# Recommendation ${REC}: Replace V-Belts with Cogged V-Belts

Recommended Action

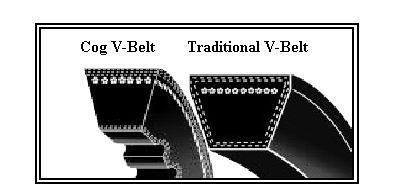
Replace standard V-belts on the air booster with cogged V-Belts for better efficiency.

Summary of Estimated Savings and Implementation Costs

|  |  |
| --- | --- |
| Annual Cost Savings | ${ACS} |
| Implementation Cost | ${IC} |
| Payback Period | ${PB} |
| Annual Electricity Savings | ${ES} kWh |
| Annual Demand Savings | ${DS} kW |
| ARC Number | 2.4111.2 |

Current Practice and Observations

The use of high efficiency V-belts (also called cog-type V-belts) have been demonstrated to provide energy savings through the reduction of belt slippage and reduced belt heating. Manufacturers claim energy savings of two to four percent when standard V-belts are replaced with cogged belts. For this analysis, savings are estimated at approximately 1.5%[[1]](#footnote-1) based on manufacturers' literature. During the visit, it was observed that the plant uses V-belts to transmit power from the motors. This recommendation will calculate the savings based on replacing the belts on the air handlers. Currently, there are ${HP} HP to motors in total in operation. Cog belts will fit into the same-channeled drive wheels/pulleys as a traditional V-belt. Cog and traditional V-belt construction is depicted in the figure below.



**Figure 1:** **Cogged V-Belt vs. Traditional V-Belt.**

Anticipated Savings

The annual electricity savings, ES, due to replacement of V-belts with cogged belts, can be estimated as follows:

ES = HP × C1 × LF × OH × FS / η

where,

HP = Total power rating of motors: ${HP} HP

C1 = Conversion constant: 0.746 kW/HP

η = Efficiency of the motor: ${ETA}%

LF = Average fraction of rated power at which motor runs: ${LF}%

OH = Annual operating hours of the equipment: ${OH} hrs/yr (${HR} hrs/day, ${DY} days/wk, ${WK} wks/yr)

FS = Fractional energy savings: 1.5%.

ES = ${HP} HP × 0.746 kW/HP × ${LF}% × ${OH} hrs/yr × 1.5% / ${ETA}%

= ${ES} kWh/yr.

The demand savings, DS, resulting from installing cogged V-belts, can be estimated as follows:

DS = HP × C1 × LF × CF × C2 × FS / η

where,

CF = Coincidence factor: probability that the equipment contributes to the facility peak demand, ${CF}%/mo

C2 = Conversion constant: 12 mos/yr

DS = ${HP} HP × 0.746 kW/HP × ${LF}% × ${CF}%/mo × 12 mos/yr × 1.5% / ${ETA}%

= ${DS} kW/yr.

The total annual cost savings, ACS, for the motors can be estimated as follows:

ACS = (ES × Electricity cost) + (DS × Demand cost)

= (${ES} kWh/yr × ${EC}/kWh) + (${DS} kW× ${DC}/kW)

= ${ECS}/yr + ${DCS}/yr.

= ${ACS}/yr

In addition to the energy and demand cost savings, manufacturers claim that cogged V-belts outlast standard V-belts and reduce wear on the equipment served (primarily through a reduction in heat and less load on bearings). These savings are difficult to quantify and have not been included in the calculations.

Implementation Cost

The energy efficient cogged V-belts cost more than standard belts, but they have a longer lifespan and are directly interchangeable with standard belts. The V-belts can be replaced with the cog belts during plant shutdown. The cost of each cogged V-belt plus the labor to install is ${CBELT}. There are ${AMT} V-belts in total to be replaced. Therefore, the total cost to replace the standard V-belts with cogged V-belts is approximately ${IC}.

**The annual electricity savings will be ${ES} kWh for this recommendation, and the annual demand savings will be ${DS} kW. The estimated annual cost savings are likely to be ${ACS} and, with an implementation cost of ${IC}, the payback period will be approximately ${PB}.**

Implementation Cost References

The below links are for implementation cost references. We do not endorse/recommend these brands or products. Furthermore, these products may or may not be suitable for the application. The client should contact a vendor(s) to conduct a detailed study of the process in order to determine the best product for the recommended application.

* <https://www.grainger.com/product/CONTINENTAL-Cogged-V-Belt-BX116-459P43>
* <https://www.grainger.com/product/DAYTON-Cogged-V-Belt-BX116-6L300>
* <https://www.mcmaster.com/6054K194/>

1. . Motor systems tip sheet#5, Replace V-Belts with Notched or Synchronous Belt Drives, https://energy.gov/sites/prod/files/2014/04/f15/replace\_vbelts\_motor\_systemts5.pdf [↑](#footnote-ref-1)