File No. 140928 Committee Item No. 1
Board Item No. _____

COMMITTEE/BOARD OF SUPERVISORS

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Committee: Budget & Finance Committee **Date** October 1, 2014

Board of Supervisors Meeting **Date** _____

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Completed by: Linda Wong **Date** September 26, 2014
Completed by: _____ **Date** _____

[Contract Amendment - AnsaldoBreda, Inc. - Light Rail Vehicle Reconditioning and Systems Rehabilitation - Not to Exceed $104,263,354]

Resolution approving Amendment No. 2 to Contract No. APT 591.01, Light Rail Vehicle (LRV) Doors and Steps Reconditioning and Systems Rehabilitation, between the City and County of San Francisco, through the San Francisco Municipal Transportation Agency and AnsaldoBreda, Inc., to remove the doors and steps and air supply unit work from the project scope and shift the balance of the money to rehabilitate the trucks of 41 LRV's with three options to rehabilitate the trucks of 24, 24, and 23 LRV's, respectively, if funds become available, for a total contract amount not to exceed $104,263,354 and to extend the term of the contract to no later than October 31, 2018.

WHEREAS, On October 29, 2009, the City and County of San Francisco, through the San Francisco Municipal Transportation Agency ("SFMTA") and AnsaldoBreda Inc. (Contractor) entered into Contract No. APT 591.01 for the reconditioning of the doors and steps and rehabilitation of other systems in 143 of SFMTA's light rail vehicles (LRVs), for a total amount not to exceed $56,752,554, and for a term not to exceed five years; and

WHEREAS, On June 2, 2010, the City and contractor entered into Amendment One to the Contract, to perform a complete rehabilitation of the trucks of 34 LRVs for $11,996,867, for a total Contract amount not to exceed $68,749,421, and to extend the term of the Contract from five years to six years; and

WHEREAS, Maintenance records show that rehabilitation of the doors and steps and the air supply units (the DS/ASU work) has not significantly improved the reliability of these systems, but the trucks of the LRV have shown significant reliability after rehabilitation; and

WHEREAS, This Amendment Two will remove the DS/ASU work from the project scope and shift the balance of the money to rehabilitate the trucks on 41 additional trucks,

with three options to perform rehabilitation of the trucks on 24, 24 and 23 LRVs, respectively, if funds become available to do the work; and

WHEREAS, Amendment Two provides that exercising the option(s) will be within the sole discretion of the Director of Transportation, subject to funding availability; and

WHEREAS, The Contract authorizes the SFMTA to terminate the Contract or any portion of the Contract for convenience with proper compensation to the Contractor for work that has been satisfactorily performed; and

WHEREAS, The termination costs for deleting the DS/ASU work are included in Amendment Two; now, therefore, be it

RESOLVED, That the Board of Supervisors authorizes the Director of Transportation to execute Amendment Two to Contract No. APT 591-01 – LRV Doors and Steps Reconditioning and Systems Rehabilitation, with AnsaldoBreda Inc., to remove the doors and steps and the air supply unit rehabilitation from the project scope and to shift the funds to rehabilitate trucks for 41 LRVs, with three options to rehabilitate the remaining sets of trucks for up to 71 LRVs (which options may be exercised within the sole discretion of the Director of Transportation subject to funding availability), for a total Contract amount not to exceed $104,263,354; and to extend the term of the contract to no later than October 31, 2018; and, be it

FURTHER RESOLVED, That within thirty (30) days of Amendment Two being fully executed by all parties, the SFMTA shall provide the final Amendment Two to the Clerk of the Board for inclusion into the official file.

CITY AND COUNTY OF SAN FRANCISCO

BOARD OF SUPERVISORS

BUDGET AND LEGISLATIVE ANALYST

1390 Market Street, Suite 1150, San Francisco, CA 94102 (415) 552-9292
FAX (415) 252-0461

September 26, 2014

TO: Budget and Finance Committee

FROM: Budget and Legislative Analyst

SUBJECT: October 1, 2014 Budget and Finance Committee Meeting

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Item 1 File 14-0928	Department: Municipal Transportation Agency (MTA)

EXECUTIVE SUMMARY

Legislative Objectives

The proposed resolution would approve the second amendment to the existing contract between the Municipal Transportation Agency (MTA) and AnsaldoBreda, Inc. (Breda). The second amendment would: (1) eliminate rehabilitation of the doors and steps system and the air supply system from the scope of work of the existing contract because this work could be completed in-house by the MTA; (2) add rehabilitation of the trucks of an additional 41 light rail vehicles; and (3) authorize the Director of Transportation, at his sole discretion, to exercise three future contract options for Breda to rehabilitate a total of 71 additional light rail vehicles.

The proposed resolution would increase the not-to-exceed amount of the contract between MTA and Breda by $35,513,933 from $68,749,421 to $104,263,354, and extend the term of the contract by three years from October 2015 through October 2018.

Key Points

- MTA entered into the original contract with Breda in October 2009 for a five-year term from November 2009 through October 2014 and for an amount not to exceed $56,752,554 to rehabilitate key components of the MTA light rail vehicle fleet. MTA amended the contract in June 2010 to (1) expand the scope of work to provide for scheduled rehabilitation of the trucks of 34 light rail vehicles, (2) extend the term by one year from October 29, 2014 through October 29, 2015, and (3) increase the contract not-to-exceed amount by $11,996,867 from an amount not to exceed $56,752,554 to an amount not to exceed $68,749,421.
- Under the second amendment, door, step system, and air supply system services currently performed by Breda will be eliminated from the contract and performed by MTA staff instead.

Fiscal Impact

- The proposed second amendment to the existing contract between Breda and the MTA would increase the total contract not-to-exceed amount by $35,513,933 from an amount not to exceed $68,749,421 to an amount not to exceed $104,263,354, which includes three future options to rehabilitate an additional 71 light rail vehicles. The Budget and Legislative Analyst recommends amending the proposed resolution to require Board of Supervisors approval of the three future options in order for MTA to report on their evaluation of Breda's performance prior to exercising the options.

Recommendations

- Amend the proposed resolution to (1) reduce the contract not-to-exceed amount by $29,613,740 from the requested not-to-exceed contract amount of $104,263,354 to a not-to-exceed contract amount of $74,649,614 and (2) state that the three future contract options would require Board of Supervisors approval prior to the Director of Transportation exercising the option.
- Approve the proposed resolution as amended.

MANDATE STATEMENT / BACKGROUND

Mandate Statement

City Charter Section 9.118(b) states that a contract entered into by a department, board or commission that (1) has a term of more than ten years, (2) requires expenditures of $10 million or more, or (3) requires a modification of $500,000 or more is subject to Board of Supervisors approval.

Background

The San Francisco Municipal Transportation Agency (MTA) currently operates 151[1] light-rail vehicles to provide mass transportation over 71.5 miles of track throughout the City. The current fleet of light-rail vehicles started operating in 1996 with an estimated 25-year operating life through 2021. AnsaldoBreda, Inc. (Breda), a private for-profit company, built and assembled the current fleet of MTA light-rail vehicles.

According to the MTA, the Breda light rail vehicles are failing regularly. On average, only 114, or approximately 75 percent, of the current fleet of 151 light rail vehicles operates on a daily basis with the remaining 37 vehicles needing maintenance and repair.

Table 1 below shows the MTA actual costs of labor and parts expended to maintain and repair the current fleet from January 2014 through June 2014 and includes the annual estimated costs.

Table 1: Light Rail Vehicle Maintenance and Repair Costs

	Actual Labor Costs Jan – June 2014	Actual Materials Costs Jan - June 2014	Total Costs Six Months	Annual Estimated Costs
Propulsion System	$862,861	$3,889,220	$4,752,081	$9,504,162
Advanced Train Control System	1,922,752	2,598,293	4,521,045	9,042,090
Door and Steps	1,145,094	871,816	2,016,910	4,033,820
Lighting	289,974	772,952	1,062,926	2,125,852
Trucks	531,986	526,312	1,058,298	2,116,596
Power Supply	557,521	394,154	951,675	1,903,350
Heating, Ventilation, and Air Conditioning	589,593	220,241	809,834	1,619,668
Brakes	339,842	371,653	711,495	1,422,990
Coupler and Draft Gear	312,506	300,073	612,579	1,225,158
Communications	133,295	296,935	430,230	860,460
Total	**$6,685,424**	**$10,241,649**	**$16,927,073**	**$33,854,146**

Source: San Francisco Municipal Transportation Agency, Budget and Legislative Analyst's Office

[1] According to the MTA Transit Fleet Management Plan (March 2014), two light-rail vehicles are damaged beyond repair and cannot return to service. There are four additional vehicles that are scheduled to return to service some time in calendar year 2015.

Contract for Rehabilitation

In May 2009, the MTA issued a competitive Request-for-Proposals (RFP) for a new contract to rehabilitate key components of the MTA light rail vehicle fleet including: (a) reconditioning the doors and steps systems, (b) rehabilitating the couplers systems, the air supply units, and a portion of the cable system, (c) upgrading the articulation wire harness, (d) replacing the resilient pins in the articulation section, and (e) replacing the bearings in the traction motor. Breda submitted the lone proposal and was awarded the contract in September 2009.

In October 2009, the Board of Supervisors approved a resolution (File 09-1109) to approve the contract between the City and Breda for a five-year term from November 2009 through October 2014 and for an amount not to exceed $56,752,554.

In June 2010, the Board of Supervisors approved a resolution (File 10-0030) to amend the original contract (first amendment) to (1) expand the scope of work to provide for scheduled rehabilitation of the trucks of 34 light rail vehicles, (2) extend the term by one year from October 29, 2014 through October 29, 2015, and (3) increase the contract not-to-exceed amount by $11,996,867 from an amount not to exceed $56,752,554 to an amount not to exceed $68,749,421. The increased contract amount for the first amendment was funded by federal American Reinvestment and Recovery Act (ARRA) grant funds awarded to the MTA.

According to the Budget and Legislative Analyst's report to the May 19, 2010 Budget and Finance Subcommittee, MTA considered issuing a new RFP to rehabilitate the trucks of 34 light rail vehicles rather than amending the existing contract between MTA and Breda, but determined that because Breda was the only proposer for the existing contract, Breda would also likely be the sole proposer if a new RFP were issued. According to MTA, federal law allowed for the award of the proposed first amendment, funded by federal ARRA grant funds, as a sole source contract if undergoing a competitive process would likely result in (a) only one bid, (b) substantial increased cost, or (c) unacceptable delay in the project.

DETAILS OF PROPOSED LEGISLATION

The proposed resolution would approve the second amendment to the existing contract between the City and Breda. The proposed second amendment would:

(1) Eliminate rehabilitation of the doors and steps system and the air supply system from the scope of work of the existing contract because this work could be completed in-house by the MTA;

(2) Add rehabilitation of the trucks of an additional 41 light rail vehicles; and

(3) Authorize the Director of Transportation, at his sole discretion, to exercise three future contract options for Breda to rehabilitate the trucks of additional light rail vehicles: trucks of 24 light rail vehicles under the first option, trucks of 24 of the light rail vehicles under the second option, and trucks of 23 light rail vehicles under the third option, or a total of 71 additional light rail vehicles.

The proposed resolution would increase the not-to-exceed amount of the contract between the City and Breda by $35,513,933 from an amount not to exceed $68,749,421 to an amount not to

exceed $104,263,354, and extend the term of the contract by three years from October 2015 through October 2018.

According to Mr. Elson Hao, MTA Principal Engineer, MTA decided to negotiate the second amendment with Breda, rather than undergoing a competitive RFP process because the MTA has been satisfied with Breda service on the all the light rail vehicle systems under the existing contract, other than the rehabilitation of the doors and steps system and the air supply system which are being removed from the scope of work.

Removal of the Doors and Steps System, and the Air Supply System from the Scope of Work

According to Mr. Hao, the Breda process for replacing the doors and steps systems requires the MTA to dedicate eight vehicles at a time for rehabilitation, takes over 30 days because Breda removes the doors and transports them to the initial manufacturer for rehabilitation, and has not significantly improved the rate of failure for these systems. According to Mr. Hao, the Breda services to the air supply system have also not produced significant improvements in the failure rate. According to Mr. Hao, the MTA can provide a higher level of service by using its own mechanics in-house, which will reduce the number of vehicles dedicated to rehabilitation and increase the number available for service within a faster time frame than Breda.

According to Mr. Hao, the MTA will be able to realign its existing group of mechanics to absorb the door and steps system and air supply system work without requiring additional mechanics or related costs.

Rehabilitation of 41 Light Rail Vehicles

According to Mr. Hao, rehabilitation of the trucks of 41 light rail vehicles is necessary because these vehicles have travelled between 200,000 and 400,000 miles since entering revenue service and have exceeded their mid-life of 12.5 years. MTA needs to perform rehabilitation of the various systems of these 41 light rail vehicles in order to keep the vehicles in a good state of repair. According to Mr. Hao, MTA's maintenance data shows that the rehabilitation of light rail vehicles by Breda under the existing contract has significantly improved the reliability of these vehicles.

FISCAL IMPACT

The second amendment to the existing contract between Breda and the MTA would increase the total contract not-to-exceed amount by $35,513,933 from an amount not to exceed $68,749,421 to an amount not to exceed $104,263,354 for (1) rehabilitating the trucks of 41 light rail vehicles, and (2) three future options to potentially rehabilitate the trucks of 71 additional light rail vehicles at the discretion of the Director of Transportation.

The MTA will re-allocate $3,405,759 in unspent funds from the existing contract, and $2,494,434 in Transportation and Street Infrastructure Program (TSIP) funds, previously appropriated by the Board of Supervisors, to pay for rehabilitation of the trucks of 41 light rail vehicles and other work under the second amendment of the contract, totaling $5,900,193. The

MTA will use future TSIP, federal, regional and other local funds when they become available, totaling $29,613,740, to fund the three proposed contract options.

Table 2 below details the source and uses of the requested not-to-exceed contract increase of $35,513,933.

Table 2: Sources and Uses of Funds

Sources	
Reallocation of existing contract funds	$3,405,759
Transportation and Street Infrastructure Program funds (TSIP, City General Fund)	2,494,434
Subtotal, TSIP	5,900,193
Future TSIP, federal, regional and local funds	29,613,740
Total Sources	**$35,513,933**
Uses	
Rehabilitating the trucks of 41 light rail vehicles	$14,999,768
Savings from removal of rehabilitation of doors, steps system, and air supply units from contract scope	(13,650,748)
Subtotal	1,349,020
Spare parts already purchased by vendor	2,151,042
Spare parts for project work	1,868,164
Taxes	281,967
Project contingency	250,000
Subtotal, Rehabilitation 41 Light Rail Vehicles and Related Work	$5,900,193
Options	
Option 1 – trucks of 24 light rail vehicles (Before June 2015)	$9,663,696
Option 2 – trucks of 24 light rail vehicles (Before December 2015)	9,846,528
Option 3 – trucks of 23 light rail vehicles (Before June 2016)	9,615,035
Option Taxes	488,481
Subtotal, Options	$29,613,740
Total Uses	**$35,513,933**

Schedule C of the second amendment contains the price schedule for the work to be performed by Breda. According to Mr. Hao, the unit cost and total price for each component of work to be performed by Breda under the second amendment are based on the original proposal by Breda from September 2009. According to Mr. Hao, the unit costs and total prices listed in Schedule C are comparable to the MTA engineer's estimate at the time of the original proposal in September 2009.

Under the existing contract, if MTA eliminates a portion of the work, then MTA must compensate Breda and its suppliers for parts that have already been purchased and cannot be sold or used on other projects. As noted above, the second amendment eliminates the rehabilitation of the doors and steps system and the air supply system from the contract's scope of work. MTA will pay Breda $1,957,831 for door and stair system parts and $193,211 for air supply system parts for a total of $2,151,042. According to Mr. Hao, the MTA will retain

these parts and use them to rehabilitate light rail vehicles through the MTA's in-house repair process.

Contract Options

The second amendment to the existing contract contains three separate future options at the sole discretion of the Director of Transportation to (1) rehabilitate the trucks of 71 additional light rail vehicles, (2) extend the term of the contract through October 31, 2018, and (3) increase the contract expenditures by $29,613,740.

As shown in Table 2 above, the three future options may be executed before June 2015, before December 2015, and before June 2016 respectively and will be funded, according to Mr. Hao, in future budgets through a combination of funds including future Transportation Street and Infrastructure Program allocations that are included in the MTA's Capital Plan.

The MTA should evaluate Breda's performance under the proposed second amendment and report to the Board of Supervisors before exercising the three contract options to rehabilitate the trucks of an additional 71 light rail vehicles. Therefore, the Budget and Legislative Analyst's Office recommends amending the proposed resolution to (1) reduce the contract not-to-exceed amount $29,613,740 to rehabilitate the trucks of 71 additional light rail vehicles from the requested not-to-exceed contract amount of $104,263,354 to an amended not-to-exceed contract amount of $74,649,614 and (2) state that any of the three contract options to rehabilitate the trucks of 71 additional light rail vehicles would require Board of Supervisors approval prior to the Director of Transportation exercising the option.

RECOMMENDATIONS

1. Amend the proposed resolution to (1) reduce the contract not-to-exceed amount by $29,613,740 from the requested not-to-exceed contract amount of $104,263,354 to a not-to-exceed contract amount of $74,649,614 and (2) state that the three future contract options would require Board of Supervisors approval prior to the Director of Transportation exercising the option.

2. Approve the proposed resolution as amended.

City and County of San Francisco
Municipal Transportation Agency
One South Van Ness 7th Floor
San Francisco, California 94107

Amendment Two to
Agreement between the City and County of San Francisco and
AnsaldoBreda Inc.
LRV Doors and Steps Reconditioning and Systems Rehabilitation

This Amendment is made this _____ day of _____, 2014, in the City and County of San Francisco, State of California, by and between: AnsaldoBreda Inc., a Delaware corporation ("Contractor"), and the City and County of San Francisco, a municipal corporation ("City"), acting by and through its Municipal Transportation Agency ("SFMTA") (collectively, the "Parties").

Recitals

A. On or about October 29, 2009, City and Contractor entered into Contract No. APT 591-01 for reconditioning the doors and steps and rehabilitating systems in 143 of SFMTA's light rail vehicles ("Contract" or "Agreement").

B. On June 2, 2010, City and Contractor entered into Amendment One to Agreement to rehabilitate 34 car sets of trucks.

C. The Parties wish to amend the Contract to remove the doors and steps and air supply unit scope of work from the Contract, eliminate the maintenance training requirement, alter the spare parts requirements, and rehabilitate 41 additional car sets of trucks with options for up to 71 more, and extend the term of the Contract by 11 months to allow for extra work and procurement of parts required to perform the work.

NOW, THEREFORE, Contractor and the City agree as follows:

1. **Section 2 of Agreement (Term of the Agreement) is amended to read as follows:**

2. Term of the Agreement

Subject to Section 1, this Agreement shall commence on the Effective Date and terminate no later than October 31, 2018 (should all Options be exercised as provided in Section 70).

2. **Section 5.1 (Amount of Contract) is deleted and replaced with the following:**

5. Compensation

5.1 **Amount of Contract.** In no event shall the amount of this Agreement exceed One Hundred Four Million, Two Hundred Sixty-Three Thousand, Three Hundred Fifty-Four Dollars ($104,263,354).

3. **Section 66.1 (Delivery Rate) is amended to read as follows:**

66.1 **Delivery Rate.** Vehicle deliveries shall be in accordance with the Project Delivery Schedule (Exhibit B). SFMTA cannot have more than five LRVs out of service at any one time for rehabilitation work and related activities, including pre-inspection, transit,

rehabilitation, testing or commissioning. Option deliveries shall be in accordance with the Project Delivery Schedule (Exhibit B). SFMTA cannot have more than five sets of trucks out of service at any one time for rehabilitation work and related activities, including pre-inspection, transit, or rehabilitation.

4. A new Section 70 is added to the Agreement to read as follows:

70. Options for Rehabilitation of Additional Trucks

At the option of the SFMTA, Contractor shall perform rehabilitation of additional trucks (See Options 1, 2 and 3, Items 2.3, 2.4 and 2.5 on the Payment Schedule - Exhibit C). Exercise of these options is subject to availability of funds, as certified by the Controller, and is within the sole and exclusive discretion of the Director of Transportation. The options may only be exercised by a letter signed by the Director of Transportation.

5. Exhibit B of the Agreement is deleted and replaced by a new Exhibit B, attached to this Amendment and incorporated by reference as though fully set forth.

6. Exhibit C of the Agreement is deleted and replaced by a new Exhibit C, attached to this Amendment and incorporated by reference as though fully set forth.

7. The Technical Specifications are amended to replace Section TP05M1 (Truck and Suspension Systems) with a new Section TP05M1 (Truck and Suspension Systems), which is attached to this Amendment and incorporated by reference as though fully set forth.

8. Contractor acknowledges and agrees that the amounts agreed for the work described above, and/or the extension of time granted herein, with or without cost, shall be full accord and satisfaction for all past, current and prospective costs incurred in connection with Contractor's performance of all work under the contract up to and including the work covered under this Amendment Two, without limitation. Said costs may include, but are not limited to, costs for labor, materials, equipment, disruption, lost productivity, escalation, delay, extended overhead, administration and extended performance time. Contractor releases the City from all claims for which full accord and satisfaction is hereby made, as set forth above.

9. Effective Date. Each of the modifications set forth above shall be effective on and after all parties have signed the Amendment.

10. Legal Effect. Except as expressly modified by this Amendment, all of the terms and conditions of the Agreement shall remain unchanged and in full force and effect.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement on the day first mentioned above.

CITY

Municipal Transportation Agency

_____
Edward D. Reiskin
Director of Transportation

Municipal Transportation Agency
Board of Directors
Resolution No. _____
Dated: _____
Attest:

_____
Secretary

Approved as to Form:

Dennis J. Herrera
City Attorney

By _____
Robin M. Reitzes
Deputy City Attorney

Board of Supervisors
Resolution No. _____
Dated: _____
Attest:

_____
Clerk of the Board

CONTRACTOR

AnsaldoBreda Inc.

_____
Mauro Melani
General Manager
1461 Loveridge Road
Pittsburg, CA 94565

City vendor number: 41208

EXHIBIT B

PROJECT DELIVERY SCHEDULE

Delivery of 143 Rehabilitated Light Rail Vehicles and Associated Deliverables

DELIVERY MILESTONE	No. of Days	AFTER NTP
a. Acceptance of Management Work Plan, Master Baseline Schedule	+30	30 days
b. Delivery of Pilot LRV ready for acceptance testing no later than	+150	180 days
c. Delivery of successful testing and Conditional Acceptance of the Pilot Car no later than	+30	210 days
d. Completion of successful testing and Conditional Acceptance of Second car	+60	270 days
e. Completion of successful testing and Conditional Acceptance of 143rd car	+1341	1611 days
f. Option 1	+170	1781 days
g. Option 2	+170	1951 days
h. Option 3	+170	2121 days

Milestone requirements are detailed in Section 67 of the Contract and in Section TP01.08 of the Technical Provisions.

Note: 231 working days (*i.e.*, 11 months) have been added to the Schedule for the extra work (transom joint work) and for procurement of parts, including long-lead items, required to perform the work under Amendment Two. The new completion date for the Contract (without options) is October 18, 2016. Each Option has time added for the extra work and for procurement of materials. The completion date for Option 1 is June 18, 2017; the completion date for Option 2 is February 18, 2018; and the completion date for Option 3 is October 18, 2018.

EXHIBIT C

PRICE SCHEDULE

FOR SFMTA REHABILITATION OF IDENTIFIED SUBSYSTEMS FOR 143 LRVs

Item No.	Description	Qty.	Unit Price	Total Price
1.1	Rehabilitated couplers (electrical and mechanical) complete assembly (A)	143	$53,500	$7,650,500
1.2	Rehabilitated doors and steps complete assembly (B)	86	$203,963	$17,540,818
1.3	Replacement PSC-2 Wiring Harnesses (C)	143	$6,860	$980,980
1.4	Re-designed new articulation wiring and harnesses complete assembly (D)	143	$37,306	$5,334,758
1.5	Rehabilitated air supply units complete assembly (E)	86	$24,003	$2,064,258
1.6.	Replacement of Center Pins and Traction Motor Bearings (F)	143	$11,210	$1,603,030
1.7	Program Management, Engineering, QA Support (G)	1	$2,813,410	$2,813,410
Subtotal of Item 1 – Rehabilitation of Couplers, Air Supply Units, Doors and Steps, Articulation Wiring and harnesses for 143 LRVs, CDRLs, Transport of Vehicle to Contractor facility and return to SFMTA facility, Site Support & Warranty				**$37,987,754**
2.1	Rehabilitate Motored and Non-Motored Trucks of the LRVs	34	$334,223	$11,363,582
2.2	Rehabilitate Motored and Non-Motored Trucks of the LRVs	41	$365,848	$14,999,768

2.3	Option 1 - Rehabilitate Motored and Non-Motored Trucks of the LRVs (expiration June 2015)	24	$402,654	$9,663,696
2.4	Option 2 - Rehabilitate Motored and Non-Motored Trucks of the LRVs (expiration December 2015)	24	$410,272	$9,846,528
2.5	Option 3 - Rehabilitate Motored and Non-Motored Trucks of the LRVs (expiration June 2016)	23	$418,045	$9,615,035
Subtotal of Item 2 – Rehabilitation of Motored and Non-Motored Trucks				**$55,488,609**
3.01	Re-designed new articulation wiring and harness; a. Jumper Cables b. Bulkhead Connectors Articulation Wiring Spares	10	$21,871	$218,710
3.02	Gearbox Spares (Axle Quill assy)	29	$113	$3,277
3.03	Gearbox Spares (117 Teeth Gear)	29	$3,518	$102,022
3.04	Gearbox Spares (Pinion Shaft)	29	$1,192	$34,568
3.05	Brake Caliper Spares (Large Lever Arm)	151	$626	$94,526
3.06	Brake Caliper Spares (Complete Caliper)	18	$15,501	$279,018
3.07	Coupler Spares (Complete Coupler)	4	$128,779	$515,116
3.08	Coupler Spares (Pneumatic Hoses)	116	$452	$52,432
3.09	Coupler Spares (Bridge)	205	$3,696	$757,680

3.10	Traction Motor Spares (Fan)	10	$1,180	$11,800
3.11	Traction Motor Spares (Speed Sensors)	25	$709	$17,725
Subtotal of Item 3 - Spares				**$2,086,874**
4.	**Allowance for latent or unforeseen mechanical conditions**			**$2,250,000**
5.	**Sales tax on materials (reimbursable)**			**$4,299,074**
6.	Termination Costs (cost of parts remaining in inventory and on order due to reduction of doors and steps quantity from 143 to 86 – a list of said parts is attached as Exhibit C-1)			**$1,957,831**
7.	Termination Costs (cost of parts remaining in inventory and on order due to reduction of air supply units quantity from 143 to 86 – a list of said parts is attached as Exhibit C-2)			**$193,212**
CONTRACT TOTAL (1+2+3+4+5+6+7)				**$104,263,354**

Exhibit C-1

Vapor Stone Parts Inventory List

Part Number	*Description*	*Inventory Total*	*Extended Termination Cost Total*
57311553	TUBE AIR .25X.179 NYLON BLK	9,946	$ 339.79
58110850	INSULATOR - SWITCH	-	$ -
58611088	LEVER ACTUATOR	341	$ 1,686.25
84251837	SCR PH FL100 HD 1/4-20X.50 STL ZN	50	$ 14.93
84254410	SCR SL PN HD 2-56X1.000 SS	1,300	$ 52.69
84254662	SCR SL PN HD SEMS EX 6-32X.875 STL ZN	-	$
84257993	SCR HX HD 3/8-16X.75 STL GR5 ZN	1,080	$ 62.81
84279761	SLEEVE BEARING .503X.690X.50 BRZ SINTERED	996	$ 406.87
84282813	TIE CABLE S/LOCK .300X14.50 NYL UV BLK	-	$ -
84283206	TUBING HEAT SHK 1/4 POLYOLEFIN BLK	-	$ -
84290105	SHRINKABLE TUBING 3/16" WHITE	1,416	$ 72.32
84293008	CABLE 2X0.93MM 250V 19X0.26 SHLD BLK NFF63808-NFF16101	-	$ -
89241311	SCR HX HD FT M6X20 STL YZN PER 881322 FE/ZN8 TYPE 2	146	$ 92.40
97211125	DIODE,1N4247	-	$ -
200320639	BLOCK STOPPER	118	$ 266.39
200320640	J BRACKET	27	$ 148.32
201010296	KIT OVERHAUL CYLINDER 1-1/8X3-3/8	192	$ 596.50
201010849	HANDLE PULL ASSY	407	$ 4,484.63
842100314	THRUST BEARING .510X1.000X.063 BRZ SINTERED	-	$ -
842100443	FLANGE BEARING .502X.627X.375 .875X.063 BRZ SINTERED	821	$ 520.72
842100444	FLANGE BEARING .502X.627X.50 .875X.063 BRZ SINTERED	3,612	$ 135.90
1551715819	GROMMET .188X.313X.125 EPT BLK	-	$ -
1581613718	STRIP TIE POINT	-	$ -
1621611333	RESISTOR-FIXED	-	$ -
1701003023	HARNESS WRAP(ROLL) 3/8 OD(BLK)	36,644	$ 1,386.28

Part Number	*Description*	*Inventory Total*	*Extended Termination Cost Total*
1741039400	RECTIFIER ,SIL (1N3880)	441	$ 1,436.45
4561610400	BEARING, BALL	1,920	$ 3,405.60
5002121800	SPACER CABLE	418	$ 1,685.06
5003153301	ARM ASSY. FIXED WELDED 36"	104	$ 9,765.73
5011049501	HARNESS ADA HOOK-UP 47" & 54" DOORS	215	$ 1,375.19
5601000733	BEARING FLANGE	3,712	$ 1,037.50
5601000755	FLANGE BEARING .1895X.314X.375 .438X.063 BRZ	771	$ 530.45
5721257600	TUBING (500 FT. COIL)	36,667	$ 2,093.06
5731232804	BEAR.,NYLON DOU.FLAN.1/4 NOM.	345	$ 356.04
5741021577	WASHER SPECIAL	1,416	$ 2,511.63
5741062302	SPACER	18	$ 116.10
5752092310	CONNECTOR PLUG CPC 24 POS 23-24 FR HG	3	$ 9.03
5782630461	LABEL IDENT.	472	$ 294.29
5782630462	LABEL IDENT.	472	$ 400.85
5831030102	TUBING-POLYURETHANE (PURC.)	-	$ -
5871085900	BEARING BALL (REAR)	176	$ 331.10
5892039721	SWITCH-PRESSURE WAVE	152	$ 7,120.97
5902478402	BEARING - SPHERICAL	1,774	$ 55,399.80
5911014625	LABEL,IDENT. (LSIA)	700	$ 511.70
5911014626	LABEL,IDENT. (LS1B)	1,111	$ 489.08
5921624300	SPACER	3	$ 19.35
5921625100	COLLAR	15	$ 225.75
5921625800	BEARING-BALL 5/16 IDX7/8 OD	1,585	$ 3,595.18
5921625900	TURN BUCKLE	32	$ 683.53
5922095504	CYLINDER	1	$ 560.08
5922095505	CYLINDER	11	$ 5,273.95
5922611700	LINK-CONNECTING	20	$ 333.25
5922611701	LINK-CONNECTING	3	$ 172.94
5922611702	LINK-CONNECTING	5	$ 499.88

Part Number	*Description*	*Inventory Total*	*Extended Termination Cost Total*
5922611900	LINK-LIFT	1	$ 28.75
5922612701	PLATE-NUT	5	$ 18.76
5922614100	STUD-BEARING	1,525	$ 7,573.91
5922615500	SPACER-CLEVIS	86	$ 336.52
5922623000	TRACK-BEARING	6	$ 558.12
5922623001	TRACK BEARING	2	$ 100.38
5922623900	STUD-BEARING	1,538	$ 5,456.06
5922624100	STUD-LINK	1,513	$ 6,912.52
5922626200	BRACKET-VALVE	5	$ 209.79
5922626300	VALVE-DOUBLE SOLENOID 4 WAY	215	$ 40,678.00
5922627400	PLATE-COVER	11	$ 243.44
5924611800	ARM-LIFT	5	$ 2,085.77
5924614500	INSERT-TRACK	1,457	$ 23,885.69
5924619001	ARM-LIFT	5	$ 6,908.54
5931053800	PLATE RETAINER	10	$ 645.00
5931054400	PIN ADAPTOR	4	$ 301.00
5931103700	PLATE - SWITCH	10	$ 164.05
5931111204	TUBING SHRINKABLE 1/4 BLACK	10	$ 30.06
5931138000	BUSHING	437	$ 2,052.92
5931625800	ARM	5	$ 430.00
5931625900	ROD-COILED CORD GUIDE	7	$ 278.95
5931625901	ROD-COILED CORD GUIDE	2	$ 165.30
5931625902	ROD-COILED CORD GUIDE	2	$ 94.54
5931626100	U-PROFILE	5	$ 195.72
5931626201	STUD BOLT	1,262	$ 5,765.76
5931626500	SPACER	15	$ 50.63
5931626501	STANDOFF HX 1/2 M6X.709 SS 303	9	$ 94.33
5931626502	SPACER	8	$ 92.45
5931636300	SPRING COMP 1.625X.125X7.01 STL 17-7 ELECTROLESS NICKEL PLATED	423	$ 3,733.29

Part Number	*Description*	*Inventory Total*	*Extended Termination Cost Total*
5931636400	PULLEY-CABLE	566	$ 2,957.07
5931636700	RING	280	$ 966.12
5931636702	RING	472	$ 2,283.30
5931636800	BUSHING	390	$ 1,530.26
5931636900	SHAFT	422	$ 5,670.63
5931637200	BOLT-SHOULDERED	99	$ 372.49
5931637800	ROLLER	740	$ 7,955.00
5931637900	SHAFT-ROLLER	729	$ 5,955.93
5931638100	SHAFT	3	$ 135.45
5931638101	SHAFT	20	$ 112.88
5931638200	PIN-STOP	733	$ 3,601.05
5931638300	WHEEL-GEAR	2	$ 451.50
5931638700	SHAFT,DIN	15	$ 598.56
5931638900	SHAFT	4	$ 322.50
5931639000	SHAFT	157	$ 794.43
5931641700	BRACKET-SPRING	6	$ 296.70
5931656100	ROLLER BEARER	469	$ 2,596.50
5931660300	PLATE END	10	$ 94.06
5931660301	PLATE-END	17	$ 159.91
5931660302	PLATE-END WITH HOLE	16	$ 44.30
5931661100	CAM	9	$ 725.63
5931661200	SUPPORT-CABLE	7	$ 141.47
5931661500	ROD THRD 6-32x5.32 SS 18-8	867	$ 2,050.46
5931661700	STRIP-COUPLING, 47"/54"	5	$ 108.08
5931686500	NUT CARRIER-SPINDLE	114	$ 3,370.13
5931686700	BRACKET 36"	6	$ 28.38
5931686800	NUT-SPINDLE, LH THREAD	79	$ 1,893.83
5931687000	BRACKET 47"/54"	9	$ 113.39
5931688100	RETAINER-SPRING	77	$ 765.67

Part Number	*Description*	*Inventory Total*	*Extended Termination Cost Total*
5931695100	BEARING FLANGE 14X16X12MM IGLIDE G300	449	$ 506.81
5931695200	BEARING FLANGE 16X18X12 IGLIDE G300	3,361	$ 1,878.80
5931695300	RACE-INNER (METRIC)	399	$ 2,702.23
5931695500	BEARING BALL 15X40X11 SR SHIELD	1,345	$ 11,075.40
5931695600	BEARING-BALL (METRIC)	168	$ 5,566.09
5931695700	BEARING BALL 10X32X9 SR RDL	165	$ 1,236.30
5931695800	BEARING BALL 25X37X7MM SR DEEP GROOVE	474	$ 2,797.43
5931695900	BEARING BALL 35X47X7MM SR	408	$ 1,552.64
5931719800	CLAMP-CABLE	826	$ 2,379.71
5931719900	TUBING-SHRINKABLE	1,962	$ 219.74
5931720300	WASHER NON METALLIC 8.1MM ID	1,888	$ 761.10
5931720400	SPACER RD .756X1.339X.059 NYLON	826	$ 511.46
5931720500	SPRING TORSION .38X.028 1.56 LEG 155DEG	472	$ 228.33
5931720800	NUT-CLAMP	826	$ 121.56
5931721000	CAM-SPLIT	10	$ 467.63
5932054600	BRACKET MTG.	17	$ 748.03
5932056999	VALVE SOLENOID (4 WAY)	352	$ 58,406.04
5932074100	INDUCTOR	12	$ 889.03
5932102100	PLATE-RETAINING	6	$ 167.06
5932102200	PAD-NYLON	393	$ 532.32
5932114700	SPACER	11	$ 413.64
5932624800	CABLE-FLEXBALL TYPE 5S	21	$ 9,824.19
5932637700	FLANGE BEARING	312	$ 8,116.68
5932638500	PULLEY-CABLE,MAIN EMERGENCY	21	$ 498.46
5932639202	SHAFT-SPLINE EXTENSION	1	$ 150.50
5932657400	SEAL-PORTAL 36"/47"-R/54"	571	$ 9,514.29
5932657700	SEAL-PORTAL	75	$ 1,088.44
5932658100	SEAL PORTAL	118	$ 1,902.75
5932662100	PLATE-MTG TERMINAL	4	$ 21.89

Part Number	*Description*	*Inventory Total*	*Extended Termination Cost Total*
5932687700	TOOTHED-FLANGE	4	$ 160.66
5932692900	CONNECTOR 4 POS M SERIES ROHS	1,652	$ 834.67
5932693202	BOLT-SHOULDERED	236	$ 1,002.12
5932693203	BOLT-SHOULDERED	391	$ 1,471.14
5932693205	BOLT SHOULDERED	944	$ 3,450.32
5932693206	BOLT SHOULDERED	1,576	$ 3,981.37
5932694400	PLATE (RH)	20	$ 190.71
5933055400	SWITCH-ROTARY	229	$ 17,283.95
5933620600	ROLLER GUIDE-RIGHT	13	$ 4,829.76
5933620700	ROLLER GUIDE-LEFT	16	$ 5,944.32
5933626300	SHAFT,UN-PLUG	3	$ 351.69
5933642001	SPINDLE	6	$ 1,193.25
5933643500	BRACKET	5	$ 28.86
5933643501	BRACKET	4	$ 23.09
5933643600	BRACKET	5	$ 228.62
5933643601	BRACKET	5	$ 132.52
5933653500	GUIDE ASSY-RAIL WELDED 47"R	13	$ 580.38
5933653600	GUIDE ASSY-RAIL WELDED 47"L	19	$ 848.25
5933653700	GUIDE ASSY RAIL WELDED 54"R	16	$ 769.70
5933653800	GUIDE ASSY-RAIL WELDED 54"L	15	$ 721.59
5933672500	SEAL ASSY-SENS EDGE 47"R/54"R	147	$ 12,642.00
5933672600	SEAL ASSY-SENS EDGE 47L/54L/36	197	$ 15,883.13
5933673700	BRACKET	8	$ 193.84
5933673701	BRACKET	5	$ 112.02
5933692300	CORD-COILED	54	$ 1,004.85
5933692301	CORD-COILED	248	$ 3,468.47
5934113100	ARM-OFF-SET LIFT	5	$ 1,688.88
5934620900	ROLLER CARRIAGE TYPE 4 47"/54"	3	$ 2,451.00
5934621000	ROLLER CARRIAGE TYPE 6 (36")	9	$ 5,756.63

Part Number	*Description*	*Inventory Total*	*Extended Termination Cost Total*
5934621100	ROLLER CARRIAGE TYPE 5 (36")	10	$ 6,396.25
5941032600	LINK-CONNECTING	10	$ 383.78
5941640800	PLUNGER-SPRING	944	$ 3,794.54
5942020400	LINK WELDMENT	10	$ 1,182.50
5942020602	PIVOT WELDMENT-RH	10	$ 1,290.00
5942020603	PIVOT WELDMENT-LH	0	$ 1,290.00
5942026801	BRACKET-SWITCH (LH)	20	$ 493.43
5943055000	SEAL-DOOR,47"R	38	$ 1,634.00
5943055001	SEAL-DOOR,54"R	113	$ 5,344.90
5943055100	SEAL-DOOR 36"	58	$ 2,805.75
5943055101	SEAL-DOOR,47"L	111	$ 4,773.00
5943055102	SEAL-DOOR,54"L	110	$ 5,203.00
5951086400	BUMPER	174	$ 1,870.50
5951086800	BUMPER 36"	118	$ 367.87
5951096800	BRACKET PANEL	51	$ 246.71
5951096810	BRACKET PANEL	102	$ 763.03
5951096811	BRACKET PANEL	257	$ 1,922.53
5951097100	STRIP MARKER	485	$ 1,564.13
5951636900	SPACER	10	$ 245.78
5951637500	HOUSING ROLLER	278	$ 12,970.09
5951639900	PIN STABILIZER	708	$ 4,947.15
5952020562	LABEL IDENT. (LS7)	40	$ 119.97
5952096700	FUSE & LEAD ASSY.	6	$ 164.11
5952096711	RELAY FUSE & LEAD ASSY LH	16	$ 666.59
5952615400	SEAL-RUBBER STRIP 36"	68	$ 365.50
5952615401	SEAL-RUBBER STRIP 47"	52	$ 314.16
5952615402	SEAL-RUBBER STRIP 54"	58	$ 342.93
5952637100	ROD HINGE 36"	63	$ 1,537.36
5952637101	ROD HINGE 47"	72	$ 1,470.60

Part Number	*Description*	*Inventory Total*	*Extended Termination Cost Total*
5952637102	ROD HINGE 54"	183	$ 3,737.78
5952637201	BLOCK TAPPING CENTER LH	5	$ 752.29
5952637300	BLOCK TAPPING SIDE RH	5	$ 156.41
5952637301	BLOCK TAPPING SIDE LH	4	$ 125.13
5953633500	SUPPORT HINGE INSIDE 47" RH	10	$ 975.98
5953633501	SUPPORT HINGE INSIDE 47" LH	3	$ 329.71
5953633600	SUPPORT HINGE OUTSIDE -47"	65	$ 32,775.57
5953633800	HINGE UPPER 47"DOOR	150	$ 18,011.63
5953633900	HINGE LOWER 47"R DOOR	145	$ 31,173.44
5953633901	HINGE LOWER 47"L DOOR	28	$ 6,832.70
5953634400	SUPPORT ASSY. S ROLLER (LH)47"	4	$ 903.00
5953634500	SUPPORT ASSY. S ROLLER (RH)47"	27	$ 6,095.25
5953635000	BEARING LINEAR ASSY.47"	137	$ 94,142.60
5953635300	HINGE UPPER 36" DOOR	81	$ 11,998.94
5953635400	HINGE LOWER 36" DOOR	70	$ 13,582.63
5953635500	HINGE UPPER 54" DOOR	235	$ 28,420.31
5953635600	HINGE LOWER 54"R DOOR	221	$ 36,253.95
5953635601	HINGE LOWER 54"L DOOR	49	$ 10,621.91
5953635700	SUPPORT HINGE OUTSIDE 36"	28	$ 16,834.93
5953635800	SUPPORT HINGE OUTSIDE 54"	1	$ 682.67
5953635900	SUPPORT ASSY. S ROLLER 36"	18	$ 4,621.17
5953636100	SUPPORT ASSY. S ROLLER LH 54"	58	$ 13,093.50
5953636200	SUPPORT ASSY. S ROLLER RH 54"	48	$ 22,962.00
5953637600	BEARING LINEAR RH 54"	286	$ 245,308.21
5953637700	BEARING LINEAR ASSY 36"	52	$ 48,068.97
5953642401	ARM ASSY. FIXED 47"/54" R WELD	157	$ 14,435.33
5953642501	ARM ASSY. FIXED WELD 47/54 LH	71	$ 6,528.08
5954079200	ARM OFFSET LIFT	5	$ 1,694.72
5961011100	COIL CORD END PIECE	123	$ 8,026.06

Part Number	*Description*	*Inventory Total*	*Extended Termination Cost Total*
5961075000	TURNBUCKLE	9	$ 222.53
5961080700	PINION	187	$ 2,080.61
5961140000	BELLOW	884	$ 9,503.00
5962065301	SHAFT CLEVIS	9	$ 419.99
5962065303	SHAFT CLEVIS	9	$ 419.99
5971085000	FLANGE BEARING .258X.378X.233 .50X.063 BRZ	846	$ 1,064.06
5971087102	BRACKET DIODE	10	$ 104.81
5972067500	SENSOR INDUCTIVE PROXIMITY PNP	245	$ 7,184.87
5972126700	SEAL-EXTRUSION PROFILE	7,600	$ 2,553.13
5973126900	GLASS-WINDOW 47" (UPPER)	15	$ 1,364.69
5973126901	GLASS-WINDOW 47" (LOWER)	15	$ 693.35
5973126902	GLASS-WINDOW 54"	16	$ 1,141.54
5973126903	GLASS-WINDOW 36"	7	$ 797.65
5981720000	NUT CARRIER SPINDLE	117	$ 4,056.24
5983721000	MOTOR ASSY. ELECTRIC	464	$ 123,792.18
5991011400	HOUSING COUPLING	340	$ 3,837.75
5991011500	HOUSING COUPLING	348	$ 3,647.48
5991012300	BRACKET SENSOR	30	$ 672.41
5991045500	HOOK	235	$ 2,943.04
5991059600	CONTACT, SOCKET, 20-16 AWG	-	$ -
5991063501	RECTIFIER, 1N3673RA, REV.POL.	439	$ 1,939.61
5991619300	BLOCK GUIDE	118	$ 2,029.60
5991620400	BUSHING	1,467	$ 3,453.68
5991621100	CAP-WELDED	-	$ -
5992033800	PLATE	5	$ 120.68
5992040000	PLATE	1	$ 21.43
5992041500	SPRING EXT .30X.037X1.50 STL 5.2LB/IN	222	$ 713.56
5992041600	SPRING EXT .25X.031X1.13 STL 4.6LB/IN	708	$ 1,369.98
5992045400	PLATE CAM	2	$ 45.15

Part Number	*Description*	*Inventory Total*	*Extended Termination Cost Total*
5992051700	SPRING EXT .30X.043X2.25 STL 6.50LB/IN	341	$ 399.57
5992053200	STEP MAT MOLDED	19	$ 2,305.94
5992053402	STEP MAT MOLDED	22	$ 1,799.53
5992053500	PLATE SWITCH	199	$ 1,140.22
5993046200	PLATE GUIDE (RH)	472	$ 3,348.84
5993046201	PLATE GUIDE (LH)	171	$ 1,516.56
5993605900	CABLE EMERGENCY 54"	77	$ 2,337.57
5993605903	CABLE EMERGENCY 36"	114	$ 3,514.73
5993619500	PLATE MTG. PINCH POINT MIT 36"	15	$ 511.79
5993619501	PLATE MTG. PINCH POINT MIT 47L	16	$ 484.83
5993619502	PLATE MTG. PINCH POINT MIT 54L	20	$ 633.35
5993619503	PLATE MTG. PINCH POINT MIT 47R	20	$ 638.06
5993619504	PLATE MTG. PINCH POINT MIT 54R	20	$ 660.23
5993619600	BLOCK NUT 36"	16	$ 438.60
5993619601	BLOCK NUT 47"	32	$ 146.00
5993619602	BLOCK NUT 54"	40	$ 935.25
5993619700	BUMPER RUBBER 36"	51	$ 411.19
5993619701	BUMPER RUBBER 47"	195	$ 1,236.79
5993619702	BUMPER RUBBER 54"	254	$ 1,911.35
6711125800	BOLT SPECIAL	569	$ 2,275.43
6711125801	BOLT SPECIAL	236	$ 1,428.33
6712103809	SCR HX SKT BTN HD 1/4-20x.50 STL ZN	-	$ -
6712107415	SCR HX HD IND 10-32X.50	368	$ 15.82
6712120220	SCR SH HX SOC HD .75X5.50 5/8-11X.75 STL OX	231	$ 1,904.75
6712122700	SCR FLT HD HX SKT M8x16mm	5,521	$ 271.83
6712122702	SCR FLT HD HX SKT M6x16	6,726	$ 373.09
6712122703	SCR FLT HD HX SOC M8 X 20MM	3,776	$ 291.45
6712122809	WSHR-PLN(METRIC DIN7349)12MM	826	$ 289.12
6712122900	NUT HEX JAM M12	1,652	$ 455.16

Part Number	*Description*	*Inventory Total*	*Extended Termination Cost Total*
6712123500	SCR HX SKT BTN HD M4 x 8mm	7,080	$ 654.55
6712123700	SCR SH HX SOC HD .50X1.25 3/8-16X.40 SS	2,136	$ 7,242.21
6712124801	SCR SH SL HD .187X1.50 8-32X.187 SS 420	440	$ 4,677.97
6712305500	NUT HX LOCK 3/8-16 STL ZN 3 PT DEFLEXION TORQUE PATCH	426	$ 1,488.47
9501002836	FUSE 15A 65A 3AB VFAST CER .25X1.25	944	$ 2,638.48
9502097165	SLEEVE BEARING .253X.377X.375 BRZ SINTERED	308	$ 2,897.13
9601601317	STRIP TERMINAL 17 TERMS	46	$ 267.03
9652002924	TUBING SHRINKABLE (POLYOLEFIN)	1,467	$ 727.95
9761042302	NUT HEX LK CAP 8-32	135	$ 40.88
9912610018	FTG-NYL TUBE (BRS) M.CONN 3/8	809	$ 1,888.06
9912610020	FTG-NYL TUBE (BRS) M.CONN 3/8	502	$ 1,066.35
9912610022	FTG-NYL TUBE (BRS) UN.TEE 3/8	428	$ 1,964.63
9912610030	FTG-NYL TUBE (BRS) M.EL 3/8	449	$ 1,127.53
9912610033	FTG-NYL TUBE (BRS) F.EL 3/8	215	$ 2,942.22
9912610052	FTG-NYL TUBE(BRS)MALE EL 3/8	103	$ 673.21
9912610314	FTG-PIPE AUTO (BRS) L.NIP 1/8	219	$ 125.25
9921086000	RECTIFIER-FULL WAVE BRIDGE	862	$ 3,549.07
20072066205	RETAINING RING INT .938 SS INVERTED	-	$ -
20101091101	PIN SHORT	50	$ 900.31
20101091102	PIN LONG	50	$ 900.31
20112004108	CABLE CLAMP .25X.50 STL GALV CUSH VINYL	826	$ 157.70
2003W0843	SPRING EXT .437X.047X1.88 STL ZN	258	$ 310.63
2004W0094	CONTACT SOC 24-20AWG GOLD SEL TYPE III+ CPC SERIES 1 G M SERIES	478	$ 192.69
2010W0154	BEARING BALL 45X58X7MM OPEN ENDS NO SEALS	1,497	$ 30,318.74
2010W0155	BEARING NEEDLE 7X16X7.8MM OPEN ENDS NO SEALS	3,080	$ 23,673.65
2010W0156	BEARING BALL 12X30X8MM OPEN END 2 SEALS	730	$ 8,184.94
2010W0369	WIPER ROD WIPER 35MM NITRILE NBR 90A	826	$ 1,935.73
2010W0370	GUIDING ELEMENT 35MM ROD 40MM BORE BRZ FILLED PTFE 60%	1,652	$ 5,150.11
5922095502R	CYLINDER 10" STROKE, REFURBISHED	25	$ 7,283.13

Part Number	*Description*	*Inventory Total*	*Extended Termination Cost Total*
5922095503R	CYLINDER 8.75" STROKE, REFURBISHED	24	$ 6,991.80
75W287	ROD END BEARING	165	$ 1,007.49
75W288	BEARING,ROD END	113	$ 619.52
80W037	LUG RING 22-16AWG #4 NYL COP TIN .140 INS DIA X .218 OD	1,484	$ 476.99
84W213	CONNECTOR MALE 1/4TX1/8NPT BRS	293	$ 434.67
89W003	GROMMET EDGING .128-.192 X 12.75 NYLON SLOTTED	2,124	$ 2,674.89
90W162	LUG FASTON MALE 22-18AWG .25X.032 FULL INS NYLON BRS TIN	-	$ -
93W240	MUFFLER SPEED CONTROL +	1,459	$ 7,340.23
95W208	CONTACT PIN 18-16AWG GOLD SEL TYPE III+ CPC SERIES 1 G M SERIES	-	$ -
97W323	CONTACT PIN 24-18AWG GOLD MNL	-	$ -
57616490	SWITCH & BRACKET ASSY LH	3.58	$ -
57616532	SWITCH & BRACKET ASSY R.H.	4.58	$ -
58710125	CAP,FASTON TAB NYLON	0.02	$ -
5922095502R	CYLINDER 10" STROKE, REFURBISHED	25	$ 7,825.13
5922095503R	CYLINDER 8.75" STROKE, REFURBISHED	18	$ 5,634.09
5922095505	CYLINDER	27	$ 14,067.90
5932056999	VALVE SOLENOID (4 WAY)	74	$ 13,192.29
5933692301	CORD-COILED	32	$ 480.85
5943055001	SEAL-DOOR,54"R	48	$ 2,439.36
5952615401	SEAL-RUBBER STRIP 47"	24	$ 155.79
5961080700	PINION	225	$ 2,689.71
5972067500	SENSOR INDUCTIVE PROXIMITY PNP	192	$ 6,049.61
9502097165	SLEEVE BEARING .253X.377X.375 BRZ SINTERED	122	$ 1,232.96
9912610018	FTG-NYL TUBE (BRS) M.CONN 3/8	550	$ 1,379.13
Subtotal for Parts			$ 1,616,347.19

Item	Description	Amount
Article 21	Vapor Overhead and Invoice preparation	$ 113,160.81
Article 21	Vapor Lost Profit	$ 86,475.40
Article 21	Vapor Material Handling	$ 5,255.00
Article 21	Subtotal for Vapor	$ 1,821,238.40
Article 21	AnsaldoBreda Overhead 7.5% of Subtotal	$ 136,592.88
Article 21	Grand Total	$ 1,957,831

Note: Decimals are dropped in the Grand Total

Exhibit C-2

Knorr Parts Inventory List

OVERHAUL KIT STU14536/H 31 PCS IN STOCK	$78,324.60
OVERHAUL KIT STU14536/H 39 PCS ON ORDER AND TOO LATE TO CANCEL	$98,537.40
TWO AIR DRYERS OVERHAUL COMPLETE FROM GW	$2,869.72
Subtotal	$179,731.72
AnsaldoBreda Overhead 7.5% of Subtotal	$13,479.88
Grand Total	$193,212

Note: Decimals are dropped in the Grand Total

TECHNICAL SPECIFICATIONS
(TECHNICAL PROVISIONS)

SECTION TP05M1

CONTRACT MODIFICATION #1 FOR TRUCKS AND SUSPENSION SYSTEMS

March 1, 2014
Rev. 0

SECTION TP05M1
TRUCK AND SUSPENSION SYSTEMS

TABLE OF CONTENTS

TP05M1: TRUCKS AND SUSPENSION SYSTEMS

TP05M1.01 GENERAL

The work described in this section shall apply only to 112 LRVs and shall be in addition to the work required in Section TP05 – Truck Assemblies of the original Contract.

TP05M1.02 SCOPE OF WORK

The Contractor shall remove, disassemble, inspect, repair, replace, overhaul, reassemble, test and reinstall the components of the trucks and suspension systems of the LRVs as specified herein. These specifications apply to both motored and non-motored trucks of the LRV.

TP05M1.03 OVERHAUL REQUIREMENTS

A. Terminology

Whenever the term "overhaul" is used herein, it shall mean the level of effort designated for a component or assembly, including, but not limited to, cleaning, refinishing, repair, or replacement.

Whenever the term "replace in kind" is used herein, it shall mean replacement with identical OEM parts, or SFMTA-approved equal. The SFMTA is not obligated to accept other than OEM parts, unless the OEM part is obsolete, and may require the Contractor to perform whatever reasonable verification activities as needed in order to demonstrate that the alternative is acceptable based on its being equivalent or superior to the OEM part per Section 1.04.C.1 of these Technical Provisions.

The costs associated with proving that an alternative is equivalent or superior to an OEM part shall be borne by the Contractor.

Whenever the term "replace" is used herein, it shall mean replacement with components compliant with applicable material and workmanship standards. This term is utilized primarily for hardware, where compliance with applicable standards is sufficient to demonstrate equivalence to the OEM part.

Whenever the term "reuse" is used herein, it shall mean disassemble, clean, inspect, verify, refinish and lubricate as needed, reassemble, and reinstall onto the overhauled assemblies; this term reflects estimation that none will require replacement, unless otherwise specified.

B. Hardware/Fasteners

All hardware and fasteners, including, but not limited to, screws, bolts, nuts, clips, washers, lock-washers, shrink wrap, c-clips, tie straps, shaft-keys, springs, shrinkable tubing, cotter pins, retaining rings, bushings, roll pins, clips, gaskets, and etc., on, or in, overhauled assemblies, components, or parts, shall be replaced unless identified for reuse herein.

C. Labels

The Contractor shall apply labels to the truck, gearbox and traction motor to indicate when it was overhauled. The labels shall be of the same type as the OEM labels currently installed on the equipment. The quantity and locations of labels shall be similar to the original labeling arrangement, per the labeling requirement in TP1.07.O of these Technical Specifications.

D. Overhaul Criteria

The Contractor shall follow the truck repair and overhaul criteria of the San Francisco Muni LRV2 Heavy Repair and Workshop Manual, Section 3 "Trucks and Suspension."

The Contractor shall follow the traction motor overhaul criteria of section 4, "Propulsion and Electronic Controls."

The Contractor shall follow the track brake overhaul criteria of section 16 "Brakes."

E. Disassembly, Cleaning & Storage

The Contractor shall disassemble the truck and clean all reusable components. Non reusable components shall be properly disposed of.

Parts waiting reassembly shall be tagged and properly stored.

F. Structural Inspection and Repair

The Contractor shall strip/clean down to clean paint and visually inspect the truck frame, bolster beam, connecting rods, axles and hubs for dimensional accuracy and inspect for cracks. All cracks found shall be documented in the truck history book and repaired as provided below.

The Contractor shall inspect all mating surfaces of the truck frame, threaded attachment points, and permanently affixed brackets for damage. All damage found shall be documented in the truck history book and repaired as provided below.

The Contractor shall notify and obtain SFMTA approval prior to performing any repairs under this Section. Such repairs shall be deemed as extra work under Section 48.2 of the Agreement.

TP05M1.04 New Components and/or Assemblies

The Contractor shall remove, replace in-kind, and install the following components or assemblies on all LRVs under Amendment Nos. One and Two to the Agreement.

A. 100% Replacement

1. Journal axle bearings
2. Shock absorbers
3. Grounding cables
4. Primary suspension (latest configuration)
5. Secondary suspension (air bags)

6. Brake caliper suspension bushings
7. Pilot bar/antenna bar mounts (latest configuration)
8. Leveling valve and hardware
9. Air hoses (Knorr)
10. Knorr test fittings (cut-out cock)
11. Wiring harnesses
12. Traction rod rubber element
13. Flexible pads (GE)
14. Connecting rod rubber elements GE
15. Miscellaneous rubber components
16. Lateral bump stop
17. Slewing Ring
18. Lubrication
19. Truck cleaning and waste disposal
20. Transom joint pin, spherical bearing, retaining flanges, seal, shims, hardware retainers, and hardware.

B. As- Needed Replacement

The Contractor shall remove, replace in-kind, and install the following components and assemblies. The number in parenthesis (##) indicates the percentage of vehicles the components or assemblies of which are estimated to be replaced under this Amendment. If the quantity of components replaced is less that the estimated quantity, Contractor shall deliver the unused quantity to SFMTA, and title to those components shall pass to the SFMTA. If the quantity of components replaced is more than the estimated quantity, the SFMTA will provide those components to the Contractor or compensate Contractor for the additional cost of the components.

1. Steel tires, rubber isolators and shunts (50% - the steel tires shall be replaced when the diameter is below 26.75 inches). The tires for the first 41 carsets of trucks under this amendment will be provided by SFMTA.
2. Ground brush assemblies (10%)
3. Gear unit coupling (both halves and sleeves) (35%)
4. Antenna receiver/transmitter (Alcatel) (10%)
5. Tachometers (10%)
6. Brake disc (15%)
7. Drive axles (10%)
8. Idler axles (10%)
9. Aluminum wheel centers (10%)
10. Miscellaneous hardware replacement (35%)
11. Air tanks (2%)
12. Air fittings and piping (25%)

The Contractor shall provide usage reports of the materials listed under paragraph B. The report shall indicate, at a minimum; material name, part number, vehicle number, truck serial numbers, amount used, and amount remaining. The Contractor shall provide a monthly report to the Engineer to satisfy this requirement **[CDRL 5-002]**.

TP05M1.05 Overhauled Components and Assemblies

The Contractor shall remove, overhaul, and reinstall the following truck components and assemblies.

Rebuilt components shall meet the requirements for adjustment and testing of section 3, "Trucks and Suspension," of the LRV2 Heavy Repair and Workshop Manual, except for the traction motors, which shall meet the requirements of section 4, "Propulsion and Electronic Controls," and the track brake, which shall be rebuilt according to section 16 "Brakes."

A. Motors (power truck)

B. Gear units and coupling (power truck)

C. SAV valves

D. Brake calipers

E. Track brakes springs and guides

TP05M1.06 Piping

The Contractor shall clean, inside and out, and reuse piping that is not damaged. The Contractor shall replace damaged piping with new piping.

TP05M1.07 Paint

The Contractor shall touch-up paint, low gloss black, the truck frame, bolster beam, air tanks, vertical bump stop brackets, pilot/antenna bar brackets, derail alarm sensor bracket, and journal box caps where bare metal is exposed.

TP05M1.08 Replacement of Suspension Components

The Contractor shall replace suspension-related components with the identical original replacement component, if available, or an upgraded version that has been used in existing SFMTA trucks. If the original-type component is not available, the Contractor shall source a substitute part which still meets the suspension requirements of the LRV conformed specification # 309 for leveling, natural frequency, motion damping-ride quality, displacement criteria-body roll, and load weigh adjustment. The motor and trailer truck primary suspensions shall be replaced with the part identified on Breda drawings J19/J20 2.55.300 sheet 1 of 3, Pirelli p/n FR-201108-F (motor truck) and Pirelli p/n FR-201109-F (trailer truck). If these part numbers are no longer available, the Contractor shall source alternative parts with the approval of the SFMTA.

TP05M1.19 Assembly, Installation & Adjustment, and Testing of Equipment

Refer to TP10 Inspection and Testing for the detailed requirements for the test and inspection program, as well as the CDRLs associated with the inspection and testing of the trucks and suspension system.

A. Assembly

The overhauled equipment shall be assembled using procedures developed in accordance with the HRWM manuals. Assembly procedures shall include any intermediate testing

and/or functional verifications required to ensure that the assembled components will function properly. Each assembly shall have sign-off sheets for workers to document that their efforts were conducted in accordance with applicable procedures, and aid in failure and/or quality assurance investigations; pass/fail entries shall be required in the sign-off sheet for all required intermediate tests and/or functional verifications performed by the assembler, including the proper application of torque marks. Multiple components may be included on tabulated sign-off sheets with approval of the Authority. Sign off sheets **[CDRL 5-001]** shall be submitted for inclusion in the Car History Book.

B. Installation & Adjustment

The overhauled equipment shall be installed and adjusted using procedures developed in accordance with the HRWM manuals. Each installation shall have sign-off sheets for workers to document that their efforts were conducted in accordance with applicable procedures, and aid in failure and/or quality assurance investigations; pass/fail entries shall be required in the sign-off sheet for all required intermediate tests and/or functional verifications performed by the installer.

C. Testing

1. Pre-Possession Test

The Contractor shall confirm before taking possession of the vehicle that the two Automatic Train Control (ATCS) Receive Antennae, the two ATCS Transmit Antennae, the truck tachometers and the truck caliper brake release switches are functioning by conducting an ATCS Yard Departure Test on the SFMTA's Track 1 at the Green facility. This test shall be Incorporated into the pre-overhaul test procedure and report referenced in TP10 of these Technical Provisions.

SFMTA personnel will operate the LRV during the test, and the Contractor shall conduct the test. All testing activities and documentation shall be compliant with TP10 Inspection and Testing section of these Technical Specifications.

2. Acceptance Testing

Upon redelivery of the LRV to the SFMTA, the LRV shall be subject to acceptance tests as required by Section TP10 of these Technical Specifications, including identification of CDRLs. After passing the test, the Contractor shall provide and sign an acceptance test report.

TP05M1.10 CONTRACT DELIVERABLE REQUIREMENTS LIST

CDRL #	Title	Reference Paragraph
5-001	Sign-off Sheets	TP05M1.11A
5-002	Monthly Material Usage Report	TP05M1.04B

End of Section

August 29, 2014

The Honorable Members of the Board of Supervisors
City and County of San Francisco
1 Dr. Carlton Goodlett Place, Room 244
San Francisco, CA 94102

Subject: ***Request for Approval of Amendment No. 2 to Contract No. CPT 591-01 - LRV Doors and Steps Reconditioning and Systems Rehabilitation***

Executive Summary

The San Francisco Municipal Transportation Agency (SFMTA) requests that the Board of Supervisors approve Amendment No. 2 to Contract No. CPT 591, LRV Doors and Steps Reconditioning and Systems Rehabilitation, between the City and County of San Francisco, through the SFMTA, and AnsaldoBreda Inc. Amendment No. 2 will remove the doors and steps and the air supply unit rehabilitation from the project scope and shift the funds to rehabilitate trucks for 41 LRVs with three options to rehabilitate up to 71 sets of trucks. The options may be exercised within the sole discretion of the Director of Transportation subject to funding availability, for a total Contract amount not to exceed $104,263,354 and to extend the term of the Contract to no later than October 31, 2018.

This contract is needed to sustain and improve the reliability of the fleet and to reduce the overall maintenance of the various systems in the LRVs.

Background

The SFMTA operates a fleet of 149 Light Rail Vehicles (LRV). These LRVs were delivered to the SFMTA from 1997 through 2003. As part of its regular daily service, the LRVs operate 21 hours per day and 365 days a year.

The majority of the LRVs have exceeded their mid-life of 12.5 years and have travelled 200,000 to 400,000 miles since entering revenue service. The SFMTA needs to perform rehabilitation of the various systems of the LRVs in order to keep these vehicles in a state of good repair.

On May 6, 2009, the SFMTA issued a Request for Proposals (RFP) for CPT 591, LRV Doors and Steps Reconditioning and Systems Rehabilitation. The scope of the project includes reconditioning the doors and steps systems; rehabilitating the couplers, air supply units and the center truck cable; upgrading the roof wiring harnesses; replacing the aging carbody connecting pins in the center truck joint; and replacing the bearings in the traction motors.

On September 15, 2009, the SFMTA Board of Directors adopted Resolution No. 09-173, which authorized execution of the Contract with AnsaldoBreda, for a total amount not to exceed $56,752,554 and for a term not to exceed five years. On October 29, 2009, the Board of Supervisors adopted Resolution No. 403-09 approving award of the Contract.

On June 2, 2010, the parties entered into Amendment No. 1 to the Contract, to rehabilitate trucks for 34 LRVs at a cost of $11,996,867, increasing the total contract amount to $68,749,421 and extending the term of the contract by one year. Amendment No. 1 was funded entirely by additional stimulus money awarded by the federal government to the agency.

Amendment No. 2

A recent evaluation of the maintenance records of the LRVs that have undergone rehabilitation shows that the rehabilitation work performed on the doors and steps and air supply units of the LRV did not significantly improve the reliability of these systems. On the other hand, maintenance data show that the rehabilitation work on the trucks significantly has improved the reliability of the trucks. See table below:

Item	Before Rehab	After Rehab	Difference
Doors & Steps	29	25	13% reduction
Air Supply Unit	3	4	70% increase
Couplers	3	2	50% reduction
Articulation and PSC-2 Wiring	13	3	76% reduction
Traction Motor Bearings	13	3	75% reduction
Trucks and Resilient Pins	15	2	86% reduction

In light of the above, staff recommends removing the rehabilitation work on the doors and steps and air supply system from the contract and shifting the remaining funds to rehabilitate the trucks of the LRVs that have not gone through rehabilitation.

The SFMTA will save $13,650,748 by removing the rehabilitation work on the doors and steps and air supply system from the remaining vehicles, and removing training and spare parts that are no longer needed. Staff estimates that due to parts order lead time and mobilization, there will be 41 LRVs remaining in the contract by the time the contractor is ready to start the truck rehabilitation project. The cost to rehabilitate 41 car sets of trucks is $14,999,768.

The Contract allows the SFMTA to terminate the entire contract or any portion of the contract for convenience. However, the SFMTA must compensate the Contractor and its suppliers for parts that have already bought and cannot sell to other properties or cannot be used in other projects. Staff

has negotiated the costs of these parts at $1,957,831 for the doors and steps work and $193,211 for the air supply system work.

The cost breakdown for the changes being proposed is shown below:

Summary of Savings By Terminating Portions of the Contract

Item	Cost
Savings from Terminating Doors and Steps Portion of Project	$11,625,891.00
Savings from Terminating ASU Portion of Project	$1,368,171.00
Savings from Terminating Training (no longer required)	$20,000.00
Savings from Cost of Spare Parts (no longer required)	$636,686.00
Total Savings	$13,650,748.00

Summary of Additional Cost to Rehabilitate 41 Car Sets of Trucks

Item	Cost
Rehabilitate 41 Car Sets of Trucks (Base Contract)	$14,999,768.00
Cost of Parts Already Purchased by Vendors	$2,151,042.00
Cost of Spare Parts to Serve as Float for the Project	$1,868,164.00
Additional Allowance for Unforeseen Work	$250,000.00
Cost of Additional Taxes	$281,967.00
Total Additional Costs	$19,550,941.00

Based on the tables above, the project will require an additional amount of $5,900,193 to rehabilitate 41 car sets of trucks. The sources of the additional amount required by the project are identified in the next section of this letter.

This will leave a balance of 71 car sets of trucks that will not be rehabilitated. Staff recommends adding the rehabilitation of these remaining car sets of trucks as options 1, 2 and 3 in the Contract to rehabilitate the trucks on 24, 24 and 23 LRVs, respectively, if funds become available. The Amendment provides that exercising the option(s) will be within the discretion of the Director of Transportation. Following is a table summarizing the costs of the options:

Summary of Cost to Rehabilitation 71 Car Sets of Trucks for Options

Item	Cost
Option 1 (Rehabilitate 24 car sets of Trucks)	$9,663,696.00
Option 2 (Rehabilitate 24 car sets of Trucks)	$9,846,528.00
Option 3 (Rehabilitate 23 car sets of Trucks)	$9,615,035.00
Cost of Additional Taxes	$488,481.00
Total Additional Cost to Rehabilitate 71 Car Sets of Trucks	$29,613,740.00

Per the Contract, the SFMTA may exercise option 1, 2 and 3 by June, 2015, December 2015 and June 2016 respectively.

Funding

The additional amount of $5,900,193 for the base contract of Amendment Two (rehabilitation of trucks on 41 LRVs) will be funded using $3,405,759 that is currently available in the project budget but are not yet committed and $2,494,434 from the Transportation and Street Infrastructure Program (TSIP) general fund allocation. The options to rehabilitate additional trucks will be exercised as funds may become available to the SFMTA through the TSIP, as well as other federal, regional or local sources. Following are the budget and the funding plan for this Contract:

Budget

Category	Amount
Original Contract Amount	$56,752,554
Amendment No. 1	$11,996,867
Amendment No. 2 (Base Amount)	$ 5,900,193
Amendment No. 2 (Options 1, 2 and 3 plus taxes)	$ 29,613,740
Total Contract Amount	$104,263,354

Funding Plan

Project Funding Source	Amount
ARRA Funds	$20,527,682
Formula Funds	$25,689,496
Local Funds	$28,432,436
TSIP, Federal, Regional and Local Funds for Options 1, 2 & 3 (TBD)	$29,613,740
Total Funding Required	$104,263,354

Recommendation

SFMTA requests that the Board of Supervisors authorize the SFMTA to execute Amendment Two to Contract No. APT 591-01, LRV Doors and Steps Reconditioning and Systems Rehabilitation, with AnsaldoBreda Inc., to remove the doors and steps and the air supply unit rehabilitation from the project scope and to shift the funds to rehabilitate trucks for 41 LRVs, with three options to rehabilitate the remaining sets of trucks for 71 LRVs, which options may be exercised within the sole discretion of the Director of Transportation, for a total Contract amount not to exceed $104,263,354; and to extend the term of the Contract to no later than October 31, 2018.

