Programme of Demands

Based on the Needs of Poultry Farmer, Laying Hen and Citizen

In your hands, you've got the Programme of Demands (PoD) of the Dutch project *Houden van Hennen*. The PoD states as concise as possible which needs should be taken into account in the design of a husbandry system for laying hens. This PoD is partly checked on the designers day on February 3rd, 2004, of which a separate report is published in Dutch (rapport nr. ASG 04/0003450).

Project team Houden van Hennen, 2005, *Programme of Demands – Based on the Needs of Poultry Farmer, Laying Hen and Citizen*, Wageningen, Wageningen UR, rapportnummer: ASG/05/I00677

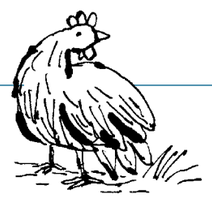
landbouw, natuur en voedselkwaliteit

Verantwoorde Veehouderij

The project Houden van Hennen is part of the programme *Verantwoorde Veehouderij (Responsible Animal Husbandry)*, a research and development programme aimed at the increase of societal acceptance of animal husbandry in the Netherlands. This programme is funded by the Dutch Ministry of Agriculture, Nature and Food Quality.

Houden van hennen

New designs for laying hen and sustainable husbandry



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WAGENINGEN UR
For quality of life

New designs for laying hen and sustainable husbandry

Houden van hennen

Reading instruction to the 'Programme of Demands'

The project 'Laying Hen Husbandry' has set up a *Programme of Demands* (PoD) to be used as basis for the concepts to be designed for the new husbandry systems for laying hens. A *PoD* is a methodological and systematic inventarisation of the needs and the demands of the various parties concerned with husbandry systems for laying hens. In general, it is a detailed programme and of a large size. A *PoD* is never 'finished'.
Although this is the starting point for the designs, the *PoD* is continuously updated and accentuated. In this *PoD* of Laying Hen Husbandry one can get an overview of the demands for the new husbandry systems according to some important parties concerned.

These parties are: 1) the laying hen 2) the poultry farmer (as entrepreneur, labourer and animal keeper) 3) the citizen & consumer. The demands of these parties concerned are based on several of their (basic)needs. The reading instruction below offers a handle to interpret the complex data of this specific *PoD* correctly.

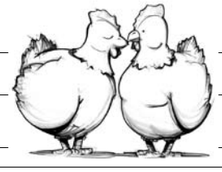
Code	Need	Specific need	Demand	Quantity	Source	Type of source	Explanation
The code in this column numbers the demands per need and per party concerned. This numbering serves especially as an aid for the communication over the 'Program of Demands'. For the party 'Laying hen' the number also indicates which main need the demand relates to: LO1 = Laying hen - suitable living environment - demand no 1.	The needs of the parties concerned are being appointed. The first step in the process of design is always the inventarisation of the needs.	For clarity's sake the needs for the 'Laying hen' and the needs for the 'Consumer' will first be specified in more detail before being translated into demands.	A 'demand' can be interpreted as a precondition or a qualitative or quantitative interpretation of the demands a husbandry system needs to fulfil in order to meet the needs of the party in a satisfied manner. Within the 'methodological' process of design it is important for the demands to be 'quantifiable'. In other words, a number or a value needs to be used as indication. This is important in order to give hands and feet to the demands. Within the 'Program of Demands' of the project 'Laying Hen Husbandry' for some cases it appeared to be impossible to use this method of quantification. This is the result of the fact that some of the demands of the parties concerned have shown to be unquantifiable. This especially concerns the demands of the 'Citizen & Consumer' and of the 'Poultry farmer'.	In this column the demands are being quantified in terms of for example cm^2 or grams. In case the requirments are unquantifiable, this column has been left blank.	Demands, and in many cases also the resulting 'quantities' need to be based on something. Needs are in principle no point of discussion. 'Quantities' however can be a point of discussion. Therefore it is important to indicate the source relating to the quantity indicated for the different demands.	The type of source can vary. In this column it is indicated whether the source is a scientific paper, or for example an expert opinion.	Some of the needs, demands and quantities are very complex c.q. have a technical character. For clarity's sake these will be explained in more detail in this column.

