AMTRAK

SPECIFICATION

FOR

FREEZE PROTECTION

SYSTEM

SPECIFICATION NO. 531

APPROVED	DATE	REVISION	DATE
R F Bruss	3/30/90		
[illegible]	04/02/90		
[illegible]	4/30/90		

ISSUED: APRIL 30, 1990

ORIGINATOR
R. F. BRUSS

ENGRE.141

SPECIFICATION NO. 531 CHANGE SHEET

REVISION LEVEL	DATE	PAGE	DESCRIPTION

CONTENTS

PARAGRAPH	TITLE
1.0	SCOPE
	1.1 Purpose
	1.2 General
	1.3 Function
	1.4 Supplier Responsibilities
2.0	GENERAL
	2.1 Configuration
	2.2 Location
	2.3 General Arrangement
	2.4 Shipping
3.0	DESIGN CONSIDERATIONS
	3.1 Environment
	3.2 Normal Operation
	3.3 Component Mounting
	3.4 Wiring and Termination
	3.5 Codes and Standards
4.0	COMPONENTS
	4.1 Heat Tape Installations
	4.2 Sink Drains - Interior
	4.3 Shower Drain
	4.4 Annunciator Panel
	4.5 Wiring
	4.6 Vendor Nameplate
5.0	TESTING
	5.1 Qualifications Test
	5.2 Acceptance Test
6.0	SYSTEM APPROVAL
	6.1 General
	6.2 Design Review
	6.3 Documentation
	6.4 First Article Inspection
	6.5 Approved Products

CONTENTS (continued)

7.0 PRODUCT SUPPORT

7.1 Drawings
7.2 Maintenance Manual
7.3 Photographs

8.0 APPLICABLE DOCUMENTS

8.1 Reference Documents
8.2 Reference Drawings

APPENDIX

Figure 1 Freeze Protection - Sleeper
2 Freeze Protection - Lounge
3 Freeze Protection - Coach
4 Freeze Protection - Diner

1.0 SCOPE

1.1 Purpose

This specification defines the requirements for a freeze protection system for use on Amtrak Viewliner passenger cars.

1.2 General

This specification is subordinate to the General Vendor Requirement Specification No. 327, which shall take precedence unless specifically excepted in this specification.

1.3 Function

The freeze protection system consists of 120VAC electrical heaters at various car locations to protect car water, drain and sewage systems from freezing in cold weather. In addition, it includes air and water sensing thermostats, contactors and indicators, to control and monitor the heaters.

1.4 Supplier Responsibilities

The General Vendor Requirements Specification 327 defines the supplier responsibility in the following areas:

a. System Approach
b. Program Planning
c. System Development
d. Construction and Workmanship
e. Nameplates
f. Testing
g. Acceptance Testing
h. Product Support
i. Detailed Documentation Requirements

2.0 GENERAL

2.1 Configuration

2.1.1 Heaters

Freeze protection heaters will take the following forms:

Function	Device
Water tanks	Self-limiting heat tape
Water piping under car	Self-limiting heat tape
Fill valves	Self-limiting heat tape
Sink Drains	Heated Pipe Assembly- Interior
Shower Drains	Self-limiting heat tape
Refrigeration Drains	Cartridge heaters
Sewage piping undercar	Self limiting heat tape
Automatic drain valve heaters	(Cartridge heater - part of water system - see Spec. No. 339).

2.1.2 Thermostats

Two thermostats will control freeze protection heaters:

1. Well-mounted thermostat, for water tank heat control, set a 55F.

2. Explosion-proof well installation, sensing ambient air temperature, for all other freeze protection control, set at 45F.

2.1.3 Contactors

Freeze protection contactors will be used to control freeze protection heat. These will be part of the Auxiliary Contactor panel, as defined in Amtrak Specification 528.

2.1.4 Annunciator Panel

The status of freeze protection thermostats and contactors will be displayed on the car temperature control panel, through the use of green and amber LED's. This panel will also incorporate a circular connector, wired to the car's thermostats, which provides access for the temperature control test unit described in Amtrak Specification No. 308 Temperature Controls.

2.2 Location

Freeze protection heaters are installed as follows:

2.2.1 Water Tanks

Heat tape is helically wrapped around the tank and secured in place with aluminum tape. Valves are thermally insulated from carbody by standoffs.

