

## Vertical Transportation Planning – MRL vs. Hydraulic

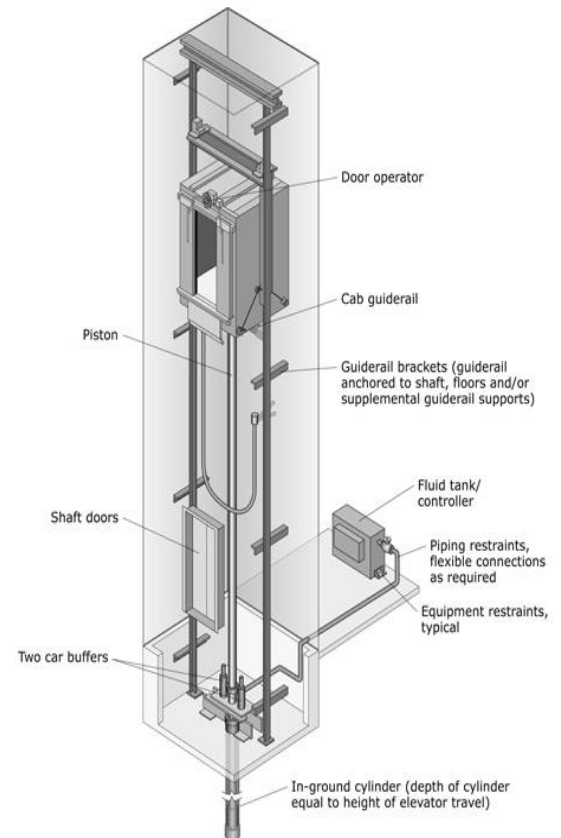
The machine-room-less (MRL) elevator was introduced to the U.S. market in 1996. Since then designers have asked MRL or hydraulic? Over the last 15 years, the decision criteria have changed as the USGBC has changed the identity of U.S. projects. This brief will provide a summary of the advantages and disadvantages of each product, as well as offer a basis on which designers can make recommendation to their clients.

### Hydraulic Elevators

The hydraulic elevator has been the preferred option in the U.S. for low-rise applications. The product is relatively inexpensive, the design is standardized, and the product is available from a number of sources.

The primary advantages are:

- Low initial cost
  - Cost 30-40% less than light duty MRL, the differential is higher to a standard MRL
- Inexpensive maintenance cost
  - 50% less than an MRL
- Availability
  - Independent manufacturers resulting in a competitive bidding field
- Ease of maintenance
  - Multiple maintenance
- Minimal structural loads
  - Imposes little vertical loads on the building
- Emergency rescue is achieved by battery lowering
  - Self-contained within the elevator system to return to lowest floor
- Less sensitive to interior cab weights
  - Provides design flexibility
- Efficient building space utilization
  - Flexible machine room location
  - Hoistway is 12-15% smaller than MRL
- Effective for high load capacity requirements
- Fast installation
  - 3 weeks or less for passenger elevators, 6-10 weeks for service or custom freight elevators



The disadvantages of hydraulic elevators are:

- Limited speeds/travel
  - 150fpm maximum/60' maximum
- Erratic Performance
  - Changes in temperature can affect leveling
- Poor ride quality
  - Abrupt up start, speed transitions are noticeable
- Potential cylinder leaks
  - Underground cylinders are subject to electrolysis, if not properly protected oil could seep into the ground
- Odor
  - The smell of hydraulic oil can be noticed near a machine room or from within the cab
- Noise
  - Starting & running noise produced by the hydraulic motor and pump
  - Noise from the oil rushing through the pipe or at the cylinder head
- High electrical requirements
  - Larger motor, high starting amps
  - Electrical service is larger to avoid "light dimming" affect
- High heat outputs
  - High BTU output increases energy expended to cool machine room
- Unknowns of underground
  - Cost from ground obstructions are passed onto the purchaser
  - Exclusion of underground components in maintenance contracts

Consideration of manufacturers' standard hydraulic products is typical for low-rise applications. Some of these products offer limited design flexibility. Custom cab or entrance designs limit standard product applications.

In terms of standard hydraulic products:

- KONE no longer sells KONE manufactured hydraulic elevators.
- Otis Elevator Company now offers a unique holeless hydraulic elevator product called the Hydrofit™. This product does not require a machine room, the pump unit is located in the pit and the controller is located within the hoistway wall space. Otis also offers holed hydraulic elevators.
- Schindler Elevator Corporation offers their standard product holed and holeless 330A™ with plastic laminate cab selections.
- ThyssenKrupp's standard hydraulic product is termed AMEE™, again a product offered with plastic laminate cabs. They also offer conventional holeless and inground products, as well as manufacturer their own custom hydraulics.

A designer faces greater risk with the standard products experiencing more of the operating disadvantages presented earlier. Thus, consideration of the hydraulic option may require a more robust custom hydraulic elevator capable of accommodating custom cab finishes. Many times custom hydraulic elevators are outsourced to a third party manufacturer who has filled a manufacturing niche for this application. These manufacturers include Minnesota Elevator, CEMCO Lift and others.

The risks associated with the below ground hydraulics can be minimized with the use of a holeless hydraulic elevator. This design lifts the cab from the top rather than pushing the cab from below. Typical holeless designs include two hydraulic cylinders mounted on both sides of the cab to balance the lifting load. This arrangement may require a higher overhead unless a two-stage cylinder is used. The holeless product is available from some of the major manufacturers as well as third party manufacturers.

## **Machine-Room-Less Elevators (MRL)**

Manufacturers now offer two MRL products:

- 1) The original MRL offering available from the major OEMs, and a few third party manufacturers.
- 2) A light duty MRL offered by KONE, Otis Elevator Company, Schindler Elevator Corporation, and ThyssenKrupp.

The original MRL has heavier lifting capacity and more design flexibility. Specific products include the KONE Mono-Space™, Otis Gen2™, Schindler 400A™, and ThyssenKrupp Synergy 300E™.

The light duty MRL is a pre-engineered, competitively priced, hydraulic replacement elevator. Specific products include the KONE EcoSpace™, Schindler 3300™, and ThyssenKrupp Synergy 85S™. These are excellent solutions for low-rise applications, to provide accessibility, and to overcome the disadvantages of a low-rise hydraulic elevator.

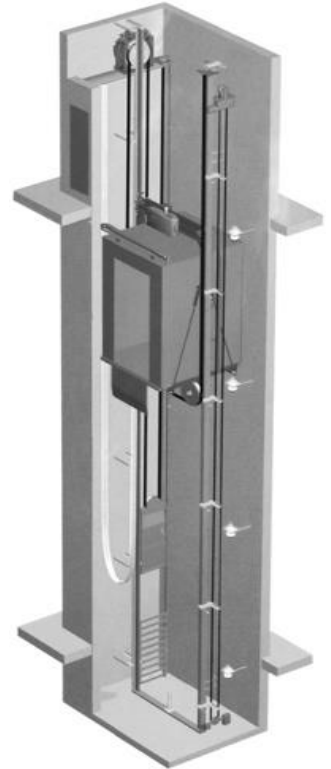
In the U.S. the MRL elevator typically still requires a separate, conditioned, control room within a certain distance from the hoistway. Designs allow for mounting the controller in the front hoistway wall, however, some jurisdictions will not allow this configuration. Code may also require access to the governor from outside the hoistway; this access requires coordination with the manufacturer's governor location. Access can be through the control room or via access panel through the hoistway wall. Outside the U.S. the controller is typically mounted in the hoistway or in the elevator entrance jamb.

The advantages of the MRL option are:

- Energy efficiency
  - Gearless machines are highly efficient; counterweight reduces the machine horsepower size
  - Drive is regenerative; the elevator feeds power back into the line in the up direction
  - 25% less K/CAL/HR than hydraulic
- Smaller power feed requirements
  - Motor size 50% less than hydraulic
- Ride quality
  - Gearless elevator ride quality; smooth starting, acceleration, deceleration and stopping
- Emergency rescue device
  - Travels to nearest available floor
- Few lubricants
  - There is no hydraulic oil; machines are gearless which eliminates gear lubrication
- Low noise levels
  - Gearless machines are relatively quiet

The disadvantages of the MRL are primarily commercial:

- Higher initial cost
- Higher maintenance cost
- Design interface
  - Dimensions can vary from manufacturer which requires oversizing the hoistway to accommodate all products



The MRL is the green choice that comes at a cost; however, with the proper upfront planning, the commercial disadvantages can be minimized.

**Design Criteria**

To assist designers in establishing a basis for recommendation to their clients we offer the following decision criteria:

Environmental Sensitivity – The hydraulic elevator is not environmentally sensitive due to the use of hydraulic oils, the high power consumption, and the high BTU output in the machine room. Review of any industry product literature notes that the MRL has been positioned against the hydraulic elevator as the green alternative.

Sustainability – Sustainable design seeks to reduce negative impacts on the environment. Given this objective, the hydraulic elevator fails this criteria in comparison to the MRL option.

Maintainability – The hydraulic elevator scores higher than the MRL. Most hydraulic elevators can be maintained either by the OEM or their competitors. Specifications of any elevator should include the requirement for either on-board diagnostic equipment or the turnover of any required handheld devices. The maintainability of the hydraulic elevator will reduce the cost of ownership over the long term.

Cost Effectiveness – The hydraulic elevator is the lowest cost solution available. Both in terms of initial installation cost and continuing maintenance cost.

Health & Comfort – The MRL provides the comfortable ride quality of a gearless elevator; the disadvantages associated with the abrupt hydraulic ride, its noise and hydraulic smell fails the hydraulic product on this criteria.

Criteria	Hydraulic	MRL
Environmental Sensitivity		✓
Sustainability		✓
Maintainability	✓	
Cost Effectiveness	✓	
Health & Comfort		✓

If equally weighted, the results score 3 to 2 in favor of the MRL elevator. Maintainability and Cost Effectiveness would both have to be weighted 2x the other three criteria in order for the hydraulic elevator to be recommended. This weighting is reasonable for various project stakeholders. Thus, the decision merits the client’s input.

## **Summary**

The decision between the MRL and hydraulic elevator on U.S. projects will continue to challenge designers for the foreseeable future. The decision is mute for international projects as the hydraulic elevator has become nearly obsolete outside the U.S.

For U.S. projects with four landings or more, there should not be a question as to which elevator is the right solution. Either the first generation or light duty MRL will typically be the prevailing choice. The selection becomes more difficult for less than four landings as this decision typically tilts towards project economics as opposed to ride quality or environmental concerns.

While the MRL performs better, it is unlikely that tenants will notice the difference in a low-rise setting. It is also unlikely that tenants will notice the MRL ride quality as it is simply expected. However, tenants will notice an uncomfortable ride, odorous smell, or noisy elevator. These types of experiences become the topic of conversation and the source of complaints.

When the elevator is part of a larger Class "A" commercial building, it will require the highest degree of visual detail and finishes. These finishes are designed in the elevator lobbies and continue into the elevator cabs. Such high quality is associated with a ride quality that provided by the MRL.

FSC recommends the MRL elevator for Class "A" projects, for applications that are four or more landings, or when a green building is a priority. The MRL scores higher on the Design Criteria, presents less of a risk to the owner and design team, and follows the intent of the USGBC guidelines. Any premium paid for the MRL will be an owner investment in tenant satisfaction.

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