LAYING HEN

Principles: non-beaktrimmed laying hen, perfect rearing (in comparison with husbandry systems on adult age)

Code	Needs	Specific needs	Demand	Quantity	Source	Type source	Explanation
LO	**Suitable living environment for the laying hen**		**Sufficient space and facilities per hen to perform ethological needs**				See for example need for movement
LO1	Experience freedom, fresh air and elements like the sun, water, earth and wind		Being outside	-			
LO2	Fresh air to live in	Total amount of dust in the air	Maximum acceptable concentration of dust particles in the air	3.7 mg / m^3	Donham, Cumro et al., 1999		Levels on basis of pigs
LO3		Respirable dust	Maximum acceptable concentration of respiratory dust in the air	0.23 mg / m^3	Donham, Cumro et al., 1999		Levels on basis of pigs
LO4		Humidity	Optimal humidity level	≥ 60 %	Handboek voor de pluimveehouderij		The maximum humidity depends on the temperature. With a low humidity (less than 60%) it is possible that the natural barrier on the mucous membranes will be damaged. With a high humidity in combination with high temperatures animals cannot sufficiently drain away the latent warmth (=heat related humidity). Hence, do not moisten the poultry house for cooling down when temperatures are high.
LO5		O_2 (Oxygen)	Optimal concentration of O_2 in the air	20.5%	Handboek voor de pluimveehouderij		In general, air comprises on average 20.4 % oxygen.
LO6		NH_3 (ammonia)	Maximum level of NH_3	20 ppm	1. Kristensen and Wathes, 2000, Ammonia and poultry welfare: a review. Worlds Poultry Science Journal, 56, 235-245 2. Artèse, H., 2000. Les gaz d'ammoniac. Sélections Avicole, Februari-nummer, 34-35. (in Monique Bestman: "Kippen houden zonder verenpikken")		Laying hens experience ammonia with a concentration of > 25 ppm as aversive
LO7		CO_2 (carbon dioxide)	Maximum level of CO_2	2000 ppm (= 0.20 vol. %)	Handboek voor de pluimveehouderij		MAC/DIN norms
LO8		SO_2 (sulphur dioxide)	Maximum level of SO_2	5 ppm (= 0.005 vol. %)	Handboek voor de pluimveehouderij		MAC/DIN norms
LO9		H_2S (sulphur hydrogen)	Maximum level of H_2S	20 ppm (0.002 vol. %)	Handboek voor de pluimveehouderij		MAC/DIN norms
LO10		CO (carbon monoxide)	Maximum level of CO	100 ppm (0.01 vol. %)	Handboek voor de pluimveehouderij		MAC/DIN norms
LO11		Ventilation	Flow of ventilation	≥ 1 m^3/ hour / kg living weight			max = 3.6 m3/hour/kg living weight. Ventilation depends on the ambient temperature, CO_2, humidity, ammonia etc. To prevent heat stress during high ambient temperatures a higher ventilation is required.
LO12			Maximum acceptable air speed on animal level	0.2 m/s	Handboek voor de pluimveehouderij		
LO13	Adequate ambient living temperature for the laying hen		Ambient temperature is within the TNZ (Thermo Neutral Zone)	18 < T < 27 degrees Celsius	Expert opinion		Thermoneutral zone (TNZ) means that within this zone the animal has to do no extra effort to maintain its body temperature (for example intake of extra food). Temperatures below the TNZ are fine for chickens to live in, but in these cases a higher feeding level or richer feed is necessary.
LO14	Presence of light and an optimal light quality to perform ethological needs	Optimal light spectrum, optimal light intensity and a minimal flickering frequency for the optimal functioning of the laying hen	Daylight spectra (inclusive UV)	280 < labda < 780 nm Daylight varies between 1,000-100,000 lux	1. Prescott, N.B., Wathes, C.M. and Jarvis, J.R., 2003. Light, vision and the welfare of poultry. Animal Welfare, 12, 269-288. 2. Maddocks, S.A., Cuthill, I.C., Goldsmith, A.R., Sherwin, C.M., 2001. Behavioural and physiological effect of absence of ultraviolet wavelengths for domestic chicks. Animal Behaviour, 62, 1013-1019. 3. Lewis, P.D. and Morris, T.R., 2000, Poultry and coloured light. World's Poultry Science Journal, 56, 189-207.		