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SPACE STATION FREEDOM SOLAR ALPHA JOINT GROWTH CAPABILITY

DAVID SNYDER

LOCKHEED MISSILES AND SPACE CO. 8/8/91

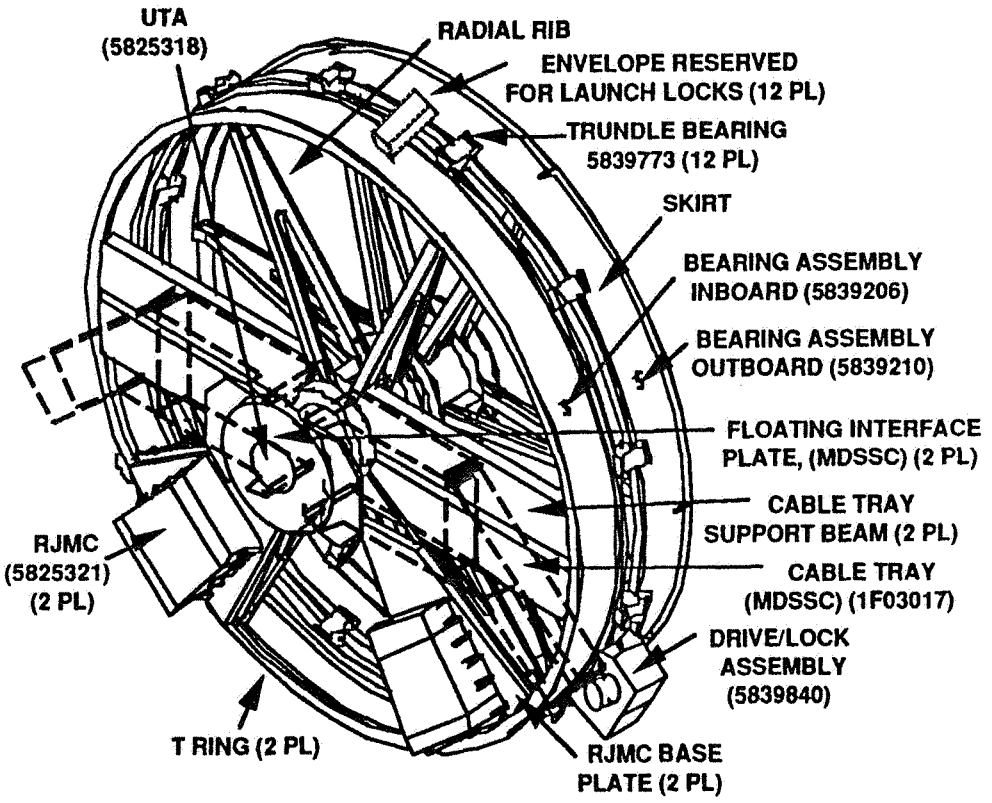
SPACE STATION FREEDOM

AGENDA

SOLAR ALPHA ROTARY JOINT GROWTH CAPABILITY

- BASELINE REQUIREMENTS AND CAPABILITY
- BASELINE CONFIGURATION
- PRELIMINARY ASSESSMENT OF KEY GROWTH ISSUES

SOLAR ALPHA ROTARY JOINT ASSEMBLY



SARJ ASSEMBLY - ISO

FUNCTIONS:

- PROVIDES STRUCTURAL CONTINUITY AND CONTINUOUS ROATION BETWEEN THE INBOARD AND OUTBOARD MB-1 PIT SECTIONS
- PROVIDES CONTINUOUS POWER, DATA, AND VIDEO TRANSFER

SARJ CAPABILITY

SARJ ROTATION :
- 360 deg continuous rotation
- 3.80 to 3.95 deg/min tracking rates
- 30 deg/min search rate in either direction
- 0.005 deg/sec/sec acceleration in either direction
- 3.8 E+06 slug feet^2 inertia load (Growth)

