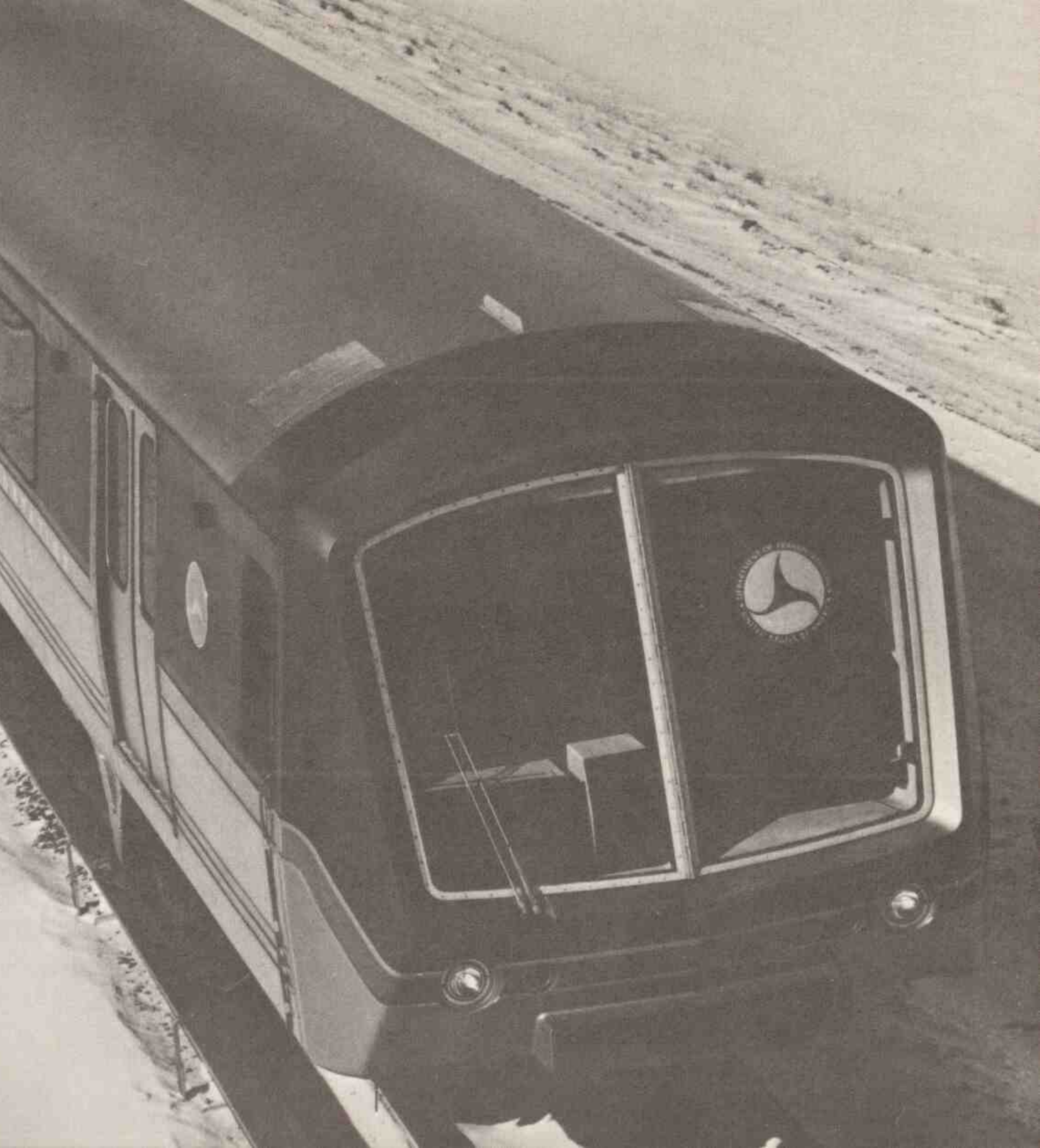
THE

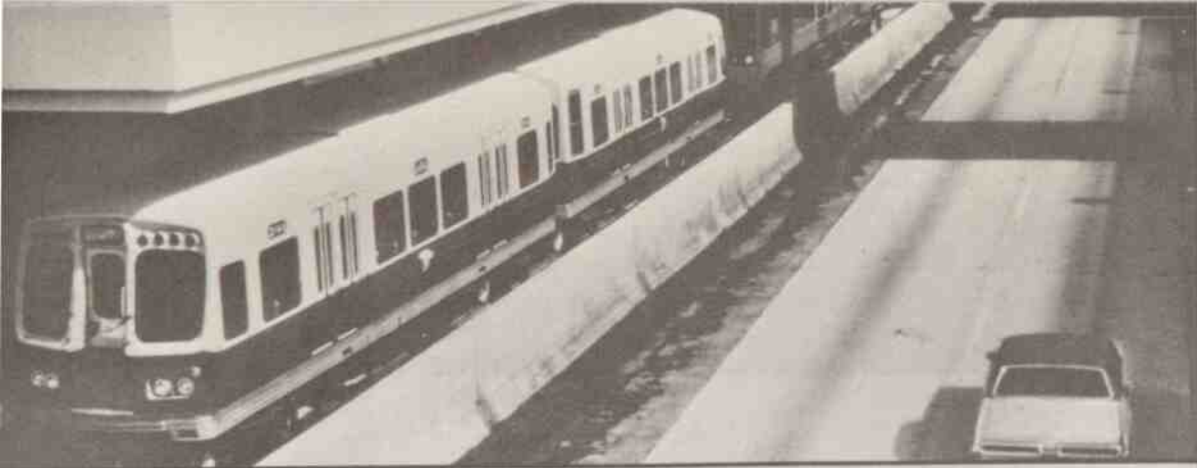
STATE-OF-THE-ART CAR

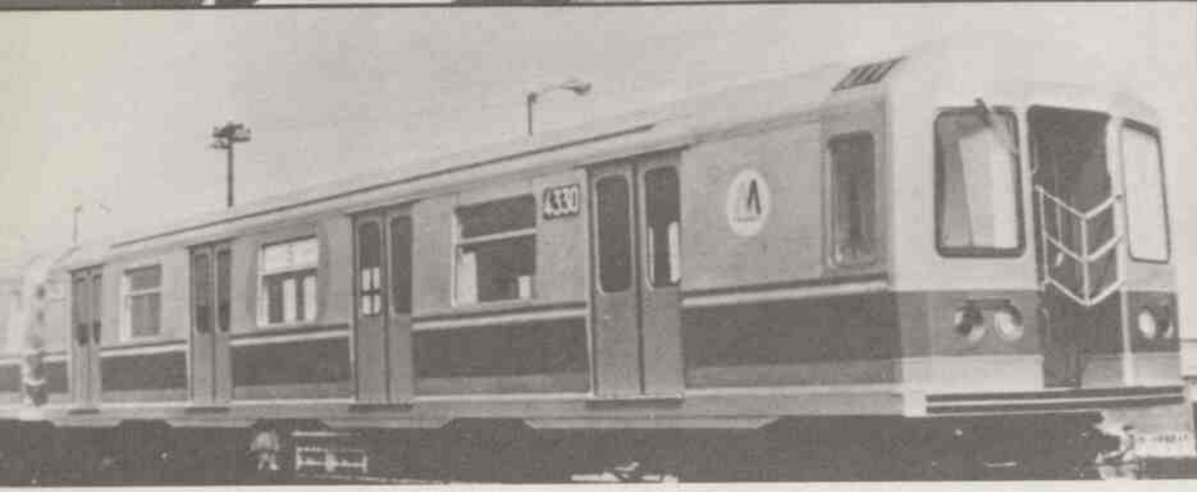
ADVANCING RAIL RAPID TRANSIT

U.S. DEPARTMENT OF TRANSPORTATION

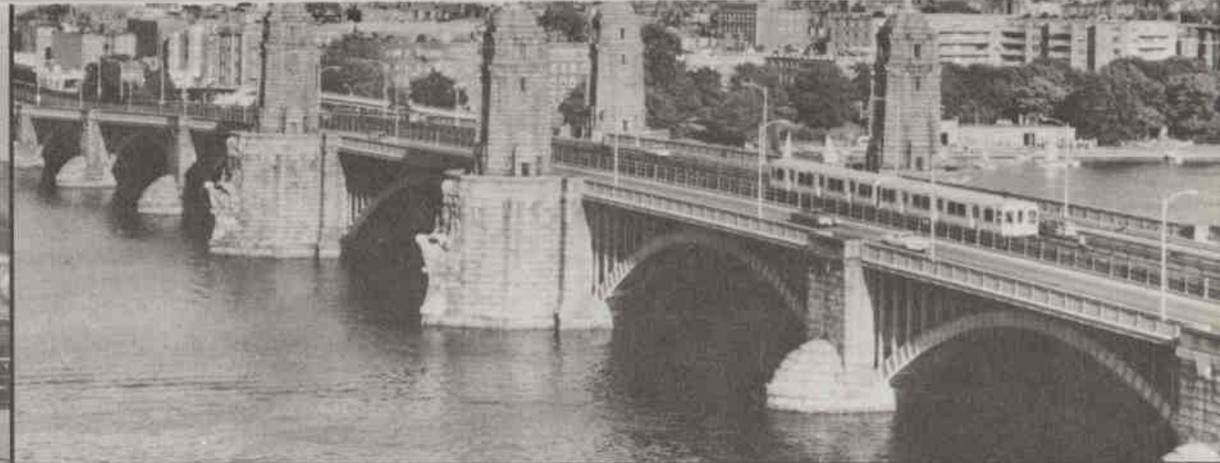
URBAN MASS TRANSPORTATION ADMINISTRATION







URBAN RAIL RAPID TRANSIT: The State-of-the-Art Cars are designed to operate on urban rail rapid transit systems. These systems are characterized by: ■ Heavy passenger volumes (up to 30,000 people per hour) ■ Frequent stops (stations as close as ½ mile apart in central cities to several miles in suburbs) ■ Exclusive right-of-way (no grade crossings) ■ Steel rails (usually standard gauge) ■ Electric power (usually 600 volts direct current) ■ Multiple-unit operation (trains up to 12 cars)



Currently, six U.S. metropolitan areas have rail rapid transit systems: ■ Boston ■ Chicago ■ Cleveland ■ New York ■ Philadelphia ■ San Francisco. In addition, Washington, D.C. is building a new rail rapid transit system, and many cities such as Atlanta, Baltimore and Buffalo are planning new systems.

The existing rail rapid transit systems carry over two billion passengers annually or ⅓ of all mass transit riders in the U.S. These systems operate approximately 10,000 rapid transit cars over 500 route miles.