Poultry prefers fluoresced light + UV light to fluoresced light withhout UV (Moinard and Sherwin, 1999) and fluoresced light to light from lightbulbs (Widowski, et al., 1992). Chickens are (in contrast to humans) capable of seeing UV-A light (320< labda<400 nm), they experience colours different compared to humans. Hens exposed to light with UV, have lower (basal) levels of the stress hormone corticosteron. Broilers prefer natural daylight to most other types of light (except warm white light) (See Kristensen et al., 2002.) Chickes are capable of seeing colours in daylight, but not in darkness. Nevertheless, they see, in comparison with humans, better in darkness. Colours influence the activity of chickens, they are more sensitive to blue and red part of the light spectrum (see Lewis and Morris, 2000).
LO15			Minimum frequency (invisible flickering for the hen)	100 Hz	1. Taylor, N.R., Prescott, N.B., Jarvis, J.R., Wathes, C.M., 2002, Can domestic fowl detect the flicker of fluorescent lights? British Poultry Science, 43 (5), dec. S13-S14.		Research has proven that it is unlikely that hens can detect the flickering of low frequency fluoresced lights. From 100 Hz onwards, chickens probably do not experience it as aversive. The level the hens still are capable of detecting is dependent on the ligh intensity and spectrum (Taylor et al., 2002)
LO16		Light with social recognition	Light spectrum and minimum light intensity needed for social recognition	Light with UVa spectrum (320 nm < labda <400 nm), minimum 70 lux	1. Moinard, C. and Sherwin, C.M., 1999. Turkeys prefer fluorescent light with supplementary ultraviolet radiation. Applied Animal Behaviour Science, 64, 261-267. 2. Widowski, T.M., Keeling, L.J. and Duncan, I.J.H., 1992. The preferences of hens for compact fluorescent over incandenscent lighting. Canadian Journal of Animal Science, 72, 203-211. 3. Kristensen, H.H., Prescott, N.B., Ladewig, J.. Perry, G., Johnsen, P.F. and Wathes, C.M., 2002, Light quality preferences of broiler chickens. British Poultry Science, 43 (5), dec 2002 4. D'Eath, R.B., Keeling, L.J., 2003. Social discrimination and aggression by laying hens in large groups from peck orders to social tolerance. Applied Animal Behaviour Science, 84, 197-212.		
LO17		Light during egg laying	Dusk	0.5 - 1.0 lux (see explanation)	1. Millam, J.R., 1987. Preferences of turkey hens for nest-boxes of different levels of interior illumination. Applied Animal Behaviour Science, 18, 341-348. 2. Appleby, M.C., McRae, H.E., Peitz, B.E., 1984. The effect of light on the choice of nests by domestic hens. Applied Animal Ethology, 11, 249-254.		Hens that are housed with a light intensity of 17-22 lux are more fearful compared to animals which are housed with a light intensity of 55-80 lux, higher light intensity results in more active animals and a larger variation in behaviour (Hughes and Black, 1974). Low light intensities in the nest is not always being prefered to a higher light intensity. Light intensity does not appear to be the most important criterium for chickens for their choice of nest. Experience and growing conditions are more significant. Not all hens prefer a dark laying nest to a light laying nest.
LO18		Light during resting (on the perch)	Dusk	0.5 - 1.0 lux (see explanation)	Expert opinion		The perch needs to be very well visible to jump to, for example using white colours.
LO18		Light during eating and drinking	Light environment	> 60 lux (see explanation)	1. Prescott, N.B. and Wathes, C.M. (2002) Preference and motivation of laying hens to eat under different illuminances and the effect of illuminance on eating behaviour. British Poultry Science, 43, 190-195. 2. Davis, N.J. Prescott, N.B., Savory, C.J. and Wathes, C.M. (1999). Preferences of growing fowls for different light intensities in relation to age, strain and behaviour. Animal Welfare, 8, 193-203.		Eating at 200 lux is being prefered to eating at 60 lux (Davis)
LO19		Light with foraging	Sufficient light in the environment during foraging	> 60 lux	Davis, N.J. Prescott, N.B., Savory, C.J. and Wathes, C.M. (1999). Preferences of growing fowls for different light intensities in relation to age, strain and behaviour. Animal Welfare, 8, 193-203.		Chickens are more active under a higher light intensity. Foraging with 200 lux is being prefered to foraging with 60 lux
