

# “EDiA EM”

## New Generation Counterbalance Electric Powered 1.3- to 2.0-Ton Forklift Trucks



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In industrial countries such as Japan, the United States, and European Union countries, electric forklift trucks have come to the fore in the small-forklift market, reflecting environmental consciousness. In a competitive market with many manufacturers, controlling total costs and improving maneuverability are important. In response to these demands, Mitsubishi Heavy Industries, Ltd. (MHI) has developed the EDiA EM forklift truck jointly with Nippon Yusoki.

### 1. What is the EDiA EM

The EDiA EM was named for Electric truck made by Mitsubishi (Mitsubishi means Three Diamonds in English). And EM has two meanings, one is “medium class (48V)” that runs on three battery voltages: 24, 48 and 80 V and the other is “to Empower customers.” To help attract customers, the development of the EDiA EM focused on total cost reduction, improved up-time, and improved maneuverability.

### 2. Total cost reduction

The EDiA EM was considered to reduce not only the initial purchase price but also the total cost including running cost such as maintenance expenses.

#### 2.1 Improved Maintenance Intervals

The newly developed drive unit uses a sealed multi-plate wet brake as the standard service brake in the drive unit, achieving a maintenance-free brake. Unlike dry single disc brakes, the periodic replacement of pads and discs is not required (**Figure 1**).

#### 2.2 Compatibility with Current Battery Types

The removable spacer in the battery compartment enables the use of DIN-type batteries, which are mainly used in Europe, in the new chassis frame, in addition to the BS-type batteries used in conventional trucks. As a result, the batteries currently owned by customers can be used, regardless of whether they are BS or DIN type.

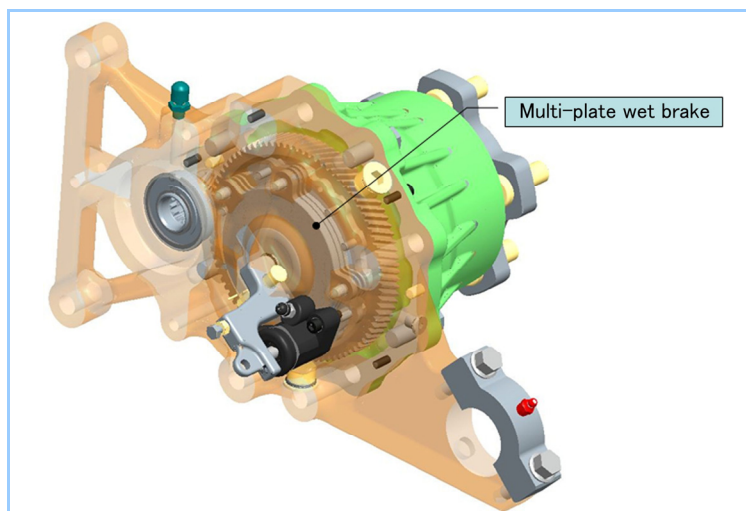


Figure 1 Sealed-type multi-plate wet brake

### 3. Improved up-time

Electric trucks cannot operate while the battery is recharging or until the time after replacing. This counts as down-time. The EDiA EM was improved to reduce the down-time and to extend the real operating hours (up-time).

#### 3.1 Improved Energy Consumption

Electric trucks, including conventional trucks, use full hydraulic steering (FHS), in which an electric motor drives a hydraulic pump and the hydraulic pressure generated moves the steering. Instead of this, the EDiA EM adopted an electrically driven steer-by-wire (SBW) system (Figure 2). SBW does not use a hydraulic system, and consumes less energy than FHS. In addition, improved energy consumption is attained by a newly developed direct-acting hydraulic control valve, the optimized layout of hydraulic components, and other features. The total energy consumption is reduced by 12%, as compared to a conventional truck (for the three-wheel specification).

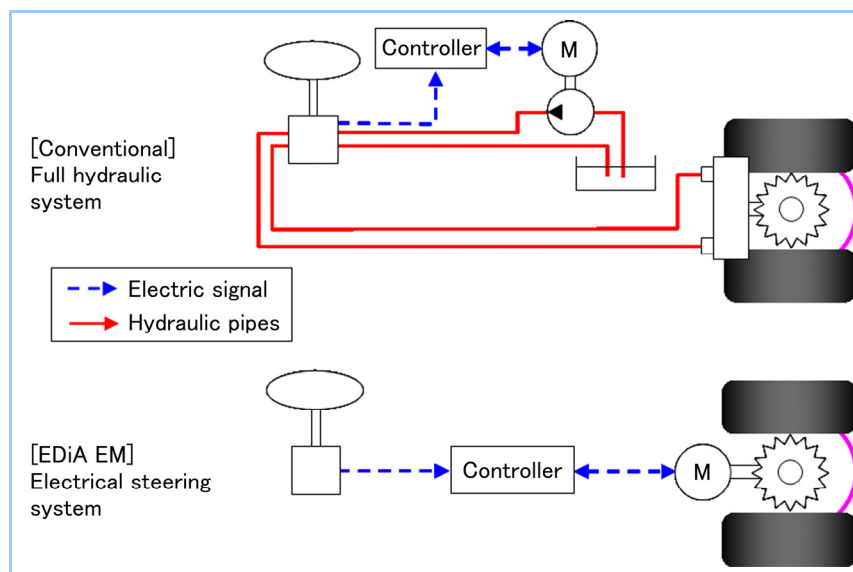


Figure 2 Electrical steering system with steer-by-wire (3-wheel spec.)

#### 3.2 Easy Battery Replacement

The battery side-way-exchange option, which was designed for conventional trucks, was improved for better handling of the batteries. In the conventional truck, the batteries slid on nylon rails, which required much effort. The EDiA EM adopted a roller bed structure to reduce the effort and significantly shorten the battery replacement time.

### 4. Improved maneuverability

With the improvements to the operator compartment and the addition of new options, the maneuverability was improved.

#### 4.1 Small Diameter Steering Wheel

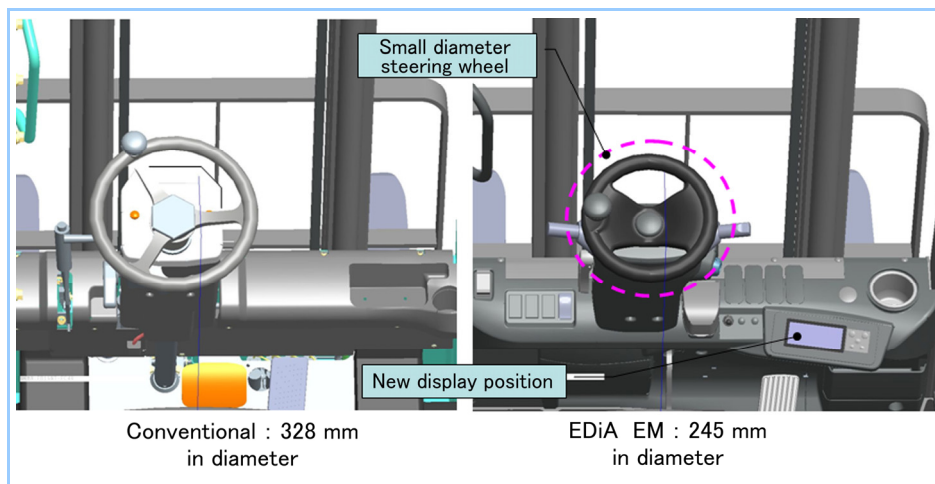
The SBW reduced the steering effort, and the operational burden of steering was reduced with the smaller-diameter steering wheel. In addition, the display that shows the truck condition was moved to the dashboard from the steering column to improve the forward view (Figure 3).

#### 4.2 Wider Foot Space

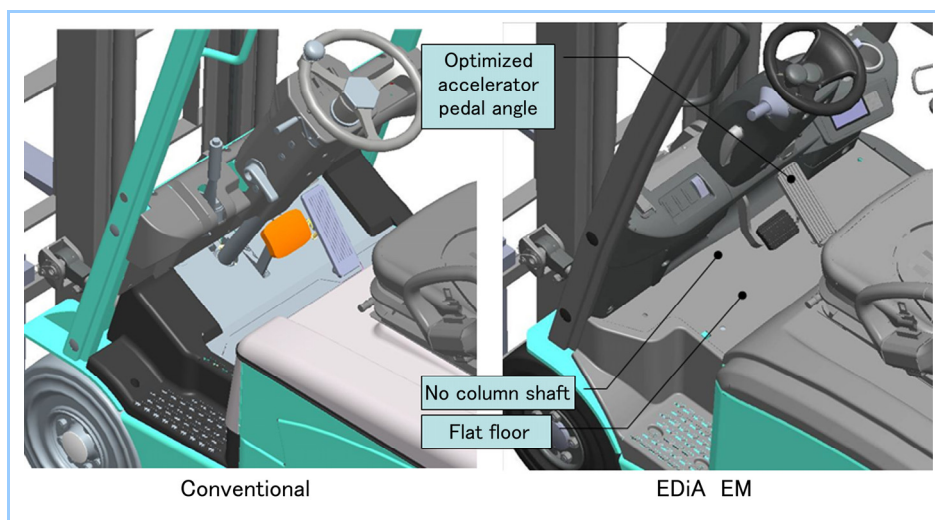
The SBW system allowed a flat foot space for the operator by downsizing the steering system devices that were incorporated in the steering column, and eliminating the hydraulic pipes. The accelerator pedal angle was optimized, alleviating operator fatigue (Figure 4).

#### 4.3 Reducing Traveling Vibration – Pitching Control Option

When a truck goes over a bump with a rated load, it sometimes pitches markedly, which may cause the load to fall. Takasago Research and Development Center developed a pitching control function, which reduces the pitching vibration on the upper fork-blade face, and this is provided as an option for the EDiA EM to improve its drivability in a bumpy yard.



**Figure 3 Small diameter steering wheel**



**Figure 4 Wider foot space**

## 5. Styling and variation

In addition to the three features mentioned above, the EDiA EM has various additions and improvements to satisfy customers' needs.

### 5.1 Smart Styling

In the industrial market, a sense of finish and styling has become one of the truck selection criteria. The truck interior and exterior designs were refurbished with the aid of the MHI Advanced Technology Research Center, making it attractive in relation to the sophisticated style of European competitors.

### 5.2 Additional Variations

New variations including 1.3- and 1.5-ton 3-wheel trucks and compact 1.6- and 1.8-ton three- and four-wheel trucks were added to respond to customers' needs.

## 6. Main specifications

**Table 1** shows the main specifications of the EDiA EM.

Table 1 Main specifications

Specification	Unit	3 wheel truck							4 wheel truck					
		FB/EP 13PNT	FB/EP 15PNT	FB/EP 16CPNT	FB/EP 18CPNT	FB/EP 16PNT	FB/EP 18PNT	FB/EP 20PNT	FB/EP 16CPN	FB/EP 18CPN	FB/EP 16PN	FB/EP 18PN	FB/EP 20PN	
Rated capacity	kg	1,300	1,500	1,600	1,800	1,600	1,800	2,000	1,600	1,800	1,600	1,800	2,000	
Load center	mm	500		500		500		500		500		500		
Maximum lift height	mm	3,325		3,325		3,325		3,325		3,325		3,325		
Free lift	mm	115		115		115		115		115		115		
Lift speed (empty/loaded)	m/s	0.6/0.5		0.6/0.5	0.6/ 0.44	0.6/ 0.5	0.6/ 0.44	0.6/ 0.4	0.6/ 0.5	0.6/ 0.44	0.6/ 0.5	0.6/ 0.44	0.6/ 0.4	
Lowering speed (empty/loaded)	m/s	0.5/0.52		0.5/0.52		0.5/0.52		0.5/0.52		0.5/0.52		0.5/0.52		
Tilt angle (forward/backward)	deg	5/7.5		5/7.5		5/7.5		5/7.5		5/7.5		5/7.5		
Travel speed	Forward (empty/ loaded)	km/h	16/16		16/16		16/16		17/17		17/17		17/17	
	Reverse (empty/ loaded)	km/h	16/16		16/16		16/16		17/17		17/17		17/17	
Minimum turning radius	mm	1,475		1,585		1,695		1,900		2,015		2,015		
Working aisle width 1000×1200mm pallets	mm	3,173		3,283		3,393		3,403	3,473	3,473	3,588	3,588	3,599	
Working aisle width 800×1200mm pallets	mm	2,993		3,103		3,213		3,222	3,273	3,273	3,388	3,388	3,399	
Overall length	mm	2,998		3,108		3,218		3,229	3,302		3,412		3,423	
Length to fork face	mm	1,848		1,958		2,068		2,079	2,152		2,262		2,273	
Overall width	mm	1,090		1,090		1,090		1,140	1,090		1,090		1,140	
Overall height	To top of mast lowered	mm	2,125		2,125		2,125		2,125		2,125		2,125	
	Mast extended	mm	4,331		4,331		4,331		4,331		4,331		4,331	
	To top of overhead guard	mm	2,050		2,050		2,050		2,050		2,050		2,050	
Front overhang	mm	373		373		373		384	373		373		384	
Rear overhang	mm	190		190		190		333		333		333		
Wheelbase	mm	1,285		1,395		1,505		1,446		1,556		1,556		
Seat height	mm	976		976		976		976		976		976		
Tow coupling height	mm	575		575		575		575		575		575		
Tread	Front	mm	920		920		920		938	920		920		938
	Rear	mm	174		174		174		898		898		898	
Front tyre height	mm	215		215		215		215		215		215		
Rear tyre height	mm	175		175		175		190		190		190		
Under clearance	At mast	mm	95		95		95		95		95		95	
	At frame	mm	85		85		85		85		85		85	
Fork	Length× width× thickness	mm	1,150×100×35		1,150×100×35		1,150×100×35		1,150×100×35		1,150×100×35		1,150×100×35	
	Fork spacing (outside)	mm	920 – 240		920 – 240		920 – 240		920 – 240	920 – 240		920 – 240		920 – 240
Weight (without battery)	kg	2,070	2,265	2,185	2,285	2,115	2,210	2,440	2,195	2,250	2,080	2,145	2,310	