URBAN RAPID RAIL VEHICLE AND SYSTEMS PROGRAM

AN INTEGRATED DEVELOPMENT PROGRAM DIRECTED TOWARDS IMPROVING URBAN RAPID RAIL SYSTEMS

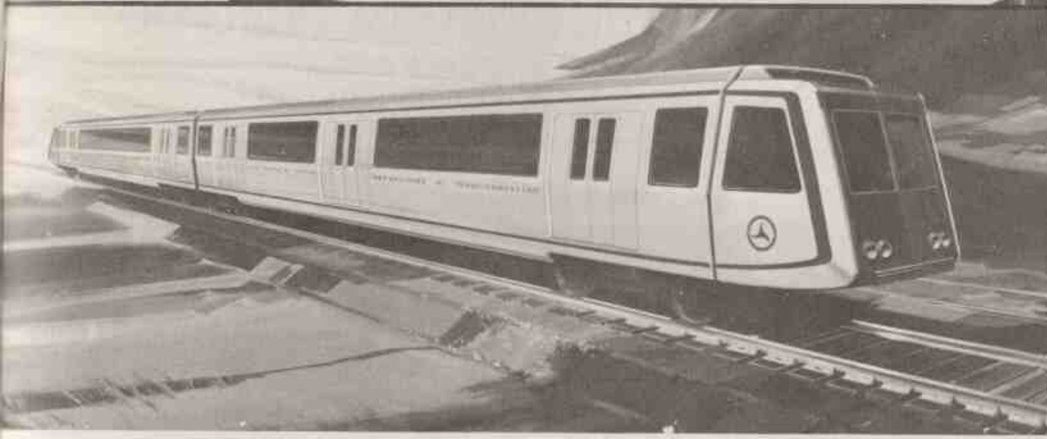
Objective:

ENHANCE THE ATTRACTIVENESS OF RAIL RAPID TRANSIT BY PROVIDING EXISTING AND PROPOSED SYSTEMS WITH SERVICE THAT IS: ▪ COMFORTABLE ▪ ECONOMICAL ▪ RELIABLE ▪ SAFE

Goals:

SHORT RANGE:
DEMONSTRATE THE STATE-OF-THE-ART IN RAPID RAIL VEHICLE TECHNOLOGY

LONG RANGE:
DEVELOP AND DEMONSTRATE ADVANCED RAPID RAIL VEHICLES




SUMMARY OF PROGRAM TASKS

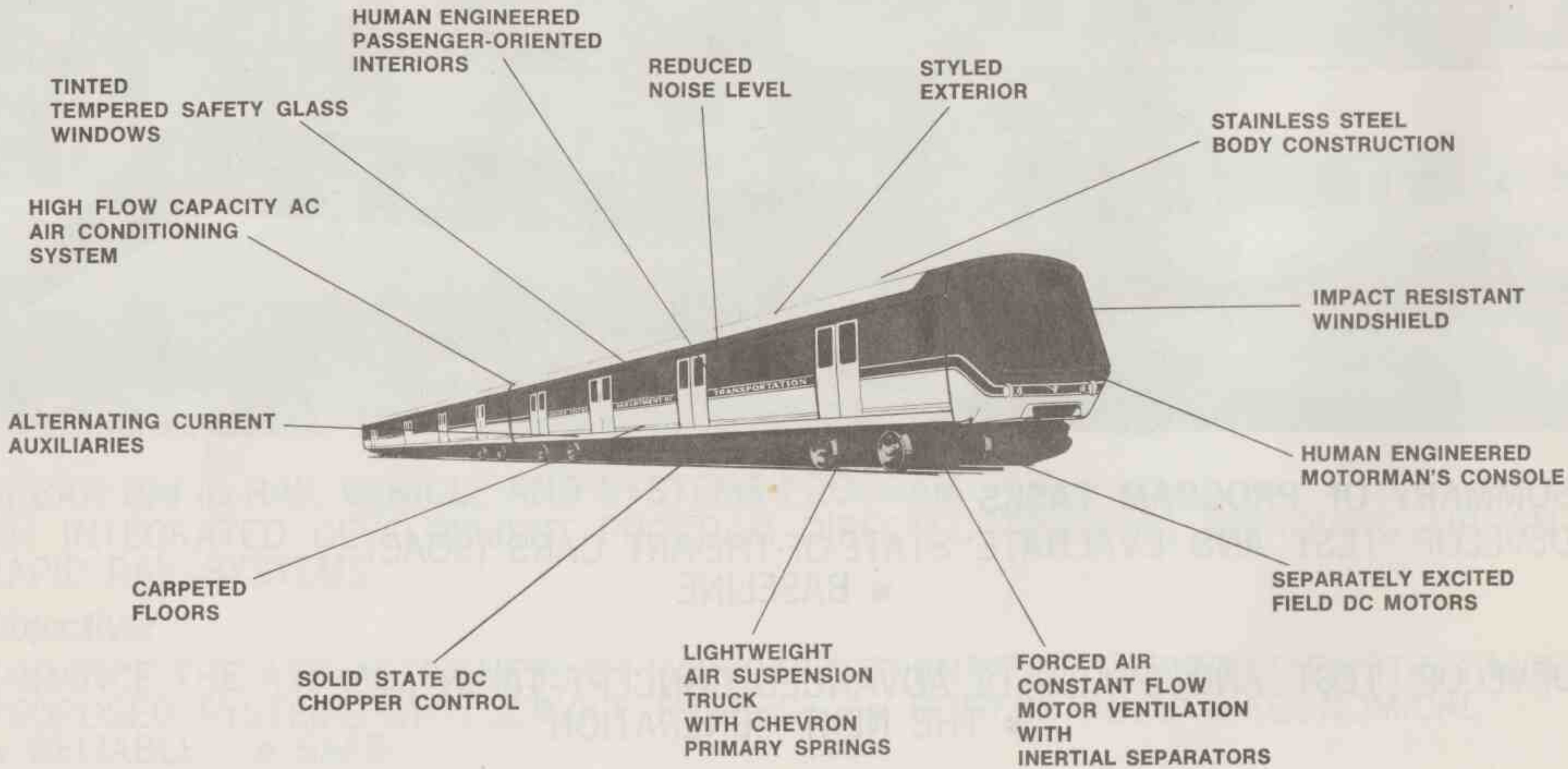
DEVELOP TEST AND EVALUATE STATE-OF-THE-ART CARS (SOAC)
- BASELINE

DEVELOP TEST AND EVALUATE ADVANCED CONCEPT TRAIN (ACT I)
- THE NEXT GENERATION

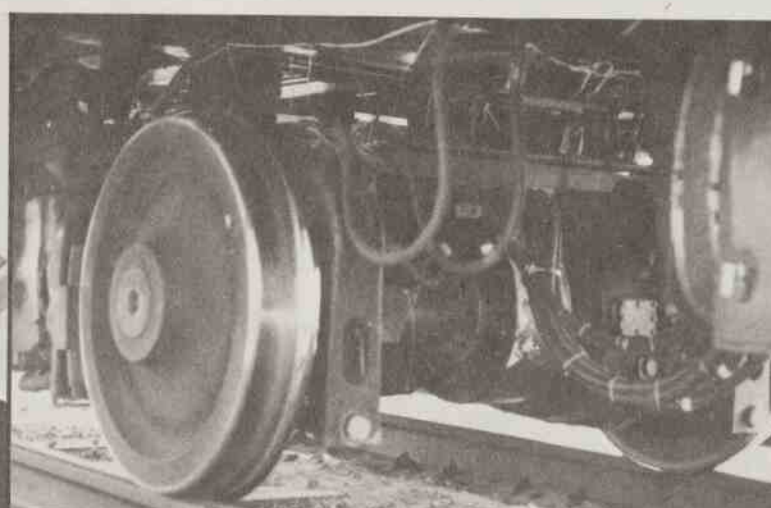
DEVELOP TEST AND EVALUATE ALTERNATE ADVANCED CONCEPT SUBSYSTEMS
- SELECTED COMPONENT IMPROVEMENTS

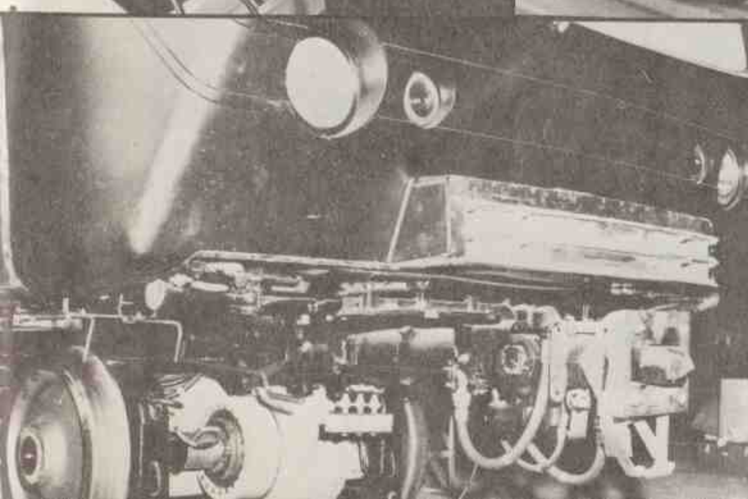
REVIEW TESTING OF BART PROTOTYPE TRANSIT CARS TO INCORPORATE APPROPRIATE IMPROVEMENTS INTO SOAC, ACT I AND SUBSYSTEMS