Please don't hesitate to contact me should you have any questions or concerns.

Sincerely,

Edward D. Reiskin
Director of Transportation

SAN FRANCISCO
MUNICIPAL TRANSPORTATION AGENCY
BOARD OF DIRECTORS

RESOLUTION No. 14-134

WHEREAS, On October 29, 2009, the City and AnsaldoBreda Inc. (Contractor) entered into Contract No. APT 591-01 (the Contract) for reconditioning the doors and steps and rehabilitating other systems in 143 of SFMTA's light rail vehicles (LRVs), for a total amount not to exceed $56,752,554, and for a term not to exceed five years; and

WHEREAS, On June 2, 2010, the City and Contractor entered into Amendment One to the Contract, to perform a complete rehabilitation of the trucks of 34 LRVs for $11,996,867, for a total Contract amount not to exceed $68,749,421, and to extend the term of the Contract from five years to six years; and

WHEREAS, Maintenance records show that rehabilitation of the doors and steps and the air supply units (the DS/ASU work) has not significantly improved the reliability of these systems, but the trucks on the LRVs have shown significant improved reliability after rehabilitation; therefore, this Amendment Two will remove the DS/ASU work from the project scope and shift the balance of the money to rehabilitate the trucks on 41 additional trucks, with three options to perform rehabilitation of the trucks on 24, 24 and 23 LRVs, respectively, if funds become available to do the work; and

WHEREAS, Amendment Two provides that exercising the option(s) will be within the sole discretion of the Director of Transportation, subject to funding availability; and

WHEREAS, The Contract authorizes the SFMTA to terminate the Contract or any portion of the Contract for convenience with proper compensation to the Contractor for work that has been satisfactorily performed; termination costs for deleting the DS/ASU work are included in Amendment Two; now, therefore, be it

RESOLVED, That the SFMTA Board of Directors authorizes the Director of Transportation to execute Amendment Two to Contract No. APT 591-01 – LRV Doors and Steps Reconditioning and Systems Rehabilitation, with AnsaldoBreda Inc., to remove the doors and steps and the air supply unit rehabilitation from the project scope and to shift the funds to rehabilitate trucks for 41 LRVs, with three options to rehabilitate the remaining sets of trucks for up to 71 LRVs (which options may be exercised within the sole discretion of the Director of Transportation subject to funding availability), for a total Contract amount not to exceed $104,263,354; and to extend the term of the contract to no later than October 31, 2018; and be it further

RESOLVED, That the SFMTA Board of Directors recommends that the Board of Supervisors approve Amendment Two to the Contract.

I certify that the foregoing resolution was adopted by the Municipal Transportation Agency Board of Directors at its meeting of August 19, 2014.

R. Boomer

Secretary to the Board of Directors
San Francisco Municipal Transportation Agency

City and County of San Francisco
Municipal Transportation Agency
One South Van Ness 7th Floor
San Francisco, California 94107

Amendment One to
Agreement between the City and County of San Francisco and AnsaldoBreda Inc.

LRV Doors and Steps Reconditioning and Systems Rehabilitation

This Amendment is made this 2nd day of June, 2010, in the City and County of San Francisco, State of California, by and between: AnsaldoBreda Inc., a Delaware corporation ("Contractor"), and the City and County of San Francisco, a municipal corporation ("City"), acting by and through its San Francisco Municipal Transportation Agency ("SFMTA") (collectively, the "Parties").

Recitals

A. On or about October 29, 2009, City and Contractor entered into Contract No. APT 591-01 for reconditioning the doors and steps and rehabilitating systems in 143 of SFMTA's light rail vehicles ("Contract" or "Agreement").

B. The Parties wish to amend the Contract to incorporate rehabilitation of the trucks of 34 LRVs and extend the term of the Contract by one year, as well as to correct errata and make several administrative changes to the Contract.

NOW, THEREFORE, Contractor and the City agree as follows:

1. **The Definitions section of the Agreement is deleted and replaced with the following:**

Definitions

Where any word or phrase defined below, or a pronoun used in place thereof, is used in any part of the contract documents, it shall have the meaning set forth herein.

Acceptance: The formal written acceptance by the City and County of San Francisco that all work, or a specific portion thereof, under the contract has been satisfactorily completed.

Award: Notification from the City to Contractor of acceptance of Contractor's proposal, subject to the execution and approval of a satisfactory Contract therefore and bond to secure the performance thereof, and to such other conditions as may be specified or otherwise required by law.

Certification: Certification by the Controller that funds necessary to make payments as required under the contract are available in accordance with the City's Charter.

City: City and County of San Francisco, a municipal corporation.

Conditional Acceptance; Conditionally Accepted: The condition of a repaired Vehicle that, in the SFMTA's determination, does not meet the requirements for full acceptance,

but is authorized by the SFMTA to enter into revenue service, pending completion of all repairs.

Conformed Contract Documents: The contract documents revised to incorporate information included in the Contractor's Proposal and accepted by the City.

Contract; Agreement: The written Contract executed by the City and Contractor, covering the performance of the work and furnishing of labor, materials, equipment, tools, and services, including work incidental to the procurement, to include the RFP, Technical Specifications, all Conformed Contract Documents, Contractor's Proposal, the Contract bonds or other security, and all supplemental agreements entered into.

Contract Modification: A written order, issued by the City to Contractor, covering changes in the Contract documents within the general scope of the Contract and establishing the basis of payment and time adjustments for the work affected by the changes.

Contractor; Consultant: The Proposer to whom award is made.

Controller: Controller of the City.

Corrective Action Plan: The plan submitted by Contractor to correct Defects that have been determined by the SFMTA to be Fleet Defects, as defined in Section 65.7(a).

Days: Unless otherwise designated, the word "days" refers to working days of the City.

Defect(s): Patent or latent malfunctions or failure in manufacture or design of any component or subsystem.

Director of Capital Programs and Construction: The Division Director in charge of the Capital Programs and Construction Division of the SFMTA.

Engineer: The SFMTA Resident Engineer assigned to the Contract or designated agent.

LRV or Vehicle: A light rail vehicle subject to repair under this Contract.

Muni: The San Francisco Municipal Railway, the public transit system of the City under the supervision and control of the San Francisco Municipal Transportation Agency.

Notice To Proceed: A written notice to the Contractor of the date on which it shall begin prosecution of the work to be done under the contract.

Proposal: The technical and management information and prices submitted in response to the Request for Proposals.

Request for Proposals; RFP: The Request for Proposals issued by the SFMTA on May 6, 2009, for LRV Doors, Steps and Systems Rehabilitation.

Senior Program Manager: The SFMTA staff person assigned to manage the Contract for the SFMTA, or designated agent.

SFMTA: The San Francisco Municipal Transportation Agency, an agency of the City with responsibility for the Municipal Railway Department and Parking and Traffic.

Subcontractor: Any individual, partnership, firm, or corporation, which undertakes integrally on the Project the partial or total design, manufacture, or performance of one or more items of work under the terms of the contract. As used herein, the terms subcontractor and supplier are synonymous.

Technical Specifications: The specifications, provisions, and requirements that detail the work and the materials, products (including the methods of manufacture, construction, assembly, and testing), and other requirements relative thereto.

Work: The furnishing of all labor, supervision, services, products, materials, machinery, equipment, tools, supplies, and facilities and the performance of all requirements called for by the Contract and necessary to the completion thereof.

Work Program: The plan submitted by Contractor to correct a declared Fleet Defect in all LRVs that have not experienced the Defect.

2. Section 2 of Agreement (Term of the Agreement) is amended to read as follows:

2. Subject to Section 1, this Agreement shall commence on the Effective Date and terminate six years thereafter.

3. Section 5 (Compensation) is deleted and replaced with the following:

5. Compensation

5.1 **Amount of Contract.** In no event shall the amount of this Agreement exceed Sixty-Eight Million, Seven Hundred Forty-Nine Thousand, Four Hundred Twenty-One Dollars ($68,749,421)

5.2 **Price Breakdown.** The breakdown of costs associated with this Agreement appears in the Price Schedule (Exhibit C) and Payment Schedule (Exhibit D), incorporated by reference as though fully set forth herein. The unit prices in Exhibit C represent the costs for each Vehicle if the Vehicle requires the entire scope of Work listed in Item Nos. 1.1 through 1.6. However, if after inspection of a Vehicle pursuant to Section TP10.03 of the Technical Specifications and design review under Section 61.4, the SFMTA determines that the Vehicle requires only a portion of the scope of Work in a particular Item No., the unit price of the Item No., and the resultant cost of the Work on each Vehicle, shall be reduced after negotiations with Contractor.

5.3 **SFMTA Approval of Work.** No charges shall be incurred under this Agreement nor shall any payments become due to Contractor until reports, services, or both, required under this Agreement are received from Contractor and approved by SFMTA as being in accordance with this Agreement. City may withhold payment to Contractor in any instance in which Contractor has failed or refused to satisfy any material obligation provided for under this Agreement.

5.4 **No Interest; Price Adjustments.** In no event shall City be liable for interest or late charges for any late payments. City will not make price adjustments to this Contract to protect Contractor from economic inflation.

4. Section 15.1(d) is amended to read as follows:

All policies (and bonds, as described in Section 15.2 below) shall provide 30 days' advance written notice to City of cancellation or reduction in coverage for any reason, mailed to the following address:

San Francisco Municipal Transportation Agency
1 South Van Ness Avenue,
3rd Floor San Francisco, CA 94103
Attention: Elson Hao
Contract No. APT 591-01 (CCO 09-1076)

5. Section 49 (Authority of Engineer) is amended to read as follows:

The Engineer shall decide all questions, which may arise as to the quality or acceptability of materials furnished and work performed and as to the manner of performance and rate of progress of the work; all questions, which may arise as to the acceptable fulfillment of the Contract on the part of the Contractor; and all questions as to compensation. In discharging the responsibilities outlined above, the Engineer shall at all times act fairly and reasonably. Any appeal of the Engineer's decisions shall be in accordance with the provisions of Section 55 of this Agreement. As with any claim, change, extra or additional work, Contractor shall be paid in accordance with the payment provisions of this Contract when the dispute is finally resolved.

Should any questions arise as to the meaning and intent of the Contract, the matter shall be referred to the Engineer, who, with input from SFMTA staff and from the Contractor, shall decide the true meaning and intent of the Contract. The Engineer's decision in this regard shall be administratively final and conclusive.

6. Sections 55.2 (Resolution of Disputes) and 55.3 (No Cessation of Work) are amended to read as follows:

55.2 Resolution of Disputes. Disputes arising in the performance of this Agreement that are not resolved by negotiation between the SFMTA Liaison and Contractor shall be decided in writing by the SFMTA Senior Program Manager. The decision shall be administratively final and conclusive unless within ten (10) days from the date of such decision, the Contractor mails or otherwise furnishes a written appeal to the Director of Capital Programs and Construction, or his/her designee. In connection with such an appeal, the Contractor shall be afforded an opportunity to be heard and to offer evidence in support of its position. The decision of the Director of Capital Programs and Construction shall be administratively final and conclusive. This section applies to all disputes unless a specific provision of this Agreement provides that the Engineer's decision as to a particular dispute is final.

55.3 No Cessation of Work. Pending final resolution of a dispute hereunder, the Contractor shall proceed diligently with the performance of its obligations under this Agreement in accordance with the written directions of the Engineer.

7. Subsection (b) (Remedy) of Section 64.7(Fleet Defects) is amended to read as follows:

> **(b) Remedy**. The Contractor shall correct a fleet defect under the warranty provisions defined in "Repair Procedures" (Section 65). Within 30 days of receipt of notification of a Fleet Defect, the Contractor shall provide the SFMTA with a Corrective Action Plan, subject to approval by SFMTA, specifying how and when all LRVs with Defects shall be corrected. No later than 10 days after correcting the Defects, the Contractor shall submit a proposed Work Program reasonably designed to prevent the occurrence of the same Defect in all LRVs remaining to be repaired, and, if applicable, spare parts purchased under this Contract. The Work Program shall specify how and when the corrective work in all remaining LRVs will be performed. If SFMTA requires changes to a Corrective Action Plan or Work Program in order to approve it, Contractor shall submit the revised Plan or Program within five days after SFMTA requests such changes. Where the specific Defect can be solely attributed to particular identifiable part(s), the Work Program shall include redesign and/or replacement of only the defectively designed and/or manufactured part(s). In all other cases, the work program shall include inspection and/or correction of all of the LRVs in the fleet via a mutually agreed to arrangement. Any Contractor-proposed changes to a Fleet Defect Corrective

Action Plan or Work Program must be submitted to the SFMTA for approval. If (a) Contractor does not provide a Corrective Action Plan or Work Program within the time specified above (or as extended by SFMTA), or (b) Contractor does not submit revisions to a Corrective Action Plan or Work Program as requested by the SFMTA, or (c) Contractor does not fully correct a specific declared Fleet Defect within the time specified in the Corrective Action Plan or in the Work Program, SFMTA will assess liquidated damages in accordance with Section 19 of this Agreement.

8. Exhibit B of the Agreement is deleted and replaced by a new Exhibit B, attached to this Amendment and incorporated by reference as though fully set forth.

9. Exhibit C of the Agreement is deleted and replaced by a new Exhibit C, attached to this Amendment and incorporated by reference as though fully set forth.

10. Exhibit D of the Agreement is deleted and replaced by a new Exhibit D, attached to this Amendment and incorporated by reference as though fully set forth.

11. The Technical Specifications are amended to add Section TP05M1 Truck and Suspension Systems, which is attached to this Amendment and incorporated by reference as though fully set forth.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement on the day first mentioned above.

CITY

Municipal Transportation Agency

Nathaniel P. Ford Sr.
Executive Director/CEO

Municipal Transportation Agency
Board of Directors
Resolution No. 10-042
Dated: 4/6/10
Attest: R. Boomer
Secretary

Approved as to Form:

Dennis J. Herrera
City Attorney

By
Robin M. Reitzes
Deputy City Attorney

Board of Supervisors
Resolution No. 250-10
Dated: 6/02/2010
Attest:
Clerk of the Board

CONTRACTOR

AnsaldoBreda Inc.

By signing this Agreement, I certify that I comply with the requirements of the Minimum Compensation Ordinance, which entitle Covered Employees to certain minimum hourly wages and compensated and uncompensated time off.

I have read and understood paragraph 35, the City's statement urging companies doing business in Northern Ireland to move towards resolving employment inequities, encouraging compliance with the MacBride Principles, and urging San Francisco companies to do business with corporations that abide by the MacBride Principles.

Lorenzo Reffreger
Vice President, Marketing, Sales and Service
1461 Loveridge Road
Pittsburg, CA 94565

City vendor number: 41208

EXHIBIT B
PROJECT DELIVERY SCHEDULE

Delivery of 143 Rehabilitated Light Rail Vehicles and Associated Deliverables

DELIVERY MILESTONE		AFTER NTP
a. Acceptance of Management Work Plan, Master Baseline Schedule	+30	30 days
b. Delivery of Pilot LRV ready for acceptance testing no later than	+150	180 days
c. Delivery of successful testing and Conditional Acceptance of the Pilot Car no later than	+30	210 days
d. Completion of successful testing and Conditional Acceptance of Second car	+60	270 days
e. Completion of successful testing and Conditional Acceptance of 143rd car	+1110	1380 days

Milestone requirements detailed in Section 67 of the Contract and in Section TP01.08 of the Technical Provisions.

EXHIBIT C

PRICE SCHEDULE

FOR SFMTA REHABILITATION OF IDENTIFIED SUBSYSTEMS FOR 143 LRVs

Item No.	Description	Qty.	Unit Price	Total Price
1.	Rehabilitation of Couplers, Truck, Air Supply Units, Doors and Steps, Articulation Wiring and harnesses for 143 LRVs including manuals, CDRLs, Transport of Vehicle to Contractor facility and return to SFMTA facility, Site Support & Warranty*			
1.1	Rehabilitated couplers (electrical and mechanical) complete assembly (A)	143	$53,500	$7,650,443
1.2	Rehabilitated doors and steps complete assembly (B)	143	$203,963	$29,166,640
1.3	Replacement PSC-2 Wiring Harnesses (C)	143	$6,860	$980,980
1.4	Re-designed new articulation wiring and harnesses complete assembly (D)	143	$37,306	$5,334,726
1.5	Rehabilitated air supply units complete assembly (E)	143	$24,003	$3,432,425
1.6.	Replacement of Center Pins and Traction Motor Bearings (F)	143	$11,210	$1,602,991
1.7	Program Management, Engineering, QA Support (G)			$2,813,410
	Subtotal of Item 1 (A+B+C+D+E+F+G)			$50,981,615
2.	Rehabilitate Motored and Non-Motored Trucks (H) of the LRVs	34	$334,223.18	$11,363,588.10
3.	Training 35 SFMTA employees and trainers on the operations and maintenance of supplied equipment including training on the use of special tools and software as applicable and manuals (I)	Lump Sum		$20,000

4.0	Spare Parts For 143 LRVs			
4.1	Rehabilitated couplers (electrical and mechanical) complete assembly (SFMTA will provide cores) (J)	10	26,750	267,498
4.2	Rehabilitated doors and steps complete assembly (K)	2	181,165	362,329
4.3	Replacement PSC-2 Wiring Harnesses (L)	1	6,859	6,859
4.4	Re-designed new articulation wiring and harnesses ; a. Jumper Cables b. Bulkhead Connectors			
	Articulation Wiring Spares a+b (M)	10	21,871	218,708
Subtotal of Spares (J+K+L+M)				**$855,394**
5.	Allowance for latent or unforeseen mechanical conditions			**$2,000,000**
6.	Sales tax on materials (reimbursable)			**$3,528,823.90**
	CONTRACT TOTAL (1+2+3+4+5)			**$68,749,421**

EXHIBIT D
PAYMENT SCHEDULE

1. Rehabilitation of 143 Light Rail Vehicles

1a.	Approval of Contractor's Management Work Plan and Program CDRL's (Program CDRL's as defined in section TP15 Deliverables Summary)	5% of the amount of Line Item 1 of Price Schedule (30% of the amount to be paid upon delivery of the Work Plan and all CDRLs to SFMTA and 70% to be paid upon approval of the Work Plan and all CDRLs by SFMTA)
1b.	Proof of ordering Major Parts and Assemblies including Couplers, Trucks, Air Supply Units, Doors and Steps, Articulation Wiring and harnesses, (Based on presentation of executed purchase orders)	Not to exceed 25% of the amount of Line Item 1 of Price Schedule
1c.	Delivery of car to Pittsburg	20% of the amount of Line Item 1 of Price Schedule, on a per car basis
1d.	Completion of Pre-Shipment testing, and Release of car for shipment (Based on TP01.08 - Release for shipment Certificate)	20% of the amount of Line Item 1 of Price Schedule, on a per car basis.
1e.	Conditional Acceptance of each Vehicle (per Section 67.2 of Agreement) (Based on TP01.08 - Approval for Revenue Service Certificate)	20% of the amount of Line Item 1 of Price Schedule, on a per car basis.
1f.	Final Acceptance, delivery of all car-based deliverables, closure of all Corrective Actions (Based on Final Acceptance Certificate, per TP01.08)	5% of the amount of Line Item 1 of Price Schedule, on a per car basis.
1g.	Closure of all contract deliverables by SFMTA (Based on Contract Closeout Certificate TP01.08)	5% of the amount of Line Item1 of Price Schedule

2. Rehabilitation of Trucks for 34 Light Rail Vehicles

2a.	Proof of ordering Major Parts and Assemblies (Based on presentation of executed purchase orders)	Not to exceed 30% of the amount of Line Item 2 of Price Schedule
2b.	Delivery of car to Pittsburg	20% of the amount of Line Item2 of Price Schedule, on a per car basis
2c.	Completion of Pre-Shipment testing, and Release of car for shipment (Based on TP01.08 - Release for shipment Certificate)	20% of the amount of Line Item 2 of Price Schedule, on a per car basis
2d	Conditional Acceptance of each Vehicle (per Section 67.2 of Agreement) (Based on TP01.08 - Approval for Revenue Service Certificate)	20% of the amount of Line Item 2 of Price Schedule, on a per car basis.
2e.	Final Acceptance, delivery of all car-based deliverables, closure of all Corrective Actions (Based on Final Acceptance Certificate, per TP01.08)	10% of the amount of Line Item 2 of Price Schedule, on a per car basis.

3. Training

3a.	Delivery and Approval of Training Plan	15% of the amount of Line Item 3 of Price Schedule
3b.	Completion of all training	80% of the amount of Line Item 3 of Price Schedule

3c.	Final acceptance of all contract deliverables	5% of the amount of Line Item 3 of Price Schedule

4. Spare parts

Spare parts delivered and accepted by SFMTA in San Francisco shall be paid according to the detailed list in Line Item 4 of Price Schedule

NOTE: Payment for the rehabilitation work will occur upon completion of listed items on this Payment Schedule, upon proper receipt of an invoice requesting payment and acceptable completion of all contract terms. Sales taxes shall be reimbursed quarterly based on evidence of payment to the California State Board of Equalization.

TECHNICAL SPECIFICATIONS
(TECHNICAL PROVISIONS)

SECTION TP05M1

CONTRACT MODIFICATION #1 FOR TRUCKS AND SUSPENSION SYSTEMS

March 10, 2010
Rev. 0

SECTION TP05M1
TRUCK AND SUSPENSION SYSTEMS

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TP05M1: TRUCKS AND SUSPENSION SYSTEMS

TP05M1.01 GENERAL

The work described in this section shall apply only to 34 LRVs and shall be in addition to the work required in Section TP05 – Truck Assemblies of the original Contract.

TP05M1.02 SCOPE OF WORK

The Contractor shall remove, disassemble, inspect, repair, replace, overhaul, reassemble, test and reinstall the components of the trucks and suspension systems of the LRVs as specified herein. These specifications apply to both motored and non-motored trucks of the LRV.

TP05M1.03 OVERHAUL REQUIREMENTS

A. Terminology

Whenever the term "overhaul" is used herein, it shall mean the level of effort designated for a component or assembly, including, but not limited to, cleaning, refinishing, repair, or replacement.

Whenever the term "replace in kind" is used herein, it shall mean replacement with identical OEM parts, or SFMTA-approved equal. The SFMTA is not obligated to accept other than OEM parts, unless the OEM part is obsolete, and may require the Contractor to perform whatever reasonable verification activities as needed in order to demonstrate that the alternative is acceptable based on its being equivalent or superior to the OEM part per Section 1.04.C.1 of these Technical Provisions.

The costs associated with proving that an alternative is equivalent or superior to an OEM part shall be borne by the Contractor.

Whenever the term "replace" is used herein, it shall mean replacement with components compliant with applicable material and workmanship standards. This term is utilized primarily for hardware, where compliance with applicable standards is sufficient to demonstrate equivalence to the OEM part.

Whenever the term "reuse" is used herein, it shall mean disassemble, clean, inspect, verify, refinish and lubricate as needed, reassemble, and reinstall onto the overhauled assemblies; this term reflects estimation that none will require replacement, unless otherwise specified.

B. Hardware/Fasteners

All hardware and fasteners, including, but not limited to, screws, bolts, nuts, clips, washers, lock-washers, shrink wrap, c-clips, tie straps, shaft-keys, springs, shrinkable tubing, cotter pins, retaining rings, bushings, roll pins, clips, gaskets, and etc., on, or in, overhauled assemblies, components, or parts, shall be replaced unless identified for reuse herein.

C. Labels

The Contractor shall apply labels to the truck, gearbox and traction motor to indicate when it was overhauled. The labels shall be of the same type as the OEM labels currently installed on the equipment. The quantity and locations of labels shall be similar to the original labeling arrangement, per the labeling requirement in TP1.07.O of these Technical Specifications.

D. Overhaul Criteria

The Contractor shall follow the truck repair and overhaul criteria of the San Francisco Muni LRV2 Heavy Repair and Workshop Manual, Section 3 "Trucks and Suspension."

The Contractor shall follow the traction motor overhaul criteria of section 4, "Propulsion and Electronic Controls."

The Contractor shall follow the track brake overhaul criteria of section 16 "Brakes."

E. Disassembly, Cleaning & Storage

The Contractor shall disassemble the truck and clean all reusable components. Non reusable components shall be properly disposed of.

Parts waiting reassembly shall be tagged and properly stored.

F. Structural Inspection and Repair

The Contractor shall strip/clean down to clean paint and visually inspect the truck frame, bolster beam, connecting rods, axles and hubs for dimensional accuracy and inspect for cracks. All cracks found shall be documented in the truck history book and repaired as provided below.

The Contractor shall inspect all mating surfaces of the truck frame, threaded attachment points, and permanently affixed brackets for damage. All damage found shall be documented in the truck history book and repaired as provided below.

The Contractor shall notify and obtain SFMTA approval prior to performing any repairs under this Section. Such repairs shall be deemed as extra work under Section 48.2 of the Agreement.

TP05M1.04 New Components and/or Assemblies

The Contractor shall remove, replace in-kind, and install the following components or assemblies on all LRVs under Amendment No. One to the Agreement.

A. 100% Replacement

1. Journal axle bearings
2. Shock absorbers
3. Grounding cables
4. Primary suspension (latest configuration)
5. Secondary suspension (air bags)
6. Brake caliper suspension bushings
7. Pilot bar/antenna bar mounts (latest configuration)
8. Leveling valve and hardware

9. Air hoses (Knorr)
10. Knorr test fittings (cut-out cock)
11. Wiring harnesses
12. Traction rod rubber element
13. Flexible pads (GE)
14. Connecting rod rubber elements GE
15. Miscellaneous rubber components
16. Lateral bump stop
17. Slewing Ring
18. Lubrication
19. Truck cleaning and waste disposal

B. As- Needed Replacement

The Contractor shall remove, replace in-kind, and install the following components and assemblies. The number in parenthesis (##) indicates the quantity of vehicles the components or assemblies of which are estimated to be replaced under this Amendment. If the quantity of components replaced is less that the estimated quantity, Contractor shall deliver the unused quantity to SFMTA, and title to those components shall pass to the SFMTA. If the quantity of components replaced is more than the estimated quantity, the SFMTA will provide those components to the Contractor or compensate Contractor for the additional cost of the components.

1. Steel tires, rubber isolators and shunts (50% - the steel tires shall be replaced when the diameter is below 26.75 inches)
2. Ground brush assemblies (10%)
3. Gear unit coupling (both halves and sleeves) (35%)
4. Antenna receiver/transmitter (Alcatel) (10%)
5. Tachometers (10%)
6. Brake disc (15%)
7. Drive axles (10%)
8. Idler axles (10%)
9. Aluminum wheel centers (10%)
10. Miscellaneous hardware replacement (35%)
11. Air tanks (2%)
12. Air fittings and piping (25%)

TP05M1.05 Overhauled Components and Assemblies

The Contractor shall remove, overhaul, and reinstall the following truck components and assemblies.

Rebuilt components shall meet the requirements for adjustment and testing of section 3, "Trucks and Suspension," of the LRV2 Heavy Repair and Workshop Manual, except for the traction motors, which shall meet the requirements of section 4, "Propulsion and Electronic Controls," and the track brake, which shall be rebuilt according to section 16 "Brakes."

A. Motors (power truck)

B. Gear units and coupling (power truck)

C. SAV valves

D. Brake calipers

E. Track brakes springs and guides

TP05M1.06 Piping

The Contractor shall clean, inside and out, and reuse piping that is not damaged. The Contractor shall replace damaged piping with new piping.

TP05M1.07 Paint

The Contractor shall touch-up paint, low gloss black, the truck frame, bolster beam, air tanks, vertical bump stop brackets, pilot/antenna bar brackets, derail alarm sensor bracket, and journal box caps where bare metal is exposed.

TP05M1.08 Replacement of Suspension Components

The Contractor shall replace suspension-related components with the identical original replacement component if available or an upgraded version that has been used in existing SFMTA trucks. If the original-type component is not available, the Contractor shall source a substitute part which still meets the suspension requirements of the LRV conformed specification # 309 for leveling, natural frequency, motion damping-ride quality, displacement criteria-body roll, and load weigh adjustment.

TP05M1.09 Assembly, Installation & Adjustment, and Testing of Equipment

Refer to TP10 Inspection and Testing for the detailed requirements for the test and inspection program, as well as the CDRLs associated with the inspection and testing of the trucks and suspension system.

A. Assembly

The overhauled equipment shall be assembled using procedures developed in accordance with the HRWM manuals. Assembly procedures shall include any intermediate testing and/or functional verifications required to ensure that the assembled components will function properly. Each assembly shall have sign-off sheets for workers to document that their efforts were conducted in accordance with applicable procedures, and aid in failure and/or quality assurance investigations; pass/fail entries shall be required in the sign-off sheet for all required intermediate tests and/or functional verifications performed by the assembler, including the proper application of torque marks. Multiple components may be included on tabulated sign-off sheets with approval of the Authority. Sign off sheets **[CDRL 5-001]** shall be submitted for inclusion in the Car History Book.

B. Installation & Adjustment

The overhauled equipment shall be installed and adjusted using procedures developed in accordance with the HRWM manuals. Each installation shall have sign-off sheets for workers to document that their efforts were conducted in accordance with applicable procedures, and aid in failure and/or quality assurance investigations; pass/fail entries shall be required in the sign-off sheet for all required intermediate tests and/or functional verifications performed by the installer.

C. Testing

1. Pre-Possession Test

The Contractor shall confirm before taking possession of the vehicle that the two Automatic Train Control (ATCS) Receive Antennae, the two ATCS Transmit Antennae, the truck tachometers and the truck caliper brake release switches are functioning by conducting an ATCS Yard Departure Test on the SFMTA's Track 1 at the Green facility. This test shall be Incorporated into the pre-overhaul test procedure and report referenced in TP10 of these Technical Provisions.

SFMTA personnel will operate the LRV during the test, and the Contractor shall conduct the test. All testing activities and documentation shall be compliant with TP10 Inspection and Testing section of these Technical Specifications.

2. Acceptance Testing

Upon redelivery of the LRV to the SFMTA, the LRV shall be subject to acceptance tests as required by Section TP10 of these Technical Specifications, including identification of CDRLs. After passing the test, the Contractor shall provide and sign an acceptance test report.

TP05M1.10 CONTRACT DELIVERABLE REQUIREMENTS LIST

CDRL #	Title	Reference Paragraph
5-001	Sign-off Sheets	TP05M1.11A

End of Section

Contract Between
The City and County of San Francisco
and

AnsaldoBreda Inc.

LRVs Doors and Steps Reconditioning
and Systems Rehabilitation

Contract No APT 591-01
CCO No. 09-1076

USDOT
TIGER
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Exhibits

Exhibit A	FTA Requirements
Exhibit B	Milestone Schedule
Exhibit C	Price Schedule
Exhibit D	Proposal Schedule

City and County of San Francisco
Municipal Transportation Agency
Municipal Railway Department
One South Van Ness 7th Floor
San Francisco, California 94107

Agreement between the City and County of San Francisco and

AnsaldoBreda Inc.

This Agreement is made this _____ day of _____, 2009, in the City and County of San Francisco, State of California, by and between: AnsaldoBreda Inc., a Delaware corporation ("Contractor"), and the City and County of San Francisco, a municipal corporation ("City"), acting by and through its San Francisco Municipal Transportation Agency ("SFMTA").

Recitals

A. SFMTA wishes to obtain the services of a qualified firm to rehabilitate 143 of SFMTA's light rail vehicles (the "LRVs").

B. A. Request for Proposals ("RFP") was issued on May 6, 2009, and City selected Contractor pursuant to the RFP.

C. Contractor represents and warrants that it is qualified to perform the services required by City as set forth under this Contract.

D. Approval for said Agreement was obtained from a Civil Service Commission Notice of Action for Contract Number 4021-09/10 on July 20, 2009 and September 21, 2009;

Now, THEREFORE, the parties agree as follows:

Definitions

Where any word or phrase defined below, or a pronoun used in place thereof, is used in any part of the contract documents, it shall have the meaning set forth herein.

Acceptance: The formal written acceptance by the City and County of San Francisco that all work, or a specific portion thereof, under the contract has been satisfactorily completed.

Award: Notification from the City to Contractor of acceptance of Contractor's proposal, subject to the execution and approval of a satisfactory Contract therefore and bond to secure the performance thereof, and to such other conditions as may be specified or otherwise required by law.

Certification: Certification by the Controller that funds necessary to make payments as required under the contract are available in accordance with the City's Charter.

City: City and County of San Francisco, a municipal corporation.

Conditional Acceptance; Conditionally Accepted: The condition of a repaired Vehicle that, in the SFMTA's determination, does not meet the requirements for full acceptance, but is authorized by the SFMTA to enter into revenue service, pending completion of all repairs.

Conformed Contract Documents: The contract documents revised to incorporate information included in the Contractor's Proposal and accepted by the City.

Contract; Agreement: The written Contract executed by the City and Contractor, covering the performance of the work and furnishing of labor, materials, equipment, tools, and services, including work incidental to the procurement, to include the RFP, Technical Specifications, all Conformed Contract Documents, Contractor's Proposal, the Contract bonds or other security, and all supplemental agreements entered into.

Contract Modification: A written order, issued by the City to Contractor, covering changes in the Contract documents within the general scope of the Contract and establishing the basis of payment and time adjustments for the work affected by the changes.

Contractor: The Proposer to whom award is made.

Controller: Controller of the City.

Corrective Action Plan: The plan submitted by Contractor to correct Defects that have been determined by the SFMTA to be Fleet Defects, as defined in Section 65.7(a).

Days: Unless otherwise designated, the word "days" refers to working days of the City.

Defect(s): Patent or latent malfunctions or failure in manufacture or design of any component or subsystem.

Engineer: The SFMTA Engineer assigned to the Contract or designated agent.

LRV or Vehicle: A light rail vehicle subject to repair under this Contract.

Muni: The San Francisco Municipal Railway, the public transit system of the City under the supervision and control of the San Francisco Municipal Transportation Agency.

Notice To Proceed: A written notice to the Contractor of the date on which it shall begin prosecution of the work to be done under the contract.

Project Manager: The Project Manager assigned to the Contract for the SFMTA of the City, or designated agent.

Proposal: The technical and management information and prices submitted in response to the Request for Proposals.

Request for Proposals; RFP: The Request for Proposals issued by the SFMTA on May 6, 2009, for LRV Doors, Steps and Systems Rehabilitation.

SFMTA: The San Francisco Municipal Transportation Agency, an agency of the City with responsibility for the Municipal Railway Department and Parking and Traffic.

Subcontractor: Any individual, partnership, firm, or corporation, which undertakes integrally on the Project the partial or total design, manufacture, or performance of one or more items of work under the terms of the contract. As used herein, the terms subcontractor and supplier are synonymous.

Technical Specifications: The specifications, provisions, and requirements that detail the work and the materials, products (including the methods of manufacture, construction, assembly, and testing), and other requirements relative thereto.

Work: The furnishing of all labor, supervision, services, products, materials, machinery, equipment, tools, supplies, and facilities and the performance of all requirements called for by the Contract and necessary to the completion thereof.

Work Program: The plan submitted by Contractor to correct a declared Fleet Defect in all LRVs that have not experienced the Defect.

1. Certification of Funds; Budget and Fiscal Provisions; Termination in the Event of Non-Appropriation

This Agreement is subject to the budget and fiscal provisions of the City's Charter. Charges will accrue only after prior written authorization certified by the Controller, and the amount of City's obligation hereunder shall not at any time exceed the amount certified for the purpose and period stated in such advance authorization.

This Agreement will terminate without penalty, liability or expense of any kind to City at the end of any fiscal year if funds are not appropriated for the next succeeding fiscal year. If funds are appropriated for a portion of the fiscal year, this Agreement will terminate, without penalty, liability or expense of any kind at the end of the term for which funds are appropriated.

City has no obligation to make appropriations for this Agreement in lieu of appropriations for new or other agreements. City budget decisions are subject to the discretion of the Mayor and the Board of Supervisors. Contractor's assumption of risk of possible non-appropriation is part of the consideration for this Agreement.

THIS SECTION CONTROLS AGAINST ANY AND ALL OTHER PROVISIONS OF THIS AGREEMENT.

2. Term of the Agreement

Subject to Section 1, the term of this Agreement shall be from the Effective Date to _____.

3. Effective Date of Agreement

This Agreement shall become effective when the Controller has certified to the availability of funds and Contractor has been notified in writing.

4. Services Contractor Agrees to Perform

The Contractor agrees to perform the services provided for in the RFP, including Volume 2 (Technical Specifications), and in the Contractor's Proposal, according to the Project Delivery Schedule set forth in Exhibit B.

5. Compensation

5.1. **Amount of Contract.** In no event shall the amount of this Agreement exceed Fifty-Six Million, Seven Hundred Fifty-Two Thousand, Five Hundred Fifty-Four Dollars ($56,752,554)

5.2. **Price Breakdown.** The breakdown of costs associated with this Agreement appears in the Price Schedule (Exhibit C) and Payment Schedule (Exhibit D), incorporated by reference as though fully set forth herein. The unit prices in Exhibit C represent the costs for each Vehicle if the Vehicle requires the entire scope of Work listed in Item Nos. 1.1 through 1.6. However, if after inspection of a Vehicle pursuant to Section TP10.03 of the Technical Specifications and design review under Section 61.4, the SFMTA determines that the Vehicle requires only a portion of the scope of Work in a

particular Item No., the unit price of the Item No., and the resultant cost of the Work on each Vehicle, shall be reduced after negotiations with Contractor.

5.3. **SFMTA Approval of Work.** No charges shall be incurred under this Agreement nor shall any payments become due to Contractor until reports, services, or both, required under this Agreement are received from Contractor and approved by SFMTA as being in accordance with this Agreement. City may withhold payment to Contractor in any instance in which Contractor has failed or refused to satisfy any material obligation provided for under this Agreement.

5.4. **No Interest; Price Adjustments.** In no event shall City be liable for interest or late charges for any late payments. City will not make price adjustments to this Contract to protect Contractor from economic inflation.

6. Guaranteed Maximum Costs

6.1. The City's obligation hereunder shall not at any time exceed the amount certified by the Controller for the purpose and period stated in such certification.

6.2. Except as may be provided by laws governing emergency procedures, officers and employees of the City are not authorized to request, and the City is not required to reimburse the Contractor for, Commodities or Services beyond the agreed upon contract scope unless the changed scope is authorized by amendment and approved as required by law.

6.3. Officers and employees of the City are not authorized to offer or promise, nor is the City required to honor, any offered or promised additional funding in excess of the maximum amount of funding for which the contract is certified without certification of the additional amount by the Controller.

6.4. The Controller is not authorized to make payments on any contract for which funds have not been certified as available in the budget or by supplemental appropriation.

7. Payment; Invoice Format; Title

7.1. **Invoices.** Invoices furnished by Contractor under this Agreement must be in a form acceptable to the Controller, and must include the Contract Progress Payment Authorization number. No more than one invoice per month shall be submitted. Invoices shall be accompanied by appropriate supporting documentation. All amounts paid by City to Contractor shall be subject to audit by City.

7.2. **Progress Payments.** Progress payments shall be made as set forth in the Payment Schedule (Exhibit D). Progress payments shall be conditioned on either (1) transfer of title to the City for the portion of the components, equipment or material paid for by the progress payment (as provided in Section 7.3 below), plus a certificate of insurance required by Section 15.1(g) of this Agreement; or (2) for payments for Item 1b of the Payment Schedule made prior to delivery of the parts or assemblies, issuance of a letter of credit in conformance with the provisions of Section 15.3, in the amount of the progress payment. Progress payments shall be made by the City to Contractor at the address specified in the section entitled "Notices to the Parties." Letter(s) of credit will be released upon transfer of full title to parts or assemblies.

7.3. **Title.** Upon the earlier of payment or acceptance of any part, component, or assembly, Contractor warrants that title to said part, component or assembly shall pass to the City free and clear of all liens, mortgages and encumbrances, financing statements, security agreements, claims and demands of any character.

8. Submitting False Claims; Monetary Penalties

Pursuant to San Francisco Administrative Code §21.35, any contractor, subcontractor or consultant who submits a false claim shall be liable to the City for three times the amount of damages which the City sustains because of the false claim. A contractor, subcontractor or consultant who submits a false claim shall also be liable to the City for the costs, including attorneys' fees, of a civil action brought to recover any of those penalties or damages, and may be liable to the City for a civil penalty of up to $10,000 for each false claim. A contractor, subcontractor or consultant will be deemed to have submitted a false claim to the City if the

contractor, subcontractor or consultant: (a) knowingly presents or causes to be presented to an officer or employee of the City a false claim or request for payment or approval; (b) knowingly makes, uses, or causes to be made or used a false record or statement to get a false claim paid or approved by the City; (c) conspires to defraud the City by getting a false claim allowed or paid by the City; (d) knowingly makes, uses, or causes to be made or used a false record or statement to conceal, avoid, or decrease an obligation to pay or transmit money or property to the City; or (e) is a beneficiary of an inadvertent submission of a false claim to the City, subsequently discovers the falsity of the claim, and fails to disclose the false claim to the City within a reasonable time after discovery of the false claim.

9. Disallowance

If Contractor claims or receives payment from City for a service, reimbursement for which is later disallowed by the State of California or United States Government, Contractor shall promptly refund the disallowed amount to City upon City's request. At its option, City may offset the amount disallowed from any payment due or to become due to Contractor under this Agreement or any other Agreement.

By executing this Agreement, Contractor certifies that Contractor is not suspended, debarred or otherwise excluded from participation in federal assistance programs. Contractor acknowledges that this certification of eligibility to receive federal funds is a material terms of the Agreement.

10. Taxes

10.1. Payment of any taxes, including possessory interest taxes and California sales and use taxes, levied upon or as a result of this Agreement, or the services delivered pursuant hereto, shall be the obligation of Contractor.

10.2. Contractor recognizes and understands that this Agreement may create a "possessory interest" for property tax purposes. Generally, such a possessory interest is not created unless the Agreement entitles the Contractor to possession, occupancy, or use of City property for private gain. If such a possessory interest is created, then the following shall apply:

(a) Contractor, on behalf of itself and any permitted successors and assigns, recognizes and understands that Contractor, and any permitted successors and assigns, may be subject to real property tax assessments on the possessory interest;

(b) Contractor, on behalf of itself and any permitted successors and assigns, recognizes and understands that the creation, extension, renewal, or assignment of this Agreement may result in a "change in ownership" for purposes of real property taxes, and therefore may result in a revaluation of any possessory interest created by this Agreement. Contractor accordingly agrees on behalf of itself and its permitted successors and assigns to report on behalf of the City to the County Assessor the information required by Revenue and Taxation Code section 480.5, as amended from time to time, and any successor provision.

(c) Contractor, on behalf of itself and any permitted successors and assigns, recognizes and understands that other events also may cause a change of ownership of the possessory interest and result in the revaluation of the possessory interest. (see, e.g., Rev. & Tax. Code section 64, as amended from time to time). Contractor accordingly agrees on behalf of itself and its permitted successors and assigns to report any change in ownership to the County Assessor, the State Board of Equalization or other public agency as required by law.

(d) Contractor further agrees to provide such other information as may be requested by the City to enable the City to comply with any reporting requirements for possessory interests that are imposed by applicable law.

11. Payment Does Not Imply Acceptance of Work

The granting of any payment by City, or the receipt thereof by Contractor, shall in no way lessen the liability of Contractor to replace unsatisfactory work, equipment, or materials,

although the unsatisfactory character of such work, equipment or materials may not have been apparent or detected at the time such payment was made. Materials, equipment, components, or workmanship that does not conform to the requirements of this Agreement may be rejected by City and in such case must be replaced by Contractor without delay.

12. Qualified Personnel

Work under this Agreement shall be performed only by competent personnel under the supervision of and in the employment of Contractor. Contractor will comply with City's reasonable requests regarding assignment of personnel, but all personnel, including those assigned at City's request, must be supervised by Contractor. Contractor shall commit adequate resources to complete the project within the project schedule specified in this Agreement.

13. Responsibility for Equipment

City shall not be responsible for any damage to persons or property as a result of the use, misuse or failure of any equipment used by Contractor, or by any of its employees, even though such equipment be furnished, rented or loaned to Contractor by City.

14. Independent Contractor; Payment of Taxes and Other Expenses

14.1. **Independent Contractor.** Contractor or any agent or employee of Contractor shall be deemed at all times to be an independent contractor and is wholly responsible for the manner in which it performs the services and work requested by City under this Agreement. Contractor or any agent or employee of Contractor shall not have employee status with City, nor be entitled to participate in any plans, arrangements, or distributions by City pertaining to or in connection with any retirement, health or other benefits that City may offer its employees. Contractor or any agent or employee of Contractor is liable for the acts and omissions of itself, its employees and its agents. Contractor shall be responsible for all obligations and payments, whether imposed by federal, state or local law, including, but not limited to, FICA, income tax withholdings, unemployment compensation, insurance, and other similar responsibilities related to Contractor's performing services and work, or any agent or employee of Contractor providing same. Nothing in this Agreement shall be construed as creating an employment or agency relationship between City and Contractor or any agent or employee of Contractor.

Any terms in this Agreement referring to direction from City shall be construed as providing for direction as to policy and the result of Contractor's work only, and not as to the means by which such a result is obtained. City does not retain the right to control the means or the method by which Contractor performs work under this Agreement.

14.2. **Payment of Taxes and Other Expenses.** Should City, in its discretion, or a relevant taxing authority such as the Internal Revenue Service or the State Employment Development Division, or both, determine that Contractor is an employee for purposes of collection of any employment taxes, the amounts payable under this Agreement shall be reduced by amounts equal to both the employee and employer portions of the tax due (and offsetting any credits for amounts already paid by Contractor which can be applied against this liability). City shall then forward those amounts to the relevant taxing authority.

Should a relevant taxing authority determine a liability for past services performed by Contractor for City, upon notification of such fact by City, Contractor shall promptly remit such amount due or arrange with City to have the amount due withheld from future payments to Contractor under this Agreement (again, offsetting any amounts already paid by Contractor which can be applied as a credit against such liability).

A determination of employment status pursuant to the preceding two paragraphs shall be solely for the purposes of the particular tax in question, and for all other purposes of this Agreement, Contractor shall not be considered an employee of City. Notwithstanding the foregoing, should any court, arbitrator, or administrative authority determine that Contractor is an employee for any other purpose, then Contractor agrees to a reduction in City's financial liability so that City's total expenses under this Agreement are not greater than they would have

been had the court, arbitrator, or administrative authority determined that Contractor was not an employee.

15. Insurance; Bonds; Letters of Credit

15.1. Insurance

(a) Without in any way limiting Contractor's liability pursuant to the "Indemnification" section of this Agreement, Contractor shall maintain in force, during the full term of the Agreement, insurance in the following amounts and coverage's:

(i) Workers' Compensation, in statutory amounts, with Employers' Liability Limits not less than $1,000,000 each accident, illness or injury; and

(ii) Commercial General Liability Insurance with limits not less than $2,000,000 each occurrence Combined Single Limit for Bodily Injury and Property Damage, including Contractual Liability, Personal Injury, Products and Completed Operations; and

(iii) Commercial Automobile Liability Insurance with limits not less than $1,000,000 each occurrence Combined Single Limit for Bodily Injury and Property Damage, including Owned, Non-Owned and Hired auto coverage, as applicable.

(iv) Garage Liability insurance, including coverage for garage operations arising from premises/operations, product/completed operations, contracts, owned vehicles, non-owned vehicles and damage to vehicles owned by others (bailment): Minimum limit of liability of not less than $10,000,000 each occurrence combined single limit bodily injury and property damage; and

(v) Garage keepers' legal liability insurance, comprehensive form, with limits not less than $10,000,000 each occurrence.

(vi) Professional liability insurance, applicable to Contractor's profession, with limits not less than $1,000,000 each claim with respect to negligent acts, errors or omissions in connection with professional services to be provided under this Agreement.

(vii) The shipping contractor shall carry, at a minimum, physical damage insurance (including destruction, damage, fire and theft) in the amount of not less than $4,000,000 and commercial liability insurance in the amount of not less than $2,000,000.

(b) Commercial General Liability, Business Automobile Liability Insurance, Garagekeepers' Legal Liability and Shippers Coverage policies must provide the following:

(i) Name as Additional Insured the City and County of San Francisco, its Officers, Agents, and Employees.

(ii) That such policies are primary insurance to any other insurance available to the Additional Insured, with respect to any claims arising out of this Agreement, and that insurance applies separately to each insured against whom claim is made or suit is brought.

(c) Regarding Workers' Compensation, Contractor agrees to waive subrogation which any insurer of Contractor may acquire from Contractor by virtue of the payment of any loss. Contractor agrees to obtain any endorsement that may be necessary to effect this waiver of subrogation. The Workers' Compensation policy shall be endorsed with a waiver of subrogation in favor of the City for all work performed by the Contractor, its employees, agents and subcontractors.

(d) All policies (and bonds, as described in Section 15.2 below) shall provide 30 days' advance written notice to City of cancellation or reduction in coverage for any reason, mailed to the following address:

San Francisco Municipal Transportation Agency
425 Geneva Ave
San Francisco, CA 94112

(e) Should any of the required insurance be provided under a claims-made form, Contractor shall maintain such coverage continuously throughout the term of this Agreement and, without lapse, for a period of three years beyond the expiration of this Agreement, to the effect that, should occurrences during the contract term give rise to claims made after expiration of the Agreement, such claims shall be covered by such claims-made policies.

(f) Should any of the required insurance be provided under a form of coverage that includes a general annual aggregate limit or provides that claims investigation or legal defense costs be included in such general annual aggregate limit, such general annual aggregate limit shall be double the occurrence or claims limits specified above.

(g) Should any required insurance lapse during the term of this Agreement, requests for payments originating after such lapse shall not be processed until the City receives satisfactory evidence of reinstated coverage as required by this Agreement, effective as of the lapse date. If insurance is not reinstated, the City may, at its sole option, terminate this Agreement effective on the date of such lapse of insurance.

(h) Before commencing any operations under this Agreement, Contractor shall do the following: (a) furnish to City certificates of insurance, and additional insured policy endorsements with insurers with ratings comparable to A-, VIII or higher, that are authorized to do business in the State of California, and that are satisfactory to City, in form evidencing all coverage's set forth above, and (b) furnish complete copies of policies promptly upon City request.

(i) Approval of the insurance by City shall not relieve or decrease the liability of Contractor hereunder.

(j) If a subcontractor will be used to complete any portion of this agreement, the Contractor shall ensure that the subcontractor shall provide all necessary insurance and shall name the City and County of San Francisco, its officers, agents and employees and the Contractor listed as additional insureds.

15.2. **Bonds**

(a) Within 20 days following the receipt of a notice of recommended award of contract and until completion of all Contract obligations and acceptance by City of the final remanufactured LRV, the Contractor shall furnish to City a performance bond and a labor and materials bond, each in the amount not less than 20% of the total Contract amount as modified by all Contract Modifications, to guarantee Contractor's faithful performance of all obligations of the Contract and to guarantee Contractor's payment to all suppliers of labor and materials under this Contract, excluding the period covered by the warranty bond described in Subsection (b) below.

(b) From acceptance by City of the 143 rehabilitated LRVs, and throughout the warranty period (including paint/corrosion) of these 143 rehabilitated LRVs , Contractor shall supply a maintenance or warranty bond or irrevocable letter of credit in the amount of $250,000 to guarantee Contractor's warranty of performance of all these cars and all spare parts.

(c) Bonding entities on the performance bond must be legally authorized to engage in the business of furnishing performance bonds in the State of California. All bonding entities or letter of credit must be satisfactory to SFMTA and to the Controller and Risk Manager of the City and County of San Francisco.

(d) During the period covered by the Agreement, if any of the sureties upon the bond shall become insolvent or, in the opinion of SFMTA, unable to pay promptly the amount of such bond to the extent to which the surety might be liable, Contractor, within thirty (30)

days after notice given by SFMTA to Contractor, shall by supplemental bond or otherwise, substitute another and sufficient surety approved by SFMTA in place of the surety becoming insolvent or unable to pay. If Contractor fails within such thirty (30) day period to substitute another and sufficient surety, Contractor, if SFMTA so elects, shall be deemed to be in default in the performance of its obligations hereunder and upon the said bond. The City, in addition to any and all other remedies, may terminate the Agreement or bring any proper suit or proceeding against moneys then due or which thereafter may become due Contractor under the Agreement. The amount for which the surety shall have justified on the bond and the moneys so deducted shall be held by City as collateral for the performance of the conditions of the bond.

15.3. **Letters of Credit.**

(a) Requirements. Any letter of credit submitted in lieu of a bond or other required security under this Agreement shall be a confirmed, clean, irrevocable letter of credit in favor of the City and County of San Francisco, a municipal corporation. It must have an original term of one year, with automatic renewals of the full amount throughout the term of the Agreement and throughout the performance of Contractor's obligations the under the Agreement. If Contractor fails to deliver the letter of credit as required, City will be entitled to cancel this Agreement. The letter of credit must provide that payment of its entire face amount, or any portion thereof, will be made to City upon presentation of a written demand to the bank signed by the Executive Director/CEO on behalf of the City and County of San Francisco.

(b) Financial Institution.. The letter of credit must be issued on a form and issued by a financial institution acceptable to the City in its sole discretion, which financial institution must (a) be a bank or trust company doing business and having an office in the City and County of San Francisco, (b) have a combined capital and surplus of at least $25,000,000.00, and (c) be subject to supervision or examination by federal or state authority and with at least a Moody's A rating.

(c) Demand on Letter of Credit. The letter of credit will constitute a security deposit guaranteeing faithful performance by Contractor of all terms, covenants, and conditions of this Agreement, including all monetary obligations set forth herein. If Contractor defaults with respect to any provision of this Agreement, SFMTA may make a demand under the letter of credit for all or any portion thereof to compensate City for any loss or damage that they may have incurred by reason of Contractor's default, negligence, breach or dishonesty. Such loss or damage may include without limitation any damage to or restoration of City property or property that is required to be constructed, maintained or repaired pursuant to this Agreement, payments to City, and claims for liquidated damages; provided, however, that City will present its written demand to said bank for payment under said letter of credit only after City first has made its demand for payment directly to Contractor, and five full Days have elapsed without Contractor having made payment to City. Should the City terminate this Agreement due to a breach by Contractor, the City shall have the right to draw from the letter of credit those amounts necessary to pay any fees or other financial obligations under the Agreement and perform the services described in this Agreement until such time as the City procures another contractor and the agreement between the City and that contractor becomes effective. City need not terminate this Agreement in order to receive compensation for its damages. If any portion of the letter of credit is so used or applied by City, Contractor, within 10 business days after written demand by City, shall reinstate the letter of credit to its original amount; Contractor's failure to do so will be a material breach of this Agreement.

(d) Expiration or Termination. The letter of credit must provide for 60 Days notice to City in the event of non-extension of the letter of credit; in that event, Contractor shall replace the letter of credit at least 10 business Days prior to its expiration. In the event the City receives notice from the issuer of the letter of credit that the letter of credit will be terminated, not renewed or will otherwise be allowed to expire for any reason during the period from the commencement of the term of this Agreement to 90 Days after the expiration or termination of this Agreement, or the conclusion of all of Contractor's obligations under the Agreement, whichever

occurs last, and Contractor fails to provide the City with a replacement letter of credit (in a form and issued by a financial institution acceptable to the City) within 10 Days following the City's receipt of such notice, such occurrence shall be an event of default, and, in addition to any other remedies the City may have due to such default (including the right to terminate this Agreement), the City shall be entitled to draw down the entire amount of the letter of credit (or any portion thereof) and hold such funds in an account with the City Treasurer in the form of cash guarantying Contractor's obligations under this Agreement. In such event, the cash shall accrue interest to the Contractor at a rate equal to the average yield of Treasury Notes with one-year maturity, as determined by the Treasurer. In the event the letter of credit is converted into cash pursuant to this paragraph, upon termination of this Agreement, Contractor shall be entitled to a full refund of the cash (less any demands made thereon by the City) within 90 Days of the termination date, including interest accrued through the termination date.

(e) Return of Letter of Credit. The letter of credit will be returned within 90 Days after the end of the term of this Agreement, as defined in Section 15.1, provided that Contractor has faithfully performed throughout the life of the Agreement, Contractor has completed its obligations under the Agreement, there are no pending claims involving Contractor's performance under the Agreement and no outstanding disagreement about any material aspect of the provisions of this Agreement. In the event this Agreement is assigned, as provided for in Section 18.8, City will return or release the letter of credit not later than the effective date of the assignment, provided that the assignee has delivered to the City an equivalent letter of credit, as determined by City.

(f) Excessive Demand. If City receives any payments from the aforementioned bank under the letter of credit by reason of having made a wrongful or excessive demand for payment, City will return to Contractor the amount by which City's total receipts from Contractor and from the bank under the letter of credit exceeds the amount to which City is rightfully entitled, together with interest thereon at the legal rate of interest, but City will not otherwise be liable to Contractor for any damages or penalties.

16. Indemnification

16.1. **General Indemnity.** To the fullest extent permitted by law, Contractor shall assume the defense of (with legal counsel subject to approval of the City), indemnify and save harmless the City, its boards, commissions, officers, and employees (collectively "Indemnitees"), from and against any and all claims, loss, cost, damage, injury (including, without limitation, injury to or death of an employee of the Contractor or its subconsultants), expense and liability of every kind, nature, and description (including, without limitation, incidental and consequential damages, court costs, attorneys' fees, litigation expenses, fees of expert consultants or witnesses in litigation, and costs of investigation), that arise our of, pertain to, or relate to, directly or indirectly, in whole or in part, the negligence, recklessness, or wilful misconduct of the Contractor, any subconsultant, anyone directly or indirectly employed by them, or anyone that they control (collectively, "Liabilities").

16.2. **Limitations.** No insurance policy covering the Contractor's performance under this Agreement shall operate to limit the Contractor's Liabilities under this provision. Nor shall the amount of insurance coverage operate to limit the extent of such Liabilities. The Contractor assumes no liability whatsoever for the sole negligence, active negligence, or willful misconduct of any Indemnitee or the contractors of any Indemnittee.

16.3. **Intellectual Property Infringement.** Contractor shall also indemnify, defend and hold harmless all Indemnitees from all suits or claims for infringement of the patent rights, copyright, trade secret, trade name, trademark, service mark, or any other proprietary right of any person or persons in consequence of the use by the City, or any of its boards, commissions, officers, or employees of articles or services to be supplied in the performance of Contractor's services under this Agreement. Infringement of patent rights, copyrights, or other proprietary rights in the performance of this Agreement, if not the basis for indemnification under the law, shall nevertheless be considered a material breach of contract.

17. Incidental and Consequential Damages

Contractor shall be responsible for incidental and consequential damages resulting in whole or in part from Contractor's acts or omissions. Nothing in this Agreement shall constitute a waiver or limitation of any rights that City may have under applicable law.

18. Liability of City

CITY'S PAYMENT OBLIGATIONS UNDER THIS AGREEMENT SHALL BE LIMITED TO THE PAYMENT OF THE COMPENSATION PROVIDED FOR IN SECTION 5 OF THIS AGREEMENT. NOTWITHSTANDING ANY OTHER PROVISION OF THIS AGREEMENT, IN NO EVENT SHALL CITY BE LIABLE, REGARDLESS OF WHETHER ANY CLAIM IS BASED ON CONTRACT OR TORT, FOR ANY SPECIAL, CONSEQUENTIAL, INDIRECT OR INCIDENTAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, LOST PROFITS, ARISING OUT OF OR IN CONNECTION WITH THIS AGREEMENT OR THE SERVICES PERFORMED IN CONNECTION WITH THIS AGREEMENT.

19. Liquidated Damages

By entering into this Agreement, Contractor agrees that in the event the Services, as provided under Section 4 herein, are delayed beyond the scheduled milestones and timelines as provided in the Project Delivery Schedule (Exhibit B), City will suffer actual damages that will be impractical or extremely difficult to determine; further, Contractor agrees that the amounts listed below for each day of delay beyond scheduled milestones and timelines are not a penalty, but is a reasonable estimate of the loss that City will incur based on the delay, established in light of the circumstances existing at the time this contract was awarded. City may deduct a sum representing the liquidated damages from any money due to Contractor. Such deductions shall not be considered a penalty, but rather agreed monetary damages sustained by City because of Contractor's failure to deliver to City within the time fixed or such extensions of time permitted in writing by SFMTA.

Failure to deliver the Management Work Plan and Project Schedule	$150 per day per deliverable
Failure to deliver the LRVs by the times stated in the Contract.	$500 per Vehicle per day
Failure to submit timely Corrective Action Plan (or required revisions)	$500 per day (per Fleet Defect)
Failure to submit timely Work Program (or required revisions)	$500 per day (per Fleet Defect)
Failure to timely complete Corrective Action Plan or Work Program	$500 per day per Vehicle

The total amount of Liquidated Damages shall not exceed $3 million, and is in addition to any other damages which are recoverable by the City specified elsewhere in the Agreement.

20. Default; Remedies

20.1. **Event of Default**. Each of the following shall constitute an event of default ("Event of Default") under this Agreement:

(a) Contractor fails or refuses to perform or observe any term, covenant or condition contained in any of the following Sections of this Agreement: 8, 10, 15, 24, 30, 37, 53, 55, 57 or 58.

(b) Contractor fails or refuses to perform or observe any other term, covenant or condition contained in this Agreement, and such default continues for a period of ten days after written notice thereof from City to Contractor.

(c) Contractor (i) is generally not paying its debts as they become due, (ii) files, or consents by answer or otherwise to the filing against it of, a petition for relief or reorganization or arrangement or any other petition in bankruptcy or for liquidation or to take advantage of any bankruptcy, insolvency or other debtors' relief law of any jurisdiction, (iii) makes an assignment for the benefit of its creditors, (iv) consents to the appointment of a custodian, receiver, trustee or other officer with similar powers of Contractor or of any substantial part of Contractor's property or (v) takes action for the purpose of any of the foregoing.

(d) A court or government authority enters an order (i) appointing a custodian, receiver, trustee or other officer with similar powers with respect to Contractor or with respect to any substantial part of Contractor's property, (ii) constituting an order for relief or approving a petition for relief or reorganization or arrangement or any other petition in bankruptcy or for liquidation or to take advantage of any bankruptcy, insolvency or other debtors' relief law of any jurisdiction or (iii) ordering the dissolution, winding-up or liquidation of Contractor.

20.2. **Remedies**. On and after any Event of Default, City shall have the right to exercise its legal and equitable remedies, including, without limitation, the right to terminate this Agreement or to seek specific performance of all or any part of this Agreement. In addition, City shall have the right (but no obligation) to cure (or cause to be cured) on behalf of Contractor any Event of Default; Contractor shall pay to City on demand all costs and expenses incurred by City in effecting such cure, with interest thereon from the date of incurrence at the maximum rate then permitted by law. City shall have the right to offset from any amounts due to Contractor under this Agreement or any other agreement between City and Contractor all damages, losses, costs or expenses incurred by City as a result of such Event of Default and any liquidated damages due from Contractor pursuant to the terms of this Agreement or any other agreement. All remedies provided for in this Agreement may be exercised individually or in combination with any other remedy available hereunder or under applicable laws, rules and regulations. The exercise of any remedy shall not preclude or in any way be deemed to waive any other remedy.

21. Termination for Convenience

21.1. **Exercise of Option**. City shall have the option, in its sole discretion, to terminate this Agreement, at any time during the term hereof, for convenience and without cause. City shall exercise this option by giving Contractor written notice of termination. The notice shall specify the date on which termination shall become effective.

21.2. **Contractor Actions**. Upon receipt of the notice, Contractor shall commence and perform, with diligence, all actions necessary on the part of Contractor to effect the termination of this Agreement on the date specified by City and to minimize the liability of Contractor and City to third parties as a result of termination. All such actions shall be subject to the prior approval of City. Such actions shall include, without limitation:

(a) Halting the performance of all services and other work under this Agreement on the date(s) and in the manner specified by City.

(b) Not placing any further orders or subcontracts for materials, services, equipment or other items.

(c) Terminating all existing orders and subcontracts.

(d) At City's direction, assigning to City any or all of Contractor's right, title, and interest under the orders and subcontracts terminated. Upon such assignment, City shall have the right, in its sole discretion, to settle or pay any or all claims arising out of the termination of such orders and subcontracts.

(e) Subject to City's approval, settling all outstanding liabilities and all claims arising out of the termination of orders and subcontracts.

(f) Completing performance of any services or work that City designates to be completed prior to the date of termination specified by City.

(g) Taking such action as may be necessary, or as the City may direct, for the protection and preservation of any property related to this Agreement which is in the possession of Contractor and in which City has or may acquire an interest.

21.3. **Contractor Invoice.** Within 30 days after the specified termination date, Contractor shall submit to City an invoice, which shall set forth each of the following as a separate line item:

(a) The reasonable cost to Contractor, without profit, for all services and other work City directed Contractor to perform prior to the specified termination date, for which services or work City has not already tendered payment. Reasonable costs may include a reasonable allowance for actual overhead, not to exceed a total of 10% of Contractor's direct costs for services or other work. Any overhead allowance shall be separately itemized. Contractor may also recover the reasonable cost of preparing the invoice.

(b) A reasonable allowance for profit on the cost of the services and other work described in the immediately preceding subsection (a), provided that Contractor can establish, to the satisfaction of City, that Contractor would have made a profit had all services and other work under this Agreement been completed, and provided further, that the profit allowed shall in no event exceed 5% of such cost.

(c) The reasonable cost to Contractor of handling material or equipment returned to the vendor, delivered to the City or otherwise disposed of as directed by the City.

(d) A deduction for the cost of materials to be retained by Contractor, amounts realized from the sale of materials and not otherwise recovered by or credited to City, and any other appropriate credits to City against the cost of the services or other work.

21.4. **Non-Recoverable Costs.** In no event shall City be liable for costs incurred by Contractor or any of its subcontractors after the termination date specified by City, except for those costs specifically enumerated and described in the immediately preceding subsection 21.3. Such non-recoverable costs include, but are not limited to, anticipated profits on this Agreement, post-termination employee salaries, post-termination administrative expenses, post-termination overhead or unabsorbed overhead, attorneys' fees or other costs relating to the prosecution of a claim or lawsuit, prejudgment interest, or any other expense which is not reasonable or authorized under such subsection 21.3.

21.5. **Deductions.** In arriving at the amount due to Contractor under this Section, City may deduct: (a) all payments previously made by City for work or other services covered by Contractor's final invoice; (b) any claim which City may have against Contractor in connection with this Agreement; (c) any invoiced costs or expenses excluded pursuant to the immediately preceding subsection (21.4); and (d) in instances in which, in the opinion of the City, the cost of any service or other work performed under this Agreement is excessively high due to costs incurred to remedy or replace defective or rejected services or other work, the difference between the invoiced amount and City's estimate of the reasonable cost of performing the invoiced services or other work in compliance with the requirements of this Agreement.

21.6. **Survival.** City's payment obligation under this Section shall survive termination of this Agreement.

22. Rights and Duties Upon Termination or Expiration

This Section and the following Sections of this Agreement shall survive termination or expiration of this Agreement:

8. Submitting false claims
9. Disallowance
10. Taxes
11. Payment does not imply acceptance of work
13. Responsibility for equipment

14.	Independent Contractor; Payment of Taxes and Other Expenses	48.	Modification of Agreement.
15.	Insurance	49.	Administrative Remedy for Agreement Interpretation.
16.	Indemnification	50.	Agreement Made in California; Venue
17.	Incidental and Consequential Damages	51.	Construction
18.	Liability of City	52.	Entire Agreement
24.	Proprietary or confidential information of City	55.	Disputes
26.	Ownership of Results	56.	Severability
27.	Works for Hire	57.	Protection of private information
28.	Audit and Inspection of Records	63.	FTA Requirements
		64.	Warranty Provisions

22.1. **Contractor Duties.** Subject to the immediately preceding subsection 22.1, upon termination of this Agreement prior to expiration of the term specified in Section 2, this Agreement shall terminate and be of no further force or effect. Contractor shall transfer title to City, and deliver in the manner, at the times, and to the extent, if any, directed by City, any work in progress, completed work, supplies, equipment, and other materials produced as a part of, or acquired in connection with the performance of this Agreement, and any completed or partially completed work which, if this Agreement had been completed, would have been required to be furnished to City. This subsection shall survive termination of this Agreement.

23. Conflict of Interest

Through its execution of this Agreement, Contractor acknowledges that it is familiar with the provisions of section 15.103 of the City's Charter, Article III, Chapter 2 of the City's Campaign and Governmental Conduct Code and sections 87100 et seq. and sections 1090 et seq. of the Government Code of the State of California, and certifies that it does not know of any facts which constitute a violation of said provision and agrees that if it becomes aware of any such fact during the term of this Agreement it shall immediately notify the City.

24. Proprietary or Confidential Information of City

Contractor understands and agrees that, in the performance of the work or services under this Agreement or in contemplation thereof, Contractor may have access to private or confidential information, which may be owned or controlled by City, and that such information may contain proprietary or confidential details, the disclosure of which to third parties may be damaging to City. Contractor agrees that all information disclosed by City to Contractor shall be held in confidence and used only in performance of the Agreement. Contractor shall exercise the same standard of care to protect such information as a reasonably prudent contractor would use to protect its own proprietary data.

25. Notices to the Parties

Unless otherwise indicated elsewhere in this Agreement, all written communications sent by the parties may be by U.S. mail, e-mail or by fax, and shall be addressed as follows:

To City:

Municipal Transportation Agency
Attn: Louis Maffei
425 Geneva Ave
San Francisco, CA 94112
Phone: (415) 337-2337
Fax: (415) 337-2369
louis.maffei@sfmta.com

To Contractor:

AnsaldoBreda Inc.
Attn: Lorenzo Reffreger
1461 Loveridge Road
Pittsburg, CA 94565
Phone: (925)
Fax: (925)
mobile: (415) 420-4125
lreffreger@ansaldobredainc.com

Any notice of default must be sent by registered mail.

26. Ownership of Results

Any interest of Contractor or its Subcontractors, in drawings, plans, specifications, blueprints, studies, reports, memoranda, computation sheets, computer files and media or other documents prepared by Contractor or its subcontractors in connection with services to be performed under this Agreement, shall become the property of and will be transmitted to City. However, Contractor may retain and use copies for reference and as documentation of its experience and capabilities.

27. Works for Hire

If, in connection with services performed under this Agreement, Contractor or its subcontractors create artwork, copy, posters, billboards, photographs, videotapes, audiotapes, systems designs, software, reports, diagrams, surveys, blueprints, source codes or any other original works of authorship, such works of authorship shall be works for hire as defined under Title 17 of the United States Code, and all copyrights in such works are the property of the City. If it is ever determined that any works created by Contractor or its subcontractors under this Agreement are not works for hire under U.S. law, Contractor hereby assigns all copyrights to such works to the City, and agrees to provide any material and execute any documents necessary to effectuate such assignment. With the approval of the City, Contractor may retain and use copies of such works for reference and as documentation of its experience and capabilities.

28. Audits and Inspection of Records

Contractor agrees to maintain and make available to the City, during regular business hours, accurate books and accounting records relating to its work under this Agreement. Contractor will permit City to audit, examine and make excerpts and transcripts from such books and records, and to make audits of all invoices, materials, payrolls, records or personnel and other data related to all other matters covered by this Agreement, whether funded in whole or in part under this Agreement. Contractor shall maintain such data and records in an accessible location and condition for a period of not less than five years after final payment under this Agreement or until after final audit has been resolved, whichever is later. The State of California

or any federal agency having an interest in the subject matter of this Agreement shall have the same rights conferred upon City by this Section.

29. Subcontracting

Contractor is prohibited from subcontracting this Agreement or any part of it unless such subcontracting is first approved by City in writing. Neither party shall, on the basis of this Agreement, contract on behalf of or in the name of the other party. An agreement made in violation of this provision shall confer no rights on any party and shall be null and void.