POINTING CAPABILITY :
- Accuracy - 0.58 deg in either direction
- Stability - 0.50 deg in either direction
- Jitter - 0.01 deg/sec

CONTROL SYSTEM :
- Closed position loop bandwidth - 0.01 to 1.00 Hz
- Transient response (Position overshoot) - no greater than 30 percent
- Break-out command from zero rate - less than 30 percent of max. torque

UTILITY TRANSFER :
- Power - 18 Crossings
  - 60 KW of 160 VDC thru 4 circuits
  - 2 Grounds
- Data/Video - 36 Crossings

SARJ CAPABILITY

STRUCTURAL CAPABILITIES :

Rigidity Capability:

Bending

- 4.4 E+10 lb-in^2

Torsional

- 4.5 E+9 lb-in^2

Shear

- 1.0 E+06 lb

Bearing Assembly Structural Loading Capability :

Operational loads :

Bending (Mx , Mz) - 125,000 in -lb

Torsion (My) - 27,500 in -lb

Max Operational Loads :

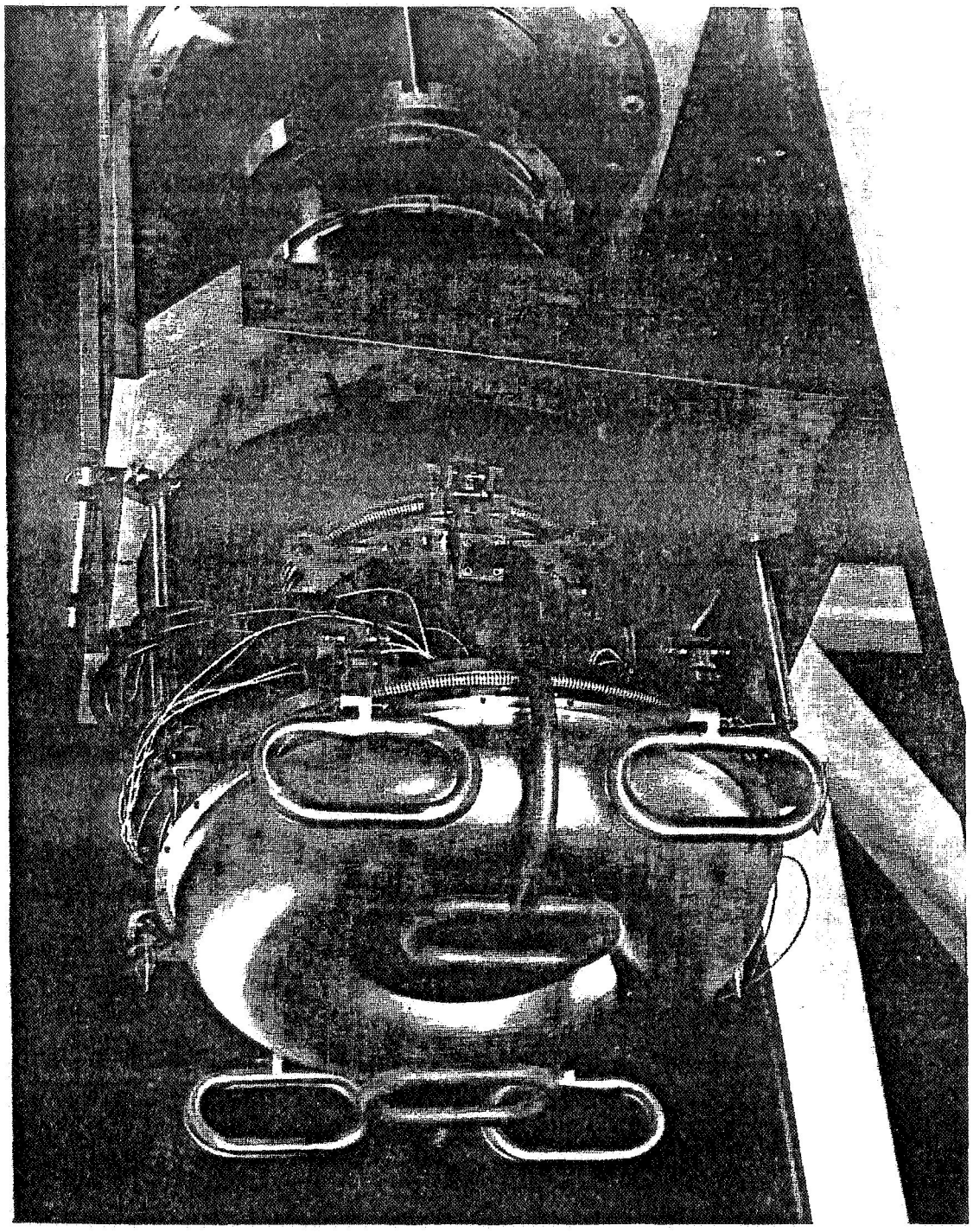
Bending (Mx , Mz) - 264,000 in -lb

Torsion (My) - 89,000 in -lb

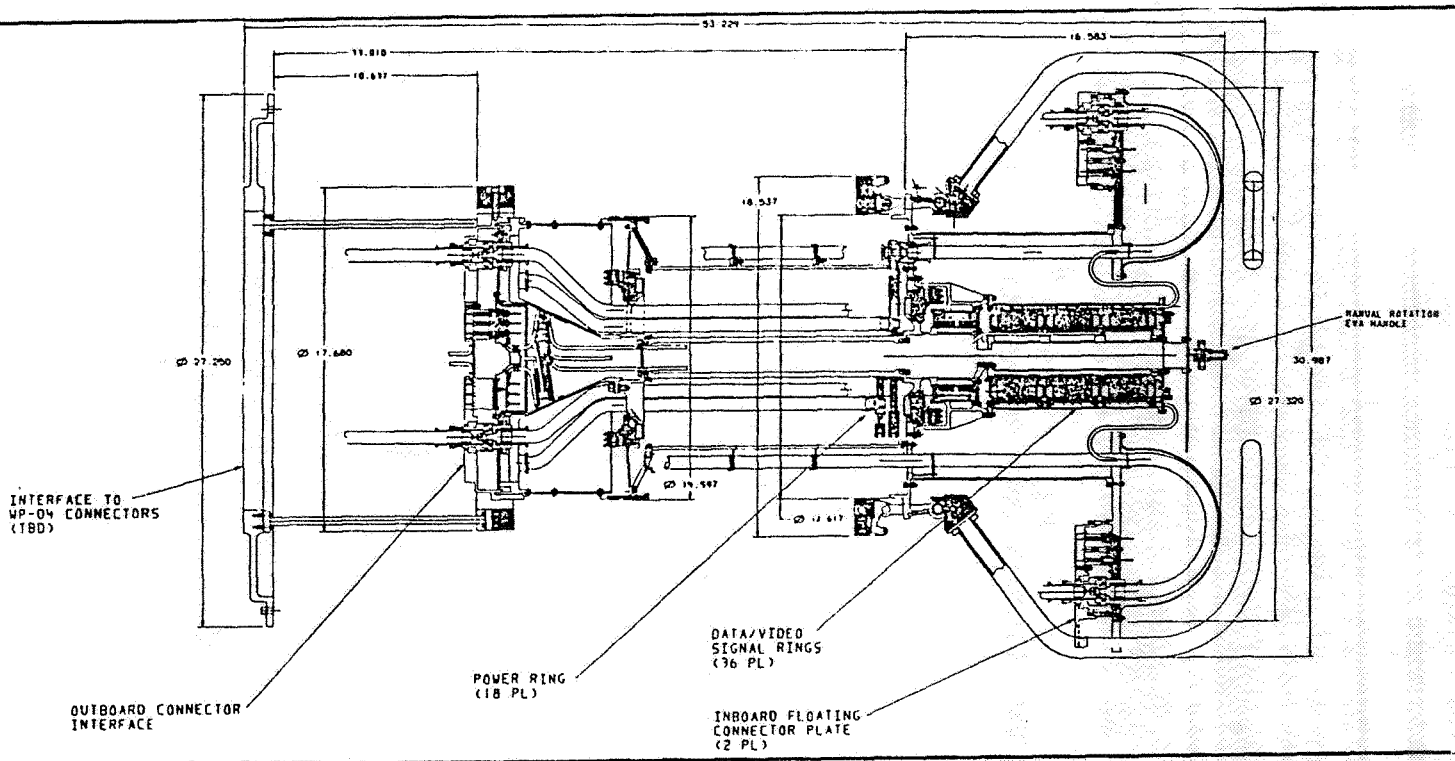
ALLOCATIONS:

Weight - 2491 lb

Power - 45 W Nominal



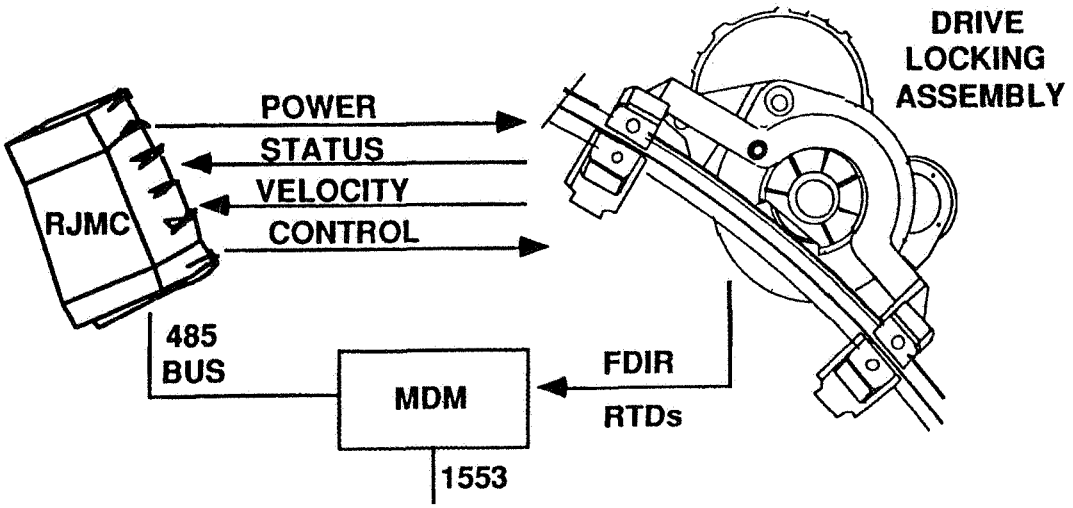
SARJ PIT UTILITY TRANSFER ASSEMBLY



- UTILITY TRANSFER:
  - 60 KW 4 CIRCUITS OF 4 WIRE STATION POWER , 2 STATION GROUNDS
  - 10 1553 DATA CIRCUITS
  - 5 VIDEO EIA/RS 170A
  - 6 SPARE RINGS
- CONTINIOUS ROTATION
- UTA IS AN ORU WITH ACCESS ON THE WP-02 SIDE
- INTERFACING CONNECTORS ARE ALL REPLACEABLE