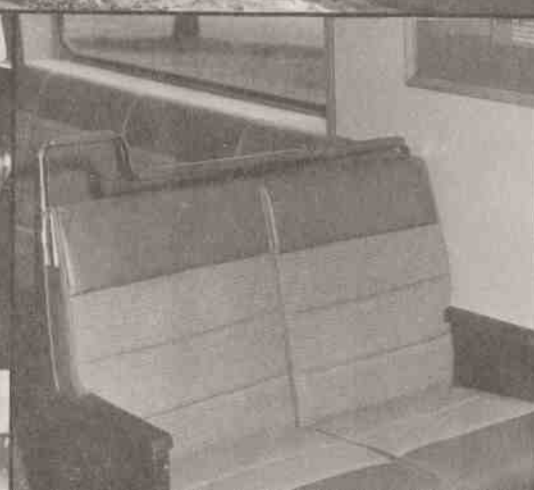
SOAC FEATURES

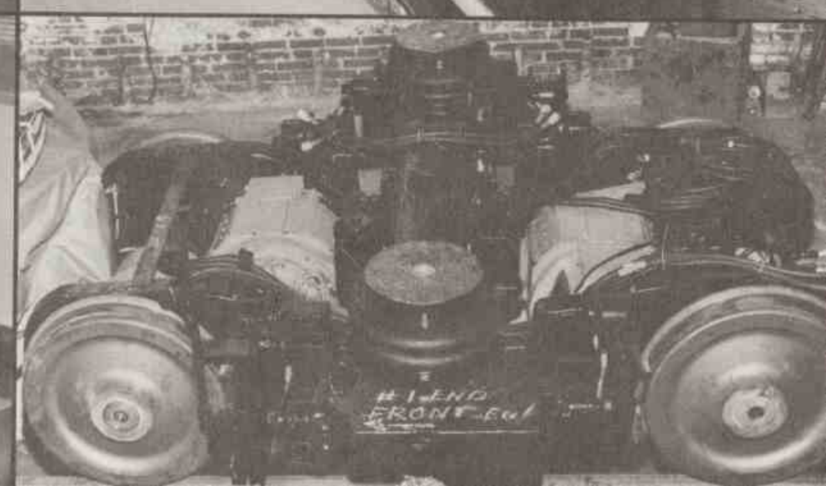


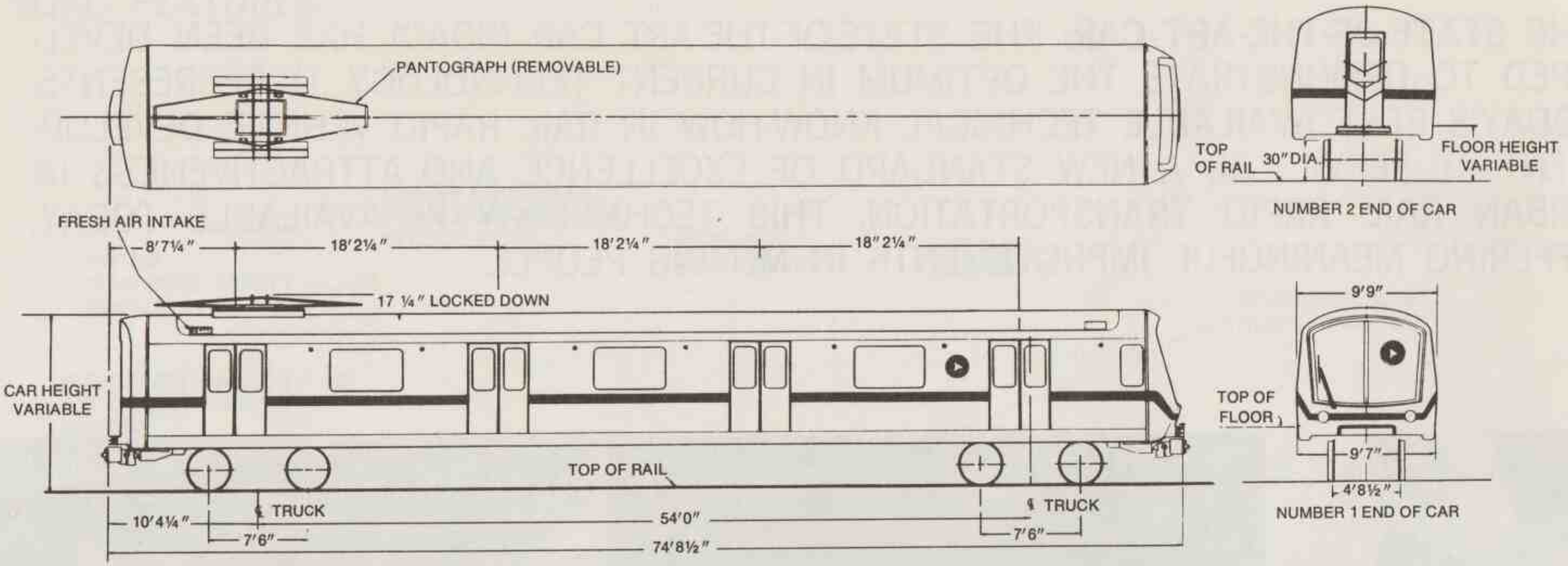
THE STATE-OF-THE-ART CAR: THE STATE-OF-THE-ART CAR (SOAC) HAS BEEN DEVELOPED TO DEMONSTRATE THE OPTIMUM IN CURRENT TECHNOLOGY. IT REPRESENTS TODAY'S BEST AVAILABLE TECHNICAL KNOW-HOW IN RAIL RAPID VEHICLE DEVELOPMENT. IT SERVES AS A NEW STANDARD OF EXCELLENCE AND ATTRACTIVENESS IN URBAN RAIL RAPID TRANSPORTATION. THIS TECHNOLOGY IS AVAILABLE TODAY, OFFERING MEANINGFUL IMPROVEMENTS IN MOVING PEOPLE.

