

ILLINOIS POLLUTION CONTROL BOARD
March 19, 1982

IN THE MATTER OF:)
PROPOSED AMENDMENT OF) R76-14
RULES 101, 205, 206, AND 209)
OF THE NOISE REGULATIONS)

OPINION OF THE BOARD (by I. Goodman):

The Forging Industry Association (FIA) and thirty individual forging companies on July 2, 1976 petitioned the Board to adopt, by amending Rules 101 and 206 of the Board's Chapter 8: Noise Regulations (Chapter 8), relaxed emission limitations and other requirements with respect to new and existing impact forging operations (Industry Proposal). Proponents alleged an inability to comply with the existing Rule 206, especially within the three years allowed by Rule 209.

The Illinois Environmental Protection Agency (Agency) on August 23, 1976 also petitioned the Board to amend Rules 101, 206 and 209 with respect to new and existing impact forging operations and to delete Rule 205 regulating sound emissions to Class C land receivers. On October 14, 1976 the Board ordered the Agency proposal to be treated as a separate proposal, docketed R76-19, but consolidated with R76-14 for purposes of hearing and decision. The following public hearings were held:

September 22, 1976	Chicago
November 4, 1976	Springfield
December 13, 1976	Chicago
December 14, 1976	Chicago
February 15, 1977	Chicago
February 16, 1977	Rockford
May 2, 1977	Chicago
May 3, 1977	Chicago
December 18, 1978	Rockford
December 19, 1978	Rockford
February 21, 1979	Chicago
September 12, 1979	Chicago

The last four hearings were economic impact hearings, the Illinois Institute of Natural Resources having filed economic impact studies regarding the proposed rule changes. Document No. 78/03, The Economic Impact of Proposed Forging Noise Regulations (R76-14, -19), and Document No. 78/36, Economic Impact of Removing Numerical Limits on Sound Emissions to Class C Land (R76-19).

On February 7, 1980 a Proposed Order was adopted by the Board which would have modified Rules 101, 205, 206, and 209, as originally adopted on July 26, 1973 as a part of Chapter 8. Rule 101 would have been amended to include definitions for A-weighted sound level and fast dynamic characteristic. The definitions for dB(A) and sound level would have been deleted. These definition changes were proposed to clarify the proposed rules changes. Rule 205 was to be deleted. Rule 206, Impulsive Sound, would have been amended to delete limitations on impulsive noise emitted to Class C land and to increase the allowable impulsive noise levels emitted from forging operations to Class A and Class B lands. Rule 209 would have been changed to specify the dates by which sources were to comply with Rule 206, as proposed.

On July 24, 1980 the Opinion concerning the Proposed Order was adopted. The rulemaking was repropoed on September 4, 1980 and sent to First Notice. Thereafter, the Illinois State Chamber of Commerce requested an extension of the public comment period which was granted for R76-14 only. R76-19 proceeded to final rulemaking on March 5, 1981. Rule 205, Sound Emitted to Class C Land, was deleted from Chapter 8 along with the companion compliance dates in Rule 209(c). By reference, those portions of the July 24, 1980 Opinion pertinent to R76-19 served as the adopting Opinion.

Pursuant to the comments received in the time extended for R76-14, three additional merit hearings were held in Chicago on January 27, February 23 and 24, 1981. Based on these, FIA and the Agency jointly prepared an Amended Version of the Industry Proposal, which was filed August 3, 1981. A public hearing was held December 15, 1981 in Chicago.

ANALYSIS OF REVISED REGULATIONS

Impulsive Sound

Formerly, impulsive sound was measured in decibels using the A-weighted sound levels, which most closely approximates the way the human ear perceives sound. During hearings there was considerable testimony about an A-weighted fast measurement mode. The fast measurement mode was demonstrated to detect almost twice as many impulse sounds then the slow measurement method. Therefore, for purposes of determining compliance with the general limitations for impulsive sound emissions, this mode is coupled with the A-weighted network. Former Rule 206, renumbered to be Rule 205, reflects this change, as well as being amended in accordance with the deregulation of sound emitted to Class C Lands (See Docket R76-19). The allowable sound levels remain the same. Accordingly, the definition of "A-weighted Sound Level" is adopted. The definition of "Fast Dynamic Characteristic" is updated.

