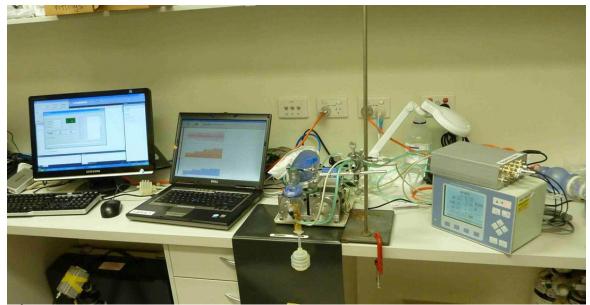Title: Newborn self-inflating manual resuscitators: precision robotic testing of safety and reliability.

Mechanical Bag Compressor Synopsis

The robotic SIB compressing mechanism comprises of a PC control program (Microsoft Visual Basic), stepping motor controller (KTA290 Ocean Controls Melb Aust), motor drivers (AM822 Ocean Controls Melb Aust) and two high torque stepping motors (MOT130 Oceans Control Melb Aust). Fabricated actuator arms were attached perpendicularly to motor shafts via collets and sleeved with silicone tubing at contact points to approximate human finger diameter. An alignment marker was placed on each actuator arm at 130mm distance from motor shaft centre. The two actuator arm motor assembles were mounted 90mm apart. Test bags were mounted horizontally between actuator arms so the compressible bag section was aligned to the midpoint on both axes with the actuator arms. Height was fine adjusted to align shaft marker with bag horizontal axis, all bags tested were aligned in this manner. This ensured a unified start point and squeeze distance for all bags tested. Mounting hardware was then clamped in position; realignment was carried out for each bag tested. Actuator arm start point could be fine adjusted to gently touch but not compress bag surface. The mean force required to compress each bag completely wall to wall was measured (mean 21.6 Newtons), and was used to calculate force required at each distance. Motor dynamics were programmed to mimic a human operator bagging at an inspiratory time of 0.5 seconds and inflation rate of 60 inflations per minute at all distances tested; the programmed acceleration profile of the arm movement over each distance provided a soft start and finish typical of human hand squeeze. Program sequence starts at a total compression distance of 15mm (+/- 0·03mm) and increments in 5mm steps to 60mm with forty inflations at each increment, arms were then returned to start position. A mechanical check of the distance between actuator arms at the start and finish of each test sequence were carried out with precision measuring device (accuracy +/- 0·05mm); any difference between start and finish distance would indicate some mechanical deviation of the test platform, electrical deviation of the stepper motors or programming anomaly during the sequence, no difference was measured on any of test sequences carried out.

Bench test setup