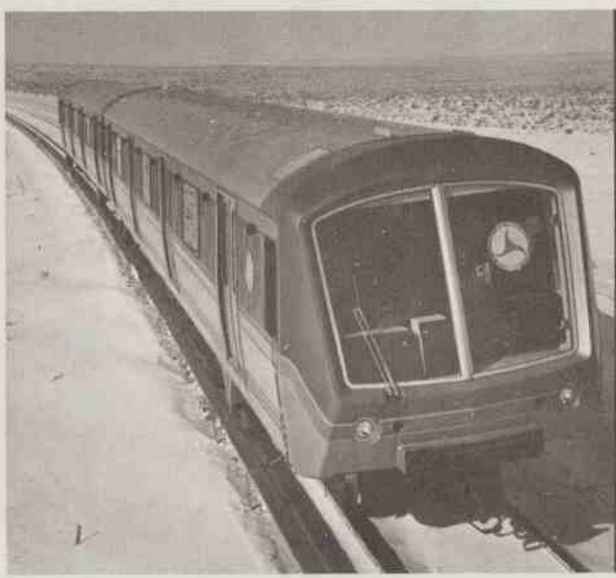


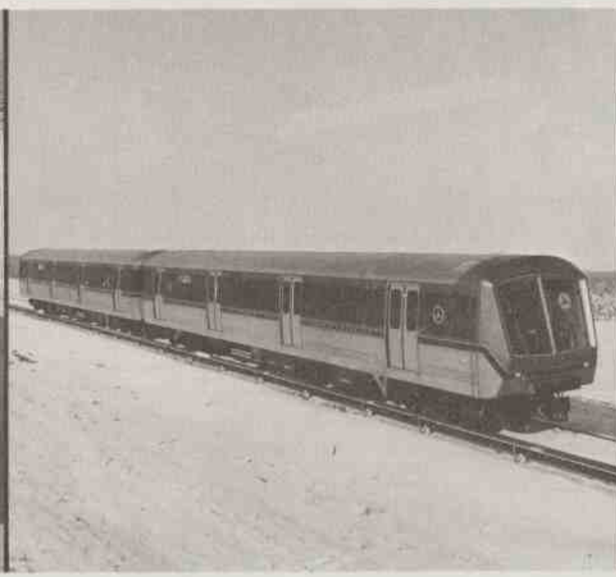


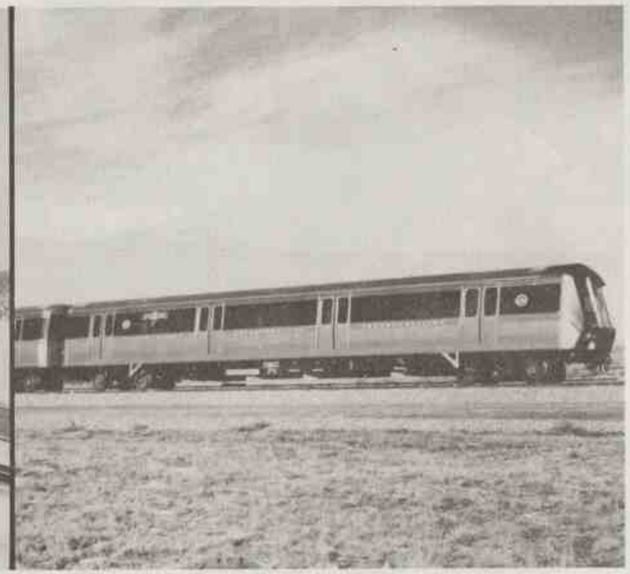


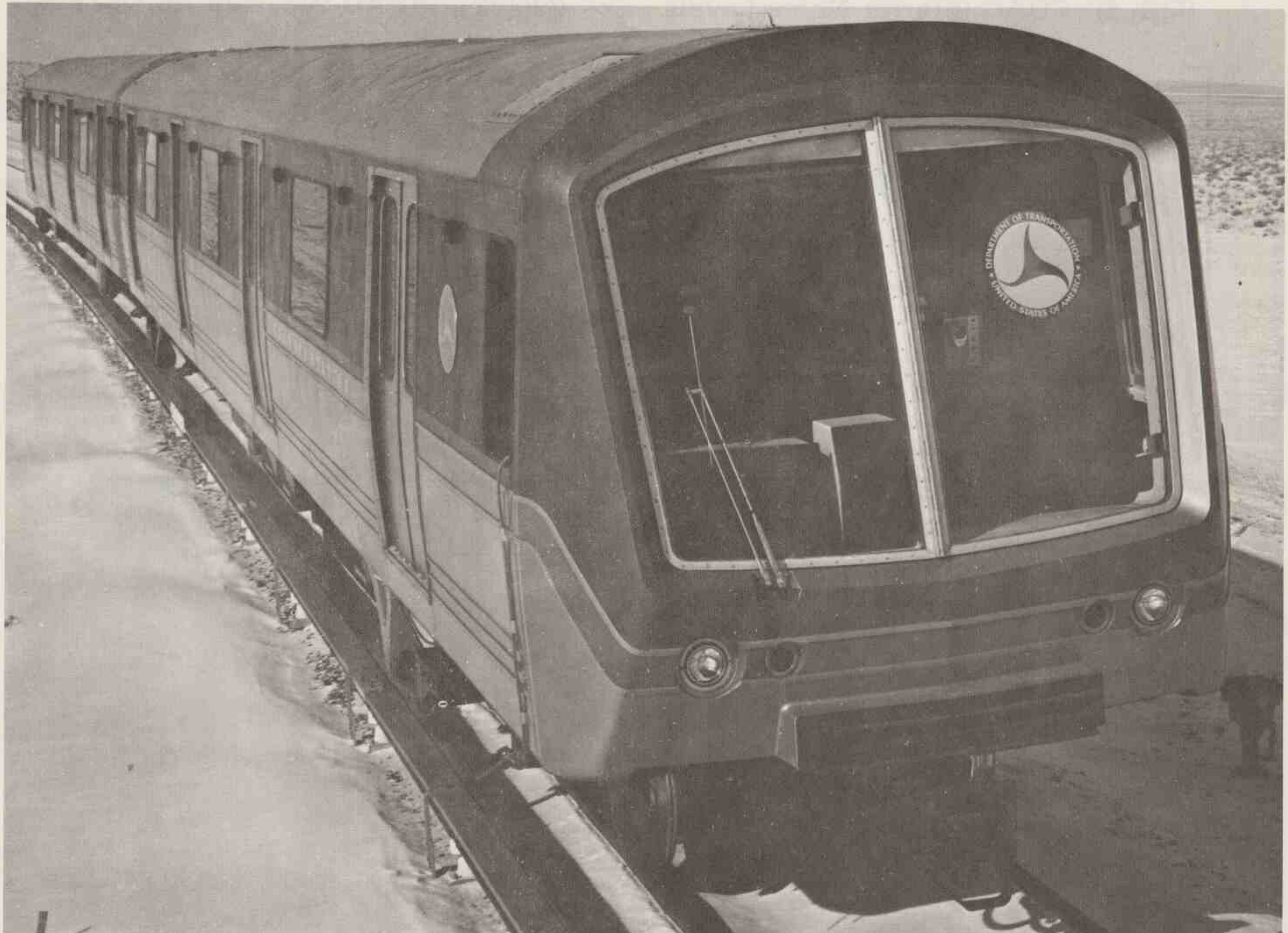



PANTOGRAPH (REMOVABLE)
FRESH AIR INTAKE
8'7¼"
18'2¼"
18'2¼"
18"2¼"
17 ¼" LOCKED DOWN
CAR HEIGHT VARIABLE
TOP OF RAIL
℄ TRUCK
℄ TRUCK
10'4¼"
54'0"
7'6"
7'6"
74'8½"
TOP OF RAIL
30"DIA.
FLOOR HEIGHT VARIABLE
NUMBER 2 END OF CAR
9'9"
TOP OF FLOOR
9'7"
4'8½"
NUMBER 1 END OF CAR

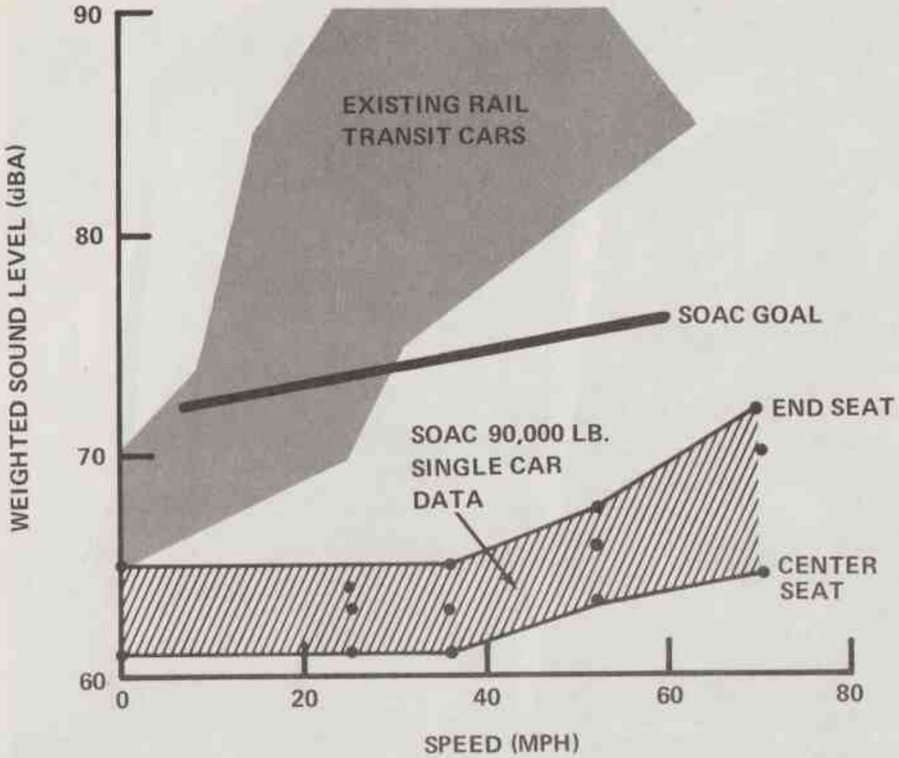






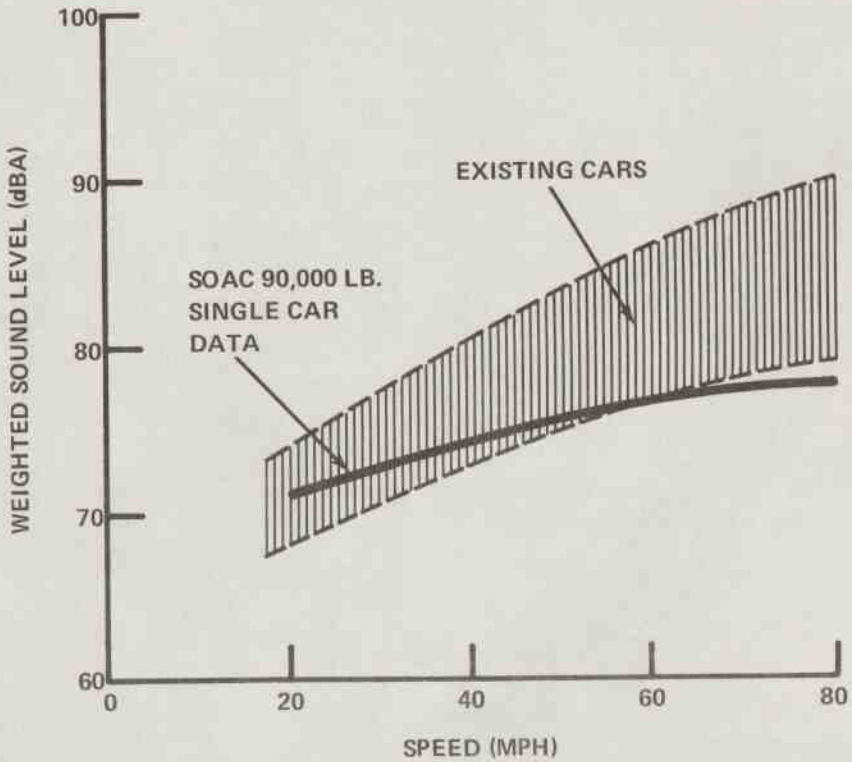

DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA

(FIG. 1) SOAC Interior Noise Levels



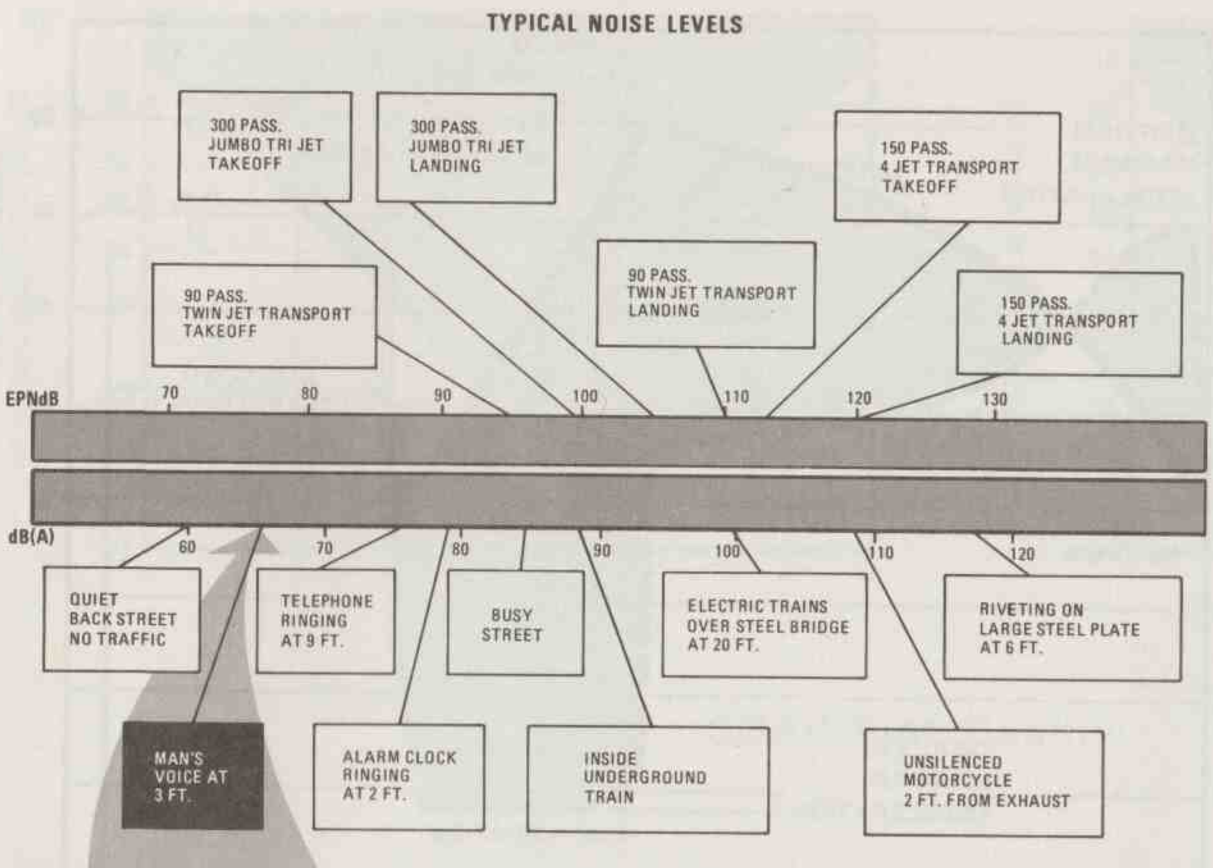
NOTES:
1. TANGENT, WELDED RAIL; WOODEN TIES
2. STEEL WHEELS
3. MICROPHONE AT EAR LEVEL OF SEATED PASSENGERS