Sound Levels Emitted From Forge Plants

During hearing, there was much testimony from representatives of the forging industry that meeting original Rule 206, adopted in 1973, is not technologically feasible. Non-compliance is primarily due to the absence of known methods of controlling the impact, or impulsive, sound emission levels from forge hammers at their sources. As a result, suitably relaxed noise limitations are necessary.

The Noise Control Task Force (NCTF) through the Forging Industry Education and Research Foundation (FIERF) performed an extensive, three-volume study of existing forge plants to determine the sources of sound emissions and ways of controlling them (Exhibits 16, 17 and 18). Based on this study, it appears that the noise is being caused by two effects. The first and primary contributor to the peak sound level is the sound generated when the ram, driven downward, hits the metal work piece and the die on the anvil. The second source of sound is caused by the vibration of the ram and the columns which guide it downward due to the sideways movement of the ram between the columns after it hits the die.

Since peak sound pressure levels are generally proportional to blow strengths, reducing the blow strength would reduce the peak sound level; however, it would also derate the hammer (R. 310). There may be some operations in which the hammer blow is stronger than necessary and could be derated (R. 319), but in the majority of forge shops derating is not feasible.

In the FIERF study, shrouding the hammer was studied, but this may cause several problems:

1. If blow strength is reduced, the hammer would not be able to produce the part.
2. Since the columns maintain the die alignment, to reduce the columns' vibrations by isolating them from the ram before the ram strikes the work piece may cause misalignment (R. 322).
3. The openings in retrofitting any shroud or enclosure will need to be minimized in order to reduce the amount of noise radiating past the treatment (R. 323). Openings are necessary for access to the work piece.
4. Dynamic stress in the shroud would have to be minimized for safety (R. 323).
5. In some cases a ram shroud could never be used due to the given relationship between the ram and the columns.

The buildings in which forge shops are operated are generally open structures which were not designed to reduce the amount of sound radiating to the neighborhood. All of the forge plants discussed in the record are hot forge plants. A forge shop must have adequate ventilation because of the amount of heat normally generated inside the plant. Consequently, the structures were designed with roof and side openings to provide natural ventilation to dissipate the heat (R. 103). The work material, typically steel, is heated to around 2200°F so that the material is plastic enough to forge (R. 105-106). After forging, the hot material is put onto skids, and when the skid is filled, it is usually moved outside to cool (R. 1043). In addition to the skids loaded with hot material (R. 1044), the furnaces used to heat the material are major sources of heat inside the plant (R. 106).

The level of sound emissions radiated from some forge shops can be reduced by 15 dB(A) by closing the open windows and doors or by covering them with silencers (R. 517). Additional noise reductions can be obtained by making structural changes in the building, such as replacing a plain metal roof deck with one made with asbestos-containing material, replacing sheet metal walls with brick or concrete blocks, and replacing plain glass windows with double glass windows.

However, in a typical, existing, unimproved forge shop, only about 4% of the acoustical energy which radiates to the outside does so through the structure itself; the remaining 96% radiates through the openings (R. 523). Hence, it appears that covering the open doors with silencers or other material would be an effective way of reducing the energy radiating from the shop (R. 523). As the openings are reduced or covered, however, the need for mechanical ventilation increases as the natural ventilation is reduced or eliminated. In addition openings are needed for vehicular and other traffic (R. 502-503).

An additional method of reducing the amount of noise radiated to the neighborhood is to use barriers such as walls or berms. Barriers placed 10-15 feet outside the perimeter of a building can achieve a 10 to 15 dB(A) reduction in sound emission levels (R. 499-501). To be effective barriers must reach higher than the openings in the plant wall (R. 1119). They can, however, interfere with necessary traffic (R. 499-501), reduce ventilation (R. 1064-1066), and may be prohibited by non-ownership of the requisite property (R. 499-501).

There was evidence that technology in controlling sound emissions is improving (R. 1054-1055). The Danville Wyman-Gordon plant, which owns and operates the largest forge and hammer shop in the country (R. 1028-1030), operates an entirely different technological approach to the manufacture of crank shaft forgings and alleges it experiences no noise problems (R. 1037). There was also evidence that a 6,000-pound hammer equipped with a hydraulic Lasco head was quieter than other 6,000-pound hammers (R. 972-976).