30. Assignment

The services to be performed by Contractor are personal in character and neither this Agreement nor any duties or obligations hereunder may be assigned or delegated by the Contractor unless first approved by City by written instrument executed and approved in the same manner as this Agreement.

31. Non-Waiver of Rights

The omission by either party at any time to enforce any default or right reserved to it, or to require performance of any of the terms, covenants, or provisions hereof by the other party at the time designated, shall not be a waiver of any such default or right to which the party is entitled, nor shall it in any way affect the right of the party to enforce such provisions thereafter.

32. Earned Income Credit (EIC) Forms

Administrative Code section 12O requires that employers provide their employees with IRS Form W-5 (The Earned Income Credit Advance Payment Certificate) and the IRS EIC Schedule, as set forth below. Employers can locate these forms at the IRS Office, on the Internet, or anywhere that Federal Tax Forms can be found.

32.1. **Provision of Forms to Employees**. Contractor shall provide EIC Forms to each Eligible Employee at each of the following times: (i) within thirty days following the date on which this Agreement becomes effective (unless Contractor has already provided such EIC Forms at least once during the calendar year in which such effective date falls); (ii) promptly after any Eligible Employee is hired by Contractor; and (iii) annually between January 1 and January 31 of each calendar year during the term of this Agreement.

32.2. **Failure to Comply**. Failure to comply with any requirement contained in subparagraph (a) of this Section shall constitute a material breach by Contractor of the terms of this Agreement. If, within thirty days after Contractor receives written notice of such a breach, Contractor fails to cure such breach or, if such breach cannot reasonably be cured within such period of thirty days, Contractor fails to commence efforts to cure within such period or thereafter fails to diligently pursue such cure to completion, the City may pursue any rights or remedies available under this Agreement or under applicable law.

32.3. **Flowdown to Subcontractors**. Any Subcontract entered into by Contractor shall require the subcontractor to comply, as to the subcontractor's Eligible Employees, with each of the terms of this section.

32.4. **Terms**. Capitalized terms used in this Section and not defined in this Agreement shall have the meanings assigned to such terms in Section 12O of the San Francisco Administrative Code.

33. Claims

Contractor shall not be entitled to the payment of any additional compensation for any action, or failure to act, by the Engineer, including failure or refusal to issue a Contract

Modification or for the happening of any event, thing, occurrence, or other cause, unless Contractor shall have given the Engineer due written notice of potential claim.

The written notice of potential claim shall set forth the reasons for which Contractor believes additional compensation will or may be due, the nature of the costs involved, and insofar as possible, the amount of the potential claim. The said notice as above required must have been given to the Engineer prior to the time that Contractor shall have performed the work giving rise to the potential claim for additional compensation, or in all other cases, within 15 days after the happening of the event, thing, occurrence, or other cause giving rise to the potential claim.

It is the intention of this Section that differences between the parties arising under and by virtue of the Contract be brought to the attention of the Engineer at the earliest possible time in order that such matters may be settled, if possible, or other appropriate action promptly be taken. Contractor hereby agrees that it shall have no right to additional compensation for any claim that may be based on any such act, failure to act, event, thing, or occurrence for which no written notice of potential claim as herein required was filed.

34. Nondiscrimination; Penalties

34.1. **Contractor Shall Not Discriminate.** In the performance of this Agreement, Contractor agrees not to discriminate against any employee, City and County employee working with such contractor or subcontractor, applicant for employment with such contractor or subcontractor, or against any person seeking accommodations, advantages, facilities, privileges, services, or membership in all business, social, or other establishments or organizations, on the basis of the fact or perception of a person's race, color, creed, religion, national origin, ancestry, age, height, weight, sex, sexual orientation, gender identity, domestic partner status, marital status, disability or Acquired Immune Deficiency Syndrome or HIV status (AIDS/HIV status), or association with members of such protected classes, or in retaliation for opposition to discrimination against such classes.

34.2. **Subcontracts.** Contractor shall incorporate by reference in all subcontracts the provisions of §§12B.2(a), 12B.2(c)-(k), and 12C.3 of the San Francisco Administrative Code (copies of which are available from SFMTA) and shall require all subcontractors to comply with such provisions. Contractor's failure to comply with the obligations in this subsection shall constitute a material breach of this Agreement.

34.3. **Nondiscrimination in Benefits.** Contractor does not as of the date of this Agreement and will not during the term of this Agreement, in any of its operations in San Francisco, on real property owned by San Francisco, or where work is being performed for the City elsewhere in the United States, discriminate in the provision of bereavement leave, family medical leave, health benefits, membership or membership discounts, moving expenses, pension and retirement benefits or travel benefits, as well as any benefits other than the benefits specified above, between employees with domestic partners and employees with spouses, and/or between the domestic partners and spouses of such employees, where the domestic partnership has been registered with a governmental entity pursuant to state or local law authorizing such registration, subject to the conditions set forth in §12B.2(b) of the San Francisco Administrative Code.

34.4. **Condition to Contract.** As a condition to this Agreement, Contractor shall execute the "Chapter 12B Declaration: Nondiscrimination in Contracts and Benefits" form (form HRC-12B-101) with supporting documentation and secure the approval of the form by the San Francisco Human Rights Commission.

34.5. **Incorporation of Administrative Code Provisions by Reference.** The provisions of Chapters 12B and 12C of the San Francisco Administrative Code are incorporated in this Section by

reference and made a part of this Agreement as though fully set forth herein. Contractor shall comply fully with and be bound by all of the provisions that apply to this Agreement under such Chapters, including but not limited to the remedies provided in such Chapters. Without limiting the foregoing, Contractor understands that pursuant to §12B.2(h) of the San Francisco Administrative Code, a penalty of $50 for each person for each calendar day during which such person was discriminated against in violation of the provisions of this Agreement may be assessed against Contractor and/or deducted from any payments due Contractor.

35. MacBride Principles—Northern Ireland

Pursuant to San Francisco Administrative Code §12F.5, the City and County of San Francisco urges companies doing business in Northern Ireland to move towards resolving employment inequities, and encourages such companies to abide by the MacBride Principles. The City and County of San Francisco urges San Francisco companies to do business with corporations that abide by the MacBride Principles. By signing below, the person executing this agreement on behalf of Contractor acknowledges and agrees that he or she has read and understood this section.

36. Tropical Hardwoods and Virgin Redwood Ban

Pursuant to §804(b) of the San Francisco Environment Code, the City and County of San Francisco urges contractors not to import, purchase, obtain, or use for any purpose, any tropical hardwood, tropical hardwood wood product, virgin redwood or virgin redwood wood product.

37. Drug-Free Workplace Policy

Contractor acknowledges that pursuant to the Federal Drug-Free Workplace Act of 1989, the unlawful manufacture, distribution, dispensation, possession, or use of a controlled substance is prohibited on City premises. Contractor agrees that any violation of this prohibition by Contractor, its employees, agents or assigns will be deemed a material breach of this Agreement.

38. Resource Conservation

Chapter 5 of the San Francisco Environment Code ("Resource Conservation") is incorporated herein by reference. Failure by Contractor to comply with any of the applicable requirements of Chapter 5 will be deemed a material breach of contract.

39. Compliance with Americans with Disabilities Act

Contractor acknowledges that, pursuant to the Americans with Disabilities Act (ADA), programs, services and other activities provided by a public entity to the public, whether directly or through a contractor, must be accessible to the disabled public. Contractor shall provide the services specified in this Agreement in a manner that complies with the ADA and any and all other applicable federal, state and local disability rights legislation. Contractor agrees not to discriminate against disabled persons in the provision of services, benefits or activities provided under this Agreement and further agrees that any violation of this prohibition on the part of Contractor, its employees, agents or assigns will constitute a material breach of this Agreement.

40. Sunshine Ordinance

In accordance with San Francisco Administrative Code §67.24(e), contracts, contractors' bids, responses to solicitations and all other records of communications between City and persons or firms seeking contracts, shall be open to inspection immediately after a contract has been awarded. Nothing in this provision requires the disclosure of a private person or organization's net worth or other proprietary financial data submitted for qualification for a contract or other benefit until and unless that person or organization is awarded the contract or

benefit. Information provided which is covered by this paragraph will be made available to the public upon request.

41. Public Access to Meetings and Records

If the Contractor receives a cumulative total per year of at least $250,000 in City funds or City-administered funds and is a non-profit organization as defined in Chapter 12L of the San Francisco Administrative Code, Contractor shall comply with and be bound by all the applicable provisions of that Chapter. By executing this Agreement, the Contractor agrees to open its meetings and records to the public in the manner set forth in §§12L.4 and 12L.5 of the Administrative Code. Contractor further agrees to make-good faith efforts to promote community membership on its Board of Directors in the manner set forth in §12L.6 of the Administrative Code. The Contractor acknowledges that its material failure to comply with any of the provisions of this paragraph shall constitute a material breach of this Agreement. The Contractor further acknowledges that such material breach of the Agreement shall be grounds for the City to terminate and/or not renew the Agreement, partially or in its entirety.

42. Notification of Limitations on Contributions

Through execution of this Agreement, Contractor acknowledges that it is familiar with section 1.126 of the City's Campaign and Governmental Conduct Code, which prohibits any person who contracts with the City for the rendition of personal services, for the furnishing of any material, supplies or equipment, for the sale or lease of any land or building, or for a grant, loan or loan guarantee, from making any campaign contribution to (1) an individual holding a City elective office if the contract must be approved by the individual, a board on which that individual serves, or a board on which an appointee of that individual serves, (2) a candidate for the office held by such individual, or (3) a committee controlled by such individual, at any time from the commencement of negotiations for the contract until the later of either the termination of negotiations for such contract or six months after the date the contract is approved. Contractor acknowledges that the foregoing restriction applies only if the contract or a combination or series of contracts approved by the same individual or board in a fiscal year have a total anticipated or actual value of $50,000 or more. Contractor further acknowledges that the prohibition on contributions applies to each prospective party to the contract; each member of Contractor's board of directors; Contractor's chairperson, chief executive officer, chief financial officer and chief operating officer; any person with an ownership interest of more than 20 percent in Contractor; any subcontractor listed in the bid or contract; and any committee that is sponsored or controlled by Contractor. Additionally, Contractor acknowledges that Contractor must inform each of the persons described in the preceding sentence of the prohibitions contained in Section 1.126.

43. Requiring Minimum Compensation for Covered Employees

43.1. Contractor agrees to comply fully with and be bound by all of the provisions of the Minimum Compensation Ordinance (MCO), as set forth in San Francisco Administrative Code Chapter 12P (Chapter 12P), including the remedies provided, and implementing guidelines and rules. The provisions of Chapter 12P are incorporated herein by reference and made a part of this Agreement as though fully set forth. The text of the MCO is available on the web at www.sfgov.org/olse/mco. A partial listing of some of Contractor's obligations under the MCO is set forth in this Section. Contractor is required to comply with all the provisions of the MCO, irrespective of the listing of obligations in this Section.

43.2. The MCO requires Contractor to pay Contractor's employees a minimum hourly gross compensation wage rate and to provide minimum compensated and uncompensated time off. The

minimum wage rate may change from year to year and Contractor is obligated to keep informed of the then-current requirements. Any subcontract entered into by Contractor shall require the subcontractor to comply with the requirements of the MCO and shall contain contractual obligations substantially the same as those set forth in this Section. It is Contractor's obligation to ensure that any subcontractors of any tier under this Agreement comply with the requirements of the MCO. If any subcontractor under this Agreement fails to comply, City may pursue any of the remedies set forth in this Section against Contractor.

43.3. Contractor shall not take adverse action or otherwise discriminate against an employee or other person for the exercise or attempted exercise of rights under the MCO. Such actions, if taken within 90 days of the exercise or attempted exercise of such rights, will be reputably presumed to be retaliation prohibited by the MCO.

43.4. Contractor shall maintain employee and payroll records as required by the MCO. If Contractor fails to do so, it shall be presumed that the Contractor paid no more than the minimum wage required under State law.

43.5. The City is authorized to inspect Contractor's job sites and conduct interviews with employees and conduct audits of Contractor

43.6. Contractor's commitment to provide the Minimum Compensation is a material element of the City's consideration for this Agreement. The City in its sole discretion shall determine whether such a breach has occurred. The City and the public will suffer actual damage that will be impractical or extremely difficult to determine if the Contractor fails to comply with these requirements. Contractor agrees that the sums set forth in Section 12P.6.1 of the MCO as liquidated damages are not a penalty, but are reasonable estimates of the loss that the City and the public will incur for Contractor's noncompliance. The procedures governing the assessment of liquidated damages shall be those set forth in Section 12P.6.2 of Chapter 12P.

43.7. Contractor understands and agrees that if it fails to comply with the requirements of the MCO, the City shall have the right to pursue any rights or remedies available under Chapter 12P (including liquidated damages), under the terms of the contract, and under applicable law. If, within 30 days after receiving written notice of a breach of this Agreement for violating the MCO, Contractor fails to cure such breach or, if such breach cannot reasonably be cured within such period of 30 days, Contractor fails to commence efforts to cure within such period, or thereafter fails diligently to pursue such cure to completion, the City shall have the right to pursue any rights or remedies available under applicable law, including those set forth in Section 12P.6(c) of Chapter 12P. Each of these remedies shall be exercisable individually or in combination with any other rights or remedies available to the City.

43.8. Contractor represents and warrants that it is not an entity that was set up, or is being used, for the purpose of evading the intent of the MCO.

43.9. If Contractor is exempt from the MCO when this Agreement is executed because the cumulative amount of agreements with this department for the fiscal year is less than $25,000, but Contractor later enters into an agreement or agreements that cause contractor to exceed that amount in a fiscal year, Contractor shall thereafter be required to comply with the MCO under this Agreement. This obligation arises on the effective date of the agreement that causes the cumulative amount of agreements between the Contractor and this department to exceed $25,000 in the fiscal year.

44. Requiring Health Benefits for Covered Employees

44.1. Contractor agrees to comply fully with and be bound by all of the provisions of the Health Care Accountability Ordinance (HCAO), as set forth in San Francisco Administrative Code Chapter 12Q, including the remedies provided, and implementing regulations, as the same may be

amended from time to time. The provisions of Chapter 12Q are incorporated by reference and made a part of this Agreement as though fully set forth herein. The text of the HCAO is available on the web at www.sfgov.org/olse. Capitalized terms used in this Section and not defined in this Agreement shall have the meanings assigned to such terms in Chapter 12Q.

44.2. For each Covered Employee, Contractor shall provide the appropriate health benefit set forth in Section 12Q.3 of the HCAO. If Contractor chooses to offer the health plan option, such health plan shall meet the minimum standards set forth by the San Francisco Health Commission.

44.3. Notwithstanding the above, if the Contractor is a small business as defined in Section 12Q.3(e) of the HCAO, it shall have no obligation to comply with part (a) above.

44.4. Contractor's failure to comply with the HCAO shall constitute a material breach of this agreement. City shall notify Contractor if such a breach has occurred. If, within 30 days after receiving City's written notice of a breach of this Agreement for violating the HCAO, Contractor fails to cure such breach or, if such breach cannot reasonably be cured within such period of 30 days, Contractor fails to commence efforts to cure within such period, or thereafter fails diligently to pursue such cure to completion, City shall have the right to pursue the remedies set forth in 12Q.5.1 and 12Q.5(f)(1-6). Each of these remedies shall be exercisable individually or in combination with any other rights or remedies available to City.

44.5. Any Subcontract entered into by Contractor shall require the Subcontractor to comply with the requirements of the HCAO and shall contain contractual obligations substantially the same as those set forth in this Section. Contractor shall notify City's Office of Contract Administration when it enters into such a Subcontract and shall certify to the Office of Contract Administration that it has notified the Subcontractor of the obligations under the HCAO and has imposed the requirements of the HCAO on Subcontractor through the Subcontract. Each Contractor shall be responsible for its Subcontractors' compliance with this Chapter. If a Subcontractor fails to comply, the City may pursue the remedies set forth in this Section against Contractor based on the Subcontractor's failure to comply, provided that City has first provided Contractor with notice and an opportunity to obtain a cure of the violation.

44.6. Contractor shall not discharge, reduce in compensation, or otherwise discriminate against any employee for notifying City with regard to Contractor's noncompliance or anticipated noncompliance with the requirements of the HCAO, for opposing any practice proscribed by the HCAO, for participating in proceedings related to the HCAO, or for seeking to assert or enforce any rights under the HCAO by any lawful means.

44.7. Contractor represents and warrants that it is not an entity that was set up, or is being used, for the purpose of evading the intent of the HCAO.

44.8. Contractor shall maintain employee and payroll records in compliance with the California Labor Code and Industrial Welfare Commission orders, including the number of hours each employee has worked on the City Contract.

44.9. Contractor shall keep itself informed of the current requirements of the HCAO.

44.10. Contractor shall provide reports to the City in accordance with any reporting standards promulgated by the City under the HCAO, including reports on Subcontractors and Subtenants, as applicable.

44.11. Contractor shall provide City with access to records pertaining to compliance with HCAO after receiving a written request from City to do so and being provided at least ten business days to respond.

44.12. Contractor shall allow City to inspect Contractor's job sites and have access to Contractor's employees in order to monitor and determine compliance with HCAO.

44.13. City may conduct random audits of Contractor to ascertain its compliance with HCAO. Contractor agrees to cooperate with City when it conducts such audits.

44.14. If Contractor is exempt from the HCAO when this Agreement is executed because its amount is less than $25,000 ($50,000 for nonprofits), but Contractor later enters into an agreement or agreements that cause Contractor's aggregate amount of all agreements with City to reach $75,000, all the agreements shall be thereafter subject to the HCAO. This obligation arises on the effective date of the agreement that causes the cumulative amount of agreements between Contractor and the City to be equal to or greater than $75,000 in the fiscal year.

45. First Source Hiring Program

45.1. **Incorporation of Administrative Code Provisions by Reference.** The provisions of Chapter 83 of the San Francisco Administrative Code are incorporated in this Section by reference and made a part of this Agreement as though fully set forth herein. Contractor shall comply fully with, and be bound by, all of the provisions that apply to this Agreement under such Chapter, including but not limited to the remedies provided therein. Capitalized terms used in this Section and not defined in this Agreement shall have the meanings assigned to such terms in Chapter 83.

45.2. **First Source Hiring Agreement.** As an essential term of, and consideration for, any contract or property contract with the City, not exempted by the FSHA, the Contractor shall enter into a first source hiring agreement ("agreement") with the City, on or before the effective date of the contract or property contract. Contractors shall also enter into an agreement with the City for any other work that it performs in the City. Such agreement shall:

(a) Set appropriate hiring and retention goals for entry level positions. The employer shall agree to achieve these hiring and retention goals, or, if unable to achieve these goals, to establish good faith efforts as to its attempts to do so, as set forth in the agreement. The agreement shall take into consideration the employer's participation in existing job training, referral and/or brokerage programs. Within the discretion of the FSHA, subject to appropriate modifications, participation in such programs may be certified as meeting the requirements of this Chapter. Failure either to achieve the specified goal or to establish good faith efforts will constitute noncompliance and will subject the employer to the provisions of Section 83.10 of this Chapter.

(b) Set first source interviewing, recruitment and hiring requirements, which will provide the San Francisco Workforce Development System with the first opportunity to provide qualified economically disadvantaged individuals for consideration for employment for entry level positions. Employers shall consider all applications of qualified economically disadvantaged individuals referred by the System for employment; provided however, if the employer utilizes nondiscriminatory screening criteria, the employer shall have the sole discretion to interview and/or hire individuals referred or certified by the San Francisco Workforce Development System as being qualified economically disadvantaged individuals. The duration of the first source interviewing requirement shall be determined by the FSHA and shall be set forth in each agreement, but shall not exceed 10 days. During that period, the employer may publicize the entry level positions in accordance with the agreement. A need for urgent or temporary hires must be evaluated, and appropriate provisions for such a situation must be made in the agreement.

(c) Set appropriate requirements for providing notification of available entry level positions to the San Francisco Workforce Development System so that the System may train and refer an adequate pool of qualified economically disadvantaged individuals to

participating employers. Notification should include such information as employment needs by occupational title, skills, and/or experience required, the hours required, wage scale and duration of employment, identification of entry level and training positions, identification of English language proficiency requirements, or absence thereof, and the projected schedule and procedures for hiring for each occupation. Employers should provide both long-term job need projections and notice before initiating the interviewing and hiring process. These notification requirements will take into consideration any need to protect the employer's proprietary information.

(d) Set appropriate record keeping and monitoring requirements. The First Source Hiring Administration shall develop easy-to-use forms and record keeping requirements for documenting compliance with the agreement. To the greatest extent possible, these requirements shall utilize the employer's existing record keeping systems, be non-duplicative, and facilitate a coordinated flow of information and referrals.

(e) Establish guidelines for employer good faith efforts to comply with the first source hiring requirements of this Chapter. The FSHA will work with City departments to develop employer good faith effort requirements appropriate to the types of contracts and property contracts handled by each department. Employers shall appoint a liaison for dealing with the development and implementation of the employer's agreement. In the event that the FSHA finds that the employer under a City contract or property contract has taken actions primarily for the purpose of circumventing the requirements of this Chapter, that employer shall be subject to the sanctions set forth in Section 83.10 of this Chapter.

(f) Set the term of the requirements.

(g) Set appropriate enforcement and sanctioning standards consistent with this Chapter.

(h) Set forth the City's obligations to develop training programs, job applicant referrals, technical assistance, and information systems that assist the employer in complying with this Chapter.

(i) Require the developer to include notice of the requirements of this Chapter in leases, subleases, and other occupancy contracts.

45.3. **Hiring Decisions.** Contractor shall make the final determination of whether an Economically Disadvantaged Individual referred by the System is "qualified" for the position.

45.4. **Exceptions.** Upon application by Employer, the First Source Hiring Administration may grant an exception to any or all of the requirements of Chapter 83 in any situation where it concludes that compliance with this Chapter would cause economic hardship.

45.5. **Liquidated Damages.** Contractor agrees:

(a) To be liable to the City for liquidated damages as provided in this section;

(b) To be subject to the procedures governing enforcement of breaches of contracts based on violations of contract provisions required by this Chapter as set forth in this section;

(c) That the contractor's commitment to comply with this Chapter is a material element of the City's consideration for this contract; that the failure of the contractor to comply with the contract provisions required by this Chapter will cause harm to the City and the public which is significant and substantial but extremely difficult to quantity; that the harm to the City includes not only the financial cost of funding public assistance programs but also the insidious but impossible to quantify harm that this community and its families suffer as a result of

unemployment; and that the assessment of liquidated damages of up to $5,000 for every notice of a new hire for an entry level position improperly withheld by the contractor from the first source hiring process, as determined by the FSHA during its first investigation of a contractor, does not exceed a fair estimate of the financial and other damages that the City suffers as a result of the contractor's failure to comply with its first source referral contractual obligations.

(d) That the continued failure by a contractor to comply with its first source referral contractual obligations will cause further significant and substantial harm to the City and the public, and that a second assessment of liquidated damages of up to $10,000 for each entry level position improperly withheld from the FSHA, from the time of the conclusion of the first investigation forward, does not exceed the financial and other damages that the City suffers as a result of the contractor's continued failure to comply with its first source referral contractual obligations;

(e) That in addition to the cost of investigating alleged violations under this Section, the computation of liquidated damages for purposes of this section is based on the following data:

(i) The average length of stay on public assistance in San Francisco's County Adult Assistance Program is approximately 41 months at an average monthly grant of $348 per month, totaling approximately $14,379; and

(ii) In 2004, the retention rate of adults placed in employment programs funded under the Workforce Investment Act for at least the first six months of employment was 84.4%. Since qualified individuals under the First Source program face far fewer barriers to employment than their counterparts in programs funded by the Workforce Investment Act, it is reasonable to conclude that the average length of employment for an individual whom the First Source Program refers to an employer and who is hired in an entry level position is at least one year;

therefore, liquidated damages that total $5,000 for first violations and $10,000 for subsequent violations as determined by FSHA constitute a fair, reasonable, and conservative attempt to quantify the harm caused to the City by the failure of a contractor to comply with its first source referral contractual obligations.

(f) That the failure of contractors to comply with this Chapter, except property contractors, may be subject to the debarment and monetary penalties set forth in Sections 6.80 et seq. of the San Francisco Administrative Code, as well as any other remedies available under the contract or at law; and

Violation of the requirements of Chapter 83 is subject to an assessment of liquidated damages in the amount of $5,000 for every new hire for an Entry Level Position improperly withheld from the first source hiring process. The assessment of liquidated damages and the evaluation of any defenses or mitigating factors shall be made by the FSHA.

45.6. **Subcontracts.** Any subcontract entered into by Contractor shall require the subcontractor to comply with the requirements of Chapter 83 and shall contain contractual obligations substantially the same as those set forth in this Section.

46. Prohibition on Political Activity with City Funds

In accordance with San Francisco Administrative Code Chapter 12.G, Contractor may not participate in, support, or attempt to influence any political campaign for a candidate or for a ballot measure (collectively, "Political Activity") in the performance of the services provided under this Agreement. Contractor agrees to comply with San Francisco Administrative Code Chapter 12.G and any implementing rules and regulations promulgated by the City's Controller.

The terms and provisions of Chapter 12.G are incorporated herein by this reference. In the event Contractor violates the provisions of this section, the City may, in addition to any other rights or remedies available hereunder, (i) terminate this Agreement, and (ii) prohibit Contractor from bidding on or receiving any new City contract for a period of two (2) years.

47. Preservative-treated Wood Containing Arsenic

As of July 1, 2003, Contractor may not purchase preservative-treated wood products containing arsenic in the performance of this Agreement unless an exemption from the requirements of Chapter 13 of the San Francisco Environment Code is obtained from the Department of the Environment under Section 1304 of the Code. The term "preservative-treated wood containing arsenic" shall mean wood treated with a preservative that contains arsenic, elemental arsenic, or an arsenic copper combination, including, but not limited to, chromate copper arsenate preservative, ammonia cal copper zinc arsenate preservative, or ammonia cal copper arsenate preservative. Contractor may purchase preservative-treated wood products on the list of environmentally preferable alternatives prepared and adopted by the Department of the Environment. This provision does not preclude Contractor from purchasing preservative-treated wood containing arsenic for saltwater immersion. The term "saltwater immersion" shall mean a pressure-treated wood that is used for construction purposes or facilities that are partially or totally immersed in saltwater.

48. Modification of Agreement

48.1. **Modification in Writing.** This Agreement may not be modified, nor may compliance with any of its terms be waived, except by written instrument executed and approved as required by law. Contractor shall cooperate with the SFMTA to submit to the Contract Compliance Office any amendment, modification, supplement or change order that would result in a cumulative increase of the original amount of this Agreement by more than 20%.

48.2. **Extra Work.** The City may order changes in the work under this Agreement and may order extra materials and extra work in connection with the performance of the Agreement, and the Contractor shall promptly comply with such orders, except that:

(a) If changes ordered in design, workmanship, services, or materials are of such a nature as to increase or decrease the cost, or the time required to execute the change in scope of work, the City shall make a reasonable and proper adjustment in the contract price, delivery schedule, or both as agreed upon by the Contractor and the City as the reasonable and proper allowance for the increase or decrease required.

(b) No order for any alteration, modification, or extra that will increase or decrease the cost of the work shall be valid unless the resulting increase or decrease in price shall have been agreed upon in writing and approved by the City. No oral statement of any person whosoever shall in any manner or degree modify or otherwise affect the terms of this contract, which include the requirements of the Technical Specifications.

(c) If the City determines that there are mechanical conditions in any Vehicle that were not known or reasonably discoverable prior to commencement of the work under this Agreement, the parties shall negotiate a lump sum cost to repair such work to be paid under the Allowance provision (item 4) in the Payment Schedule. The terms and conditions of any such repair work shall be memorialized in a written contract modification to be executed by the parties.

49. Authority of Engineer

The Engineer shall decide all questions, which may arise as to the quality or acceptability of materials furnished and work performed and as to the manner of performance and rate of

progress of the work; all questions, which may arise as to the acceptable fulfillment of the Contract on the part of the Contractor; and all questions as to compensation. In discharging the responsibilities outlined above, the Engineer shall at all times act fairly and reasonably. Any appeal of the Engineer's decisions shall be in accordance with the provisions of Section 56 of this Agreement. As with any claim, change, extra or additional work, Contractor shall be paid in accordance with the payment provisions of this Contract when the dispute is finally resolved.

Should any questions arise as to the meaning and intent of the Contract, the matter shall be referred to the Engineer, who, with input from SFMTA staff and from the Contractor, shall decide the true meaning and intent of the Contract. The Engineer's decision in this regard shall be administratively final and conclusive.

50. Agreement Made in California; Venue

The formation, interpretation and performance of this Agreement shall be governed by the laws of the State of California. Venue for all litigation relative to the formation, interpretation and performance of this Agreement shall be in San Francisco.

51. Construction

All paragraph captions are for reference only and shall not be considered in construing this Agreement.

52. Entire Agreement

This contract sets forth the entire Agreement between the parties, and supersedes all other oral or written provisions. This contract may be modified only as provided in Section 48.

53. Compliance with Laws

Contractor shall keep itself fully informed of the City's Charter, codes, ordinances and regulations of the City and of all state, and federal laws in any manner affecting the performance of this Agreement, and must at all times comply with such local codes, ordinances, and regulations and all applicable laws as they may be amended from time to time.

54. Services Provided by Attorneys

Any services to be provided by a law firm or attorney must be reviewed and approved in writing in advance by the City Attorney. No invoices for services provided by law firms or attorneys, including, without limitation, as subcontractors of Contractor, will be paid unless the provider received advance written approval from the City Attorney.

55. Disputes

55.1. **Notice of Dispute.** For any dispute involving a question of fact that does not involve a claim for additional compensation, the aggrieved party shall furnish the other party with a notice of dispute within fifteen (15) days of the determination of the dispute. The party receiving a notice of dispute shall submit a written reply with fourteen (14) days of delivery of the notice. The notice and response shall contain the following: (ai) a statement of the party's position and a summary of the arguments supporting that position, and (bii) any evidence supporting the party's position.

55.2. **Resolution of Disputes.** Disputes arising in the performance of this Agreement that are not resolved by negotiation between the SFMTA Liaison and Consultant's shall be decided in writing by the SFMTA Manager of Project Management. The decision shall be administratively final and conclusive unless within ten (10) days from the date of such decision, the Contract Consultant mails or otherwise furnishes a written appeal to the Chief Operating Officer, or his/her designee. In connection with such an appeal, the Consultant shall be afforded an opportunity to be heard and to offer evidence in

support of its position. The decision of the Chief Operating Officer shall be administratively final and conclusive. This section applies to all disputes unless a specific provision of this Agreement provides that the Engineer's decision as to a particular dispute is final.

55.3. **No Cessation of Work.** Pending final resolution of a dispute hereunder, the Consultant shall proceed diligently with the performance of its obligations under this Agreement in accordance with the written directions of the Engineer.

55.4. **Alternative Dispute Resolution.** If agreed to by both parties, disputes may be resolved by a mutually agreed to alternative dispute resolution process.

55.5. **Claims for Additional Compensation.** For disputes involving a claim for additional compensation, parties involved shall attempt to resolve such disputes expediently and in good faith so as not to impact the performance or schedule of the Project. Under no circumstances shall the Consultant or its subconsultants stop work due to an unresolved dispute.

55.6. **Disputes among Consultant Partners.** The resolution of any contractual disputes related to Consultant's Joint Venture or Association partners (if any) shall be the sole responsibility of the Consultant. Each party of the Joint Venture or Association shall resolve all such disputes within thirty (30) calendar days of when the dispute first surfaced so as not to impact the performance of the contract with the City. Any such disputes which impact the Project and which are left unresolved for more than one month shall be cause for the City to withhold and/or reduce invoice payments to the Consultant's Joint Venture or Association firms until the dispute is resolved.

56. Severability

Should the application of any provision of this Agreement to any particular facts or circumstances be found by a court of competent jurisdiction to be invalid or unenforceable, then (a) the validity of other provisions of this Agreement shall not be affected or impaired thereby, and (b) such provision shall be enforced to the maximum extent possible so as to effect the intent of the parties and shall be reformed without further action by the parties to the extent necessary to make such provision valid and enforceable.

57. Protection of Private Information

Contractor has read and agrees to the terms set forth in San Francisco Administrative Code Sections 12M.2, "Nondisclosure of Private Information," and 12M.3, "Enforcement" of Administrative Code Chapter 12M, "Protection of Private Information," which are incorporated herein as if fully set forth. Contractor agrees that any failure of Contactor to comply with the requirements of Section 12M.2 of this Chapter shall be a material breach of the Contract. In such an event, in addition to any other remedies available to it under equity or law, the City may terminate the Contract, bring a false claim action against the Contractor pursuant to Chapter 6 or Chapter 21 of the Administrative Code, or debar the Contractor.

58. Graffiti Removal

Graffiti is detrimental to the health, safety and welfare of the community in that it promotes a perception in the community that the laws protecting public and private property can be disregarded with impunity. This perception fosters a sense of disrespect of the law that results in an increase in crime; degrades the community and leads to urban blight; is detrimental to property values, business opportunities and the enjoyment of life; is inconsistent with the City's property maintenance goals and aesthetic standards; and results in additional graffiti and in other properties becoming the target of graffiti unless it is quickly removed from public and private property. Graffiti results in visual pollution and is a public nuisance. Graffiti must be abated as quickly as possible to avoid detrimental impacts on the City and County and its residents, and to prevent the further spread of graffiti.

Contractor shall remove all graffiti from any real property owned or leased by Contractor in the City and County of San Francisco within forty eight (48) hours of the earlier of Contractor's (a) discovery or notification of the graffiti or (b) receipt of notification of the graffiti from the Department of Public Works. This section is not intended to require a Contractor to breach any lease or other agreement that it may have concerning its use of the real property. The term "graffiti" means any inscription, word, figure, marking or design that is affixed, marked, etched, scratched, drawn or painted on any building, structure, fixture or other improvement, whether permanent or temporary, including by way of example only and without limitation, signs, banners, billboards and fencing surrounding construction sites, whether public or private, without the consent of the owner of the property or the owner's authorized agent, and which is visible from the public right-of-way. "Graffiti" shall not include: (1) any sign or banner that is authorized by, and in compliance with, the applicable requirements of the San Francisco Public Works Code, the San Francisco Planning Code or the San Francisco Building Code; or (2) any mural or other painting or marking on the property that is protected as a work of fine art under the California Art Preservation Act (California Civil Code Sections 987 et seq.) or as a work of visual art under the Federal Visual Artists Rights Act of 1990 (17 U.S.C. §§ 101 et seq.).

Any failure of Contractor to comply with this section of this Agreement shall constitute an Event of Default of this Agreement.

59. Food Service Waste Reduction Requirements

Effective June 1, 2007, Contractor agrees to comply fully with and be bound by all of the provisions of the Food Service Waste Reduction Ordinance, as set forth in San Francisco Environment Code Chapter 16, including the remedies provided, and implementing guidelines and rules. The provisions of Chapter 16 are incorporated herein by reference and made a part of this Agreement as though fully set forth. This provision is a material term of this Agreement. By entering into this Agreement, Contractor agrees that if it breaches this provision, City will suffer actual damages that will be impractical or extremely difficult to determine; further, Contractor agrees that the sum of one hundred dollars ($100) liquidated damages for the first breach, two hundred dollars ($200) liquidated damages for the second breach in the same year, and five hundred dollars ($500) liquidated damages for subsequent breaches in the same year is reasonable estimate of the damage that City will incur based on the violation, established in light of the circumstances existing at the time this Agreement was made. Such amount shall not be considered a penalty, but rather agreed monetary damages sustained by City because of Contractor's failure to comply with this provision.

60. Time of Essence

Time is of the essence in this Agreement.

61. Technical Specifications

61.1. **Fabrication**. The 143 rehabilitated LRVs shall be rehabilitated and guaranteed in accordance with the Technical Specifications.

61.2. **Omission**. Notwithstanding the Technical Specifications or other data provided by the Engineer, the Contractor shall have the responsibility of supplying all parts and details required to rehabilitate the systems specified in the Technical Specifications and return the Vehicles in a condition that is complete and ready for service. Items that are installed by SFMTA shall not be the responsibility of the Contractor unless they are included in this contract or should have been installed by the Contractor.

61.3. **Priority**. In the event of any deviation between the description of these 143 rehabilitated LRVs in the Technical Specifications and in this document, the Technical Specifications shall govern.

61.4. **Design Review**. Prior to completion of cars rehabilitation, the Contractor and the Engineer shall agree to the specific details of the rehabilitation. These details may include, but not be limited to, items such as: engineering and design details, test plans and procedures, appropriate training, sub-suppliers equipment, colors, wording, and placement of numbers and signs. In cases where consensus cannot be reached, the opinion of the Engineer as to design details shall be administratively final unless clearly arbitrary or capricious. Disputes regarding cost and other matters shall be subject to the provisions of Sections 33 and 55. When plans, drawings, requests for information, procedures or other contract deliverables are submitted to SFMTA for approval and/or comments, the Contractor shall delineate any deviations from the Contract specifications in such deliverables. SFMTA shall approve, disapprove and/or comment on such deliverables within 30 days after receipt. However, no extension of time will be allowed for review of submittals that have been disapproved. Such disapproved submittals shall be resubmitted and will be reviewed and returned within 30 days after subsequent receipt. Neither review nor approval of any plans, drawings, procedures, other contract deliverables or the materials supplied under this contract shall in any way relieve the Contractor of its obligations to perform work under the provision of this Contract.

61.5. **Preliminary Drawings**. Preliminary drawings shall provide enough detail to conduct preliminary engineering evaluations of structural, electrical, mechanical, and other subsystems. Drawings shall show the general arrangement of equipment layout and subsystems and such detail as is necessary to give a comprehensive idea of the product contemplated.

61.6. **Materials/Accessories Responsibility**. The Contractor shall be responsible for all materials and workmanship in the rehabilitation of the LRV systems required by the Technical Specifications and all accessories used, whether the same are manufactured by the Contractor or purchased from a subcontractor during the rehabilitation of the Vehicle systems. This provision excludes equipment leased or supplied by SFMTA, except insofar as such equipment is damaged by the failure of a part or component for which the Contractor is responsible, or except insofar as the damage to such equipment is caused by the Contractor during the manufacture of the Vehicle.

62. Assumption of Risk of Loss

Prior to acceptance of the rehabilitated LRVs, the Contractor shall bear risk of loss of the car, including any damage sustained during transportation to the delivery site or during acceptance testing. The City shall assume risk of loss of these cars only after acceptance.

63. FTA Requirements

The provisions contained in "FTA Requirements for Personal Services and Procurement Contracts," attached as Exhibit A, are incorporated into this Agreement. If there is any conflict between the FTA terms and conditions and any other terms and conditions of this Agreement, the FTA terms and conditions shall take precedence.

64. Warranty Provisions

64.1. **Contractor Warranty**. Warranties in this document are in addition to any statutory remedies or warranties imposed on the Contractor. Warranties include 100 percent of parts and labor costs. "Defects" are patent or latent malfunctions or failure in manufacture or design of any component or subsystem that causes an LRV to cease operating or to operate in a degraded mode. "Related Defects" are damage inflicted on any component or subsystem as a direct result of a Defect. Consistent with these requirements and definitions, the Contractor warrants and guarantees to the SFMTA each complete LRV, and specific subsystems and components, as follows.

(a) Complete LRV. The rehabilitated systems of the LRV, are warranted to be free from Defects and Related Defects for one year, beginning on the date of acceptance, or Conditional Acceptance, of each LRV under "Acceptance of LRV" (Technical Specifications, TP01). The warranty is based on regular operation of the LRV under the operating conditions prevailing in Muni service.

(b) Spare Parts. Spare parts purchased shall be warranted and guaranteed to be free from Defects and Related Defects for the longer of two (2) years or the manufacturer's standard warranty, beginning on the date the part is accepted by the SFMTA.

64.2. **Extension of Warranty.** If, during the warranty period, repairs or modifications on any on any LRV, made necessary by defective design, materials or workmanship, are not completed due to lack of material or inability to provide the proper repair for 30 calendar days, the applicable warranty period shall be extended by the number of days equal to the delay period.

64.3. **Voiding Of Warranty.** The warranties shall not apply to the failure of any part or component of the LRV that directly results from misuse, negligence, accident, or repairs not conducted in accordance with the Contractor-provided maintenance manuals and with workmanship performed by adequately trained personnel in accordance with recognized standards of the industry. The warranty shall also be void if the SFMTA fails to conduct normal inspections and scheduled preventive maintenance procedures as recommended in the Contractor's maintenance manuals and that omission solely caused the part or component failure.

64.4. **Exceptions And Additions To Warranty.** The warranties shall not apply to scheduled maintenance items, normal wear-out items, and items furnished by the SFMTA, except insofar as such equipment may be damaged by the failure of a part or component for which the Contractor is responsible.

64.5. **Detection Of Defects.** If the SFMTA detects a Defect within the warranty period, it shall within 20 working days, notify the Contractor's representative. Within five working days after receipt of notification, the Contractor's representative shall either agree that the Defect is in fact covered by warranty, or reserve judgment until the subsystem or component is inspected by the Contractor's representative or is removed and examined at the SFMTA's property or at the Contractor's plant. At that time, the status of warranty coverage on the subsystem or component shall be mutually resolved between the SFMTA and the Contractor. Work shall commence to correct the Defect within 10 working days after receipt of notification and shall be conducted in accordance with "Repairs by Contractor" (Section 66.2).

64.6. **Scope Of Warranty Repairs.** When warranty repairs are required, the SFMTA and the Contractor's representative shall agree within five working days after notification on the most appropriate course for the repairs and the exact scope of the repairs to be performed under the warranty. If no agreement is obtained within the five-day period, the SFMTA reserves the right to commence the repairs in accordance with "Repairs by SFMTA" (Section 66.3).

64.7. **Fleet Defects**

(a) Occurrence. A Fleet Defect is defined as cumulative failures of any kind in the same components in the same or similar application, where such items are covered by the warranty and such failures occur in the warranty period in at least 10 percent of the LRVs to be rehabilitated under this Agreement.

(b) Remedy. The Contractor shall correct a fleet defect under the warranty provisions defined in "Repair Procedures" (Section 66). Within 30 days of receipt of notification of a Fleet Defect, the Contractor shall provide the SFMTA with a Corrective Action Plan, subject to approval by SFMTA, specifying how and when all LRVs with Defects

shall be corrected. No later than 10 days after correcting the Defects, the Contractor shall submit a proposed Work Program reasonably designed to prevent the occurrence of the same Defect in all LRVs remaining to be repaired, and, if applicable, spare parts purchased under this Contract. The Work Program shall specify how and when the corrective work in all remaining LRVs will be performed. If SFMTA requires changes to a Corrective Action Plan or Work Program in order to approve it, Contractor shall submit the revised Plan or Program within five days after SFMTA requests such changes. Where the specific Defect can be solely attributed to particular identifiable part(s), the Work Program shall include redesign and/or replacement of only the defectively designed and/or manufactured part(s). In all other cases, the work program shall include inspection and/or correction of all of the LRVs in the fleet via a mutually agreed to arrangement. Any Contractor-proposed changes to a Fleet Defect Corrective Action Plan or Work Program must be submitted to the SFMTA for approval. If (a) Contractor does not provide a Corrective Action Plan or Work Program within the time specified above (or as extended by SFMTA), or (b) Contractor does not submit revisions to a Corrective Action Plan or Work Program as requested by the SFMTA, or (c) Contractor does not fully correct a specific declared Fleet Defect within the time specified in the Corrective Action Plan or in the Work Program, SFMTA will assess liquidated damages in accordance with Section 19 of this Agreement.

65. Repair Procedures

65.1. **Repair Performance.** The Contractor is responsible for all warranty-covered repair work. To the extent practicable, the SFMTA will allow the Contractor or its designated representative to perform such work. At its discretion, the SFMTA may perform such work if it determines it needs to do so based on transit service or other requirements. Such work shall be reimbursed by the Contractor.

65.2. **Repairs By Contractor**

(a) Unless the time is extended by the SFMTA, the Contractor or its designated representative shall begin work on warranty-covered repairs within five calendar days after receiving notification of a Defect from the SFMTA. The SFMTA shall make the LRV available to complete repairs timely with the Contractor repair schedule.

(b) The Contractor shall provide at its own expense all spare parts, tools, and space required to complete repairs. At the SFMTA's option, the Contractor may be required to remove the LRV from the SFMTA's property while repairs are being performed. If the LRV is removed from the SFMTA's property, repair procedures must be diligently pursued by the Contractor's representative. Contractor shall bear all costs for transporting the LRV for repairs.

65.3. **Repairs By SFMTA**

(a) Parts Used. If the SFMTA performs the warranty-covered repairs, it shall correct or repair the Defect and any Related Defects utilizing parts supplied by the Contractor specifically for this repair. At its discretion, the SFMTA may use Contractor-specified parts available from its own stock if deemed in its best interest. Monthly, or at a period to be mutually agreed upon, reports of all repairs covered by this warranty shall be submitted by the SFMTA to the Contractor for reimbursement or replacement of parts. The Contractor shall provide forms for these reports.

(b) Contractor Supplied Parts. The SFMTA may require that the Contractor supply new parts for warranty-covered repairs being performed by the SFMTA. These parts shall be shipped prepaid to the SFMTA from any source selected by the Contractor within 10 working days of receipt of the request for said parts. Parts supplied by the Contractor shall be Original Equipment Supplier (OEM) equivalent or superior to that used in the LRV original manufacture.

(c) Return of Defective Components. The Contractor may request that parts covered by the warranty be returned to the manufacturing plant. The total cost for this action shall be paid by the Contractor. Materials should be returned in accordance with Contractor's instructions.

(d) Failure Analysis. The Contractor shall, upon specific request of the SFMTA, provide a failure analysis of fleet defect-or safety-related parts, or major components, removed from LRVS under the terms of the warranty, that could affect fleet operation. Such reports shall be delivered within 60 days of the receipt of failed parts.

(e) Reimbursement For Labor. Contractor shall reimburse the SFMTA for labor. The amount shall be determined by multiplying the number of man-hours actually required to correct the Defect by the current top mechanic's hourly overtime wage rate. The wage rate, and therefore, the warranty labor rate, is subject to adjustment each year. Through June 30, 2009, the warranty labor rate shall be based on the mechanic's wage rate of $148.72/hour, which includes labor, fringe benefits, and overhead. Contractor shall also reimburse the SFMTA for the cost of transporting the Vehicle if such action was necessary. These wage and fringe benefit rates shall not exceed the rates in effect in the SFMTA's service division at the time the Defect correction is made.

(f) Reimbursement For Parts. Contractor shall reimburse the SFMTA for defective parts and for parts that must be replaced to correct the Defect. The reimbursement shall be at the current price at the time of repair and shall include taxes where applicable and 15 percent handling costs.

(g) Reimbursement Requirements. The Contractor shall reimburse the SFMTA for warranty labor and/or parts within 60 days of receipt of the warranty claim.

65.4. **Warranty After Replacement/Repairs.** If any component, unit, or subsystem is repaired, rebuilt or replaced by the Contractor, or by the SFMTA with the concurrence of the Contractor, the component, unit, or subsystem shall be assigned a new warranty period equal to the original manufacturer's warranty, effective the replacement date.

The warranty on items determined to be fleet defects as defined in Section 65.7 shall be shall be assigned a new warranty period equal to the original manufacturer's warranty, effective the repair/replacement date for corrected items on each LRV.

66. Delivery of Vehicles

66.1. **Delivery Rate.** Vehicle deliveries shall be in accordance with the Project Delivery Schedule (Exhibit B). SFMTA shall not have more than 8 LRVs out of service at any one time for rehabilitation work and related activities, including pre-inspection, transit, rehabilitation, testing or commissioning.

66.2. **Pilot Delivery**. The pilot LRV shall be delivered and ready for acceptance testing in accordance with Exhibit B. SFMTA will test the pilot LRV in accordance with the test program in TP10 of the Technical Specifications. After receiving written approval of the pilot LRV, the 2nd car shall be delivered to SFMTA for testing and approval in accordance with Exhibit B. The remaining LRVs shall be delivered to SFMTA on a schedule and rate per month to be approved by SFMTA. The Contractor proceeds at its own risk prior to SFMTA's written approval of the pilot LRV.

66.3. **Vehicle Delivery Conditions**:. All deliveries to SFMTA shall be to an SFMTA-specified Light Rail Vehicle facility, weekday working hours, Monday through Friday, 9 a.m. – 3 p.m., except SFMTA holidays, or as otherwise specified in writing by SFMTA. Contractor shall provide at least 48 hours notice to SFMTA prior to delivery.

67. Acceptance of Vehicles

67.1. **Procedure.** After arrival at the designated point of delivery at the SFMTA, each Vehicle will undergo acceptance tests by SFMTA as described in the Technical Specifications, TP10.09. When a Vehicle passes all of the these tests, the SFMTA will issue a Final Acceptance Certificate to Contractor (see Technical Specifications, TP01.08.D). If a Vehicle fails acceptance tests, the SFMTA will notify the Contractor in writing of the reasons for non-acceptance, and the Vehicle will not be accepted until the repair procedures described in Section 69 of this Agreement have been completed and the Vehicle has successfully passed the tests. All deliveries of Vehicles shall be halted whenever two (2) or more Vehicles have failed the acceptance tests and are awaiting corrective action.

67.2. **Conditional Acceptance.** Notwithstanding the provisions of Section 67.1, if a Vehicle does not meet all requirements for full acceptance, the SFMTA may, at its exclusive option, "Conditionally Accept" the Vehicle and place it into revenue service, pending receipt of Contractor-furnished materials and/or labor necessary to effectuate corrective action for acceptance. For any Conditionally Accepted LRV, payments shall be made as provided in Section 7.2 above.

68. Repairs Prior to Acceptance.

68.1. **General.** The SFMTA may require the Contractor, or its designated representative, to perform repairs after non-acceptance or conditional acceptance, or the Contractor may request that the work be done by SFMTA personnel with reimbursement by the Contractor. Contractor shall inform SFMTA in advance of any modifications made to the Vehicle during the acceptance period.

68.2. **Repairs by Contractor.** If the SFMTA requires the Contractor to perform repairs after non-acceptance of the coach, the Contractor's representative must begin the repair within five (5) working days after receiving notification from the SFMTA of failure of acceptance tests. The Contractor shall provide, at its own expense, all spare parts, tools, and labor required to complete the repairs. At the SFMTA's option, the Contractor may be required to remove the Vehicle, at the Contractor's expense, from SFMTA property while repairs are being performed. The Contractor shall then provide a space to complete the repairs, shall diligently pursue the repairs, and shall assume risk of loss while the Vehicle is under its control.

68.3. **Repairs by SFMTA.**

(a) If the SFMTA agrees to a request by the Contractor for SFMTA to perform repairs on a Vehicle prior to SFMTA acceptance, SFMTA shall correct or repair the defect using parts supplied by the Contractor specifically for this repair. Monthly, or at a period to be mutually agreed upon, SFMTA shall submit to Contractor reports of all repairs covered by this procedure for actual cost reimbursement. The Contractor shall provide forms for these reports.

(b) If the Contractor supplies parts for repairs being performed by SFMTA before acceptance of the coach, Contractor shall ship these parts prepaid to SFMTA within 10 working days after receipt of the request for said parts. The Contractor may request that defective components covered by this provision be returned to the manufacturing plant. Contractor shall bear all expenses for supplying such parts and for any associated costs.

(c) Contractor shall reimburse SFMTA for all costs of labor and materials (including taxes) for repairs made or caused to be made by SFMTA. If SFMTA performs the repairs itself, the amount shall be determined by multiplying the number of man-hours actually required to correct the defect by the current technician's hourly overtime wage rate, which includes fringe benefits and overhead, plus the cost of transporting the Vehicle if such action was necessary. If SFMTA requires the service of an outside repair shop, Contractor shall reimburse SFMTA for all such repair invoices. Contractor shall also reimburse SFMTA for administrative costs incurred in performing the repairs. The use of SFMTA labor will not

relieve the Contractor from the responsibility to ensure that repairs are carried out in accordance with proper procedures.

(d) The City may deduct the cost of repairs from any monies due or that may become due to the Contractor under the Agreement, or if such monies are insufficient, the contractor or its surety shall pay to the City any deficiency.

69. Unavoidable Delays

69.1. **Definition.** An Unavoidable Delay is an interruption of the work beyond the control of the Contractor, which the Contractor could not have avoided by the exercise of care, prudence, foresight, and diligence. Such delays include and are limited to acts of God; floods; windstorms; tornadoes; wars; riots; insurrections; epidemics; quarantine restrictions; strikes and lockouts; freight embargoes; acts of a governmental agency; priorities or privileges established for the manufacture, assembly, or allotment of materials by order, decree, or otherwise of the United States or by any department, bureau, commission, committee, agent, or administrator of any legally constituted public authority; changes in the work ordered by the City insofar as they necessarily require additional time in which to complete the entire work; the prevention by the City of the Contractor's commencing or prosecuting the work. The duration of said Unavoidable Delays shall be limited to the extent that the commencement, prosecution, and completion of the work are delayed thereby, as determined by the City.

69.2. **Notification of Delay.** The Contractor shall notify SFMTA as soon as the Contractor has, or should have, knowledge that an event has occurred that will delay deliveries. Within five calendar days, the Contractor shall confirm such notice in writing, furnishing as much detail as is available.

69.3. **Request for Extension.** The Contractor agrees to supply, as soon as such data are available, any reasonable proof that is required by SFMTA to make a decision on any request for extension due to Unavoidable Delays. SFMTA shall examine the request and any documents supplied by the Contractor and shall determine if the Contractor is entitled to an extension and the duration of such extension. SFMTA shall notify the Contractor of its decision in writing. The granting of an extension of time because of Unavoidable Delays shall in no way operate as a waiver on the part of the City of the right to collect liquidated damages for other delays or of any other rights to which the City is entitled.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement on the day first mentioned above.

CITY

Municipal Transportation Agency

Nathaniel P. Ford, Sr.
Executive Director/CEO

Municipal Transportation Agency
Board of Directors
Resolution No. 09-173
Dated: SEPT. 15, 2009
Attest: R. Boomer
Secretary

Approved as to Form:

Dennis J. Herrera
City Attorney

By
Robin M. Reitzes
Deputy City Attorney

Board of Supervisors
Resolution No. 403-09
Dated: 10-29-09
Attest:
Clerk

CONTRACTOR

AnsaldoBreda Inc.

By signing this Agreement, I certify that I comply with the requirements of the Minimum Compensation Ordinance, which entitle Covered Employees to certain minimum hourly wages and compensated and uncompensated time off.

I have read and understood paragraph 35, the City's statement urging companies doing business in Northern Ireland to move towards resolving employment inequities, encouraging compliance with the MacBride Principles, and urging San Francisco companies to do business with corporations that abide by the MacBride Principles.

Lorenzo Reffreger
Director, Marketing, Sales and Service
1461 Loveridge Road
Pittsburg, CA 94565

City vendor number: 41208

Exhibits

Exhibit A:	FTA Requirements For Personal Services And Procurement Contracts
Exhibit B:	Project Delivery Schedule
Exhibit C:	Price Schedule
Exhibit D:	Payment Schedule

EXHIBIT A

FTA REQUIREMENTS FOR FEDERALLY FUNDED PERSONAL SERVICES AND PROCUREMENT CONTRACTS

I. DEFINITIONS

A. **Approved Project Budget** means the most recent statement, approved by the FTA, of the costs of the Project, the maximum amount of Federal assistance for which the City is currently eligible, the specific tasks (including specified contingencies) covered, and the estimated cost of each task.

B. **Contractor** means the individual or entity awarded a third party contract financed in whole or in part with Federal assistance originally derived from FTA.

C. **Cooperative Agreement** means the instrument by which FTA awards Federal assistance to a specific Recipient to support a particular Project or Program, and in which FTA takes an active role or retains substantial control.

D. **Federal Transit Administration (FTA)** is an operating administration of the U.S. DOT.

E. **FTA Directive** includes any FTA circular, notice, order or guidance providing information about FTA's programs, application processing procedures, and Project management guidelines. In addition to FTA directives, certain U.S. DOT directives also apply to the Project.

F. **Grant Agreement** means the instrument by which FTA awards Federal assistance to a specific Recipient to support a particular Project, and in which FTA does not take an active role or retain substantial control, in accordance with 31 U.S.C. § 6304.

G. **Government** means the United States of America and any executive department or agency thereof.

H. **Project** means the task or set of tasks listed in the Approved Project Budget, and any modifications stated in the Conditions to the Grant Agreement or Cooperative Agreement applicable to the Project. In the case of the formula assistance program for urbanized areas, for elderly and persons with disabilities, and non-urbanized areas, 49 U.S.C. §§ 5307, 5310, and 5311, respectively, the term "Project" encompasses both "Program" and "each Project within the Program," as the context may require, to effectuate the requirements of the Grant Agreement or Cooperative Agreement.

I. **Recipient** means any entity that receives Federal assistance directly from FTA to accomplish the Project. The term " Recipient" includes each FTA "Grantee" as well as each FTA Recipient of a Cooperative Agreement. For the purpose of this Agreement, Recipient is the City.

J. **Secretary** means the U.S. DOT Secretary, including his or her duly authorized designee.

K. **Third Party Contract** means a contract or purchase order awarded by the Recipient to a vendor or contractor, financed in whole or in part with Federal assistance awarded by FTA.

L. **Third Party Subcontract** means a subcontract at any tier entered into by Contractor or third party subcontractor, financed in whole or in part with Federal assistance originally derived from FTA.

M. **U.S. DOT** is the acronym for the U.S. Department of Transportation, including its operating administrations.

II. FEDERAL CHANGES

Contractor shall at all times comply with all applicable FTA regulations, policies, procedures and directives, including without limitation those listed directly or by reference in the Master Agreement between the City and FTA, as they may be amended or promulgated from time to time during the term of this contract. Contractor's failure to so comply shall constitute a material breach of this contract.

III. ACCESS TO RECORDS

A. The Contractor agrees to provide the City and County of San Francisco, the FTA Administrator, the Comptroller General of the United States or any of their authorized representatives access to any books, documents, papers and records of the Contractor which are directly pertinent to this Agreement for the purposes of making audits, examinations, excerpts and transcriptions.

B. The Contractor agrees to permit any of the foregoing parties to reproduce by any means whatsoever or to copy excerpts and transcriptions as reasonably needed.

C. The Contractor agrees to maintain all books, records, accounts and reports required under this Agreement for a period of not less than three years after the date of termination or expiration of this Agreement, except in the event of litigation or settlement of claims arising from the performance of this Agreement, in which case Contractor agrees to maintain same until the City, the FTA Administrator, the Comptroller General, or any of their duly authorized representatives, have disposed of all such litigation, appeals, claims or exceptions related thereto. 49 CFR 18.36(i)(11).

IV. DEBARMENT AND SUSPENSION

See Certification Regarding Debarment, Suspension, and Other Responsibility Matters.

V. NO FEDERAL GOVERNMENT OBLIGATIONS TO CONTRACTOR

A. The City and Contractor acknowledge and agree that, notwithstanding any concurrence by the Federal Government in or approval of the solicitation or award of the underlying contract, absent the express written consent by the Federal Government, the Federal Government is not a party to this contract and shall not be subject to any obligations or liabilities to the City, Contractor, or any other party (whether or not a party to that contract) pertaining to any matter resulting from the underlying contract.

B. The Contractor agrees to include the above clause in each subcontract financed in whole or in part with Federal assistance provided by FTA. It is further agreed that the clause shall not be modified, except to identify the subcontractor who will be subject to its provisions.

VI. CIVIL RIGHTS

A. **Nondiscrimination** - In accordance with Title VI of the Civil Rights Act, as amended, 42 U.S.C. § 2000d, section 303 of the Age Discrimination Act of 1975, as amended, 42 U.S.C. § 6102, section 202 of the Americans with Disabilities Act of 1990, 41 U.S.C. § 12132, and Federal transit law at 49 U.S.C. § 5332, the Contractor agrees that it will not discriminate against any employee or applicant for employment because of race, color, creed, national origin, sex, age, or disability. In addition, the Contractor agrees to comply with applicable Federal implementing regulations and other implementing requirements FTA may issue.

B. **Equal Employment Opportunity** - The following equal employment opportunity requirements apply to the underlying contract:

1. **Race, Color, Creed, National Origin, Sex** - In accordance with Title VII of the Civil Rights Act, as amended, 42 U.S.C. § 2000e, and Federal transit laws at 49 U.S.C. § 5332, the Contractor agrees to comply with all applicable equal employment opportunity requirements of U.S. Department of Labor (U.S. DOT) regulations, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor," 41 CFR Parts 60 et seq., (which implement Executive Order No. 11246, "Equal Employment Opportunity," as amended by Executive Order No. 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," 42 U.S.C. § 2000e note), and with any applicable Federal statutes, executive orders, regulations, and Federal policies that may in the future affect construction activities undertaken in the course of the Project. The Contractor agrees to take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, creed, national origin, sex, or age. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

2. **Age** - In accordance with section 4 of the Age Discrimination in Employment Act of 1967, as amended, 29 U.S.C. § 623 and Federal transit law at 49 U.S.C. § 5332, the Contractor agrees to refrain from discrimination against present and prospective employees for reason of age. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

3. **Disabilities** - In accordance with section 102 of the Americans with Disabilities Act, as amended, 42 U.S.C. § 12112, the Contractor agrees that it will comply with the requirements of U.S. Equal Employment Opportunity Commission, "Regulations to Implement the Equal Employment Provisions of the Americans with Disabilities Act," 29 CFR Part 1630, pertaining to employment of persons with disabilities. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

C. The Contractor also agrees to include these requirements in each subcontract financed in whole or in part with Federal assistance provided by FTA, modified only if necessary to identify the affected parties.

VII. PATENT RIGHTS *(applicable to contracts for experimental, research, or development projects financed by fta)*

A. **General.** If any invention, improvement, or discovery is conceived or first actually reduced to practice in the course of or under this Agreement, and that invention, improvement, or discovery is patentable under the laws of the United States of America or any foreign country, the City and Contractor agree to take actions necessary to provide immediate notice and a detailed report to the FTA.

B. Unless the Federal Government later makes a contrary determination in writing, irrespective of the Contractor's status (large business, small business, state government or instrumentality, local government, nonprofit organization, institution of higher education, individual), the City and Contractor agree to take the necessary actions to provide, through FTA, those rights in that invention due the Federal Government described in U.S. Department of Commerce regulations, "Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements," 37 CFR Part 401.

C. The Contractor also agrees to include the requirements of this clause in each subcontract for experimental, developmental, or research work financed in whole or in part with Federal assistance provided by FTA.

VIII. RIGHTS IN DATA AND COPYRIGHTS *(applicable to contracts for planning, research, or development financed by fta)*

A. **Definition.** The term "subject data" used in this section means recorded information, whether or not copyrighted, that is delivered or specified to be delivered under this Agreement. The term includes graphic or pictorial delineation in media such as drawings or photographs; text in specifications or related performance or design-type documents; machine forms such as punched cards, magnetic tape, or computer memory printouts; and information retained in computer memory. Examples include, but are not limited to, computer software, engineering drawings and associated lists, specifications, standards, process sheets, manuals, technical reports, catalog item identifications, and related information. The term "subject data" does not include financial reports, cost analyses, and similar information incidental to contract administration.

B. **Federal Restrictions.** The following restrictions apply to all subject data first produced in the performance of this Agreement.

1. **Publication of Data.** Except for its own internal use in conjunction with the Agreement, Contractor may not publish or reproduce subject data in whole or in part, or in any manner or form, nor may Contractor authorize others to do so, without the written consent of the Federal Government, until such time as the Federal Government may have either released or approved the release of such data to the public; this restriction on publication, however, does not apply to any contract with an academic institution.

2. **Federal License.** In accordance with 49 CFR §§ 18.34 and 19.36, the Federal Government reserves a royalty-free, non-exclusive and irrevocable license to reproduce, publish or otherwise use, and to authorize others to use, "for Federal Government purposes," any subject data or copyright described below. As used in the previous sentence, "for Federal Government purposes" means use only for the direct purposes of the Federal Government. Without the copyright owner's consent, the Federal Government may not extend its Federal license to any other party:

i. Any subject data developed under this Agreement, whether or not a copyright has been obtained; and

ii. Any rights of copyright purchased by City or Contractor using Federal assistance in whole or in part provided by FTA.

3. **FTA Intention.** When FTA awards Federal assistance for a experimental, research or developmental work, it is FTA's general intention to increase transportation knowledge available to the public, rather than to restrict the benefits resulting from the work to participants in the work. Therefore, unless FTA determines otherwise, the Contractor performing experimental, research, or developmental work required by the underlying Agreement agrees to permit FTA to make available to the public, either FTA's license in the copyright to any subject data developed in the course of the Agreement, or a copy of the subject data first produced under the Agreement for which a copyright has not been obtained. If the experimental, research, or developmental work which is the subject of this Agreement is not completed for any reason whatsoever, all data developed under this Agreement shall become subject data as defined in Subsection a. above and shall be delivered as the Federal Government may direct. This subsection does not apply to adaptations of automatic data processing equipment or programs for the City's use the costs of which are financed with Federal transportation funds for capital projects.

4. **Hold Harmless.** Unless prohibited by state law, upon request by the Federal Government, the Contractor agrees to indemnify, save, and hold harmless the Federal Government, its officers, agents, and employees acting within the scope of their official duties, against any liability, including costs and expenses, resulting from any willful or intentional violation by the Contractor of proprietary rights, copyrights, or right of privacy, arising out of the publication, translation, reproduction, delivery, use, or disposition of any data furnished under this Agreement. The Contractor shall not be required to indemnify the Federal Government for any such liability arising out of the wrongful acts of employees or agents of the Federal Government.

5. **Restrictions on Access to Patent Rights.** Nothing contained in this section on rights in data shall imply a license to the Federal Government under any patent or be construed as affecting the scope of any license or other right otherwise granted to the Federal Government under any patent.

6. **Application to Data Incorporated into Work.** The requirements of Subsections (2), (3) and (4) of this Section do not apply to data developed by the City or Contractor and incorporated into the work carried out under this Agreement, provided that the City or Contractor identifies the data in writing at the time of delivery of the work.

7. **Application to Subcontractors.** Unless FTA determines otherwise, the Contractor agrees to include these requirements in each subcontract for experimental, developmental, or research work financed in whole or in part with Federal assistance provided by FTA.

C. **Provision of Rights to Government.** Unless the Federal Government later makes a contrary determination in writing, irrespective of the Contractor's status (large business, small business, state government or instrumentality, local government, nonprofit organization, institution of higher education, individual, etc.), the City and Contractor agree to take the necessary actions to provide,

through FTA, those rights in that invention due the Federal Government described in U.S. Department of Commerce regulations, "Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements," 37 CFR Part 401.

D. **Flow Down.** The Contractor also agrees to include these requirements in each subcontract for experimental, developmental, or research work financed in whole or in part with Federal assistance provided by FTA.

IX. CONTRACT WORK HOURS AND SAFETY STANDARDS *(applicable to nonconstruction contracts in excess of $100,000 that employ laborers or mechanics on a public work)*

A. **Overtime requirements** - No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

B. **Violation; liability for unpaid wages; liquidated damages** - In the event of any violation of the clause set forth in paragraph A of this section the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph A of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph A of this section.

C. **Withholding for unpaid wages and liquidated damages** - The City and County of San Francisco shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2) of this section.

D. **Subcontracts** - The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraphs A through D of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs A through D of this section.

X. ENERGY CONSERVATION REQUIREMENTS

The Contractor agrees to comply with mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act.

XI. CLEAN WATER REQUIREMENTS *(applicable to all contracts in excess of $100,000)*

A. The Contractor agrees to comply with all applicable standards, orders, or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. §§ 1251 et seq. Contractor agrees to report each violation of these requirements to the City and understands and agrees that the City will, in turn, report each violation as required to assure notification to FTA and the appropriate EPA regional office.

B. The Contractor also agrees to include these requirements in each subcontract exceeding $100,000 financed in whole or in part with Federal assistance provided by FTA.

XII. CLEAN AIR *(applicable to all contracts and subcontracts in excess of $100,000, including indefinite quantities where the amount is expected to exceed $100,000 in any year)*

A. Contractor agrees to comply with applicable standards, orders, or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. §§ 7401 et seq. The Contractor agrees to report each violation to the City and understands and agrees that the City will, in turn, report each violation as required to assure notification to FTA and the appropriate EPA Regional Office.

B. The Contractor also agrees to include these requirements in each subcontract exceeding $100,000 financed in whole or in part with Federal assistance provided by FTA.

XIII. PRIVACY

If Contractor or its employees administer any system of records on behalf of the Federal Government, Contractor and its employees agree to comply with the information restrictions and other applicable requirements of the Privacy Act of 1974, 5 U.S.C. § 552a (the Privacy Act). Specifically, Contractor agrees to obtain the express consent of the Federal Government before the Contractor or its employees operate a system of records on behalf of the Government. Contractor acknowledges that the requirements of the Privacy Act, including the civil and criminal penalties for violations of the Privacy Act, apply to those individuals involved, and that failure to comply with the terms of the Privacy Act may result in termination of this Agreement. The Contractor also agrees to include these requirements in each subcontract to administer any system of records on behalf of the Federal Government financed in whole or in part with Federal assistance provided by FTA.

XIV. DRUG AND ALCOHOL TESTING

To the extent Contractor, its subcontractors or their employees perform a safety-sensitive function under the Agreement, Contractor agrees to comply with, and assure compliance of its subcontractors, and their employees, with 49 U.S.C. § 5331, and FTA regulations, "Prevention of Alcohol Misuse and Prohibited Drug Use in Transit Operations," 49 CFR Part 655.

XV. TERMINATION FOR CONVENIENCE OF CITY *(required for all contracts in excess of $10,000)*

See Agreement Terms and Conditions.

XVI. TERMINATION FOR DEFAULT *(required for all contracts in excess of $10,000)*

See Agreement Terms and Conditions.

XVII. BUY AMERICA

The Contractor agrees to comply with 49 U.S.C. 5323(j) and 49 CFR Part 661, which provide that Federal funds may not be obligated unless steel, iron, and manufactured products used in FTA-funded projects are produced in the United States, unless a waiver has been granted by FTA or the product is subject to a general waiver. General waivers are listed in 49 CFR 661.7, and include microcomputer equipment, software, and small purchases ($100,000 or less) made with capital, operating, or planning funds. Separate requirements for rolling stock are set out at 49 U.S.C. 5323(j)(2)(C) and 49 CFR 661.11. Rolling stock not subject to a general waiver must be manufactured in the United States and have a 60 percent domestic content.

XVIII. CARGO PREFERENCE - USE OF UNITED STATES FLAG VESSELS

The Contractor agrees: (a) to use privately owned United States-Flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to the underlying Agreement to the extent such vessels are available at fair and reasonable rates for United States-Flag commercial vessels; (b) to furnish within 20 working days following the date of loading for shipments originating within the United States or within 30 working days following the date of leading for shipments originating outside the United States, a legible copy of a rated, "on-board" commercial ocean bill-of-lading in English for each shipment of cargo described above to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590 and to the FTA recipient (through the Contractor in the case of a subcontractor's bill-of-lading.); and (c) to include these requirements in all subcontracts issued pursuant to this Agreement when the subcontract may involve the transport of equipment, material, or commodities by ocean vessel.

XIX. RECYCLED PRODUCTS

The Contractor agrees to comply with all the requirements of Section 6002 of the Resource Conservation and Recovery Act (RCRA), as amended (42 U.S.C. 6962), including, but not limited to, the regulatory provisions of 40 CFR Part 247, and Executive Order 12873, as they apply to the procurement of the items designated in Subpart B of 40 CFR Part 247.

XX. PRE-AWARD AND POST-DELIVERY AUDIT REQUIREMENTS *(applies to contracts for rolling stock)*

To the extent applicable, Contractor agrees to comply with the requirements of 49 U.S.C. § 5323(l) and FTA implementing regulations at 49 CFR Part 663, and to submit the following certifications:

A. **Buy America Requirements**: The Contractor shall complete and submit a declaration certifying either compliance or noncompliance with Buy America. If the Bidder/Offeror certifies compliance with Buy America, it shall submit documentation which lists (1) component and subcomponent parts of the rolling stock to be purchased identified by manufacturer of the parts, their country of origin and costs; and (2) the location of the final assembly point for the rolling

stock, including a description of the activities that are planned to take place and actually took place at the final assembly point and the cost of final assembly.

