

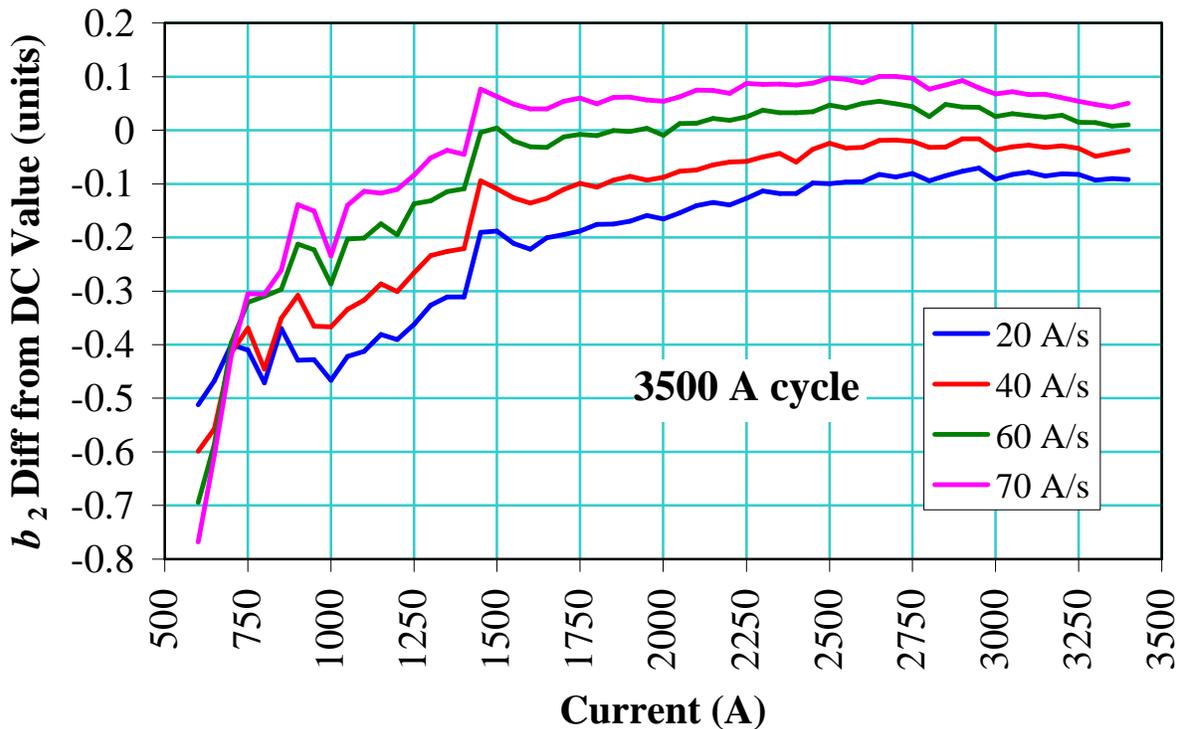
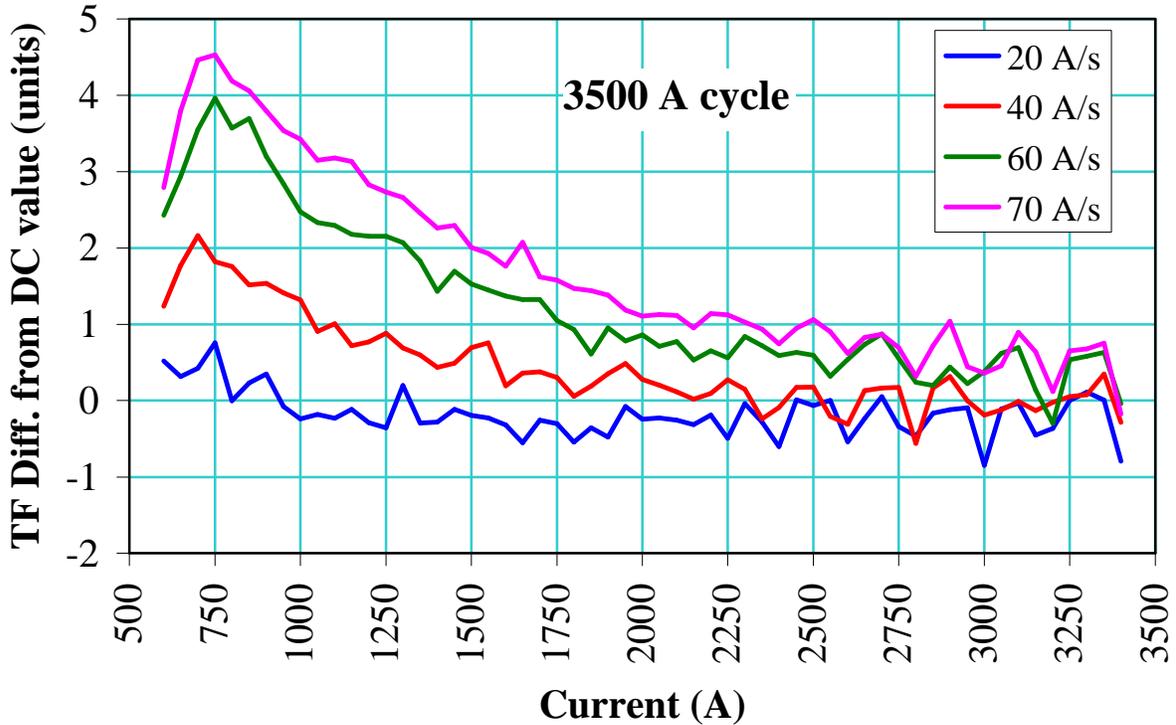
## A Comparison of Ramp Rate Effects in D96525 and QR7109 After Cycles to 3500A and 5kA