Since the means and extent of abating noise differ for existing and new forging operations, Rule 206 is amended to distinguish between the two, as well as a new Rule 205 to distinguish between impulsive noise in general and forging impulsive noise. New forging operations are those for which construction commences after the effective date of the amended Rule. Any others are existing forging operations.

Determination of Allowable Sound Emission Levels

Impulsive noise affects people who hear it by interfering with speech and hearing and with degree of relaxation. When it exists at night it can interfere with sleep. One witness testified that impulsive noise interferes more with the ability to relax than does steady state noise, but that steady state noise interferes more with speech than does impulsive noise (R. 1219). There is no evidence in the record of the relative importance to human health or welfare concerning relaxation, speech, hearing, sleeping, or other activities.

Existing impulsive sound emission levels of drop forge hammers are estimated to be as high as 121 dB(A) for a 1,000-2,000 pound hammer (R. 240-241). The typical hammer operates at 500-20,000 blows per shift (R. 245). The average time between hammer strikes is one to three seconds (R. 439).

According to the record, present daytime sound emission levels result in the stipulation that roughly 60% of the 45 forge plants are not complying with present Rule 206 (R. 486). The present daytime limitation of 56 dB(A) is exceeded by 62% of all plants considered; the limitation of 61 dB(A) by 53% of all plants; the limitation of 66 dB(A) by 44% of all plants, the limitation of 72-76 dB(A) by 9% of all plants, and the limitation of 82 dB(A) and higher by 9% of all plants (R. 1000). There was also testimony that 58% of the plants could meet a limitation of 66 dB(A), at the present time (R. 579-580, 583). There was evidence that 95% of all plants could meet a limitation of 66 dB(A) with an emission improvement of between 5 and 20 dB(A), and 1% of the plants would have to improve their emission levels by 35 dB(A) to reach this limit (R. 542-544).

The Agency presented data of sound emission levels from 45 forge plants in Illinois (Ex. 56). At one of the shops it tape recorded the sound level of a 2,000-pound drop hammer (R. 1013). This tape was played back through a sound level meter into a strip chart recorder to determine which measurement mode would be the most appropriate for measuring the impulsive noise (R. 1013-1014). For the same reasons explained above, the A fast measurement mode is the best. In addition, however, there was considerable testimony which related maximum A-Weighted fast response levels to the energy equivalent sound level, or a time-weighted average expressed in Leq. Sound levels expressed in terms of Leq are useful in estimating effects on the health and welfare of persons

exposed to them. Leq measurements reflect reduction in reverberations, whereas A-fast weighted measurements do not because of the differences between reverberated and dead sound. While reverberations do not necessarily impair speaking, they do have an impact on the health and welfare of persons exposed. If the limits for forging noise are not expressed in Leq, there may be no incentive to reduce this type of sound. Therefore, the Board finds Leq the appropriate measurement to express noise limits for forging noise.

The technical information offered about available noise abatement measures supports separate sound emission limitations for new and existing forging operations. The economic information, detailed below, coupled with the technical data, support relaxation of the Board's current 56 dB(A) daytime standard for all forging operations. Both the Agency and the FIA agree that a relaxation to at least 61 dB(A) is needed. The Agency will not concede that a greater lessening is necessary or wise and the FIA did not convincingly prove the 61 dB(A) limit is economically infeasible for all forging operations. The Board is unwilling to relax the limitation beyond 66 dB(A) when the supporting economic data is at best only marginally reliable. For existing forging operations a daytime standard at the higher end of the scale is adopted. New forging operations will have to comply with a relaxed, but still more stringent limitation. In the record, these limitations were in dB(A). They have been converted to Leq's in accordance with the reasoning set out above.

Economic Evidence¹

The author of the Economic Impact Study, Doc. No. 78/03, chose three measurements of cost. One measurement was "base case" estimates of costs to the entire forging industry. These costs, however, could be twice as high as true costs would be. The second measure was estimates of cost to all plants of reducing emissions by 6 dB(A). These figures are similarly subject to error. The third measure was estimates of cost to 10 particular plants, both individually and in the aggregate (Ex. 70, p. iv.). The author relied on data derived by Bolt, Beranek and Newman, Inc. (BBN) to develop adjusted statewide cost estimates and, from these estimates, the base case estimates. Although there is considerable diversity among plants, BBN statistics were not derived on a plant-by-plant basis but rather from a model (Ex. 70, pp. 11-13).