2.2.2 Water Piping Undercar

Heat tape is run parallel to all the piping and secured in place with aluminum tape. At least a single run is made along small diameter piping; at least 2 runs are made along larger pipe sizes, 1½"od and larger.

2.2.3 Fill Valves

Heat tape is wrapped around the valve bodies and secured with aluminum tape and ty-wraps. (Valves are thermally insultaed from carbody by standoffs.)

2.2.4 Sink Drains - Interior

Sink drains, including:

- all sleeping car sinks
- lounge galley sinks
- coach toilet sinks
- diner galley sinks

will be equipped with heated drains, located within the car interior, immediately above the floor.

2.2.5 Shower Drains

Shower drains will be equipped with heater assemblies, mounted undercar at the drain outlet.

2.2.6 Refrigeration Drains (Refer to Spec. Nos. 350 and___)

2.2.7 Sewage Piping Undercar (Refer to Spec. No. 317)

Heat tape will be run in at least two (2) parallel runs along all under car piping, and secured in place with aluminum tape. On sleepers, a separate segment of heat tape will originate at each toilet bowl junction box, and passing through the floor, will provide heat for about 8 feet of the sewage trunk line undercar.

2.2.8 Automatic Drain Valve Heaters

These heaters are part of the automatic drain valves, used throughout the car to automatically drain car water at low car interior temperatures (refer to Amtrak spec #339). The heaters provide heat to the valve temperature sensor so the valve closes quickly when the car is restored to power after being in storage. This allows filling car water tanks after only a short wait, rather than having to wait for the car interior to warm up.

2.2.9 Thermostats

The water tank thermostat will be mounted within a well in the undercar water tank, thus sensing water temperature. (An access door will be provided in the tank shroud to service the thermostat.) The air-sensing thermostat will be in an explosion proof installation under, to sense ambient air temperature. The assembly shall be located so as to avoid influence of sun light, brake heat, and other sources of undercar heat.

2.2.10 Contactor Panel

The panel will be located in the electric locker.

2.2.11 Annunciators (Temperature Control Panel)

The temperature control panel will be located in the switch locker.

2.3 General Arrangement

For installation details, refer to figures 1-4.

2.4 Shipping

Freeze Protection System Components shall be packaged to protect against damage during shipment and storage prior to use. The shipping label shall include the following information as a minimum:

(a) Part name
(b) Manufacturer name
(c) Type/catalog/part number
(d) Serial number
(e) Manufacture date
(f) AMMS number (Amtrak part number)
(g) Warning and safety precautions for shipping and storage (this side up do not stack, etc.)

Preparation for delivery shall assure arrival at the destination without degradation of hardware and performance.

3.0 DESIGN CONSIDERATIONS

Freeze Protect System design must include the following goals:

(a) Safety
(b) Reliability
(c) Maintainability
(d) Availability
(e) Interchangeability

3.1 Environment

The railroad environment is severe and imposes considerable demands on the system. Refer to Amtrak specification 60-429 Environmental Operating Conditions for details. For purposes at that specification, the Freeze Protection System constitutes a vital system. Power source for freeze protection equipment will be 120VAC, 30/, 60 Hz. The freeze protection system must protect car equipment from freezing at a temperature down to at least -40F, during normal train operation. Particular attention must be paid to protecting the electrical connections from moisture due to the wet environment in which the heaters often operate. Design shall anticipate and protect against heater failure from routine mechanical problems, such as toilet and sink overflowing, etc. Heat tape installation shall protect the tape from mechanical damage. Undercar application of heat tape shall not expose the tape directly to the elements in any location. Heating system sizing shall be coordinated with related equipment insulation; refer to respective specifications.

Tests must be run to determine adequacy of proposed heaters.

3.2 Normal Operation

In normal operation, the freeze protection system is passive, requiring no crew interaction. Car belly tank water temperature is maintained at approximately 55F, and undercar piping drains, fill valves, etc., are activated when ambient temperatures drop below 45. Indicator lights provide Amtrak maintenance personnel with system status indication. Water tank freeze protection shall be a balanced, 3-phase 120VAC load.

Other freeze protection heaters shall be arranged so as to present a balanced 3 phase load both at cold startup, as well as during cycling on local heater thermostats, i.e., all heat tapes should not be on one phase while drain heaters are on another, etc.).