- Measurements are in the straight section with a 1 m long coil for D96525 and 0.23 m long coil for QR7109.
- Measurements are with a time resolution of ~0.66 second.
- AC cycles done from 25 Amps to X Amps and back at 60 A/s, where X = 1000 A, 2500 A, 3500 A, or 5100 A (5000 A for QR7109). The magnets were quenched before the 1000 A AC cycle.
- Current ramped from 25A to 470A at 40 A/s and then ramped again from 470 A to various current limits (see above) at 20 A/s, 40 A/s, 60 A/s, or 70 A/s. Measurements were made during this ramp to study ramp rate effects.
- Smooth current ramp profile with quadratic time dependence at the beginning and the end of the ramp.
- In order to compare values of T.F. and harmonics in various runs, the measured data were interpolated in 50 A steps. A linear interpolation between two neighboring currents was used.
- The differences between measurements made at various ramp rates and the “DC” values are shown in the following figures. Data are shown for the transfer function and the first allowed harmonic (normal sextupole,  $b_2$ , in the dipole and normal 12-pole,  $b_5$ , in the quadrupole).
- Maximum change in T.F. is seen in the case of the dipole at ~750 A. The change from DC value is ~4.5 parts in 10,000 (0.045%) at 70 A/s. There is practically no difference between a 3500 A cycle and a 5100 A cycle. Data for 1000 A and 2500 A cycles are not analyzed using such interpolation.
- Change in sextupole in D96525 is found to be the largest at 20 A/s, and is less at higher ramp rates. This is somewhat unexpected and could be due to time dependent effects (The DC measurements are made after a 20 s wait).
- There is practically no ramp rate effect seen in the quadrupole T.F.
- The ratio of quadrupole to dipole transfer functions is shown in the last three plots.