LO20		Light with sunbathing and dustbathing	Sun light for sunbathing and dustbathing	Daylight varies between 1,000-100,000 lux			Daylight + warmth
LO21	Day- and night rhythm	Light / Dark cycles	The presence of a light/dark periodicity	min. 8 hours continuous darkness	1. Prescot, Wathes and Jarvis, 2003. Light, vision and the welfare of poultry. Animal Welfare, 12, 269-288. 2. Manser, C.E. (1996). Effects of lighting on the welfare of domestic poultry: a review. Animal Welfare, 5, 341-360.		Alternated darkness and light periods (intermittend) results in abberant sleeping behaviour, Blokhuis, 1983 and Coenen et al., 1988, see Manser). Light periods of 22 hours and more, result in eye handicaps and blindness. Not more than 20 hours of light(minimum 14-16 hours of light necessary for the egg laying).
LO22	Noise	Volume	Maximum noise volume in the poultry house caused by hens and/or machineries	< 90-110 dB(A)	1. McAdie, T.M., 1993. A method for measuring the aversiveness of sounds of domestic hens. Applied Animal Behaviour Science, 37, 223-238. 2. MacKenzie, Foster, T.M., Temple, W., 1993. Sound avoidance by hens. Behavioural Processes, 30, 143-156.		Hens communicate via many sounds. Too strong environmental noise could deteriorate the communication between the animals in the flock, and could be stressfull. MacKenzie showed that hens experience noises of approximately 90-110 decibel as aversive.
LO (continuation)	**To map and explore the environment**						
LO23	Orientation possibilities 	Facilities for a good orientation of the living environment	Orientation towards the sun	-	1. Maddocks, S.A., Cuthill, I.C., Goldsmith, A.R., Sherwin, C.M., 2001. Behavioural and physiological effect of absence of ultraviolet wavelengths for domestic chicks. Animal Behaviour, 62, 1013-1019. 2. Zimmerman, P.H., Pope, S.J., Guilford, T., Nicol, C.J., 2003. Navigational ability of the domestic fowl (Gallus gallus domesticus). Applied Animal Behaviour Science, 80, 327-336.		Chickens direct towards the sun (work of Patrick Zimmerman)
LO24			Recognition points (light points), variation in the environment		1. Maddocks, S.A., Cuthill, I.C., Goldsmith, A.R., Sherwin, C.M., 2001. Behavioural and physiological effect of absence of ultraviolet wavelengths for domestic chicks. Animal Behaviour, 62, 1013-1019. 2. Zimmerman, P.H., Pope, S.J., Guilford, T., Nicol, C.J., 2003. Navigational ability of the domestic fowl (Gallus gallus domesticus). Applied Animal Behaviour Science, 80, 327-336.		Colours, light, variation in the environment
LO25		Space for foraging	Presence of sufficient and adequate foraging space for the laying hen	1.5 *(0,052 * W $^{0.67}$ *10,000) = 1.5 x allometric formula scraping hen = 1199 cm^2 with W = 1.9 kg (Baxter), see explanation	1. Savory, Jack, Mclean and Sandilands, 2003. Behaviour of pen-housed hens in relation to floor space allowance. In: Welfare of the laying hen, 27th Poultry Welfare Symposium, Bristol, UK, p. 82. 2. Baxter, M.R., 1992. The space requirements of houses lifestock. In: Farm animals and the environment. Phillips, C. and Piggins (Eds.), Chapt 4, 67-81. 3. Stamp Dawkins & Hardie (1989) Space needs of laying hens. British Poultry Science, 30 (413-416)		Our calculations are based on a laying hen of 1.9 kg bodyweight. Additionally, we presume that a hen needs 1.5 times more space for foraging and scraping. W=bodyweight.
LO26		Space for scraping	Sufficient space to scrape	(0.052 * W $^{0.67}$ * 10,000) = allometric formula scraping hen = 799 cm^2 with W = 1.9 kg (Baxter)	1. Stamp Dawkins & Hardie (1989) Space needs of laying hens. British Poultry Science, 30 (413-416)		
LO27		Adequate substrate for foraging (pecking, scraping)	Loose, dry and not dusty	-			
LO28			Sufficient thick layer of litter to scrape	> 10 cm	1. Report on the welfare of laying hens in colony systems, 1991, Farm Animal Welfare Council.		

