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## **Understanding Concepts of Design from Differences – Comparison Between Japan and the U.S. in Rigging –**

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In about 20 years from the manufacture of MBTA-bound LRVs by Kinki Sharyo in a U.S. project to a recent LRV project for Seattle, applied systems and rigging methods have changed with the change of the times. Regarding the main circuit system, technology has changed from resistance cam control used in early projects to recent IGBT technology. Regarding rigging design also, we have introduced new products and features to reduce costs and simplify rigging methods, taking advantage of our experience in manufacturing many LRVs of the same type. To put it in an exaggerated manner, we understand, in a U.S. project, that we can do everything which is not expressly prohibited in specifications, and submit bold proposals for cost reduction and improvement for the customer's approval. In a U.S. project, therefore, we feel that we have more latitude in introducing new ideas than in a Japanese project. For a designer, this represents the interest and charm of U.S. and other overseas projects. To introduce novelties, however, we are naturally obliged to secure technical feasibility and reliability as minimum requisites.

### Differences in Rigging Method

As for the rigging method, flexible electric wire tubes have been used for part of vehicles recently manufactured and used in Japan. In Europe and the U.S., exposed thin wires are always put into flexible tubes for protection. Also, a general practice there seems to be connecting the tubes with equipment connectors without using sealant. Copper pipes are mainly used for air piping (though this depends on customer specifications). These pipes are advantageous because they are highly workable and machinable, and do not need painting as a rule. Accordingly, the pipes are used for all U.S.-bound vehicles manufactured by Kinki Sharyo. I hear that in the past, an inspector from the customer made an absurd request to polish pipes clean, because brown rust seemed to have formed on them. However, the "rust" on the surface is actually a corrosion-resistant protective film consisting of cuprous oxide. Recently, brazed joints are seldom used because they require much work and high skills. Instead, bite type joints are used heavily, which are advantageous in terms of workability. NPT taper screws as specified in the ANSI standard is used as fitting joints; this specification is unique to the U.S. While the wire size is shown in mm<sup>2</sup> in Japan, Europe and many other countries it is shown using the AWG (American Wire Gauge) in the U.S. JRIS and other standards are referred to in Japan as to the method of determining wire size, while such standards as NEC and APTA are used in the U.S. for the same purpose.

### Conformance with Local Standards

Specifications or restrictions on materials to be used represent an obstacle for a Japanese vehicle manufacturer. In most cases, materials with a long track record in Japan, as well as JIS-accredited ones, cannot be used without prior examination in the U.S. Regrettably, JIS is only one among many local standards in an international perspective. Recent specifications often cite standards used internationally, i.e. in Europe or other large regions. In the U.S., however, domestic standards are cited more often. There, nearly all combustible materials must be approved prior to use; judgment on whether they can be used is made through quantitative examination based on such standards as NFPA130, ASTM and BSS. The use of vinyl chloride is basically forbidden, though it is often used in Japan as floor or packing material. NFPA130, a standard on fireproofing requirements, includes strict requirements on fireproofing performance. It requires combustion tests for floors and roofs. Regarding rigging, the standard requires e.g. the use of fireproof sealants for through sections that may lead flames from a floor or rooftop into a room.

### Differences in System/Equipment

Though it is difficult to point out general differences between Japan and the U.S. in vehicle systems, I will describe some differences as examples. As I haven't conducted any detailed research regarding every part of this description, I ask readers to kindly forgive me if it contains some errors.

Regarding installed equipment, grounding switches are not required specially for U.S.-bound products, while they are installed in Japan to facilitate testing, maintenance etc. Also, the installation of main fuses is not required specially in the U.S., while it is obligatory in Japan. There are many other differences between Japan and the U.S. stemming from differences in law, rules and specifications. Regarding low-voltage circuits, a body may used to lay a retrace line in Japan, while it may not be used for that purpose in the U.S.; instead, a negative bus insulated from the vehicle is installed. A control power supply of DC 100 V is mainly used in Japan, while a power of DC 24 V (battery voltage) etc. is mainly used in the U.S., probably to facilitate the use of appliances for general consumers. Regarding instructions on power running and braking, many America-bound vehicles are controlled via PWM signals generated with a generator (0 to 100%) and a metal through line, instead of using only logic signals transmitted digitally

(which is a recent feature) or via a metal through line. Regarding the velocity detection circuit, the design of logic in the U.S. is converse to that in Japan. In our country, a signal for “5 km/h or more” from a velocity detector is run via a through line to indicate the detection of some velocity. In the U.S., however, a signal for “6 km/h or less” (this velocity varies according to customer) is run via the line to indicate the detection of “no velocity.” While the zero velocity detection circuit is among critical circuits in Japan also, the design concept in the U.S. is different in that there, the designer thinks that the speeding down of a vehicle below a certain safety speed is a prerequisite for door opening and other operations. Also, there are some design differences regarding theftproofing equipment. In Japan, CCTV cameras have begun to be introduced for monitoring in a vehicle. In the U.S., CCTV cameras are not used only for monitoring, as specifications sometimes include a provision that the camera should be designed in such a manner that recorded images can be presented as a court evidence in the event of an incident. Also, a silent alarm light is sometimes installed on a vehicle roof. In the event that the vehicle is hijacked, the operator can flicker the strobe light (and send an alarm) by pushing a hidden button, to allow the vehicle to be identified easily from a helicopter above. In a project, the original requirement was to install a covered luggage container in the cab. As a result of a later change, however, an uncovered container was used in the final design, on the ground that a covered container would make it difficult to discover a suspicious object inside. This made me think of the influence of recent social circumstances, especially a heightened consciousness of the danger of terrorism. Another interesting feature is the wig-wag headlight operation for Phoenix-bound LRVs. No such feature is used for vehicles operated in Japan. You often notice a similar function while watching an American movie, e.g. a patrol car flickering right and left headlamps alternatively at short intervals. In actual vehicle operation, this function is used in combination with emergency braking, horn operation etc.

I have described some examples in the above, but cannot talk about many for want of space. It is difficult to explain differences between specifications used in Japan and the U.S. in a few words. These differences are influenced significantly by differences in culture, way of thinking, and standard. A vehicle must be so designed as to meet specifications and requirements from the customer and national authorities. As a designer, I strive to design a vehicle that can satisfy the customer and passengers in whichever country the vehicle is destined for, by introducing new, good features.