B. **Solicitation Specification Requirements**: The Contractor shall submit evidence that it will be capable of meeting the bid specifications and provide information and access to Recipient and its agents to enable them to conduct post-award and post-delivery audits.

C. **Federal Motor Vehicle Safety Standards (FMVSS)**: The Contractor shall submit (1) manufacturer's FMVSS self-certification sticker information that the vehicle complies with relevant FMVSS or (2) manufacturer's certified statement that the contracted buses will not be subject to FMVSS regulations.

XXI. FALSE OR FRAUDULENT STATEMENTS AND CLAIMS

A. The Contractor acknowledges that the provisions of the Program Fraud Civil Remedies Act of 1986, as amended, 31 U.S.C. §§ 3801 et seq. and U.S. DOT regulations, "Program Fraud Civil Remedies," 49 CFR Part 31, apply to its actions pertaining to this Project. Upon execution of the underlying Agreement, the Contractor certifies or affirms the truthfulness and accuracy of any statement it has made, it makes, it may make, or causes to be made, pertaining to the underlying contract or the FTA-assisted project for which this contract work is being performed. In addition to other penalties that may be applicable, the Contractor further acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification, the Federal Government reserves the right to impose the penalties of the Program Fraud Civil Remedies Act of 1986 on the Contractor to the extent the Federal Government deems appropriate.

B. The Contractor also acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification to the Federal Government under a contract connected with a project that is financed in whole or in part with Federal assistance originally awarded by FTA under the authority of 49 U.S.C. § 5307, the Government reserves the right to impose the penalties of 18 U.S.C. § 1001 and 49 U.S.C. § 5307(n)(1) on the Contractor, to the extent the Federal Government deems appropriate.

C. The Contractor agrees to include the above two clauses in each subcontract financed in whole or in part with Federal assistance provided by FTA. It is further agreed that the clauses shall not be modified, except to identify the subcontractor who will be subject to the provisions.

XXII. FLY AMERICA

The Contractor agrees to comply with 49 U.S.C. 40118 (the "Fly America" Act) in accordance with the General Services Administration's regulations at 41 CFR Part 301-10, which provide that recipients and subrecipients of Federal funds and their contractors are required to use U.S. Flag air carriers for U.S Government-financed international air travel and transportation of their personal effects or property, to the extent such service is available, unless travel by foreign air carrier is a matter of necessity, as defined by the Fly America Act. The Contractor shall submit, if a foreign air carrier was used, an appropriate certification or memorandum adequately explaining why service by a U.S. flag air carrier was not available or why it was necessary to use a foreign air carrier and shall, in any event, provide a certificate of compliance with the Fly

America requirements. The Contractor agrees to include the requirements of this section in all subcontracts that may involve international air transportation.

XXIII. INCORPORATION OF FEDERAL TRANSIT ADMINISTRATION (FTA) TERMS

The preceding provisions include, in part, certain Standard Terms and Conditions required by DOT, whether or not expressly set forth in the preceding contract provisions. All contractual provisions required by DOT, as set forth in FTA Circular 4220.1E, are hereby incorporated by reference. Anything to the contrary herein notwithstanding, all FTA mandated terms shall be deemed to control in the event of a conflict with other provisions contained in this Agreement. The Contractor shall not perform any act, fail to perform any act, or refuse to comply with any (name of grantee) requests which would cause (name of grantee) to be in violation of the FTA terms and conditions.

XXIV. TRANSIT EMPLOYEE PROTECTIVE AGREEMENTS *(applicable to each contract for transit operations performed by employees of a contractor recognized by fta to be a transit operator)*

A. The Contractor agrees to the comply with applicable transit employee protective requirements as follows:

1. **General Transit Employee Protective Requirements** - To the extent that FTA determines that transit operations are involved, the Contractor agrees to carry out the transit operations work on the underlying contract in compliance with terms and conditions determined by the U.S. Secretary of Labor to be fair and equitable to protect the interests of employees employed under this contract and to meet the employee protective requirements of 49 U.S.C. A 5333(b), and U.S. DOL guidelines at 29 C.F.R. Part 215, and any amendments thereto. These terms and conditions are identified in the letter of certification from the U.S. DOL to FTA applicable to the FTA Recipient's project from which Federal assistance is provided to support work on the underlying contract. The Contractor agrees to carry out that work in compliance with the conditions stated in that U.S. DOL letter. The requirements of this subsection A, however, do not apply to any contract financed with Federal assistance provided by FTA either for projects for elderly individuals and individuals with disabilities authorized by 49 U.S.C. § 5310(a)(2), or for projects for nonurbanized areas authorized by 49 U.S.C. § 5311. Alternate provisions for those projects are set forth in subsections (2) and (3) of this clause.

2. **Transit Employee Protective Requirements for Projects Authorized by 49 U.S.C. § 5310(a)(2) for Elderly Individuals and Individuals with Disabilities** - If the contract involves transit operations financed in whole or in part with Federal assistance authorized by 49 U.S.C. § 5310(a)(2), and if the U.S. Secretary of Transportation has determined or determines in the future that the employee protective requirements of 49 U.S.C. § 5333(b) are necessary or appropriate for the state and the public body subrecipient for which work is performed on the underlying contract, the Contractor agrees to carry out the Project in compliance with the terms and conditions determined by the U.S. Secretary of Labor to meet the requirements of 49 U.S.C. § 5333(b), U.S. DOL guidelines at 29 C.F.R. Part 215, and any amendments thereto. These terms and conditions are identified in the U.S. DOL's letter of certification to FTA, the date of

which is set forth Grant Agreement or Cooperative Agreement with the state. The Contractor agrees to perform transit operations in connection with the underlying contract in compliance with the conditions stated in that U.S. DOL letter.

3. **Transit Employee Protective Requirements for Projects Authorized by 49 U.S.C. § 5311 in Nonurbanized Areas** - If the contract involves transit operations financed in whole or in part with Federal assistance authorized by 49 U.S.C. § 5311, the Contractor agrees to comply with the terms and conditions of the Special Warranty for the Nonurbanized Area Program agreed to by the U.S. Secretaries of Transportation and Labor, dated May 31, 1979, and the procedures implemented by U.S. DOL or any revision thereto.

B. The Contractor also agrees to include the any applicable requirements in each subcontract involving transit operations financed in whole or in part with Federal assistance provided by FTA.

XXV. AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009 (ARRA) REQUIREMENTS

A. Registration Requirements. The Contractor shall maintain a current registration in the federal Central Contractor Registration database, located at www.ccr.gov and provide the City with its CCR registration number and legal name as entered into CCR. A valid DUNS number and Tax Identification Number (TIN) are required in order to register.

B. Reporting Requirements. The Contractor shall be required to provide information to the SFMTA on the employment impact of all work being performed with ARRA funds so that SFMTA can report such information as required to agencies of the Federal Government. SFMTA will provide forms to Contractor for this purpose, as well as more detailed information and examples. At a minimum, Contractor shall track and/or report information regarding the following:

1. Number of direct jobs working on the project (including all created, retained, or existing jobs). An example of a direct job is a worker employed to construct a facility or to maintain or repair equipment on-site whose time is charged directly to the project.

2. Number of direct, on-project job hours that were worked. (expressed as "full-time equivalents" or FTEs) - calculated as total hours worked in jobs created, retained or existing divided by the number of hours in a full-time schedule, as defined by the contractor.

3. The amount of payroll for the jobs. (Total dollar amount of wages paid by the contractor or consultant for employees on the specified project. Payroll only includes wages and does not include overhead or indirect costs.)

4. The classification (or broad job category) of each job on the project.

5. A description of what was obtained for payment.

C. Records. Contractor agrees to maintain separate and distinct accounts, records, and documents that adequately identify the source and application of ARRA funds and must track accounting and reporting transactions accordingly.

XXVI. WHISTLEBLOWER PROVISIONS *(ARRA-funded contracts)*

Contractor cannot discharge, demote, or otherwise discriminate against an employee as a reprisal for disclosing, including a disclosure made in the ordinary course of an employee's duties, made to the Recovery Accountability and Transparency Board, an inspector general, the Comptroller General, a member of Congress, a State or Federal regulatory or law enforcement agency, a person with supervisory authority over the employee (or such other person working for the employer who has the authority to investigate, discover or terminate misconduct), a court or grand jury, the head of a Federal agency or their representative, information that the employee reasonably believes is evidence of :

- gross mismanagement of an agency contract or grant relating to covered funds;
- a gross waste of covered funds;
- a substantial and specific danger to public health or safety related to the implementation or use of covered funds;
- an abuse of authority related to the implementation or use of covered funds; or
- a violation of law, rule, or regulation related to an agency contract (including the competition for or negotiation of a contract) or grant, awarded or issued relating to covered funds.

Contractor agrees to post notice of the rights and remedies as required by ARRA.

EXHIBIT B
PROJECT DELIVERY SCHEDULE

Delivery of 143 Rehabilitated Light Rail Vehicles and Associated Deliverables

DELIVERY MILESTONE		AFTER NTP
a. Acceptance of Management Work Plan, Master Baseline Schedule	+30	30 days
b. Delivery of Pilot LRV ready for acceptance testing no later than	+150	180 days
c. Delivery of successful testing and Conditional Acceptance of the Pilot Car no later than	+30	210 days
d. Completion of successful testing and Conditional Acceptance of Second car	+60	270 days
e. Completion of successful testing and Conditional Acceptance of 143rd car @ 4/month.	+1110	1380 days

Milestone requirements detailed in Section 67 of the Contract and in Section TP01.08 of the Technical Provisions.

EXHIBIT C

PRICE SCHEDULE
FOR SFMTA REHABILITATION OF IDENTIFIED SUBSYSTEMS FOR 143 LRVs

Item No.	Description	Qty.	Unit Price	Total Price
1.	Rehabilitation of Couplers, Truck, Air Supply Units, Doors and Steps, Articulation Wiring and harnesses for 143 LRVs including manuals, CDRLs, Transport of Vehicle to Contractor facility and return to SFMTA facility, Site Support & Warranty*			
1.1	Rehabilitated couplers (electrical and mechanical) complete assembly (A)	143	$53,500	$7,650,443
1.2	Rehabilitated doors and steps complete assembly (B)	143	$203,963	$29,166,640
1.3	Replacement PSC-2 Wiring Harnesses (C)	143	$6,860	$980,980
1.4	Re-designed new articulation wiring and harnesses complete assembly (D)	143	$37,306	$5,334,726
1.5	Rehabilitated air supply units complete assembly (E)	143	$24,003	$3,432,425
1.6.	Replacement of Center Pins and Traction Motor Bearings (F)	143	$11,210	$1,602,991
1.7	Program Management, Engineering, QA Support (G)			$2,813,410
	Subtotal of Item 1 (A+B+C+D+E+F+G)			$50,981,615
2.	Training 35 SFMTA employees and trainers on the operations and maintenance of supplied equipment including training on the use of special tools and software as applicable and manuals (H)	Lump Sum		$20,000

3.	Spare Parts For 143 LRVs			
3.1	Rehabilitated couplers (electrical and mechanical) complete assembly (SFMTA will provide cores) (I)	10	26,750	267,498
3.2	Rehabilitated doors and steps complete assembly (J)	2	181,165	362,329
3.3	Replacement PSC-2 Wiring Harnesses (K)	1	6,859	6,859
3.4	Re-designed new articulation wiring and harnesses ; a. Jumper Cables b. Bulkhead Connectors			
	Articulation Wiring Spares a+b (L)	10	21,871	218,708
	Subtotal of Spares (I+J+K+L)			**$855,394**
4.	Allowance for latent or unforeseen mechanical conditions			**$2,000,000**
5.	Sales tax on materials (reimbursable)			**$2,895,545**
	CONTRACT TOTAL (1+2+3+4+5)			**$56,752,554**

TOTAL CONTRACT PRICE $ 56,752,554
(amounts are rounded to the nearest dollar)

EXHIBIT D

PAYMENT SCHEDULE

1. Rehabilitation of 143 Light Rail Vehicles

1a.	Approval of Contractor's Management Work Plan and Program CDRL's (Program CDRL's as defined in section TP15 Deliverables Summary)	5% of the amount of Line Item 1 of Price Schedule (30% of the amount to be paid upon delivery of the Work Plan and all CDRLs to SFMTA and 70% to be paid upon approval of the Work Plan and all CDRLs by SFMTA)
1b.	Proof of payment of Major Parts and Assemblies including Couplers, Trucks, Air Supply Units, Doors and Steps, Articulation Wiring and harnesses, (Based on presentation of executed purchase orders)	Not to exceed 25% of the amount of Line Item 1 of Price Schedule
1c.	Delivery of car to Pittsburg	20% of the amount of Line Item 1 of Price Schedule, on a per car basis
1d.	Completion of Pre-Shipment testing, and Release of car for shipment (Based on TP01.08 - Release for shipment Certificate)	20% of the amount of Line Item 1 of Price Schedule, on a per car basis.
1e.	Conditional Acceptance of each Vehicle (per Section 68.2 of Agreement) (Based on TP01.08 - Approval for Revenue Service Certificate)	20% of the amount of Line Item 1 of Price Schedule, on a per car basis.
1f.	Final Acceptance, delivery of all car-based deliverables, closure of all Corrective Actions (Based on Final Acceptance Certificate, per TP01.08)	5% of the amount of Line Item 1 of Price Schedule, on a per car basis.
1g.	Closure of all contract deliverables by SFMTA (Based on Contract Closeout Certificate TP01.08)	5% of the amount of Line Item1 of Price Schedule

2. Training

2a.	Delivery and Approval of Training Plan	15% of the amount of Line Item 2 of Price Schedule
2b.	Completion of all training	80% of the amount of Line Item 2 of Price Schedule
2c.	Final acceptance of all contract deliverables	5% of the amount of Line Item 2 of Price Schedule

3. Spare parts

Spare parts delivered and accepted by SFMTA in San Francisco shall be paid according to the detailed list in Line Item 3 of Price Schedule

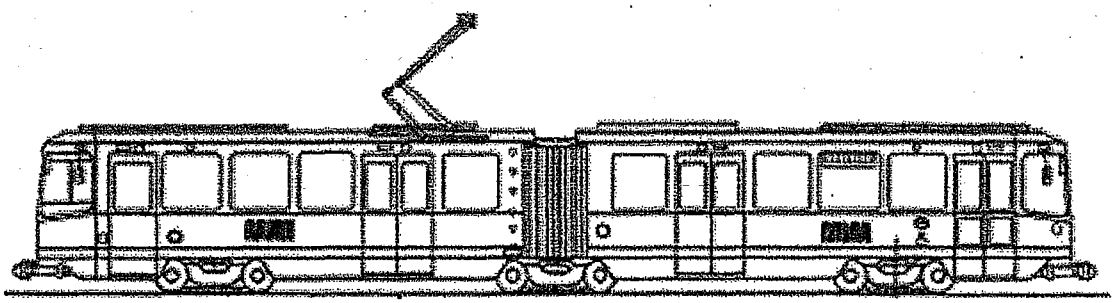
NOTE: Payment for the rehabilitation work will occur upon completion of listed items on this Payment Schedule, upon proper receipt of an invoice requesting payment and acceptable completion of all contract terms. Sales taxes shall be reimbursed quarterly based on evidence of payment to the California State Board of Equalization.

Municipal Transportation Agency

LRV Doors and Steps Reconditioning and System Rehabilitation

Volume 2
TECHNICAL SPECIFICATIONS

Date: 8/28/2009
Revision 4



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(TECHNICAL PROVISIONS)

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SCOPE AND RESPONSIBILITIES

August 28, 2009
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SECTION TP01
SCOPE AND RESPONSIBILITIES

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TP01: SCOPE AND RESPONSIBILITIES

TP01.01 SCOPE AND PURPOSE

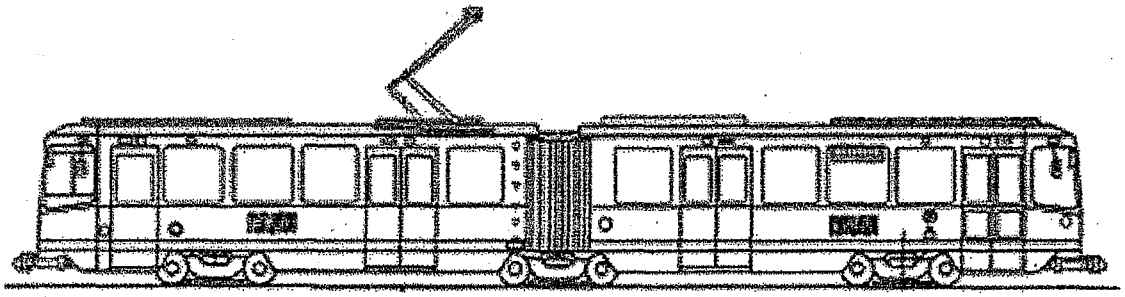
A. General

These Technical Provisions provide a general description for the rehabilitation of five specific systems on the San Francisco Municipal Transportation Agency (SFMTA) light rail vehicles (LRV's). The fleet includes the following:

Vehicle	Quantity	Year of Acceptance	Builder
LRV2	77 (75)*	1996-1999	Ansaldo Breda
LRV3	74 (72)*	2000-2003	Ansaldo Breda

*The work in question will be performed on all of the aforementioned vehicles with the following exceptions. Two LRV2 and two LRZV3 vehicles are currently out of service due to minor collision damage. They will be provided to the Contractor for rebuild following completion of the collision damage repair. An additional two LRV2 and two LRV3 vehicles are out of service with major collision damage, and are not included in the scope of this rebuild task.

The most noticeable difference between LRV2's (shown below) and LRV3's is that the door operators are distinctly different, as discussed in the Door and Step System Section TP04 of these Technical Provisions.



The five specific rehabilitation/replacement tasks are as follow:

- Automatic Doors and Steps Rehabilitation
- Air Supply System Rehabilitation
- Automatic Coupler Rehabilitation
- Roof Articulation Wiring Harness Redesign and Replacement
- Trailer Truck Electric System Cable Assembly (PSC-2) Replacement

The following subsections provide an overview of each task. Specific work to be performed for each task is provided by section in these Technical Provisions.

1. Automatic Doors and Steps Rehabilitation

This task is the major element of the project. The SFMTA LRV's are rather unique in that they utilize a movable step box that adjusts the boarding height from level boarding at a platform, to a two-step boarding at street level. Additionally, during level boarding, an automatic bridge plate extends outward from the car to further close the gap with the platform. Thus, the step system is as complicated as the automatic door system. The doors on these vehicles are of two designs. One set of cars uses a single operator for both leaves of a door opening, while the other uses one operator per leaf. It is required to rebuild the door and step systems in-kind. In general, all mechanical components of the door and step operators shall be rebuilt or replaced, and all supporting electrical hardware shall likewise be tested, rebuilt, and or replaced.

2. Air Supply Unit Rehabilitation

Air supply units consist primarily of a compressor, motor, and dryer. Rebuild procedures are provided by the OEM, but it is the responsibility of the Contractor to verify these procedures and propose changes as appropriate. These units must be rebuilt and placed back into service.

3. Automatic Coupler Rehabilitation

This task requires the rebuild or replacement of the entire coupling system, both electrical and mechanical. The bulk of the work is mechanical, such as replacement of bushings, bellows, guides, etc. The electrical connections in the coupler head must also be refurbished. Rebuild procedures are provided by the OEM, but it is the responsibility of the Contractor to verify these procedures and propose changes as appropriate.

4. Articulation Wiring Harness Redesign and Replacement

The control wiring on the rooftop connecting the two carbodies is in a high fatigue environment. Only the A-Car is fitted with bulkhead connectors. The jumpers are hard-wired into the B-Car. The task is to install bulkhead connectors on the B-Car, replace A-Car connectors, provide new jumpers, and design a cable support system that minimizes fatigue and chafing.

5. Trailer Truck Electric System Cable Assembly (PSC-2) Replacement

The PSC-2 wiring harness is installed in the center truck, and connects the ATC antenna and tachometer signals to the carbody wiring system. This harness is subject to fatigue, damage from debris strikes, and general dirt, grease, and grime. A replacement cable must be installed.

All work must be performed at the Contractor's facility, and all logistics associated with transporting the LRVs between SFMTA shops and the Contractor's facility are the sole responsibility of the Contractor.

Other Sections of these Technical Provisions define various aspects of the LRV operating environment, carbody design, propulsion equipment, materials and workmanship, quality assurance, testing, and documentation.

The LRV systems shall be designed and built/rebuilt to comply in all respects with all applicable laws, regulations, standards, and recommended practices of the following agencies and organizations:

- US Department of Transportation (USDOT)
- Federal Transit Administration (FTA)
- US Department of Homeland Security (DHS)
- American Public Transportation Association (APTA)
- State of California
- Environmental Protection Agency (EPA)
- National Fire Protection Association (NFPA)
- Occupational Safety and Health Administration (OSHA)
- OEM Maintenance Manuals

Where there is a conflict, the most restrictive requirement shall apply.

All integral systems and components shall embody the latest tested and service-proven developments and improvements available to the Contractor, as approved by the Engineer. All systems shall be designed in accordance with the Technical Provisions to meet or exceed all applicable safety standards, optimize reliability, promote energy conservation, minimize routine maintenance requirements, reduce the number of parasitic power losses, and minimize noise emissions.

This project, as with all SFMTA programs shall comply with all applicable current environmental regulations and work to embrace new regulations, standards, and technologies as they are developed and implemented. All work shall comply with regulations in place at the time of vehicle acceptance.

The Contract and Technical Provisions also include, but are not limited to, the provision of the following where applicable:

- Design Documentation
- Testing
- Manuals
- Training
- Special Tools, Test Equipment, and Apparatus
- Other required deliverables and services associated with the LRVs, complete with warranties and guarantees.

Whenever a question arises regarding the requirements of the Contract Documents, the Contractor shall apply to the Engineer for further written explanations as may be necessary and shall conform to the explanations provided.

Notwithstanding the above, the Contractor shall not be relieved of the responsibility to comply with the latest rules, regulations, and standards applicable to this Contract and to ensure the suitability of the systems, devices, apparatus, components, and parts for the service intended.

B. Intent

The Technical Provisions and referenced drawings describe the overall dimensions, shape, appearance, and functions of the cars, and the environment in which they will operate. Certain design details are given, where necessary, where experience has dictated a need to limit the Contractor's choice of materials or direct its design. Other details and clarifications have been defined for the benefit of prospective Contractors not familiar with North American standards and practices.

It shall be the sole responsibility of the Contractor to design, develop, and rebuild systems that are, in all respects, suitable for the purpose intended. If any part, device, or component is required to make the LRV function as specified, it shall be the Contractor's responsibility to provide that part, device, or component.

Although the required warranty is defined elsewhere in the Contract Documents, the design of the systems and the level of quality and durability of the LRV, its systems and components shall be consistent with minimum useful life of 30 years.

TP01.02 DEFINITIONS

The definitions provided in this Section are meant to supplement and complement those included Volume I of these contract documents. Wherever the following terms are used in these Technical Provisions, the intent and meaning shall be interpreted as follows:

A" BODY SECTION: The half of an articulated car containing the pantograph.

APPROVAL: Review and acceptance, in writing, by the named party, typically the Engineer.

APPROVED OR APPROVED TYPE: Design, type of material, procedure, or method given approval by the Engineer.

APPROVED EQUAL: Whenever the words "approved equal" are used in connection with a specific manufacturer or item of equipment in the Technical Provisions, they shall be interpreted to mean that in order to substitute any other component for use in lieu of the specified component, the proposed substitute brand or make of material, device, or equipment must be approved in writing by the Engineer. The following areas shall be considered before requesting approval from the Engineer:

- Safety
- Quality

- Workmanship
- Economy of Operation
- Life Cycle Cost
- Reliability
- Maintainability
- Interchangeability
- Suitability for the purpose intended

ASSEMBLY: The ordered arrangement of components that form the subset or complete set of parts that constitutes a system.

AUXILIARY EQUIPMENT: Any mechanism or structure, other than the vehicle body, traction motor, or propulsion equipment gearing, that performs a function at some time during the operation of the transit vehicle -- e.g., heating and cooling subsystem, pumps, static inverter, vehicle door mechanism, motor alternator or motor-generator set, air compressor or hydraulic power unit, transit vehicle lighting.

AVAILABILITY: The percentage of the car fleet useable for revenue service at the beginning of each day's schedule. Also on a per car basis, the percentage of time a car is useable for service: (MTBF)/ (MTBF + MTTR).

"B" BODY SECTION: The half of an articulated car not containing the pantograph.

BASELINE DESIGN: The design of the car or any of its components, apparatus, systems, subsystems, or materials which have received both drawing approval and first article approval.

BURN-IN: The operation of an item under stress to stabilize its characteristics.

CAR: See LIGHT RAIL VEHICLE

CATENARY: Overhead power supply consisting of a combination of conductors and other hardware suspended above the tracks by means of cantilevers and wayside structures. See also OVERHEAD CONTACT SYSTEM.

COMMISSIONING: Pre-acceptance Contractor activities involved in delivering, adjusting, and testing the cars to demonstrate compliance with the requirements of the Technical Provisions.

COMMENT: Written critiques of the Contractor's submittals to SFMTA.

CONSIST: The quantity and specific identity of vehicles that make up a train.

CONSOLE: The control panel located in the cab directly in front of the operator's seat.

CONTRACT DATA REQUIREMENTS LIST (CDRL): A matrix listing data, such as drawings, catalogs, reports, notices, and samples, required to be submitted by the Contractor. The matrix

also shows when such submittals are required and resubmittal requirements and their frequency.

CONTRACTOR: A public company or conglomerate selected to provide SFMTA with a specified level of commuter rail service along four corridors. The Contractor will like provide commuter rail system financing, design, construction, operations, and maintenance through a long-term partnership with SFMTA. The Contractor will ultimately purchase, take delivery of, and own the specified commuter rail vehicles.

CONTRACTOR'S DRAWINGS: Items such as general arrangement drawings, detail drawings, graphs, diagrams, and sketches which are prepared by the Contractor to detail its work.

CORRECTIVE MAINTENANCE: Those actions performed, as a result of a failure, to restore an item to a specified condition.

COUPLER: A device for mechanically coupling transit vehicles together. This term is also applied to connectors, as in "electric coupler" and "pneumatic coupler."

DEADMAN FEATURE: A device to detect inattention or disability of a train operator, which causes a brake application.

DELIVERY: The transfer of the completed vehicle (with all in-plant testing completed and results accepted by SFMTA) to SFMTA property, ready for commissioning and acceptance testing.

DRAFT GEAR: The energy-absorbing mechanism that attaches the coupler to the anchorage.

ENGINEER: The individual designated by SFMTA to manage the technical aspects of the Contract on a day-to-day basis. The duly authorized representative acting, directly or through his duly authorized representatives, within the scope of the particular duties assigned.

FAIL-SAFE: Equipment configurations that are implemented in hardware where each component has a known set of predictable failure modes that may be individually analyzed for their effect on equipment performance and function. Any failure or set of failures resulting from a single causative event must cause the equipment to revert to a safe state that is self-annunciating. The probability of an unsafe state must be zero.

FAILURE: The inability of a component, system, or subsystem to function or perform in accordance with the Technical Provisions and requiring a corrective action to restore the specified function or performance.

FAILURE PATTERN: The occurrence of three or more failures of the same or identically replaceable Items (i.e., the same part number) within the lesser of 10,000 fleet hours of operation or 400,000 fleet miles of travel, in identical applications or functional modes.

FAILURE RATE: A measure of the mean rate at which items from the same application population fail. The failure rate is determined by dividing the total number of failures by the total number of life units expended by that application population during a particular measurement interval. The life units used within SFMTA are "miles".

FAILURE, SERVICE: A Service Failure is a Component/System Failure that meets any one of the relevant failure criteria:

- The car is taken out of service at the start or en route to its destination due to a problem or failure that has occurred resulting in an unsafe condition, or due to a problem or failure which prevents the car from completing its mission.
- The car, after beginning its mission, continues to its final destination but with a problem or failure that renders it unacceptable for continued service.
- The car is unacceptable for service as determined by SFMTA due to a problem or failure that was detected prior to the start of the mission.

FAILURE, TRAIN DELAY: A Train Delay Failure is a component failure that causes a train a delay of more than 5 minutes and 59 seconds.

FIRST ARTICLE: The first unit of any production component of the car that is produced in accordance with approved drawings.

FIRST ARTICLE INSPECTION (FAI): An extraordinary inspection of a First Article, which accomplishes two purposes:

- Observation in three dimensions by the Engineer, the Contracting Officer, etc., to see what could be seen only on drawings up to that point. If the First Article Inspection is of a component that the Contractor is purchasing, rather than manufacturing, the First Article Inspection discloses details that were not previously visible. The First Article Inspection is usually the first point at which maintainability of the component can be evaluated, inasmuch as it is the first point at which relationships between elements can be discerned. The Engineer may approve the design that is revealed at the First Article Inspection, or may require changes in order that the component can meet the requirements of the Contract. The first article inspection can be performed only if the design drawings for the subject article have been approved by SFMTA.
- Establishes the level of the quality of workmanship that will be maintained for the balance of the components.

FULL MAINTENANCE: All servicing and repairs as required by the manufacturer's maintenance manuals, including cleaning and repairs due to accidents.

GAUGE, TRACK: The distance between the inside face of rails, usually measured 5/8 inch below the top of the centerline of heads of running rails and at a right angle thereto.

GENERAL TERMS: Whenever the words "acceptable," "approved," "submitted," "designated," "established," "permitted," "required," "satisfactory," "suitable," "unacceptable," "unsatisfactory," or "unsuitable" are used they shall be understood to imply "by SFMTA" or "to SFMTA" unless the context clearly indicates a different meaning. Whenever the verbs "submit," "designate," "notify," "bear," "use," "furnish," "install," "comply," and other like verbs are used, without being preceded by a subject, it shall be understood that the subject is the Contractor and the action is to be the responsibility of the Contractor unless the context clearly indicates a different meaning.

HIGH VOLTAGE: See PRIMARY POWER

INDICATED: As described in the Specifications, or as required by the other contract documents.

INSPECTOR: The person or firm designated by SFMTA as its quality assurance representative.

INTERCHANGEABLE: A condition where two or more modules of similar or different design perform identical functions and have identical interface characteristics.

INTERFACE: The points at which two or more systems, subsystems, or structures meet, transfer energy, or transfer information.

ITEM: A non-specific term used to denote any portion of the vehicle or car, including software. The Item Levels used by SFMTA from the simplest to the more complex are as follows: part, component, assembly, subsystem, system, and car.

INTERLOCK: A condition whereby one function is dependent on the operation of another function.

LEAD CAB: The controlling cab in a consist.

LEAD CAR: In the direction of travel, the forward-most car of the consist.

LEFT HAND: Left side of the transit vehicle when one looks toward the operator's end from inside the vehicle.

LIGHT RAIL VEHICLE: A light rail car whose configuration and performance are described by these specifications.

LINE REPLACEABLE UNIT (LRU): A unit which is designated by the maintenance plan to be removed upon failure from a larger entity (assembly, subsystem, system or car) and replaced to return the car to a serviceable condition.

LOWEST LEVEL REPLACEABLE UNIT (LLRU): The lowest LRU which is designated by the maintenance plan to be removed upon failure from a larger entity (assembly, subsystem, system or car) and replaced to return the car to a serviceable condition.

LOAD WEIGHING: A function that measures transit vehicle weight to permit control of tractive effort in order to achieve a constant effort-to-weight ratio.

LOW VOLTAGE: The voltage used for most auxiliary equipment on the vehicle, usually between 24 and 72 volts DC or 110 to 240 volts AC.

MASTER RESOLUTION LIST: Master list of engineering resolutions during design review.

MAINTAINABILITY: A measure of a vehicle's ability to be properly maintained, taking into account the ease and frequency of maintenance tasks, ability to efficiently use applied labor, and accessibility of equipment to be maintained by the maintenance staff.

MAINTENANCE, ACTIVE (AM): All tasks associated with the troubleshooting and isolating of a Failure or problem down to a single faulty item that must be repaired, replaced, or temporarily disabled.

MAINTENANCE, CORRECTIVE (CM): All tasks associated with the restoration of an item to an operational status due to an unscheduled event, such as failure, accident, damage, act of nature, or similar event, or other maintenance tasks that must be done.

MAINTENANCE, PREVENTIVE (PM): All maintenance tasks associated with the performance of scheduled activities to cars, subsystems, equipment or facilities. This activity may consist of Servicing and Inspections (S&I), Life Cycle Maintenance (LCM), equipment overhaul, or functional checks of operating systems.

MAINTENANCE, RESTORATION (RM): All tasks associated with the restoration of an item to an operational status following Active Maintenance (AM), including removing and replacing the faulty item, and performing functional checkout to verify the restoration to operational status.

MAINTENANCE TIME, ACTIVE (TAM): The summation of elapsed time in person-hours actively expended during Active Maintenance after the car has been appropriately located and all tools and parts are on-hand at the work location.

MAINTENANCE TIME, CORRECTIVE (TCM): The summation of Active Maintenance Time (TAM) and the Restoration Maintenance Time (TRM).

MAINTENANCE TIME, RESTORATION (TRM): The summation of elapsed time in person-hours actively expended during Restoration Maintenance after a car has been appropriately located for the work to be performed and all tools and parts are on-hand at the work location.

MEAN DISTANCE BETWEEN FAILURES (MDBF): A measure of reliability of a car expressed as the mean operating distance mileage traveled between relevant delays.

MEAN DISTANCE BETWEEN COMPONENT FAILURE (MDBCF): A measure of reliability of an item expressed as the mean operating mileage traveled between all relevant component failures.

MEAN DISTANCE BETWEEN SERVICE FAILURES (MDBSF): A measure of reliability of an item expressed as the mean operating mileage traveled between all relevant service failures.

MEAN TIME BETWEEN FAILURES (MTBF): A measure of reliability of a car expressed as time durations between relevant failures.

MEAN TIME TO REPAIR (MTTR): A measure of maintainability defined as the time required to restore a car system or car to proper operating condition.

MICROPROCESSOR: All embedded systems, digital signal processors, and microcontrollers.

MILEAGE, OPERATING: The total distance traveled by the car during scheduled and unscheduled movements over established routes as recorded by SFMTA.

MISSION: A one-way trip from the beginning terminal to the destination terminal as defined by SFMTA.

MULTIPLE UNIT: Two or more cars.

NO-MOTION: The status of the car when the velocity is less than a nominal 1 mph. The no-motion status shall be lost when the train is accelerated above a nominal 3 mph.

NOISE: Sound pressure level (SPL) or sound level as defined in ANSI Standards S1.2 and S1.13.

NORMAL OPERATING CONDITIONS: The actual conditions the cars shall be subject to within the SFMTA operating environment. Normal Operating Conditions includes revenue service, non-revenue service, daily inspections, periodic inspections and powered down storage.

OPERATOR: Individual on board who is responsible for train operation in manual modes and for overseeing train operation in the automatic mode.

OVERHEAD CONTACT SYSTEM (OCS): A system of overhead contact and support wires used to supply electrical power to LRV trains.

PANTOGRAPH: A device used for current collection from a catenary system. It consists of a dual-strip electrical collection shoe carried by a collapsible and adjustable frame.

PERFORMANCE: The measure of output or results obtained by a component, system, person, team, and so forth, as specified.

PRIMARY POWER: High-voltage DC power supplied to the transit vehicle via the interface between the current collector and the overhead contact wire.

PROPERTY: A transit agency or system.

READY-TO-RUN (RTR): A complete car, fully equipped and outfitted for passenger service.

REDUNDANCY: The existence of more than one means of accomplishing a given function.

RELIABILITY: The probability of a component, system, or car performing a specified function without failure and within design parameters, for the period of time intended, under normal operating conditions.

REQUIREMENTS: The criteria that must be met in designing the transit vehicle.

REVENUE SERVICE: Service on routes established for train use by the public.

RIGHT HAND: Right side of the transit vehicle when one looks toward the operator's end from inside the vehicle.

ROLL, BODY: The number of degrees in an area, having its base at top-of-rail height and at the centerline of the track, swept by a point in the center of the roof as the vehicle sways from side to side during normal running at any speed on level tangent track.

SAFETY CRITICAL: Any condition, event, operation, process, component, assembly, subsystem, or system, the failure or malfunction of which can result in severe injury, severe occupational illness, or major damage.

SFMTA-SUPPLIED EQUIPMENT: Equipment furnished by SFMTA to the Contractor for installation in or on the transit vehicle.

SERVICE PROVEN: Car Components, Assemblies, Subassemblies or Systems which offer a demonstrated history of satisfactory performance defined by SFMTA in commuter rail service with a high level of availability under duty cycle and environmental conditions similar to those encountered in SFMTA operations.

SHIPMENT: The physical departure of the car from the Contractor's facility to SFMTA.

SHOP DRAWINGS: Drawings or sketches prepared by the Contractor for use in its manufacturing or other activities.

SLIDE, WHEEL: The condition in which the equivalent linear velocity of the wheel is less than the linear velocity of the transit vehicle.

SPECIFICATIONS: The directions, provisions, and requirements contained or referred to herein, together with all written agreements made, or to be made, that pertain to the manner of performing the work, or the quantities of work and materials, to be provided under the contract.

STANDARD TRAIN: For performance test purposes, a specific consist size, configuration, and load.

SUBSYSTEM: A portion of a System defined in the Technical Provisions and refined in the design process consisting of Parts, Components and/or Assemblies.

SYSTEM: A set of subsystems, assemblies and components that provide the functions as described in sections TP01 through TP26 of the Technical Provisions.

TRACTIVE EFFORT: The horizontal force that is measured at the wheel-rail interface.

TRACTIVE EFFORT SIGNAL: Linear analog signal that effects continuous proportional control of the tractive effort.

TRAINLINE: The means of sending a signal to all transit vehicles in a consist via a continuous electrical or fluid circuit connected through appropriate coupling devices.

TRAM: A condition of ideal truck geometry in which the axles are perfectly parallel and the wheels longitudinally in perfect alignment. The centers of the journal bearings represent the corners of a perfect rectangle. Tram is checked by measuring the diagonal and longitudinal distances between reference points on the axle bearing housings.

VITAL: A function or a unit which is critical to overall system safety and which, if not designed, processed, or treated correctly, may cause a hazard. The probability of an unsafe failure must be statistically inconsequential.

WATERPROOF: The design, construction, and/or treatment of a device, component, apparatus, or structure that allows the device, component, apparatus, or structure to operate or function normally with its intended level of reliability for the duration of its design life without detrimental effect from the presence of moisture or water resulting from leakage or condensation in its operating or functional environment.

WATERTIGHT: The design, construction, and/or treatment of a device, component, apparatus, or structure that precludes the entrance of moisture or water into that element under any and all operating, maintenance, servicing, and test conditions for the life of the device, component, apparatus, or structure.

WARRANTY CLAIM REVIEW BOARD (WCRB): Representatives from both the Contractor and SFMTA who as formal participants determine the need for and depth of failure analyses and corrective actions. The WCRB shall also classify failure types.

WEATHERPROOF: The design, construction, and/or treatment of a device, component, apparatus, or structure shall be able to withstand any and all exposure to all weather conditions without damage or malfunction.

WEIGHTS, ACTUAL: The measured weights of finished transit vehicles ready to run.

WEIGHTS, ASSIGNED: The loaded transit vehicle categories assigned as the basis for system design and for subsystem and transit vehicle testing. Four weight categories are assigned:
AW0 Empty transit vehicle weight
AW1 Empty transit vehicle weight plus passenger seated load
AW2 Empty transit vehicle weight plus passenger seated and normal rated standing load
AW3 Empty transit vehicle weight plus passenger seated and full rated standing load.

ZERO SPEED: Vehicle velocity of less than 2 mph for more than 1 second.

TP01.03 ABBREVIATIONS

The abbreviations provided in this Section supplement and complement those included in the General Provisions. The following is a list of abbreviations used in the Technical Provisions. The list is provided as information and is neither intended to be all inclusive nor are all abbreviations necessarily used herein.

AAR	Association of American Railroads
AATCC	American Association of Textile Chemists and Colorists
AC	Alternating Current
ACL	Access Control List
ADA	Americans with Disabilities Act of 1990 as amended.
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMP	Amperes
ANSI	American National Standards Institute
APS	Auxiliary Power Supply
APTA	American Public Transportation Association
APU	Auxiliary Power Unit

AREA	American Railway Engineering Association
AREMA	American Railway Engineering and Maintenance of Way Association
ASC	Automatic Speed Control
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATCS	Automatic Train Control System
ATS	Automatic Train Stop
AWG	American Wire Gauge
AWS	American Welding Society
BIL	Basic Insulation Level
BNC	Baby "N" Connector
BTE	Bench Test Equipment
BTL	Battery Trainline
C	Degree Celsius
CDB	Degrees Celsius Dry Bulb
CWB	Degrees Celsius Wet Bulb
C	Capacitance
CAD	Computer Aided Design
CDRL	Contract Deliverable Requirement List
CER	Critical Engineering Review
cfm	Cubic Feet per Minute
CM	Corrective Maintenance
CMP	Configuration Management Control Plan
CN	Car Network
CNC	Car Network Controller
COTS	Commercial Off The Shelf Software
CPM	Critical Path Method
CQP	Contract Quality Plan
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
CRF	Critical Radiant Flux
CS	Communication System
CSS	Cab Signal System
DAU	Data Acquisition Unit
dB	Decibel
DB	Dry Bulb
dBA	Decibel, A-Weighted Scale
DBU	Disc Brake Unit
DC	Direct Current
DCN	Data Car Network
DCS	Door Control System
D_s	Specific Optical Density
DTN	Data Trainline Network
E	Modulus of Elasticity
ECR	Engineering Change Request
ECU	Electronic Control Unit
EEPROM	Electrically Erasable Programmable Read Only Memory
EIA	Electronic Industries Association
EMC	Electromagnetic Control
EMCP	Electromagnetic Compatibility Plan

EMI	Electromagnetic Interference
EP	Electro Pneumatic
EPIC	Electro-Pneumatic Integrated Control
EPROM	Erasable Programmable Read-Only Memory
ERTIS	En-Route Transit Information System
ESD	Electrostatic Discharge
F	Degrees Fahrenheit
FDB	Degrees Fahrenheit Dry Bulb
FWB	Degrees Fahrenheit Wet Bulb
FAI	First Article Inspection
FBCU	Friction Brake Control Unit
FAP	Frequency Allocation Protocol
FAR	Federal Acquisition Regulations
FCC	Federal Communications Commission
FDA	Food and Drug Administration
FEA	Finite Element Analysis
FMECA	Failure Mode Effects and Criticality Analysis
FTA	Federal Transit Administration
fpm	Feet Per Minute
FRACAS	Failure Reporting and Corrective Action System
FRP	Fiberglass Reinforced Plastic
g	Gravitational Acceleration
GP	General Purpose
GPS	Global Positioning System
GTO	Gate Turn-Off
HAZ	Heat Affected Zone
HCFC	Hydrochlorofluorocarbon
HDLC	High Level Data Link Control
HEP	Head End Power
HFC	Hydrofluorocarbon
HP	Horsepower
HVAC	Heating, Ventilation, and Air Conditioning
Hz	Hertz
I/O	Input/Output
IC	Integrated Circuit
ICEA	Insulated Cable Engineers Association
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IEM	Interactive Electronic Manual
IES	Illuminating Engineering Society
IFD	Indentation Force Deflection
IGBT	Insulated Gate Bipolar Transistor
IPC	Institute of Printed Circuits
IPS	Iron Pipe Size
ISO	International Standards Organization
I_s	Flame Spread Index
JEDEC	Joint Electronic Device Engineering Council
kHz	Kilohertz
kVA	Kilovolt Ampere
kW	Kilowatt

LAN	Local Area Network
LAHT	Low Alloy High Tensile Strength (Steel)
lb	Pounds
lbf	Pounds Force
LCD	Liquid Crystal Display
LDTS	Local Diagnostic and Test System
LED	Light Emitting Diode
LRU	Line Replaceable Unit
LLRU	Lowest Level Replaceable Unit
LVDB	Low Voltage Distribution Bus
LVDN	Low Voltage Distribution Network
LVPS	Low Voltage DC Power Supply
MC	Master Controller
MDBF	Mean Distance Between Failure
MDS	Monitoring and Diagnostics System
MDU	Maintenance Display Unit
MHz	Megahertz
MIL	Military Specification
mph	Miles Per Hour
mphps	Miles Per Hour Per Second
mphpsps	Miles Per Hour Per Second Per Second
MRB	Material Review Board
MS	Margin of Safety
ms	Millisecond
MS-DOS	Microsoft Disc Operating System
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
MU	Multiple-Unit
ΦA	Micro Ampere
NBS	National Bureau of Standards
NBR	Net Braking Ratio
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
NFL	No Field Lubrication
NFPA	National Fire Protection Association
NTP	Notice to Proceed
OD	Outside Diameter
ODK	Operator's Display Keyboard
OEM	Original Equipment Manufacturer
OHDS	Overhead Heat Duct Sensor
OSHA	Occupational Safety and Health Administration
PA	Public Address
PC	Printed Circuit
PCB	Printed Circuit Board
PCMCIA	Personal Computer Memory Card International Association
PCU	Pneumatic Control Unit
PDE	Portable Diagnostic Equipment
PEI	Passenger Emergency Intercom
PER	Preliminary Engineering Review
PFC	Pulling Face of Coupler

PHA	Preliminary Hazard Analysis
PIV	Peak Inverse Voltage
PLDS	Passenger Load Determination System
ppm	Parts Per Million
PROM	Programmable Read-Only Memory
PS	Pressure Switch
psi	Pounds Per Square Inch
psia	Pounds Per Square Inch, Absolute
psig	Pounds Per Square Inch, Gauge
PTE	Portable Test Equipment
PTFE	Polytetrafluoroethylene
PTS	Positive Train Separation
PTU	Portable Test Unit
PWM	Pulse Width Modulation
QA	Quality Assurance
R-C	Resistive-Capacitive
RAM	Random Access Memory
RFI	Radio Frequency Interference
RH	Relative Humidity
rms	Root Mean Square
ROM	Read-Only Memory
rpm	Revolutions Per Minute
SAE	Society of Automotive Engineers
SBCO	Service Brake Cutout
SCCO	Speed Control Cutout Switch
SCE	Software Capability Evaluation
scfm	Standard Cubic Feet Per Minute
SCI	Software Configuration Item
SCR	Silicone Controlled Rectifier
SCS	Speed Control System
SDD	Software Design Description
SDU	Speed Display Unit
SFMTA	San Francisco Municipal Transportation
SIC	Standard Industrial Code (U.S. Department of Labor)
SPL	Sound Pressure Level
SSP	System Safety Program
S&I	Service and Inspection Facility
S/N	Signal-to-Noise Ratio
T_s	Ambient Temperature
T_i	Interior Temperature
TBU	Tread Brake Unit
TDMS	Train Data Monitoring System
TFE	Tetrafluoroethylene
TIG	Tungsten Inert Gas
TIR	Total Indicated Runout
TLDS	Train Level Diagnostic System
TN	Train Network
TOR	Top-of-Rail
TWC	Train-to-Wayside Communications
TXV	Thermal Expansion Valve

UA-Factor	Total Carbody Heat Transmission Value
UL	Underwriters Laboratories Inc.
UN	Unit Network
UNC	Unified National Coarse (Thread)
UNF	Unified National Fine (Thread)
URL	Uniform Resource Locator
US	United States
USASI	United States of America Standards Institute
USB	Universal Serial Bus
USDOT	United States Department of Transportation
UV	Ultraviolet
V AC	Volts, Alternating Current
V DC	Volts, Direct Current
VMU	Vehicle Monitoring Unit
VOM	Volt/Ohm Meter
VPI	Vacuum Pressure Impregnation
Vp-p	Voltage peak-to-peak
VSWR	Voltage Standing Wave Radio
W	Watt
WB	Wet Bulb
WCRB	Warranty Claim Review Board
WMDS	Wayside Monitoring and Diagnostic Systems
WPS	Weld Procedure Specifications

TP01.04 RESPONSIBILITIES OF THE CONTRACTOR

A. General

The Contractor shall submit a complete Master Program Schedule to the Engineer for review and approval no later than 60 days after Notice to Proceed (NTP) and provide monthly updates thereafter as outlined in Section 1.04J of these Technical Provisions **[CDRL 1-001]**.

With respect to the five systems being rebuilt or replaced, the Contractor shall be directly and exclusively responsible for the proper interrelational functioning and system integration. The Contractor shall perform all necessary detail and design work required for any new system elements, and shall prepare all necessary detail drawings, design calculations, other specified technical documentation, and Contract-required submittals. The Contractor shall submit such additional or revised drawings, diagrams, calculations, test results, and demonstrative evidence as the Engineer deems necessary to confirm the completeness and accuracy of Contractor's submittal. See individual work scope sections for specific CDRL items.

Copies of Purchase Orders (which may have prices deleted) and revisions to purchase orders for all major items of equipment, as determined by the General Provisions, shall be submitted to the Engineer on an ongoing basis, no less frequent than every 30 days **[CDRL 1-002]**.

B. Drawings and Other Relevant Documents

1. SFMTA-Supplied Drawings and Manuals

SFMTA will make existing system drawings and maintenance manuals, prepared by the vehicle manufacturer (Ansaldo Breda) and their sub-suppliers. It is the responsibility of the Contractor to verify the accuracy of these documents.

2. Contractor's Drawings and Manuals

The Contractor shall develop and submit to the Engineer for review and approval detailed design of any system or component that is intended to replace existing systems or components. Any new manuals or modifications to existing manuals to reflect the new system configuration shall be submitted for review and approval. See individual work scope sections for specific CDRL items.

C. Design Approval

1. General

The Contractor shall conduct formal design review meetings with the Engineer for any new design elements. The purpose of these meetings will be to ensure that the requirements of the Technical Provisions are met by the design. The schedule for design review meetings shall be included in the Master Program Schedule. A minimum of two reviews, preliminary and final, shall be conducted. With approval of the Engineer, the design review process may also incorporate the drawing review approval process.

The Contractor shall not release any design for manufacture before the approval of the final design by the Engineer. Approval of a design by the Engineer shall not relieve the Contractor of responsibility for the design and construction of the cars to comply with all requirements of the Contract.

D. Reports

The Contractor shall submit the required reports and submittals in compliance with the format and content specified throughout these Technical Provisions. If a cited reference is not readily available to SFMTA, the Contractor shall provide the reference or copies of the pertinent pages. All references shall be in English. If an English reference cannot be found, an English translation shall be provided, and both the original and the translation shall be included in the report.

E. First Article Inspection (FAI)

As a minimum, the Contractor shall perform First Article Inspections (FAIs) on each rebuilt system or new/replacement system. See individual work scope sections for specific FAI CDRL items. Multiple FAIs must be performed to demonstrate the various unique door/step systems by location and car type.

First Article Inspections shall also evaluate component and system maintainability. FAIs shall be performed only on components built using approved production processes and tooling, and shall establish the standard of quality of workmanship for the balance of like components.

SFMTA shall have the option of witnessing any or all FAIs.

In the event the Contractor schedules Type (Qualification) Testing immediately preceding an FAI or in conjunction with the FAI, the Type Test Procedures shall be submitted to the Engineer for review and approval no less then 30 days prior to testing.

Prior to conducting any Routine (Production) Tests, the Contractor shall have conducted and successfully passed the corresponding Type Tests, and received approval of the Test Report from SFMTA.

An FAI will not be approved by the Engineer until the requisite Type Test and Routine Test are completed and approved by the Engineer.

F. Quality Assurance

An audit of the Contractor's Quality Assurance Program may be conducted by SFMTA and/or the Engineer prior to issuance of the Purchase Order. The Contractor shall establish and maintain a Quality Assurance (QA) program as described in TP09 and in compliance with ISO-9001 or ANSI/ASQC-Q91 or equivalent. The program shall ensure compliance with the requirements of the Contract and shall include provisions for ensuring Contract compliance by subcontractors, suppliers, and manufacturers.

Work undertaken by the Contractor or any of its subcontractors or suppliers before review and approval of the QA Program by the Engineer will be at the Contractor's risk and expense. The Contractor's approved QA Program shall not be changed without the approval of the Engineer. Work undertaken by the Contractor before receipt of written approval from the Engineer will be at the Contractor's risk and expense.

The implementation of any aspect of the Contractor's operation as it relates to Quality Assurance or the QA Program shall be subject to verification by the Engineer at any time. Verification shall include, but not be limited to: audit of the quality assurance program; surveillance of the operations to determine that practices, methods, and procedures of the program are being properly implemented; inspection to measure the quality of items offered for acceptance; and inspection of items prior to release for shipment to ensure compliance with requirements of the Contract. These requirements do not imply that the SFMTA Inspector or the Engineer will be considered a level of Quality Assurance for the Contractor.

Failure by the Contractor to promptly correct deficiencies following notification by the Engineer may be cause for suspension of the work until corrective action has been taken or until conformance of items to prescribed criteria has been demonstrated to and approved by the Engineer.

G. Testing

The Contractor shall perform or arrange for the performance of all tests listed in TP10. No test shall be conducted without prior approval of the procedure for such test. If the Contract Documents, laws, ordinances, rules, regulations, and orders of any public authority having jurisdiction require any portion of the procurement process or products to be inspected, tested, and approved, the Contractor shall:

H. Subcontracts

I. Master Program Schedule

The Contractor shall develop and submit a Master Program Schedule for review and approval no later than 60 days after NTP. The program schedule shall identify all milestones, the earliest and latest possible dates for accomplishing each milestone, the shortest and longest permissible time span between each dependent milestone, and major and minor paths which are critical for accomplishment of program objectives. The initial baseline schedule shall be maintained for the duration of the contract for review. A complete CDRL list with proposed delivery dates shall also be provided.

The Master Program Schedule shall be monitored and controlled by the Contractor's management team responsible for all management functions and shall be updated and submitted to the Engineer for review and approval at least monthly for the duration of the project.

TP01.05 DRAWINGS

A. Approval Drawings

While it is recognized that most of the drawings required for this project exist, the Contractor, in compliance with the approved Master Program Schedule, shall submit in electronic form to the Engineer for review and approval each new drawing required by the Technical Provisions or necessary to demonstrate compliance with the Technical Provision requirements. Each drawing shall be provided as an AUTOCAD 2000 drawing with *.DXF or *.DWG file extensions or other format as approved by the Engineer. Review and approval of the Contractor's submittals shall be attained before beginning any manufacture. Sufficient drawings shall be submitted to convey concept, design, dimensions, operation, maintenance, overall assembly, and interfaces for any new design work. Detailed part drawings shall be submitted for any new assemblies, as well as arrangements and details of all apparatus, including apparatus within equipment boxes. Outline or incomplete drawings will not be acceptable. These conditions shall also apply to subcontractor-furnished material and components **[CDRL 1-010]**.

The Contractor shall provide an indexed drawing database listing all drawings in an electronic format in Microsoft Excel or approved equal, containing information on all drawings. The database shall include the builder's and manufacturers' drawing numbers and shall be arranged in ascending order and embody the following information:

Drawing Size	Electronic File	Blank (SFMTA use)

	Location	
Drawing Number	System	System Identity
Revision Number	Number of Sheets	Drawing Title
Issue Date	Company Name	Revision Date

This database file shall be uploaded to the Project Extranet. This database shall be continuously maintained and kept current **[CDRL 1-011]**. The database shall be compatible with the capabilities of the Extranet in that by accessing the database on the Project Extranet, the user shall be able to search the database in a variety of linear and non-linear ways, depending on the user's starting point. The user shall be able to browse the database and search for files by system, manufacturer, drawing title (both by keyword and text string) and, drawing number. When the desired drawing file is located, the user shall be able to locate and view the electronic file within the Project Extranet. The Project Extranet shall also contain all other project related documentation such as letters and submittals.

Within 60 days after NTP, the Contractor shall submit to the Engineer a fully functioning database with all capabilities described above for review and approval. The database shall represent all drawing types and shall be subject to Engineer approval.

The Engineer will review all drawings submitted. All submitted drawings will be documented as Approved, Conditionally Approved, or Disapproved, along with appropriate comments. The Engineer will formally document the status of each drawing within 30 calendar days of the date the drawing is electronically transferred to the Project Extranet. The Contractor shall not proceed with procurement or manufacture of systems or components until the respective drawings have been approved unless specifically authorized to do so by the Engineer in writing. If the Contractor chooses to proceed regardless of approval or authorization by the Engineer, it shall do so at its own risk.

Conditionally Approved and Disapproved drawings shall be resubmitted by the Contractor after revision for review and approval by the Engineer. All details of drawings affected by any change shall be highlighted when resubmitted to the Engineer for review and approval.

Drawings submitted by subcontractors or suppliers shall be thoroughly reviewed and approved by the Contractor to ensure that they meet Contract Documents (as to form, fit, and purpose) and the Technical Provisions requirements before submittal to the Engineer for review and approval.

B. Submittal Form

All submissions shall be properly referenced to clearly indicate the location, service, and function of each particular subject, and shall include the proper references to the appropriate Technical Provisions section including drawing numbers and details. Where the manufacturer's publications, in the form of catalogs, pamphlets, or other data sheets, are submitted in lieu of prepared shop drawings, such submissions shall specifically indicate the item for which approval is requested. Identification of items shall be made in ink. Submissions showing only general information will not be acceptable.

The dimensions on all drawings shall be expressed in the English system; the wording on all drawings shall be in the English language. All terminology used on drawings and in correspondence shall be conventional to the North American railroad industry. Where temperatures are expressed in both Fahrenheit and Celsius, the value in parentheses is for reference only; compliance with the Technical Provision shall be measured in terms of the value first stated, whether Fahrenheit or Celsius.

Drawings shall be made to the third-angle projection system. All submitted drawings shall be full size to the scale specified on the drawings. Reduced size copies will not be permitted. Every drawing shall include a complete bill of material and parts list in the field of the drawing or on a separate sheet of the same drawing. All parts or subassemblies, including subcontractor-furnished items, which form a part of the assembly, subassembly, or piece depicted, shall be described. All drawings shall reference the number of the drawing of the next higher subassembly or assembly on which it is used. This requirement does not apply to standard hardware or electrical and electronic components. Final drawings shall be of not more than four standard sizes, with "D" size as the largest drawing permissible size. "E"-size drawings shall be used only during design reviews.

Revisions to drawings and drawing change orders affecting previously submitted drawings shall be re-submitted for approval as they are issued. No more than three revisions shall remain unincorporated on any drawing at any time.

Drawings on which changes have been made, even though less than three, shall be revised to incorporate those changes no less frequently than at 60 day intervals. The revision block shall describe the details of the changes made by that revision, or, in lieu of detailed descriptions, the numbers of the applicable drawing change orders may be used. In the latter case, the drawing change orders shall have been submitted no later than the time of submittal of the revised drawing. The details of all changes shall be highlighted on the drawing(s) sent to the Engineer for review and approval. Alternate methods shall be subject to approval by the Engineer.

Approval of a drawing does not relieve the Contractor of its obligation to meet all requirements of the Contract. Approval of a drawing which contains a deviation from, or breach of, the Technical Provisions does not constitute authority for that deviation or breech unless such deviation has been specifically requested in writing and approval granted in writing according to Contract requirements separate from the drawing approval process.

All requests for deviations from approved drawings shall be submitted, reviewed, and approved by the Engineer prior to release of the drawing for installation.

Each Engineering Change, Deviation, Material Review Board (MRB) repair, or similar variance affecting form, fit, or function shall be incorporated on the affected drawings when it applies to two or more cars of LRV design. Such drawings shall be clearly labeled with the SFMTA car numbers that apply to each configuration. Those variances applying to fewer than four cars may also be incorporated on the affected drawings or the variances may be furnished separately. If furnished separately, they shall also be described in the Car History Book (TP01.06) for each car involved with cross reference to the affected drawings.

If the Contractor's drawing system is such that drawings of details are not included in assembly, sub-assembly, and arrangement drawings as described above, the Contractor shall submit copies of all detail drawings to the Engineer. The Contractor shall maintain all drawings for a period of 30 years. The Contractor shall make available, without charge, for a minimum of five years from the date of acceptance of the last car, drawings of any details required for extraordinary repairs arising from accidents or mandated or unanticipated changes. During the remaining 25 years of drawing availability, SFMTA shall be provided with all requested drawings at cost.

The submittal of electronic files of all drawings, letters, attachments, CDRL's, and other documents shall be via the Project Extranet. The Project Extranet shall be a designated URL address on the World Wide Web (www) to which all submittals to the Engineer will be uploaded. All electronic transmittals from SFMTA or the Engineer to the Contractor will be via the Project Extranet.

C. Contract Drawings

The Contractor shall submit to the Engineer for review and approval, within 60 days after completion of the first car, upon completion of the last car, and then again after completion of all modifications, a list of all "as-built" drawings to be supplied in accordance with this Section. The as-built drawings shall include one set of hard-copy prints and two sets of electronic media files, supplied on CD-ROM in AUTOCAD 2000 (*.DXF, *.DWG) format or approved equal of the following drawings **[CDRL 1-013]**:

1. Drawings of any new assemblies, subassemblies, and changes to arrangements of the cars, as finally manufactured and modified.

2. All detail drawings of those assemblies, subassemblies, and arrangements.

3. A complete indented bill of material for all assemblies, subassemblies, and arrangements for systems that have changed.

4. If necessary, a revised final integrated electrical schematic, wiring diagram, and wire list defining all wiring and electrical apparatus.

5. All approved detailed Contractor and subcontractor drawings.

The as-built drawings shall incorporate all engineering and manufacturing changes. Deviations shall also be incorporated, with copies provided in a separate indexed section.

The Contractor shall provide to the Engineer and SFMTA, at no additional cost, at any time requested prior to delivery of the reproducible drawings, working drawing prints in electronic files to enable the maintenance staff to maintain, service, and repair the cars. The Contractor shall also provide the Engineer, within 60 days after delivery of the first vehicle, a list of all drawings to be supplied to the Engineer and SFMTA which may be needed to perform extraordinary repairs **[CDRL 1-014]**.

The electronic version of the Contract drawings shall be provided in an AUTOCAD or approved equal format that allows the maintenance staff to update the drawings to

incorporate enhancements and product improvements developed after completion of the work and warranty period.

TP01.06 CAR HISTORY BOOKS

The Contractor shall furnish to SFMTA electronic and paper copies of pages to be added to existing Car History Books per car at the time of issuance of an Approved for Revenue Service Certificate for each LRV. Updates must be made to the following sections as appropriate based on the work performed:

1. Car Number.
2. Written report of each test performed on the car and its apparatus.
3. Serial numbers of all required components.
4. All approved contract changes, engineering changes, and deviations incorporated into the car which are not incorporated on all cars.
5. All modifications to the car that are not incorporated on all the other cars. Repair, rework and modifications that are specific to one or more cars but not to all cars.
6. List of all MRB repairs applying to the car.
7. Copy of each test report log sheet for all tests performed on equipment on the car and the car.
8. Any other information required by the Technical Provisions to be in the Car History Book.

The Car History Books shall be kept up-to-date by the Contractor and shall record all changes, retrofits, and additions made to each car until completion of the base warranty period **[CDRL 1-015]**.

TP01.07 INTEGRATED MANAGEMENT PLAN

A. General

The Contractor shall develop a Management Program Plan per requirements in this section with adequate details even if the specifics are not identified herein. This applies to but is not limited to all correspondence, Schedule, meetings, systems engineering/integration, configuration control, Weight Control Program, inspections, testing, compliance with regulations/requirements/codes, Quality Assurance/Quality Control (QA/QC) Program, Safety Program, Submittals, Acceptance, and Warranty.

Upon written request by the Contractor, SFMTA shall make the drawings and schematics for the vehicles available to the Contractor. SFMTA does not guarantee nor confirms the accuracy of these documents and the Contractor shall thoroughly inspect the vehicles to verify the accuracy of the drawings. For all such inspection and verification activities, the Contractor shall provide a written request at least one (1) week prior to the inspection date.

B. Pre-Bid LRV Inspections

The Contractor shall be given opportunity to review selected LRVs in the SFMTA's maintenance facility prior to bidding. Based on these inspections, the Contractor shall assess the vehicle conditions. Any issues, discrepancies, and problems noticed during this inspection shall be promptly brought to the SFMTA's attention. Based on the significance of the findings, the SFMTA may choose to issue an addendum to this RFP.

C. Correspondence and Communications

The Contractor shall submit all communications in writing on letterhead to the SFMTA. Verbal and informal communications shall not be considered contractually binding. All contractual documents shall be mailed to the address below:

Attention: TBD
San Francisco Municipal Transportation Agency (SFMTA)
1 South Van Ness Avenue, 7th Floor
San Francisco, CA 94103

For CDRLs, one (1) original and six (6) copies shall be sent to the address identified above. Special arrangements shall be made for manuals and training materials.

D. Contractor's Management Plan

The Contractor shall submit a detailed Management Plan **[CDRL 1-016]** including the overall organization, planning, schedule, and control of the Rehabilitation Program. The plan shall include sufficient details for SFMTA to comprehend the overall management and control process of the Rehabilitation Program. As a minimum the Contractor shall include the following details in the Management Plan:

i. Approach and methodology to manage the Rehabilitation Program

ii. An organization chart of the team planning to support the vehicle rehabilitation, including resume of the key staff members, and all staff conducting special activities such as Acceptance testing

iii. Detailed description of project schedule activities including methodology to control schedule

iv. Work task breakdown, including activities performed by the Prime and Subcontractors, and system integration in flowchart format

v. A comprehensive Contractual Data Requirements List

vi. Configuration Management Plan for all hardware, software, Submittals, drawings/schematics including description of change/modification control

vii. Systems Engineering and Integration Plan describing in depth the approach to systems engineering and integration process and control

viii. Subcontractor Management Plan identifying the subcontractors, including their organization, role on the Program, QA/QC, configuration control, inspection, and testing requirements compliance

ix. Labeling and Tagging Plan identifying methodology for assembly numbers, part numbers, serial numbers, and numbering system for wiring and harnesses

x. Quality Assurance Program plan for all hardware and software

xi. Inspection and Test Plan for all LRVs and all Subsystems

xii. System Assurance Plan with target reliability, maintainability, availability goals and design means and methods to achieve those goals, and plans for remedial action if goals are not achieved

xiii. Manufacturing Plan for LRVs and all Subsystems including disassembly and rehabilitation process

xiv. A detailed matrix demonstrating compliance with all requirements in the Contractual documents including document references (such as test results/data etc.)

This is a partial list of requirements and the Contractor shall include additional items based on past experience. SFMTA or its designee shall have the liberty to request the Contractor to provide or include additional information as deemed necessary for the rehabilitation program.

E. SCHEDULE

The Contractor shall maintain the Program Management Schedule per Section 1.04J of these Technical Provisions as part of the overall Management Plan. The schedule shall be in a time-scaled, bar-chart format indicating the detailed progress of the Program from the NTP through closeout. The Contractor shall update the schedule and submit it to SFMTA each month based on the progress. As a minimum the schedule shall include the following details:

i. Completed activities and progress during previous two weeks in narrative format and highlighted on the schedule

ii. Planned and actual progress for each unit and each LRV

iii. Key milestones including but not limited to payments, Submittals, deliverables, Approvals, FAIs, static tests, Acceptance tests, delivery, and Acceptance

iv. Planned activities for the next two months

All milestones, start-dates, completion dates shall be consistent with the Contract milestone dates.

F. MEETINGS

The Contractor shall schedule meetings and shall send invitations to SFMTA. The objectives of meetings shall vary but in general meetings shall be held to provide information, discuss an issue, request information, or update SFMTA of the progress. The duration of meetings may vary based on the type of agenda, however, the Contractor shall be responsible for documenting meeting minutes and submitting the minutes to the SFMTA for Approval. The meetings shall include design review meetings, progress update meetings, and other meetings.

1. Design Review Meetings

The Contractor shall schedule and organize design review meetings every four (4) weeks. The Contractor shall develop an agenda and distribute it to SFMTA with at least two (2) weeks of advance notice. The objective of such meetings shall be to update SFMTA on the design process and to facilitate the understanding of Contractor's design. The Contractor shall invite attendees to these meetings and shall record minutes for Approval by SFMTA. The Contractor shall make copies of all necessary documents such as reports, drawings/schematics, and test results as applicable to facilitate the meetings. In an event the issues are not resolved during this meeting the SFMTA shall assign a deadline for resolution, and the Contractor shall update SFMTA.

2. Progress Update Meetings

The Contractor shall schedule and organize progress update meetings every four (4) weeks. The Contractor shall develop an agenda and shall distribute it to SFMTA with at least two (2) weeks of advance notice. The objective of progress update meetings shall be to assess the milestones achieved, the progress made against planned schedule, and to identify schedule slippage and deficiencies. The Contractor shall prepare meeting minutes and shall submit it to SFMTA for review and approval.

3. Other Meetings

Throughout the duration of the Contract, it shall be necessary to hold special meetings to discuss specific issues. Either the SFMTA or the Contractor may initiate such meetings and shall distribute an agenda with one (1) week of advance notice to other party. The Contractor shall record minutes and shall distribute it to SFMTA for approval if deemed necessary by SFMTA.

G. SYSTEMS ENGINEERING AND INTEGRATION

As part of this Contract, the Contractor shall develop a comprehensive and detailed System Engineering and Integration Plan (SEIP) **[CDRL 1-017]**. The plan shall include details of the Contractor's approach to the overall systems engineering and integration process. The SEIP shall include specifics of each subsystem being rehabilitated including

description of tests verifying that the couplers, trucks, air supply units, doors and steps, articulation wires and harnesses interface seamlessly with the existing equipment.

The SEIP shall include specifics on at least the following:

i. Description of general approach to systems engineering and integration to satisfy requirements of LRV Rehabilitation

ii. Subsystem development and interfaces

iii. Hardware and software integration

iv. Subsystem installation and testing

v. Influence of reliability, maintainability, safety, quality control/quality assurance, testing, and human ergonomics in design and maintenance

This is a minimal list and the Contractor shall be responsible for including all pertinent information to SFMTA. If deemed necessary, the SFMTA may request additional information. Throughout the document references shall be made as needed to each Subsystem installation drawings, schematics, installation plans, and other documents as necessary. Generic statement repeating the RFP language shall not be accepted.

H. Configuration Control

The Contractor shall develop and maintain a Configuration Control Plan and a system and shall Submit both to SFMTA for review and approval **[CDRL 1-018]**. The Configuration Control System shall include all details necessary to identify, update, and track modifications, updates, changes to the LRV or its Subsystems. The Contractor shall keep the information and documentation within Configuration Control System up-to-date and shall furnish it to SFMTA upon request for review and Approval.

I. Weight Control Program

The Contractor shall employ a Weight Control Program until the last vehicle is Accepted. As part of this program, the Contractor shall ensure and certify that the vehicle weight has not increased due to the Rehabilitation process. The Contractor shall assess the weight of each subsystem being rehabilitated and shall ensure that the weight does not exceed the original LRV weight. The Contractor shall include results of LRV weighting as part of the Car History Books prior to acceptance of the vehicles.

J. Inspections

SFMTA shall conduct inspections on the vehicles and Subsystems. The intent of such inspections shall be to ensure that the Subsystem design conforms to the requirements identified within these documents. This shall include FAIs, routine in-shop inspections, and special inspections. The inspections shall be conducted at the Contractor's and/or Subcontractor's facilities and at SFMTA's facilities when the vehicles are shipped to SFMTA. The Contractor shall cooperate and support all inspections and shall provide all necessary information to the SFMTA. Inspections at Subcontractor's facilities shall be

conducted with a ten (10) days advance notice, and inspections at SFMTA facilities shall be conducted without notice or with mutual arrangements with Contractor and SFMTA.

K. Testing

The Contractor shall develop a comprehensive and detailed testing program as defined in Section TP10 of these Technical Provision.

L. Industry Standards, Codes, and Regulations

The Contractor shall comply with all applicable requirements such as standards, codes, regulations, laws and requirements whether specified in these documents or not. The Contractor shall ensure that all such requirements are identified within appropriate documents and recorded. Whenever there is a conflict between two requirements, the Contractor shall bring it to SFMTA's immediate attention in writing and the most stringent requirement complying with these technical specifications shall prevail.