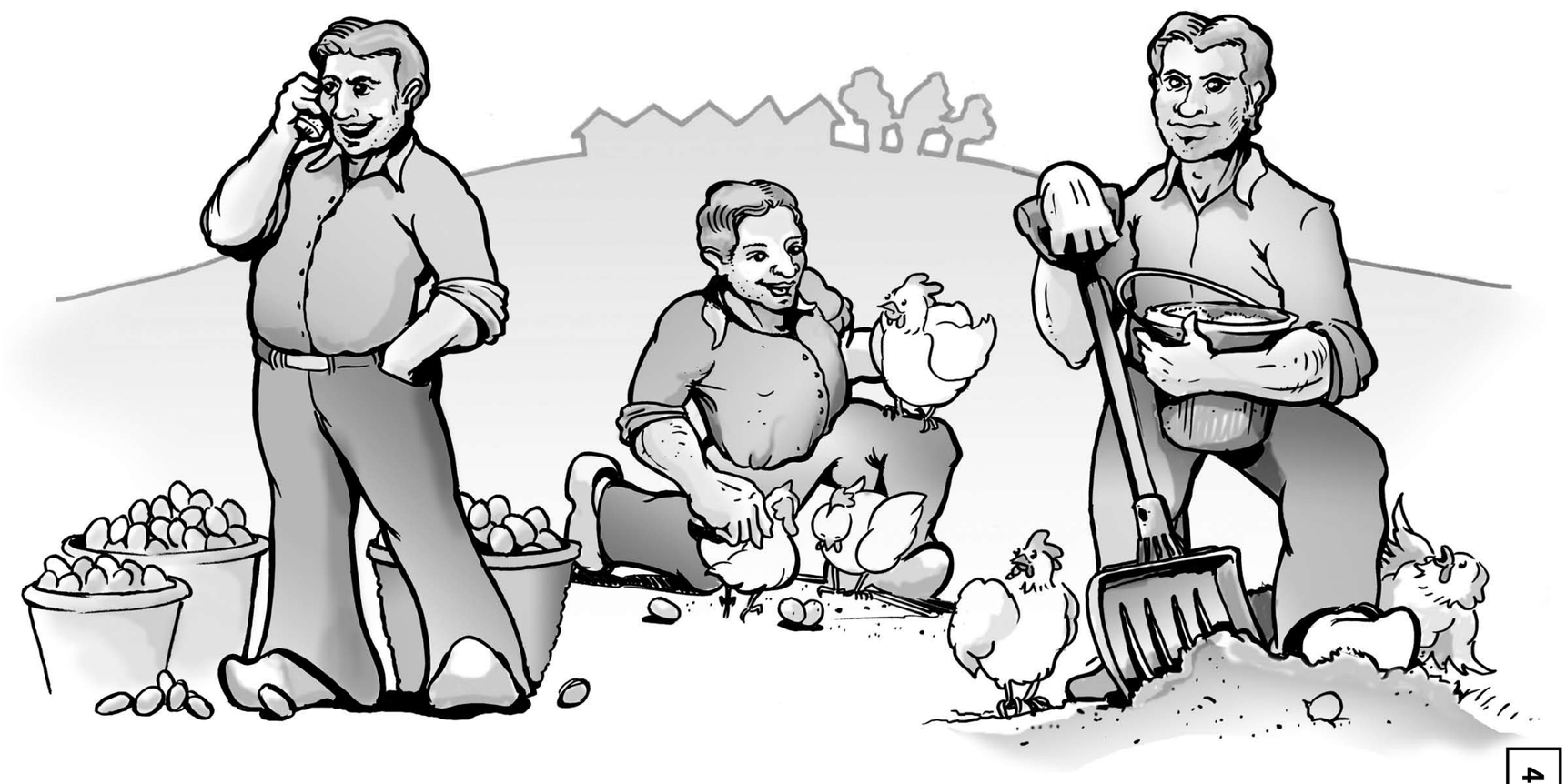
Code	Needs	Specific needs	Demand	Quantity	Source	Type source	Explanation
LZ	**Saturation**	**(Physiological + mental) = food composition and food intake behaviour**					
LZ1	Saturation of hunger- and thirst feelings	Sufficient nutrient supply (amongst others energy, protein, vitamins and minerals) for maintenance (movement, wearing of feathers, warmth loss) and (re)production as preconditions	Nutrient intake	-	See for example 'Handboek voor de pluimveehouderij'		Optimal food composition for a healthy hen (maintenance, egg laying, grow)
LZ2		Food structure	Optimal size of the food particles and a determined amount of foodfibres with a large particles	Diameter 0.25 - 2 mm, non-water dissolvable NSP's (Non starch polysaccharides)	1. Walser, P. and Pfirter, H.P., Feed structure influences behaviour of laying hens. In: Proceedings of the 6th European Symposium on Poultry Welfare, 2001, 181-186. 2. Personal communication Marinus van Krimpen		Structure has influence on feather pecking (not too coarse and not too fine). Wheat decreases (in connection to the grains) the chance on feather pecking. Feed additional roughage (see booklet Monique Bestman). A higher level of NSP in the food might decrease the level of feather pecking. NSP's are situated on the outside of different seeds.
LZ3		Variation in types of food	Different types of food in terms of structure and size	Grain in the foraging area (grit), roughage	1. Steenfeldt, S., Engberg, R.M. and Kjaer, J., 2001. Feeding roughage tot laying hens affects egg production, gastrointestinal parameters and mortality. Proceedings of 13th European Symposium on Poultry Nutrition, september 30- oktober 3, 2001. Blankenberge, Belgium, pp 238-239 (uit Kippen houden zonder verenpikken, Monique Bestman) 2. Savory,C.J. 1980 Diurnal feeding patterns in domestic fowl: a review. Applied Animal Behaviour Science, 6, 71-82. Meunier, M.C. and Faure, J.M., 1984. On the feeding and social behaviour of the laying hen. Applied Animal Behaviour Science, 13, 129-141.		There is less feather pecking in animals that receive roughage. Structure needs to result in an increased eating time, without problems arising with for example food seperation and selective eating. Sufficient coarse and fine fraction, minimal middle fraction.
LZ4		The exact way of food administering	Correct amount and method of food distribution (which causes the least disturbance in the flock)	ad libitum			