## Ramp Rate Effects on T.F. and Sextupole in D96525

AC cycle to 3500A. Runs 162, 150, 154 and 158

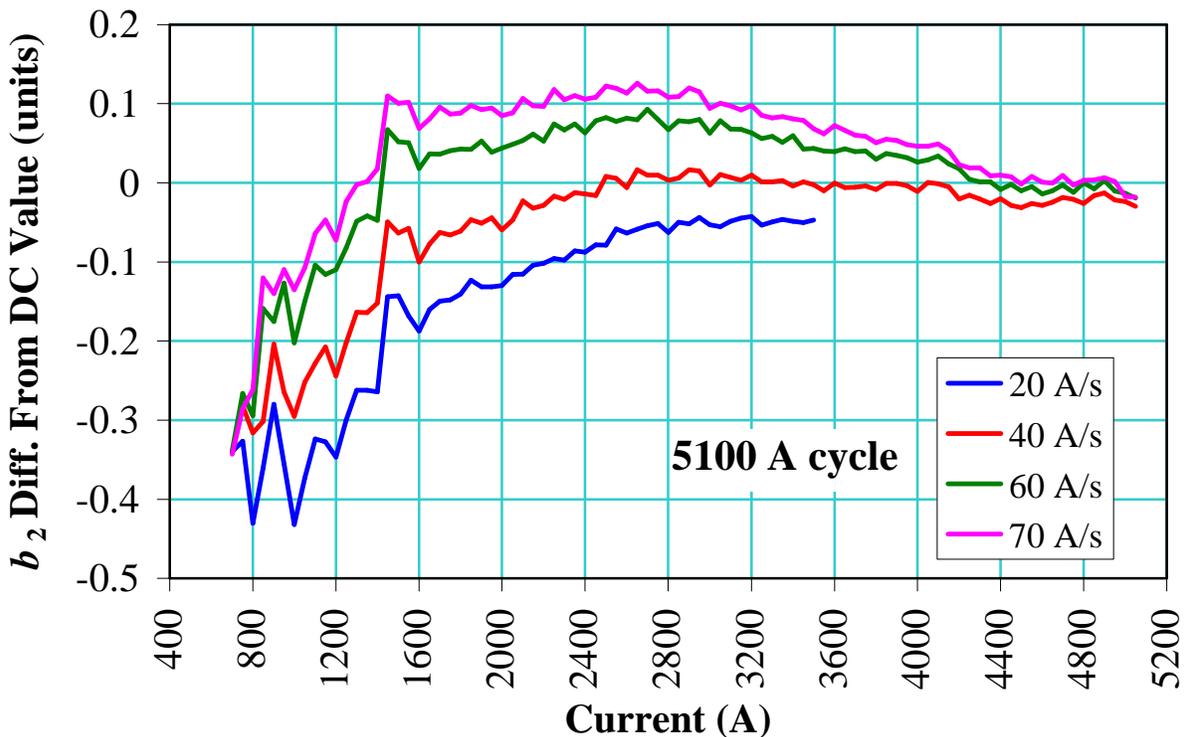