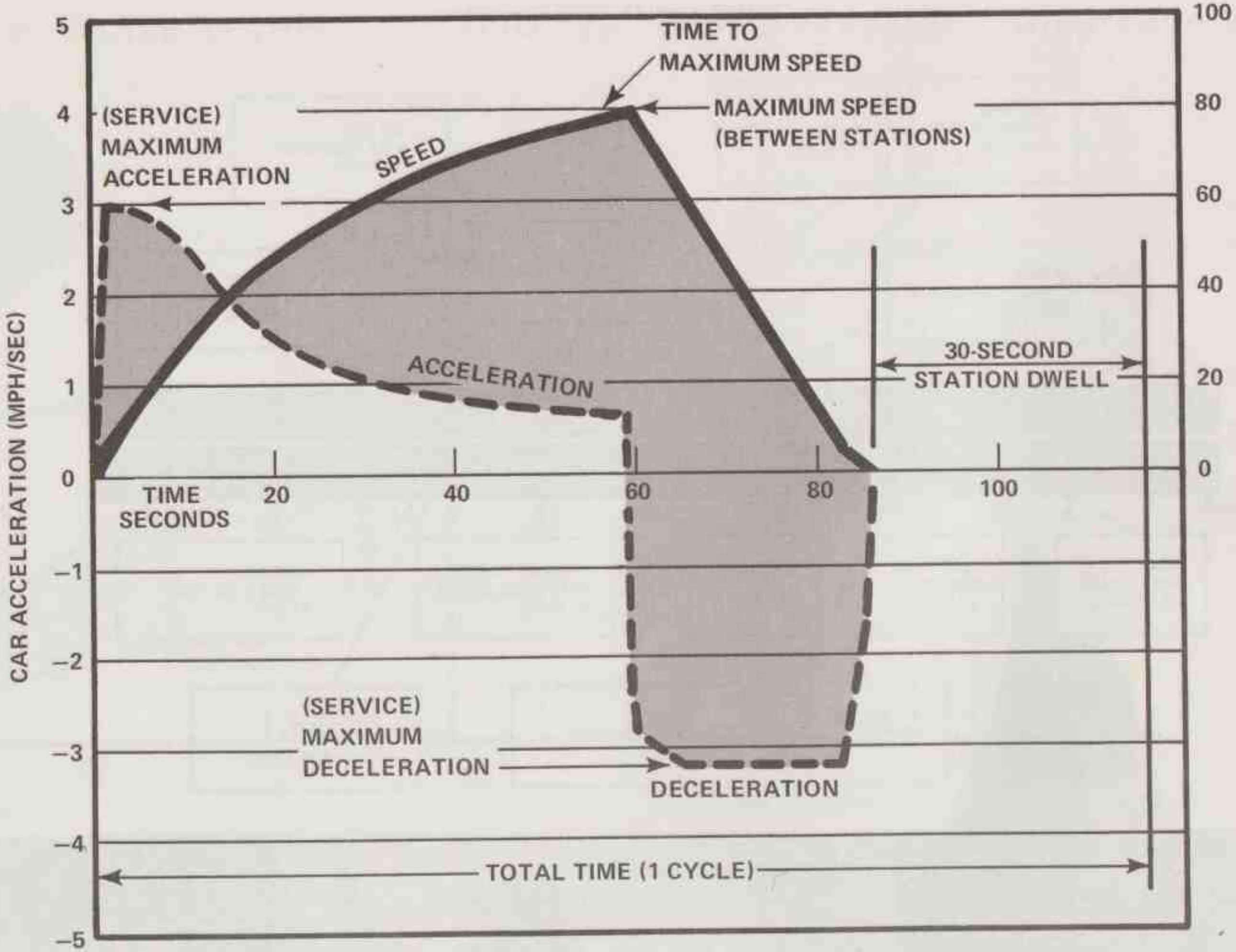
(FIG. 2) SOAC Wayside Noise Levels



NOTES:
1. TANGENT, WELDED RAIL; WOODEN TIES
2. STEEL WHEELS
3. MICROPHONE 50 FEET FROM TRACK CENTERLINE

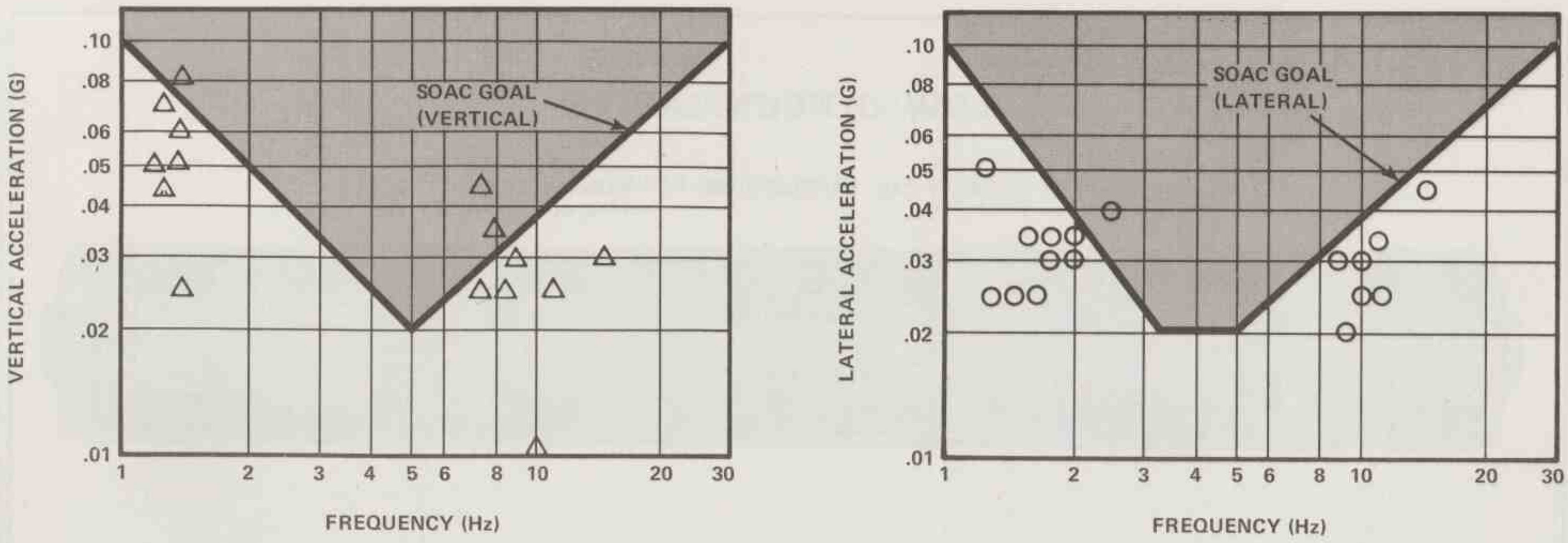
Special emphasis has been placed on the control of interior and wayside noise of the SOAC vehicles. As may be seen in Figure 1 the interior SOAC noise level is considerably less than that experienced on present in-service cars and is better than the noise goal specified. The quiet interior was achieved without additional cost or weight by considering noise reduction as a factor during the design and construction of the car.
As may be seen in Figure 2 the SOAC cars also produce less wayside noise than most cars now in service.


TYPICAL NOISE LEVELS
EPNdB
70
80
90
100
110
120
130
300 PASS.
JUMBO TRI JET
TAKEOFF
300 PASS.
JUMBO TRI JET
LANDING
150 PASS.
4 JET TRANSPORT
TAKEOFF
90 PASS.
TWIN JET TRANSPORT
TAKEOFF
90 PASS.
TWIN JET TRANSPORT
LANDING
150 PASS.
4 JET TRANSPORT
LANDING
dB(A)
60
70
80
90
100
110
120
QUIET
BACK STREET
NO TRAFFIC
TELEPHONE
RINGING
AT 9 FT.
BUSY
STREET
ELECTRIC TRAINS
OVER STEEL BRIDGE
AT 20 FT.
RIVETING ON
LARGE STEEL PLATE
AT 6 FT.
MAN'S
VOICE AT
3 FT.
ALARM CLOCK
RINGING
AT 2 FT.
INSIDE
UNDERGROUND
TRAIN
UNSILENCED
MOTORCYCLE
2 FT. FROM EXHAUST



SOAC Vehicle Operating Profile

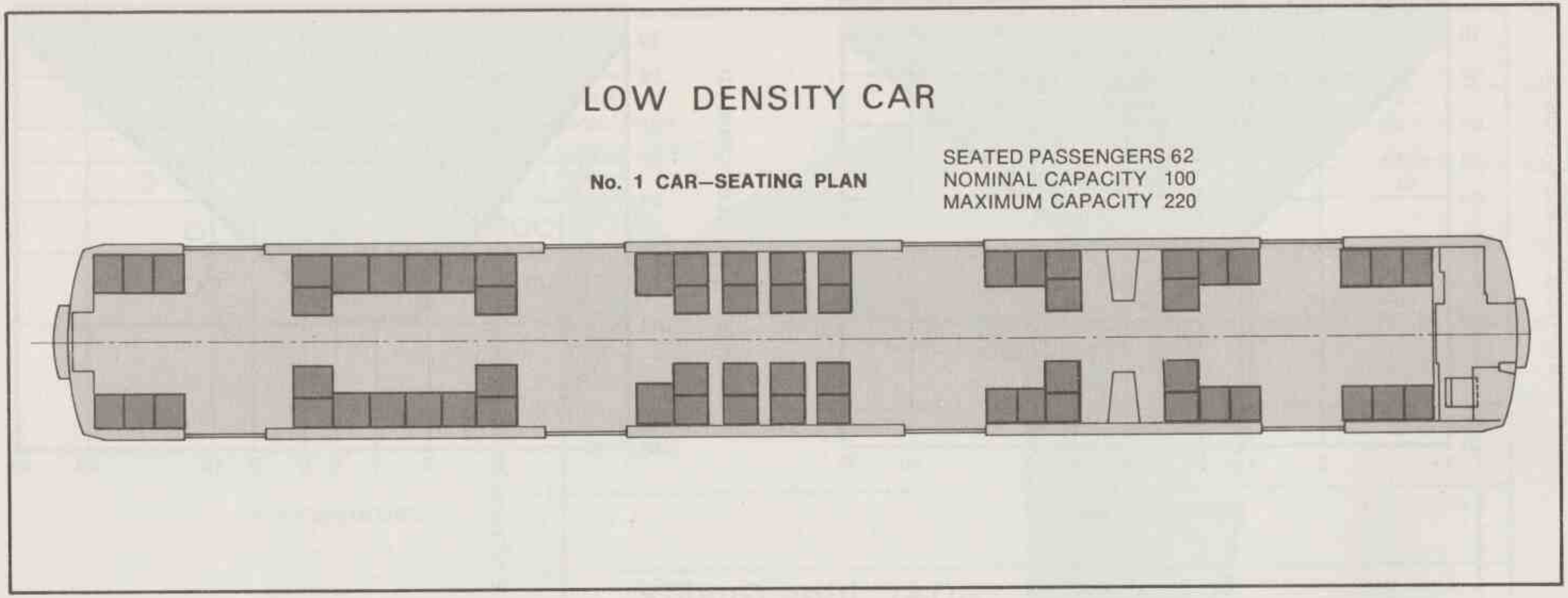
The SOAC cars, each carrying 100 passengers are capable of reaching 80 mph in less than 60 seconds. Braking from 80 mph can be achieved with any of the three brake systems (blended-dynamic/air, dynamic only, air only) in less than 2000 feet. Yet, the acceleration/deceleration rates are well within the limits of passenger comfort, contributing to the excellent ride quality of the cars.