LZ5		Sufficent space for food intake	Correct ration food places / number of hens and sufficient eating space per animal	15 cm feeding space per hen (dimension of the average standing hen); 0.029 * W $^{0.67}$ * 10,000 = allometric formula standing hen = 446 cm^2 with a W= 1.9 kg (Baxter)	1. Hughes and Black, 1976, Br. Poultry Science, 17, 327-336. 2. Baxter, M.R., 1992. The space requirements of houses lifestock. In: Farm animals and the environment. Phillips, C. and Piggins (Eds.), Chapt 4, 67-81. 3. Stamp Dawkins & Hardie (1989) Space needs of laying hens. British Poultry Science, 30 (413-416)		The EU standards: a feeding trough length of 10 cm per animal with elongated feeding troughs, of 4 cm with round feeding troughs. The correct ratio feeding places / number of animals is dependent on: size of the flock, synchronisation, ad lib feeding or not, the physical space per hen, the social space per hen. Allometric formula for the space of a standing chicken, with W=bodyweight (Baxter) Round feeding troughs require less animal space because the hen has a conisch shape.
LZ6		Healthy water	Correct water characteristics (safe water)	-	See handboek voor de pluimveehouderij		Optimum water composition for the health of the hen
LZ7		Water on the desired place and time	Water supply / laying hen / day	ad libitum			
LZ8			Optimal method of water distribution	Open water or drinking nippels			Open water: risk for polution (bacteria). More natural, although hens do peck at water drops.
LZ9		Sufficient space for water intake	Correct ration drinking water places / number of hens and sufficient drinking space per animal	15 cm feeding space per hen (dimension of the average standing hen); 0.029 * W $^{0.67}$ * 10,000 = allometric formula standing hen = 446 cm^2 with a W= 1.9 kg (Baxter)			The EU standards: a drinking trough length of 2.5 cm / animal with continuously working drinking troughs, or 1 cm with round drinking troughs or 1 drinking nipple or 1 drinking trough / 10 hens, at which at least 2 drinking nipples or troughs need to be accessible per chicken. According to Fölsch et al. chickens prefer open water to nippels.
LZ10	To forage	Foraging space	Sufficient foraging space per laying hen	1199 cm^2 with W = 1.9 kg (See Baxter and LO25)	1. Baxter, M.R., 1992. The space requirements of houses lifestock. In: Farm animals and the environment. Phillips, C. and Piggins (Eds.), Chapt 4, 67-81. 2. Stamp Dawkins & Hardie (1989) Space needs of laying hens. British Poultry Science, 30 (413-416)		Our calculations are based on a laying hen of 1.9 kg bodyweight. Additionally, we presume that a hen needs 1.5 times more space for foraging and scraping. W=bodyweight.
LZ11		Forage substrate	Suitable substrate of sufficient quality and thickness (quantity)	> 10 cm thick in height, loose and dry	1. Report on the welfare of laying hens in colony systems, 1991, Farm Animal Welfare Council.		
			Presence of edible particles in the substrate	> 5 g per laying hen / day (see explanation)			5 gram is based on the standard for biological laying hens in the Netherlands