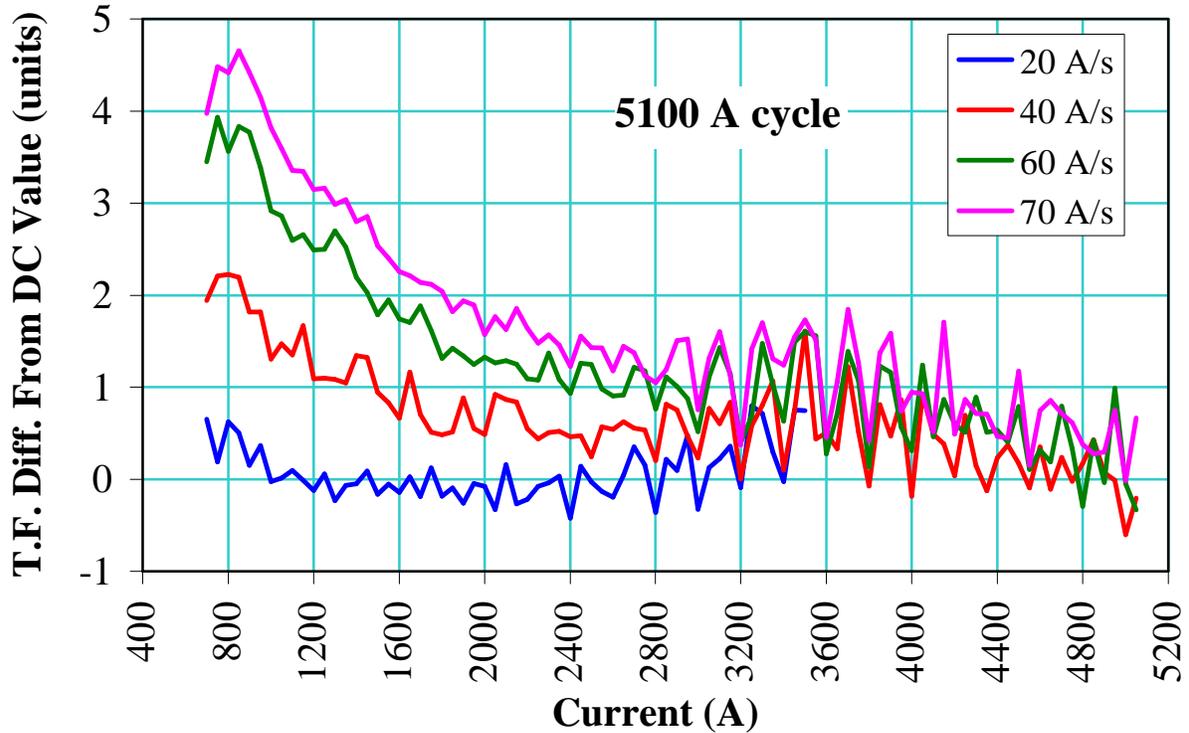
DC data with fast system; average of 8 reads/current (Run 181, 5100A AC Cycle)



