



Product



Application

Custom Gearboxes and Gear Couplings

San Francisco Cable Car System

Highlights

Nuttall Gear Custom Reducers

feature reverse engineered ground gearing with redesigned lubrication system and repaired/refurbished steel housings

Ameridrives Amerigear Couplings

feature fully-crowned teeth for higher torque, higher speed and higher misalignment capacity

The San Francisco Municipal Transportation Agency (SFMTA) recently completed its Cable Car Barn Propulsion Gearbox Rehabilitation Project. Originally installed in 1982, the gearboxes on the iconic cable car system had eclipsed their design life and were in dire need of overhaul.

The large gearboxes are positioned between 300 HP electric motors and massive 19,000 lb., 18 ft. diameter sheaves that drive the continuously-running cables installed beneath four streets in the city. The gearboxes are all housed in the Cable Car Barn Museum and Powerhouse, where the entire drive system can be viewed by the public.

Based on Nuttall Gear's extensive experience in major, highly visible public works/infrastructure projects, including drives on the six massive bulkhead gates on the Folsom Dam auxiliary spillway in Sacramento, the SFMTA awarded Nuttall the contract to inspect and rehabilitate the four primary gearboxes.

After the first gearbox was delivered and inspected at the Nuttall facility in Niagara Falls, New York, it was determined that the original gearing could not be saved due to excessive wear, including large sections of broken gear teeth. The Nuttall team reverse-engineered the required gearing and furnished the SFMTA with certified construction drawings of the complete upgraded gear sets.

The inspection also revealed that the gear couplings connecting the gearboxes and motor shafts had reached the limit of their wear life and needed to be replaced. Nuttall engineers also redesigned the original force-fed gearbox lubrication system to include customer cooler connections.

Nuttall technicians were required to be on-site for each 8-day installation outage and approve the final results of the initial testing with cable cars on the line.

See back for more details.



Nuttall Gear Custom Gearboxes

Completely new gear sets were designed for the identical enclosed parallel-shaft, helical gear drives. Reverse-engineered gear sets fit within the existing steel housings.

- 300 HP (with a 3.0 service factor)
- AGMA Q13 quality through-hardened gearing (original gearing was Q10 at best).
- 59.78 :1 reduction ratio
- 1150 RPM input speed; 19.23 RPM output speed
- 2,949,688 in.lbs. constant output torque. Per AGMA standards, this rating includes the capacity to sustain a limited number of 200% momentary overload cycles of 5,899,376 in.lbs. (typically less than four starts in 8 hours with a peak not exceeding one second duration)
- Laser inspections were performed on all housings to check for bore placement, concentricity and parallelism
- Machining errors, discovered on the high-speed center distance of all 5 housings, were corrected
- One housing had a damaged bore that required AWS-certified weld repair and re-machining
- All new gearing steel met a "Buy USA" requirement
- Custom paint required to match the color of the other equipment in the cable car barn/museum
- Original force-fed lubrication system used on all units was re-designed to include customer cooler connections



Ameridrives Amerigear Couplings

Amerigear flexible couplings feature fully-crowned teeth for higher torque, higher speed and higher misalignment capacity.

- Positive-type O-ring seals keep lubricant in contaminants out. Enshrouded seals prevent damage
- Accurately machined medium carbon steel hubs and sleeves
- Self-locking nuts and positive type O-ring seals

Custom Amerigear FD-107 sliding couplings were designed specifically for the cable car drives. If the electric drive motor on one of the cable car routes goes down, the FD107 coupling allows two gearboxes to be driven from the same motor, so there is no loss of service.

11 in. diameter Amerigear C204.5 continuous sleeve, double engagement gear couplings with 324 in.lbs. torque capacity are used to connect the motor output shaft to the gearbox input shaft. Units are designed with a smooth, cylindrical one-piece sleeve for smoother, faster, quieter and safer operation.

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