LG	**Health as a precondition**						
LG1	Health (good functioning without suffering)	Limited exposure to germs of diseases	Maximum acceptable level of germs of diseases	-			
LG2		Natural resistance	To promote the natural resistance	-			
LG3			In case of illness or disorders: seperate hens	-			Chickens suffering from a disease are often being pecked. But social isolation causes stress, therefore seperation but no social isolation.
LG4	Health improving living environment	The presence of optimal air quality, optimal light, optimal temperature, health and sufficient water and food, etc.	See living environment, and saturation	-			Comfort behaviour (preening, dustbathing, sunbathing) helps the hen to keep healthy feathers. Additionally, many physiological processes are influenced by the sunlight. Sunlight stimulates health, stimulates the production of vitamin D and red and white bloodcells, and dustbathing and sunbathing behaviour.
LB	**Movement**						
LB1	Movement possibilities	Fluttering	Sufficent space to flutter	0.06 * W $^{0.67}$ * 10,000 = allometric formula preening hen = 922 cm^2 with W = 1.9 kg (Baxter)	1. Baxter, M.R., 1992. The space requirements of houses lifestock. In: Farm animals and the environment. Phillips, C. and Piggins (Eds.), Chapt 4, 67-81. 2. Stamp Dawkins & Hardie (1989) Space needs of laying hens. British Poultry Science, 30 (413-416)		
LB2		Turning	Sufficient space for turning	0.09 * W $^{0.67}$ * 10,000 = allometric formula preening hen = 1383 cm^2 with W = 1.9 kg (Baxter)	1. Baxter, M.R., 1992. The space requirements of houses lifestock. In: Farm animals and the environment. Phillips, C. and Piggins (Eds.), Chapt 4, 67-81. 2. Stamp Dawkins & Hardie (1989) Space needs of laying hens. British Poultry Science, 30 (413-416)		The total space per behaviour depends on: the flocksize, the physical space / hen during that behaviour, the social space single hens prefer, the level of synchronising during that particular behaviour.
LB3		Running	Sufficient space for foraging	1199 cm^2 with W = 1.9 kg (see LO25)	1. Baxter, M.R., 1992. The space requirements of houses lifestock. In: Farm animals and the environment. Phillips, C. and Piggins (Eds.), Chapt 4, 67-81. 2. Stamp Dawkins & Hardie (1989) Space needs of laying hens. British Poultry Science, 30 (413-416) 3. Keeling, L.J., 1994. Inter-bird distances and behavioural priorities in laying hens: the effect of spatial restriction. Applied Animal Behaviour Science, 39, 131-140.		Hens do like to keep a relative large distance (237-310 mm) from each other