M. Quality Assurance/Quality Control (QA/QC)

The Contractor shall develop and maintain a QA/QC Program consistent with Section TP09 throughout the duration of this Contract which shall be binding to all Subcontractors on the team.

N. Labels

The Contractor shall apply labels to all rehabilitated equipment to indicate when it was rehabilitated. The labels shall be of the same type as the OEM labels currently installed on the equipment. The quantity and locations of labels shall be similar to the original labeling arrangement.

TP01.08 DELIVERY AND ACCEPTANCE CRITERIA

A. Test Plans

The Contractor shall submit to the Engineer a Master Test Plan, listing all tests and equipment adjustments required by these Technical Provisions and updated as required throughout the test program. The Test Plan shall cover all supplier and subcontractor tests to be completed at the supplier's or subcontractor's plant, all Contractor tests to be completed at its plant (in order to determine if the car meets the requirements of the Technical Provisions and is fully operational), prior to issuance by the Engineer of a "Certificate of Release for Shipment" and all testing to be conducted on SFMTA property prior to issuance by the Engineer of a "Certificate of Approval for Revenue Service." The plan shall include a plan for correction of defects and deficiencies. CDRLs are identified in Section TP10 of these Technical Provisions.

Should the Test Plan not be adequate and/or fail to meet the requirements of the Technical Provisions, the Engineer will require the submittal of additional plans, details, and schedules to ensure that the program is adequate to meet Technical Provisions requirements. The approval of the Engineer does not in any way relieve the Contractor of responsibility for the adequacy of the program within the scope of the Technical Provisions.

B. Release for Shipment

A "Release for Shipment Certificate" for each LRV shall be submitted by the Contractor for SFMTA signature when all required supplier and Contractor "plant" tests, have been completed, reviewed, and accepted for the car and its equipment in accordance with the Technical Provisions, and when all documentation entered into the Car History Book has been reviewed and approved. A LRV shall not be delivered to SFMT property without a "Release for Shipment Certificate" signed by SMTA. The Contractor shall make any necessary repairs and perform other necessary corrective action so that all Open Items are corrected. **[CDRL 1-021]**

C. Acceptance

An "Acceptance Certificate" for each LRV shall be submitted by the Contractor for SFMTA signature when all tests conducted on SFMTA property are complete in accordance with the Technical Provisions and the required reports have been received and approved, and all outstanding and/or revised CDRLs have been submitted for the LRV. . **[CDRL 1-022]**

TP01.09 CONTRACT DELIVERABLE REQUIREMENTS LIST

CDRL #	Title	Reference Paragraph
1-001	Master Program Schedule	1.04.A
1-002	Purchase Orders	1.04.A
1-010	Approval Drawings	1.05.A
1-011	Drawing Database and Updates	1.05.A
1-013	List Of Contract Drawings	1.05.C
1-014	Contract Drawings	1.05.C
1-015	Car History Books	1.06
1-016	Management Plan	1.07.D
1-017	Systems Engineering and Integration Plan	1.07.G
1-018	Configuration Management Plan	1.07.H
1-021	Release for Shipment Certificate	1.08.B
1-022	Acceptance Certificate	1.08.C

End of Section

TECHNICAL SPECIFICATIONS
(TECHNICAL PROVISIONS)

SECTION TP02

DESIGN CRITERIA

August 28, 2009
Rev. 4 Final

SECTION TP02
DESIGN CRITERIA

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TP02 DESIGN CRITERIA

While the scope of these Technical Provisions limits the amount of design required, it is the responsibility of the Contractor to ensure that all work, including new design and rehabilitation is performed in a manner that is consistent with the SFMTA operating environment. Thus, a select amount of design information is provided in this section, for reference purposes.

TP02.01 MUNI SYSTEM DESCRIPTION

A. General Description

The SFMTA refers to its light rail system as the San Francisco MUNI Metro. The Metro system has five lines which presently operate over 40.8 track miles. Because the lines overlap, they account for a total of 72.5 line miles, as follows:

- J-Church 10.9 line miles
- K-Ingleside 15.6 line miles
- L-Taraval 16.1 line miles
- M-Oceanview 18.2 line miles
- N-Judah 14.0 line miles

B. Operations

The Metro system operates in subway in downtown San Francisco and on surface alignments in San Francisco's other neighborhoods. Patronage averages 135,000 per day, served by a current fleet of 147 light rail vehicles (LRVs). The vehicles operate in one- or two-car consists on surface streets, and in mixed-route consists of up to four cars in the subway (for example, a consist may be composed of one K-line, one L-line, and two M-line cars; or one J-line and two N-line cars). Cars are coupled and uncoupled at tunnel portals located at the intersections of Duboce and Church Streets and Carl and Cole Streets, and at the West Portal.

The subway route is served by nine stations, one of which is at grade (the West Portal Station). At Embarcadero, Montgomery, Powell and Civic Center Stations, MUNI Metro shares station mezzanines with the Bay Area Rapid Transit system, enabling transfers between the two rail systems.

Metro trains begin operation on weekdays at 3:45 a.m., and weekends at 5:00 a.m. Revenue service ends at 12:37 a.m. each night when the last train leaves Embarcadero Station for Metro Center. On weekdays trains operate at 6- to 10-minute headways until 6:00 p.m., at 10- to 20-minute headways until 8:30 p.m., and at 20-minute headways after 8:30 p.m.

Metro trains operate on power supplied by 600-volt overhead lines. The power system is supplied by 12 substations located within the city limits. Each substation, depending on its location, is capable of serving from 2 to 13 feeder sections.

C. Track

The MUNI Metro system incorporates track on reserved surface right-of-way, in tunnels, and on surface streets shared with motor vehicle traffic. Approximately 80 percent of the system is on tangent track. The minimum curve radius is 42 feet, 7 1/2 inches (inside rail). Mainline track superelevation is generally 4 inches in the subway and 1 1/2 inches on the surface. Transition spirals are used on each superelevated curve. Curves within paved streets are not superelevated, unless such is required to meet the street cross section. Curves within the yard are not superelevated. A maximum train speed of 50 miles per hour is permitted in tunnels where conditions allow. Train speed within paved street segments is controlled by vehicular speed limits. All tangent and large-radius curved track is standard 4 foot, 8 1/2 inch gauge. Track gauge is slightly increased on sharp-radius curved track.

Within paved streets, the track profile follows that of the street. Within reserved right-of-way, the track profile also generally follows that of adjacent streets. The maximum grade on the system is 9 percent.

All rail within the system is continuous welded rail, except at the following locations: from Market Street to 18th Street on the J-Church line, and on Ocean Avenue on the K-Ingleside line. Bolted rail is used at these two locations. Standard six-hole insulated joints are used within the system where insulated joints are required.

Most of the special trackwork units have standard rail joints. Some non-insulated joints, however, have been replaced with field welds.

Direct fixation track with fasteners spaced 36 inches apart is used within the Metro subway tunnel. Elsewhere, all MUNI Metro track is either embedded track or tie and ballast track using sawn timber ties spaced 24 inches center-to-center. Special trackwork is fastened and anchored to timber ties (or tie blocks) with standard AREA tie plates, cut spikes, and rail anchors throughout the system.

Switches within the MUNI Metro subway have electrically operated switch machines. Elsewhere switches are manually operated, except for a few switches that are activated by train approach.

Any modifications to vehicle systems shall be designed for normal operation with no interferences over all track on the MUNI Metro system, which has the following general characteristics:

Track gauge	4 ft., 8 1/2 in.
Minimum lateral radius (to centerline)	45 ft., 0 in.
Maximum superelevation	0 ft., 6 in.
Minimum vertical radius, crest	310 ft., 0 in.
Minimum vertical radius, sag	460 ft., 0 in.
Maximum grade	9 percent
Minimum combined lateral and vertical radius	
Lateral	45 ft., 0 in.
Vertical	410 ft., 0 in.

The MUNI Metro system incorporates both AREA and street railway type trackwork. The street railway trackwork includes such features as flange-bearing special work and single point turnouts.

The standard rail for all new tee rail track construction is 100 lb/yd ARA-B in mainline track and 90 lb/yd RA-A in yard track. The standard rails for all new girder rail track construction are 128 and 149 lb/yd RE-7A. Girder rail is used only where the system operates within paved streets. The 128 lb/yd RE girder rail is used on tangent track, and the 149 lb/yd RE girder-grooved rail is used as the inside rail on tight-radius curved track.

D. Structures

Station platform height from top of rail	2 ft., 9 in.
Distance, centerline track to finished edge of platform	4 ft., 8 in.
Station platform length	
(minimum)	300 ft., 0 in.
(maximum)	400 ft., 0 in.

E. Primary Power

Line voltage at the MUNI Metro trolley wire ranges from 450 VDC to a maximum of 750 VDC. Occasional voltage spikes of 1800 volts peak with a duration of 30 milliseconds can be expected.

Vehicle equipment shall be designed and tested for operation at nominal 600 VDC power, but normal voltage variations and power isolation gaps shall not cause damage. Full performance of any vehicle system shall be provided down to 575 VDC. Performance may be degraded between 575 and 450 VDC.

For line voltages outside the normal 450-750 VDC limits, equipment may be designed to shut down or operate at modified performance levels.

Contact wire ranges in height from 12 feet, 2 inches to 19 feet. The wire size is 4/0 grooved.

TP02.02 VEHICLE CHARACTERISTICS

Basic car dimensions are provided for reference purposes. It is the responsibility of the Contractor to verify any dimensions required for design and rehabilitation work.

Length of car on centerline over anti-climbers (maximum)	73 ft., 0 in.
Length of car over coupler pulling faces (maximum)	75 ft., 0 in.±1/2 in.
Distance, center to center of trucks (maximum)	24 ft., 0 in.±3/8 in.
Truck wheel base (maximum)	6 ft., 3 in.
Truck wheel base (minimum)	5 ft., 10.5 in.
Wheel diameter, new wheels	0 ft., 28 in
Wheel diameter, worn wheels (condemning limit)	0 ft., 26 in.
Maximum overall car width at threshold	8 ft., 8 in.

Maximum overall car width at belt line	9 ft., 0 in.
Width of car at front corner posts (maximum)	5 ft., 7 in.
Width of side door openings (hi-low step)	4 ft., 6 in.
Width of left side front door (hi-low step)	3 ft., 0 in.
Height of car, top of rail to top of power collector (locked down)	11 ft., 6 in.
Height of car, top of rail to top of roof equipment (maximum)	11 ft., 6 in.
Height of car, top of rail to top of roof sheet (maximum)	11 ft., 0 in.
Height of car floor from top of rail	2 ft., 10 in. ± 1/4 in.
Height of centerline of coupler face from top of rail	1 ft., 5-1/2 in.
Minimum clearance, top of rail to coupler over vertical curves	0 ft., 4 in.
Minimum clearance, top of rail to truck and undercar components	0 ft., 2 in.
Height, floor to bottom of window sheet opening (minimum)	2 ft., 8 in.± 1 in.
Height, floor to headlining of car (minimum at low ceiling)	6 ft., 8 in.
Height, floor to ceiling at centerline (minimum)	6 ft., 11 in.
Height, door openings over car floor (minimum)	6 ft., 3 in.
Minimum width of aisle	2 ft., 8 in.
Minimum width of articulation corridor	4 ft., 2 in.
Maximum height, lower step from top of rail	1 ft., 2 in.
Minimum step tread depth	0 ft., 10 in.
Maximum width of gap between door threshold with steps in high position and subway station platform edge	0 ft., 41/2 in.
Carbody end overhang (center line truck to anticlimber surface)	12 ft., 6 in.
Carbody end overhang (center line truck to coupler face)	13 ft., 6 in.

TP02.03 GENERAL REQUIREMENTS

A. General Design Requirements

This Section establishes performance, environmental and general design criteria for the SFMTA Light Rail Vehicles and its systems. All equipment and components shall have a proven history of successful operation in revenue service similar to that of the SFMTA. Proof of proven operation shall be substantiated by submission of reliability/failure data, service time and location, modification information and maintenance records.

B. Submittals

In addition to other contract-required submittals, for proposed design modifications, the following items shall be submitted for approval of any design change or new component:

(a) Proof of proven operation, including reliability/failure data, service time and location, modification information, and maintenance records.

(b) Descriptive, analytical, and graphic data to substantiate the performance characteristics and dimensional requirements of the component.

(c) As-appropriate based on design changes to the systems specified in these Technical Provisions, static and dynamic vehicle outlines, including drawings, test results, and analyses to indicate that vehicle consists will negotiate all curves, tunnels, and surface conditions, including the overhead power line, on the existing system and new

extensions and layovers under MUNI's normal operating requirements and conditions, with no interference from other vehicles or wayside objects. .

(d) If necessary, analyses showing how acoustic noise and electromagnetic interference requirements will be met.

C. Environmental Criteria

The vehicle shall be capable of being operated, stored, and maintained at specified performance levels within the environment of the San Francisco MUNI Metro.

(a) Temperature Range: Between 25 and 100 degrees F.

(b) Relative Humidity: Between 5 and 100 percent.

(c) Wind: High winds are characteristic of the system right-of-way. Winter storms occasionally are accompanied by wind velocities up to 80 mph.

(d) Precipitation: Average annual rainfall is 15 to 20 inches. Storms occasionally bring 1 to 2 inches of rain within 24 hours.

(e) Moisture Acidity: Vehicle will be subjected over extended periods to moisture having a pH of 4.0.

(f) Fog: Heavy fog is characteristic of the area.

(g) Chloride Content: High-volume samples taken by the Bay Area Air Pollution Control District indicate that airborne suspended particles of chloride are to be expected in areas exposed to ocean and bay airflow. Maximum quantity measured during sampling was 13.9 micrograms per cubic meter.

D. Weight Criteria

As a baseline for performance design purposes, the following maximum weights are defined based on vehicle capacity:

(a)	AW0 Empty car weight	76,000 lbs
(b)	AW1 Seated load car weight (62 pass. + operator) (AW0 plus 9,700 lbs passenger load)	85,700 lbs
(c)	AW2 Seated plus standees (155 pass.+ operator) (AW0 plus 24,000 lbs passenger load)	100,000 lbs
(d)	AW3 Crush load car weight (220 pass.+ operator) (AW0 plus 34,000 lbs passenger load)	110,000 lbs

Passenger weight is assumed to be 154 pounds per person.

E. General Testing Requirements

The Contractor shall develop and maintain a test program in compliance with the requirements of TP10 and the requirements of each system design Technical Provisions section.

TP02.04 SHOCK AND VIBRATION

Equipment design and mounting arrangements shall be based on the specific location of the equipment on the vehicle and shall take into account the influence of adjacent components as well as the effect of normal vehicle operation. In addition to any shock or vibration encountered in normal operation, equipment shall withstand the following vibration levels:

(a) Components mounted on the carbody shall be designed and installed to successfully sustain a vibration test consisting of 0.1 g input along three mutually perpendicular axes over a frequency scan of 0.5 to 40 Hz at one octave per minute sweep rate with dwell of 15 seconds at each integral frequency.

(b) Components mounted on the truck frame shall be designed and mounted to withstand, without fatigue or deterioration for the life of the vehicle, the normally occurring random shock and vibration magnitudes present at the support points on the truck frame. These magnitudes shall be considered to be: vibrations of 1.0 g rms with a crest factor of 5 (ratio of peak to rms acceleration level), within a frequency range of 10 Hz to 10 kHz in all directions; and shocks of 20 g peak in the vertical axis and 6 g peak in the lateral axis, with pulse durations ranging from 4 milliseconds to 10 milliseconds, occurring up to 100 times per operating day.

(c) Axle mounted components shall be designed to withstand, at a minimum, continuous random vibrations of 10g rms within a frequency range up to 100 Hz in all directions; and shock pulses of 50 g in the vertical axis and 10g horizontally with durations ranging from 0.5 milliseconds to 2.0 milliseconds, occurring approximately 100 times per operating day.

(d) With the car stationary and with all auxiliary units operating simultaneously at rated capacity, the vertical or horizontal vibrations of floors, walls, seat frames, or any surface with which a passenger or operator can come in contact shall not exceed any of the following values:

(1) Displacement, peak-to-peak 0.10 in.
(2) Acceleration, peak value 0.02 g below 20 Hz
(3) Velocity, peak value 0.045 in./sec. above 20 Hz.

TP02.05 SYSTEM SAFETY REQUIREMENT

A. General

The car shall conform to all applicable laws, rules, regulations, standards and recommended practices specified within these Technical Provisions.

B. Failures

Protection shall be provided against failures, including software failures, which could cause an unsafe condition such that two or more sequential failures will be required for

such condition to occur. The first such failure shall not result in an unsafe condition and shall energize an alarm.

C. Fire Protection and Toxicity

All materials used on the car, except for incidental materials used in small parts (such as knobs, rollers, fasteners, clips, grommets and small electrical parts) which would not contribute significantly to fire propagation or smoke emission, shall conform to the following maximum toxic gas release limits, when tested in accordance with Boeing Specification Support Standard (BSS) 7239:

- Carbon Monoxide (CO) 3500 ppm
- Hydrogen Fluoride (HF) 200 ppm
- Nitrogen Dioxide (NO2) 100 ppm
- Hydrogen Chloride (HCL) 500 ppm
- Hydrogen Cyanide (HCN) 150 ppm
- Sulfur Dioxide (SO2) 100 ppm

SFMTA reserves the right to have testing performed on any production lot of material in addition to the tests required of the Contractor to demonstrate performance.

D. Potentially-Hazardous Electromagnetic Fields

The vehicle shall not produce any health hazard to the public, passengers, train crew, or maintenance personnel.

E. Fire and Life Safety

All vehicle components, subsystems, and systems shall be designed for the prevention of fire; protection of the public, employees, and emergency response personnel from injury due to fire, smoke, explosion, or panic due to fire; and protection of system elements from damage by fire or explosion.

F. Safety Under Normal Operating Conditions

The vehicle shall present a safe, hazard-free environment to passengers and operating and maintenance personnel to the extent practical, and as such, any system that is rehabilitated or redesigned shall take the following into account:

Passengers shall not be exposed to tripping hazards, sharp points and edges; any voltage of 50 V or more, including between cars on adjacent tracks; toxic materials; abrupt or unexpected accelerations; or similar hazards.

Normal and emergency equipment and controls which the passenger may operate shall be clearly identified, and operating procedures shall be presented in both text and graphic formats.

Exposure of maintenance personnel to lethal or injurious voltages shall be minimized through compartmentalization, interlocks, and similar measures. All equipment shall be free from sharp points and edges. All equipment enclosures containing hazardous materials, lethal or injurious voltages, or other risks shall be clearly labeled on both the outside and inside of the equipment enclosures.

TP02.06 CONTRACT DELIVERABLE REQUIREMENTS LIST

CDRL #	Title	Reference Paragraph

End of Section

TECHNICAL SPECIFICATIONS

(TECHNICAL PROVISIONS)

SECTION TP03

LRV AUTOMATIC COUPLER ASSEMBLY REHABILITATION

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SECTION TP03
LRV AUTOMATIC COUPLER ASSEMBLY REHABILITATION

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TP03: AUTOMATIC COUPLER ASSEMBLY OVERHAUL

TP03.01 GENERAL

The Contractor shall be responsible for the removal, cleaning, disassembly, overhaul, repair, testing and re-installation of the automatic coupler assemblies on all cars. This includes mechanical, electrical, and pneumatic elements.

TP03.02 SCOPE OF WORK

A. GENERAL

The Contractor shall perform the following tasks during the overhaul:

- Removal and replacement from the vehicle, disassembly, cleaning, stripping, and repainting of the coupler per section 7 of the HRWM.
- Installation of new or rebuilt components listed in Section TP3.02B of these Technical Provisions
- Pre-delivery testing of the coupler, per Breda HRWM section 7, as defined in TP10
- Post-delivery testing of the coupler installed on the LRV, as defined in TP10

B. COUPLER COMPONENT OVERHAUL

The Contractor shall overhaul or provide new and install the following components:

1. Draft Gear

Overhaul by replacing all bearings, bushings, rubber springs, seals, grease fittings, washers and fastener.

2. Center Devices

Overhaul by replacing all bearings, disc spring, washers and fasteners.

3. Buffer Assembly

Overhaul by replacing all bearings, scraper, washers, fasteners and seals including rebuilding of the hydraulic buffer. All new welds shall be tested non-destructively.

4. Rubber Bellow

Provide new.

5. Support Spring

Provide new or rebuild by replacing all bearings and fasteners.

6. Mechanical Coupler Head

Rebuild by replacing all bearing, springs, pin, cable for the uncoupling handle and the rotating hook plate.

7. Operating Device

Rebuild electrical and mechanical parts.

8. Uncoupling Device/Guide Rail

Contractor shall rebuild the uncoupling device/guide rail by replacing all bearings, springs, grease fittings, washers and fasteners and rebuild the uncoupling cylinder.

9. Suspension Attachment (LH)

Contractor shall rebuild the suspension attachment by replacing all bearings, grease fittings, springs, washers, roll pins and lock nuts. The attachment bridge shall be inspected for cracks and repaired as needed. New welds shall be tested non-destructively.

10. Suspension Attachment (RH)

Contractor shall rebuild the suspension attachment by replacing all bearings, grease fittings, springs, washers, roll pins and lock nuts. The attachment bridge shall be inspected for cracks and repaired as needed. New welds shall be tested non-destructively.

11. Electrical Coupler (LH)

Contractor shall rebuild or provide new. Contractor shall use fixed contacts developed by Voith Turbo Inc. for SFMTA with part number 304006929, or equivalent as approved by the Engineer. Rebuild shall include providing new cable or contact device.

12. Electrical Coupler (RH)

Contractor shall rebuild or provide new. Contractor shall use fixed contacts developed by Voith Turbo Inc. for SFMTA with part number 304006955, or equivalent as approved by the Engineer. Rebuild shall include providing new cable or contact device.

13. Electrical Coupler (top)

Contractor shall rebuild or provide new. Contractor shall use fixed contacts and moving contacts developed by Voith Turbo Inc. for SFMTA with part numbers 304006930 and 304006927 respectively, or equivalent as approved by the SFMTA. Rebuild shall include providing new cable and accessories.

14. Limit Switch

Provide new.

15. Pneumatic Valves and Tubing

Provide new.

16. Cut-out Cock and Air Filter

Provide new.

17. Coupler Stops

Repair as needed and reinforce.

18. Coupler Face

Wear and flatness shall be verified and repaired as needed.

19. Manual Uncoupling Cable and Handle

Inspect and repair or replace as needed.

TP03.03 OVERHAUL PROCEDURES

The OEM manuals contain procedures that are sufficient for removing, disassembling, reassembling, installing, adjusting, and testing the complete door system; subsets of these are relevant to the scope-of-work defined herein. The Contractor shall generate work procedures to comprehensively define the scope of work associated with this overhaul, using the OEM Heavy Repair and Workshop Manual (HRWM) procedures as a basis.

The procedure shall include sign-off sheets that shall be utilized during overhaul. A sign-off sheet shall be maintained for each coupler and submitted **[CDRL 3-003]** for insertion into the Car History Book. Each critical step in the overhaul shall be signed off by the responsible person.

TP03.04 INSPECTIONS AND TESTING

The Contractor shall verify the condition and functionality of the car couplers before shipping each vehicle from the SFMTA shop to their rebuild facility. This inspection and testing shall be included in the Pre-Possession Inspection Procedure specified in Section TP10.02 of these Technical Provisions.

The Contractor shall also perform proper tests and inspections prior to shipping the completed car and upon deliver of the car to SFMTA, as detailed in Section TP10 Inspections and Testing in these Technical Provisions. Such tests will require coupling to another vehicle and demonstrating performance of all trainlined commands including but not limited to, propulsion, doors, communication, braking, coupling/uncoupling, auxiliary electric.

TP03.05 LABELS

The Contractor shall apply labels to all overhauled equipment to indicate when it was overhauled. The labels shall be of the same type as the OEM labels currently installed on the

equipment. The quantity and locations of labels shall be similar to the original labeling arrangement, consistent with the labeling plan specified in TP01, Section 1.07.O.

TP03.06 FIRST ARTICLE INSPECTION

The first rebuilt unit shall be presented to SFMTA for approval, prior to continuation of the rebuild effort. The Contractor shall support this process with a complete set of documentation, including test reports. **[CDRL 3-004]**

TP03.07 CONTRACT DELIVERABLE REQUIREMENTS LIST

CDRL #	Title	Reference Paragraph
3-004	Coupler Overhaul FAI Package	3.06

TECHNICAL SPECIFICATIONS
(TECHNICAL PROVISIONS)

SECTION TP04

DOOR OPERATOR & STEP SYSTEMS

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SECTION TP04
DOOR OPERATOR & STEP SYSTEMS

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TP04: DOOR AND STEP SYSTEMS

This Chapter describes the overhaul requirements for the Door and Step Systems on the SFMTA fleet of Breda-built LRVs. The Contractor is responsible for overhauling the door and step systems per the requirements of this section, and any other applicable portions, of this specification. Overhauled equipment shall be verified via testing to demonstrate that it functions in accordance with the Original Equipment Manufacturer's (OEM's) requirements, as defined herein, and in the referenced documents and manuals. Terminology used herein generally is the same as that utilized in the OEM manuals for these systems.

TP04.01 DESCRIPTIONS

A. LRV Configurations

The LRVs were procured in two groups that have distinct differences; particularly as pertains to the door system. These differences are detailed herein to the extent relevant to the scope of work. The vehicle groups are:

- **LRV2: Vehicles 1400 through 1476**
- **LRV3: Vehicles 1477 through 1550**

The LRV2 cars were accepted between November of 1996 and July of 1999; the LRV3 cars were accepted between March of 2000 and September of 2003. The terms LRV2 and LRV3 are used interchangeably with the vehicle groups identified above.

B. OEM Manuals

1. Accuracy

The OEM manuals have been utilized to generate the listing of assemblies, components, and parts described herein. Although there are known to be a small quantity of minor errors with respect to the labeling of some illustrations and parts, there are none known that influence the Contractor's ability to accurately identify the parts requiring rehabilitation.

2. Part Quantities, Part Numbers & Part Groupings

The quantities of each item associated with the various door system components and assemblies are not defined herein and must be discerned from the equipment and manuals by the Contractor.

The OEM changed the Bill Of Material (BOM) groupings for some door system assemblies between the LRV2 and LRV3 manuals, with the LRV3 BOMs having separate illustrations and parts lists for subassemblies that were included with the parent assemblies in the LRV2 manuals. The parts groupings herein do not reflect the groupings in the OEM manuals for some assemblies, as the LRV3 groupings were reassembled to match that of the LRV2 manuals in order to generate overhaul requirements for common assemblies. The contractor shall review the OEM manuals to obtain part numbers and total quantities for all door system elements requiring overhaul for each operator and car type.

3. Procedures

OEM manual procedures identify differences between each operator and car type to the extent that these differences influence completion of the procedures. Thus, OEM manual procedural references herein often do not require delineation between operator and car types.

4. Special Tools

Some procedures in the OEM manuals require "special tools" to complete. The contractor will be provided one complete set of all special tools required to perform defined processes, which shall be returned to the Authority upon completion of the work; additional special tools may be provided by the Authority on a case-by-case basis, at its discretion, based on availability.

C. Door Opening Configurations

Each LRV has eight door openings, of which there are three different door-opening widths, as defined below:

- There are four 54-inch door openings
- There are two 47-inch door openings
- There are two 36-inch door openings

Each door opening has two door panels except for the 36-inch door opening, which has one.

D. Door Operator Configurations

There are two distinctly different door operator configurations present in the fleet. The following describes these configurations and the cars each is installed on:

1. 36-Inch Door Openings

The door operators for the 36-inch door openings are the same on all cars. These openings have a single door panel driven by a single door operator assembly equipped with an interior manual door release mechanism and both interior and exterior crew-switch controls.

2. 47-Inch Door Openings

- **LRV2**
  There are two door panels, each of which is driven by a single door operator assembly, i.e., two operators per opening. These doors are equipped with interior and exterior manual door release mechanisms and crew-switch controls, each of which controls both door operators.
- **LRV3**
  There are two door panels, both of which are driven by a single door operator assembly, i.e., one operator per opening. These doors are equipped with interior and exterior manual door release mechanisms and crew-switch controls.

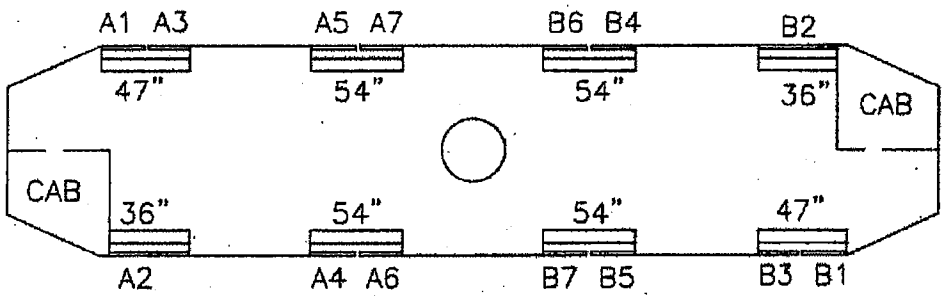
3. 54-Inch Door Openings

- **LRV2**
  There are two door panels, each of which is driven by a single door operator assembly, i.e., two operators per opening. These doors are equipped with only an interior manual door release mechanism; no crew switches.
- **LRV3**
  There are two door panels, both of which are driven by a single door operator assembly, i.e., one operator per opening. These doors are equipped with only an interior manual door release mechanism; no crew switches.

All door operator configurations consist of overhead-mounted, bi-parting, except for the 36-inch single-panel operators, outside-sliding, plug-doors. The door operators are controlled by an electronic control unit, one per door operator.

E. Door Panel Configurations

Each door panel is constructed of an extruded aluminum frame with bonded skins. There are five unique door panel types installed onto each LRV. The diagram below conveys the car layout and depicts the established convention for identifying each door panel:



The following groupings are of like door panel configurations:

- Center Left-Hand Door Panels: A5, A6, B5, B6
- Center Right-Hand Door Panels: A4, A7, B4, B7
- End Left-Hand Door Panels: A1, B1
- End Right-Hand Door Panels: A3, B3
- Single End Door Panels: A2, B2

Each door panel configuration includes a window in the upper portion; panels A1, A3, B1, and B3 also have a window in the lower portion of the panel.

TP04.02 STEP SYSTEM DESCRIPTION

A. Step Configurations

The step system accommodates both high- and low-level boarding through each of the eight door openings. There are three distinct step configurations, one for each of the three door opening widths.

B. Step Operations

The step system utilizes pneumatic power for raising and lowering the step treads to provide floor-level boarding at platforms and step boarding at street level, respectively. When the steps are positioned for high-level boarding and the doors are opened, a plate extends from beneath the outboard step tread to reduce the car-platform gap passengers must negotiate when entering or exiting the cars. The operations of the step system are synchronized with that of the door operators such that step and extension-plate movements are completed at the appropriate times with respect to door panel movements.

TP04.03 OVERHAUL REQUIREMENTS

A. Resource Documents

The OEM manuals for the LRVs will be at the disposal of the Contractor for use as needed to perform the overhaul of this equipment. These manuals contain detailed instructions for the removal, inspection, installation, adjustment, testing, and as needed overhaul, of the door and step system assemblies and components. A key aspect of these manuals is the Specific Safety Precautions associated with these various activities. The equipment and processes described herein have inherent dangers associated with their being handled other than in accordance with the OEM's recommendations. The Contractor is required to be thoroughly familiar with these precautions and is responsible for the safety of the equipment in addition to that of the personnel performing the work. SFMTA shall not be responsible for incident caused due to neglect, carelessness, lack of proper attention, or willful misuse of equipment.

B. Document Conflicts

All door system assemblies, components, and parts shall be overhauled in accordance with this specification and any applicable OEM requirements. Should the contents herein conflict with OEM requirements, the Contractor shall identify the conflict to the SFMTA for disposition. In such cases, the SFMTA shall have the option of choosing which conflicted requirement must be adhered to without incurring additional costs.

C. Terminology

- Whenever the term "overhaul" is used herein, it shall mean the level of effort designated for a component or assembly, including, but not limited to, cleaning, refinishing, repair, or replacement.
- Whenever the term "replace in kind" is used herein, it shall mean replacement with identical OEM parts, or SFMTA approved equal. The SFMTA is not obligated to accept other than OEM parts, unless the OEM part is obsolete, and may require the Contractor to perform whatever reasonable verification activities it desires in order to demonstrate that the alternative is acceptable based on its being equivalent or superior to the OEM part per Section 1.04.C.1 of these Technical Provisions.
- The costs associated with proving that an alternative is equivalent or superior to an OEM part shall be borne by the Contractor.

- Whenever the term "replace" is used herein, it shall mean replacement with components compliant with applicable material and workmanship standards. This term is utilized primarily for hardware, where compliance with applicable standards is sufficient to demonstrate equivalence to the OEM part.
- Whenever the term "reuse" is used herein, it shall mean disassemble, clean, inspect, verify, refinish and lubricate as needed, reassemble, and reinstall onto the overhauled assemblies; this term reflects estimation that none will require replacement, unless otherwise specified.

D. Hardware/Fasteners

All hardware and fasteners, including, but not limited to, screws, bolts, nuts, clips, washers, lock-washers, shrink wrap, c-clips, tie straps, shaft-keys, springs, shrinkable tubing, cotter pins, retaining rings, bushings, roll pins, clips, gaskets, and etc., on, or in, overhauled assemblies, components, or parts, shall be replaced unless identified for reuse herein.

E. Labels

The Contractor shall apply labels to all overhauled equipment to indicate when it was overhauled. The labels shall be of the same type as the OEM labels currently installed on the equipment. The quantity and locations of labels shall be similar to the original labeling arrangement, per the labeling requirement in TP1.07.O of these Technical Provisions.

F. Overhaul Procedures

The OEM manuals contain procedures that are sufficient for removing, disassembling, reassembling, installing, adjusting, and testing the complete door system; subsets of these are relevant to the scope-of-work defined herein. The Contractor shall generate work procedures to comprehensively define the scope of work associated with this overhaul, using the OEM Heavy Repair and Workshop Manual (HRWM) procedures as a basis. There shall be sections, or separate procedures, as follows, for the major assemblies:

- Removal from cars
- Disassembly
- Overhaul
- Assembly
- Installation & Adjustment
- Testing

The Contractor's overhaul procedures shall include, but shall not be limited to the following, as applicable:

- A list of tools and materials required to complete the procedure, including cleaning products, coatings, lubricants, paints, and other items as required.
- Equipment handling instructions
- Equipment storage instructions
- Safety warnings, including all warnings from the OEM manuals
- Illustrations when needed for clarity
- Torque values and requirements for torque marking

- Use of thread-adhesives and/or lubricants
- Bill of Material for all replacement parts
- Any instructions required to safely ensure comprehensive completion of the overhaul efforts
- Any other procedures required herein

The majority of the above-defined content is available in the manuals.

The Contractor shall submit for approval overhaul procedures **[CDRL 4-001]** to the SFMTA prior to completing any overhaul activities.
Once approved by SFMTA, the contractor shall not change the overhaul procedures without prior SFMTA approval.

TP04.04 Removal, Disassembly, and Inspection of Equipment

A. Removal

The door system equipment shall be removed from the cars in accordance with procedures contained in the OEM manuals. The procedures for removing the door and step system equipment reflect removal of all equipment, and in some instances, the removal procedure includes the disassembly procedure. Since not all door and step system equipment will be overhauled, some equipment will not need removal from the cars.

All door and step system equipment that requires overhaul shall be removed from the cars for overhauling. Any equipment, components, or parts that shall be removed to facilitate removal of equipment to be overhauled, shall be cleaned and reinstalled with new hardware, unless the attachment is designed for repeated removal and reinstallation. The contractor shall identify any items that must be removed, or partially removed, to facilitate completion of the scope-of-work, which are not required to be overhauled, as well as the cleaning and hardware replacement details, to the Authority for approval prior to beginning overhaul efforts on the third car.

The contractor shall identify any door system elements that will not be removed from the cars in order to complete the scope-of-work, i.e., the door controllers and relay panels, as to ensure that door system equipment not included in the scope-of-work are not unnecessarily handled by the Contractor. The contractor shall not be permitted to remove such door system equipment from the cars for use in off-car testing of overhauled door system equipment without prior written authorization from the Authority.

B. Disassembly

The HRWM contains detailed disassembly procedures. These procedures often include figures from the Illustrated Parts Catalog (IPC), which reflect the required level of disassembly for components to be overhauled.

C. Inspection

The Contractor is to identify damages to any component intended for reuse as soon as the damage is observed. This is necessary in order to avoid interruptions to the overhauling processes and disputes related to the cause of the damage.

All components that are to be reused shall be cleaned and inspected after disassembly. Should obvious damage be identified, other than through nondestructive testing activities, after completion of the cleaning and inspection activities, they shall be construed to have been caused by the Contractor, and shall be the responsibility of the Contractor to repair/replace.

TP04.05 Door System Overhaul

The following sections define the overhaul requirements for the various door system assemblies and subassemblies. Overhaul requirements for components that are common to more than one assembly may not be repeated for each assembly, but are applicable to all assemblies having the component.

A. Rubber and Plastic Parts

1. All rubber and plastic parts shall be replaced.

B. Rubber and Plastic Parts

1. All door system wiring harnesses and terminal strips shall be inspected and repaired as necessary, including replacement of any damaged bridge diodes

C. Door Panel

1. The door panel shall be cleaned
2. All seals shall be replaced in kind, except for the window seals, which need not be removed.
3. The sensitive edge is to be replaced in kind, and includes the tube for attachment to the pressure wave switch
4. The mating carbody-mounted seals with which the door panels interface shall all be replaced in kind

D. Pressure-wave Switch

1. The switch shall be replaced in kind
2. The insulator and all hardware, including the cover hardware, shall be replaced

E. Hanger

1. The geometry of the hanger assembly components shall be verified
2. All hardware/fasteners shall be replaced
3. The hanger slide-bearings shall be replaced in kind

F. Fixed Arms

1. All hardware/fasteners and the loop clamp shall be replaced
2. The bearing shall be replaced in kind
3. The spindle nut and carrier shall be replaced
4. The eccentric rod shall be cleaned and reused, 25% are estimated to require replacement

5. The welded fixed arm bracket assembly shall be cleaned and 100% non-destructively tested for cracks and other damage or defect, 25% are estimated to require replacement

G. Bottom Linkage Assembly

1. All hardware/fasteners shall be replaced
2. The "special shouldered bolt" that attaches the push-pull rod to the ball joint shall be reused
3. The ball joint shall be reused, 25% are estimated to require replacement
4. The block shall be reused
5. The Eckart Mechanism shall be cleaned, lubricated, and have new bearings installed
6. The push-pull rod shall be reused

H. Traversing Wheel Assembly

1. Wheel brackets shall be replaced in kind
2. Guide rails shall be reused

I. Door Operator Assembly

1. The operators shall be completely disassembled
2. All hardware/fasteners shall be replaced
3. All limit switches shall be replaced in kind, actuators and insulators shall be replaced
4. All bearings shall be replaced in kind, unless otherwise specified
5. The five preceding items also apply to the each of the following door operator subassemblies, unless otherwise indicated:

1. Upper Telescope Assemblies

1. Coiled cords and m-base connectors shall be replaced in kind
2. Shrink tubing shall be replaced
3. Coiled cord end-pieces and mounting brackets may be reused
4. Coil cord guide rods shall be reused
5. Rubber bumpers shall be replaced
6. Spindles, spindle-nuts, and spindle coupling shall be reused
7. Spindle inner race and coupling set screw shall be replaced

2. Roller Carriage Assemblies

The following requirements are comprehensive of each carriage assembly configuration; however, not all carriage assemblies have all components listed below, therefore, these requirements are as applicable to each configuration:

1. Roller carriage brackets are to be reused
2. All bearings, roller and bushing, shall be replaced in kind
3. Bearing shafts shall be reused; both types
4. Gears shall be reused

3. Gearbox Assembly

1. Planetary gearbox shall be reused

2. Both flanges and bearings shall be reused
3. Bellows shall be replaced in kind
4. Shrink tubing, and harness ties shall be replaced

4. Motor Bracket Assemblies

1. All bearings and bearing bushings shall be replaced in kind
2. Cam assemblies shall be reused
3. Pull-spring shafts may be reused; springs shall be replaced
4. Thrust washers and Delrin rings shall be replaced in kind
5. Unplug arms and shafts may be reused, including the ball bearing shafts
6. The motor brackets, release pulley, toothed segment shall be reused

5. Motor Assemblies

There are two different door operator motor assembly configurations:

- LRV2

  The DC motors are equipped with two proximity switches that detect metal plates mounted on the motor shaft. When the shaft is rotating, these sensors are used to determine speed, direction, and position of the door panel. The wiring harness for this motor-sensor configuration terminates with a circular nine-pin connector.

- LRV3

  The DC motors are equipped with an optical encoder to determine speed, direction, and position of the door panel. The wiring harness for this motor-sensor configuration terminates with a rectangular 12-pin connector.

1. All motors, sensors, encoders, and connectors shall be replaced in kind
2. Wiring harnesses shall be replaced
3. LRV2 transmitter brackets and pulse generators may be reused
4. The motor shaft coupling and pinion shall be reused. NOTE: these components shall be attached to the motor shaft, and one another, using 4-mm roll pins instead of the 3-mm pins reflected in the OEM manuals

6. Door Out of Service Switch Assembly

1. Rotary switch shall be replaced in kind
2. Double-flange nylon-bearings shall be replaced
3. The adapter pin, mounting bracket, cylinder and housing assembly, spacers, and retainer plate shall be reused

7. Emergency Release Cables

1. Interior emergency release cables shall be replaced in kind
2. Exterior emergency release cables shall be replaced in kind

TP04.06 Step System Overhaul

The following sections define the overhaul requirements for the various step system assemblies and subassemblies. The mobile step assemblies shall be removed from the cars in accordance

with approved overhaul procedures. They shall be completely disassembled, cleaned and inspected. All rubber and plastic parts shall be replaced.

1. All hardware/fasteners shall be replaced
2. All limit switches shall be replaced in kind
3. All limit switch actuators and insulators shall be replaced
4. All tubing shall be replaced
5. All valves, mufflers, bushings and seals shall be replaced in kind
6. All springs shall be replaced in kind
7. All bearings, including the orbital and flange bearings, shall be replaced in kind
8. All rubber components, except the step treads, shall be replaced
9. All side track assembly frames shall be replaced in kind
10. Wiring harnesses shall be inspected and repaired where damaged
11. Diode assemblies on terminal strips shall be replaced if bent or broken (assume 25%)
12. Wiring harnesses and terminal strips may be reused, or replaced if damaged (assume 25%)
13. Wear surfaces shall be cleaned and dimensionally verified
14. Corrosion shall be removed and finishes restored on corroded components. It is estimated that light corrosion will exist at interfaces that are not visible while assembled, i.e., within linkage pivot joints
15. Both main and extension cylinders shall be cleaned, dimensionally verified, have all seals replaced, and be reused. It is estimated that *10%* of the extension cylinders will require replacement

TP04.07 Assembly, Installation & Adjustment, and Testing of Equipment

Refer to TP10 Inspection and Testing for the detailed requirements for the test and inspection program, as well as the CDRLs associated with the inspection and test of doors and steps.

A. Assembly

The overhauled equipment shall be assembled using procedures developed in accordance with the OEM manuals and shall utilize the same lubricants used on the original equipment and by the Authority's personnel. Assembly procedures shall include any intermediate testing and/or functional verifications required to ensure that the assembled components will function properly. Each assembly shall have sign-off sheets for workers to document that their efforts were conducted in accordance with applicable procedures, and aid in failure and/or quality assurance investigations; pass/fail entries shall be required in the sign-off sheet for all required intermediate tests and/or functional verifications performed by the assembler, including the proper application of torque marks. Multiple components may be included on tabulated sign-off sheets with approval of the Authority. Sign off sheets **[CDRL 4-003]** shall be submitted for inclusion in the Car History Book.

B. Installation & Adjustment

The overhauled equipment shall be installed and adjusted using procedures developed in accordance with the OEM manuals. Each installation shall have sign-off sheets for workers to document that their efforts were conducted in accordance with applicable procedures, and aid in failure and/or quality assurance investigations; pass/fail entries

shall be required in the sign-off sheet for all required intermediate tests and/or functional verifications performed by the installer.

C. Testing

1. Prerequisites

Power and/or air shall not be applied to overhauled equipment installed on the cars until a Contractor's Quality Assurance (QA) representative signs-off indicating that all Assembly and Installation & Adjustment sign-off sheets have been completed, and reflect successful completion of all testing and/or functional verifications performed prior to installation and/or as part of the installation process, and the Authority's representative signs verifying the same.

The Authority's representative shall be afforded the opportunity to be present when power and/or air is first applied to overhauled equipment installed back into the cars, and whenever an official acceptance test is conducted.

2. Test Types

In addition to any tests the Contractor establishes, the Authority requires that the door and step systems be 100% tested using the original door and step acceptance test procedures developed by the OEM, which the Authority will provide to the Contractor for this purpose. The entire test shall be completed by the Contractor, including those portions that verify the functionality of non-overhauled door and step system components, such as lights, switches, and chimes, as their functionality could be impacted by the scope of the overhaul efforts.

The contractor shall make all adjustments required in order to successfully pass the acceptance tests, even if the adjustments are required to components the contractor did not remove or modify, as overhauled equipment with new seals and other components may need the items with which they interface to be adjusted to achieve proper functionality.

Should the Contractor conclude that the test cannot be completed due to an issue associated with a component that is outside the scope-of-work of this overhaul, the issue shall be presented to the Authority for disposition, which may include the repair or replacement of the failed component by Authority personnel, or issuance of a replacement for installation into the car by the Contractor's personnel to enable completion of the test.

Both static and dynamic tests shall be conducted by the Contractor. This shall include, but shall not be limited to, continuity tests, insulation-resistance tests, functional tests, clearance tests, ADA requirements tests. All test procedures shall be submitted by the Contractor to the SFMTA for review and approval.

3. Acceptance Test Logistics

This test shall be completed on Authority property, at a time and location of its choosing, after the overhauled cars are returned, and as a condition of their acceptance by the Authority. A minimum of three working days notice must be

given in advance of an official vehicle-level test date; the Authority will accommodate testing with less notice, at its discretion, whenever possible.

TP04.08 First Article Inspection

The first rebuilt unit shall be presented to SFMTA for approval, prior to continuation of the rebuild effort. The Contractor shall support this process with a complete set of documentation, including test reports. **[CDRL 4-004]**

TP04.09 Remaining Stock

All remaining stock purchased in anticipation of replacement based on estimated percentages in these Technical Provisions shall become the property of SFMTA.

TP04.10 Contract Deliverable Requirements List

CDRL #	Title	Reference Paragraph
4-001	Overhaul Procedures	4.03.F
4-003	Sign-off Sheets	4.07.A
4-004	FAI Package	4.08.

End of Section

TECHNICAL SPECIFICATIONS
(TECHNICAL PROVISIONS)

SECTION TP05

Truck Assemblies:

Trailer Truck Electric System Cable Assembly
(PSC-2) Replacement

Articulation Resilient Pin Replacement

Traction Motor Bearing Replacement

August 28, 2009
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SECTION TP05
PSC-2 CABLE ASSEMBLY REPLACEMENT

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PSC-2 CABLE ASSEMBLY REPLACEMENT

The Contractor shall design and install a replacement Trailer Truck Electric System Cable Assembly (PSC-2) on each LRV.

The Contractor shall design the cable modifications, manufacture or procure new cables, and install and test them on each vehicle.

TP05: SCOPE OF WORK

TP05.01 TRAILER TRUCK

The Contractor shall carefully disconnect, from the trailer (center) truck, the connectors from the two Receive Antennae, the two Transmit Antennae, the two brake calipers and the two tachometers.

The Contractor shall release the cable clamps, remove and dispose of the old cable assembly.

The Contractor shall clean the mating connectors, and contact pins or points on both the carbody and center truck of all dirt, grease and grime.

The Contractor shall design and manufacture or procure a replacement PSC-2 harness.

The Contractor shall install the new cable, properly connecting and securing it with sufficient cable slack for truck rotation and with no binding or chaffing against fixed or moving parts.

The Contractor shall properly reinstall the Caliper and Antennae cover plates.

The Contractor shall replace all cable clamp hardware with new.

The Contractor shall carefully reconnect the two carbody connectors and the other connectors.

The Contractor shall verify proper functionality of all affected systems per TP10 Inspections and Testing.

All materials and workmanship shall comply with the requirements of Section TP08.

A. Cable Assembly Possible Source of Supply:

DIGI-COM ELECTRONICS, vendor part number: 9558-15
5327 Jacuzzi St #3N, Richmond CA 94804
Contact: Mohammed R Ohady
Phone: (510) 525-3570
Fax: (510) 527-8187

SFMTA shall consider the above assemblies or approved equal. Alternate sources must be submitted to the SFMTA for evaluation, testing and approval. The submittal package shall

include appropriate schematics, component descriptions, and manufacturer's test reports. **[CDRL 5-001]**

TP05.02 RESILIENT PIN

The Contractor shall replace the Articulation Joint Resilient Pins.

TP05.03 TRACTION MOTOR BEARINGS

The Contractor shall replace all traction motor bearings with original type roller bearings.

TP05.04 SFMTA FURNISHED DRAWINGS, SCHEMATICS, AND DOCUMENTS

The SFMTA shall make available an LRV and dismounted center truck for the Contractor's inspection, measurement and testing to determine the necessary cable assembly lengths, and the receptacles installation conditions for mounting and wiring to the existing LRV circuit wires.

Copies of related drawings, schematics and documents from the SFMTA's archives will be made available to the Contractor. They are to be used for reference purposes only and do not necessarily reflect the existing configuration of the vehicles. It is the Contractor's responsibility to verify accuracy of all drawings and documents provided by SFMTA.

Basic cable layout details are provided for reference in Section TP16 of these Technical Provisions.

TP05.05 TASKS

A. Pre-Possession Test

The Contractor shall confirm, before taking possession of the vehicle, that the two Automatic Train Control (ATCS) Receive Antennae, the two ATCS Transmit Antennae, the two center truck tachometers and the two center truck caliper brake release switches are functioning by conducting an ATCS Yard Departure Test on the SFMTA's Track 1 at the Green facility. This test shall be Incorporated into the pre-overhaul test procedure and report referenced in TP10 of these Technical Provisions.

While SFMTA personnel will operate the LRV during the test, the Contractor shall conduct the test. All testing activities and documentation shall be compliant with TP10 Inspection and Testing section of these technical provisions.

B. Cable Replacement Procedure and Sign Off Sheet

The Contractor shall submit for approval a complete cable replacement procedure, including references to inspection and test procedures . This procedure shall be the same procedure as supplied to the Contractor's work crew. The procedure shall describe in detail the steps required to perform the replacement. This procedure **[CDRL 5-003]** shall be submitted for review and approval.

The Contractor is advised to pay close attention to phasing, as wiring the cable backwards is common and will cause a departure test failure. For each vehicle, the Contractor shall provide a

cable replacement sign off sheet **[CDRL 5-004]**. As each replacement is completed, the Contractor shall sign and date the sign off sheet, confirming that the work has been completed.

C. Acceptance Testing

Upon redelivery of the LRV to the SFMTA, the LRV shall be subject to acceptance tests as required by Section TP10 of these Technical Provisions, including identification of CDRLs. After passing the test, the Contractor shall provide and sign an acceptance test report. The Engineer will accept the replaced cable assembly by signing the test report.

These tests shall include at a minimum:

- Continuity test to confirm proper connections
- Yard departure test

D. First Article Inspection

The first overhauled unit shall be presented to SFMTA for approval, prior to continuation of the rebuild effort. The Contractor shall support this process with a complete set of documentation, including test reports. **[CDRL 5-005]**

TP05.06 CONTRACT DELIVERABLE REQUIREMENTS LIST

CDRL #	Title	Reference Paragraph
5-002	Cable Replacement Procedure	5.05B
5-003	Revised Cable Replacement Procedure	5.05.B
5-004	Cable Replacement Sign Off Sheet	5.05.B
5-005	First Article Inspection Package	5.05.D

TECHNICAL PROVISIONS

SECTION TP06

LRV AIR SUPPLY UNIT REHABILITATION

August 28, 2009
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SECTION TP06
LRV AIR SUPPLY UNIT REHABILITATION

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TP06: AIR SUPPLY UNIT REHABILITATION

TP06.01 GENERAL

The Contractor shall be responsible for the removal, clean, disassembly, overhaul, repair, testing and re-installation of the air supply unit (ASU). The air supply unit includes compressor/motor assembly, controls and air dryer assembly. After removal, the Contractor shall thoroughly clean the ASU and inspect for damage prior to commencing the work. Any damaged parts shall be replaced as part of the work.

SFMTA Light Rail Vehicles (LRVs) are equipped with Knorr Air Brake type STU14536 Air Supply Units. Most of the SFMTA ASUs have been fitted with Graham White type 995-225 air dryer units; however, an undetermined number still retain their original Knorr type LTZ-012H units. For ASUs with the original Knorr air dryers, the Contractor shall replace the unit with a new Graham White type 995-225 air dryer unit, which will be provided by the SFMTA. The Contractor will reduce the cost by the amount of Air Dryer Unit rebuild and only charge for the replacement labor.

The ASU shall be inspected and overhauled according to the San Francisco Muni LRV2 Heavy Repair and Workshop Manual – Section 6 "Air Compressor/Pneumatic System" except for the Air Dryer system which shall be rebuilt according to the Graham White Overhaul and Maintenance Manual #995-225. Parts subject to wear shall be dimensionally checked as part of the work. All elastomeric parts, hoses, seals, wire harnesses, damage and broken parts and other components as required in this specification shall be replaced. Parts exceeding wear limits and which can not be reconditioned shall be replaced in kind.

The Contractor shall be responsible for the mechanical refitting of the ASU into the LRV, and its pneumatic and electrical connections to the LRV.

SFMTA will make available to the Contractor drawings, schematics, and manuals from its archives. This information is for reference purposes and may not represent the existing configuration of the air supply unit and its installation.

TP06.02 SCOPE OF WORK – AIR SUPPLY UNIT

The Contractor shall remove, disassemble, inspect, repair/replace/overall, reassemble, test and reinstall the following assembles as part of the work to be performed:

- Air compressor
- Compressor motor
- Air dryer
- HVAC motor contactor
- LVDC terminal box

- Pressure switch
- Test fitting

The Contractor shall include sign-off sheets that shall be utilized during overhaul. A sign-off sheet shall be maintained for each coupler and submitted **[CDRL 6-003]** for insertion into the Car History Book. Each critical step in the overhaul shall be signed off by the responsible person.

A. AIR COMPRESSOR

The SFMTA ASU's are fitted with Knorr Air Brake type LP8851 air compressors. The Contractor shall disassemble and thoroughly inspect the compressor, and before commencing any reconditioning work, check the dimensions of parts subject to wear to determine if part reconditioning is feasible or replacement is required. The Contractor shall inspect and overhaul the compressor according to the San Francisco Muni LRV2 Heavy Repair and Workshop Manual – Section 6 "Air Compressor/Pneumatic System".

The crankcase assembly shall be inspected for damage, cracks and deformed/damaged threads. Replace any damaged or distorted studs.

The crankshaft shall be inspected for cracks and for wear on all bearing surfaces. If bearing surfaces are worn beyond acceptable conditions, replace the crankshaft.

Inspect cylinders for cracks and damage. All cylinders shall be reconditioned. If determined to be needed during inspection, bore the cylinders to next size up. If determined to be needed during inspection, provide and install new oversized pistons, new piston and spring rings. For all compressors, the Contractor shall perform the following work:

- Install new wrist pins.
- Install new wrist pin bearings.
- Install new wrist pin C-clips.
- Install new connecting rod and crankshaft bearings, including a new wear ring.
- Rebuild valve assemblies with new springs and flap valves.
- Install new filter element.
- Replace or rebuild check valve.
- Install new safety valves.
- Install all new gaskets and seals.

B. COMPRESSOR MOTOR

The SFMTA ASUs are fitted with either a Stone Safety or Tech Systems 9 horsepower, 1750 rpm, 600 volt dc, 14 amps full load, series wound motors, with external frame mounted buffer resistors. The Contractor shall disassemble and thoroughly inspect the motors, and before commencing any reconditioning work, check the dimensions of parts subject to wear to determine if part reconditioning is feasible or replacement is required.

The Contractor shall overhaul of the motors in accordance with the San Francisco Muni LRV2 Heavy Repair and Workshop Manual, Section 6 "Air Compressor/Pneumatic System" and as described by the following summary.

1. Motor Frame

For the motor frame, the Contractor shall perform the following work:

- Disassemble the motor clean and inspect all parts.
- Reuse, and repair, if necessary, the end bells and bearing seats and brush covers, and air inlets and resistor boxes (prime and paint).
- Replace bearings.
- Install new brushes and brush-holders.
- Replace resistor (3 resistors used for the stone safety motor, 2 for the Tech systems motor)

2. Motor Armature

For the armature, the Contractor shall perform the following work:

- Disassemble the motor and thoroughly clean all of the parts.
- Remove the commutator and shaft, strip away the armature coil windings.
- Inspect and core loss test the armature core laminations and install a new core as needed.
- Rewind the armature core with new coils using class H insulated windings, TIG welded to the risers and with new bandings installed.
- Install a new commutator.
- Inspect the shaft for damage/distortion and replace with new as necessary.
- Voltage test the new commutator, bar to bar and ground test. Current test armature winding. Surge test the armature winding. Surge test armature winding and commutator connected.

- Vacuum Pressure Impregnate (VPI) the rewound armature twice with Epoxylite resin # 478 or other suitable resin if approved by the Engineer.
- Cure and clean VPI'd armature.
- Turn, the commutator, undercut the mica and balance the armature with the drive coupling attached to the shaft end.
- Spin season the commutator.
- Measure and record the Total Indicated Runout in the sign-off sheet

3. Motor Stator

For the motor stator, the Contractor shall perform the following work:

- Thoroughly clean the stator assembly.
- Strip away all stator windings from the 2 main poles and the 2 interpoles.
- Abrasive blast the stator frame.
- Inspect the poles stack laminations and repair as needed.
- Rewind the stator with new coils using Class H insulated windings: main field, interpole.
- VPI the rewound stator twice with Epoxylite resin # 478 or other suitable resin if approved by the Engineer.
- Cure and clean VPI'd stator.

4. Motor Assembly and Test

The Contractor shall prime and paint the motor frame gloss black enamel, reassemble the motor with new bearings, rings, and retainers matched to the motor frame end bells and new standard hardware.

The Contractor shall install new armature leads, field leads, brush leads, thermal switches as appropriate, new bus bars.

Adjacent to the original nameplate, the Contractor shall install a new permanent metal nameplate stamped with the rewind completion date and the Contractor's company name.

The Contractor shall continuity test, insulation test, and hi-potential test all stator windings and leads and impedance test the completed motor, as required in Section TP10 of these Technical Provisions.

For final motor acceptance, the Contractor shall load test the motor on a dynamometer to the full load capability (9 hp).

The Contractor shall record in the acceptance test report, the test data for insulation temperature rise, insulation resistance, seating of brushes, commutator film build-up, commutation and full-load regulation tests, rotation CW and CCW speeds, vibration, dielectric strength, armature rotational runout and endplay.

C. AIR DRYER UNIT

Most of the SFMTA ASUs have been fitted with Graham White type 995-225 air dryer units; however, an undetermined number still retain their original Knorr type LTZ-012H units.

For ASUs with Graham White air dryers, the Contractor shall rebuild the units as described in the Graham White Overhaul and Maintenance manual #995-225. Additionally, the contractor shall install new desiccant bags, a new coalescer, a new final element filter and a new muffler.

The Contractor shall inspect the other components for excessive wear or damage and repair or replace the components as necessary to assure proper function.

D. HVDC MOTOR CONTACTOR

For the HVDC motor contactor, the Contractor shall perform the following work:

- Disassemble the motor contactor and thoroughly clean all of the parts.
- Replace contacts
- Replace relays
- Replace conical springs.

E. LVDC TERMINAL BOX

For the LVDC terminal box, the Contractor shall perform the following work:

- Disassemble the terminal box and thoroughly clean all of the parts.
- Replace wire harnesses

F. PRESSURE SWITCH

For the pressure, the Contractor shall perform the following work:

- Replace pressure switch.

G. TEST FITTINGS

For the test fittings, the Contractor shall perform the following work:

- Disassemble the fitting and thoroughly clean all of the parts.

- Replace spring, o-ring and circlip.

H. OTHER COMPONENTS

The Contractor shall perform the following work:

- Install all new rubber components including the resilient mounts.
- Install new hose assemblies.
- Install a new pressure switch.
- Install all new standard hardware.
- Rebuild all test fittings.
- Paint the air frame black enamel.
- Paint the terminal box both in and out (inside with non conductive paint).
- Repair as necessary and clean the inter and after-coolers.
- Rebuild the motor/compressor coupling.
- Repair the air pipe if necessary.
- Install new high voltage contactor assembly with appropriate rating.
- Rebuild the low voltage contactor assembly.
- Provide and install new air cock.

TP06.03 LABELS

The Contractor shall apply labels to all overhauled equipment to indicate when it was overhauled. The labels shall be of the same type as the OEM labels currently installed on the equipment. The quantity and locations of labels shall be similar to the original labeling arrangement, consistent with the labeling plan specified in TP01, Section 1.07.O.

TP06.04 FIRST ARTICLE INSPECTION

The first rebuilt unit shall be presented to SFMTA for approval, prior to continuation of the rebuild effort. The Contractor shall support this process will a complete set of documentation, including test reports. **[CDRL 6-004]**

TP06.05 ADJUSTMENT AND TESTING

The Contractor shall perform detailed functional and performance tests for the complete ASU, as defined in Section TP10 of these Technical Provisions. The tests shall demonstrate that the ASU is fully operational prior to installation and that the ASU is properly interfaced when installed. As a minimum, test procedures shall include:

- Leakage
- Temperature rise
- Capacity and efficiency
- Operating current and voltage
- Pressure output
- Start/stop settings

Test procedures and reports, as specified as CDRLs in TP10, shall be submitted to the SFMTA for approval. The Contactor shall provide a test report for each ASU. The report shall include description of tests, detailed description of the ASU under test including serial numbers, instrumentation setup, all raw data collected/actual test results (pass/fail is not acceptable data entry), all data reduction forms and summary of the results.

TP06.06 FLOAT OF REBUILT AIR SUPPLIES

At the SFMTA's discretion, The Contractor shall create a "float" of spares by rebuilding up to eight SFMTA air supplies.

At the discretion of the SFMTA, a portion of the spare air supplies will be sent to the SFMTA facility and the remaining units will be used by the contractor for the replacement portion of the rebuild program.

TP06.07 SFMTA FURNISHED DRAWINGS, SCHEMATICS, AND DOCUMENTS

The SFMTA shall make available reference documents listed in this section. It is the Contractor's responsibility to verify accuracy of all drawings and documents provided by SFMTA.

TP06.08 CONTRACT DELIVERABLE REQUIREMENTS LIST

CDRL #	Title	Reference Paragraph

CDRL #	Title	Reference Paragraph
6-003	Sign-off Sheets	6.02
6-004	ASU Overhaul FAI Package	6.04

TECHNICAL SPECIFICATIONS

(TECHNICAL PROVISIONS)

SECTION TP07

LRV ROOF ARTICULATION WIRING HARNESS REPLACEMENT

August 28, 2009
Rev. 4 Final

SECTION TP07
ARTICULATION WIRING HARNESS REPLACEMENT

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TP07: ARTICULATION WIRING HARNESS REPLACEMENT

TP07.01 GENERAL

The Contractor shall design and install removable wiring harness cable assemblies in the roof area above the articulation bellows on each LRV.

The Contractor shall design the harness modifications, manufacture new harnesses, and install and test them on each vehicle.

TP07.02 SCOPE OF WORK

A. DESIGN REVIEW

As this is a new design, the Contractor shall prepare design review arrangement under worst-case conditions of vehicle movements for review and approval. **[CDRL 7-001]** and The Contractor shall submit drawings and samples of all assemblies, connectors, wires, and cables to SFMTA for review and approval in the package.

B. B END MODIFICATION.

Above the articulation bellows on the SFMTA's LRVs are seven cable assemblies. Each cable assembly consists of multiple insulated wires, enclosed in an outer jacket, hard-wired to the "B" half of the vehicle and terminated at the "A" half with a multiple pin bayonet connector. The Contractor shall develop a comprehensive wiring list for these circuits and submit them to SFMTA for review and approval. **[CDRL 7-003]**

The Contractor shall shorten the existing cable assemblies on the "B" half of the car and install bulkhead receptacles. An appropriate bulkhead plate or box shall be fitted to mount the receptacles. The receptacles shall match and mirror the receptacles on the "A" half of the car.

The Contractor shall prepare and submit for approval a modification procedure that describes both the electrical and mechanical work and sequence to be performed. **[CDRL 7-004]**

C. A END CONNECTOR REPLACEMENT

The Contractor shall replace and re-pin the bulkhead receptacles on the "A" half of the car with new.

D. JUMPER CABLES

The Contractor shall manufacture "jumper cable" wiring harnesses to bridge the circuits between the two banks of bulkhead receptacles. The jumper cable assemblies shall be built with new wires, outer protective jackets, and bayonet connectors.

All wires within the seven jumper cable assemblies, EYP7, EYP8, EYP9, EYP10, EYP11, EYP12, and EYP13 shall use the proper wire gauge and wire marker identification as indicated in the attached wiring reference list.

The contractor is responsible for maintaining the integrity of connecting the wires to the matching identified contacts on the receptacles as indicated in the wiring reference list in Section TP16. The SFMTA does not guarantee the accuracy of these contacts, the Contractor shall verify the accuracy of these drawings and lists.

The articulation Jumper Cables shall be wired identical to the attached wiring reference list.

Any variances discovered by the Contractor from the attached list are to be submitted to the SFMTA for correction. **[CDRL 7-006]**

The jumper cable assemblies shall be designed to be able to withstand the service and environmental conditions as specified in Section TP02 of these Technical Provisions.

Each wire shall have a terminal marker at both ends per the requirements of Section TP08 Materials and Workmanship of these Technical Provisions. Each Jumper Cable shall be identified with a metal collar at each end.

E. CABLE SUPPORT SYSTEM

The Contractor shall install the pre-fabricated jumper cables with a support system above the bellows to control the motion of the cables, to prevent the cables from tangling, chafing, and binding. Sufficient cable loop or slack shall be provided to eliminate fatiguing of the wires while the vehicle moves through turns (horizontal and vertical) without too much slack. The harnesses shall slope down from the connectors to prevent water from accumulating at the connector seal or in the connector in case of harness failure. The Contractor shall submit the drawings indicating arrangements under worst-case conditions of vehicle movements for review and approval. **[CDRL 7-007]**

F. INSTALLATION TESTING

As part of the Acceptance Testing, the Contractor shall test each circuit of the cable assemblies for continuity, insulation, and circuit function.

The cable assemblies shall be tested under static cold circuit conditions and under dynamic hot circuit conditions. The Contactor shall conduct these car tests with the Contractor provided Break-Out Connection Boxes.

TP07.03 MATERIALS AND WORKMANSHIP

All materials and workmanship shall comply with the requirements of Section TP08 Materials and Workmanship of these Technical Provisions.

The connectors shall be of the original watertight bayonet style as used on the "A" side of the car. The name-brand such as ITT, Veam or Commital, or approved equal as detailed in the attached part number list shall be used unless otherwise first approved by the Engineer.

TP07.04 SFMTA FURNISHED DRAWINGS, SCHEMATICS, AND DOCUMENTS

The SFMTA shall make available an LRV for the Contractor's inspection, measurement and testing to determine the necessary cable assembly lengths, and the receptacles installation conditions for mounting and wiring to the existing LRV circuit wires.

Copies of related drawings, schematics and documents from the SFMTA's archives will be made available to the Contractor. They are to be used for reference purposes only and do not necessarily reflect the existing configuration of the vehicles. It is the Contractor's responsibility to verify accuracy of all drawings and documents provided by SFMTA.

Jumper wire lists are provided in Section TP16 Supplemental Drawings and Reference Drawings.

TP07.05 INITIAL INSPECTION AND DYNAMIC TESTING

The Contractor shall conduct a pre-modification inspection to determine the as-is condition and completeness of the roof articulation harnesses prior to initiating the modifications. The Contractor shall prepare and submit for approval an inspection report, describing the condition of the harnesses towards a successful modification of the vehicle. See Section TP10 Inspections and Testing for all test requirements and CDRL identification..

The prototype vehicle shall be subjected to dynamic testing under service conditions to show if the cable harnesses are able to flex without buckling, tangling, or binding through all service speeds and turns (horizontal and vertical), and be able to withstand environmental conditions.

The dynamic test shall include an endurance component to show that the cable assemblies will perform correctly without failure or degradation in 3000 miles of actual service conditions.

At the end of the 3000 mile period, the Contractor shall test the cable assemblies and connectors for continuity and circuit function, environmental wear, and inspect the assemblies for chafing, binding, and tangling. Individual conductors within the bundles shall be inspected for chafing, pulling, and environmental ingress. See Section TP10 of these Technical Specifications for test requirements.

TP07.06 FIRST ARTICLE INSPECTION

The first rebuilt unit shall be presented to SFMTA for approval, prior to continuation of the rebuild effort. The Contractor shall support this process with a complete set of documentation, including test reports. **[CDRL 7-008]**

TP07.07 SPECIAL TOOLS

The contactor shall provide two (2) carsets of test break-out boxes as required in Section TP14 Special Tools and Equipment. One carset shall be used for the static and dynamic testing of the installed cable assemblies and one shall be used for bench testing of the cable assembles during repair and replacement of the circuit wires. The bench testing unit shall illuminate a lamp for each conductor when continuity exists between the end connectors.

TP07.08 CONTRACT DELIVERABLE REQUIREMENTS LIST

CDRL #	Title	Reference Paragraph
7-002	Cable Design Submittal Package	7.02.A
7-003	Wiring list.	7.02.B
7-005	Cable Replacement Procedure	7.02.B
7.006	Wiring List Corrections	7.02.D
7-007	Cable movement drawings	7.02.E
7-008	Cable Installation First Article Inspection	7.06

TECHNICAL SPECIFICATIONS
(TECHNICAL PROVISIONS)

SECTION TP08

MATERIALS AND WORKMANSHIP

August 28, 2009
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SECTION TP08
MATERIALS AND WORKMANSHIP

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TP08: MATERIALS AND WORKMANSHIP

The scope of the SFMTA LRV Doors and Steps Reconditioning and Systems Rehabilitation project is much narrower than a new LRV procurement, or entire vehicle overhaul, and many of the elements of this Materials and Workmanship section may not apply. However, the documentation has been provided as a guideline for the Contractor in the event that their chosen means of executing the specified tasks involves materials or construction methods not originally anticipated by SFMTA. Any CDRL listed in this section should only be submitted for elements of this project to which they apply, if at all.

The vehicles contain a variety of miscellaneous components including: labels, grommets, springs, gaskets, mounting hardware, captive screws, threaded fasteners, washers, lock washers, nuts, hangers, tape, tamper proof hardware, elastomeric components, seals, couplings, link pins and hook plates, vertical support rods/eye bolts; packing seals; springs, cotter pins, fuses, etc. Wherever such components are identified to be replaced, they shall be replaced in kind with new components. All new materials used in the work shall comply with the requirements of this section.

TP08.01 GENERAL

A. Overview

Inclusion of a material or method in this Section shall not necessarily indicate approval for application or use in a specific situation. Specific requirements detailed in applicable Technical Provisions shall take precedence. The most recent standards and specifications applicable at the time of issuance of the Notice to Proceed (NTP) shall apply unless otherwise approved by the Engineer

Surfaces exposed to passengers, crew, and maintenance personnel shall be kept smooth and free of burrs, sharp edges or corners, and dangerous protrusions. The rebuilt vehicle shall avoid pinch points, tripping hazards, snagging points, water traps, and debris accumulation points.

The Contractor shall ensure that any fastening or joining to structural members does not result in moisture accumulation within any structural member.

