

PCR amplicons shearing using Bioruptor® Pico

With the Bioruptor® Pico and the former model Bioruptor® NGS it is possible to shear PCR amplicons of at least 500 bp in size.

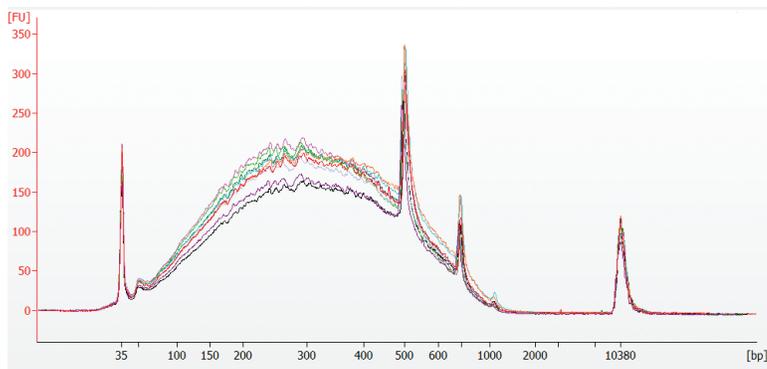
While PCR fragments bigger than 700 bp are sheared according to the standard protocol (detailed on next page), small PCR fragments from 500 - 700 bp are less susceptible to sonication.

For Fragments of this size range the sonication time has to be increased by adding 3 to 5 additional cycles to the standard protocol. Afterwards, the size should be checked on the BioAnalyzer® (Agilent Technologies).

Example:

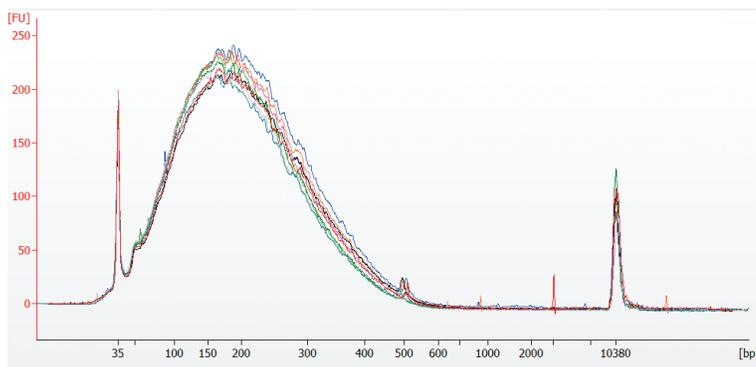
If the target size is 200 bp, the standard protocol recommends a sonication of 13 cycles (30 sec ON/ 30 sec OFF). In order to reach the same target size when starting from small PCR fragments (500-700 bp), the sample should be sonicated for 16 to 18 cycles (30 sec ON/ 30 sec OFF).

100 µl Volume Small DNA Fragments Shearing Results



HyperLadder™ 500bp* DNA size distributions after shearing with Bioruptor Pico using 0.65 ml Diagenode tubes (C30010011).

Upper panel shows an average 304.09 bp sheared DNA size using standard conditions of 13 cycles (30 sec ON, 30 sec OFF). While large fragments are sheared, 500 bp and 700 bp small fragments are not affected. Lower panel shows an average 194.54 bp sheared DNA size using 5 additional cycles to the standard conditions (i.e. 18 cycles of 30 sec ON and 30 sec OFF) and the efficient shearing of 500 bp and 700 bp small fragments.



*HyperLadder™ 500bp (Bioline) is a ready-to-use molecular weight marker of 11 bands from 500 to 5000 bp. The DNA ladder is formulated in TE buffer (pH 7.6).

Standard operating conditions

Sample volume: 100 µl

Tubes: 0.65 ml Bioruptor® Microtubes (Cat. No. C3001001)

Tube holder: 0.65 ml tube holder for Bioruptor® Pico (Cat. No. B01200042) for 12 x 0.65 ml tubes

Sonication buffer: TE (10 mM Tris, 1mM EDTA, pH 7.5 - 8.0)

DNA concentration: 1-20 ng/µl (10 ng/µl recommended)

Samples are vortexed (5-10 sec) and centrifuged (10 sec) before shearing.

For optimal results samples should be stored on ice during 5-10 minutes prior to sonication.

Temperature: 4°C – *Water Cooler*

Sonication cycle & total sonication time: varies depending on desired DNA size (see table)

Note: Recommended protocols are subject to change without notice. Additional protocols are available on demand.

Target size	Cycle condition (On/Off cycle time)	Cycle number
150 bp	30"/30"	30
200 bp	30"/30"	13
300 bp*	30"/90"	6
400 bp*	15"/90"	7 - 8
1000 bp*	5"/90"	7 - 8

* For longer fragments (300 up to 1000 bp), a short centrifugation step after half of the cycle numbers can significantly improve the results. Protocols for other size ranges (incl. longer fragments up to 1300 bp) are available on request.

The protocol settings listed above are recommended guidelines and actual results may vary depending on the type and amount of starting material, purity level, concentration and/or sample viscosity. It is highly recommended that a time course response experiment be carried out (e.g. varying the time of "on" and "off" durations as well as the number of cycles) to determine the appropriate treatment for your specific sample. Starting material with a smaller sample volume and a greater concentration than the recommended range may require a different time course to ensure homogenous shearing results.