Benefits of sound emission reduction were calculated by analyzing the distribution of homes around plants and studies regarding the contribution of sound emission levels to differential property values (Ex. 70, pp. iv-v). Although benefits can be measured by monetarizing physical effects of sound on human life

¹The dollar amounts in this Section are expressed in 1978 dollars.

and human activities, and have been covered extensively in literature, the author did not include these physical effects in his assessment of benefits. He instead measured benefits in terms of damage to transactions engaged in "in which, implicitly, we place a value on [reduced noise]". Buying a house was singled out as one of these transactions (Ex. 70, p. 58).

An accurate evaluation of the economic reasonableness of any proposed reduction from the present 56 dB(A) level is difficult based on the entire hearing record. Essentially, the author states that costs exceed benefits at any level (including the present one) (R. 1319-1320), and the Agency states that benefits exceed costs at any level (R. 1619). Even though cost-benefit comparisons are factors in determining the reasonableness of an economic impact, they are not the only factors which should be considered. The disparity between the author's and the Agency's conclusions is illustrated below.

The Agency states that the author's costs should be revised downward because (1) the least-complying plant in a group was used as the compliance cost model for each plant within the group (groupings were made according to actual emissions) (R. 1678); (2) lighting costs are 75% lower than the costs used by the author (R. 1569); (3) the method of amortization of control costs, the estimate of the number of new or modified pieces of ventilation equipment needed, and the estimate of fuel consumed to maintain inplant temperatures all overestimate operating costs (R. 1572-1575); (4) silencers coupled with natural ventilation systems were not considered (R. 1562-1565, 1682, 1697); (5) reduction in ventilation sizings will reduce mechanical ventilation system costs (R. 1565); and (6) costs of barriers are two times too high (R. 1560-1562, 1644). The Agency, however, does state that the author properly considered engineering and consultant fees (R. 1686-1689).

Conversely, the author states that the Agency's costs should be revised upward because (1) costs of nighttime operations are excluded; (2) the increased closing of ventilation openings will raise inplant noise and necessitate additional costs; and (3) costs of stopping production to effectuate control technology are excluded (R. 1769-1770). The author, however, does say that the Agency's costs should be revised downward because of the data used in arriving at natural and mechanical ventilation equipment and lighting (R. 1763-1767).

The Agency states that the author's benefits should be revised upward because (1) property values were underestimated by a factor of 2.63 (R. 1613, 1635); (2) home buyers are unaware of sound emission effects in the environment until they have lived in the home for a period of time (R. 1580-1584); (3) airport noise studies raise questions as to effects on fetuses (R. 1715); (4) the traffic noise index used underestimated damages (R. 1587-1592); and (5) personal health effects benefits are not considered (R. 1788).

Conversely, the author states that the Agency's benefits should be revised downward because (1) homes which are mobile should not reap full benefits and (2) if plants could not meet a 50-db(A) level, benefits would be illusory (R. 1771). The author, however, states that in some areas the Agency's benefits would exceed costs by a factor of 2 (R. 1786).

Aside from the disparity between the cost and benefits estimates made by the Author and Agency, the Board finds in the record several questionable assumptions which appear to have been made, and some not to have been made. The author assumed (1) buyers and occupiers of homes differ in their valuation of benefits of sound reduction, e.g., a buyer or occupier of a \$50,000 house values sound reduction twice as much as a buyer or occupier of a \$25,000 house (R. 1415-1423); (2) annoyance occurs primarily from single, defined emissions rather than multiple or repetitious emissions (R. 1425-1432, 1557); (3) hearing loss is not a significant enough factor to be taken into account (R. 1479); (4) outside research of the effects of noise pollution other than those in the hearing record would not have uncovered additional effects (R. 1481-1482). Finally, the author's benefit figures excluded benefits which could accrue to hospitals and physically immobile persons (R. 1555-1559), to employment in the noise control abatement industry (R. 1534-1536), and to citizens due to the technology-forcing policy of the Illinois Environmental Protection Act (Section 2) (R.1485-1488).

It is clear to the Board from the testimony and documents in the record that cost and benefit figures cannot be relied upon with any reasonable accuracy. Therefore, it may not be true, as the author asserts, that costs will be greater than benefits in every instance. Neither does the Board find, as the Agency asserts, that benefits will be greater than costs in every instance.