SOAC Ride Quality

RIDE QUALITY

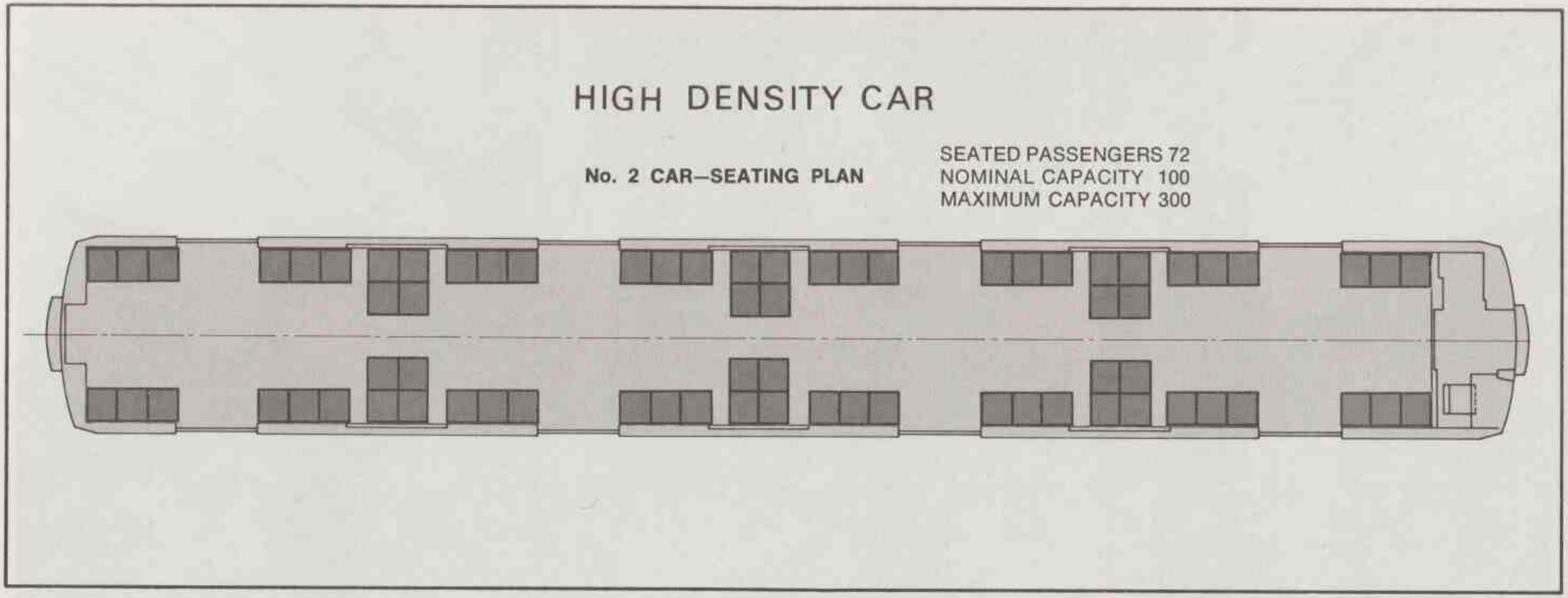
The improved truck and suspension system design, incorporating rubber chevrons and air bags have achieved a ride quality as good or better than any other rail transit car. Values are shown above. These values are based on measurements taken on the Rail Transit Test Track which consists of variations of welded and jointed rails, concrete and wooden ties, and different tie spacing. Values are defined in terms of acceleration vs. frequency and are compared to constant vertical and lateral comfort design goals.



SOAC INTERIOR DESIGN

THE STATE-OF-THE-ART CARS ARE ORIENTED TOWARDS PEOPLE. THEIR DESIGN REPRESENTS THE BEST IN COMFORTABLE, QUIET, AND APPEALING PASSENGER TRANSPORTATION. THEIR STYLING MAKES USE OF PRACTICAL AND EYE-APPEALING MATERIALS AND COLORS.

THE LOW DENSITY AND HIGH DENSITY SEATING ARRANGEMENTS SELECTED FOR THE TWO CARS ARE TYPICAL OF THE VARIETY OF SEATING PATTERNS AVAILABLE TO MEET THE DEMANDS OF VARYING PASSENGER PREFERENCE AND RIDERSHIP REQUIREMENTS.



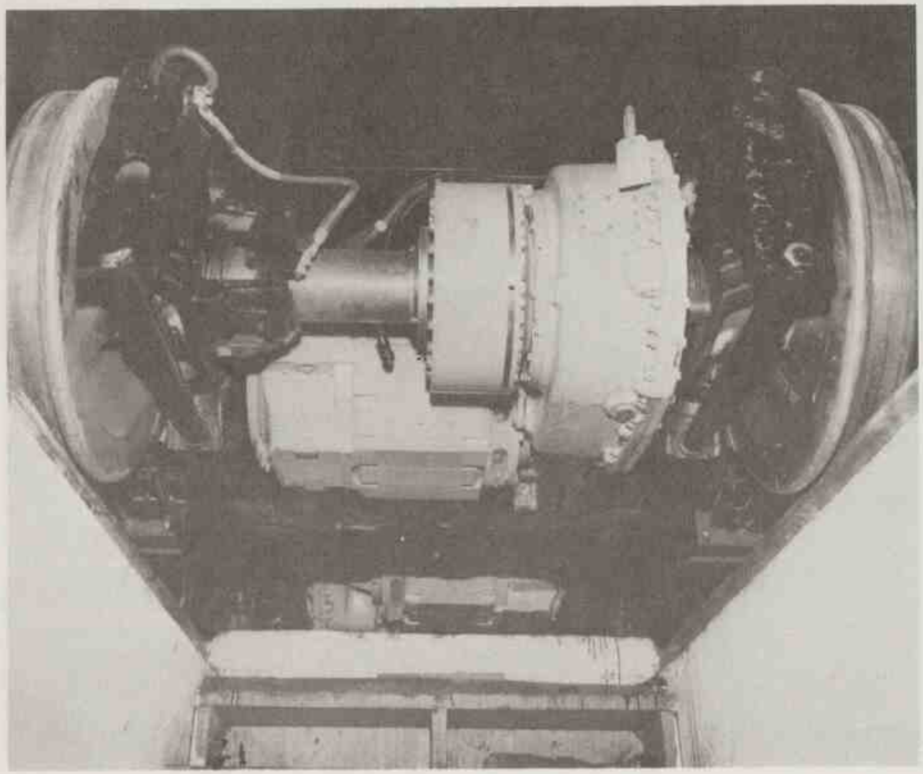
THE ONE-PIECE MOLDED FIBERGLASS SEATS ARE FITTED WITH UPHOLSTERED CUSHIONS AND ARE DESIGNED FOR MAXIMUM COMFORT. SEAT MATERIALS ARE READILY CLEANABLE AND RESISTANT TO VANDALISM. CUSHIONS ARE EASILY REPLACED IF REQUIRED.

FROM THE FULLY CARPETED FLOORS TO THE PLEASING LINES OF THE CEILING THESE CARS DEMONSTRATE THE BEST OF TODAY'S TECHNOLOGY IN MAKING MASS TRANSPORTATION A PLEASANT AND COMFORTABLE INTERLUDE FOR THE COMMUTER.