## Ramp Rate Effects on T.F. and Sextupole in D96525

AC cycle to 5100A. Runs 166, 170, 174 and 178

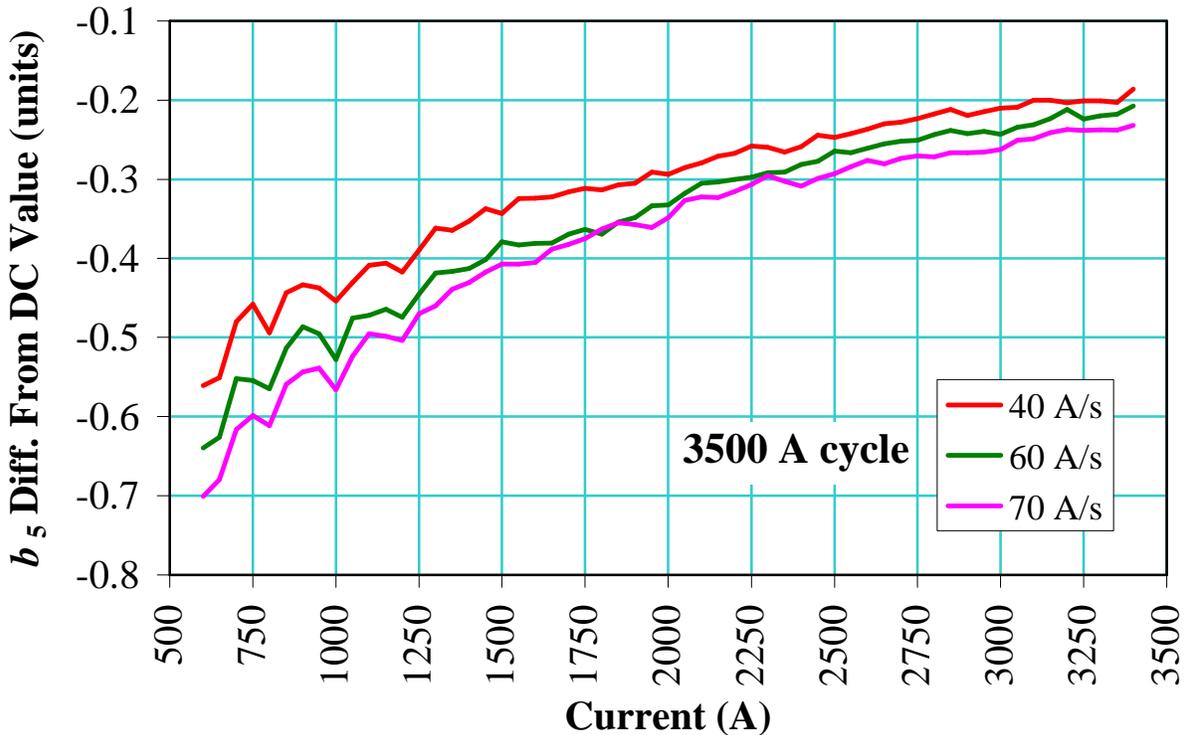
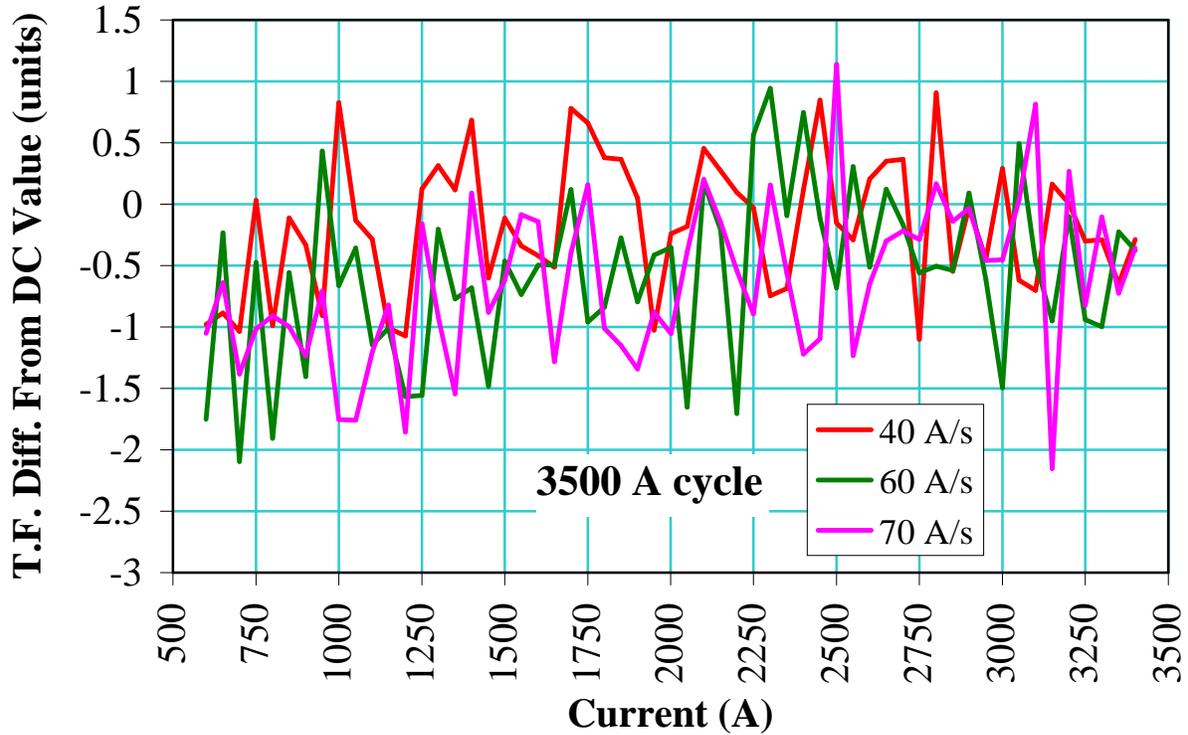
DC data with fast system; average of 8 reads/current (Run 181, 5100A AC Cycle)