All materials shall withstand the environment in which the vehicle operates and the cleaning agents used without degraded performance, compromised functions, physical deformation or structural damage, and shall be inherently corrosion resistant, or be suitably finished with a corrosion resistant finish to minimize corrosion and degradation of appearance or function.

All materials utilized in the rebuild of the vehicle shall be subject to the approval of SFMTA.

As applicable, all materials shall comply with the Flammability, Smoke Emission and Toxicity requirements of this section.

B. Standards

The following domestic standards and specifications shall define the materials for this Contract: Federal or Military Specifications or Standards, the Specifications of the Aluminum Association of America, AAR, AISI, ANSI, ASME, ASTM, FRA, IEEE, APTA Standards and Recommended Practices for Rail Passenger Equipment, and others, as specified herein.

C. Prohibited Materials

The following materials shall be prohibited from use on the cars:

- PVC
- Asbestos
- Cadmium (except for battery)
- Lead, all applications including in paint and coatings, except for electronics solder
- PCBs
- Carcinogenic materials as listed by current Publication of the American Conference of Governmental Industrial Hygienists (ACGIH)
- All CFC and HCFC compounds
- Urethane foam
- Materials listed in 29 CFR Sec. 1910.9

D. Material Handling

The Contractor shall exercise care in the handling of all material used in the rebuild and overhaul of the SFMTA vehicle systems. Examples of mishandling material include but are not limited to the following:

- Exposure to corrosives or other elements that may deteriorate the subject material
- Inappropriate storage (stacking beyond packaged limits, careless placement of material, temperature extremes beyond the manufacturer's recommendations)
- Dragging materials across rough surfaces that may cause damage (e.g. dragging cables)
- Stretching materials during handling
- Exposure of certain materials to excessive UV light

TP08.02 JOINING AND FASTENING

A. Joining

1. General

Isolating and moisture-proofing materials, appropriate to the materials being joined, shall be employed at all times where these combinations exist.

2. Corrosion Control

Equipment located in areas highly susceptible to corrosion shall be made from inherently corrosion resistant material

Areas exposed to corrosive fluids, materials, or cleaning solutions shall be protected with coatings resistant to those fluids. Except as otherwise indicated, all aluminum exposed to view in finished work in the interior of the vehicle shall have a protective anodized coating.

The recommendations contained in "a Corrosion Control Manual for Rail Rapid Transit", UMTA-DC-06-0152-83-1, shall be used, except as otherwise directed by SFMTA.

3. Dissimilar Metal Treatment

All metals used in the fabrication process shall be surface treated with corrosion-resistant materials prior to assembly, with consideration being given to the severity of exposure to which the surface shall be subjected.

The joining of incompatible metals and materials shall be minimized as much as possible. When such metals must be joined, provision shall be made in accordance with MIL-STD-889 to prevent chemical reactions between the metals.

Surfaces of aluminum alloy parts secured to ferrous parts shall be protected with one-part polysulfide or non-corrosive silicone sealant used as joint compound, or with joint material that is non-hygroscopic and is free from chlorides and heavy metal ions.

Fibrous joint material shall be impregnated with bitumen or other water-repellant substance, which shall completely cover interfacing surfaces.

All ferrous metal surfaces, other than stainless steel, shall be protected by painting or zinc plating as defined in this specification, unless otherwise specified. Steel surfaces not requiring protection shall be galvanized by the methods and requirements described in ASTM A123. Minor damage to galvanized coatings shall be repaired with an approved zinc rich paint.

4. Joint Fitting

Joints shall be properly fitted. When not otherwise specified in Contractor drawings or specifications, gaps between joints shall be held to a dimension less than 10% of the thinner material being joined or 0.002 inch, whichever is greater. Gaps shall be uniform in width. Edges shall be free of burrs and sharp edges and shall have a smooth, finished appearance.

Where excessive gaps (greater than those permitted by approved drawings or standards) are found to exist at the faying surfaces of structural bolted or riveted connections, metal shims of the same material as that of the deficient part may be used, but only with the written approval of the Engineer. Shims, if used, shall be permanently fastened to one of the base parts being joined in a manner approved by the Engineer.

5. Metal-to-Metal Connections

Where metals contact each other, the contact surfaces shall be free of dirt, grease, rust, and scale. Unless specified otherwise, the contact surfaces shall be coated with a metal based primer which conforms to Society for Protective Coatings Specification SSPC-Paint 25. Metal primer may be omitted for austenitic stainless steel to austenitic stainless steel joints.

B. Fasteners

1. General

The Contractor and suppliers shall be responsible for selecting fastener types, sizes, styles, lengths, materials, grades, and finishes that will meet the requirements of the Technical Provisions. The Contractor shall minimize the number of different sizes and styles of fasteners used. Unless otherwise specified, screws, rivets, mounting bolts, or similar items shall be replaced in kind. Interior fasteners shall be countersunk where possible, or low profile heads shall be used where countersinking is not possible.

Fasteners exposed to public view shall be treated as follows:

- On the vehicle interior, all exposed fasteners shall be stainless steel (Grade 316), with flat or oval heads, properly countersunk.
- On the vehicle exterior, all exposed fasteners shall be stainless steel.
- Exposed screws shall be "Pin in Head" Torx tamper-resistant type and approved by the Engineer.

Threaded fasteners shall conform to current SAE J429 standards for externally threaded fasteners and SAE J995 standards for internally threaded fasteners. Steel fasteners ¼" diameter and above shall be SAE grade 5 minimum. For overhead and underfloor mounted equipment, the bolt diameter shall not be less than 3/8 inch.

Stainless steel fasteners shall be manufactured from austenitic stainless steel alloys, according to ASTM F 593, with a nominal tensile strength of 100 ksi.

All safety-related fasteners that are plated or chemically cleaned shall have certifications showing freedom from hydrogen embrittlement, based on a representative sample of the actual production fasteners which have been tested for hydrogen embrittlement by the OEM Contractor or a supplier following ASTM F519 procedures. An ASTM F606 wedge-test sample may be used in place of the ASTM F519 standard samples. Test loads shall be a minimum of 80% of yield strength or proof load and held for a minimum of 168 hours. Any failures shall reject the entire lot.

All bolts or rods passing through wood shall be coated with aluminum paint conforming to Federal Specification TT-P-38.

Use of self-tapping fasteners is prohibited, unless expressly approved by the Engineer.

Fasteners used throughout the car shall be inch-standard fasteners, except that ISO metric fasteners may be used in conformance with the requirements of this section.

When bolts are used to secure apparatus, where the bolt head is not accessible, a reusable mechanical locking device shall be used to prevent the bolt head from turning when the nut is being turned.

At least 1 1/2 full screw threads shall be visible beyond all nuts. When used without elastic stop nuts, bolts shall not project more than 1 1/2 full threads plus 1/4 inch for bolts, 1/4-inch diameter or less, and shall not project more than eight threads for larger diameter bolts, unless otherwise approved by the Engineer. With elastic stop nuts, bolt threads shall not project more than 1/4 inch, regardless of bolt size.

All-metal prevailing torque-type locknuts shall only be used where there is insufficient clearance to install ESNA type locknuts, or where the locknut is exposed to temperatures above 200 degrees Fahrenheit.

1. Threaded Fasteners

a. Inch-Standard Fasteners

All inch-standard threaded fasteners shall conform to ANSI B1.1 Standard, Unified Inch Screw Threads (UN and UNR Thread Form), or Industrial Fasteners Institute Fastener Standards.

Prevailing torque-type locknuts shall be nylon insert type, ESNA, or approved equal, conforming to IFI Fastener Standards or Military Standard MS-21044.

b. Metric Fasteners

Upon approval by the Engineer, specific Line Replacement Units (LRUs) that are supplied by a supplier or sub-supplier to the Contractor may be supplied with metric fasteners to ANSI B1.13M (ISO-metric) standards. All internal fasteners and threaded components of the approved unit shall have ISO-metric threads. Internal to components, there shall be no mixing of metric and inch-threaded fasteners. External mounting fasteners and threaded connecting components shall have ISO-inch threads to ANSI B1.1 Standards. Each unit, component, or group containing ISO-metric threads shall be indelibly identified in an approved manner and in a conspicuous approved location, to signify that the unit contains metric threaded fasteners. All repair and maintenance manuals shall be conspicuously marked to indicate where metric threaded fasteners are used within the unit.

Metric fasteners shall be marked as required in "Metric Fastener Standards," Industrial Fasteners Institute's latest edition.

2.

3. Torquing

All safety-related fasteners and all fasteners exposed to fatigue loads, shall be torqued to a minimum preload equal to 75% of their proof load and "torqued striped" after torquing by paint or other approved means. All other fasteners shall be torqued to a value appropriate to the application, so that they do not loosen in service.

4. Washers and Lock Washers

Washers shall be used under the heads of all bolts, screws and under all nuts. Washers shall ANSI B18.22.2 or ANSI B18.22M, latest revisions, as is appropriate for the application. Where high strength fasteners are applied, washers shall be hardened and comply with IFI Fastener Standards.

Lock washers, when applied, shall conform to IFI Fastener Standards. Lock washers shall not be used for fatigue applications where the fastener must be torqued and marked. If applicable, prevailing torque nuts shall be used for these applications.

5. Rivets and Lock Pins

Structural steel rivets shall conform to ASTM A 502 or American National Standard B 18.1.2 standards. Exposed heads shall be concentric with the shank and free from rings, fins, pits, and burrs.

Swage-locking (Huckbolt type) fasteners shall conform to Military Specification MIL-P-23469. All rough surfaces of the collar end of these fasteners shall be machined or ground smooth where accessible to passengers, crew, and maintenance personnel.

7. Plating of Fasteners

All carbon, alloy, and martensitic stainless steel fasteners shall be plated with zinc, unless specifically waived by the Engineer. Zinc plating shall conform to ASTM-B-633, Type II, and SC2, SC3, or SC4 or ASTM B695, Class 8, Type II. Cadmium plated fasteners shall not be permitted.

Grade 8, Metric 10.9, or stronger fasteners shall not be plated if the OEM finish is other than plating.

Regardless of the coating's propensity for hydrogen embrittlement, each lot of high strength fasteners, including OEM plated zinc or yellow bolts (Grade 5 or Metric Grade 8.8 or higher) shall be tested for hydrogen embrittlement. Each lot of lower strength fasteners shall be tested for hydrogen embrittlement if the coating has the possibility of causing hydrogen embrittlement.

8. Rivet and Bolt Holes

Rivet and bolt holes shall be accurately located, aligned, free of burrs and, when necessary, during assembly, holes shall be reamed round to specified size in position. Bolt hole clearances shall not exceed the Industrial Fasteners Institute's requirements. All removed and replaced rivets shall have the holes reamed to the size required such that the next larger rivet may be driven securely.

TP08.03 STAINLESS STEEL

A. General

Ferritic stainless steels shall be painted where exposed to passengers or the weather. Austenitic stainless steels may be unpainted. Unpainted stainless steels exposed to passengers shall be a single grade of austenitic stainless steel in which both the color and surface finish of abutting pieces shall match, except where the design specifically calls for contrasting appearance.

B. Austenitic Stainless Steel

Structural austenitic, stainless steel components assembled by fusion or resistance welding, shall be of AISI type 201L (UNS S20103), 301L (UNS S30103), 301LN (UNS S30153), or JIS SUS301L (with Nitrogen) and shall conform to the requirements of ASTM A 666, except that the carbon content shall not exceed 0.03% and the nitrogen content of type 301LN and SUS301L (with Nitrogen) shall not exceed 0.25%.

Stainless steel used in structural applications covered by the Technical Provisions shall also conform to APTA SS-C&S-004-98, *"Standard for Austenitic Stainless Steel for Railroad Passenger Equipment."*

Stainless steel to be used in structural applications shall be tested for susceptibility to intergranular corrosion in accordance with ASTM A 262, latest revision.

Ferritic stainless steel shall be used only with the specific written approval of the Engineer.

TP08.04 LOW-ALLOY, HIGH-TENSILE STEEL

A. General

Low Alloy High Tensile (LAHT) steel structural shapes, plates, and bars shall conform to the requirements of ASTM A 588, where available. General requirements for delivery of LAHT shapes, plates, and bars shall be as required by ASTM A 6.

Cold and hot rolled LAHT sheet and strip shall conform to the requirements of ASTM A 606, Type 4. General requirements for delivery of these products shall be as required by ASTM A 568.

Welded LAHT steel shall develop 15 ft-lbs Charpy V Notch impact strength in the CGHAZ (Coarse grain heat affected zone) 0.039 inches from fusion area at -20 degrees Fahrenheit.

TP08.05 STRUCTURAL CASTINGS

A. Repair Welding and Cast-Weld Design

Castings requiring repair or modification by welding after completion of heat treatment may be stress relieved locally by using electrically-controlled heating to a temperature not greater than 1,150 degrees Fahrenheit and slow cooling. Manual torch stress relief shall

not be permitted except for cosmetic welds and only then after the procedures have been submitted for review and approval. For cast-weld designs, the entire length of all assembly welds on any welded assembly of several separate castings selected for design qualification shall be radiographically inspected to ANSI/ASTM E 94 and E 142, using reference radiographs from the International Institute of Welding's *"Collection of Reference Radiographs of Welds,"* quality level Green. Portions of assembly welds stressed in tension by service loads shall meet quality level Blue.

No repair welding of stainless steel castings is permitted without express written approval of the Engineer.

TP08.06 ALUMINUM

A. General

Aluminum alloy mill products shall be identified by Unified Numbering System designations and shall conform to The Aluminum Association specifications contained in the Association's publication *"Aluminum Standards and Data."* Aluminum alloy castings used for door thresholds shall conform to ASTM B 26, B 85, or B 108 for, respectively, sand, die, or permanent mold castings, respectively. Aluminum alloy forgings shall conform to ASTM B 247.

B. Design Stresses

All aluminum structural members shall be designed so that calculated stresses under the specified AW3 passenger load do not exceed the allowable stresses per APTA SS-C&S-015-99, *"Standard for Aluminum Alloys for Passenger Equipment Car Body Construction".*

C. Fabrication and Fastening

The forming of aluminum parts, joining of parts by bolting, riveting, and welding, and the protection of contact surfaces shall conform to the requirements of the Aluminum Company of America's Technical Report Number 524, *"Specification Covering Use of Aluminum in Passenger Carrying Railway Vehicles,"* except as otherwise specified herein.

D. Protection of Contact Surfaces

Aluminum alloy surfaces shall not be secured to or make direct contact with the surfaces of copper, copper-bearing aluminum alloy, brass, bronze, silver, nickel, nickel alloys, nickel plated parts, lead, tin, or wood.

The contact surfaces of aluminum alloy with aluminum alloy shall be painted with zinc chromate primer or approved equal before securement.

The surfaces of aluminum alloy parts secured to steel parts, where exposed shall be protected with a one-part polysulphide sealant, zinc chromate paste, mica insulation joint material, or an approved equivalent material which completely covers the faying surfaces. The insulating material shall be non-hygroscopic, and, if fibrous, shall be impregnated with bitumen or an approved, non-corrosive, water- and moisture-repellant substance.

Stainless steel and carbon steel fasteners plated with zinc shall be coated with zinc chromate paste or approved equal before installation. Where possible, only the head and the shank of the bolt shall be in contact with the aluminum part when secured in place. Suitable bushings may be used in place of the zinc-chromate paste.

E. Interior Trim

Where unpainted aluminum is exposed to contact by passengers, it shall have a clear (natural) anodic finish. The finish process shall be the Aluminum Company of America's "Alumilite 204" with a minimum coating thickness of 0.0004 inch and a minimum coating weight of 21 mg/square inch, or approved equal process.

TP08.07 ELASTOMERS

A. General

Where a direct replacement part is not available, new elastomeric parts must meet the requirements of this section.

The elastomers shall have high resistance to ultraviolet radiation, weather, and all proposed car washing and other cleaning fluids. All elastomeric parts shall be resistant to ozone, oxidation, heat, oil, grease, and acid, and have the longest possible life consistent with the other characteristics specified.

All resilient mounts and elastomeric truck components shall be of natural rubber. Synthetic rubber compounds may be substituted for natural rubber only when approved by the Engineer for a specific application.

B.

Elastomer Test Requirements

Physical Property	Test Method	Test Value
Hardness	ASTM D2240	45 to 75, Durometer A
Tensile strength	ASTM D412	1500 psi
Ultimate elongation	ASTM D412	300%, min
Ozone resistance	ASTM D1149, Type A, 7 Days, Ozone concentration 100ppm, 104°F	No cracks under 7x magnification
Oil aging resistance	ASTM D471, Test oil/fuel shall be representative of application, 72 hours, 158°F	+30% maximum change in volume
Permanent-set resistance	ASTM D395, Method a or B	25% Maximum Set
Tear resistance	ASTM D624, Method B	300 lb/in
Brittleness temperature	ASTM D746	Brittleness temperature no greater than -40F
Resistance to heat aging	ASTM D573, 72 hours, 158°F	-30% change in elongation -15% change in tensile strength -5 to +15 change in hardness

C. Life Expectancy

For all parts made by vulcanizing an elastomer to metal, any premature failure (less than six years) between metal and the elastomer or in the elastomer, occurring when the parts are used in normal service shall be considered as having been caused by defect of materials or workmanship.

Door seals, door nosings, glazing rubber and gasket shall have a minimum service life of 10 years.

D. Metal Parts

Metal parts to which elastomeric material is vulcanized shall be made of SAE 1020 or 1045 hot-rolled steel, unless otherwise approved by the Engineer.

E. Bonding

The joining of elastomeric pieces shall be conducted by the hot vulcanization process. Bonding of elastomers by other processes shall not be allowed unless approved by the Engineer.

F. Truck Parts

Truck bumpers, snubbers, and the exterior surfaces of air springs shall be made of natural rubber or approved equal. They shall be compounded to be resistant to abrasion, oil, grease, and acid.

G. Seals

Glazing strips shall be of neoprene conforming to ASTM C 542, or approved equal material.

TP08.08 RUBBER FLOOR COVERING

A. General

Rubber floor covering shall contain a minimum of 38% (nominal, by weight of compound) Butadiene Styrene rubber, shall be non-staining, non-discoloring, and 100% non-oil extended. Only high quality, fine, hard clay shall be used as filler. No whitening (limestone) shall be used in the compound.

At 68 degrees Fahrenheit, the rubber flooring shall bend 180 degrees around a 3/4-inch diameter mandrel without breaking, cracking, crazing, or showing any change in color.

The rubber flooring material shall be fully homogeneous throughout and shall meet the requirements of ASTM F 1344.

Prior to the installation of the floor covering, any depressions, voids, or cracks in the sub-floor shall be filled and the sub-floor shall be leveled and smoothed with an Engineer approved leveling compound.

The coefficient of friction of the floor rubber shall not be less than 0.60 when tested to ASTM D 2047.

B. Inspection Criteria

This Section addresses defects that shall be cause for rejection, their allowable limits, and repair methods where repairs are permitted.

1. Thin-Skinned Blister

A thin-skinned blister is a blister which, when finger pushed, will collapse upon itself. Any thin-skinned blisters which exceed the limits listed below shall be cause for rejection of the floor sheet.

Maximum Size – 0.030-inch high, 0.80-square inch area with longest dimension of 2 inches.

Maximum Population – three blisters in a 12-inch x 12-inch area with only one other blister within 3 feet of this area.

Repair Method – using a hypodermic needle, apply just enough Super Bond 420 or Bostik 1685 or equivalent, compress the blister and bring to a flush surface.

2. Thick-Skinned Blister

A thick-skinned blister is a blister which, when finger-pushed, will collapse and then returns to its original condition.

Maximum Size – 0.030-inch high, 0.80-square inch area with longest dimension of 2 inches.

Maximum Population – three blisters in a 12-inch x 12-inch area, and only one other blister within 3 feet this area.

Repair Method – no repair authorized, not an acceptable condition.

3. Lump

A lump is a blister without a void, consisting of solid material.

Maximum Size – 0.030-inch high, 0.80-square inch area with longest dimension of 2 inches.

Maximum Population – three 12-inch x 12-inch area, and only one other lump within 3 feet of this area.

Repair Method – no repair required.

4. Hole

A hole is a defect which is 50% or more through the material. Any holes found in the floor sheet shall be cause for rejection of the sheet.

5. Thin Area

A thin area is a defect where the sheet is of reduced thickness locally.

Maximum Size – 0.030-inch deep at the lowest point, 3 square inches with the longest dimension of 5 inches.

Maximum Population – one thin area in a 40-inch x 40-inch area, and no other thin area within 3 feet of this area.

Repair Method – rub with #00 steel wool to blend this area into the normal thickness material and then buff to a normal surface finish.

TP08.09 FIBERGLASS-REINFORCED PLASTIC

A. General

Fiberglass-reinforced plastic (FRP) shall be a laminated material, consisting of a gel coated surface and a combination of reinforced fibers in a thermoset polymer resin matrix,

where the reinforcement has an aspect ratio that enables the transfer of load between fibers, and the fibers are chemically bonded to the resin.
An analysis shall be performed to confirm that the proposed construction method, glass content and laminate structure is adequate for its intended purpose and meets the strength requirements provided in the Technical Provisions.

FRP parts shall have a minimum thickness of 0.125 inch and shall have a greater thickness at attachment points and edges. If fasteners are used to attach and/or assemble FRP parts, the parts shall be reinforced in a manner approved by the Engineer to preclude the development of cracks. Exposed sharp edges shall not be allowed on any parts.

B. Construction

1. Resin

The resin shall be of good commercial grade, thermosetting, polyester, phenolic, vinyl-ester,, or, or acrylic material selected to meet the physical properties of the Technical Provisions and molding process requirements.

1. Reinforcement

The fiberglass reinforcement shall be mat, fabric, woven roving, continuous roving, spun roving, or swirl mat as required to meet the physical properties of the Technical Provisions and the molding process requirements. The proposed glass content shall be a minimum 20% by weight, and shall be confirmed through testing to ASTM D 2584.

2. Gel Coat

The gel coat shall be resistant to scuffing, fire, weather, and cleaning agents. The gel coat shall have a minimum thickness of 0.016 inch and a maximum thickness of 0.030 inch. If the surface of the FRP panel is to be painted, a primer gel coat shall be used and the part shall be painted in accordance Technical Provisions. If the FRP panel does not receive paint, then the gel coat shall be pigmented to match the car's color scheme.

Finished gel coated surfaces shall have a minimum gloss value of 85 when measured with a 60 degree glossometer and shall exhibit no print through of the reinforcements or have any appreciable orange peel.

3. Additives

Antimony trioxide is prohibited as a component.

4. Strength Requirements

Independent laboratory test reports of production items shall be provided confirming that the production reinforced plastic material complies with the requirements of the following standards. Test specimens shall be conditioned in accordance with ASTM D 618.

Mechanical Property	Test	Class I	Class II
Tensile Strength	D 638	10,000 lbf/in^2	18,000 lbf/in^2
Compressive Strength	D 695	18,000 lbf/in^2	24,000 lbf/in^2
Flexural Strength	D 790	15,000 lbf/in^2	30,000 lbf/in^2
Impact Strength	D 256	10 foot pounds per inch of notch	13 foot pounds per inch of notch
Hardness		45 Barcol	45 Barcol

Class I: Items which are non-structural or will not be exposed to any loads such as window masks, destination sign shrouds, ceiling cove panels, ceiling headers, etc.

Class II: Items which are structural or will be exposed to loads from passengers or impacts such as end bonnets, under floor equipment enclosures, door pocket panels, wainscot panels, toilet room modules, toilet shrouds, passenger seat back shrouds, windscreens, stair wells, etc.

TP08.10 THERMOPLASTIC SHEET

A. General

Thermoplastic sheet shall be used as extruded or vacuum-formed and shall not contain plasticizers in polymer blend.

Thermoplastic sheet shall be homogeneous and extruded from virgin stock which does not include any regrind of vacuum formed parts. The applicable ASTM procedure shall be used to measure each of the characteristics. Only UV stabilized pigments shall be used to create the specified color of the thermoplastic sheet.

B. Quality

The finished parts shall be free of waves and quilting on both sides. Degraded polymer in the sheet shall not be allowed. Voids, lumps, and contamination shall be cause for rejection of parts.

C. Strength Requirements

Independent laboratory test certificates shall be provided stating that the thermoplastic sheet complies with the requirements of the following standards. Extruded sheet in the surface finish specified shall be used for testing.

Mechanical Properties	ASTM Method	Value
Specific Gravity	D 792	1.20 to 1.45
Tensile Strength	D 638	5,500 lbf/in^2 minimum
Elongation	D 638	50%
Flexural Strength	D 790	8,000 lbf/in^2 minimum
Flexural Modulus	D 790	3.3 x 105 lbf/in^2
Hardness Rockwell "R" Scale	D 785	90 to 110
Heat Shrinkage - 15 minutes at 350 degrees Fahrenheit		10% maximum in machine direction 5% maximum in transverse direction
Heat Deflection (annealed) @ 264 lbf/in^2	D 648	165 degrees Fahrenheit minimum
Impact Strength Fabricated Parts Gardener Dart Drop 0.5-inch diameter ball: at 73 degrees Fahrenheit at -20 degrees Fahrenheit	D 3029	 320 in-lb minimum 80 in-lb minimum

TP08.11 PIPING AND TUBING

A. General

All piping valves, fittings, installation methods, and testing shall be in accordance with the Code for Pressure Piping, ANSI B31.1. All joints shall be easily accessible.

Air or hydraulic hose applications shall not be permitted in locations where adequate visual inspections cannot be made. Hose installations shall be arranged in such a manner as to prevent accidental cross connections to other hoses located in the same general area.

Hose installations shall be such that kinking, rubbing, straining, and unnecessary swinging are precluded. Routing that requires other piping, or cables, as the sole means of support shall not be accepted.

All piping systems shall be cleaned to remove dirt, metal chips, oily contamination, and moisture. After full installation on the vehicle, and before connection or installation of system components, the piping system shall be completely flushed with a suitable liquid solution, using appropriate pressure and velocity to fully dissolve all contaminants from manufacture and installation.

Following installation, piping systems shall be pressure tested in accordance with ASME B31.1 or other approved method. All leaks shall be repaired to the Authorities' approval

and re-tested until acceptable under the approved test criteria.

The Contractor shall perform a leak test on the final air or hydraulic piping system, with all components installed, on each vehicle in accordance with IEC 61133. The Contractor shall submit a copy of the test procedure for approval. A copy of the test report for each vehicle, including retest reports if appropriate, shall be included with each Vehicle History Book.

Pipe routing and support shall keep the total length and number of fittings and bends to a minimum. The minimum clearance of ⅛ inch shall be maintained on all piping and tubing. Joints that serve the sole purpose of connecting straight runs of pipe shall not be used. Unavoidable joints in piping shall be made in an approved manner. All inaccessible runs of tubing or piping shall be without joints.

Piping and tubing shall be adequately supported at least every 24 inches throughout its length and at connections, and must not interfere with the removal of or access to other components. At all locations where pipe or tubing passes through holes in the floor, bulkheads, structure, or any fixed member, it shall be rigidly clamped to protect against possible damage or noise due to bearing, abrasion, or car dynamics-induced rattling. Clamps shall not be welded, brazed or otherwise permanently fastened to any pipe or tubing. Pipe and tubing interfaces with clamps shall be insulated with an elastomeric material to protect and sound-insulate the pipe or tubing.

Wherever piping interfaces with vibration-isolated rotating equipment approved flexible vibration eliminators shall be used. The pipe connection at either end of the flexible elements shall be rigidly clamped. All pipe clamps shall be inherently rigid and shall be firmly attached to car structure. All clamps shall be of a suitable material for the application.

B. Air Piping, Tubing, and Fittings

All piping shall be seamless stainless steel per ASTM A269, or carbon steel per ASTM A822, as determined by the application.

Stainless steel fittings must be used with stainless steel piping and tubing. Forged steel fittings, zinc plated to ASTM B633, Type II, Yellow, SC3 / SC4, may be substituted upon Authority approval. Forged steel fittings, zinc plated to ASTM B633, Type II, Yellow, SC3 / SC4, shall be used with carbon steel tubing.

Type "K" annealed copper tube per ASTM B88, latest revision, may also be used, when specifically approved by the Engineer.

All air piping must comply in all respects with the brake supplier's design and installation requirements. The diameter of the main reservoir pipe and brake pipes shall meet the brake supplier's requirements. All air pipes shall be sized in accordance with the function intended.

All hoses used shall comply with AAR M-618. All hose fittings shall be of an approved reusable type.

All piping shall be installed in accordance with AAR 2518 as incorporated in Standard S-400 (AAR Manual E) and in such a manner as to provide drainage to prevent freezing.

C. Brazing and Soldering of Piping, Tubing, and Fittings

All brazing and soldering shall comply with the applicable parts of Technical Provisions

TP08.12 PRESSURE VESSELS

All pressure vessels shall conform to the latest revision of Section VIII of the ASME Boiler and Pressure Vessel Code for Unfired Pressure Vessels.

TP08.13 WIRE AND CABLE

A. General

Selection of wire sizes and insulations shall be based on the current-carrying capacity, voltage drop, mechanical strength, temperature, and flexibility requirements in accordance with applicable AAR, APTA, ICEA, ASTM, NEC, NFPA 70, and MIL Specifications,and these Technical Provisions.

All wire and cable shall comply with the flammability, smoke generation and toxicity requirements of this section.

The use of solid wire shall not be permitted. Extra-fine wire stranding shall be utilized on applications subject to repetitive motion.

Leakage between primary wiring and vehicle body shall be measured in accordance with IEEE 11. The resistance shall be at least 10 MOhms when measured with 1,000-volt megOhmeter.

Hi-Pot shall be accomplished on all primary power wiring at 2,500 VAC for 1 minute per IEEE 11.

B. Conductors

Conductors for irradiated, cross-linked polyolefin wire shall be soft, annealed tinned copper in accordance with ASTM B33. Minimum stranding shall conform to AAR Standard S501, S502 (Number 589), or ASTM B-172 Class K, or ICEA S-66-524/Nema WC7, Table L-7, Class K for AWG No. 10 or larger, as appropriate for the application.

Stranding and conductor construction for wire sizes AWG No. 12 to AWG No. 16 shall be in accordance with ASTM B-174, Class K, or ICEA S-66-524, Table L-8, Class M, as appropriate for the application.

Stranding and conductor construction for wire sizes AWG No. 18 and smaller shall be in accordance with ASTM B-174 Class L or ICEA S-19-81, Table L-8, Class M, or shall be 19-strand construction as appropriate for the wire size.

C. Insulation

1. General Wiring Insulation

For all general car body wiring, the insulation shall be a flame retardant, flexible, irradiated cross-linked polyolefin material having a continuous temperature rating of 230 degrees Fahrenheit. The insulation shall be rated at 2,000 V, AC and dc, in the case of wires carrying a nominal voltage greater than 150 V AC or dc, and rated at 600 V, AC and dc, in the case of wires carrying a nominal voltage of 150 V or less, AC or dc. For wire sizes AWG No. 6 and larger, the insulation material shall be formulated for extra flexibility.

Flexibility for cable sizes up to AWG No. 2/0 shall comply with AAR RP-585, paragraph 5.9.7.1, for the appropriate wire size.

Flexibility for cable sizes AWG No. 2/0 and larger shall comply with AAR RP-585, paragraph 5.9.7.

Cross-linked polyolefin insulation shall not be permitted for use on wires connected to heater

2. Wire Insulation for High Temperature Applications

Teflon, mineral-filled, abrasion-resistant insulation may be used on wire sizes AWG No. 12 to AWG No. 28. High temperature insulation shall be used where wiring is connected to heat-generating apparatus, where the ambient temperature can exceed 257 degrees Fahrenheit (125 degrees Celsius), or where Teflon is specified as a requirement. The insulation shall be rated at 1,000 V, AC and dc, in the case of wires carrying a nominal voltage greater than 150 V, AC or dc, and rated at 600 V, AC and dc, in the case of wires carrying a nominal voltage equal to or less than 150 V, AC or dc. The insulation shall have a continuous temperature rating of 302 degrees Fahrenheit (150 degrees Celsius) or greater and shall be in accordance with the following requirements:

For wire sizes AWG No. 16 and larger: abrasion resistant Teflon (Polytetrafluorethylene – PTFE) meeting MIL-W-22759/6B or 10B, as appropriate for the voltage level used, or silicone rubber meeting AAR RP-587C. Conductors for high temperature wire AWG No. 12 and smaller shall be soft, annealed nickel-plated copper constructed in accordance with MIL-W-22759/6B.

For wire sizes AWG No. 18 and smaller: abrasion resistant Teflon (PTFE) meeting MIL-W-22759/6B or 10B, as appropriate. When used for interconnecting of apparatus, this type wire shall be in bundles with a protective covering of high temperature-rated, low smoke-generating insulation.

No high temperature insulated wire shall be used in conduit or raceways without specific approval. The Contractor shall submit all applications of high temperature wire insulation for review and approval.

3. Wire Insulation within Equipment

Insulation on wiring within replaceable modular units, electronic apparatus such as cards and card racks, and other equipment, as approved, shall be Tefzel (Ethylenetetrafluoroethylene – ETFE) per ASTM D 3159, and insulation construction per Military Specification MIL-W-22759/16 (AS), irradiated cross-linked polyolefin or Teflon (Polytetra-fluorethylene – PTFE) type EE, per Military Specification MIL-W-16878/5.

4. Wire Insulation in Crowded Locations

Wire for connections locations where there are crowded concentrations of low voltage control wiring, may be insulated with Tefzel (ETFE) per ASTM D 3159 and insulation construction per Military Specification MIL-W-22759/16 (AS), except that the wall thickness shall be 0.025 inch. When used for this application, wires shall be bundled with a protective covering of irradiated, cross linked modified polyolefin insulation.

D. Multi-Conductor Cables

1. General

For high-temperature applications, the cable shall conform to MIL-C-27072, with Type V connectors, Style 4 sheaths, Class D jackets, if needed, and shields, if needed. All conductors in multi-conductor cables shall be color coded or otherwise permanently identified as approved. In applications where current is not a factor in wire size selection, AWG No. 16 may be used between repeater devices and displays. For multi-conductor cables carrying low-voltage, high-speed, serial data, exceptions to the wiring requirements may be submitted for approval, based upon availability of wire to meet the application requirements.

2. Fillers

Where required to obtain a circular cross-section, fillers shall be made of non-hygroscopic materials compatible with the wire insulation and jacket, and shall be of the same or of a higher temperature rating than the wire insulation.

3. Tape

The binder tape material shall be non-hygroscopic and shall be of the same (or better) temperature class as the wire insulation, and shall be of a compatible material.

4. Shield

The shield shall consist of either tin-plated copper braid, concentrically-served copper, or aluminum/polyester tape with a drain wire, as appropriate for the application. The shields shall have the following minimum properties:

- Copper shield shall be made of either tinned, coated copper strands which conform to ASTM B 33, or silver-coated copper strands which conform to ASTM B 298, as is appropriate for the wire insulation. Shield coverage shall not be less than 85%. Shield strand size and application shall not be smaller than AWG No. 38.

- Aluminum/polyester tape shields shall consist of a helical wrap of aluminum/polyester tape with a nominal thickness of 0.0004-inch aluminum on a backing of 0.001-inch polyester. The tape shall have a minimum overlap of 10% of the tape width to ensure complete coverage. In contact with the aluminum side of the shielding tape shall be AWG No. 22 7/30 tinned copper drain wire conforming to ASTM B 33 and B 174.

5. Jackets

The overall jacket of multi-conductor cables shall be of flame-retardant, irradiated, cross-linked, modified polyolefin, Tefzel (ETFE), or Teflon (PTFE) to be fully compatible with the wire insulation and application as approved. The jacket shall be extruded and vulcanized over the cabled conductors, and shall be centered, with a smooth appearance without objectionable roughness or irregularities, consistent with good industry practice. The nominal jacket thickness shall be that shown below, with the minimum wall thickness not less than 80% of the nominal value.

Nominal Jacket Wall Thickness in Inches			
Cable Diameter Under Jacket	**Modified Polyolefin**	**Teflon or Tefzel**	**Neoprene**
0.000-0.250	0.045	0.010	0.072
0.251-0.500	0.045	0.015	0.087
0.501-0.750	0.060	0.021	0.100
0.751-1.000	0.080	0.021	0.100
1.000-1.500	0.080	0.025	0.115
1.501-2.000	0.11		0.135
2.001-2.500	0.13		0.152
2.501-3.000	0.14		0.195

E. Wire Wrap

- Wire wrap connections may be used in selected electronic applications, where approved by the Engineer.

TP08.14 WIRING

A. General

All car wiring shall be in conformance with APTA RP-E-002 *"Recommended Practice for Wiring of Passenger Equipment"* and the AAR Manual of Standards, Section F S-538,

"Wiring Practice and Rolling Stock Standard," except where otherwise specified. Circuit protection shall be in conformance with Chapter 2 of NFPA 70, Article 240.

B. Wire Handling

All wiring shall be performed by qualified, experienced wiring personnel using appropriate tools for stripping insulation, cutting, tinning, soldering, harness making, attaching terminals, and other wire fabrication tasks. All wiring tools and equipment shall be used as recommended by the tool and equipment manufacturer.

Wire shall be protected from damage during all phases of equipment manufacture.

When removing insulation, wire strands shall not be nicked or broken in excess of the limits of FAA Specification Number AC 43.13-1A, Section 449, "Stripping Insulation." Additionally, the following criteria shall apply:

Wire Size	Maximum Number of Nicked Strands*
Wires smaller than AWG No.10	None
AWG No.10 through AGW 1/0	7.4%
Above AWG 1/0 through 1600/24	4.4%
Above AWG 1600/24	Graduated Scale

*Definitions:

- A cutoff strand shall count as two nicked strands
- A nick is defined as 25% or more of the strand area damaged or cut more than 33% of its diameter.
- Longitudinal scratches in a copper strand are not considered cause for rejection.

C. Wiring Layout and Installation

1. Wire Harness

Wiring shall be pre-fabricated into standard harnesses, wrapped or tied with spiral wrap or tie wraps. Harnesses shall be installed with identical arrangement and location in each car having similar equipment. Separate harnesses shall be provided for major circuit groups or types, or as required for specified circuit separation. All circuits and branches shall be separated for troubleshooting and searching for undesired grounds. All circuits subject to periodic high potential tests shall be so arranged that they can be conveniently set up for the tests.

The layout of the wiring shall be designed in advance of its installation and in cooperation with those furnishing the related equipment.

Harnessed wires shall not be installed in conduit. Wires from different conduits or other openings shall not be harnessed together with wires running within the box or entering the box through another entrance point.

2. Circuit Separation

Circuits shall be physically separated to reduce the possibility of unsafe conditions, interference, or equipment damage.

The following major circuit groups shall not be harnessed or bundled together, shall not run in the same conduit, and shall be physically separated and secured in enclosures, wire ducts, junction boxes, or other wire routing devices:

- High voltage circuits
- AC circuits
- Communication circuits
- Battery voltage level circuits
- Semiconductor gating voltage level circuits
- Conductors carrying in excess of 100 amps

Wires in circuits with potentials differing by 50 V or more shall be separated by a physical barrier. Where a raceway, duct, junction box, or enclosure is divided into two or more distinct areas by metallic partitions, each area may be considered separately in this application.

All wiring within an enclosure shall be insulated for the highest voltage in the enclosure. All wiring connected to apparatus shall be insulated for the highest voltage connected.

Wiring connected to transient-generating apparatus, such as unsuppressed contactor coils, shall not be run adjacent to wiring carrying signals to, from, or between semiconductor circuits, logic circuits, vital no-motion circuits, or communication circuits.

3. Wire and Cable Runs

Wire runs shall be continuous and unbroken between connection points, shall be supported at no greater than 24-inches spacing, and shall be protected at each support point against mechanical crushing and abrasion. A watertight bushing and drip loop shall be provided on all exposed cable entries.

All undercar wiring smaller than AWG No. 6 shall be run in closed wire ducts, conduits, or open wire mesh wireways in an approved manner. Wire and cable shall be secured within ducts or open wireways, including each entrance and exit point, to prevent chafing and movement. Wire ducts and conduits shall be of waterproof construction. Permanently retained watertight strain relief bushings, with insulated throat liners of an approved design, shall be used at locations where wires, cables, or harnesses enter or exit conduit, ducts, apparatus, and equipment enclosures.

Strain relief bushings on equipment enclosures shall include a permanently retained O-ring type seal.

Lead wires to resiliently-mounted electrical apparatus shall be carried in conduit to a point as close to the apparatus as possible. The length of the leads between the end of the conduit and each piece of apparatus shall be as approved. Short runs of cables or harnesses entering or leaving conduit and apparatus shall have an approved guard mounted to the carbody to protect the wires from mechanical damage. Lead wires to solidly-mounted electrical apparatus and equipment enclosures shall run in conduit connected to the apparatus or enclosure.

Any wiring run through the floor shall be run in ducts or conduit. Wiring must not be run through partitions without suitable bushings at such points of passage.

Cables shall be laid in place with sufficient slack at the bends so that cables will clear the inside bend surface of the wireway/wire duct.

All wire and cable shall be free of kinks, insulation damage, insulation abrasions, and nicked strands. Wire installation shall not be subject to accumulations of water, oil, or other foreign matter.

Wires or cables shall not pass through or over the battery compartment and shall not pass over heat-generating equipment even if the wires or cables are in conduit.

Exposed harnesses, short cable runs, and harnesses entering or leaving exposed raceways shall have approved, fire-resistant, flexible dielectric sleeving installed over the raceway edges and grommet-type insulation at penetration holes.

a. Cable Cleating and Support

All cable and wiring, exiting wireways/wire ducts, and that which is not installed in conduit, shall be cleated using split-block cleats of molded neoprene rubber. Cables shall be cleated and bushed when passing through bulkheads and structural members. The cushioning neoprene shall be non-conductive, fire-retardant insulating material. Each cleat shall have a stiffener of at least 10-gauge material on the side away from the mounting bracket which shall act to spread the bolt clamping force over the entire length of the cleat. Bolts shall have lock nuts.

AWG No. 6 or larger insulated wire may be cleated in place without conduit, duct, or open wireway. In the areas over the truck in the wheel wash and not protected by underfloor-mounted equipment, the wire shall be mechanically protected by an approved guard.

Cleats shall be designed to grip each cable individually and firmly, but without causing damage to cable insulation, including cold flow of the insulation. Cleated cables shall be routed and supported such that they cannot, under any combination of forces and car movement, touch each other or any other part of the car.

Wire and cable runs shall be continuous and unbroken between terminations. Wires that run under the car shall be supported at not greater than 18-inch intervals. The wire shall be protected at each support point from mechanical crushing and abrasion.

Wire splices shall not be permitted.

Concealed wires, such as within conduits and wire ducts, shall be such that wires may be replaced or added to without the removal of other than access panels.

Wiring run in loom shall not be carried over potential chafing hazards.

Wires entering any removable box shall be harnessed and secured to facilitate removal of the box.

b. Wire Securement and Termination

Wiring and cabling shall be readily accessible for inspection and maintenance.

All wiring shall be located and secured such that normal equipment motion, maintenance access, heat sources, and the environment do not damage or reduce the life of the wiring.

Junction boxes with terminal boards shall be used for wire terminations. Exterior junction boxes shall be weathertight.

Wire and cable dress shall allow for sufficient slack at equipment terminals to provide for movement induced by shock and vibration, equipment shifting, alignment, cover removal, and component replacement. Sufficient lengths shall be provided at points of termination for additional reterminations without applying tension to the wire and without splicing as follows:

- AWG No. 10 and smaller – Three reterminations
- AWG No. 8 and larger – Two reterminations

A drip loop shall be provided on all exposed wires and cables to prevent fluid runoff into connected equipment.

Wire-tying devices shall be of such material and construction that they will adequately retain the wires for the life of the wiring and shall be resistant to ozone and ultraviolet light. Wire and cable ties shall be trimmed and located to eliminate any hazard to personnel from sharp edges. Wire-tying devices shall be mechanically fastened to a permanent structure.

All wire bundles and cables within an enclosure shall be supported by the use of tape rails, shall be spaced away from the equipment box structure, metal edges, bolt heads, and other interference points, and shall have electrical clearance from the covers, regardless of the insulation properties of covers.

Truck wiring shall be designed to ensure sufficient slack and shall be provided with clamp supports and abrasion protection. T-splices shall not be permitted.

All jumpers, jumper heads, and jumper receptacles shall be sealed in an approved manner to prevent the entry of water at any operational speed of the car.

Wire and cables that are subject to high currents in fault conditions or normal operation shall be secured against secondary damage from high magnetic forces.

3. Circuit Shielding

The wire shields shall be connected through all applicable connectors and junction boxes. Circuits shall be categorized. Shields in one circuit category shall not be interconnected with shields of another category. Shields used to protect against interference shall not carry signal currents.

Shields on low-level signal wires shall not be interconnected with shields on high-level signal wires in the same category. Each group of shields (other than at the electric jumper receptacles and couplers) shall be carried through on a connector pin or pins, or on terminal strips which shall be in the immediate proximity of the categorized group of circuits.

Coaxial cables used as constant impedance transmission lines shall be terminated as required by the circuit termination design and shall not be considered to be shielded conductors. Triaxial cables may be used as coaxial impedance transmission lines with the outer conductor employed as an RF shield.

The following three guidelines shall be applicable in so far as possible, but are not requirements:

- Shields used to suppress electromagnetic interference (EMI) at all frequencies shall be terminated only at the low potential side of the interference circuit, at the termination which exhibits maximum susceptibility.

- Shields used to protect against the effect of, or to exclude, EMI at frequencies below 150 kHz, shall be terminated either to the low potential side or at the balance point of the protected circuit at the termination which exhibits maximum susceptibility.

- Cables requiring both audio frequency (AF) and radio frequency (RF) shields shall be electrically isolated from each other. The resistance between these circuits shall be at least 500 mega-ohms when 500 V DC is applied. Double shielding shall be required on circuits that are both AF-susceptible and RF-susceptible.

D. Marking and Designation

Wire numbers shall be assigned to all electrical conductors, whether individual wires or

cables, within the entire car. The Contractor shall emulate the numbering system, employed on the existing vehicle.

All wires and cable shall be marked within 305 mm (12 in) of the end of the wire. The methodology and wire marking system employed shall be approved by the Engineer.

Wires shall be identified according to circuit function, wire number, wire segment, and gauge.

Each circuit shall be individually designated from point to point. Common designations for return circuits will not be permitted.

No disassembly of the wire harness or the connection shall be required to read the wire marking. Wires shall be marked with an alpha-numeric circuit designation.

There shall be no duplication of wire codes in unrelated circuits throughout the car. Where there is more than one identical assembly per car, each assembly shall be wired identically to the other(s) and wire marking shall be identical at each assembly.

Wire markers shall meet the adherence and solvent resistance requirements specified by MIL-M-81531, latest revision, and shall withstand all combinations of ambient and equipment temperatures. Hand printing is prohibited.

For cable identification, the Contractor shall use a basic identification system in conformance with ANSI/IEEE 200 and shall submit the system selected for review and approval by the Engineer.

E. Pulling Compound

Pulling compound shall be non-conductive, non-hygroscopic, non-odorous, and shall not support bacterial activity nor attract vermin.

F. Solder

Solder shall be in accordance with ASTM B 32, Grade Sn60. A non-corrosive flux shall be applied immediately before soldering.

G. Tape

Electrical tape shall be in accordance with AAR Standard S-540, or equivalent approved for railway practice. Electrical tape shall meet or exceed the voltage rating of wire where the tape is applied.

TP08.15 WIRE AND CABLE CONNECTIONS

A. General

All equipment enclosures and junction boxes, except primary power circuits, shall be fitted with terminal boards or connectors. Primary power circuits shall be fitted with compression terminals and knuckle joint connectors as described herein. Unused connector pin positions shall be sealed with either connector contacts or plastic sealing plugs designed for that purpose.

IPC/WHMA-A-620 Requirements and Acceptance for Cable and Wire Harness Assemblies shall be integrated into the wiring production plan.

Terminal boards with M4 or No. 6 or smaller screws and quick-disconnect terminals shall be permitted only with prior approval by the Engineer.

B. Terminal Boards and Terminal Points

Molded case, modular terminal blocks which utilize a spring clamp to hold the wire may be used for low voltage circuits. Each terminal block shall be properly identified with a permanent marking and each assembly shall be secured to the mounting (DIN) rail by end clamps which incorporate metallic hardware. All wires AWG No. 12 and smaller shall receive a ferrule. All molded case, modular terminal blocks are subject to review and approval by the Engineer.

All other electrical terminal points and terminal boards shall be one of the following types:

- Stud type in accordance with MIL-T-55164A
- Binding head screw type in accordance with MIL-T-55164A, only where approved.

Stud-type terminal points shall have brass studs and connections, each of which shall be locked using a single brass nut with brass flat washer and a plated spring-type lock washer. Studs, nuts, and washers may also be made of corrosion-resistant, plated steel, where approved. All terminal boards shall be in accordance with Military Specification MIL-T-55164A.

Threaded studs shall have a minimum of 2 1/2 threads exposed beyond the final nuts. Adequate space shall be provided to permit connecting wire terminals with standard tools. All terminals shall be properly torqued to assure sound connections.

Jumpers between terminal board points shall be brass or plated steel.

A maximum of two terminals shall be connected to any one binding screw. A maximum of four terminals shall be connected to any one threaded stud, provided that there is no interference among terminal barrels. On terminal boards, the wiring shall be arranged so that no more than two terminals are connected to a stud from each side.

C. Wire Terminations

Terminals and connections used throughout the car shall be mechanical, solderless, crimp type as manufactured by AMP Incorporated or other approved manufacturer with a comprehensive line of terminals, connector pins, and application tools available. All terminals for the same wire size shall be crimped with the same model tool and attached to the wiring with proper crimping tools and dies as recommended by the manufacturer.

The terminals used on AWG N0. 10 and smaller wires shall securely grip and hold the insulation of the conductor, unless otherwise approved. Terminals shall be ring lugs in accordance with Military Standard MS-25036; spade and hook-type terminals shall not be used.

Conductors subject to motion relative to the terminal shall be protected to prevent breakage of the conductor at or near the terminal. Sufficient slack shall be provided in all wires and cables to prevent breaking or pull out of bushings and terminals. Only one wire shall be crimped in any one terminal.

Wherever several wires are connected to terminals of a terminal strip on a device which is removable from the car for maintenance, the wires shall be terminated, with double-ring terminations which shall be screwed to an insulating fanning strip which shall serve to keep the terminations in the correct relative locations while disconnected from the device, unless otherwise approved by the Engineer.

D. Power Cable Terminations

Power cables shall be terminated with an approved compression terminal. Sufficient cable slack shall be provided to preclude breaking or pull-out from bushings or terminals and to allow two reterminations. Compression terminals shall be applied using tools and procedures recommended by the terminal manufacturer for that purpose. Swaging tools shall be of a type that ensures complete swaging in every case.

E. Cable Connectors

All cable connector applications shall be subject to approval.

Unused connector pin positions shall be sealed with either connector contacts or plastic sealing plugs designed for that purpose.

All cable connectors shall conform to MIL-C-5015 or an equivalent standard as approved. They shall employ removable crimp contacts of the correct size for the wire being terminated.

Adjacent connectors shall use either different inserts or different insert orientations to prevent erroneous connections. The receptacle portion of all cable connectors shall be rigidly mounted.

All cable connectors used in exterior locations shall be of the environmental watertight variety. Cable connectors shall be equipped with sealing gaskets on the front mating surface and on the back where the cable enters. The cable jacket shall be held by a clamp within the connector body.

Plastic-bodied connectors shall not be used in exterior locations.

Quarter-turn, bayonet-lock connectors shall conform to all provisions in MIL-C-5015, or other approved standard, except for the screw coupling requirement.

Connectors in high vibration or high motion areas shall have the wire connections soldered and potted and shall have a watertight jacket molded over the cable and connector to form a unitized assembly.

F. Quick-Disconnect Terminals

Quick-disconnect terminals shall be utilized to facilitate maintenance and inspection. They shall provide positive terminal engagement and be shock- and vibration-proof. All terminals shall be provided with insulation equal to that of the wire. No "push-to-fit" (FASTON) type terminals shall not be permitted unless specifically approved by the Engineer.

G. Grounding

1. Connections

Grounding connections to carbody and equipment shall be made through silver-soldered or brazed copper pads of an area adequate for the anticipated maximum current that may be carried under any circumstances. Transition (base) plates, if used, shall be of the same alloy group as the respective carbody part or apparatus. The base plate shall be welded to the carbody or apparatus.

All ground pads shall be visible and accessible for inspection and troubleshooting. The ground connections shall be attached by a bolt, washer, and nut designed for the purpose. Anti-corrosive grease shall be applied over the connection.

All equipment enclosures and shock-mounted equipment shall be grounded with flexible, grounding leads bolted between a car body grounding pad and the equipment's grounding pad. Braided, strap-type leads shall be used where there is relative motion between the two items being connected. The ground strap termination method shall apply uniform pressure to the conductive surface and the current density shall not exceed the bonding requirements.

Ground cables and shunts shall not be less than No. 10 AWG.

2. Bonding

All grounding and bonding jumpers and straps shall be sized to carry fault current and lightning discharge current for which the voltage drop shall not exceed 25 V. The bonding method employed shall not produce a DC resistance in excess of 0.0025 ohms, or more than 0.025 ohms at 150 kHz for any applied AC voltage. Grounding and bonding jumpers and brazed shunt straps shall be "extra-flexible."

H. Wire Splicing

Splicing of conductors shall be permitted only with approval by the Engineer on a case-by-case basis. Splicing of conductors in conduit shall not be permitted.

TP08.16 CONDUIT

A. Types

All conduit and conduit couplings shall be of an ANSI-approved type. All exterior rigid conduit shall be standard weight, galvanized steel with threaded fittings. All conduit ends shall be deburred inside and out to remove sharp edges and all pieces shall be blown out with compressed air and cleaned before installation to remove filings and other foreign material.

Steel conduit shall be mild steel in standard lengths with threaded ends and hot-dipped zinc-coated exterior and interior surfaces. Conduit shall conform to the requirements of ANSI Standard C-80.1. The threads per inch and length of threading shall conform to ANSI Standard B-2.1 for pipe threads.

Steel fittings shall be used to assemble steel conduit. Elbows, nipples, and couplings shall be made of the same grade of steel as that of the conduit. All fittings shall be treated, coated, and threaded according to the requirements for zinc-coated, rigid steel conduit and shall conform to UL 6.

Flexible conduit shall be watertight and interlocking aluminum, or steel strip protected, with an approved rust-resistive coating. Flexible covering on conduit shall not contain polyurethane, nylon, or PVC vinyl. Cross-linked polyolefin may be used.

Liquid-tight flexible nonmetallic conduit, if required for special applications, may be used with the Engineer's approval. Liquid-tight flexible nonmetallic conduit shall not be used where subject to physical damage or in lengths longer than 6 feet.

B. Installation

All conduit bends and offsets used shall be made by the use of special forms or tools and shall have the largest radius possible so that wires can be pulled without the use of tackle or power.

Conduit shall be securely clamped with all runs electrically grounded to make a continuous ground.

All conduits shall be arranged to prevent moisture traps and shall drain toward control boxes, except that all open-ended conduits shall be installed in such a manner as to ensure gravity drainage out the end. Conduit shall be supported to the carbody at least every 24 inches.

TP08.17 CONDUIT FITTINGS AND JUNCTION BOXES

A. General

All conduits and their connections to electrical equipment shall be installed to make a continuous ground. All conduit fittings and junction boxes shall be provided with gaskets. Gaskets for conduit fittings and covers shall prevent the ingress of dust, debris, and water encountered in the operating environment.

B. Boxes

All exterior junction boxes shall be fabricated of minimum 14-gauge steel or aluminum (where permitted). All exterior junction boxes shall be weatherproof and shall be connected in such a way that drainage from equipment groups will not pass through conduit into the junction boxes.

Interiors of all junction boxes shall be primed and then protected with a white, insulating coating.

C. Conduit Interface

The open ends of conduit shall be provided with strain relief-type fittings with extended rubber bushings, bell-mouth fittings, or insulated throat box connections as approved by the Engineer. All conduit entries into removable equipment boxes shall be secured by means of a bolt-on watertight access panel.

D. Covers

All junction box covers shall be retained captive screws as approved on a location-by-location basis. All fasteners used in junction boxes shall be stainless steel. All covers shall be designed to accept or mate with an approved seal/gasket.

TP08.18 WIREWAYS

All wireways shall be of rigid, stainless steel construction. The trays shall be completely de-burred, leaving absolutely no sharp edges, before installation on the vehicles. Grommet clamps shall be provided at all locations where cables or wires enter or leave the wireways. Metal wireways, elbows, couplings, and similar fittings shall be flush with the metal surface.

The wireways shall be routed such that they avoid:

- Sources of heat;
- Wheel splash; and
- Areas subject to damage by debris or foreign objects.

Wireways shall be located to provide access to the harnesses contained within for maintenance. They shall be provided with approved covers which may be interrupted for entry and exit of wires and cables.

Wireways shall be designed to prohibit the collection of dirt and debris, and shall be perforated, without compromising their requisite strength, to permit ventilation and drainage. They shall preclude water entrapment.

Metal raceways and the elbows, couplings, and fittings shall be electrically and mechanically coupled while protecting wires from abrasion, and shall make a continuous ground with the car structure.

Bends in wireways shall be avoided; however, if required, approved protection shall be provided to avoid insulation chafing at the bends.

All wire and cable shall be securely fastened within wireways to eliminate movement and chafing.

TP08.19 WELDING AND BRAZING

A. General

The Contractor shall be responsible for the quality of its welding and brazing as well as that of its suppliers and subcontractors. Cleaning prior to welding shall be in accordance with applicable parts of Section 2, MIL-HDBK-132, *"Protective Finishes."*

B. Structural

All structural welding practices shall be according to requirements of the AWS D1.1, *"Structural Welding Code – Steel;"* AWS D1.2, *"Structural Welding Code – Aluminum;"* AWS D1.3, *"Structural Welding Code – Sheet Steel;"* AWS D1.6, *"Structural Welding Code – Stainless Steel;"* AWS D15.1, *"Railroad Welding Code;"* and the AWS Handbook. Requirements for dynamically loaded structures shall be applied. Cast steel welding shall be according to ASTM A 488/488M, *"Steel Castings, Welding, Qualification of Procedures and Personnel."* Resistance welding shall be in accordance with AMS-W-6858B. AWS D1.1 shall apply to steel of 1/8-inch and greater thickness. AWS D1.3 shall apply to steel less than 1/8-inch thickness.

Structural welding of ferritic and austenitic stainless steel shall be governed by AWS D1.6. ASME Section IX and ASME Section VIII, Part UHA shall apply when appropriate. AISI 201L (UNS 20103) and 301LN (UNS 30153) stainless steels shall be treated as P-Number 8, Group-Number 3, category for reference to ASME requirements. Ferrite number for welds shall be between WRC4 and WRC10, or as proposed by the Contractor and approved by the Engineer. Weld heat-affected zones (HAZ) and weld metal shall be limited to maximum allowable stress values in ASME Section VIII, Table UHA-23, for UNS S20100 stainless steel and Table UW-12 rating of welds. Fatigue allowable stresses shall not exceed the lesser of fatigue limits in AWS D1.1, Section 2.20.6, or 50% of the joint strength level calculated from ASME maximum allowable stress values. Higher values shall only be used if qualified by Contractor tests.

All Welding Procedure Specifications (WPS) shall be fully qualified by test by the Contractor. The use of AWS-B2.1 shall not be permitted and shall not be included or referenced in Welding Procedure Specifications (WPS) and Procedure Qualification

Records (PQR). The use of any WPS purchased from AWS shall not be permitted. All WPS shall be fully qualified by the Contractor PQR-welding tests and subject to approval by the Engineer and a Certified Welding Inspector.

C. Welder Qualification

Welders shall make only those welds for which they have been qualified according to the requirements of the AWS, ASME Section IX, ASTM A 488/488M, or other approved qualifying procedures. (AWS B2.1 shall not be used, as noted above.) Records of welder qualification tests shall be made available for review.

D. Inspection

The Contractor shall visually inspect all structural welds in accordance with AWS D1.1 requirements.

Nondestructive surface inspection (dye penetrant or magnetic particle methods, as appropriate) shall also be used to inspect all first-production welds. The Contractor shall specify a sample nondestructive inspection rate for all subsequent welds. A record of all NDT inspections shall be included in the Car History Book.

E. Post-Weld Cleaning Requirements

All welds exposed to passengers or on sliding contact surfaces of truck frames and bolsters shall be completely cleaned of spatter.

F. Special Welding

Procedures and qualification records for structural welding of stainless steel to LAHT, or other combinations of metals or conditions not covered by AWS specifications or codes, shall be submitted for approval. As part of the qualification of all dissimilar metal welds, sample welds shall be sectioned and examined metallographically to determine HAZ hardness. The HAZ hardness shall not exceed 400 HV (Vickers Hardness).

Austenitic stainless steel electrodes or wire shall be used to join carbon or LAHT steels to stainless steels. Galvanized steel shall not be welded to stainless steel.

G. Resistance Welding

Resistance welding of stainless or carbon steels shall be according to AMS-W-6858, Class B for structural applications and Class C for non-structural applications. All resistance welding procedures shall be qualified per AMS-W-6858B.

Design strengths higher than standard certification and production strength requirements shall be qualified according to AMS-W-6858, Figure 11b, for one thickness. This shall require a test lot size of 180 spot welds.

Surface indentation shall not exceed 20% of material thickness (t) or 0.01 inch, whichever is greater. For exterior resistance-welded areas exposed to passenger view, indentation shall not exceed 10% of t or 0.005 inch, whichever is greater. Surface burn and

discoloration shall be removed by chemical cleaning, or an approved equal method, and sanding or polishing to match the surrounding surface.

H. Resistance Spot Weld and Intermittent Weld Spacing

Spacing of structural resistance and spot welds shall be according to approved structural drawings.

For non-structural applications, weld spacing shall be designed and qualified in accordance with the appropriate welding code requirements.

I. Toughness of Welded Assemblies

The Contractor shall prove all welded steel structures are above the ductile-brittle transition temperature for the specified environmental exposure. Specifically, the weld heat-affected zone (HAZ) and base metal shall resist service impact loads at the lowest specified operating temperature without brittle failure.

The Engineer shall have the right to require impact tests to verify the specified toughness. Verification of HAZ toughness shall be done on a test sample welded according to PQR parameters. Base metal toughness shall be certified on a heat basis by the steel manufacturer or steel supplier; if these data are not available, the Contractor shall perform tests on each heat of as-received base metal.

J. Torch Brazing

All brazing, defined as heating above 840 degrees Fahrenheit, shall follow the recommendations of the latest AWS Welding Handbook, Volume 2 issue. Procedures and personnel who perform brazing work shall be qualified in accordance with AWS B2.2, *Standard for Brazing Procedure and Performance Qualification.*

K. Torch Soldering

All structural (not electrical) soldering, defined as heating below 840 degrees Fahrenheit, shall follow the recommendations of the latest AWS Welding Handbook, Volume 2 issue. Procedures and personnel who perform torch soldering shall be qualified through the preparation and testing of samples of production torch soldering. Test samples shall be prepared and submitted for approval before production torch soldering.

TP08.20 PAINTS AND COATINGS

A. General

All painting on the carbody or any component shall be performed in accordance with the paint manufacturer's recommendations.

B. Materials and Preparation

Preparation of the substrate surface and application of painting materials by roller, brush, or spray shall be in accordance with the paint manufacturer's recommendations. Only primers recommended and approved by the paint manufacturer shall be used. Painting

shall be performed by experienced labor, using proper equipment under competent supervision following documented and approved procedures.

Painting materials for all surfaces shall provide a high quality finish resistant to corrosion, chipping, fading, and shall retain the gloss level. All components of the paint system shall be provided by the same manufacturer. All paint and filler materials which are to be superimposed to form a finish system shall be mutually compatible and shall be warranted for use as a system by the manufacturer of the components.

C. Exterior Painting

All exterior surfaces that are to be painted shall be prepared as specified, and the paint shall be applied according to the paint manufacturer's recommendations. The paint shall be free from runs, sags, or other application defects.

Before painting any car surface that is exposed to view, all dents, gashes, nicks, roughness, or other surface imperfections or depressions shall be removed, in so far as possible, by straightening and shall then be properly prepared to receive a filler material. These surfaces shall be properly cleaned and wash primed following straightening. Any remaining dents or other surface imperfections shall then be filled with an approved filler and sanded smooth. The maximum allowable filler thickness shall be as recommended by the filler manufacturer for the environment and service to which it is to be exposed.

D. Apparatus and Underfloor Equipment

All underfloor- and overhead-mounted apparatus shall be primed and painted in accordance with the following requirements unless otherwise indicated. All other apparatus shall be painted in an approved color.

The exterior surfaces of undercar equipment enclosures and apparatus, other than propulsion control equipment, made from carbon steel shall be prepared, primed, and painted.

The interior and exterior surface of all electrical equipment enclosures shall be coated with an approved insulating, thermosetting, resin-based, powder coating or polyurethane paint system.

Parts of undercar equipment enclosures made from plastic or fiberglass shall be painted in accordance with the above requirements for metal portions, except that the paint system shall be compatible with the plastic used and an insulating coating need not be applied.

E. Painting Restrictions

Any equipment or parts of equipment which can be damaged or suffer impaired operation from painting shall not be painted and shall be corrosion resistant.

The following items shall not be painted:

- Copper tubing, piping, and fittings;

- Wearing surfaces;
- Couplers, including yoke and draft gear;
- Wire and cable;
- Power resistors;
- Heat transfer surfaces;
- Electrical insulators;
- Elastomeric parts;
- Grounding pads; and
- Conduit and fittings.

The following truck-related items shall not be painted:

- Wheels;
- Axles;
- Elastomeric parts;
- Grease fittings;
- Linkages;
- Threaded adjustment parts;
- Electrical equipment; and
- Wearing Surfaces.

F. Interior Painting

Interior surfaces requiring painting shall be coated with an approved painted finish in accordance with the recommendations of the paint manufacturer.

The Contractor and its paint manufacturer shall provide a touch-up procedure and assure that a continued supply of touch-up paint in the proper colors suitable for spot application will continue to be available in the United States.

G. Acoustic Insulation

Acoustic insulating materials shall be applied to properly cleaned underframe, sides, ends, roof and floor sheets, in accordance with the supplier's recommendations. The materials shall be resistant to dilute acids, alcohols, grease, gasolines, aliphatic oils, and vermin. The material shall be unaffected by sunlight and ozone and shall not become brittle with age. It shall be Daubert Chemical Company's V-Damp 3680 sound deadening compound, 3M Corporation's 2552 Damping Foil, or approved equal.

H. Thermal Insulation

Thermal insulation materials shall be transportation grade of the rigid, non-rigid, or spray-on type. Insulation shall be installed with a vapor barrier to preclude moisture accumulation.

The type of thermal insulation to be used shall not be susceptible to mold or rot and shall not absorb water. Metals, which are attached to the insulation, shall be corrosion resistant, and not settle under vehicle vibration. The vehicle thermal insulation shall not have an odor or be capable of absorbing odors, and shall not sustain vermin. Urethane foam insulation is expressly prohibited.

Thermal insulation material shall have the same thermal conductivity as the originally used material.

TP08.21 FLAMMABILITY, SMOKE EMISSION, AND TOXICITY REQUIREMENTS

A. General

All combustible materials used in the construction of the cars shall satisfy the flammability, toxicity and smoke emissions requirements of this Section and 49 CFR 238.103 and NFPA 130. In case of conflict, the more restrictive requirement shall prevail. The Contractor shall comply with all provisions of APTA RP-PS-005-00, *"Fire Safety Analysis of Existing Passenger Rail Equipment."*

B. Toxicity

Materials and products identified by state agencies, Federal agencies, and the American Conference of Governmental Industrial Hygienists (ACGIH) as containing toxic properties or to emit toxic products of combustion in excess of the limits defined in the Technical Provisions shall not be used. Materials and products generally recognized to have highly toxic products of combustion shall not be used.

All materials used in the car construction, except for materials used in small parts such as knobs, rollers, fasteners, clips, grommets, and small electrical parts that would not contribute significantly to fire propagation or to smoke or toxic gas generation and are distributed throughout the car, shall be tested for toxicity using Boeing Specification Support Standard BSS-7239. Alternative test protocols may be proposed for the Engineer's consideration providing that the results are reported as noted below. Materials

shall meet the following maximum toxic gas release limits (ppm) as determined per BSS-7239:

Carbon Monoxide (CO)	3,500 ppm
Hydrogen Fluoride (HF)	200 ppm
Nitrogen Dioxide (NO_2)	100 ppm
Hydrogen Chloride (HCL)	500 ppm
Hydrogen Cyanide (HCN)	150 ppm
Sulfur Dioxide (SO_2)	100 ppm

The tests shall be conducted in the flaming mode after 240 seconds using the NBS Smoke Density Chamber for sample combustion. The gas sampling may be conducted during the smoke density test.

C. D. Electrical Fire Safety

Electrical equipment, wiring and apparatus shall conform to NFPA 130 except where more restrictive requirements are imposed by the Technical Provisions.

TP08.22 ELECTRICAL AND ELECTRONIC DESIGNS

A. General

Except as otherwise noted herein, electronic equipment shall conform to IEC 60571, *Electronic Equipment Used on Rail Vehicles*, Class TX, unless otherwise approved by the Engineer.

B. Ability to Repair

Where practical, all electrical assemblies, including such items as PC boards, shall be designed for repair by the maintenance staff in their electronics laboratory.

Assemblies that must be potted or sealed or can not be repaired by design shall have a minimum 10 year warranty. Such non-repairable components shall be identified and shall be designed to allow unit replacement.

All USB connections and all other removable storage devices shall have a sacrificial pass through connector that can be easily replaced without requiring special tools or unsoldering.

C. Hardware

All hardware associated with electronic and electrical control systems shall be protected against moisture, oxidation, and common airborne contaminants.

D. Enclosures/Racks

All circuit boards that are rack-mounted shall plug into racks containing the mating half of the circuit board connector. The rack, circuit board, and circuit board hardware shall be designed as an integrated system. All circuit boards and connectors in a rack shall be keyed to ensure the correct board is installed in the proper location.

The rack and enclosure shall provide environmental and EMI shielding to meet the requirements of the Technical Provisions.

Printed circuit boards shall be positively retained. The enclosure or rack cover shall not be used to retain the circuit boards, unless specifically designed to do so.

The rack and the edge of each board, or the card ejector, shall be labeled with corresponding numbers to identify board location within the enclosure.

The enclosure/rack shall not be connected to the power supply return or signal common.

Where it is necessary to use printed circuit boards that are not plug-in and not mounted in an enclosure, the following additional requirements shall apply:

- The PC board shall be protected from mechanical damage and hostile environments such as arc discharge and contact with high voltage.
- If the PC board is part of a high voltage circuit, it shall be design with regard to strike distance and creepage in the rail vehicle environment. APTA RP-E-004-98 shall apply where applicable.
- Any test points required in routine testing or fault isolation to the user replaceable level, shall be easily accessible without disassembly or tools.

If replacement of the PC board is required, no special tools or soldering shall be required. Each PC board use and application of this type shall be subject to Engineer approval.

E. Optical Fibers

Any application of optical fibers shall be approved by the Engineer prior to implementation. The connections between optical fibers and car-replaceable units shall be via approved "quick-disconnects."

TP08.23 ELECTRICAL DEVICES AND HARDWARE

A. General

All electrical devices shall be rail industry proven.

B. Contactors and Relays

All contactors and relays shall meet the following qualifications.

Devices shall be tested for proper functioning in orientations up to 30 degrees from the orientation in which they are mounted in the vehicle in each of the three possible rotations: pitch, yaw, and roll.

Contactors and relays shall comply with the requirements of MIL-R-6106 (for ratings of 10 amperes or greater) and MIL-R-5757 (for ratings of less than 10 amperes.

All devices shall be constructed and utilized in a fail-safe manner such that passengers, crew, and equipment are not placed in jeopardy.

All devices shall be installed so that they are fully accessible for inspection, trouble-shooting, repair-in-place, or removal and replacement. Contactors and relays shall incorporate means of visually determining whether they are picked up or dropped out.