HIGH DENSITY CAR

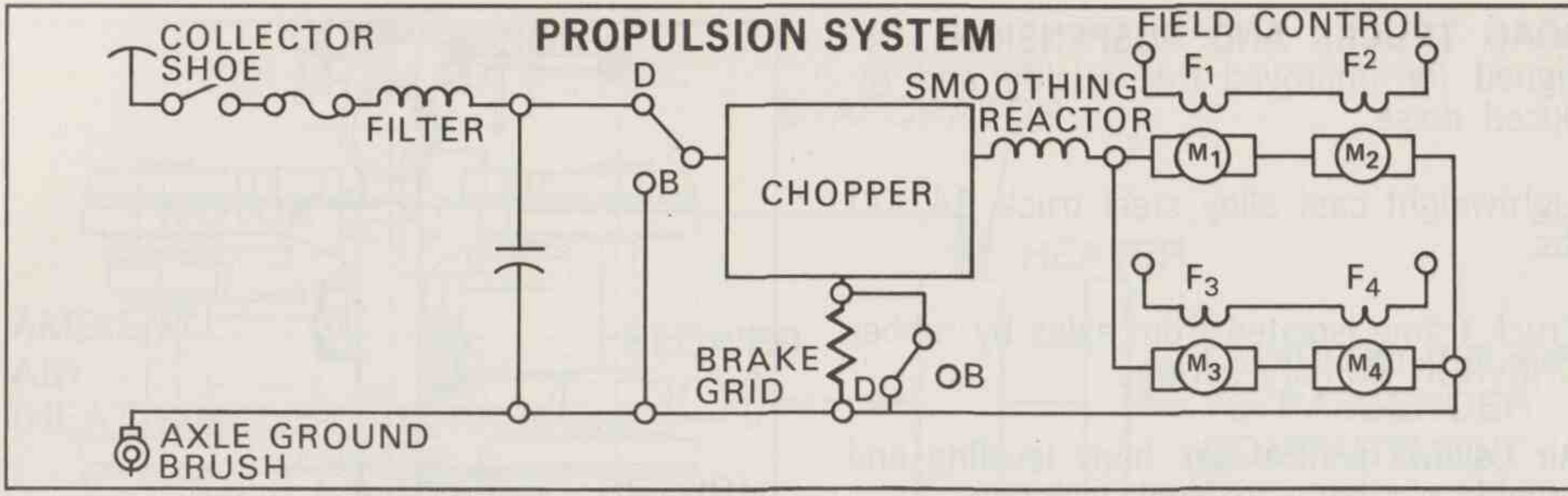
LOW DENSITY CAR

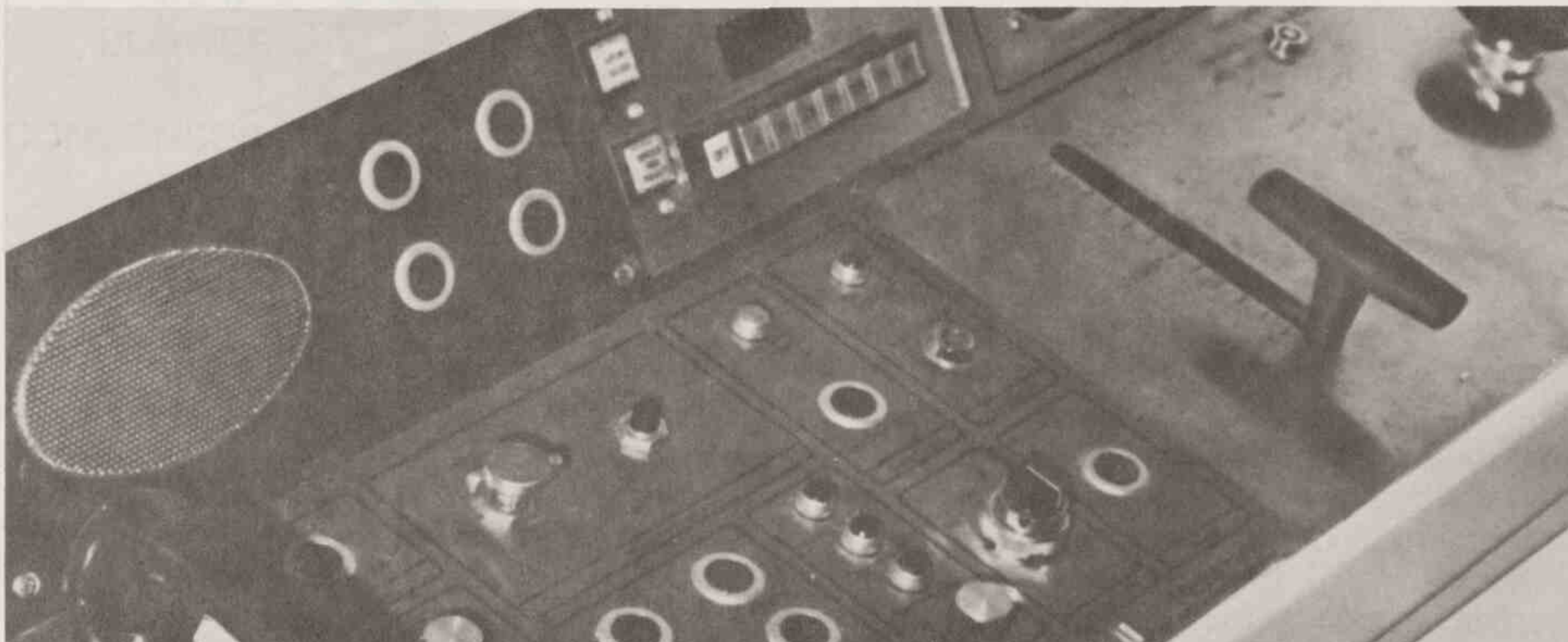
SOAC PROPULSION SYSTEM



Designed for Increased Efficiency, Smooth Operation, Improved Reliability and Reduced Maintenance.

- **Motors:** Four truck-mounted 175 hp (continuous rating) separately excited field, fully-compensated DC motors. Constant flow forced air motor ventilation.
- **Drive:** Double reduction, helical gears partially immersed with supplemental directed flow lubrication and elastomer-metal coupling.
- **Control:** Solid-state chopper utilizing thyristors to vary voltage from power source to the motors and incorporating speed maintaining systems.
- **Dynamic Braking:** Utilizing motors as generators to provide smooth retardation from maximum speeds down to zero.
- **Friction Braking:** Pneumatic tread brakes capable of providing full emergency braking with electro-pneumatic analog control.


PROPULSION SYSTEM
COLLECTOR SHOE
FILTER
D
B
CHOPPER
SMOOTHING REACTOR
FIELD CONTROL
F_1
F^2
M_1
M_2
F_3
F_4
M_3
M_4
BRAKE GRID
D
B
AXLE GROUND BRUSH

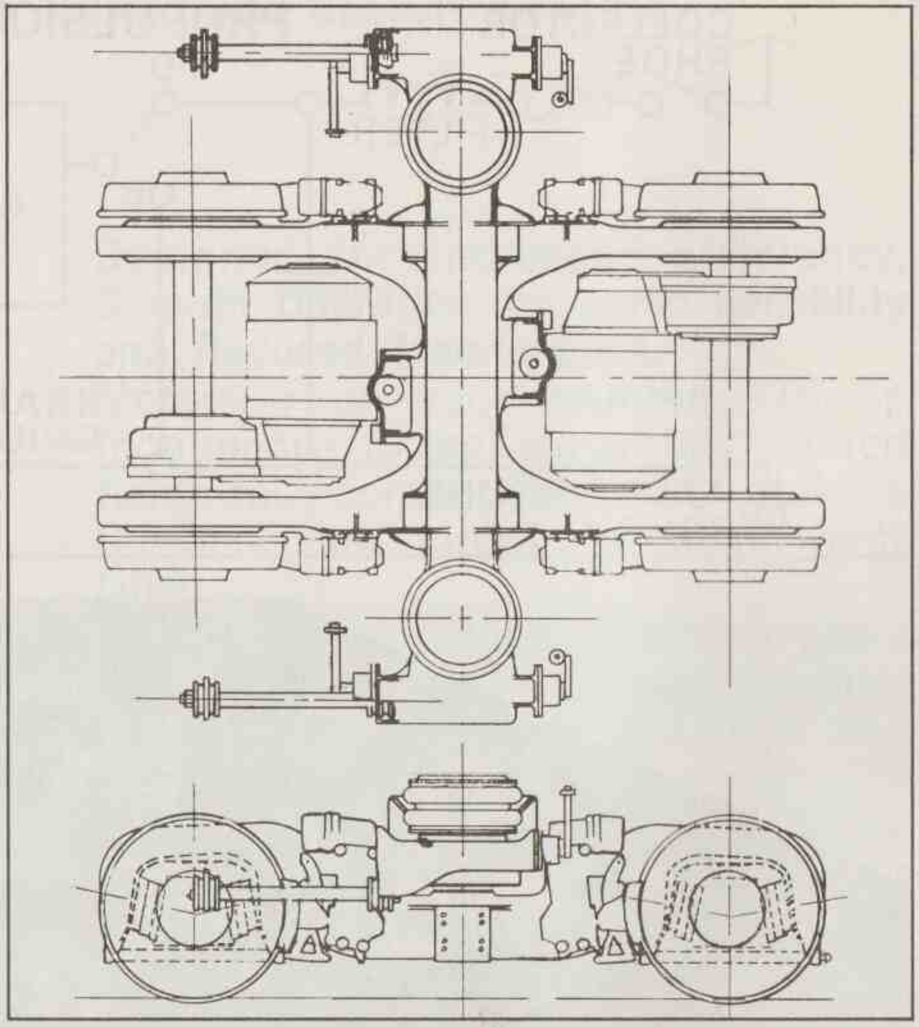


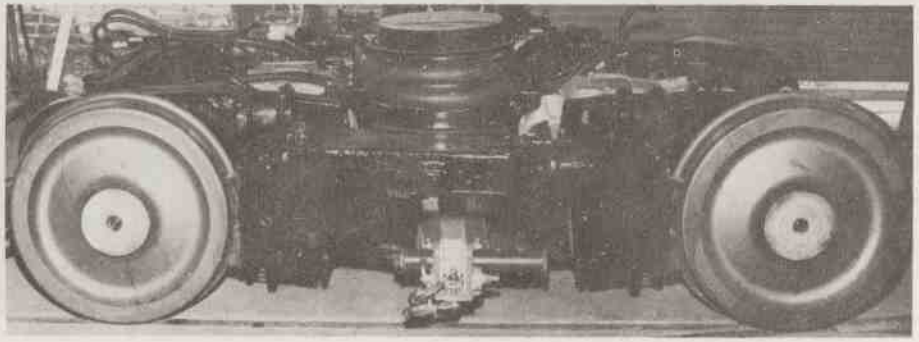
SOAC TRUCKS AND SUSPENSION: Designed for improved ride quality and reduced noise.

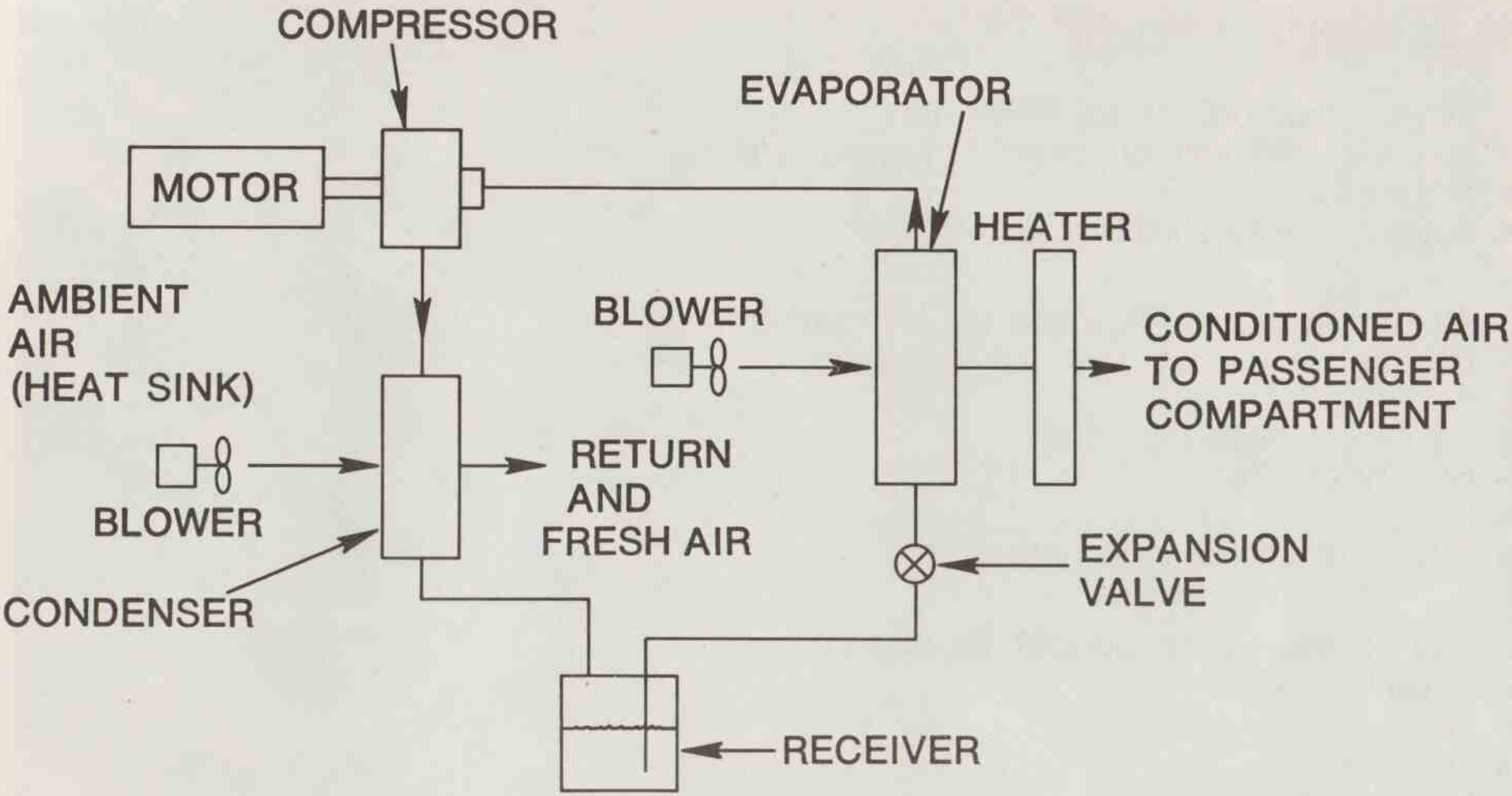
Lightweight cast alloy steel truck. 14,000 lbs.