## Ramp Rate Effects on T.F. and 12-pole in QR7109

AC cycle to 3500A. Runs 140, 144 and 148

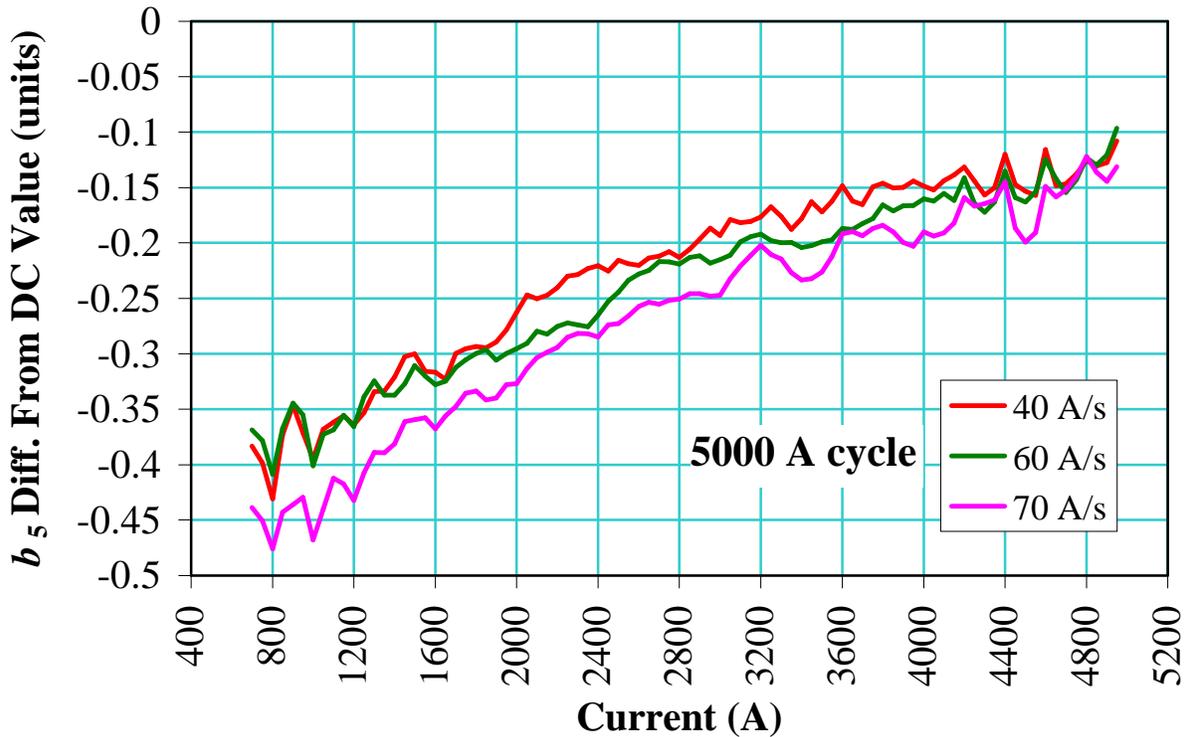
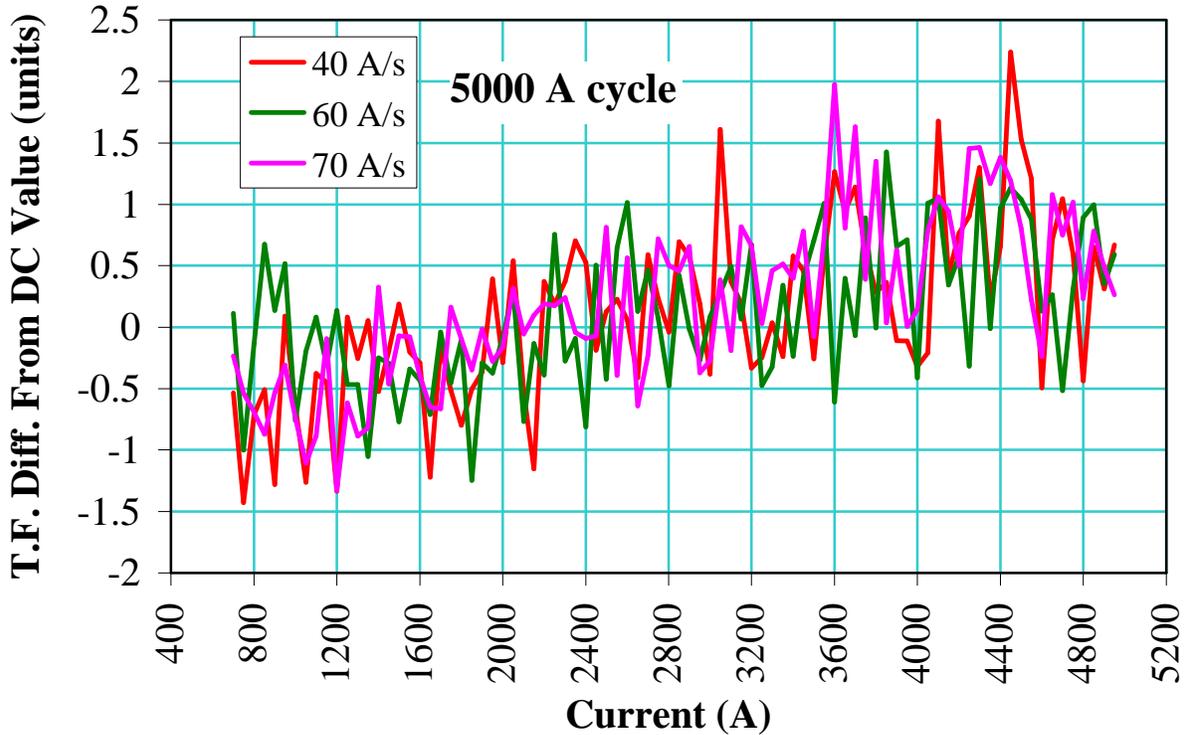
DC data with fast system; average of 8 reads/current (Run 165, AC Cycle to 5000A)