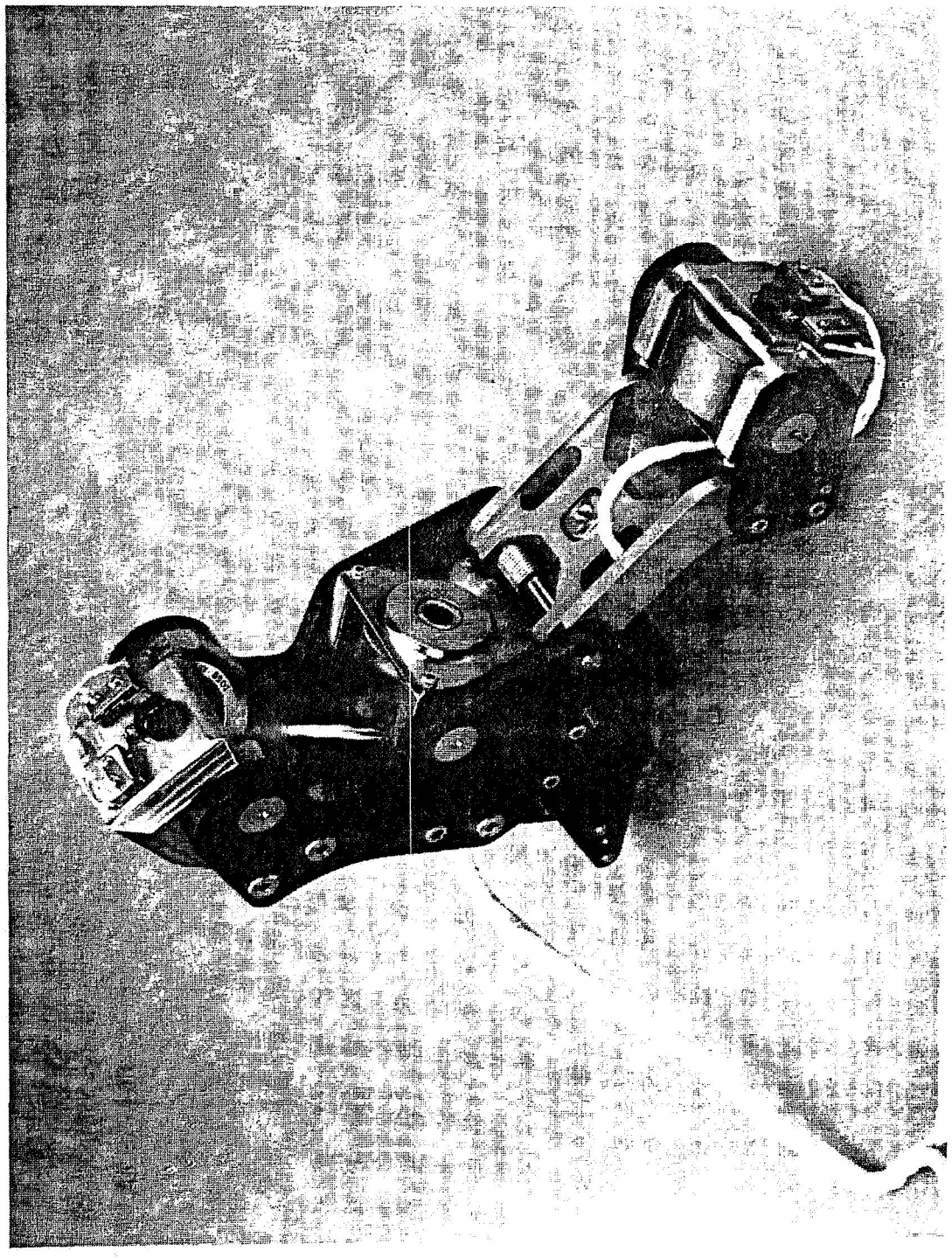
SPACE STATION FREEDOM

DRIVE / CONTROL SYSTEM

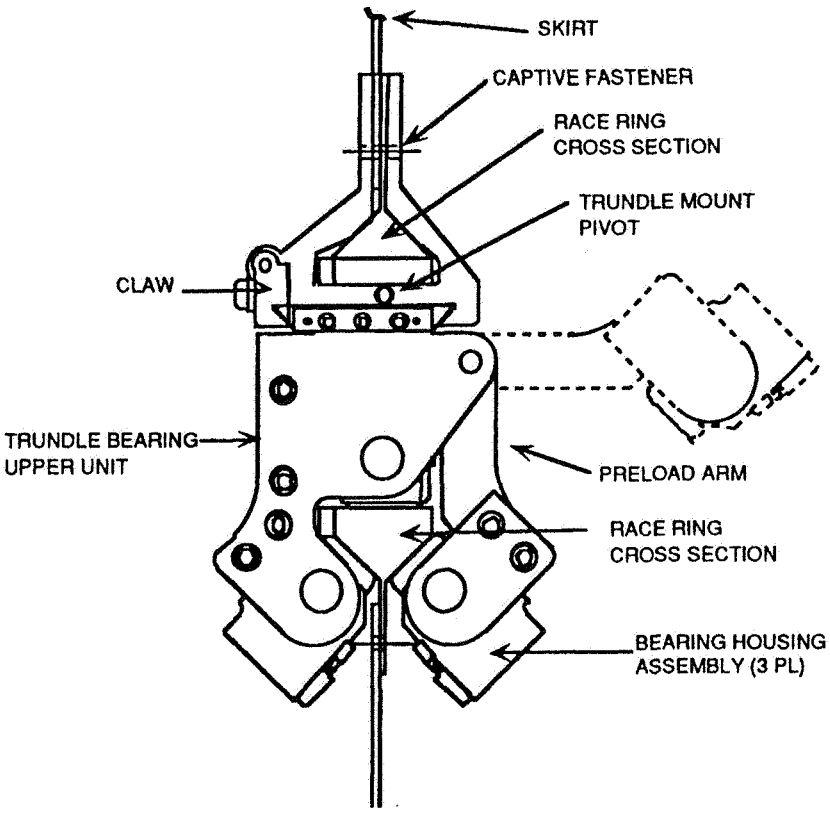


DESIGN DESCRIPTION

- PROVIDES SOLAR ALPHA JOINT DRIVE TORQUE: 2400 ft lb WITH A 283:1 GEAR RATIO
- PROVIDES LOCKING OF INBOARD AND OUTBOARD SEGMENTS
- PROVIDES PRECISE POINTING AND ALIGNMENT OF PIT FOR SOLAR TRACKING AND MOBILE TRANSPORTER TRANSLATION
- DRIVE LOCKING & ENGAGE/DISENGAGE FUNCTION INTEGRATED INTO ONE UNIT



SARJ TRUNDLE BEARING / RACE RING



FUNCTIONS:

TRUNDLE

- CONTINUOUS LINE CONTACT OF BEARING TO RACE
- TRUNDLE PACKAGE REVERSIBLE FOR ALTERNATE RACE RING OPERATION
- SELF-ALIGNING BEARING PACKAGE

RACE RING

- TRIANGULAR RACE RING
- DRIVE GEAR ON O.D.
- 15-5 PH CORE MATERIAL
- WEAR COATING FOR RACE AND GEAR APPLICATION: NITRIDED

SPACE STATION FREEDOM

DRIVE SYSTEM AND TRUNDLE DESIGN

- DRIVE CAPABILITY BASED ON OPERATIONAL LOADING
  - DRIVE CAPABILITY : 2 X JOINT FRICTION + ACCELERATION
  - JOINT FRICTION IS DIRECTLY PROPORTIONAL TO TRUNDLE PRELOAD
  - TRUNDLE PRELOAD IS SIZED TO PREVENT GAPPING DURING OPERATIONAL LOAD EVENTS
- TRUNDLE STRUCTURAL CAPABILITY BASED ON OPERATIONAL AND MAXIMUM ON-ORBIT LOADS (LOCKED)
  - TRUNDLE PRELOAD IS SIZED TO PREVENT GAPPING DURING OPERATIONAL LOAD EVENTS
  - MAXIMUM ON-ORBIT LOADS SIZE THE TRUNDLE FOR STRESS.