There shall be a maximum of two wire terminations on any one contact of any device.

The coils of all devices shall be suppressed to protect the low-voltage network from transients.

Contact tip ratings shall be stated for the worst condition of reduced surface contact which may result from tip misalignment and wear during normal operation.

Contactor installation shall be such that the arc spray is directed by an arc chute away from ground and any other electrical devices proximate to the contactor.

All contactors shall be constructed so that the main contact tips make and break with a wiping motion that prevents deposits and pitting.

All DC contactors shall have series-fed blowout coils. The Contractor shall demonstrate the ability of each contactor type to reliably interrupt current over the full design operating range.

The identification strip shall be mounted adjacent to the mounting of said device.

Bifurcated contacts shall be used in low voltage applications, whenever necessary, due to dry contacts or low current switching requirements.

All time delay relays shall be of the R-C delay or solid state type.

Where plug-in relays shall be positively retained by means of a retaining clip or bar. When the relay is removed, the retainer shall itself be retained so that it cannot come in contact with devices which may have exposed energized electrical circuits, and it shall not interfere with the operation of any other device when in this position.

Adequate gap and creepage distances shall be maintained from high voltage contactor tips and low voltage coil and auxiliary contacts, to prevent entry of high voltage arcs or transients into low voltage circuits.

C. Switches

Under no circumstances shall poles of switches be placed in parallel in order to carry currents in excess of the contact pole rating given by the manufacturer.

Switches shall be provided with a "keying" feature so that after installation, the body of the switch is constrained from mechanical rotation.

All control switches subject to water splash (switches mounted near windows or doors, or mounted on the Operator's console) shall be environmentally sealed. Toggle and push button switches shall be per MIL-S-3950, MIL-S-8805, MIL-S-83731, or equal.

There shall be a maximum of two wires connected to each terminal of the device.

Switches shall be individually replaceable by disconnecting only the mounting fasteners and electrical connections of the switch to be replaced.

All switches and pushbuttons shall comply with the following requirements:

- Contact resistance shall be less than 0.050 ohm at 3 V DC and 10 milliamps.
- Open circuit resistance shall be 50 mega-ohms minimum.
- Resistance to case shall be 1000 mega-ohms minimum at 500 V DC.

Contact shall be rated for inductive loads. The contacts shall normally operate at not more than 20 percent of the manufacturer's inductive rating for 25,000 cycles of operation at 25 °C. The electrical contact material shall be plated with silver or silver with a gold flash or gold plate, and be normally a break-before-make type.

D. Circuit Breakers

1. General

All circuit breakers of the same rating shall be of the same manufacture and model throughout the vehicle. Circuit breakers shall be Din Rail mounted when ever possible.

The "ON," "OFF," and "TRIPPED" positions of all circuit breakers shall be permanently marked on the handle or the case of the circuit breaker. The circuit breaker, when tripped, shall assume a distinct position to permit determination that it has been tripped by either its overcurrent or shunt trip elements. All circuit breakers shall be mounted in the vertical direction with the "ON" position up.

Circuit breakers shall be individually replaceable by disconnecting only the mounting fasteners and electrical connections of the breaker to be replaced.

Electrical connections to circuit breakers shall either be threaded to accept machine screws or use a threaded stud.

All circuit breakers shall be sized by current rating and trip time to protect both the associated equipment and the minimum size wire used for power distribution within the protected circuit without causing nuisance trips.

Each circuit breaker pole shall be equipped with a means of arc extinguishment to prevent flashover.

The continuous current rating of thermal-magnetic trip circuit breakers shall be selected in accordance with ANSI C37.16 for the load and type of service specified.

All thermal-magnetic trip circuit breakers shall conform to the requirements of ANSI C37.13 and ANSI C37.14.

Circuit breaker current rating shall be clearly and permanently marked.

2. High Voltage Circuit Breakers

All distribution-type, high voltage circuit breakers shall be Westinghouse Series C, FDB frame, Heinemann type GH, or approved equal.

The trip elements shall be thermal-magnetic, or magnetic, connected in series.

The circuit breaker handle shall protrude from the circuit breaker panel cover sufficiently to be manipulated in all positions.

3. Low-voltage Circuit Breakers

Low voltage circuit breakers shall be either one-pole or two-pole devices, depending on the intended function. Trip elements shall be thermal-magnetic, or magnetic, as appropriate for the application.

All low voltage circuit breakers shall be:

- General Use – Westinghouse Series C, Quicklag C frame, Heinemann Series AM, or approved equal, with front connection, and approved labeling.
- Fast Operation – Airpax type IMLK, dust sealed, magnetic breaker, or Airpax type UP, hermetically sealed, magnetic breaker, or approved equal.

E. Fuses

Fuses shall be used only where specifically called for in the Technical Provisions and only with specific approval. Fuses may be considered in applications as follows:

- To protect solid state equipment from catastrophic damage.
- Where current or voltage levels prohibit circuit breakers.

Fuses shall be permanently identified in a location adjacent to the fuse. The rating of each fuse shall be permanently and clearly marked directly on each fuse.

Fuses shall be readily accessible.

Fuse holders shall contain fuse retention devices at both ends.

Air gap and creepage distances shall be subject to approval by the Engineer. APTA RP-E-004-98 shall apply where applicable.

Voltage ratings for fuses in high voltage circuits shall be submitted for review and approval by the Engineer.

High voltage fuses shall be mounted in totally enclosed, dead front fuse holders, with no exposed high voltage connections. The fuse shall be extracted from the circuit when the fuse holder is opened and the exposed fuse shall be safely isolated.

F. Bus Bars

Bus bars shall be fabricated from OFE (Oxygen Free Electronic CDA C10100) or ETP (Electrolytic Tough Pitch CDA C11000) copper. Bus bar conductivity shall be 100% IACS. All bus bar joints shall be silver or tin plated.

Current densities, other than at joints, shall not exceed 1,000 amperes per square inch, and in any case shall not exceed a value which would cause a bus bar temperature rise greater than 86 degrees Fahrenheit (30 degrees Celsius). Current densities in brazed joints shall not exceed 150 amperes per square inch.

Bus bars shall be properly brazed together at joints unless bolted connections are found to be absolutely necessary for maintenance purposes and have been approved. The overlap at bus bar joints shall be no less than 10 times the thickness of the bus material. Bus bar connection bolts shall be torqued to obtain a uniform bus bar connection pressure of 200 psi. Bolting hardware shall be plated steel with Belleville washers to maintain connection pressure. Current densities in bolted joints shall not exceed 300 amperes per square inch for a minimum bolt size of 5/16 inch. The bus temperature rise including joints shall not be greater than 86 degrees Fahrenheit (30 degrees Celsius) above 104 degrees Fahrenheit (40 degrees Celsius) ambient.

Except for connection areas, bus bars shall be safety-insulated, using a high-dielectric powder coating, heat shrink tubing or other approved means. Bus bars that are behind insulating panels are exempt from this requirement.

G. Capacitors and Resistors

Capacitors shall be derated 20% for voltage based on the nominal supply voltage and maximum case temperature. If filter capacitors are exposed to low ripple voltages, lesser values of derating may be accepted if it can be shown that reduced operating temperatures can be achieved due to reduced dissipation. The sum of the DC and AC

ripple voltages shall always be less than the capacitor's voltage rating at a maximum case temperature of 185 degrees Fahrenheit (85 C).

Except for braking power resistors, all resistors shall be derated 50% for power dissipation. Applications for approval of less derating may be submitted on a case-by-case basis.

H. Transformers and Inductors

Transformers and inductors shall be derated 10% for current. Transformers shall:

- Have vacuum-impregnated windings.
- Be rated to withstand at least twice the maximum peak-to-peak voltage that they shall be subjected to in operation.
- Not emit audible noise in excess of 60 dB referenced to 20 micropascals at a distance of 2 feet while operating at rated voltage and load.
- Be designed to minimize radiated and induced EMI.

Power inductors shall have vacuum-impregnated windings and shall be rated to withstand at least twice the maximum peak to peak voltage expected in normal operation.

I. Motor Starters

Motor starters, if used, shall be rated for continuous duty and, shall be equipped with magnetic holding coils.

Starters shall be equipped with sufficient auxiliary contacts to comply with requirements for annunciator circuits, as indicated.

Thermal overload protection shall be provided.

Three-phase starters shall be three-pole.

TP08.24 CONTRACT DELIVERABLE REQUIREMENTS LIST

CDRL #	Title	Reference Paragraph

End of Section

TECHNICAL SPECIFICATIONS
(TECHNICAL PROVISIONS)

SECTION TP09

QUALITY ASSURANCE REQUIREMENTS

August 28, 2009
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SECTION TP09
QUALITY ASSURANCE REQUIREMENTS

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TP09 QUALITY ASSURANCE REQUIREMENTS

TP09.01 QUALITY PROGRAM SCOPE AND OBJECTIVES

To provide a quality product to SFMTA, the Contractor shall have planned and established a documented quality assurance program. The Contractor shall enforce the elements of the quality assurance program within all parts of its organization and with all manufacturers, subcontractors, and suppliers performing Contract work.

This section defines the minimum project quality assurance requirements. The objectives of the Contractor's QA Program for this project shall be both to assure that design, materials, processes and workmanship comply with the Specification, and that its design and manufacturing documentation are approved by the Contractor, by SFMTA as required, and released in a timely manner. The Contractor's quality system for this work shall utilize training, internal auditing, and periodic management review as means to support, maintain, and improve effectiveness of its quality program and its application to this work

TP09.02 QUALITY SYSTEM AND IMPLEMENTATION

A. QA Manuals, Procedures, and Plans

The Contractor's Quality Assurance Manual shall cover all requirements of this Quality Assurance specification. The manual shall establish and communicate the company's quality policy, which shall be a clear statement of top management commitment and direction with regard to quality of its products and services. The manual shall establish authority for Quality Manual requirements and include or refer to all Contractor quality system procedures, explaining the hierarchical structure of quality system documents. Amendments may be included in the Contractor's Quality Assurance Manual to fully comply with the quality assurance requirements of this MUNI Contract.

Quality system documentation shall be consistent with the skills needed, methods used, and training resident among personnel performing Contract work in accordance with the requirements of this specification.

The Contractor shall submit for review and approval, 90 days after NTP, its proposed Project Quality Assurance Program Plan. **[CDRL 12-001]** This Plan shall identify the controls, processes, procedures, resources, and skills the Contractor will apply to satisfy project quality system requirements of the Contract. For each specified quality system requirement, the Plan shall identify how it will be satisfied, when, where, and by which job function. It shall include a flow chart of the manufacturing sequence with all planned inspections indicated. The chart shall indicate entities participating in the inspections and if inspections are customer-witnessed or hold-point verifications. Necessary inspection equipment, extraordinary measurement requirements, required personnel certifications, workmanship acceptance standards, methods of inspection, and required quality records documentation shall be identified in the Plan. The Plan may refer to specific sections of other Contractor documents, such as the Quality Manual and supporting procedures, if appropriate description of quality plan details applicable to this Contract are presented there.

B. Management Responsibility for QA Program

The Contractor shall assign to a member of its management the overall responsibility for implementing and maintaining its quality assurance program throughout the Contract period. The interrelation of all Contractor personnel affecting the quality of this Contract's products and services shall appear on the company organization chart. The Contractor shall provide for periodic reporting to management and management review of its quality system's effectiveness, taking appropriate action whenever so indicated.

The Contractor shall provide adequate trained resources to perform verification activities. These activities include inspections, test witnessing, monitoring its operations, participating in and supporting design reviews, and conducting internal quality audits.

C. Internal Quality Auditing

Auditing is a crucial activity for maintaining effectiveness of quality systems. The Contractor shall establish and maintain procedures for internal quality system auditing. The Contractor shall schedule audits of its operations so that it assesses compliance with each Quality Manual section throughout its organization on a planned periodic basis. Contractor's auditors shall be independent of the operations they audit and perform audits in accordance with established auditing procedures. Auditors shall communicate results to appropriate personnel. Follow-up shall occur to verify and document that personnel have determined and applied effective corrective action with respect to deficiencies.

TP09.03 PLANNING FOR QUALITY

Before performing Contract work, the Contractor shall have prepared written procedures to assure that SFMTA's requirements are met in planning the quality-related functions listed below.

A. Contract Review

To ensure that SFMTA's requirements are met throughout the performance of Contract work, SFMTA requires the Contractor to review and continually consider Contract requirements, both as work is planned and as it is carried out. The Contractor shall take steps to ensure that all work reflects a thorough understanding of Contract provisions, and that any disagreements with Contract requirements are resolved through established channels for change control. Contract review shall also serve to assure that sufficient resources are available and applied to furnish products and services of the required quality within the time allotted under the Contract.

B. Design Control

The Contractor and suppliers shall establish and maintain documented procedures to control and verify design of products and services while ensuring compliance with all Contract requirements. Design tasks shall be assigned to qualified personnel provided

with adequate resources. To this end, the Contractor shall define, document, coordinate, and control sources of design input. This shall be accomplished by identifying interfaces between different groups, both within and outside its organization; then reviewing and updating design input on a regular basis to assure designs are adequate for their intended applications and free from conflict.

Design output, including drawings, specifications, instructions, software, and procedures, shall be documented in such a way that they can be verified as meeting design input requirements. Design output documents shall contain or refer to acceptance criteria and identify any design characteristics that are crucial to safety. The Contractor shall subject all design output to a documented system of review and authorized approval prior to releasing designs for procurement or manufacturing. This shall include SFMTA's prior approval for design documentation so specified.

At appropriate times during processes of design development, manufacturing, and testing, the Contractor shall validate design, confirming that it meets defined SFMTA requirements.

C. Document and Data Control

The Contractor shall establish and maintain procedures for controlling all project documents and data. The Contractor's procedures shall identify who is responsible to maintain its master listing of documents, revision levels, and status. The Contractor shall ensure that documents are reviewed and approved prior to their release, and that current versions are available where needed. Obsolete documents shall be controlled to prevent unintended use, and if retained, segregated and suitably identified as obsolete.

Changes to released documents and data shall be subject to review and approval by the same functions and organizations that performed the original review, whether internal or external, unless other arrangements are justified, and approved.

D. Control of Purchased Items and Services

The Contractor shall establish and maintain procedures to ensure that products and services purchased to complete this work comply with specification requirements. Procedures shall describe the Contractor's method of evaluating purchased items from subcontractors and suppliers on the basis of their ability to meet requirements, and establish methods of controlling subcontractor and supplier activities and products to obtain that result within the time allotted under the Contract. The Contractor's records of acceptable subcontractors and suppliers for this Contract shall be maintained and available for SFMTA's examination.

Contractor shall ensure that purchasing documents describe clearly the products and services ordered, including precise description of items, relevant data, and all applicable specification requirements, codes, and standards. Requirements for quality assurance, documentation, testing, packaging, and shipping shall also be included, as applicable. The Contractor's purchasing procedures shall require purchasing documents to be reviewed by appropriate personnel for meeting specified requirements.

Refer to Inspection and Correction Section TP9.05 for inspection verification requirements for purchased products.

E. Control of Customer-Supplied Products

The Contractor shall establish and maintain procedures for controlling any products, equipment, or services furnished or loaned to the Contractor by SFMTA. Procedures shall ensure that all such items are properly accounted, stored, maintained, and protected from loss or damage. The Contractor shall report to SFMTA in writing any SFMTA-supplied items that may become lost, damaged, or degraded, and any items or services that are unsuited for the intended use.

TP09.04 QUALITY ASSURANCE PROVISIONS FOR WORK IN-PROGRESS

A. Process Control

A significant part of the Contractor's quality program shall be to prevent problems by controlling manufacturing processes, thereby lessening the demands on required inspection and correction activities. To this end, the Contractor shall identify and plan processes necessary to produce, under controlled conditions, products, and services of the specified quality. Where necessary to accomplish this, the Contractor shall prepare documented instructions and workmanship criteria, and monitor and approve production processes. Production equipment and processes shall be maintained as necessary to ensure that products satisfy specified requirements.

B. Product Identification and Traceability

The Contractor shall establish and maintain procedures for identifying product, where appropriate, during all stages of production, installation, and delivery. As practical, individual items or lots shall retain unique identification of the items and their acceptance, rejection, or uninspected status.

TP09.05 INSPECTION, TESTING AND CORRECTION

The Contractor shall maintain and apply sufficient resources for inspection and testing verification. While production worker inspection of output is strongly encouraged, inspection by trained Contractor inspectors who are independent of the means of production is required under this Contract. The Contractor shall establish and maintain inspection and testing procedures for this project that address the following quality functions:

A. Control of Inspection, Measuring, and Test Equipment

The Contractor shall establish and maintain procedures to control, calibrate, and maintain inspection, measuring, and test equipment to demonstrate to SFMTA that products

conform to requirements. Calibrated equipment shall be used consistent with the required measurement accuracy. The capability of test software and hardware used for inspection shall be checked periodically. Procedure shall include provisions for determining the validity of previous inspection and test results when measurement equipment is found out of calibration, and taking appropriate corrective action. Inspection, measuring, and test equipment shall be suitably stored to ensure continued accuracy and fitness for use.

B. Inspection and Test Status

The Contractor shall identify by suitable means the inspection and test status of products throughout production and installation so that only acceptable products are used. The Contractor's Quality Assurance Plan shall identify the inspection authority responsible for releasing product as conforming at each stage of production.

C. Controlling Nonconforming Products and Services

The Contractor shall establish and maintain a procedure to prevent the inadvertent use or installation of nonconforming product. Nonconforming products shall be segregated from acceptable items where practical. In any case, the Contractor remains solely responsible to prevent unauthorized use of nonconforming material.

D. Corrective and Preventive Action

The difference between corrective and preventive action shall be clearly expressed in the Contractor's Quality Assurance Manual. Corrective Action procedures shall address actual nonconformities that have occurred. Preventive Action procedures shall address the potential for nonconformity. The Contractor shall establish and maintain procedures for taking corrective and preventive action that is appropriate to the size of the problems and commensurate with the risks they present.

Corrective Action procedures shall be effective in handling complaints from nonconformance reports and from all entities, including SFMTA. Methods shall include problem analysis, recording results, determining the most effective corrective action, verifying that corrective actions have been taken, and that they are effective.

Preventive Action procedures shall require use of all available information to eliminate potential sources of nonconformity. Methods shall include data and information analysis, determining the best approaches to preventing nonconformity, implementing and ensuring effectiveness of preventive action plans, and forwarding significant details of actions taken for review by management.

E. Use of Statistical Techniques

Specific needs and requirements for statistical techniques in controlling production processes shall be identified in the Contractor's Quality Plan for the Project. Statistical quality control applications used in acceptance of parts, materials, or processes by the

Contractor or its suppliers shall be fully documented and based on generally recognized and accepted statistical quality control methods.

F. Inspections and Tests

Inspections and testing are specified as means for the Contractor to demonstrate specification compliance to SFMTA. As such, inspections and tests are tools for assessing the quality yielded by the Contractor and supplier quality systems and processes. The Contractor shall establish and maintain procedures for inspection/verification activities listed below. Procedures shall be suitably documented to provide objective evidence that specified product requirements have been met.

1. First Article Inspection (FAI)

A First Article Inspection (FAI) will be performed jointly by SFMTA and the Contractor on each piece of equipment, and all major vehicle structures, the complete vehicle, and integration of vehicle systems. Equipment shall be shipped from the point of manufacture only after an FAI has been offered and either passed, or waived by SFMTA. The Contractor shall perform independent pre-FAIs when necessary to ensure that the subcontractor is prepared.

First Article Inspection will evaluate component and system maintainability where possible. FAI's shall be performed only on components built using approved production processes and tooling, and shall establish the standard of quality of workmanship for the balance of like components. The quality shall be established jointly by SFMTA, the Engineer, and the Contractor.

First Article Inspection will not be conducted until the design drawings of the article have been atleast conditionally approved or approved. If conditionally approved drawings are used, the conditions for approval shall be satisfied at the FAI and represented by the inspection article.

The inspection work space shall provide a proper, well-lit environment for inspection of piece part, subassembly or car final assembly. When appropriate, the inspection article shall be displayed on a stand or table with all necessary inspection tools, go/no-go gauges, plug gauges and handling aids. Correct tools and labor to take mechanical or electrical measurements shall be provided, including tools and labor for disassembly and removal of covers. Functional testing shall be performed in conjunction with the FAI when practical.

The Contractor shall submit a plan which shall include a list and schedule for all FAI's to the Engineer for review and approval not later than 120 days after Notice to Proceed. **[CDRL 12-002]** No less than thirty (30) days before each FAI, the Contractor shall submit to the Engineer an FAI package for review and approval. The FAI shall not be conducted until the FAI package has been approved. The Engineer shall have the option of witnessing any or all FAI's. In the event the Contractor schedules qualification testing immediately following an FAI or in conjunction with the FAI, the qualification test procedures must be submitted to the

Engineer for review and approval prior to testing. Prior to conducting any qualification test, the Contractor shall conduct a First Article Inspection (FAI) of each component.

SFMTA will, at its option, participate in FAI's. The Contractor shall provide an individual notice to the Engineer for each FAI, a minimum of thirty (30) calendar days prior to the FAI. The Contractor shall not schedule more than two (2) FAI's on the same date without prior approval by the Engineer. Except where the requirement has been waived by the Engineer, the Contractor shall perform pre FAI's when it is needed to assure the subcontractor is prepared.

2. FAI Components, Equipment, and Apparatus

Inspected "First Articles" (components, equipment, and apparatus) shall be retained for the duration of the manufacturing period and stored in a secure area at the Contractor's facilities. These items shall be made available for inspection and comparison at the request of the Engineer and/or SFMTA's on-site Inspector. These items may be utilized for production of the last cars with prior approval by the Engineer.

1) Requirements

The following requirements shall apply to each FAI:

a. An FAI package shall be submitted to SFMTA in advance of the FAI to provide the following:

Schedule and Agenda of Inspection
Vendor
Vendor Address
Vendor Phone Number
Vendor Contact
Component List with Latest Drawing Status
Contractor Inspection Plan.

b. A complete set of approved or conditionally approved drawings and software documentation (with SFMTA comments) for the item to be inspected.

c. For purchased items, a copy of the Vendor's purchase order with commercial items excluded.

d. Completed Vendor inspection forms that control and document acceptance of in process work.

e. Completed Vendor and Contractor final inspection reports.

f. Completed test documents that reflect that the unit has passed.

g. Inspection work space that provides the proper environment for inspection of the piece part, subassembly, or car.

h. When appropriate, display of the inspection article on a stand or table in a well lit workspace with all necessary inspection tools, go/no go gauges, plug gauges, and handling aids.

i. Correct tools and labor to take mechanical or electrical measurements.

j. Tools and labor for disassembly and removal of covers.

k. Performance of functional testing.

2) Receiving Inspection and Testing

The Contractor shall utilize Receiving Inspection to verify that subcontractors and suppliers are meeting all requirements of the contract specification, and as listed on purchasing documents. The Contractor's procedure for this activity shall prohibit use including processing of purchased items and materials until they have been inspected per approved procedure and verified with respect to requirements. The inspection status of items shall be positively identified and recorded to support recall and replacement, should that be necessary.

3) In-Process Inspection and Testing

The Contractor shall ensure that all products are inspected and tested as required elsewhere in the Technical Provisions and the approved Acceptance Test Plan. Products shall be withheld from release to the next stage of production or delivery until required inspections and tests have been completed to the satisfaction of the Engineer.

4) Pre-shipment Inspection

Pre-shipment inspections shall be conducted for items that make up the work performed for this Contract. The Contractor shall provide SFMTA a minimum of ten (10) days notice for each inspection, including the agenda and list of items to be inspected. The Contractor shall ensure that all necessary drawings, specifications, standards, tools, and facilities are provided to support these inspections.

5) Final Inspection and Testing

The Contractor's Quality Assurance Program Plan shall identify all Final Inspections and Tests upon which the final release of vehicles and equipment are based. Products shall not be released for shipment to SFMTA until all final inspections and tests have been completed to SFMTA's satisfaction.

6) Inspection and Test Records

The Contractor shall establish and maintain records that indicate whether products have passed required inspections and tests. Any items that have failed inspection or test shall have such failure documented and processed via the Contractor's nonconformance procedures. Inspection and Test Records shall identify the Contractor authority responsible for releasing inspected and tested products.

TP09.06 TP12.06: QUALITY ASSURANCE SUPPORT SYSTEMS

A. Handling, Storage, Preservation and Delivery

The Contractor shall establish and maintain procedures for handling, storage, packaging, preservation, and delivery of items furnished under this Contract. The Contractor and suppliers shall implement procedures that:

- Identify methods for preventing damage or deterioration,
- Provide for secure storage that includes documented receipt and dispatch,
- Control packaging, packing, and marking processes,
- Provides methods for preserving and segregating products in production, assembly, and storage, and
- Preserve product quality following final inspection and testing until delivered.

B. Control of Quality Records

The Contractor shall establish and maintain procedures for handling, maintaining, and disposing of quality records, including pertinent quality records of subcontractors. Quality records may be in the form of paper copies, electronic files, or other media. All quality records shall be legible and traceable to the items they describe. Quality records shall be stored to prevent loss or damage, and shall be available for the Engineer examination upon request. The Contractor shall establish retention periods for quality records that shall be approved by the Engineer.

C. Quality Assurance & Training

The Contractor shall establish and maintain procedures to identify training needs as necessary to complete work successfully under this Contract. The Contractor shall provide appropriate training to personnel performing activities that affect the quality of products and services. Records of training needs and training completed shall be maintained.

D. Servicing During Warranty

The Contractor shall establish and maintain procedures for servicing delivered products during the warranty period that include verifying warranty requirements are being met. Procedures shall clarify the Contractor's servicing and warranty responsibilities in accordance with this SFMTA Contract. Both Contractor and any subcontracted servicing

and warranty activities shall be planned and supported by suitable instructions, documentation, and competent, trained personnel.

The Contractor's staff shall collect and feed back to responsible Departments any information during the warranty period that supports servicing, design, and product improvements necessary to fulfill specification requirements reliably.

TP09.07 CONTRACT DELIVERABLE REQUIREMENTS LIST

CDRL #	Title	Reference Paragraph
9-001	Quality Assurance Manual	9.02
9-002	FAI Schedule	9.05.F

End of Section

TECHNICAL SPECIFICATION
(TECHNICAL PROVISIONS)

SECTION TP10
INSPECTIONS AND TESTING

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SECTION TP10
INSPECTIONS AND TESTING

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TP10: INSPECTIONS AND TESTING

TP10.01 GENERAL

Inspections and testing are specified as means for the Contractor to demonstrate compliance with the requirements of the Technical Provisions to SFMTA. As such, inspections and tests are tools for assessing the quality achieved by Contractor and supplier quality systems and processes. The Contractor shall document, through the Quality Assurance and Quality Control Plan and the Master Test Program Plan **[CDRL 10-001]**, the processes and procedures that are in place to demonstrate that the work is completed in compliance with the Contract requirements.

TP10.02 PRE-POSSESSION INSPECTION AND TESTING

Prior to taking possession of the LRV at the SFMTA property, the Contractor shall conduct inspections and tests to determine the state of the vehicle. All inspections and tests shall be documented in the:

- Pre-possession Inspection Procedure **[CDRL 10-002]**
-

The Contractor shall inspect and note the as-is condition and completeness of the vehicle and identify any damage and missing parts. Any subsequent damage and missing parts not noted on the report and which were not concealed at the time of the Pre-possession Inspection shall be the Contractor's responsibility to correct. The results of the inspection shall be summarized in the Pre-possession Inspection Report and agreed to by both parties.

The Contractor shall perform verification tests on the vehicle systems as a single vehicle to determine the baseline functionality of the vehicle. At a minimum, this shall include:

The results of the test shall be summarized in a report and agreed to by both parties. The In addition, the following vehicle systems shall be tested:

- ATCS (departure test)
- All trainline functions
- All coupler functions
- Air supply system
- Doors and steps
- Propulsion
- Braking
- Lighting
- Communications.

While SFMTA personnel will operate the LRV during the tests, the Contractor shall conduct the test. All testing activities and documentation shall be included in the Pre-possession Test Report.

TP10.03 INSPECTION

The Contractor shall establish and maintain procedures for the inspection/verification activities listed below. Procedures shall be suitably documented to provide objective evidence that specified product requirements have been met.

A. General

The Contractor shall notify SFMTA's Resident Inspector of any unforeseen work that was not apparent at the time the Pre-possession Inspection was conducted that becomes evident once the work has commenced. Such work shall not be undertaken prior to evaluation and disposition by SFMTA.

This Contract requires that inspections of the Contractor's work and materials, as well as of the supplier's materials, parts and components, be the responsibility of the Contractor and be performed at the Contractor's facilities or as appropriate at the subcontractors' facilities, giving opportunity to correct any inadequacies found under factory conditions.

Further inspection by the Contractor at the Contractor's facility shall determine any damage in transit, plus any unforeseen that may become apparent. SFMTA and the Engineer may also inspect selected items, with or in addition to those of the Contractor or its supplier. Such inspection shall in no way negate or lessen the Contractor's responsibility for proper inspections.

The Contractor shall be solely responsible for ensuring that they and their suppliers provide the necessary inspections in accordance with the approved Quality Assurance Plan submitted in compliance with TP09.

B. Resident Inspectors

Resident Inspectors may be provided by SFMTA in the Contractor's plant(s) and the manufacturing and assembly facilities of its Subcontractors and Suppliers from the start of any substantive work on the first vehicle set of equipment until the last vehicle is shipped.

The Resident Inspector will assist in assuring that the Contractor meets all Contract requirements on the vehicles by the Contractor.

C. Access to Plants

Authorized representatives of SFMTA shall have access at all times during working hours to those areas of the Contractor's and subcontractors' plants involved in the design, manufacture, or testing of the vehicles or any parts thereof.

A testing laboratory may be designated as an authorized SFMTA representative for the purpose of testing vehicles or any parts thereof.

SFMTA may station its own inspectors at the Contractor's or subcontractors' and Suppliers' facilities during the term of the Contract. The inspectors shall be authorized to inspect all work done, materials furnished, take measurements, determine quality of work performed, and make periodic assessments of the Contractor's, Subcontractors' and Suppliers' work. The Inspectors shall also assess the Contractor's, Subcontractors', and Suppliers' compliance with the

configuration management requirements identified in the Quality Assurance Plan for all technical documents.

The Contractor shall provide, at each facility, an office for the resident inspector with the following:

1. Access to parking nearby
2. Lockable doors and windows
3. Access to restrooms nearby
4. Desk, file cabinet, chairs, telephone, internet connection
5. Access to fax and copy machines

The facility and its contents shall be subject to the approval of the Engineer.

The inspector shall have access to and be provided with copies, upon request, of all Contract drawings, diagrams, data, test procedures and reports, and information used in connection with the Contract. Any requested documents and information shall be provided to the inspector as expeditiously possible to avoid program delays.

Maintenance and services shall be provided at each site by the Contractor throughout the term of the Contract. Such maintenance and services shall include, but are not limited to:

- Janitorial services for cleaning office and parking spaces
- All utilities
- Security measures and area protection equivalent to that used by the Contractor
- Uniform lighting in the office of not less than 100-foot candles at desk height
- Same level of maintenance and service as provided for Contractor employees, as a minimum.

D. Cooperation

The Contractor shall extend and shall ensure that its subcontractors extend to SFMTA and its representative's full cooperation and necessary facilities to permit the convenient inspection of all materials, work, and equipment supplied.

This shall include access to copies of all drawings (including unincorporated but approved changes), diagrams, data (along with verification that they are current releases), non-conformance and inspection reports, modifications and change notices, and status reports for the aforementioned information, which may be needed to properly inspect and evaluate the design, construction, assembly, installation, workmanship, clearance, tolerance, and functioning of the equipment and parts thereof.

There shall be a suitable means to inspect and test all parts and equipment at the Contractor's facility, including final mechanical and electrical tests of all vehicle systems.

SFMTA representatives shall be permitted an agreed upon period of time to conduct each of their inspections. In no case shall formal inspections be scheduled at or near the end of a work shift without the prior approval of SFMTA.

E. Rejections

The Engineer or the SFMTA Inspector shall have the right to reject material and workmanship which does not fully conform to the Technical Provisions or to approved Contractor's and suppliers' drawings and specifications.

When repetitious rejections are identified by SFMTA representative at any Contractor or subcontractor facility due to its failure to maintain proper quality, the condition will be cause for withdrawal of SFMTA inspection. The work shall be stopped until satisfactory improvement has been instituted and an agreement is reached for continuing work.

F. Defective Work

Should the Engineer or Inspector have evidence that defective work has been permitted by the Contractor or a subcontractor, or that defective materials have been used, and should an examination of work partly or fully completed be requested, the Contractor or subcontractor shall provide the appliances and labor to conduct such investigation and inspection as may be required, as well as all QA material inspection sheets showing inspections of that material or item to the date in question.

Any imperfect construction or materials which may be disclosed shall be corrected promptly. If investigation discloses no defect, the delay caused by such investigation will be considered as beyond the Contractor's control.

G.

H. Rejected Material

Material or apparatus intended for use on these vehicles, or the parts thereof, which has been rejected by authorized representatives of SFMTA or Contractor, or found unsuitable, or not in conformity with the Technical Provisions, shall be corrected to fully comply with the Technical Provisions, or clearly marked and disposed of so as to assure that such material or apparatus will not be used or offered for use again on these vehicles. Conforming material shall be substituted without delay.

I. Inspection Costs

The costs of SFMTA's inspection and compensation to SFMTA inspection personnel will be the responsibility of SFMTA and no provision for these costs shall be included in the bid prices.

If a test or inspection, such as a First Article Inspection, must be repeated as a result of a lack of preparation on the part of the Contractor or its suppliers, the costs of SFMTA project and inspection personnel, including engineering services consultant, shall be the responsibility of the Contractor.

TP10.04 TEST REQUIREMENTS

A. General

All test procedures shall include the description of the functions being tested, the performance parameters being verified, and the quantifiable pass/fail criteria. The required tests and adjustments shall be performed on the vehicles systems repaired, replaced and overhauled under this Contract and are grouped into four classifications:

1. Type Tests performed on components, systems, and complete Vehicles. These tests will be performed at the supplier, manufacturer, independent laboratory, independent facilities, Contractor facilities, or at SFMTA. These tests shall demonstrate that all required functions and performance parameters are satisfied.

2. Routine Tests performed on all components and complete vehicles. These tests will be performed at the supplier, manufacturer, independent facilities or Contractor facilities. These tests shall demonstrate that all functions are achieved and operate as intended.

3. Pre-Delivery (Routine) Tests performed on all complete vehicles. These tests will be performed at the Contractor's final assembly facility. These tests shall demonstrate the equipment and systems are properly integrated into the vehicle.

4. Acceptance Tests performed on all complete vehicles at SFMTA.

The Contractor shall provide at least 5 working days notice to the Engineer prior to the start of any test referred to herein. Prior to shipment to SFMTA, each vehicle shall be fully inspected by the Contractor and any part, device or equipment requiring adjustment, repair, or replacement shall be corrected by the Contractor. After receipt at SFMTA and prior to acceptance testing, SFMTA will completely inspect each vehicle for compliance with the specification, and the Contractor shall correct all discrepancies at its expense to the satisfaction of the Engineer. This shall not relieve the Contractor of its obligation to correct defects.

All working and moving parts, and all operating devices and controls of each vehicle and its equipment, as germane to and affected by the overhaul activities in the scope of this contract, shall be tested and put in operating condition by the Contractor before the vehicles are presented for Acceptance.

All tests, specified in the Technical Provisions, shall be conducted by the Contractor at its expense. SFMTA shall make available to the Contractor, test train operating crews and all other individuals required by SFMTA policies at SFMTA's expense. If the Contractor must re-test due to test failure, and the re-test requires additional SFMTA crew expenses, the Contractor shall reimburse SFMTA for those expenses.

These tests shall be conducted at such times and on such portions of SFMTA lines as mutually determined by the Engineer and Contractor. Each vehicle shall be subjected to all tests to show compliance with the specified performance.

The Contractor shall supply all recorders, sensors, pickups, and wiring. When instrumentation is used on-board the vehicle, it shall use battery power. Access to the vehicles' 120 V AC supply shall only be allowed at SFMTA discretion. Internal combustion engine driven generators will not be permitted. The equipment shall not be damaged by the conditions specified in TP02. Uninterruptible Power Supplies (UPS) provided by the Contractor shall be used, if needed to ensure the integrity of the instrumentation through all vehicle operating conditions. Isolation amplifiers and voltage dividers shall be provided as part of the instrumentation package to isolate the inside vehicle instrumentation wiring and equipment from high voltages; no exposed terminals with potential differences greater than 50 V shall be permitted. The accuracy and response of the instrumentation shall be sufficient to determine the degree of compliance with the Technical Provisions and design data.

The Contractor shall perform all tests specified herein unless the Contractor can provide test reports acceptable to the Engineer which indicate that equipment furnished under this Contract is identical to equipment, which has been previously tested for the same application and can show compliance with the requirements of the Technical Provisions. The Engineer shall review such submittals for test methodology and test results. If, as a result of the review, the Engineer has comments and/or questions related to the test methodology and/or test results and/or the applicability of the test methodology, the Engineer shall notify the Contractor in writing, within 30 days of receipt of the submittals. The Contractor and its subcontractors may, at their option, perform additional testing as they deem necessary as part of the quality assurance program. Unless indicated otherwise, all costs associated with any tests performed shall be borne by the Contractor.

In the event of a failure to meet the Technical Provisions requirements in any test, necessary corrections shall be made by the Contractor at its expense, and the failed test shall be rerun in its entirety at the Contractor's expense. Depending on the test deficiency, the Contractor may be required to perform additional system or vehicle level tests to confirm acceptability of the corrective action.

SFMTA reserves the right to perform, at its own expense, additional operating tests of each vehicle separately, or in consist, to verify the acceptability of the vehicles. These additional tests will be conducted within 30 days after completion of Contractor acceptance testing. The Contractor may be required to participate and furnish technical assistance for such tests. If the result of the testing indicates that the vehicle was non-compliant with the Technical Provision (in line with the stated purpose of the testing), the vehicles in question shall be returned to the Contractor for correction, and subsequently made available to the Engineer which will have an additional 30 days to retest.

B. Vehicle Acceptance Testing Facilities

The Engineer shall coordinate the track occupancy concerns between the desired on-track vehicle testing, track construction, systems construction, and systems testing. The Contractor shall give a minimum of one 24-hour business days written notice of crew and track requirements to the Engineer or when canceling or postponing a previously scheduled test. The Engineer gives no assurance to the Contractor that the requested number of hours per day, time of day, or number of days per week of track time will be available for testing.

All expenses and costs incurred in the removal of vehicles from the designated delivery point for correction of defects shall be borne by the Contractor.

C. Master Test Program Plan

A Test Matrix of all tests to be performed on all material, equipment and systems supplied under the contract shall be submitted with the Master Test Program Plan and shall be updated as required throughout the test program. SFMTA will not witness any testing until there is an approved Master Test Program Plan. The Master Test Program Plan shall meet the following requirements:

1. Tests shall be grouped in the following categories:
    a. Component or system routine tests
    b. Vehicle routine tests
    c. Vehicle acceptance tests
    d. Material tests, including smoke, flammability, toxicity, physical characteristics, etc.
    e. Component or System type tests
    f. Vehicle type tests
2. Each line item test in the matrix shall include data fields for the following:
    a. Name of test
    b. TP references for the test
    c. Location of the test (contractor or sub-contractor's facility, independent test lab, SFMTA, etc.)
    d. Number of units to be tested
    e. Contractors document number, including latest revision identification, for the associated procedure and report

f. Letter reference providing status (disapproved, accepted, etc.) of the test document

g. Other data to which the Contractor and SFMTA mutually agree

The Master Test Program Plan, previously identified as CDRL 10-001, shall be submitted within 180 days after NTP and shall be updated as required.

Approval of the Test Plan by SFMTA does not relieve the Contractor of responsibility to meet the requirements of the Technical Provisions.

TP10.05 COMPONENT AND SYSTEM TYPE TESTING

The summary requirements for component and system level type tests shall be provided in the Master Test Program Plan. As applicable, the entire system shall be tested such that the functional operation of each vehicle subsystem shall be simulated. The first component and system manufactured using the approved work procedures shall be designated for type testing. All components and interfaces shall be of the production configuration. As required, the Plan shall include any intermediate testing and functional verification required in the course of performing the work to ensure that the assembled components function properly.

The Contractor shall be responsibility to ensure that all tests required by the Technical Provision are performed in accordance with the requirements of the approved Test Plan and test procedures. As a minimum, test procedures and reports shall be submitted to verify the functions and performance of the as assembled equipment prior to installation. All required production routine tests shall be successfully completed prior to commencing component and system type tests. These type tests shall include:

- Cable/wire harness assemblies
- Air Supply Unit and controls
- Door operators
- Step Assemblies
- Coupler Assemblies

TP10.06 VEHICLE LEVEL TYPE TESTING

These tests shall demonstrate that all components and systems as integrated into the vehicle comply with the functions and performance parameters defined in the Technical Provisions. All equipment, as indicated in the approved Master Test Program Plan, on each vehicle supplied under this Contract shall be given a vehicle level type test at the Contractor's facility prior to shipment to assure proper operation. The first vehicle to be modified shall be designated for vehicle level type testing. Test procedures shall be provided for approval to the Engineer and test reports for each vehicle shall be approved by the Engineer prior to shipment from the Contractor's facility. Copies of all test reports for each vehicle shall be submitted to SFMTA at the time the vehicle is delivered. Unless otherwise specified, the vehicle level type testing shall be performed at the Contractor's facility.

The overhauled equipment shall be installed and adjusted using procedures developed in accordance with the OEM manuals. All adjustments shall be made and verified prior to conduct these tests. Should the Contractor conclude that the test cannot be completed due to an issue associated with a component that is outside the scope-of-work of this overhaul, the issue shall be presented to SFMTA for disposition, which may include the repair or replacement of the failed component by SFMTA personnel, or issuance of a replacement for installation into the vehicle by the Contractor's personnel to enable completion of the test.

These type tests shall verify proper functions and performance of equipment and systems as install in the vehicle. All required vehicle routine tests shall be successfully completed prior to commencing any type tests. These type tests shall include:

- Cable assemblies
- Air Supply Unit and controls
- Door operators
- Step Assemblies
- Coupler Assemblies

TP10.07 PRODUCTION (ROUTINE) TESTS

All equipment and systems, as indicated in the approved Master Test Program Plan, on each vehicle supplied under this Contract shall be given a routine test (production test) at the manufacturer's facility prior to shipment to the Contractor to assure proper adjustment and operation Prior to shipment to the Contractor. Test procedures shall be provided for approval to the Engineer and test reports shall be made available for approval at the Contractor's plant.

No equipment shall be submitted for test until a physical examination of the product has been successfully completed that confirms the equipment has been manufactured to the design accepted. Each unit shall successfully complete its routine test before it is released for shipment to the vehicle builder.

Test procedures and test reports shall be submitted to the Engineer for approval, and shall become the property of SFMTA. Test Reports shall be included in each Car History Book.

The test to be performed by each manufacturer and the Contractor on each vehicle component or subsystem shall be in accordance with the applicable industry standards listed in the Technical Provisions and the approved Master Program Test Plan.

TP10.08 PRE-DELIVERY (VEHICLE ROUTINE) TESTS

The completed vehicle shall be subjected to a series of tests, as indicated in the approved Master Test Program Plan, to verify that the vehicle and its systems are fully functional prior to shipment from the Contractor's final assembly facility. All vehicles shall successfully complete all vehicle routine tests prior to requesting the Engineer's signature of the Release for Shipment document. The Contractor's production test shall include all tests and adjustments, which can be made prior to delivery in order to keep vehicle acceptance testing and adjustments to a

minimum. Completion of the vehicle routine tests shall result in the vehicle being considered ready to run.

Complete series of tests shall be made on all vehicle systems which are affected by the work performed as part of the Contract to demonstrate proper functional and performance operation as specified. All fault and failure operations and indications for all vehicle systems shall be tested. The specifics of these tests shall be provided in the test procedures submitted for approval. If any component, equipment or system fails a routine test, it will not be approved for shipment until any and all deficiencies have been corrected and the non-comply item has been retested and passes.

Test procedures and test reports shall be submitted to the Engineer for approval, and shall become the property of SFMTA. Test Reports shall be included in each Vehicle History Book .

In addition to the required functional routine tests, the following routine tests shall be conducted on all vehicles:

A. Water Test:

Doors and roof articulation of each vehicle shall be given a complete test for watertightness. The tests shall be performed before installation of sound deadening material, thermal insulation, and interior finish. Water shall be sprayed from nozzles which are spaced no more than three (3) feet from, and aimed directly at, the surface being tested. The nozzles shall be positioned no more than seventeen (17) inches apart in an equilateral triangle pattern and shall produce an overlapping spray pattern. Not less than 0.625 gallon per minute shall be delivered to each square foot of surface being tested, and the nozzle velocity of the water shall not be less than 150 feet per second. All spray applications for complete vehicle body assembly shall run for ten (10) minutes before the inspection for leaks and shall run continuously during the inspection. A local test can be used. The Contractor shall submit, as part of the watertightness test procedure, an analysis of the water test fixture and apparatus demonstrating that all water nozzle pressures, amounts, and directions meet the requirements of this Section. Leakage due to pre-existing damage, noted in the pre-overhaul inspection report, and not within the scope of this overhaul effort, shall not be deemed a failure of this test.

B. Door and Step Cycle Test:

All door operators and steps on each vehicle shall be adjusted and tested to ensure correct operation per OEM test procedure SF3VF 6/15.

C. Wiring Test:

When all new wiring is completed on each vehicle, the Contractor shall test each wire to verify continuity and proper polarity, connections, and wire identification. The Contractor shall perform a high-potential ground insulation test as listed below on all new wiring. All components and systems shall be in place when the high potential tests are performed, except that electronic or other low-voltage devices which may be damaged by the test voltages may be disconnected and their wire connections suitably jumpered. The Contractor shall jumper the various wires in a system to insure that all parts of the system are tested. These tests shall be conducted at the Contractor's plant to demonstrate compliance with the requirements of this Section prior to vehicle shipment.

1. Wiring Continuity Test

All new wiring shall be tested on each vehicle to ensure continuity and correct polarity of equipment and devices. All wiring connections and terminals shall be examined for tightness.

2. Insulation Resistance Tests

Insulation resistance tests shall be conducted before high potential tests are conducted. Tests shall be conducted to verify the state of the insulation to the wiring assembly and harnesses

The following insulation resistance limits shall apply under all environmental conditions including high humidity when new wiring assemblies and harnesses on the vehicle of a given voltage class are connected in parallel:

Nominal Circuit Voltage dc or ac rms	Minimum Insulation Resistance
Below 90 volts	2 mega ohms at 500 Vdc
90 to 300 volts	4 mega ohms at 1,000 Vdc
Above 300 volts	5 mega ohms at 1,000 Vdc

3. High Potential Tests

A high potential test shall be conducted after the insulation resistance test is completed and passed. Tests shall be conducted to qualify the state of the insulation of the wiring assemblies and harnesses.

The test shall be conducted by applying the test voltage, as listed below, for a period of one (1) minute, across the insulation being tested, the test shall be passed if there is no insulation breakdown or excessive leakage current. The test voltage shall be at a frequency of 60 Hz with a sinusoidal wave form. V, in the formula below, shall be the nominal system voltage for a circuit:

Nominal Circuit Voltage Volts dc or ac rms	Test Voltage, ac rms
Below 300 volts	2 V + 1,000 volts
Equal to or above 300 volts	2.25 V + 2,000 volts

Standard apparatus may be production tested for one (1) second at a test voltage twenty (20) percent higher than the above listed one (1) minute test voltage. Alternative high potential test criteria may be proposed, subject to approval by the Engineer.

4. Coupler:

The tests listed in this section shall be conducted on all vehicles with the coupler properly adjusted. No single vehicle functionality tests may fail unless already noted in the pre-possession test report.

- Single vehicle functionality verification; doors, steps, propulsion, braking, ATCS, and communications.
- Single vehicle isolate/connect switch functionality.

5. Air Supply Unit:

The Contractor shall perform detailed functional and performance tests for complete ASU. The test procedures shall demonstrate that ASU is fully operational and that the ASU is properly interfaced when installed. As a minimum, test shall include:

- Leakage
- Temperature rise
- Capacity and efficiency
- Operating current and voltage
- Pressure output
- Start/stop settings

TP10.09 ACCEPTANCE FOR REVENUE SERVICE TESTS

Each vehicle delivered shall be subjected to tests, as indicated in the approved Master Test Program Plan, performed by the Contractor on SFMTA property. The tests shall be satisfactorily completed and approved by SFMTA as a condition of acceptance.

Test procedures and test reports shall be submitted to the Engineer for approval for inclusion in the Master Test Program Plan, and shall become the property of SFMTA. Test Reports shall be included in each Car History Book.

A. Inspection and Repair Requirements

After receipt of each vehicle at the SFMTA site and before it is operated, it shall be vehicle fully inspected jointly by SFMTA and the Contractor, and any part, device, or apparatus that requires adjustment, repair, or replacement shall be recorded by the Contractor who shall make such adjustment, repair, or replacement before acceptance testing is begun. All expenses and costs incurred in any necessary removal of vehicles from the designated

delivery point and their return there for correction of defects shall be borne by the Contractor.

B. Functional Tests

A complete, orderly, and comprehensive check of each vehicle system affected by the work shall be performed to assure its proper operation before commencement of test track operation. SFMTA-owned PTE shall not be used to perform any test. If any PTE is required, such PTE shall be furnished separately by the Contractor. Devices bypassed by the use of PTE (Master Controller, door-open, and door-close buttons for example) shall also be functionally checked. The Engineer reserves the right to test/check the vehicles as deemed necessary.

The following tests shall be performed with another vehicle coupled to the overhauled vehicle. Tests shall be performed on both Couplers. The vehicle with the overhauled Coupler shall always be the lead controlling vehicle.

- Doors, steps, local door control, and communications.
- Emergency door release, passenger emergency stop
- Couple, uncouple, isolate/connect.
- ATCS YDTD verification.
- J line right-of-way propulsion/braking test.
- All trainline functions
- All systems affected by the articulation jumper replacement

After operating the LRV on the MUNI system, the Contractor shall test the cable assemblies and connectors for continuity and circuit function, environmental wear, and inspect the assemblies for chafing, binding, and tangling. Individual conductors within the bundles shall be inspected for chafing, pulling, and environmental ingress.

While SFMTA personnel will operate the LRV during the test, the Contractor will conduct the test

The Contractor shall submit an acceptance test report form to the Engineer for approval. The Contractor shall fill out the report form, documenting the results of each test procedure. The Contractor shall sign and date the form upon completion.

If any component, equipment or system fails an acceptance test, it will not be accepted until any and all deficiencies have been corrected and the non-comply item has been retested and passes.

C. Miscellaneous Tests

At a minimum, the following tests shall be performed on each vehicle at SFMTA, when the vehicle is declared ready for test:

- Auxiliary circuits and equipment shall be tested for proper operation.
- All interior and exterior vehicle lighting shall be tested for proper function, including emergency operation.
- The proper functioning of the radio
- Any fault or failure operation and indication testing requiring road test and not completed elsewhere
- Lengths, heights, and locations of electrical jumpers and any other end connections shall be validated .
- Coupler installation shall be verified or adjusted to proper height and level.
- Air springs shall be leveled in accordance with SFMTA procedures.

TP10.10 PILOT CAR 500-MILE 30 DAY TEST

The first LRV delivered shall be placed into service following execution of the "Acceptance for Revenue Service" certificate, and shall run for 500 miles or 30 days, whichever comes first. The Contractor, with assistance from SFMTA shall regularly inspect the rehabilitated systems to verify proper performance.

TP10.11 CONTRACT DELIVERABLE REQUIREMENTS LIST

CDRL #	Title	Reference Paragraph
10-001	Master Program Test Plan	10.01
10-002	Pre-Possession Inspection Procedure	10.02
10-003	Pre Possession Inspection Report	10.02

End of Section

TECHNICAL SPECIFICATIONS

(TECHNICAL PROVISIONS)

SECTION TP12

TECHNICAL DOCUMENTS AND TRAINING

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TECHNICAL DOCUMENTS AND TRAINING

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TP12: TECHNICAL DOCUMENTS

TP12.01 GENERAL REQUIREMENTS

The Contractor shall provide update pages for the LRV Maintenance Manuals and the Integrated Parts Catalog for the Articulation Wiring Harness modification.

[CDRL 12-001] CONTRACT DELIVERABLE REQUIREMENTS LIST

CDRL #	Title	Reference Paragraph
12-001	Technical Document Updates	TP12.01

End of Section

TECHNICAL SPECIFICATIONS

(TECHNICAL PROVISIONS)

SECTION TP13

RELIABILITY, MAINTAINABILITY, SYSTEM SAFETY AND LIFE CYCLE MAINTENANCE

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SECTION TP13
RELIABILITY, MAINTAINABILITY, SYSTEM SAFETY AND LIFE CYCLE MAINTENANCE

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TP13: RELIABILITY, MAINTAINABILITY, SYSTEM SAFETY AND LCM

TP13.01 RELIABILITY

The functional design of the LRV overhauled and redesigned systems shall provide reliability and maintainability characteristics that provide a high degree of reliability and durability, and minimize downtime during preventive and corrective maintenance activities and troubleshooting and fault isolation. The intent is to maximize on-time performance, minimize time delays, minimize unscheduled repairs, minimize service failures, optimize safety, and optimize maintainability and durability by increasing diagnostics and fault isolation, providing test points and designing for ease and accessibility of troubleshooting, active maintenance, and repair without sacrificing quality, safety and individual system performance.

In general, reliability of the LRVs shall be attained by adherence to service-proven designs of equipment. Hardware and software shall be selected to achieve superior levels of reliability through adherence to the following criteria:

- Use of systems and components, the reliability of which has been proven in similar operating conditions and service to that which these LRVs are to provide.
- Use of the simplest possible equipment to attain the desired functions and performance.
- System or component derating.
- Increased factors of safety.
- Selection of high-quality components.
- Development of an operational profile used in making the reliability predictions and analyses for each vehicle, system and subsystem in determining the percent of non-moving profile based on the time percent of the moving profile.

TP13.02 MAINTAINABILITY

The linkage between maintenance and design is a major contributing factor for providing a high degree of reliability and minimizing downtime. Maintenance requirements to be considered in the design include:

- Rapid and positive identification of replaceable defective components
- Unit exchange of major components
- Modular design, "plug-and-play" mounting
- Define wear-out limits to provide a clear margin of performance over the maintenance objective
- Minimize the number of maintenance tasks such as calibrations, adjustments, and inspections

In the overhaul and/or redesign of systems and components the Contractor shall not require that maintenance be performed more frequently than 92-day intervals, except where approval has

been given specifically in writing by the Engineer for a shorter interval, or previously accepted by SFMTA in the original LRV design.

TP13.03 SYSTEM SAFETY

The Contractor shall maintain a comprehensive System Safety Program as referenced in Section TP01 of these technical provisions.

The general safety design requirements shall be incorporated into the design of all vehicle systems affecting safety:

- Only components with high reliability and which have been proven in conditions similar to the projected service shall be utilized.
- All devices not guaranteed fail-safe shall be assumed capable of failing in permissive modes.
- All electronic circuits and software shall be assumed capable of failing in permissive modes.
- Systems shall be based on closed-circuit principles in which energized circuits result in permissive conditions, while interrupted or de-energized circuits result in restrictive conditions.
- All vital circuits not wholly within the system apparatus enclosure shall be double-wire and double-break, with the exception of connections to non-vital circuits, which may be single-wire and single-break.
- Any component or wire becoming grounded shall not cause a permissive condition. Safety circuits shall be kept free of any combination of grounds that will permit a flow of current equal to, or in excess of, 75% of the release value of any safety device in the circuit.
- Circuit impedances, signal encoding, shielding, layout, and isolation shall be selected to minimize the effects of interference to the extent that safety is maintained under all conditions.
- Commands that result in permissive conditions shall be propagated by no less than two independent signals, both of which must be present before the permissive condition can occur. The lack of either signal shall be interpreted as a restrictive command.
- Systems controlled by variable level signals shall be arranged such that zero signal level results in the most restrictive condition. At least one enabling signal, however, independent from the variable control signal, shall be present before the control signal can modulate the system to a more permissive level.
- Circuit breakers and fuses shall be guaranteed by the manufacturer to successfully interrupt circuit overcurrents. Circuit breakers and fuses shall be applied such that the maximum circuit fault currents cannot exceed the manufacturer's guaranteed operating ranges.
- Systems that rely on structural integrity for safety shall have sufficient safety factors such that failures are not possible within the life of the vehicle under all possible conditions.

- Systems subject to wear shall not wear to permissive states within a period less than three times the overhaul period under the worst-case combination of duty cycle, environment, and all other influences. Such devices shall be clearly indicated as SAFETY CRITICAL in the maintenance manuals.
- Mechanical systems which apply force to achieve safe states shall not depend upon the application of fluid pressure or electrical energy, unless specifically approved.
- All locks, catches, and similar devices affecting safety shall be either self-engaging without application of power, or, if engaged by application of power, shall remain fully and safely engaged in the absence of power.
- All systems shall function safely under all combinations of supply voltages, fluid pressures, shock, vibration, dirt accumulation, and SFMTA's environment.
- All safety-related systems, and devices within those systems, shall be clearly identified as SAFETY CRITICAL in all maintenance manuals, procedures, and training materials.

TP13.04 LIFE CYCLE MAINTENANCE

The Contractor shall support SFMTA's Life Cycle Maintenance (LCM) program by providing updates to existing drawings, procedures, and bills of material where necessary to accurately represent the state of the LRV and its systems after the overhaul effort. These documentation requirements are provided in TP01 of these Technical Provisions.

End of Section

TECHNICAL SPECIFICATIONS
(TECHNICAL PROVISIONS)

SECTION TP14

SPECIAL TOOLS AND TEST EQUIPMENT

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SPECIAL TOOLS AND TEST EQUIPMENT

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TP14: SPECIAL TOOLS AND TEST EQUIPMENT

TP14.01 DIAGNOSTIC TEST EQUIPMENT AND SPECIAL TOOLS

A. GENERAL

The tools and special test equipment requirements for this overhaul effort are limited. However, the Contractor shall be responsible for procurement of all special tools identified throughout these Technical Provisions. Any special tools procured by the Contractor to perform work on this contract shall become the property of SFMTA at the completion of the project. The Contractor shall provide the equipment specified unless otherwise noted as optional, in this Section for comprehensive maintenance and in-service testing of vehicles and bench testing of components and subsystems. All of the special tools and test equipment procured by the Contractor for this program shall be surrendered to SFMTA upon program completion

Within 120 days of NTP, the Contractor shall submit to the Engineer for review and approval, a comprehensive list of all proposed special tools and test equipment. For each different tool and item of test equipment, the Contractor shall submit a description of the use and operation of the item, and drawings that define equipment envelope, required work space envelope, and utility requirements. The Contractor shall be responsible for revising the list for any design changes to the cars and test equipment that affects the special tools and test equipment. Each special tool and item of test apparatus shall be accompanied by:

- Complete diagrams, schematics, and maintenance and calibration instructions for the device itself;
- Test equipment procedures, maintenance, calibration, and troubleshooting procedures for the associated carborne system, assembly, sub-assembly and sub-components.

The Contractor shall be responsible for acceptance of all special tools and test equipment. It is recommended that the Contractor demonstrate that the tools and test equipment perform their intended function. The Contractor shall make all modifications to tools and test equipment specified herein that are required because of changes and modifications made to the vehicle or any of its subsystems.

The Contractor shall supply manuals and training for all test equipment including custom software applications supplied with test equipment.

B. OPTIONAL MAINTENANCE FACILITY BENCH TEST EQUIPMENT (MFBTE)

If the Contractor develops bench test equipment that is unique to a system overhaul and it is determined that SFMTA does not currently posses similar capability, the Contractor shall provide one set of test equipment within 30 days of pilot car acceptance, so that it can be used for training SFMTA staff, and for troubleshooting/maintenance of the LRVs as

they are delivered. The Contractor will provide an additional set of MFBTE upon completion of all cars. This may be equipment that was used by the Contractor during overhaul, but shall be in good repair.

C. PORTABLE TEST EQUIPMENT (PTE)

If the Contractor develops PTE that is unique to a system overhaul and it is determined that SFMTA does not currently posses similar capability, the Contractor shall provide one set of test equipment within 30 days of pilot car acceptance, so that it can be used for training SFMTA staff, and for troubleshooting/maintenance of the LRVs as they are delivered. The Contractor will provide an additional set of PTE upon completion of all cars. This may be equipment that was used by the Contractor during overhaul, but shall be in good repair.

The PTE shall include all cables, connectors, and associated equipment required to interface with the test points.

D. FUNCTIONAL REQUIREMENTS

The function of the PTE shall be to produce all of the operating commands and other input signals necessary to fully exercise all functions and components of the particular system or subsystem under test, and to measure or indicate all of the signals, responses, and outputs produced by a system by means of indicators such as lamps, meters, oscilloscopes, gauges, or computer-controlled displays. It shall be acceptable to require a visual check for system response, such as closure of a contactor, provided the responding item of equipment does not require removal of other equipment, or use of hand tools to permit observation of response, and does not require the maintenance technician to move more than 15 feet to make the required observation. When used according to the instructions supplied by the Contractor, each PTE shall enable the maintenance technician to fully check and calibrate the system or subsystem under test and to locate and replace any removable component which has fully or partially failed. The PTE shall also operate in a passive monitoring mode to permit observation of the functions of those systems while the vehicle is being operated at all normal operating speeds. Response indicators and input signal generators shall be built into the PTE to the maximum extent possible and shall have accuracy commensurate with the alignment tolerances specified.

E. PHYSICAL REQUIREMENTS

The test equipment shall perform under the environmental conditions imposed by the activities of the vehicle inspection and repair shop with temperatures ranging from 20 degrees Fahrenheit (-7 degrees Celsius) to 115 degrees Fahrenheit (46 degrees Celsius) in the test areas. The test equipment shall be completely portable and suitable for rough handling during use on the shop floor, pit locations, and in the yard. The test equipment shall be self-protected in the event of an overload, ground, or short-circuit condition.

Response and output indicators and input signal generators shall be industrial grade. Each PTE shall be housed in aluminum or fiberglass suitcase-type enclosure with a removable cover suitable for use in a shop environment and as manufactured by Zero

Manufacturing Co., Skydyne, or approved equal. All meters supplied as part of the PTE shall be of a variety capable of withstanding industrial service. The weight for any PTE shall not exceed 30 pounds without the prior approval of the Engineer.

F. INTERFACE CONNECTIONS

Connection of the PTE to the equipment shall be through a test plug conveniently located on the vehicle so that the maintenance technician is able to observe the functioning of the system while it is tested.

Connectors used in the interface between the PTE and the system under test shall have recessed pins to prevent bending and breakage during frequent use. All connections shall be hand-operated, robust, weather-tight, quick-disconnect, multi-pin connectors.

G. CABLES AND HOSES

External hook-up, multi-conductor cables shall be furnished to connect the vehicle systems with the PTE. A minimum number of cable connections shall be used to connect the test equipment to the systems under test. Cables shall be flexible, abrasion-resistant, and oil-resistant. The connecting cables and hoses shall be stored within the PTE case.

The Contractor shall not require connection of external apparatus to the PTE without the prior written approval of the Engineer. In such cases, terminals shall be provided to allow connection of the required apparatus to the PTE. However, such apparatus shall be considered part of the PTE and shall be supplied with it on a one-to-one basis.

If a laptop computer is used as the PTE for two or more systems, and if the connection to these systems is by means of a serial or Ethernet data link, the Contractor shall define a standard cable and connector for use in connecting the laptop computer to any system for which it functions as the PTE. One of each such cable shall be supplied with each laptop computer which functions as a PTE.

H. SOFTWARE

If a computer is used as a test device, a master program software CD shall be provided with the test device.

TP14.02 SPECIFIC TEST EQUIPMENT REQUIRED

A. AUTOMATIC COUPLER

No specific test equipment required, unless used by the Contractor as discussed in TP14.01

B. DOORS AND STEPS

The Contractor is required to provide their own portable test unit, cable, and software for working with the door system.

C. PSC-2 HARNESS

No specific test equipment required, unless used by the Contractor as discussed in TP14.01

D. AIR SUPPLY

No specific test equipment required, unless used by the Contractor as discussed in TP14.01

E. ROOF ARTICULATION HARNESS

TP14.03 CONTRACT DELIVERABLE REQUIREMENTS LIST

CDRL #	Title	Reference Paragraph

End of Section

TECHNICAL PROVISIONS

SECTION TP15

DELIVERABLES SUMMARY

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DELIVERABLES SUMMARY

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TP15: CONTRACT DELIVERABLES REQUIREMENTS SUMMARY

TP15.01 PROGRAM-LEVEL CDRLS – DUE 30 DAYS AFTER NTP

Each of the following CDRLs shall be submitted within 30 days after NTP. These CDRLs shall be resubmitted promptly if revisions are made by the Contractor.

CDRL #	Title	Reference Paragraph	Due Date
1-001	Master Program Schedule	1.04.A	30 days after NTP
1-016	Management Plan	1.07.D	30 days after NTP
1-017	Systems Engineering and Integration Plan	1.07.G	30 days after NTP
1-018	Configuration Management Plan	1.07.H	30 days after NTP
9-001	Project Quality Assurance Program Plan	9.02.A	30 days after NTP
9-002	First Article Inspection Schedule	9.05.F	30 days after NTP
10-002	Pre-Possession Inspection Procedure	10.02	30 days after NTP

TP15.02 PROGRAM-LEVEL CDRLS – DUE DURING THE PROJECT

Each of the following CDRLs shall be submitted at the appropriated time during the program and resubmitted promptly if revisions are made by the Contractor, and all CDRLs shall be submitted prior to acceptance of the last LRV or project closeout.

CDRL #	Title	Reference Paragraph	Due Date
1-002	Purchase Orders	1.04.A	Every 30 days
1-010	Approval Drawings	1.05.A	Ongoing
1-011	Drawing Database and Updates	1.05.A	Continuous
1-013	List Of Contract Drawings	1.05.C	60 days after delivery of first car
1-014	Contract Drawings	1.05.C	60 days after delivery of first car
3-004	Coupler Overhaul FAI Package	3.06	After completion of 1st car
4-002	Door and Step Overhaul Procedures	4.03.F	Prior to start of 3rd car
4-004	Door and Step FAI Package	4.08.	After completion of 1st car
5-001	PSC-2 Cable Design Submittal Package	5.03.A	60 days prior to start of 1st car
5-003	Revised PSC-2 Cable Replacement Procedure	5.05.B	Prior to start of 3rd car
5-005	PSC-2 Cable First Article Inspection Package	5.05.D	After completion of 1st car
6-004	ASU Overhaul FAI Package	6.04	After completion of 1st car
7-002	Articulation Cable Design FDR Submittal	7.02.A	30 days prior to start of 1st car
7-003	Articulation Wiring List	7.02.B	60 days prior to start of 1st car
7-005	Articulation Cable Replacement Procedure	7.02.B	Prior to start of 3rd car
7-007	Articulation Cable movement drawings	7.02.E	60 days prior to start of 1st car
7-008	Articulation Cable Installation FAI Package	7.06	After completion of 1st car
10-001	Master Program Test Plan	10.01	180 days after NTP
10-011	Type Test Reports	10.04.E.3	14 days after test
10-014	Pilot Car Test Procedure	10.10	prior to test shipment of 1st car
10-015	Pilot Car Test Report	10.10	prior to test shipment of 2nd car

TP15.03 LRV-LEVEL CDRLS – DUE DURING EXECUTION OF THE PROJECT

One set of the following CDRLs shall be submitted for each LRV at the appropriated time during the program. All CDRLs shall be submitted prior to acceptance of the LRV.

CDRL #	Title	Reference Paragraph	Due Date
1-015	Car History Books	1.06	Acceptance for rev service
1-021	Release for Shipment Certificate	1.08.B	Prior to LRV shipment
3-003	Coupler Sign-off Sheets	3.03	LRV Delivery
4-003	Door and Step Sign-off Sheets	4.07.A	LRV Delivery
5-004	PSC-2 Cable Replacement Sign Off Sheet	5.05.B	LRV Delivery
6-003	ASU Sign-off Sheets	6.02	LRV Delivery
10-003	Pre Possession Inspection Report	10.02	Prior to shipping LRV out
10-013	Acceptance Test Reports	10.04.D.7	5 days after test

TP15.04 CDRLS ONLY REQUIRED IF CONTRACTOR CHOOSES TO USE MATERIALS OR METHODS NOT CURRENTLY ANTICIPATED

The following CDRLs shall only be required if the Contractor chooses to use materials or methods not specifically defined in the work scope sections of these Technical Provisions. This may include the use of new materials, suppliers, construction methods, etc.

CDRL #	Title	Reference Paragraph	Due Date
7-006	Articulation Wiring List Corrections	7.02.D	As needed
14-001	Special Tools and Test Equipment List	14.01.A	As needed
14-002	Master Program Software CD	14.01.H	As needed

End of Section

TECHNICAL SPECIFICATIONS

(TECHNICAL PROVISIONS)

SECTION TP16

SUPPLEMENTAL DRAWINGS AND REFERENCE DOCUMENTS

August 28, 2009
Rev. 4 Final

SECTION TP16
SUPPLEMENTAL DRAWINGS AND REFERENCE DOCUMENTS

TABLE OF CONTENTS

Section **Page**

TP16: SUPPLEMENTAL DRAWINGS & REFERENCE DOCUMENTS

TP16.01 DOCUMENTS AND DRAWINGS AVAILABLE ON CD

The following documentation is available to the Contractor on CDs.

1. LRV2 Conformed Specification (in PDF format)
2. LRV2 Heavy Preventive Maintenance Manual (in PDF format)
3. LRV2 Running Maintenance and Service Manual (in PDF format)
4. LRV2 Running Preventive Maintenance Manual (in PDF format)
5. LRV2 Heavy Repair Workshop Manual (in PDF format)
6. LRV2 Illustrated Parts Catalog (in PDF format)
7. LRV2 Drawing List (in Excel spread sheet format)
8. LRV2 Drawings (in TIFF format)

TP16.02 DOCUMENTS AND DRAWINGS PROVIDED ON PAPER

The following documentation is available to the Contractor to copy.