3.3 Component Mounting

All components of the freeze protection system shall be mounted so as to make servicing easy. As much as possible, it shall be possible to remove any freeze protection system component without disturbing any other car components. Heat trace tape shall be installed so fittings which must be accessed for normal servicing, such as valves, can be serviced without cutting or disconnecting the heat tape. It shall be possible to renew sewage piping heat trace tape by simply pulling new tape through the floor - heat tape shall not be permanently imbedded in the floor penetration seal by potting.

3.4 Wiring and Terminations

Wiring to heaters will terminate on terminal blocks located in a small junction box near each heater. Junction boxes shall be moisture resistant if within car interior, and water proof if located outside the carbody. Sewage piping heat tape terminations will share the toilet stand junction box.

Spacing between these components shall be such that all internal and external connection points are readily accessible. The design shall also insure that adequate space is provided to prevent any wiring from being crushed by mechanical components, being sharply bent, or located adjacent to surfaces where vibrations from device operation could create failure due to insulation abrasion. Adequate clearance shall also be provided between all exposed electrical contacts and terminals and adjacent conductive components and surfaces. Protective edging shall be used as required to protect against wire abrasion.

Heat tapes shall be terminated at both ends with termination kits, as supplied by the heat tape supplier.

3.5 Codes and Standards

Heaters and thermostats must meet applicable grounding requirements of the National Electrical Code, and applicable NEMA standards.

4.0 COMPONENTS

4.1 Heat Tape Installations

Heat tape assembly shall be supplied complete as a kit, including:

- o heat tape
- o end termination kit (both ends)
- o aluminum mounting tape
- o ty-wraps (as required)

4.2 Sink Drains-Interior

The assembly shall include:

- ocopper tubing, length sufficient to fully penetrate car floor
- oheater element with high limit thermostat and red LED to indicate when power is on
- ohousing, potted to encapsulate the heater element, etc, onto the copper tubing
- oflexible "rubber" hose, which is looped to form trap for sink drain.

The complete assembly shall be removable from inside car without disassembly of adjacent plumbing and toilet equipment. Heater assembly shall be electrically grounded for safety.

4.3 Shower Drain

Design shall ensure shower drain never gets hot enough to startle a passenger who steps on it barefoot. Assembly shall be electrically grounded for safety.

4.4 Annunciators

The temperature control panel is defined in Amtrak Specification No. 308. The circular connector connects thermostat wiring to the panel, by disconnecting the connector and mating it with the test unit, it is possible to:

- oDetermine state (open or closed) of each thermostat
- oSimulate open or closed thermostat condition to test operation of freeze protection equipment.

4.5 Wiring

Wiring shall be stranded wire, as per Amtrak Specification No. 323, "High Performance Wire and Cable.

Wiring will be terminated using crimp-type pre-insulated ring-tongue lugs, per Amtrak specification No. 359. Wiring shall be adequately secured in position, using ty-wraps, screw-down cable clamps, etc. Cable clamps secured by an adhesive are not acceptable for this purpose. All wires shall be labeled on both ends using heat-shrink tubing type labels, per Amtrak Specification No. 319. Wires 4" or less in length need only 1 label. Certified crimp tools will be used on all crimped connections.

4.6 Vendor Nameplate:

Each assembly shall be labeled as follows:

Vendor name
Vendor part number
Date of manufacture
Amtrak AMMS number
Serial number

5.0 TESTING

5.1 Qualification Test (one sample each type)

A qualification test plan (QTP) shall be submitted for Amtrak approval in a timely fashion prior to the manufacturer's intent to perform the test.

The qualification test is an engineering proof-of-design test, and will be run on one sample of each component configuration.

All vibration testing is to be performed in accordance with MIL-STD-202 Vibration test Method 204, test condition D, with the equipment powered.

The QTP shall, as a minimum, demonstrate the following:

1. Proper operation of thermostats.
2. High potential test (2 x circuit voltage 1,000v for one minute)
3. Logic check
4. Cold room test to determine adequacy of heaters to prevent freezing
5. Thermal cycling test - to determine if heaters degrade from effects of thermal cycling 10,000 cycles.

Amtrak reserves the right to request additional tests as may be required.

5.2 Acceptance Tests

An Acceptance Test Plan (ATP) shall be submitted for Amtrak approval at the same time the qualification test plan is submitted.

The acceptance test is a quality control test used to ensure all panels produced are built consistently and operate properly.