SPACE STATION FREEDOM

GROWTH SUMMARY

- POWER AND DATA TRANSFER

  GROWTH CAN BE ACCOPLISHED AT A RELATIVELY LOW COST THROUGH ORU UPGRADES. SCARS FOR GROWTH SHOULD BE PLACED IN THE DESIGN BY THE END OF FY91

- STRUCTURAL

  GROWTH CAN BE ACCEPTED IF THE CAPABILITY OF THE BEARING ASSEMBLY STRUCTURE IS NOT EXCEEDED.

- DRIVE SYSTEM

  GROWTH CAN BE ACCOMPLISHED THROUGH ORU REPLACEMENT UP TO THE CAPABILITY OF THE EXISTING GEAR DESIGN.

POWER GROWTH ASSESSMENT

- POWER:

GROWTH CAPABILITY

- CURRENT UTA HAS NO SPARE POWER RINGS

OPTIONS:

- FLOW GROWTH POWER THROUGH EXISTING RINGS
  - + EVALUATE FOR THERMAL IMPACTS
- REALLOCATE POWER CHANNELS IN UTA TO ACCEPT NEW CHANNELS
  - + NO IMPACT ON UTA
- ADDITIONAL POWER RINGS TO UTA
  - + MODIFY EXISTING UTA
    - PRE-PIT DESIGN EXISTS AND HAS BEEN TESTED FOR AN ADDITIONAL SIX POWER RINGS
    - INTERFACES DO NOT CURRENTLY SUPPORT THIS GROWTH (UTA ADAPTERS, CABLE TRAYS, UTA)
  - + LIMIT IS 24 RINGS DUE TO BEARING ASSEMBLY HUB DIAMETER AND UTA DESIGN COSTS

DATA GROWTH ASSESSMENT

DATA:

GROWTH CAPABILITY:

6 SPARE ROLL RINGS (3 1553 CHANNELS)

(ADDITIONAL RINGS AVIALABLE DUE TO PIT CHANGES)

GROWTH REQUIREMENT: TBD

OPTIONS:

6 OR LESS RINGS: USE EXISTING UTA

7 OR MORE CHANNELS:

- UTA DESIGN EXISTS FOR 48 ROLL RINGS

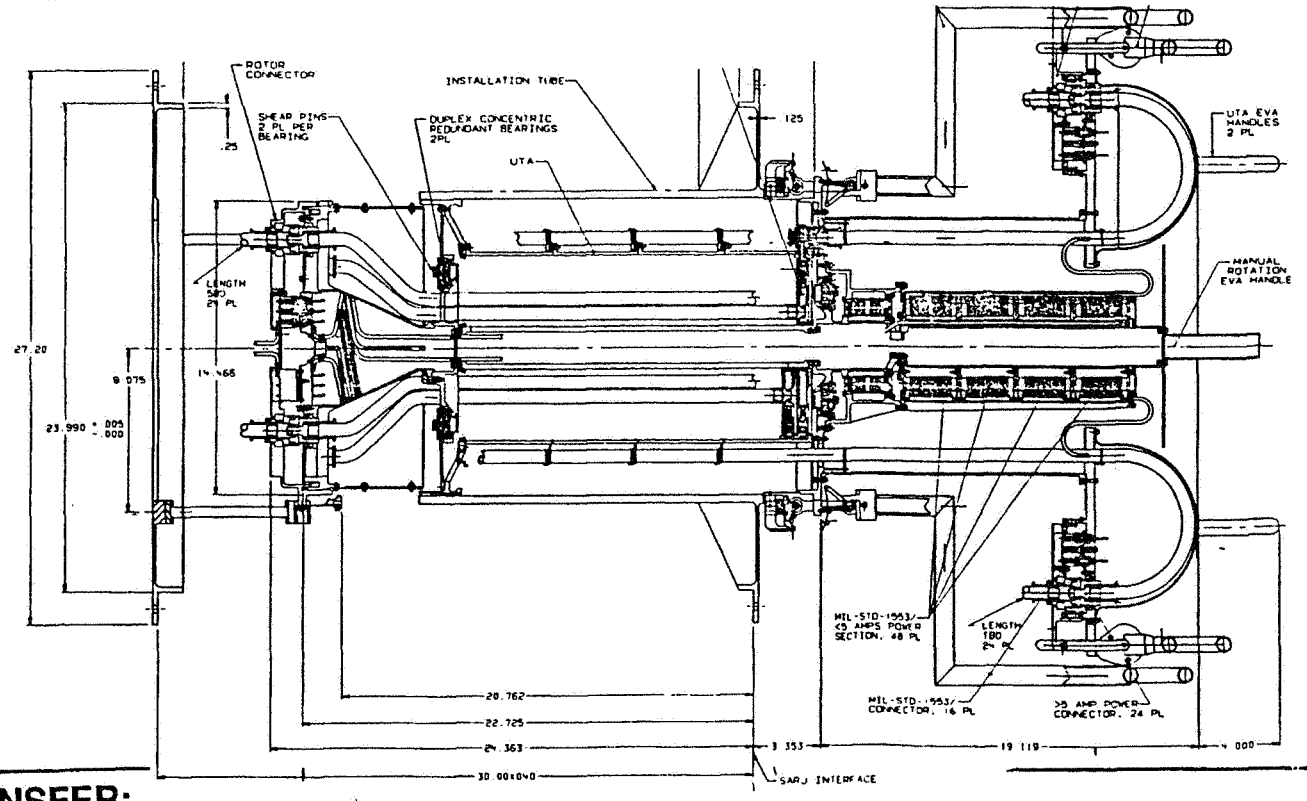
  + 18 CHANNELS FOR GROWTH POSSIBLE

  + INTERFACES DO NOT SUPPORT GROWTH (CABLE TRAY , UTA ADAPTERS, UTA)

- USE Ku BAND COMMUNICATION AND BYPASS SARJ
- LIMIT IS 48 RINGS DUE TO BEARING ASSEMBLY HUB DIAMETER AND UTA DESIGN COSTS

SPACE STATION FREEDOM

SARJ PRE- PIT
UTILITY TRANSFER ASSEMBLY



- UTILITY TRANSFER:
  - 75 KW 24 POWER ROLL RINGS
  - 48 DATA/VIDEO ROLL RINGS (24 CIRCUITS POSSIBLE)
- CONTINIOUS ROTATION
- UTA IS AN ORU WITH ACCESS ON THE WP-02 SIDE
- INTERFACING CONNECTORS ARE ALL REPLACEABLE

SPACE STATION FREEDOM

STRUCTURAL GROWTH CAPABILITY

STRUCTURE:

GROWTH CAPABILITY:

- NON-ORU COMPONENTS (SKIRT, RACE RING, RIBS, T-RING, HUBS)

  + NO GROWTH CAPABILITY

- ORU COMPONENTS (TRUNDLE PACKAGES):

  + BEARING ASSEMBLY CAPABILITY

OPTIONS:

- NON-ORU COMPONENTS: REPLACE ENTIRE MB-1 SEGMENT OR PROVIDE ADDITIONAL CAPABILTIY (COST AND SCHEDULE IMPACT ON MB-1)
- ORU COMPONENTS: DESIGN NEW COMPONENTS AND REPLACE ON ORBIT

DRIVE SYSTEM GROWTH CAPABILITY

DRIVE SYSTEM

GROWTH CAPABILITY:

- ROTARY JOINT MOTOR CONTROLLER (RJMC)
  - + NO GROWTH CAPABILITY
- DRIVE MOTORS
  - + NO GROWTH CAPABILITY

OPTIONS:

- DRIVE MOTORS AND RJMCS ARE REPLACEABLE ORUS
- CAPABILTIY LIMITED BY RACE RING BULL GEAR STRESS