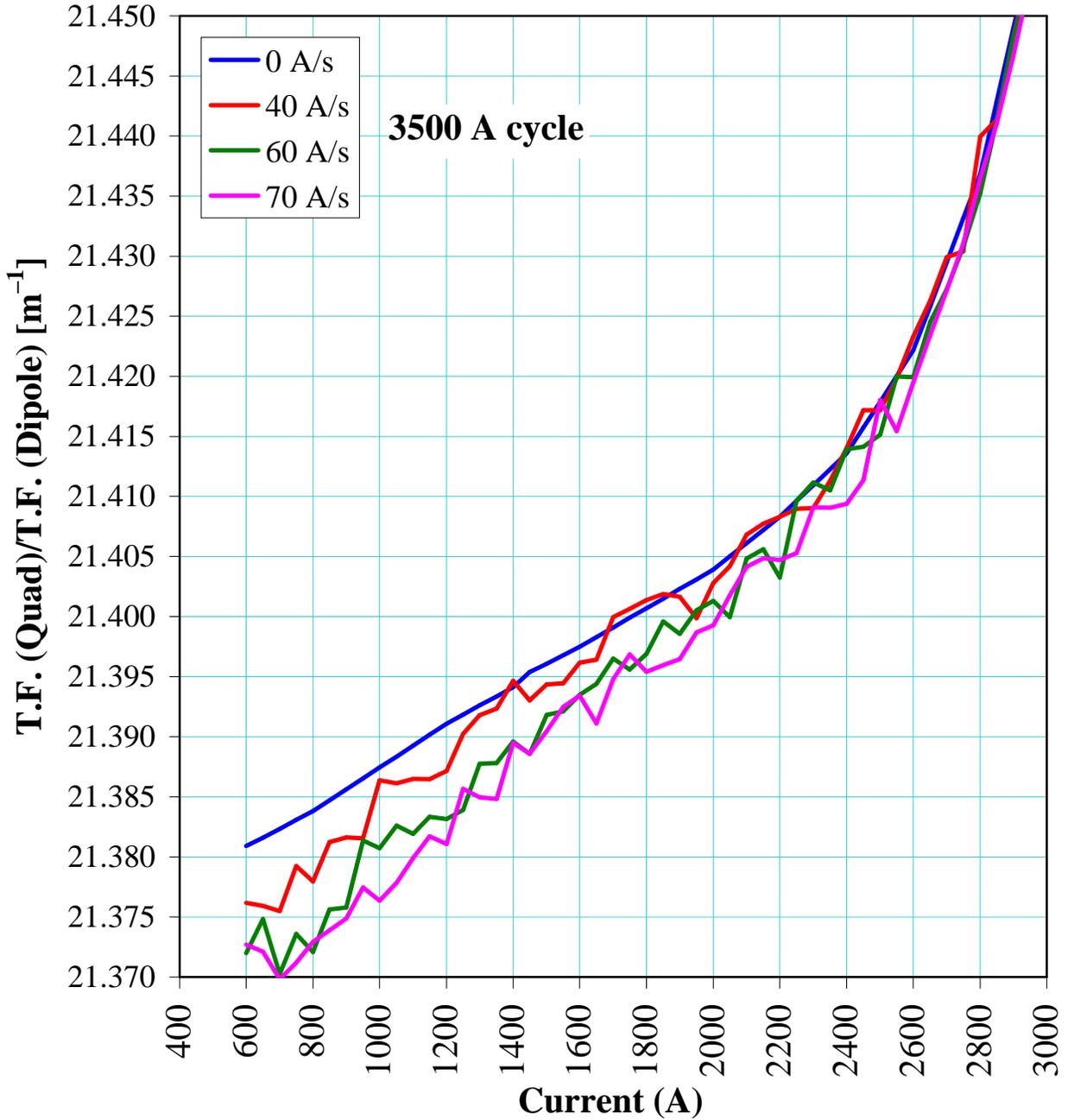
## Ramp Rate Effects on T.F. and 12-pole in QR7109

