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Survey on $(96, 20, 4)$ difference sets.

McFarland constructed abelian difference sets with parameters $(q^{s+1} (\frac{q^{s+1}-1}{q-1} + 1), q^s (\frac{q^{s+1}-1}{q-1}), q^s (\frac{q^s-1}{q-1}))$, where q here is a prime power and s is a positive integer.

As a particularly interesting case, take $q = 4$ and $s = 1$ to obtain the parameters $(96, 20, 4)$. This parameter set is the first one not covered in Kibler's survey of difference sets.

There are 231 groups of order 96. Up till recently, little is known about $(96, 20, 4)$ nonabelian difference sets. For a group G of order 96 which has normal subgroups of order three and four, we used the software GAP to construct 32- and 24-images of hypothetical difference sets in G . Then we combined these 32- and 24-images to construct a difference set or to show no such difference set exist. Also, we will state all other results have been done on $(96, 20, 4)$ difference sets. Among the 231 groups of order 96, there are 90 groups that admit $(96, 20, 4)$ difference sets and 121 groups that do not admit $(96, 20, 4)$ difference sets. The other 20 groups are still in doubt. (Received September 25, 2005)