This means that the true costs of meeting a 56 dB(A) sound emission limitation are probably less than \$38.1 million (or \$1.1 million per 34 noncomplying shops) (R. 1313), but more than whatever costs the Agency would calculate;² the true costs of meeting a 61 dB(A) limitation are probably less than \$28 million (or \$0.9 million per 30 noncomplying shops) (R. 1313) but more than \$10.3 million (or \$0.3 million per 30 noncomplying shops); and the true costs of meeting a 66 dB(A) limitation are probably less than \$20.9 million (or \$0.8 million per 26 noncomplying shops) (R. 1313) but more than \$7.4 million (or \$0.3 million per 26 non-complying shops). From these wide ranges, it can be estimated that the cost of compliance with limitations of either 56, 61 or 66 dB(A) could range from \$300,000-\$1,100,000 per shop. As to the benefits of compliance with a 56, 61, or 66 dB(A) limitation, the Board estimates from Exhibits 70 and 74 that the total range of benefits is between \$2.8 million and \$9.3 million.

Site Specific Operational Levels

Subsequent to Board proposing these noise limitations, it became apparent that a small number of Illinois forging operations could never achieve compliance for reasons technical and economic. Normally an appropriate standard would be adopted. For these operation, however, no one standard or even site specific limitation can be scientifically determined. To effectively abate noise from these operations, FIA and the Agency proposed permanent site-specific operational levels. These are to be premised on operational changes and abatement measures. Although akin to site specific rulemaking under Section 28 of the Act, Rule 206(d) delineates the information petitioner must submit prior to public hearing. The economic and technical inability to comply with the established limits must be explained, along with the intended means of reducing noise as much as possible, and the current and future health and welfare impacts on the surrounding community. Rule 206(d) differs from the Act in that Petitioners have a limited time within which to apply for an individualized operational level and that the Agency must submit a Recommendation for each petition.

The Board will treat the petitions submitted pursuant to Rule 206(d) jointly and individually. For purposes of hearings and economic impact studies, the petitions will be consolidated under one regulatory docket. However, at the conclusion, those forging operations satisfying Rule 206(d)'s requirements shall be granted individual permanent operational levels, including any necessary noise abatement measures. These plans will then become rules within Chapter 8. The actual levels of noise emitted to receiving lands will be determinable only after the required abatement measures and operational levels are accomplished. Subsequent modification of the plan will not be allowed, unless approved by the Board, if an increase in decibel levels, measured in Leq, emitted to Class A or B Lands would result.

Surrounding Land Use Classification


To avoid penalizing the forging operation which has complied with the applicable noise limitation, Rule 206(e) has been added. It provides that the use classification of the land surrounding such an operation, and any future modifications thereof, is preserved as of the effective date of this Rule. The only classification change that can occur is one which would relax the applicable noise limitations. This is not to say that the zoning status of the surrounding land cannot change. For purposes of enforcing the sound limits and operational levels established in Rule 206, however, only the appropriate land use classification will be considered. The Industry Proposal specified a distance of one mile from the property line for this purpose. Nothing in the record contested this distance, so it is accepted. New forging operations do not require the same protection. Since they are not confronted with inherent limitations, these shops can be initially designed and constructed to comply with the

most stringent standard for sounds emitted to Class A lands (Rule 206(b)). That way they will not be jeopardized by fluctuating land classifications. If this method of compliance assurance is unacceptable, the shop has the alternative of providing a buffer zone sufficient to prevent enforcement actions.

Conclusion

Relaxed noise limitations have been adopted for those forging operations which can achieve them through reasonable technical and economic measures. However, the information produced in this rulemaking evidenced major structural dissimilarities in forging operations, often necessitating individually tailored means to abate their noise. Also, the economic evidence was disparate, but nevertheless indicative of high costs to effectively renovate existing shops. For these operations, the site-specific rule-making mechanism is contained in Rule 206. Thereby, individual operational programs will, within a limited time frame, abate forging operation impact noise to the greatest extent reasonably possible for the protection of those affected persons nearby.

I, Christan L. Moffett, Clerk of the Illinois Pollution Control Board, hereby certify that the above Opinion was adopted on the 19th day of March, 1982 by a vote of 4-0.


 Christan L. Moffett, Clerk
 Illinois Pollution Control Board