AC cycle to 5000A. Runs 97, 100 and 103

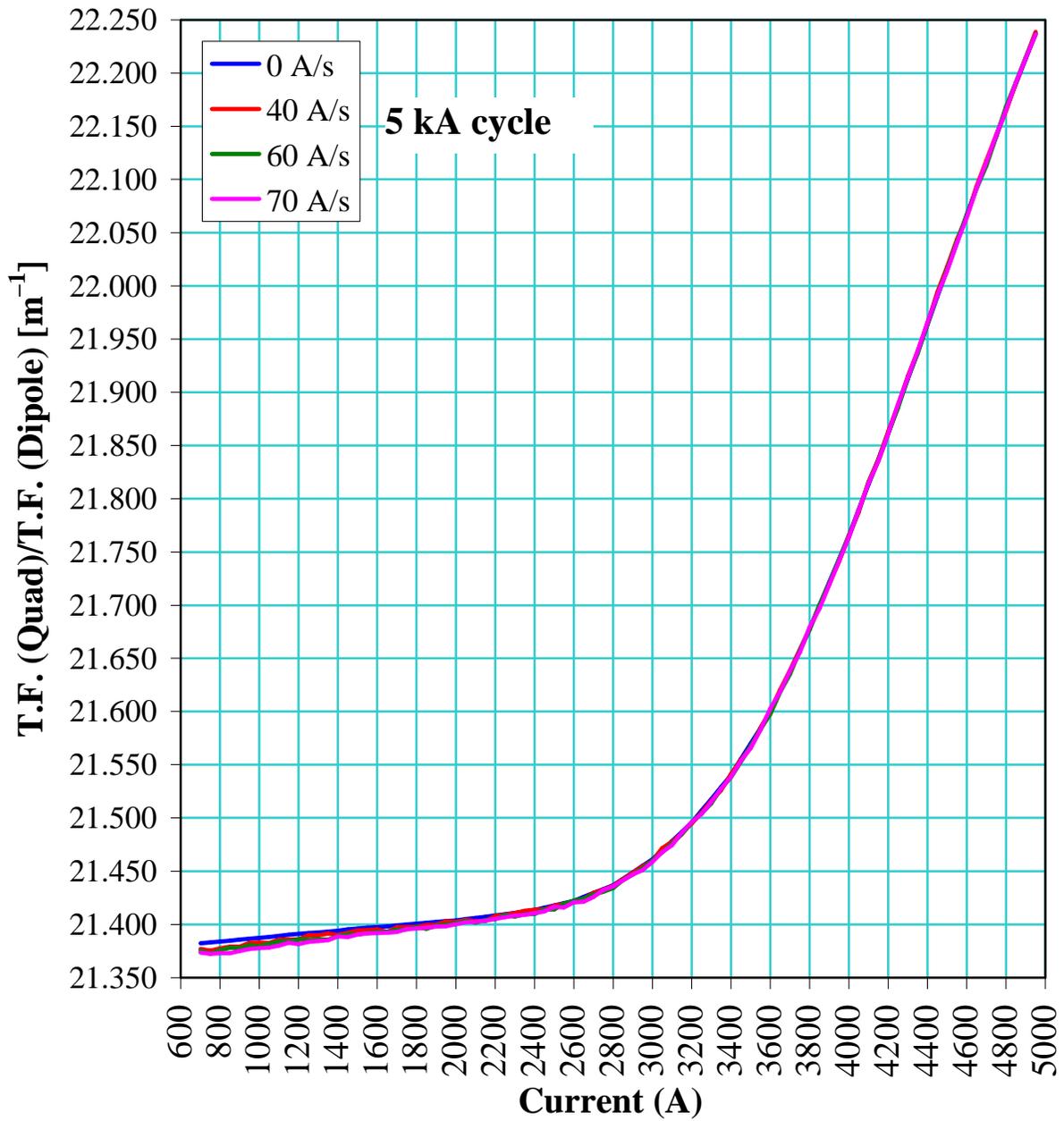
DC data with fast system; average of 8 reads/current (Run 165)



**Ratio of Quadrupole and Dipole T.F. as a Function of Current and Ramp Rate**  
Straight Section Measurements in QR7109 and D96525 (AC Cycle to 3500A)



**Ratio of Quadrupole and Dipole T.F. as a Function of Current and Ramp Rate**  
Straight Section Measurements in QR7109 and D96525 (AC Cycle to 5100A)



**Ratio of Quadrupole and Dipole T.F. as a Function of Current and Ramp Rate**  
Straight Section Measurements in QR7109 and D96525 (AC Cycle to 5100A)