1. LRV2 Drawings (Select drawings not available as TIFF)
2.)

TP16.03 WIRE LISTS REFERENCED IN SPECIFICATION

A. LRV2 ARTICULATED CONNECTION JUMPER

EYP7 35 pin					
Pin	**A Side**	**B Side**	**AWG**	**Purpose**	**Comments**
1	ET084	ET084	12	Passenger Intercom T/L	3-conductor
2	ET085	ET085	12	Passenger Intercom T/L	3-conductor
3	TH-31,32,33	TH-31,32,33	12	Shields	3-conductor
5	ET081	ET081	12	PA Audio T/L	3-conductor
14	ET086	ET086	12	PA Audio T/L	3-conductor
15	ET082	ET082	12	Cab to Cab Intercom T/L	3-conductor
16	ET083	ET083	12	Cab to Cab Intercom T/L	3-conductor
4	ET042	ET042	12	PSR T/L +	
6	ET026	ET026	12	Sanding T/L +	
7	ET070	ET070	12	Tow Mode T/L +	
8	ET040	ET040	12	Regen Cutout T/L +	
9	ET066	ET066	12	Zero Speed T/L +	
10	ET041	ET041	12	Cutout Bypass Status T/L +	
11	ET064	ET064	12	Propulsion Fault T/L +	
12	ET045	ET045	12	Derail Sensors T/L +	
13	ET101	ET101	12	Steps High Status Indicator (and ADA chime)	
17	ET054	ET054	12	EB T/L +	3-conductor
18	ET053	ET053	12	EB T/L -	3-conductor
19	TH-65	TH-65	12	Shield	3-conductor
21	ET034-4	ET034	12	Trake Brake On Status T/L	
22	ET033	ET033	12	Track Brake On T/L	
23	ET006-5	ET007-2	12	Right Steps Low/Left Steps Low T/L Control	
24	ET005-5	ET008-2	12	Right Steps High/Left Steps High T/L Control	
25	ET007-4	ET006-4	12	Left Steps Low/Right Steps Low T/L Control	
26	ET008-4	ET005-4	12	Left Steps High/Right Steps High T/L Control	
27	ET029	ET028	12	Turn Signal On Left/Right +	
28	ET028	ET029	12	Turn Signal On Right/Left +	
29	ET018	ET018	12	Head/Tail Lights T/L +	
30	14BB-2	14BH-2	12	Steps Low T/L Status	
31	14CB-2	14BG-2	12	Steps High T/L Status	
32	14BH-2	14BB-2	12	Steps Low T/L Status	
33	14BG-2	14CB-2	12	Steps High T/L Status	
34	43AN-3	43AN-3	12	Local EB loop +	3-conductor
20	43AF-3	43AF-3	12	Local EB loop -	3-conductor
35	TH-74	TH-74	12	Shield	3-conductor

EYP8 35 pin					
Pin	**A Side**	**B Side**	**AWG**	**Purpose**	**Comments**
1	ET057	ET057	12	Brk Mode T/L +	
2	ET058	ET058	12	Brk Mode T/L -	

3	ET067	ET067	12	Auto Mode T/L	
4	ET055	ET056	12	Forward T/L +	3-conductor
5	ET056	ET055	12	Reverse T/L +	3-conductor
6	TH-80,83	TH-80,83	12	Shields	3-conductor
7	ET052	ET052	12	P-Wire T/L Out	3-conductor
8	64AA-1	64AA-1	12	P-Wire T/L In	3-conductor
9	18DA-1	18DA-2	12	Left Doors Opn/Rls/Close	
10	18EA-1	18EA-2	12	Left Doors Opn/Rls/Close	
11	18FA-1	18FA-2	12	Left Doors Opn/Rls/Close	
12	18AA-2	18AA-1	12	Right Doors Opn/Rls/Close	
13	18BA-2	18BA-1	12	Right Doors Opn/Rls/Close	
14	18CA-2	18CA-1	12	Right Doors Opn/Rls/Close	
15	36VA-1	36VA-1	12	Radio Wiring	
16	ET065	ET065	12	Cab to Cab Intercom Reset	
17	ET011-8	ET011-20	12	Steps Low Status (Cab Dependant)	
18	ET011-9	ET011-26	12	Steps Low Status (Cab Dependant)	
19	ET063	ET063	12	Pass Emer Stop Indication T/L	
20	ET046	ET046	12	Emer Door Rls Indication T/L	
21	ET059-10	ET059-1	12	ATCS FSB Loop T/L +	
22	ET060	ET060	12	FSB Loop T/L +	
23	ET073	ET073	12	FSB Loop T/L -	
24	ET068	ET068	12	Positive T/L #2	
25	ET048	ET048	10	Negative T/L #2	
26	ET069	ET069	12	Positive T/L #1	
27	ET049	ET049	10	Negative T/L #1	
28	ET071	ET071	12	Aux On T/L +	
29	ET072	ET072	12	Aux Off T/L +	
30	ET062	ET062	12	MC Interlock T/L -	
31	ET061	ET061	12	MC Interlock T/L +	
32	ET037	ET037	12	Frict Brk Fault T/L	
33	ET035	ET035	12	Frict Brk On Status T/L	
34	ET039	ET039	12	Brake Dragging T/L	
35	ET019	ET019	12	Low Air Pressure T/L	

EYP9 35 pin					
Pin	**A Side**	**B Side**	**AWG**	**Purpose**	**Comments**
1	ET095-1	ET095	12	ATCS Serial Data Link T/L	3-conductor
2	ET096-1	ET096	12	ATCS Serial Data Link T/L	3-conductor
3	TH-127	TH-127	12	Shield	3-conductor
4	ET089-2	ET089	12	ATCS Active T/L	
5	89HA-1	ET090	12	ATCS Train Integrity T/L	
6	ET038-2	ET038	12	ATCS Power Return T/L	
7	ET036-3	ET036	12	ATCS Cutout T/L	
8					*Not Used*
9	ET027	ET027	12	Interior Lights T/L +	
10	ET047	ET047	12	Interior Lights T/L -	
11	ET025	ET024	12	Doors Right Summary T/L -	

12	ET024	ET025	12	Doors Left Summary T/L +	
13	ET014-4	ET014	12	Doors Left Closed T/L +	
14	ET013-4	ET013	12	Doors Right Closed T/L -	
15	89FA-1	ET091	12	ATCS Train Integrity T/L	
16	89AC-1	89AC-1	12	ATCS Check Loop T/L	
17	ET093-10	ET093	12	ATCS Check Loop T/L	
18	89BA-1	89BA-1	12	ATCS Transfer Switch Interlock T/L	
19	89CA-1	ET020	12	ATCS Transfer Switch Interlock T/L	
20	ET099-4	ET100	12	Auto Cab Select T/L	
21	ET050-10	ET050-2	12	ATCS EB Loop -	3-conductor
22	ET087-10	ET087-1	12	ATCS EB Loop +	3-conductor
23	TH-68	TH-68	12	Shield	3-conductor
24	ET022	ET022	12	Pan Up T/L	
25	ET023	ET023	12	Pan Down T/L	
26	ET043	ET043	12	Aux PS Fault T/L	
27	ET100-4	ET099	12	Auto Cab Select T/L	
28	ET098-4	ET098	12	VOBC Reset T/L	
29	50AE-2	50AE-2	12	Horn & Gong +	
30	ET075	ET075	12	Zero Speed for Trk Brks T/L +	
31	50AD-2	50AD-2	12	Horn & Gong +	
32	45EA-4	45EA-4	12	Interior Emerg Lights Relay Control	
33	ET071-11	ET071-11	12	Interior Emerg Lights Relay Control	
34	89GA-1	ET092	12	ATCS Train Integrity T/L	
35	ET021	ET021	12	Ventilation Blower Cutout T/L +	

EYP10 60 pin					
Pin	**A Side**	**B Side**	**AWG**	**Purpose**	**Comments**
1	36QA-2	36QA-4	16	Passenger Intercom T/L	
2	36RA-2	36RA-4	16	Passenger Intercom T/L	
3	TH-23	TH-23	16	Shield	3-conductor
4	36CA-5	36CA-6	16	Communication Control Amp Wiring	3-conductor
5	36DA-5	36DA-6	16	Communication Control Amp Wiring	3-conductor
6	34AB-2	34AB-3	16	Communication Control Amp Wiring	
7	34BB-2	34BB-3	16	Communication Control Amp Wiring	
8	34CB-2	34CB-3	16	Communication Control Amp Wiring	
9	34DB-2	34DB-3	16	Communication Control Amp Wiring	
10	34EB-2	34EB-3	16	Communication Control Amp Wiring	
11	34FB-2	34FB-3	16	Communication Control Amp Wiring	
12	34GB-2	34GB-3	16	Communication Control Amp Wiring	
13	34HB-2	34HB-3	16	Communication Control Amp Wiring	
14	34JB-2	34JB-3	16	Communication Control Amp Wiring	
15	34YD-4	34YD-3	16	LRV2 Local Radio Control	
16	34YC-6	34YC-5	16	LRV2 Local Radio Control	
17	34KB-2	34KB-3	16	Communication Control Amp Wiring	
18	34LB-2	34LB-3	16	Communication Control Amp Wiring	
19	34MB-2	34MB-3	16	Communication Control Amp Wiring	
20	34NB-2	34NB-3	16	Communication Control Amp Wiring	

21	34PB-2	34PB-3	16	Communication Control Amp Wiring	
22	34QB-2	34QB-3	16	Communication Control Amp Wiring	3-conductor
23	34RB-2	34RB-3	16	Communication Control Amp Wiring	3-conductor
24	TH-30	TH-30	16	Shield	3-conductor
25	34SB-2	34SB-3	16	Communication Control Amp Wiring	
26	34TB-2	34TB-3	16	Communication Control Amp Wiring	
27	34WB-2	34WB-3	16	Communication Control Amp Wiring	
28	36PA-1	36PA-1	16	Radio Wiring	
29	14EC-3	14EC-3	16	Steps Down Control -	
30	35RA-1	35RA-1	16	Radio Wiring	
31	35SA-1	35SA-1	16	Radio Wiring	
32	36NA-4	36NA-6	16	Radio Wiring	
33	36HA-2	36HA-4	16	Radio Wiring	
34	36JA-2	36JA-4	16	Radio Wiring	
35	36KA-2	36KA-4	16	Radio Wiring	
36	36LA-2	36LA-4	16	Radio Wiring	
37	36MA-2	36MA-4	16	Radio Wiring	
38	36GA-4	36GA-5	16	Radio Wiring	2-conductor
42	TH-14	TH-14	16	Shield	2-conductor
39					*Not Used*
40	35GA-1	35GA-2	16	Radio Wiring	
41	35HA-1	35HA-2	16	Radio Wiring	
43	35DA-9	35DA-10	16	Interior Speakers	3-conductor
44	35CA-9	35CA-10	16	Interior Speakers	3-conductor
45	TH-xx	TH-xx	16	Shield	3-conductor
46	TH-03	TH-03	16	Shield	3-conductor
47	35BA-2	35BA-4	16	Exterior Speakers	3-conductor
48	35AA-2	35AA-4	16	Exterior Speakers	3-conductor
49	35TA-1	35TA-1	16	Radio Wiring	
50	35UA-1	35UA-1	16	Radio Wiring	
51	35VA-1	35VA-1	16	Radio Wiring	
52	35WA-1	35WA-1	16	Radio Wiring	
53	35XA-1	35XA-1	16	Radio Wiring	
54	35YA-1	35YA-1	16	Radio Wiring	
55	35ZA-1	35ZA-1	16	Radio Wiring	
56	36XA-1	36XA-1	16	Radio Wiring	
57	36YA-1	36YA-1	16	Radio Wiring	
58	TH-150	TH-150	16	Shield	2-conductor
59	36BA-4	36BA-4	16	Radio Wiring	2-conductor
60					*Not Used*

EYP11 85 pin					
Pin	**A Side**	**B Side**	**AWG**	**Purpose**	**Comments**
A	NB27-5	NB27-5	16	Destination & Run Number Sign -	
B	X27-7	X27-7	16	Destination & Run Number Sign +	
C	49BA-5	49BA-5	16	Destination & Run Number Sign Network	3-conductor
D	49AA-5	49AA-5	16	Destination & Run Number Sign Network	3-conductor

E	TH-61	TH-61	16	Shield	3-conductor
F	X16-8	X16-8	16	Stop Request Circuit +	
H	47DA-5	47DA-5	16	Stop Request Circuit +	
J	81EB-3	81EB-4	16	Sander Control Cutout	
K	81EA-3	81EA-2	16	Sander Control Cutout	
L	80AA-2	80AA-2	16	Zero Speed Bypass Loop	
M	81SA-2	81SA-2	16	Prop Inverter #2 Cutout	
N	81TA-2	81TA-2	16	Prop Inverter #1 Cutout	
P	44BC-2	44BC-1	16	Emerg Door Rls Bypass & Overspd Aud Cutout	
R	84YA-2	84YA-2	16	Overspeed Indicator and Chime	
S	81UA-2	81UA-2	16	Propulsion Stall Indicator	
T	81VA-2	81VA-2	16	KT panel Prop Fault A	
U	81WA-2	81WA-2	16	KT panel Prop Fault B	
V	54EA-2	54EA-2	16	Friction Brake C Cutout	
W	54FA-2	54FA-2	16	Friction Brake B Cutout	
X	28BA-1	28BA-1	16	Pantograph Control Cutout +	
Y	28CA-1	28CA-1	16	Pantograph Control Cutout +	
Z	28CB-4	28CB-3	16	Pantograph Control Cutout	
a	28BB-4	28BB-3	16	Pantograph Control Cutout	
b	14AF-1	14AF-1	16	B Cab Steps Up Command	
c	46RA-2	46RA-1	16	B Cab Right Turn Button	
d	46SA-2	46SA-1	16	B Cab Left Turn Button	
f	46FA-3	46FA-3	16	B Cab Emergency Flasher Button	
g	58AA-6	58AA-6	14	Turn Signal Lights T/L +	
h	58BA-6	58BA-6	14	Turn Signal Lights T/L +	
i	NB8-4	NB8-4	14	Turn Signal Lights -	
j	46FB-4	46FB-4	16	Emerg Flashers Steps Down Doors Open	
k	14BC-4	14DB-4	16	Stepwell Lights Right Timer Relay +	
m	56FA-1	56FA-1	16	Zero Speed Track Brake Control	
n	14CD-4	14BC-4	16	Stepwell Lights Left Timer Relay +	
p					*Not Used*
q	18HA-1	18HA-1	16	Door Chime Relay Control	
r	18ZA-26	18ZA-25	16	B Car Right Doors Lock Command	
s	18FB-20	18FB-3	16	B Car Right Doors Lock Command	
t	18GA-1	18GA-1	16	Local Door Control Relay Control	
u	46MB-10	46MB-2	16	Stop Request Circuit +	
v	46MA-10	46MA-2	16	Stop Request Circuit +	
w	46FG-2	46FG-2	16	Emerg Flashers Steps Down Doors Open	
x	14EA-2	14EA-2	16	Steps Up Control -	
y	17EA-11	17EA-11	16	Door Operator Zero Speed B+	
z	26LB-2	26LB-2	16	RTX Time Out Control Loop	
AA	26GA-2	26GA-2	16	Aux On +	
AB	17LA-2	17LA-3	16	Right Doors Closed Relay Control	
AC	17MA-2	17MA-3	16	Left Doors Closed Relay Control	
AD	17LD-2	17LD-1	16	Right Doors Closed Loop	
AE	17ME-2	17ME-1	16	Left Doors Closed Loop	
AF	17KA-3	17KA-3	16	Local Doors Closed Indicator	

AH	41CD-5	41CD-6	16	LVPS Fault Indication	
AJ	41CC-5	41CC-6	16	Aux PS Fault Indication	
AK	34YB-1	34YB-2	16	LRV2 Local Radio Control	
AL	26BA-4	26BA-4	16	Aux On +	
AN	55SC-2	55SC-1	16	B17 Valve Cutout Status	
AP	X29-36	X29-34	16	Friction Brake Control CB	
AR	43AD-4	43AD-4	16	Emerg Brake Indicator	
AS	66BF-10	66BF-1	16	Emerg Door Release and Pass Emerg Loop	
AT	34ZA-1	34ZA-1	16	Sound Powered Telephone Circuit	
AU	34XA-1	34XA-1	16	Sound Powered Telephone Circuit	
AV	42KA-3	42KA-3	16	Speedometer -	3-conductor
AW	42FB-2	42FB-2	16	Speedometer +	3-conductor
AM	TH-130	TH-130	16	Shield	3-conductor
AX	54DA-2	54DA-1	16	Friction Brake Fault C Indicator	
AY	54CA-2	54CA-1	16	Friction Brake Fault B Indicator	
AZ	56AA-3	56AA-3	14	Track Brake Cutout	
BA	88JA-3	88JA-3	16	VOBC Overspeed Chime	
BB	56AC-3	56AC-3	14	Track Brake Cutout	
BC	ET019-6	ET019-5	16	Low Air Pressure T/L	
BD	54GA-2	54GA-2	16	Friction Brake A Cutout	
BE	55EA-3	55EA-3	16	Friction Brake On Indicator	
BF	44BC-39	44BC-39	16	A Car Trouble Lights (Knorr ECU) +	
BH	54BA-2	54BA-1	16	Friction Brake Fault A Indicator	
BJ	26LA-2	26LA-2	16	RTX Time Out Control Loop	
BK	46DA-3	46DA-3	16	B Car Car Cleaner Switch	
BL	46DB-3	46DB-3	16	B Car Car Cleaner Switch	
BM	36ZA-1	36ZA-1	16	Radio Wiring	
BN	46CB-3	46CB-3	16	Interior Lights Timer Relay Control	
BP	46CA-3	46CA-3	16	Interior Lights Timer Relay Control	
BR	48BA-12	48BA-11	16	Stepwell Lights and DC Ballasts +	
BS	48BD-2	48BD-3	16	Stepwell Lights and DC Ballasts +	
BT	48BE-3	48BE-3	16	Stepwell Lights and DC Ballasts +	
BU	C11-3	C11-10	16	Cab and Destination Sign Lights +	
BV	51AA-1	51AA-10	16	Cab and Destination Sign Lights +	

EYP12 85 pin					
Pin	**A Side**	**B Side**	**AWG**	**Purpose**	**Comments**
A	42NA-10	42NA-3	16	B Cab ATCS DDU	3-conductor
B	42PA-10	42PA-3	16	B Cab ATCS DDU	3-conductor
C	TH-138	TH-138	16	Shield	3-conductor
D	42QA-10	42QA-3	16	B Cab ATCS DDU	3-conductor
E	42RA-10	42RA-3	16	B Cab ATCS DDU	3-conductor
F	TH-141	TH-141	16	Shield	3-conductor
H	89DA-1	89DA-1	16	ATCS Check Loop T/L	
J	75GA-10	75GA-5	16	VOBC Coupler Loop (B end)	
K	75GB-10	75GB-2	16	Uncoupling Control (B end)	
L	75JA-10	75JA-3	16	Coupler Isolate/Connect (B end)	

M	18DA-22	18DA-14	16	VOBC Left Doors Opn/Close	
N	18EA-20	18EA-12	16	VOBC Left Doors Opn/Rls/Close	
P	18BA-20	18BA-12	16	VOBC Right Doors Opn/Rls/Close	
R	18AA-20	18AA-12	16	VOBC Right Doors Opn/Rls/Close	
S	26AA-10	26AA-7	16	B End VOBC Cab Relay Control	
T	75BA-10	75BA-2	16	End Train Control (coupling)	
U					*Not Used*
V					*Not Used*
W	ET062-20	ET062-8	16	VOBC MC Interlock T/L -	
X					*Not Used*
Y					*Not Used*
Z	88MA-11	88MA-12	16	B End VOBC Transfer Switch Interlock	
a	56DC-3	56DC-4	16	Track Brake Sonalert (VOBC)	
b	95TA-30	95TA-2	16	VOBC to B end DU	1400, 1401, 1403, & 1449 only
c	64BA-11	64BA-3	16	Brk Mode	
d	56AD-13	56AD-13	16	Zero Speed Track Brake Control	
f	X19-4	X19-4	16	Track Brake Control CB +	
g	46MC-25	46MC-25	16	Stop Request Circuit (HSR) +	
h	55KA-5	55KA-6	16	Friction Brake On Status	
i	SPARE38	SPARE38			*Not Used*
j	SPARE39	SPARE39			*Not Used*
k	SPARE40	SPARE40			*Not Used*
m	94TA-30	94TA-2	16	VOBC to B end DU	
n	94SA-30	94SA-2	16	VOBC to B end DU	
p	94RA-30	94RA-2	16	VOBC to B end DU	
q	94QA-30	94QA-2	16	VOBC to B end DU	
r	94PA-30	94PA-2	16	VOBC to B end DU	1400, 1401, 1403, & 1449 only
s	94NA-30	94NA-2	16	VOBC to B end DU	1400, 1401, 1403, & 1449 only
t	94MA-30	94MA-2	16	VOBC to B end DU	1400, 1401, 1403, & 1449 only
u	94LA-30	94LA-2	16	VOBC to B end DU	1400, 1401, 1403, & 1449 only
v	95GA-30	95GA-2	16	VOBC to B end DU	
w	95HA-30	95HA-2	16	VOBC to B end DU	
x	95JA-30	95JA-2	16	VOBC to B end DU	1400, 1401, 1403, & 1449 only
y	95KA-30	95KA-2	16	VOBC to B end DU	1400, 1401, 1403, & 1449 only
z	95LA-30	95LA-2	16	VOBC to B end DU	1400, 1401, 1403, & 1449 only
AA	95MA-30	95MA-2	16	VOBC to B end DU	1400, 1401, 1403, & 1449 only
AB	95NA-30	95NA-2	16	VOBC to B end DU	1400, 1401, 1403, & 1449 only
AC	95PA-30	95PA-2	16	VOBC to B end DU	1400, 1401, 1403, & 1449 only
AD	95QA-30	95QA-2	16	VOBC to B end DU	1400, 1401, 1403, &

					1449 only
AE	95RA-30	95RA-2	16	VOBC to B end DU	1400, 1401, 1403, & 1449 only
AF	95SA-30	95SA-2	16	VOBC to B end DU	1400, 1401, 1403, & 1449 only
AH					*Not Used*
AJ	95UA-30	95UA-2	16	VOBC to B end DU	1400, 1401, 1403, & 1449 only
AK	95VA-30	95VA-2	16	VOBC to B end DU	1400, 1401, 1403, & 1449 only
AL	92HA-30	92HA-2	16	VOBC to B end DCB, and DCB to DCB	
AM	92JA-30	92JA-2	16	VOBC to B end DCB, and DCB to DCB	
AN	92KA-30	92KA-2	16	VOBC to B end DCB, and DCB to DCB	
AP	92LA-30	92LA-2	16	VOBC to B end DCB, and DCB to DCB	
AR	92MA-30	92MA-2	16	VOBC to B end DCB, and DCB to DCB	
AS	92NA-30	92NA-2	16	VOBC to B end DCB, and DCB to DCB	
AT	91TA-4	91TA-2	16	VOBC to B end DCB, and DCB to DCB	
AU	91MA-3	91MA-2	16	VOBC to B end DCB, and DCB to DCB	
AV	91LA-3	91LA-2	16	VOBC to B end DCB, and DCB to DCB	
AW	91KA-3	91KA-2	16	VOBC to B end DCB, and DCB to DCB	
AX	91JA-3	91JA-2	16	VOBC to B end DCB, and DCB to DCB	
AY	91HA-3	91HA-2	16	VOBC to B end DCB, and DCB to DCB	
AZ	91GA-3	91GA-2	16	VOBC to B end DCB, and DCB to DCB	
BA	91FA-3	91FA-2	16	VOBC to B end DCB, and DCB to DCB	
BB	91EA-3	91EA-2	16	VOBC to B end DCB, and DCB to DCB	
BC	91DA-3	91DA-2	16	VOBC to B end DCB, and DCB to DCB	
BD	91CA-3	91CA-2	16	VOBC to B end DCB, and DCB to DCB	
BE	91BA-3	91BA-2	16	VOBC to B end DCB, and DCB to DCB	
BF	91AA-3	91AA-2	16	VOBC to B end DCB, and DCB to DCB	
BH	93AA-2	93AA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BJ	93BA-2	93BA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BK	93CA-2	93CA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BL	93DA-2	93DA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BM	93EA-2	93EA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BN	93FA-2	93FA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BP	93GA-2	93GA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BR	93HA-2	93HA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BS	93JA-2	93JA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BT	93KA-2	93KA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BU	93LA-2	93LA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BV	93MA-2	93MA-1	16	VOBC to Train ID Thumbwheel (A and B)	

EYP13 36 pin					
Pin	**A Side**	**B Side**	**AWG**	**Purpose**	**Comments**
A	X47-8	X47-3	16	ADA Door Chime +	
B	NB47-1	NB47	16	ADA Door Chime -	
C	33GG-3	33GG-2	16	ADA Door Chime Control (Steps Up)	
D					*Not Used*

E					*Not Used*
F					*Not Used*
G					*Not Used*
H					*Not Used*
I					*Not Used*
J					*Not Used*
K					*Not Used*
L					*Not Used*
M					*Not Used*
N					*Not Used*
P					*Not Used*
R					*Not Used*
S					*Not Used*
T					*Not Used*
U					*Not Used*
V					*Not Used*
W					*Not Used*
X					*Not Used*
Y					*Not Used*
Z					*Not Used*
a					*Not Used*
b					*Not Used*
c					*Not Used*
d					*Not Used*
e					*Not Used*
f					*Not Used*
g					*Not Used*
h					*Not Used*
i					*Not Used*
j					*Not Used*
m					*Not Used*
n					*Not Used*

B. LRV2 ARTICULATED CONNECTION JUMPER

EYP7 35 pin					
Pin	**A Side**	**B Side**	**AWG**	**Purpose**	**Comments**
1	ET084	ET084	12	Passenger Intercom T/L	3-Conductor
2	ET085	ET085	12	Passenger Intercom T/L	3-Conductor
3	TH-31,32,33	TH-31,32,33	12	Shields (x3)	3-Conductor
5	ET081	ET081	12	PA Audio T/L	3-Conductor
14	ET086	ET086	12	PA Audio T/L	3-Conductor
15	ET082	ET082	12	Cab to Cab Intercom T/L	3-Conductor
16	ET083	ET083	12	Cab to Cab Intercom T/L	3-Conductor
4	ET042	ET042	12	PSR T/L +	
6	ET026	ET026	12	Sanding T/L +	
7	ET070	ET070	12	Tow Mode T/L +	
8	ET040	ET040	12	Regen Cutout T/L +	
9	ET066	ET066	12	Zero Speed T/L +	
10	ET041	ET041	12	Cutout Bypass Status T/L +	
11	ET064	ET064	12	Propulsion Fault T/L +	
12	ET045	ET045	12	Derail Sensors T/L +	
13	ET101	ET101	12	Steps High Status Indicator (and ADA chime)	
17	ET054	ET054	12	EB T/L +	3-Conductor
18	ET053	ET053	12	EB T/L -	3-Conductor
19	TH-65	TH-65	12	Shield	3-Conductor
21	ET034	ET034	12	Trake Brake On Status T/L	
22	ET033	ET033	12	Track Brake On T/L	
23	ET006-5	ET007-2	12	Right Steps Low/Left Steps Low T/L Control	
24	ET005-5	ET008-2	12	Right Steps High/Left Steps High T/L Control	
25	ET007-4	ET006-4	12	Left Steps Low/Right Steps Low T/L Control	
26	ET008-4	ET005-4	12	Left Steps High/Right Steps High T/L Control	
27	ET029	ET028	12	Turn Signal On Left/Right +	
28	ET028	ET029	12	Turn Signal On Right/Left +	
29	ET018	ET018	12	Head/Tail Lights T/L +	
30	14BB-2	14BH-2	12	Steps Low T/L Status	
31	14CB-2	14BG-2	12	Steps High T/L Status	
32	14BH-2	14BB-2	12	Steps Low T/L Status	
33	14BG-2	14CB-2	12	Steps High T/L Status	
34	43AN-3	43AN-3	12	Local EB loop +	3-Conductor

20	43AF-3	43AF-3	12	Local EB loop -	3-Conductor
35	TH-74	TH-74	12	Shield	3-Conductor

EYP8 35 pin					
Pin	**A Side**	**B Side**	**AWG**	**Purpose**	**Comments**
1	ET057	ET057	12	Brk Mode +	
2	ET058	ET058	12	Brk Mode -	
3	ET067	ET067	12	Auto Mode T/L	
4	ET055	ET056	12	Forward T/L +	3-Conductor
5	ET056	ET055	12	Reverse T/L +	3-Conductor
6	TH-80,83	TH-80,83	12	Shields	3-Conductor
7	ET052	ET052	12	P-Wire T/L Out	3-Conductor
8	64AA-1	64AA-1	12	P-Wire T/L In	3-Conductor
9	18DA-1	18DA-2	12	Left Doors Opn/Rls/Close	
10	18EA-1	18EA-2	12	Left Doors Opn/Rls/Close	
11	18FA-1	18FA-2	12	Left Doors Opn/Rls/Close	
12	18AA-2	18AA-1	12	Right Doors Opn/Rls/Close	
13	18BA-2	18BA-1	12	Right Doors Opn/Rls/Close	
14	18CA-2	18CA-1	12	Right Doors Opn/Rls/Close	
15					*Not Used*
16	ET065	ET065	12	Cab to Cab Intercom Reset	
17	ET011-8	ET011-20	12	Steps Low Status (Cab Dependant)	
18	ET011-9	ET011-26	12	Steps Low Status (Cab Dependant)	
19	ET063	ET063	12	Pass Emer Stop Indication T/L	
20	ET046	ET046	12	Emer Door Rls Indication T/L	
21	ET059-10	ET059-1	12	ATCS FSB Loop T/L +	
22	ET060	ET060	12	FSB Loop T/L +	
23	ET073	ET073	12	FSB Loop T/L -	
24	ET068	ET068	12	Positive T/L #2	
25	ET048	ET048	10	Negative T/L #2	
26	ET069	ET069	12	Positive T/L #1	
27	ET049	ET049	10	Negative T/L #1	
28	ET078	ET078	12	Aux On T/L +	
29	ET072	ET072	12	Aux Off T/L +	
30	ET062	ET062	12	MC Interlock T/L -	
31	ET061	ET061	12	MC Interlock T/L +	
32	ET037	ET037	12	Frict Brk Fault T/L	
33	ET035	ET035	12	Frict Brk On Status T/L	
34	ET039	ET039	12	Brake Dragging T/L	
35	ET019	ET019	12	Low Air Pressure T/L	

EYP9 35 pin

Pin	A Side	B Side	AWG	Purpose	Comments
1	ET095-1	ET095	12	ATCS Serial Data Link T/L	3-conductor
2	ET096-1	ET096	12	ATCS Serial Data Link T/L	3-conductor
3	TH-127	TH-127	12	Shield	3-conductor
4	ET089-2	ET089	12	ATCS Active T/L	
5	89HA-1	ET090	12	ATCS Train Integrity T/L	
6	ET038-2	ET038	12	ATCS Power Return T/L	
7	ET036-3	ET036	12	ATCS Cutout T/L	
8					*Not Used*
9	ET027	ET027	12	Interior Lights T/L +	
10	ET047	ET047	12	Interior Lights T/L -	
11	ET025	ET024	12	Doors Summary T/L -	
12	ET024	ET025	12	Doors Summary T/L +	
13	ET014-4	ET014	12	Doors Closed T/L +	
14	ET013-4	ET013	12	Doors Closed T/L -	
15	89FA-1	ET091	12	ATCS Train Integrity T/L	
16	89AC-1	89AC-1	12	ATCS Check Loop T/L	
17	ET093-10	ET093	12	ATCS Check Loop T/L	
18	89BA-1	89BA-1	12	ATCS Transfer Switch Interlock T/L	
19	89CA-1	ET020	12	ATCS Transfer Switch Interlock T/L	
20	ET099-4	ET100	12	Auto Cab Select T/L	
21	ET050-10	ET050-2	12	ATCS EB Loop -	3-Conductor
22	ET087-10	ET087-1	12	ATCS EB Loop +	3-Conductor
23	TH-68	TH-68	12	Shield	3-Conductor
24	ET022	ET022	12	Pan Up T/L	
25	ET023	ET023	12	Pan Down T/L	
26	ET043	ET043	12	Aux PS Fault T/L	
27	ET100-4	ET099	12	Auto Cab Select T/L	
28	ET098-4	ET098	12	VOBC Reset T/L	
29	50AE-2	50AE-2	12	Horn & Gong +	
30	ET075	ET075	12	Zero Speed for Trk Brks T/L +	
31	50AD-2	50AD-2	12	Horn & Gong +	
32	45EA-4	45EA-4	12	Interior Emerg Lights Relay Control	
33	ET071-11	ET071-11	12	Interior Emerg Lights Relay Control	
34	89GA-1	ET092	12	ATCS Train Integrity T/L	
35	ET021	ET021	12	Ventilation Blower Cutout T/L +	

EYP10 60 pin					
Pin	**A Side**	**B Side**	**AWG**	**Purpose**	**Comments**
1	36QA-2	36QA-4	16	Passenger Intercom T/L	
2	36RA-2	36RA-4	16	Passenger Intercom T/L	
3					*Not Used*
4					*Not Used*

5					*Not Used*
6	34AB-2	34AB-3	16	Communication Control Amp Wiring	
7	34BB-2	34BB-3	16	Communication Control Amp Wiring	
8	34CB-2	34CB-3	16	Communication Control Amp Wiring	
9	34DB-2	34DB-3	16	Communication Control Amp Wiring	
10	34EB-2	34EB-3	16	Communication Control Amp Wiring	
11	34FB-2	34FB-3	16	Communication Control Amp Wiring	
12	34GB-2	34GB-3	16	Communication Control Amp Wiring	
13	34HB-2	34HB-3	16	Communication Control Amp Wiring	
14	34JB-2	34JB-3	16	Communication Control Amp Wiring	
15					*Not Used*
16					*Not Used*
17	34KB-2	34KB-3	16	Communication Control Amp Wiring	
18	34LB-2	34LB-3	16	Communication Control Amp Wiring	
19	34MB-2	34MB-3	16	Communication Control Amp Wiring	
20	34NB-2	34NB-3	16	Communication Control Amp Wiring	
21	34PB-2	34PB-3	16	Communication Control Amp Wiring	
22	34QB-2	34QB-3	16	Communication Control Amp Wiring	3-Conductor
23	34RB-2	34RB-3	16	Communication Control Amp Wiring	3-Conductor
24	TH-30	TH-30	16	Shield	3-Conductor
25	34SB-2	34SB-3	16	Communication Control Amp Wiring	
26	34TB-2	34TB-3	16	Communication Control Amp Wiring	
27	34WB-2	34WB-3	16	Communication Control Amp Wiring	
28					*Not Used*
29	14EC-3	14EC-3	16	Steps Down Control -	
30					*Not Used*
31					*Not Used*
32					*Not Used*
33					*Not Used*
34					*Not Used*
35					*Not Used*
36					*Not Used*
37					*Not Used*
38					*Not Used*
39					*Not Used*
40					*Not Used*
41					*Not Used*
42					*Not Used*
43	35DA-9	35DA-10	16	Interior Speakers	3-Conductor
44	35CA-9	35CA-10	16	Interior Speakers	3-Conductor
45	TH-xx	TH-xx	16	Shield	3-Conductor
46	TH-03	TH-03	16	Shield	3-Conductor

47	35BA-2	35BA-4	16	Exterior Speakers	3-Conductor
48	35AA-2	35AA-4	16	Exterior Speakers	3-Conductor
49					*Not Used*
50					*Not Used*
51					*Not Used*
52					*Not Used*
53					*Not Used*
54					*Not Used*
55					*Not Used*
56					*Not Used*
57					*Not Used*
58					*Not Used*
59					*Not Used*
60					*Not Used*

EYP11 85 pin					
Pin	**A Side**	**B Side**	**AWG**	**Purpose**	**Comments**
A	NB27-5	NB27-5	16	Destination and Run Number Sign -	
B	X27-7	X27-7	16	Destination and Run Number Sign +	
C	49BA-5	49BA-5	16	Destination and Run Number Sign Network	3-Conductor
D	49AA-5	49AA-5	16	Destination and Run Number Sign Network	3-Conductor
E	TH-61	TH-61	16	Shield	3-Conductor
F	X16-8	X16-8	16	Stop Request Circuit +	
H	47DA-5	47DA-5	16	Stop Request Circuit +	
J	81EB-3	81EB-4	16	Sander Control Cutout	
K	81EA-3	81EA-2	16	Sander Control Cutout	
L	80AA-2	80AA-2	16	Zero Speed Bypass Loop	
M	81SA-2	81SA-2	16	Prop Inverter #2 Cutout	
N	81TA-2	81TA-2	16	Prop Inverter #1 Cutout	
P	44BC-2	44BC-1	16	Emerg Door Rls Bypass & Overspd Aud Cutout	
R	84YA-2	84YA-2	16	Overspeed Indicator and Chime	
S	81UA-2	81UA-2	16	Propulsion Stall Indicator	
T	81VA-2	81VA-2	16	KT panel Prop Fault A	
U	81WA-2	81WA-2	16	KT panel Prop Fault B	
V	54EA-2	54EA-2	16	Friction Brake C Cutout	
W	54FA-2	54FA-2	16	Friction Brake B Cutout	
X	28BA-1	28BA-1	16	Pantograph Control Cutout +	
Y	28CA-1	28CA-1	16	Pantograph Control Cutout +	
Z	28CB-4	28CB-3	16	Pantograph Control Cutout	
a	28BB-4	28BB-3	16	Pantograph Control Cutout	
b	14AF-1	14AF-1	16	B Cab Steps Up Command	
c	46RA-2	46RA-1	16	B Cab Right Turn Button	
d	46SA-2	46SA-1	16	B Cab Left Turn Button	

f	46FA-3	46FA-3	16	B Cab Emergency Flasher Button	
g	58AA-6	58AA-6	14	Turn Signal Lights T/L +	
h	58BA-6	58BA-6	14	Turn Signal Lights T/L +	
i	NB8-4	NB8-4	14	Turn Signal Lights -	
j	46FB-4	46FB-4	16	Emerg Flashers Steps Down Doors Open	
k	14BC-4	14DB-4	16	Stepwell Lights Right Timer Relay +	
m	56FA-1	56FA-1	16	Zero Speed Track Brake Control	
n	14CD-4	14BC-4	16	Stepwell Lights Left Timer Relay +	
p					*Not Used*
q	18HA-1	18HA-1	16	Door Chime Relay Control	
r	18ZA-26	18ZA-25	16	B Car Right Doors Lock Command	
s	18FB-20	18FB-3	16	B Car Right Doors Lock Command	
t	18GA-1	18GA-1	16	Local Door Control Relay Control	
u	46MB-10	46MB-2	16	Stop Request Circuit +	
v	46MA-10	46MA-2	16	Stop Request Circuit +	
w	46FG-2	46FG-2	16	Emerg Flashers Steps Down Doors Open	
x	14EA-2	14EA-2	16	Steps Up Control -	
y	17EA-11	17EA-11	16	Door Operator Zero Speed B+	
z	26LB-2	26LB-2	16	RTX Time Out Control Loop	
AA	26GA-2	26GA-2	16	Aux On +	
AB	17LA-2	17LA-3	16	Right Doors Closed Relay Control	
AC	17MA-2	17MA-3	16	Left Doors Closed Relay Control	
AD	17LD-2	17LD-1	16	Right Doors Closed Loop	
AE	17ME-2	17ME-1	16	Left Doors Closed Loop	
AF	17KA-3	17KA-3	16	Local Doors Closed Indicator	
AH	41CD-5	41CD-6	16	LVPS Fault Indication	
AJ	41CC-5	41CC-6	16	Aux PS Fault Indication	
AK					*Not Used*
AL	26BA-4	26BA-4	16	Aux On +	
AN	55SC-2	55SC-1	16	B17 Valve Cutout Status	
AP	X29-36	X29-34	16	Friction Brake Control CB	
AR	43AD-4	43AD-4	16	Emerg Brake Indicator	
AS	66BF-10	66BF-1	16	Emerg Door Release and Pass Emerg Loop	
AT	34ZA-1	34ZA-1	16	Sound Powered Telephone Circuit	
AU	34XA-1	34XA-1	16	Sound Powered Telephone Circuit	
AV	42KA-3	42KA-3	16	Speedometer -	3-conductor
AW	42FB-2	42FB-2	16	Speedometer +	3-conductor
AM	TH-130	TH-130	16	Shield	3-conductor
AX	54DA-2	54DA-1	16	Friction Brake Fault C Indicator	
AY	54CA-2	54CA-1	16	Friction Brake Fault B Indicator	
AZ	56AA-3	56AA-3	14	Track Brake Cutout	
BA	88JA-3	88JA-3	16	VOBC Overspeed Chime	
BB	56AC-3	56AC-3	14	Track Brake Cutout	
BC	ET019-6	ET019-5	16	Low Air Pressure T/L	
BD	54GA-2	54GA-2	16	Friction Brake A Cutout	

BE	55EA-3	55EA-3	16	Friction Brake On Indicator	
BF	44BC-39	44BC-39	16	A Car Trouble Lights (Knorr ECU) +	
BH	54BA-2	54BA-1	16	Friction Brake Fault A Indicator	
BJ	26LA-2	26LA-2	16	RTX Time Out Control Loop	
BK	46DA-3	46DA-3	16	B Car Car Cleaner Switch	
BL	46DB-3	46DB-3	16	B Car Car Cleaner Switch	
BM					*Not Used*
BN	46CB-3	46CB-3	16	Interior Lights Timer Relay Control	
BP	46CA-3	46CA-3	16	Interior Lights Timer Relay Control	
BR	48BA-12	48BA-11	16	Stepwell Lights and DC Ballasts +	
BS	48BD-2	48BD-3	16	Stepwell Lights and DC Ballasts +	
BT	48BE-2	48BE-3	16	Stepwell Lights and DC Ballasts +	
BU	C11-3	C11-10	16	Cab and Destination Sign Lights +	
BV	51AA-1	51AA-10	16	Cab and Destination Sign Lights +	

EYP12 85 pin					
Pin	**A Side**	**B Side**	**AWG**	**Purpose**	**Comments**
A	42NA-10	42NA-3	16	B Cab ATCS DDU	3-Conductor
B	42PA-10	42PA-3	16	B Cab ATCS DDU	3-Conductor
C	TH-138	TH-138	16	Shield	3-Conductor
D	42QA-10	42QA-3	16	B Cab ATCS DDU	3-Conductor
E	42RA-10	42RA-3	16	B Cab ATCS DDU	3-Conductor
F	TH-141	TH-141	16	Shield	3-Conductor
H	89DA-1	89DA-1	16	ATCS Check Loop T/L	
J	75GA-10	75GA-3	16	VOBC Coupler Loop (B end)	
K	75GB-10	75GB-2	16	Uncoupling Control (B end)	
L	75JA-10	75JA-3	16	Coupler Isolate/Connect (B end)	
M	18DA-22	18DA-14	16	VOBC Left Doors Opn/Close	
N	18EA-20	18EA-12	16	VOBC Left Doors Opn/Rls/Close	
P	18BA-20	18BA-12	16	VOBC Right Doors Opn/Rls/Close	
R	18AA-20	18AA-12	16	VOBC Right Doors Opn/Rls/Close	
S	26AA-10	26AA-7	16	B End VOBC Cab Relay Control	
T	75BA-10	75BA-2	16	End Train Control (coupling)	
U					*Not Used*
V					*Not Used*
W	ET062-20	ET062-8	16	VOBC MC Interlock T/L -	
X					*Not Used*
Y					*Not Used*
Z	88MA-11	88MA-12	16	B End VOBC Transfer Switch Interlock	
a	56DC-3	56DC-4	16	Track Brake Sonalert (VOBC)	
b					*Not Used*
c	64BA-11	64BA-3	16	Brk Mode	
d	56AD-13	56AD-13	16	Zero Speed Track Brake Control	

f	X19-4	X19-4	16	Track Brake Control CB +	
g	46MC-25	46MC-25	16	Stop Request Circuit (HSR) +	
h	55KA-5	55KA-6	16	Friction Brake On Status	
i	SPARE38	SPARE38			*Not Used*
j	SPARE39	SPARE39			*Not Used*
k	SPARE40	SPARE40			*Not Used*
m	94TA-30	94TA-2	16	VOBC to B end DU	
n	94SA-30	94SA-2	16	VOBC to B end DU	
p	94RA-30	94RA-2	16	VOBC to B end DU	
q	94QA-30	94QA-2	16	VOBC to B end DU	
r					*Not Used*
s					*Not Used*
t					*Not Used*
u					*Not Used*
v	95GA-30	95GA-2	16	VOBC to B end DU	
w	95HA-30	95HA-2	16	VOBC to B end DU	
x					*Not Used*
y					*Not Used*
z					*Not Used*
AA					*Not Used*
AB					*Not Used*
AC					*Not Used*
AD					*Not Used*
AE					*Not Used*
AF					*Not Used*
AH					*Not Used*
AJ					*Not Used*
AK					*Not Used*
AL	92HA-30	92HA-2	16	VOBC to B end DCB, and DCB to DCB	
AM	92JA-30	92JA-2	16	VOBC to B end DCB, and DCB to DCB	
AN	92KA-30	92KA-2	16	VOBC to B end DCB, and DCB to DCB	
AP	92LA-30	92LA-2	16	VOBC to B end DCB, and DCB to DCB	
AR	92MA-30	92MA-2	16	VOBC to B end DCB, and DCB to DCB	
AS	92NA-30	92NA-2	16	VOBC to B end DCB, and DCB to DCB	
AT	91TA-4	91TA-2	16	VOBC to B end DCB, and DCB to DCB	
AU	91MA-3	91MA-2	16	VOBC to B end DCB, and DCB to DCB	
AV	91LA-3	91LA-2	16	VOBC to B end DCB, and DCB to DCB	
AW	91KA-3	91KA-2	16	VOBC to B end DCB, and DCB to DCB	
AX	91JA-3	91JA-2	16	VOBC to B end DCB, and DCB to DCB	
AY	91HA-3	91HA-2	16	VOBC to B end DCB, and DCB to DCB	
AZ	91GA-3	91GA-2	16	VOBC to B end DCB, and DCB to DCB	
BA	91FA-3	91FA-2	16	VOBC to B end DCB, and DCB to DCB	
BB	91EA-3	91EA-2	16	VOBC to B end DCB, and DCB to DCB	
BC	91DA-3	91DA-2	16	VOBC to B end DCB, and DCB to DCB	
BD	91CA-3	91CA-2	16	VOBC to B end DCB, and DCB to DCB	
BE	91BA-3	91BA-2	16	VOBC to B end DCB, and DCB to DCB	
BF	91AA-3	91AA-2	16	VOBC to B end DCB, and DCB to DCB	
BH	93AA-2	93AA-1	16	VOBC to Train ID Thumbwheel (A and B)	

BJ	93BA-2	93BA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BK	93CA-2	93CA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BL	93DA-2	93DA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BM	93EA-2	93EA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BN	93FA-2	93FA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BP	93GA-2	93GA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BR	93HA-2	93HA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BS	93JA-2	93JA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BT	93KA-2	93KA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BU	93LA-2	93LA-1	16	VOBC to Train ID Thumbwheel (A and B)	
BV	93MA-2	93MA-1	16	VOBC to Train ID Thumbwheel (A and B)	

EYP13 36 pin					
Pin	**A Side**	**B Side**	**AWG**	**Purpose**	**Comments**
A	X47-8	X47-3	16	ADA Door Chime +	
B	NB47-1	NB47	16	ADA Door Chime -	
C	33GG-3	33GG-2	16	ADA Door Chime Control (Steps Up)	
D					*Not Used*
E					*Not Used*
F					*Not Used*
G					*Not Used*
H					*Not Used*
I					*Not Used*
J					*Not Used*
K					*Not Used*
L					*Not Used*
M					*Not Used*
N					*Not Used*
P					*Not Used*
R					*Not Used*
S					*Not Used*
T					*Not Used*
U					*Not Used*
V					*Not Used*
W					*Not Used*
X					*Not Used*
Y					*Not Used*
Z					*Not Used*
a					*Not Used*
b					*Not Used*
c					*Not Used*
d					*Not Used*
e					*Not Used*
f					*Not Used*
g					*Not Used*
h					*Not Used*
i					*Not Used*

j					*Not Used*
m					*Not Used*
n					*Not Used*

TP16.04 PSC-2 CABLE DATA

A construction drawing of this cable does not exist. A cable will be made available for reverse engineering upon request. Schematics 136787 and 167298 provide signal details and 1455888 provides some installation detail. They will be provided upon request. Additional data is available in the OEM manuals and illustrated parts catalog. General arrangement drawings are provided here for reference.

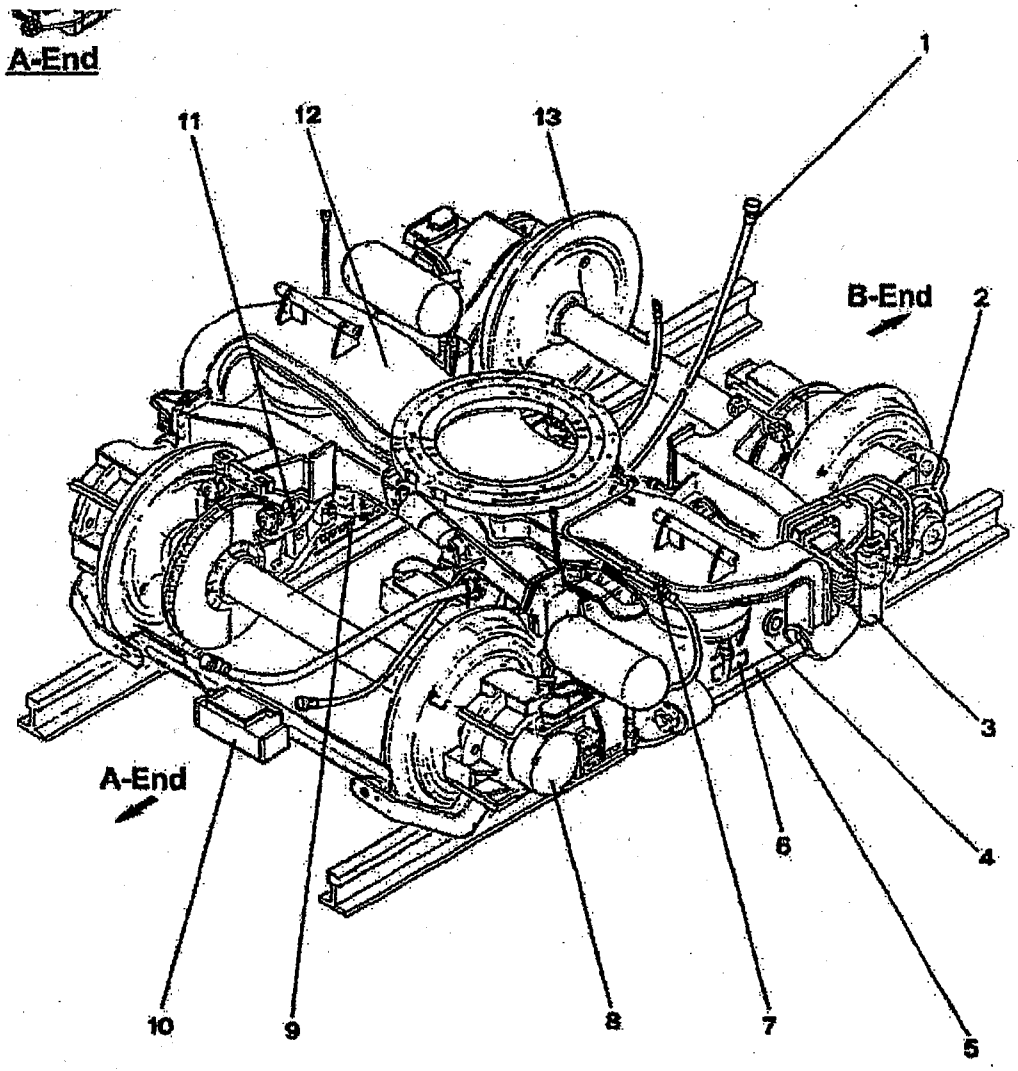

Figure 3-17 Trailer Truck Assy

Trailer Truck Assy (Fig. 3-17)

Section Figure Item	P/N	MFR P/N	MFR Code	Description	MUNI Code	U/M	Q.ty per Assy	v s c
03-17-	J20200000		A0185	TRAILER TRUCK ASSY - SEE FIG. 03-01 FOR NHA		EA	1	
1	J20291000	1=A 00C8K	A0185	.TRAILER TRUCK, ELECTRIC SYSTEM, CABLE ASSY - SEE FIG.05-49 FOR DETAIL		EA	1	
2	J20255000		A0185	.PRIMARY SUSPENSION, TRAILER TRUCK - SEE FIG.03-20 FOR DETAIL		EA	4	
3	J20290500		A0185	.FRAME PNEUMATIC SYSTEM, TRAILER TRUCK - SEE FIG.03-25 FOR DETAIL		EA	1	
4	J20251000		A0185	.FRAME ASSY, TRAILER TRUCK - SEE FIG.03-19 FOR DETAIL		EA	1	
5	J20252000		A0185	.SECONDARY SUSPENSION, TRAILER TRUCK - SEE FIG.03-18 FOR DETAIL		EA	1	
6	J20256900		A0185	.LABELS, TRAILER TRUCK - SEE FIG.03-23 FOR DETAIL		EA	1	
7	J20290100		A0185	.BOLSTER BEAM PNEUMATIC SYSTEM, TRAILER TRUCK - SEE FIG.03-24 FOR DETAIL		EA	1	
8	J20255500		A0185	.JOURNAL BOXES, TRAILER TRUCK - SEE FIG.03-22 FOR DETAIL		EA	1	
9	J19253600	390050	34922	.TRACK BRAKE ASSY - SEE FIG.16-66 FOR DETAIL		EA	2	
10	J20256800		A0185	.TRAILER TRUCK, ATCS ANTENNAS INSTL - SEE FIG.17-02 FOR DETAIL		EA	1	
11	J20253000		A0185	.TRAILER TRUCK, BRAKE CALIPER UNIT, INSTL - SEE FIG.16-13 FOR DETAIL		EA	1	
12	J20252100		A0185	.BOLSTER BEAM ASSY		EA	1	
13	J20254010		A0185	.WHEEL-SET ASSY, TRAILER TRUCK - SEE FIG.03-21 FOR DETAIL		EA	2	

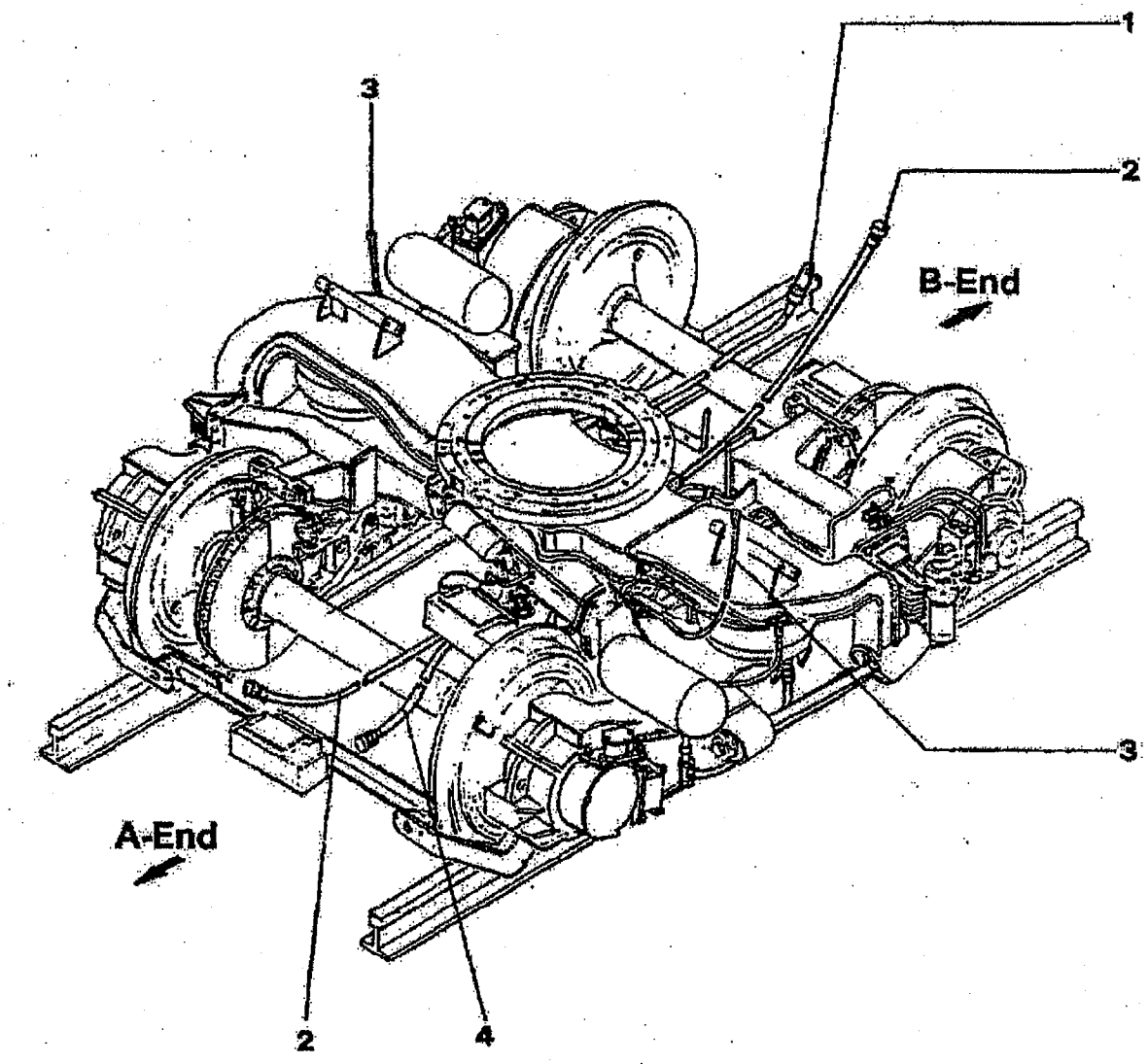

Figure 5-49 Trailer Truck, Electric System, Cable Assy

Trailer Truck, Electric System, Cable Assy (Fig. 5-49)

Section Figure Item	P/N	MFR P/N	MFR Code	Description	MUNI Code	U/M	Q.ty per Assy	V S C
05-49-	J20291000		A0185	TRAILER TRUCK, ELECTRIC SYSTEM, CABLE ASSY - SEE FIG. 03-17 FOR NHA		EA	1	
1	J20291800		A0185	.TRAILER TRUCK, RETURN CURRENT CABLE, INSTL - SEE FIG.05-50 FOR DETAIL		EA	1	
2	J20291400		A0185	.TRAILER TRUCK, SIGNAL RECEIVER, ELECTRICAL CONNECTIONS, INSTL - SEE FIG.17-04 FOR DETAIL		EA	1	
3	J20291850		A0185	.TRAILER TRUCK, GROUND CABLE, INSTL - SEE FIG.05-51 FOR DETAIL		EA	1	
4	J20291300		A0185	.TRAILER TRUCK, TRACK BRAKE CONNECTION - SEE FIG.16-70 FOR DETAIL		EA	1	

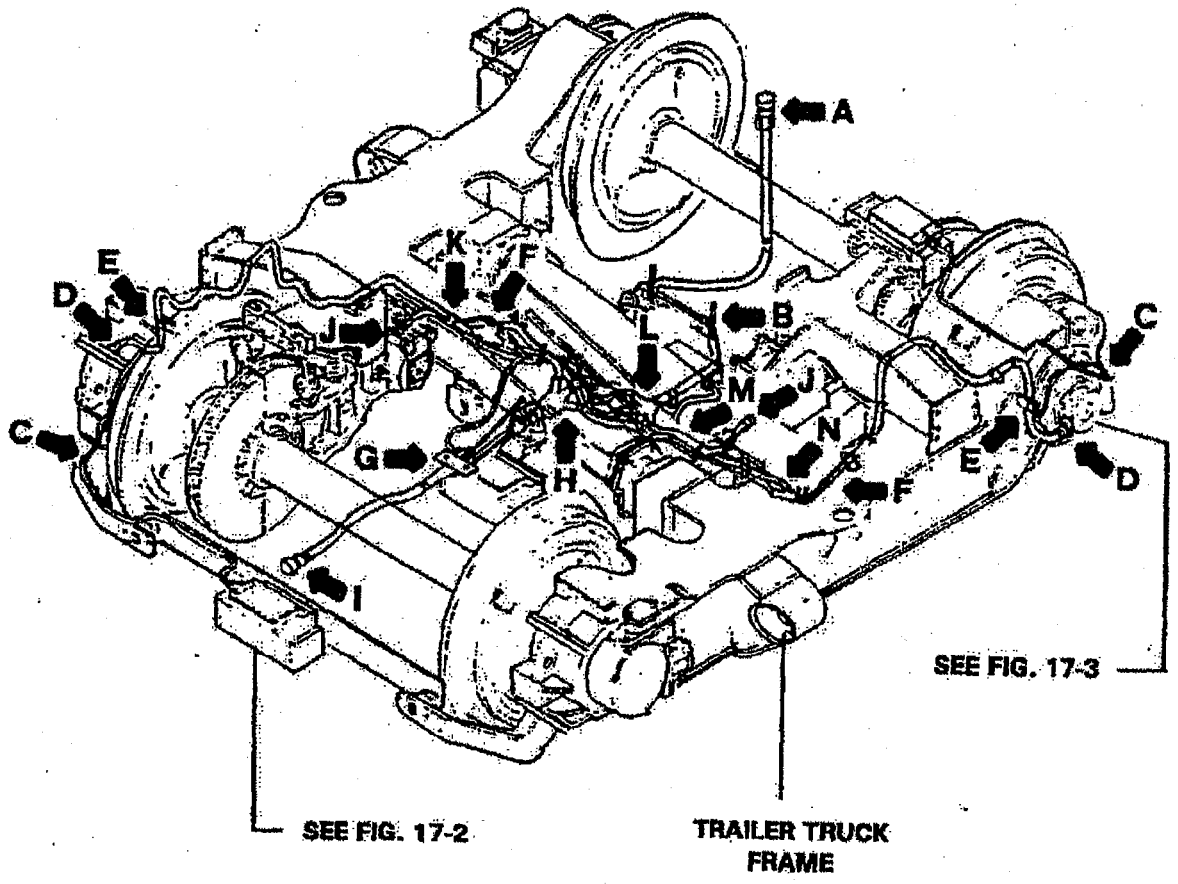

Figure 17-4 Trailer Truck, Signal Receiver, Electrical Connections, Instl (Sheet 1 of 3)

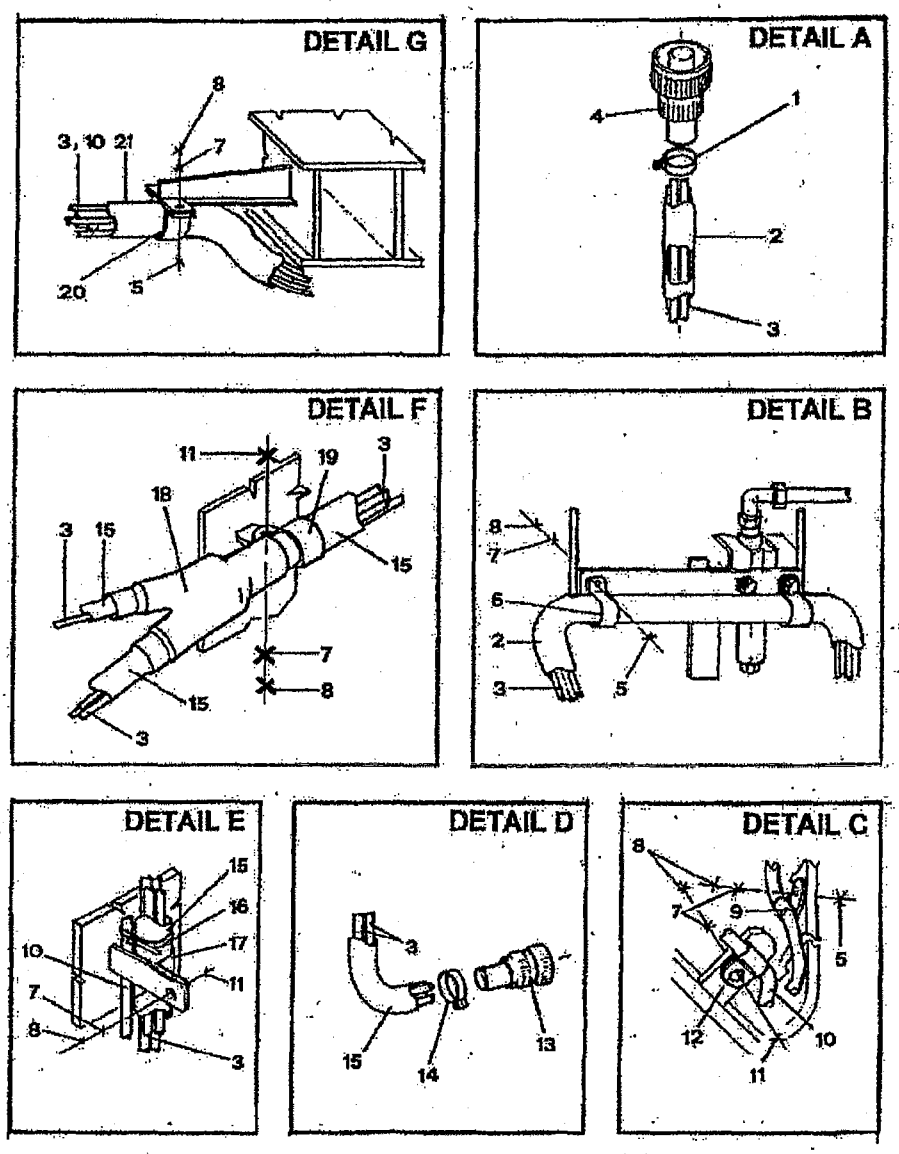

Figure 17-4 Trailer Truck, Signal Receiver, Electrical Connections, Instl (Sheet 2 of 3)

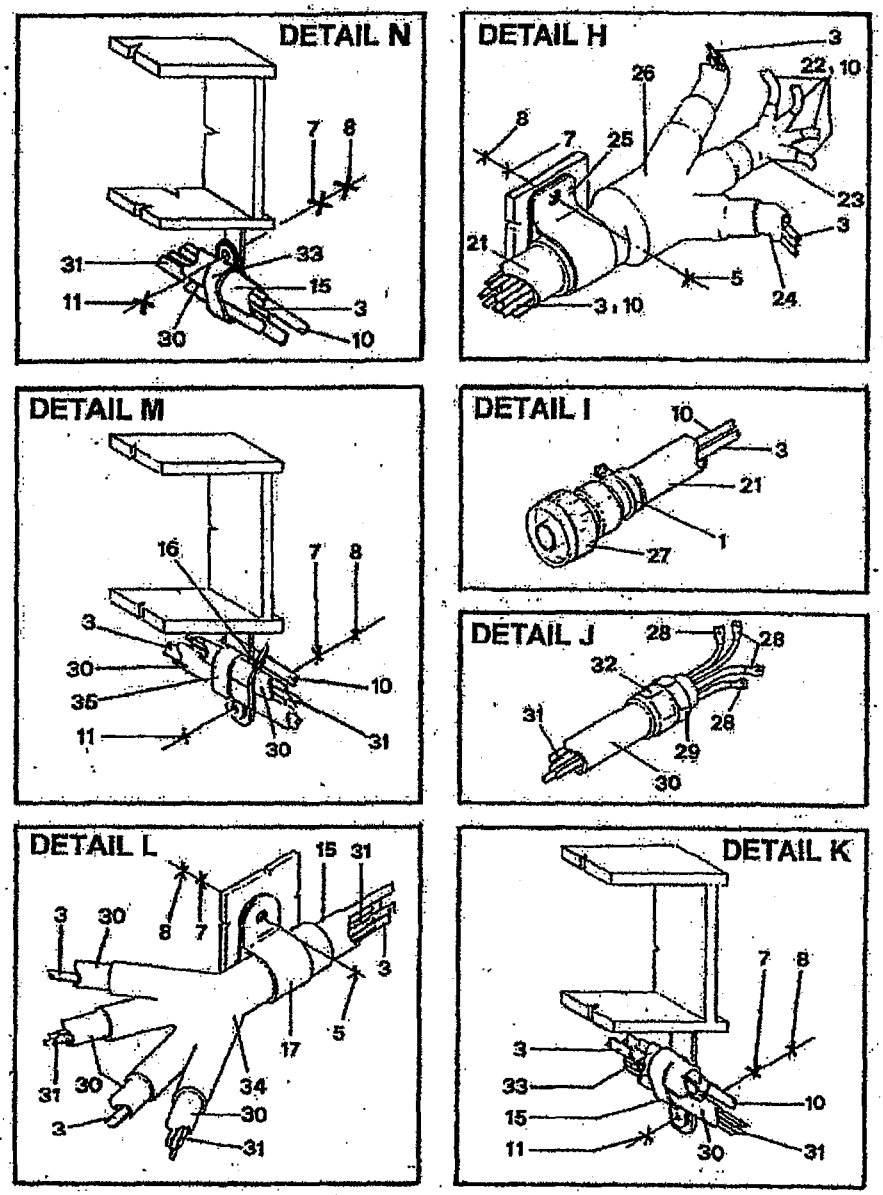

Figure 17-4 Trailer Truck, Signal Receiver, Electrical Connections, Instl (Sheet 3 of 3)

End of Section

End of Technical Provisions

Print Form

Introduction Form

By a Member of the Board of Supervisors or the Mayor

Time stamp
or meeting date

I hereby submit the following item for introduction (select only one):

☒ 1. For reference to Committee.
An ordinance, resolution, motion, or charter amendment.

☐ 2. Request for next printed agenda without reference to Committee.

☐ 3. Request for hearing on a subject matter at Committee.

☐ 4. Request for letter beginning "Supervisor [ ] inquires"

☐ 5. City Attorney request.

☐ 6. Call File No. [ ] from Committee.

☐ 7. Budget Analyst request (attach written motion).

☐ 8. Substitute Legislation File No. [ ]

☐ 9. Request for Closed Session (attach written motion).

☐ 10. Board to Sit as A Committee of the Whole.

☐ 11. Question(s) submitted for Mayoral Appearance before the BOS on [ ]

Please check the appropriate boxes. The proposed legislation should be forwarded to the following:

☐ Small Business Commission ☐ Youth Commission ☐ Ethics Commission

☐ Planning Commission ☐ Building Inspection Commission

Note: For the Imperative Agenda (a resolution not on the printed agenda), use a Imperative

Sponsor(s):

Supervisor Wiener

Subject:

Approval of Amendment Two to Contract No. APT 591-01 between the City and County of San Francisco and AnsaldoBreda Inc.

The text is listed below or attached:

Resolution approving Amendment Two to Contract No. APT 591.01, LRV Doors and Steps Reconditioning and Systems Rehabilitation, between the City and County of San Francisco, through the San Francisco Municipal Transportation Agency and AnsaldoBreda Inc., to remove the doors and steps and air supply unit work from the project scope and shift the balance of the money to rehabilitate the trucks of 41 LRVs with three options to rehabilitate the trucks of 24, 24 and 23 LRVs, respectively, if funds become available, for a total contract amount not to exceed $104,263,354 and to extend the term of the contract to no latest than October 31, 2018.

140928

File No.

FORM SFEC-126:
NOTIFICATION OF CONTRACT APPROVAL
(S.F. Campaign and Governmental Conduct Code § 1.126)

City Elective Officer Information *(Please print clearly.)*	
Name of City elective officer(s): Members, SF Board of Supervisors	City elective office(s) held: Members, SF Board of Supervisors

Contractor Information *(Please print clearly.)*	
Name of contractor: **AnsaldoBreda Inc.**	
Please list the names of: *(1) Members of the contractor's board of directors ;* ***Maurizio Manfellotto, Andrea Pepi, Giancarlo Fantappie, Giuseppe Marino*** *(2) The contractor's chief executive officer, chief financial officer, and chief operating officer ;* ***Giancarlo Fantappie (ABI CEO), Dario Nicotra (ABI CFO), Mauro Melani (ABI GM)*** *(3) Any person who has an ownership of 20 percent or more in the contractor;* ***None*** *(4) Any subcontractor listed in the bid or contract;* ***Vapor Stone Rail Systems (Wabtec Corp.), Knorr Brake Corp., Dellner Inc., Swiger Coil Systems (Wabtec Corp.), McCain Inc.*** *(5) Any political committee sponsored or controlled by the contractor.* ***None***	
Contractor address: **101 The Embarcadero, Suite 210 San Francisco, CA 94105**	
Date that contract was approved:	Amount of contract: **Not to Exceed: $104,263,354**

Describe the nature of the contract that was approved:
SFMTA: Amendment Two to CPT 591 LRV Doors and Steps Reconditioning and Systems Rehabilitation
Comments:

This contract was approved by (check applicable):

☐ the City elective officer(s) identified on this form

☒ a board on which the City elective officer(s) serves San Francisco Board of Supervisors
Print Name of Board

☐ the board of a state agency (Health Authority, Housing Authority Commission, Industrial Development Authority Board, Parking Authority, Redevelopment Agency Commission, Relocation Appeals Board, Treasure Island Development Authority) on which an appointee of the City elective officer(s) identified on this form sits

_____
Print Name of Board

Filer Information *(Please print clearly.)*	
Name of filer:	Contact telephone number: 0
Address:	E-mail:

_____ _____
Signature of City Elective Officer (if submitted by City elective officer) Date Signed

_____ _____
Signature of Board Secretary or Clerk (if submitted by Board Secretary or Clerk) Date Signed

Signature of Sponsoring Supervisor: Scott Wiener

For Clerk's Use Only: