Transport Air conditioning Special Reference To Bus Air Conditioning

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APPLICATIONS :

The air conditioning applications for transport sector includes all mobile equipment, like passenger cars, bus air coniditioning, truck refrigeration, mobile homes (house on wheels) mobile electronic testing vans, tanks, containers, air crafts, space ships, defence shelters, fishing trawlers, ships, railways, mobile cranes or any other special requirements.

This presentation deals mainly with bus air conditioning requirements, standards, specifications, and various parameters which the body builder should consider while constructing air conditioned buses with particular attention to air management and insulation.

INDIAN SCENARIO :

The air conditioned buses manufactured in India were introduced in early 80's. The policies of government and the duty structures, at that time, were not conducive for rapid growth of this segment and this sector therefore had hardly any growth in the decade. The realisation of requirement of air conditioning for buses as essential prerequisite for tourism and for improving general comfort of passengers started getting due attention in late 80's and early 90's. Till such time there was only one manufacturer in India producing units in collaboration with German technology. Other leading manufacturers who tried to assemble and produce bus air conditioning equipment from the available components used for land installations did not succeed as design of mobile equipment requires special attention and materials, components which are much different than those, successful for land applications.

Presently all the leading manufacturers all over the world, of this specialised equipment have entered in India, which itself indicates that globally it is recognised that this segment is going to grow very rapidly as compared to other industrial products. This is evident form the fact that in 80's hardly 10% cars were air conditioned and there was no manufacturer giving factory fitted car air conditioners.

Today practically 30 to 40% cars are air conditioned and all the leading world manufacturers, putting their plants in India are giving AC as factory fitted option.

BUS CHASSIS MANUFACTURERS :

In India as on date there is not a single manufacturer who produces chassis exclusively for buses. The two leading manufactures are truck chassis manufacturers who build bus chassis as well by carrying out modifications in suspension mechanism and other minor changes.

The total chassis manufactured for large size trucks and buses together is around 150,000 per annum, out of which around 30,000 are used for converting and constructing buses and remaining for goods transport. The air conditioned buses build every year do not exceed 500 per year. This also includes contribution of small manufacturers who build 2 to 3 air conditioned buses in a year.

Demand for air conditioned buses is increasing repidly due to four major factors.

1. Duty structure has been rationalised to a great extend over last 3 years although much needs to be done still. The cost of A/C equipment is nearly 30 to 35% of total bus cost in India as against 5 to 10% elsewhere in developed countries.

2. Many state governments have made it mandatory that tourist bus operators must fit A/C unit, then only they are eligible for operating and the licences are issued on this basis.

3. Once any tourist operator introduces A/C bus on a popular route, the tourists then give preference to air conditioned travel over normal bus and other tourist operators have to follow the suit if they have to remain in that particular market segment and retain their share.

4. Consumers/passengers have started realising the benefits for A/C travel, and as the paying power is gradually increasing the demand for such A/C travel is increasing ingeometric proportion, since commuters can see that by paying little extra amount, they are able to reach destination in as fresh a condition as when they started their journey without spoiling their clothes and without exposing themselves to pollution hazard like dust, smoke etc. The efficiency also improves as they are fresh less exhausted when they reach destination.

THE PRESENT BUS A/C SCENARIO :

The Indian market is divided in three major segments.

1. Small buses upto 10 to 15 passenger carrying capacity, used by corporate world for commuting their executives from residences to place of work, Airport shuttles, Hotel vans, Ambulances and other specific needs.

2. Medium size buses up to 18 to 25 passengers mainly called as LCV'S. These buses are also predominantly used for intra-city operations as mentioned above and some of they are also used for between the city operations on small distance travel, for tourist travel.

3. Large buses carrying 38 to 45 passengers mainly used over long distance travel for tourism and for inter city operations for mass transport in metropolitan cities.

The small and medium bus air conditioning requirements are met by integrated units using indpendent components. Condensers are either roof mounted or skirt mounted although first option is more popular in India due to bad road conditions and dusty atmosphere, water flooding etc. which tends to make condenser very dirty in a short time. The evaporator section is normally mounted at the back, suspended from the roof, and compressor is driven by main engine. This leads to compressor and correspondingly the unit changing its capacity constantly as the engine speed fluctuates from idling to full speed. The evaporators can be either ducted or free blow type. In short, the system is more or less identical to car A/C systems, but of bigger capacity.

Further part of this presentation deals with finer aspects of bus body construction and air management for large bus segment and compares with international practices as this is the potential growth area from tourism point of view.

The most important difference between Indian buses and buses used abroad lies in main engine power. In USA,Europe, and most of the Asia Pacific countries use engines of having horse power in excess of 250 HP are used. This enables the air conditioning compressor to be run from main engine as the engine performance does not deteriorate when A/C compressor takes 25 HP out of it for running A/C system. The system therefore then becomes similar to car or medium size buses except for the capacities. This is not possible in India, as both our chassis manufacturers have engines fitted on tourist buses of less than 130 HP. The main engine power is therefore inadequate to spare power for A/C unit, which requires approx. 25 HP. It becomes therefore essential to install separate power pack for driving refrigeration compressor utilising separate diesel engine. This naturally adds cost, noise, and additional vibrations associated with it. The system also becomes complicated as regards wiring, electrical panels, etc. Although manufacturers have plans to upgrade the engine power in the range of 180 to 200 HP. It is understood that these would be used mainly for trucks carrying cargo as they see no benefit in putting larger horse power engines for passenger buses; the contention being it would not reduce travel time looking at the heavy traffic on roads and bad road conditions, but on other hand would add to the fuel cost which the bus operators would be reluctant to bear.
Power pack therefore becomes unavoidable for large A/C buses and necessary expertise in designing reliable unit with silent engine, reliable alternator, compressor dirive components such as electromagnetic clutch, noise shield etc. have to be engineered for which less technology is available from partners abroad who do not use such equipment extensively. Power pack requirements exists in countries mainly China, India and few Asian countries and India could serve as a leading supplier globally for such equipment.

As there are no chassis manufacturers in India producing bus chasisis exclusively, there are also no body builders, who have necessary expertise to build air conditioned coaches, hence this presentation now deals on this aspect.

The technology in constructing leak proof body with properly sealed windows, and air management are some of the aspect discussed.

The Indian fleet owners and therefore body builders prefer partition between passenger compartment and driver's cabin, thus depriving the driver air conditioned comfort, due to worng notions that drivers are likely to fall alsleep if they are given more comfort than they are used to it. Another reason put forward is that the driver and his colleague needs privacy. The third reason is they require partition for supporting video/TV monitors. This practice is not followed elsewhere in the world and the system needs to be designed to cool entire bus than only the passenger compartment.

The another major difference is the units now available world over are using environmentally friendly refrigerants like R 134a, R 404a in place of R 12 or R 502. The CFC refrigerants are banned in developed countries as per Montreal Protocol agreement from December 95 for use in all new equipment. In India we are allowed to use R 12 up to 2010 being developing country, and it seems that unless we are driven to the limit or forced by legislation internally, we may not switch over to new refrigerants so soon. The reluctance of Indian refrigerant manufacturers is also a major contributing factory. Because of governments liberalisation policy, the multinationals entering into the country are pressuring Indian users/manufacturers to use new refrigerants and this could be the major reason for earlier switch over. The high pressure refrigerant R 22 is continued to be used, however the entire transport industry globally is shifting towards R 134a as a refrigerant of choice.
The use of new refrigerants require special expetise, special materials for hoses, rubber components, compressors, and special controls, fittings to make system leak proof besides needing new type of oils.
Coupled with this skilled, trained manpower is also essential to attend to installations/field servicing, more or less on similar lines as boiler attendant certification. This skills need to be developed speedily if we decide to hasten the switching over to new refrigerants and lot of training efforts would go into it.

The air conditioning cooling requirements are given applicable for standard Indian buses in the annexure, however these vary depending on various factors such as type of application, bus body construction, ambient conditions, operating hours, etc. and detailed user friendly computer programs are available to arrive at reasonably accurate cooling load esitmates.

The typical specifications and requirements are also spelled out in detail in the annexure enclosed.

We shall now deal in more details as to the additional precautions, the body builder should take while constructing A/C bus.
The foremost objective of the body builder should be to minimise heat ingress inside the bus so that an A/C system is not overburdened.
If the analysis is done, as to which are major contributors, it can be seen that engine heat ingress, outside air leaking in and proper roof and flooring insulation becomes top three items on which the body builder should concentrate.

1) The engine heat ingress can be substantially reduced by spraying PUF foam on the under side of the bonnet. In addition it is also essential many times to provide insulated canopy, so that radiated heat ingress is minimised. In India no body builders should procure equipment need to spray PUF which will help in better working of the A/C unit.

2) The construction of bus body should be such that it is made leak proof/air tight. One does not readily realises the importance of this but when the bus is travelling at average speed of 50 miles an hour, even a small slit or crack becomes equivalent to 6 ft. long slit allowing outside air quantities as high as 1400 cft. is in reality higher than air ingress due to door openings. Air infiltration is more pronounced when vehicle is in motion. This outside air adds addtional heat load not taken into account and distrubs the efficient working of the cooling system.

3) The bus body after construction can be tested for leak proofness by water spray method or smoke test method.

4) Particular attention must be paid to make door airtight, using requisite gasket materials and better workmanship compared to non A/C buses.

5) Out of total solar heat gain, the roof contributes maximum load, hence roof needs to be insulated with atleast 50 mm thick PUF insulation, whereas for the entire bus 25 to 37 mm insulation should suffice. The flooring also needs special additional treatment since solar reflection from roads affects floor more than exterior walls. A temperature correction of at least 7 to 10 degree F needs to be taken into account. The flooring could be covered by wooden planks, rubber mating, and heavy carpets to minimise heat ingress. Below the chassis higher temperature exists due to tar roads getting overheated.

6) The effect of solar heat gain is more pronounced when vehicle is stationery.

7) The insulation or any other material used should be fire proof/fire resistant/ fire retardant.

8) Door openings, and duration of each opening should be kept minimum.

9) The dark colours absorb heat and light colours reflect heat. Hence while selecting the bus painting, light shades to be preferred as much as possible while constructing A/C bus to reduce heat load.