The ATP shall, as a minimum include the following:

1. Mechanical inspection
2. High potential test (2 x circuit voltage 1,000v for one minute)
3. Operational Test for each thermostat
4. Current measurement of each heater
5. Operation of indicator lights.

Also Refer to specification #366, car tests

6.0 SYSTEM APPROVAL

6.1 General

Thermostats and installations as well as each type of freeze protection heater and its installation will be submitted to Amtrak approval. All major components shall be submitted for approval.

6.2 Design Reviews

Design reviews shall be held at times mutually agreed upon between Amtrak and the manufacturer of the system; such reviews are intended to convey design concepts not readily shown on equipment drawings.

6.3 Documentation

For system approval, the manufacturer of the system shall submit, as a minimum, the following drawings and documents:

1. System bill of material
2. System arrangement
3. System electrical schematic
4. System interconnection diagram

5. Component (assembly) interface drawings, showing:
   a. Outline and mounting dimensions
   b. Weight and center gravity
   c. Electrical connections
   d. Electrical schematic
   e. Bill of materials
6. Component cut sheets
7. Qualification test plan
8. Acceptance test plan

Amtrak reserves the right to request additional drawings and documents as required for system approval.

6.4 First Article Inspection

Prior to the delivery of the first production system, each component type shall be subject to a first article inspection. Such inspection shall include but not be limited to:

a. A mechanical inspection to determine compliance with the specification and approved drawings.

b. The performance of an acceptance test.

c. The performance of the qualification test. (It is permissible to have the vibration, testing previously performed at an independent testing laboratory, the results being available at the first article inspection).

Successful completion of the first article inspection shall constitute final system approval.

6.5 Approved Products

Only products which have successfully operated in Amtrak service for 1 year minimum will be considered for use on production cars. The following products have been successfully demonstrated in Amtrak service:

Heat Tape
Nominal8 watt/foot, 120VAC
Raychem No. TLT-120-CC-CR

Aluminum Tape
Raychem No. AT-150

End Seal/Termination Kit
Raychem No. STK-1

Heated Drain

1¼"	Ogontz No. 2-3-4-65-009
1½"	Ogontz No. 2-3-4-65-010
	Ogontz No. 2-3-4-65-002

Well-Type Thermostat, Assy Water Tank
Fenwal No. 80016-4-55 O,R,

Air Sensing Thermostat Assy,
Fenwall No. 80016-4-45 O,R,

7.0 PRODUCT SUPPORT

7.1 Drawings

All assembly, subassembly, and arrangement drawings shall include a complete bill of material and parts list on the field of the drawing describing all items, including vendor's parts, which form a part of the assembly. Amtrak shall reserve the right to review and approve all drawings prior to construction of a prototype system.

Amtrak shall be supplied, upon completion of the system design, with one set for first generation (not DIAZO) 35 mm file (mounted in accordance with Amtrak Specification No. 199 of all assembly drawings, diagrams, schematics, etc.

7.2 Maintenance Manual

The equipment supplier shall provide a maintenance manual in accordance with Amtrak Specification No.10-353. Manual draft shall be presented for Amtrak approval.

7.3 Photographs

A set of photographs shall be supplied showing the following features of the system:

- each heater type
- each heater type installation
- each thermostat type
- each thermostat type installation
- contactor panel
- other salient features of the system

8.0 APPLICABLE DOCUMENTS

8.1 Reference Specifications

The following shall be considered part of this specification:

Amtrak Specification No.	Name
199	Microfilm
319	Wire, Terminal, Terminal Block, Contactor/Relay and Connector Identification
323	High Performance Wire and Cable
327	System and Component Vendor Responsibility
328	Materials and Workmanship
352	Flame Smoke and Toxic Gas
353	Vendor Maintenance Manual
354	Carbuilder Operating and Maintenance Manual
359	Solderless Wire Termination
429	Environmental Operating Conditions
308	Temperature Control System
317	Waste System
339	Water System
528	Relay and Contactor Panels
350	Food Service Equipment Diner
366	Car Testing
309	System Control Panels

8.2 Reference Drawings

The following drawings shall be considered part of this specification:

D-37-2956 Electrical Schematic-Freeze Protection Sleeper
D-04-2641 Installation - Freeze Protection

Figure 1-4

Arrangement - Freeze Protection - Sleeper
Arrangement - Freeze Protection - Lounge
Arrangement - Freeze Protection - Coach
Arrangement - Freeze Protection - Diner