Important comments about DNA shearing

The Diagenode **ACT** (Adaptative Cavitation Transfer technology) process is highly reproducible. However, attention must be paid to the following treatment attributes to ensure best results:

- **Tubes:** At present, the recommended tube vessels are the 0.65 ml Bioruptor® Microtubes (Cat No. WA-005-0500). Pay attention not to damage the cap when closing the tubes since this could alter sonication results.
- **Sample volume:** The recommended volume of the 0.65 ml Bioruptor® Microtubes (Cat No. WA-005-0500) is 100 µl. When using lower volumes (e.g. ≤ 50 µl), less reproducible results may be observed due to an alteration of the ultrasonic waves distribution in the sample fluid; thus, reducing the efficiency of sonication which may result in broader size distribution or larger peaks.
- **Sample concentration:** Diagenode recommends using DNA concentration ranging between 1 and 20 ng/µl (10 ng/µl recommended). Using larger concentration (e.g. 50-100 ng/µl) may result in broader peaks or variable peak distribution.
- **Sample preparation:** Sample viscosity may have a major impact on sonication results. Careful resuspension of DNA sample is strongly recommended before sonication processing. Multiple pipetting and gentle vortexing followed by a short centrifugation to recover sample volume at the bottom of the tube is therefore strongly recommended. Storing DNA samples on ice during 5-10 minutes before sonication has also been shown to improve reproducibility.
- **DNA quality:** DNA quality and quantity must be considered carefully since bad quality and quantity DNA may have several impacts on sonication and Next-Gen sequencing downstream applications. First, DNA contamination (e.g. from superfluous nucleic acids such as RNA, small nucleic acid fragments, excess proteins, or other contaminating materials) may interfere with DNA measurement method leading to incorrect DNA quantitation thus. Also contaminating RNA in genomic DNA preparation might generate a biased fragment distribution profile on microfluidics-based platform (e.g. Agilent Bioanalyzer) or alter sonication efficiency.

Therefore it is highly recommended to use only high quality DNA when sonicating DNA for Next-Gen sequencing library preparation. The DNA sample to be processed should be highly pure, having an OD_{260/280} ratio of between 1.8 and 2.0, and should be as intact as possible. DNA extracted using standard techniques (e.g. Proteinase K digested, double phenol/chloform extraction, ethanol precipitated, treatment with RNase-DNase free enzymatic digestion to remove contaminant RNA) or commercial spin-column based kits are recommended.

- **Water temperature:** Propagation of ultrasound in a liquid unavoidably produces heat that can ultimately alter DNA sample (e.g. by thermal denaturation). To ensure the best preservation of the sample, it is recommended to start the sonication process with cold water in the water bath. During sonication, especially when doing long sonication runs, the temperature must also be controlled. This is obtained by the automatic temperature control.

Note: The permanent installation of the Bioruptor® Pico in a cold room is possible, although not sufficient to avoid the temperature increase due to sonication.

- **Automatic temperature control:** A recirculating *water cooler* is used to guarantee the automatic temperature control of the water bath during the whole sonication process. This *water cooler* (Cat. No. BioAcc-cool) produces a regular water flow with a constant water level in the tank.

An additional regulating valve (Single Cycle Valve, Cat. No. B02020004) ensures that water will only be replaced during the off cycle to avoid any interference between the water flow and the sonication process.

- **Sonication time:** Minor adjustments in cycle number may be made to optimize results for various sample types and concentrations. Cycle number listed above is a recommended guideline. Actual results may vary depending on the amount and type of starting material, concentration, viscosity and/or plastic tubes. Diagenode recommends setting up a time dose response experiment for determining appropriate cycle number. Larger length starting material (e.g. total genomic DNA) and higher concentration may require a longer dose to ensure a homogeneous shearing result.
- **Water bath:** The sonication water bath is a critical component of the Bioruptor® Pico sonication system.
 1. **Water purity:** Contaminants such as algae and particules may alter the ultrasonic waves propagation, resulting in broader size distribution or larger peaks. Bath water should be pure **distilled water**, changed regularly (at least once per week).
 2. **Water bath maintenance:** The water bath metal surface is fragile and requires a careful maintenance. Use only soft sponge to remove traces. Never use scratch scrub sponge since this would alter the ultrasonic wave emitter surface.
 3. **Water type: Distilled water**

Supplementary Data:

Please note that there are three main sources of variation in both peak base-pair size and distribution:

- 1) The physical process of DNA fragmentation might not be entirely random in AT- or GC- rich regions.
- 2) The analytical process to determine fragment size has inherent variances (for example, gel electrophoresis and microfluidics-based platform). Therefore, fragment distributions and peak values, even from technical replicates, may not appear identical. If the sheared DNA sample will be resin or column purified or concentrated prior to analysis, please remember to take out an aliquot for use as control prior to that step. Column purification and concentration of the sheared DNA will generate a biased fragment distribution profile due to the inherent greater loss of the smaller DNA fragments.
- 3) RNA contamination in genomic DNA preparation should be carefully removed using RNase-DNase free enzymatic digestion since they might generate a biased fragment distribution profile on microfluidics-based platform (e.g. Agilent Bioanalyzer) or alter sonication efficiency.