the dynamic load of 0.3 million pounds for a 50 mph wind.
- The maximum speed is 0.25 degree/sec with a 85 degree rotation
- Antenna elevation axis is supported with 4 spherical roller bearing
- The bearing static capacity rating is way above the actual load. (Fracture rating is approximately a factor of eight above the static rating)
- Bearing had a catastrophic failure in 1989 after 18 years service. Two major contributors were:
  - Axial holes drilled through the roller center (to control heat treatment)
  - Unequal load existed on two bearings within each bearing assembly
- Challenge
  - How to predict the life of bearing for our application?
  - Is there any other bearing type to better fit our application?

THE ELEVATION BEARINGS (Cont'd)

Pictures of elevation bearings

THE 34M DIAMETER ANTENNA



BEARING POSSIBILITIES

The slewing bearing will be used for the turret of the vessel