Truck frame isolated from axles by rubber CHEVRON primary springs.

Air bellows control car body leveling and provide car body to truck isolation.







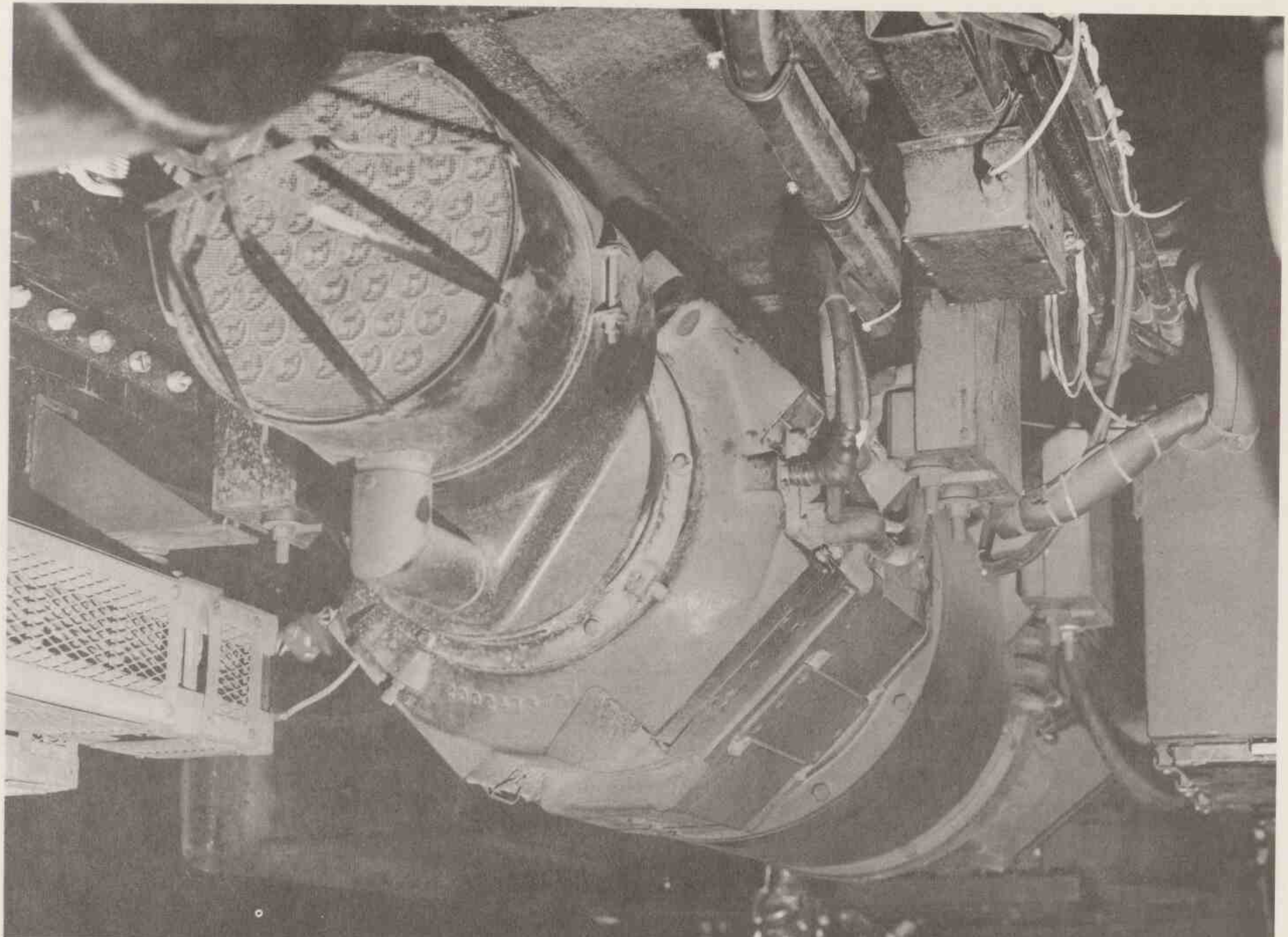
SOAC HVAC SYSTEM: Heating, Ventilating and Air-Conditioning: Designed for all-season passenger comfort. ■ Two independent 8-ton air-conditioning systems, each separately controlled by its own temperature control panel and thermostats. ■ 75°F maximum interior temperature maintained over an outside temperature range of—15°F to 105°F. ■ 1800 cubic feet of fresh air circulated per minute. ■ Smaller size alternating current motors resulting in lighter weight and improved reliability.

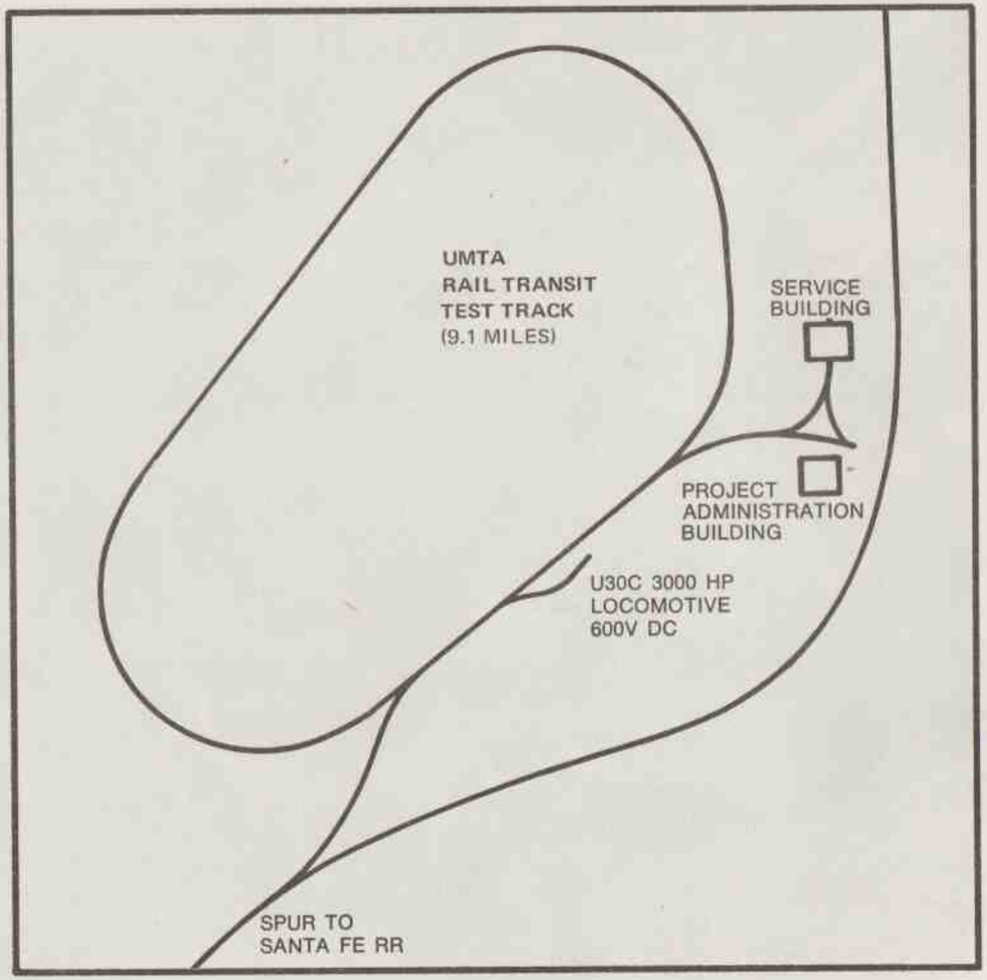
SOAC AUXILIARY POWER:

Single Shaft D.C. Motor-Alternator:
- Provides 230 volt 60 cycle 3-phase alternating current
- Self-ventilated
- Automatic load shedding and restart

All Car Auxiliaries Powered by Alternating Current:
- Heating, ventilation, and air conditioning
- Air compressor
- Equipment ventilation fans
- Battery charger
- Lights
- Other miscellaneous equipment

Use of Alternating Current Results In:
- Smaller size motors
- Lower cost
- Improved reliability
- Reduced maintenance
- Lower weight





SOAC TESTING: SOAC system tests were accomplished on the Urban Mass Transportation Administration's Rail Transit Test Track at the U.S. Dept. of Transportation's High Speed Ground Test Center in Pueblo, Colorado. The Test Track consists of an electrified 9.1 mile oval with variations in curve, grade, and track characteristics. System tests included the measurement of speed, acceleration, braking, noise levels, ride quality and radio frequency interference. Functional tests were made of operating characteristics, safety and emergency systems.

SOAC OPERATIONAL TEST and EVALUATION:

Operation of the STATE-OF-THE-ART CARS on existing rapid transit systems allows first-hand evaluation of current technology by transit and public officials, the business community and the riding public. The chart below indicates the city, transit operator and routes where SOAC will be operated.

City	Operator	Line
New York	New York City Transit Authority (NYCTA)	6th Ave. 8th Ave. (Others)
Boston	Massachusetts Bay Transportation Authority (MBTA)	Cambridge-Dorchester/Quincy
Philadelphia	Southeastern Pennsylvania Transportation Authority (SEPTA)	Broad street
Cleveland	Cleveland Transit System (CTS)	Windermere-Airport
Chicago	Chicago Transit Authority (CTA)	Skokie Swift

Sponsored by:
U. S. DEPARTMENT OF TRANSPORTATION
Urban Mass Transportation Administration
400 7th Street S.W.
Washington, D.C. 20590

Systems Manager:
Boeing Vertol Company

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