LB4		Comfort behaviour: preening, wing stretching, leg stretching, bodyshaking, wingflapping	Sufficient space for mentioned behavious	0.07 * W $^{0.67}$ * 10,000 = allometric formula preening hen = 1076 cm^2 with W = 1.9 kg (Baxter)	1. Baxter, M.R., 1992. The space requirements of houses lifestock. In: Farm animals and the environment. Phillips, C. and Piggins (Eds.), Chapt 4, 67-81. 2. Stamp Dawkins & Hardie (1989) Space needs of laying hens. British Poultry Science, 30 (413-416) 3. Keeling, L.J., 1994. Inter-bird distances and behavioural priorities in laying hens: the effect of spatial restriction. Applied Animal Behaviour Science, 39, 131-140.		The space between two preening hens is small (154mm) and independent of the size of the animal house (Keeling, 1994)
LB5		Dustbathing	Sufficient space for dustbathing	1150 cm^2 / hen (preening, wing stretching, leg stretching, bodyshaking) 1085 - 2606 cm^2/ hen (wingflapping)	1. Baxter, M.R., 1992. The space requirements of houses lifestock. In: Farm animals and the environment. Phillips, C. and Piggins (Eds.), Chapt 4, 67-81. 2. Stamp Dawkins & Hardie (1989) Space needs of laying hens. British Poultry Science, 30 (413-416) 3. Keeling, L.J., 1994. Inter-bird distances and behavioural priorities in laying hens: the effect of spatial restriction. Applied Animal Behaviour Science, 39, 131-140.		We presume the required space for the hen during dustbathing and sunbathing is equivalent to the space needed for preening
LB6		Sunbathing	Sufficient space for sunbathing	0.07 * W $^{0.67}$ * 10,000 = allometric formula preening hen = 1076 cm^2 with W = 1.9 kg (Baxter)	1. Baxter, M.R., 1992. The space requirements of houses lifestock. In: Farm animals and the environment. Phillips, C. and Piggins (Eds.), Chapt 4, 67-81. 2. Stamp Dawkins & Hardie (1989) Space needs of laying hens. British Poultry Science, 30 (413-416)		
LB7		Facilities for dustbathing	Loose substrate suitable for dustbathing	Sand, peat	1. van Liere, 1991 Function and organization of dustbathing in laying hens (PhD thesis).		During dustbathing it is important that the substrate is able to come between the feathers to absorb dirt
LB8		Facilities for sunbathing	Access to direct sunlight	Sunlight			Is sunbathing a real ethological need? Yes, the motivation is very high, sunbathing is immediately present when sufficient sunlight enters. What is the sunbathing frequency?
LS	**Social interaction**						
LS1	Presence of conspecifics	Group size with clear and constant dominance relationships (see explanation)	Group size (x)	x < 15 of x > 60 hens	1. Keeling, I.J., Estevez, I. Newberry, R.C., et al., 2003. Production-related traits of layers reared in different sized flocks. The concept of problematic intermediate group sizes. Poultry Science, 82, 1393-1396. 2. D'Eath, R.B., Keeling, L.J., 2003. Social discrimination and aggression by laying hens in large groups from peck orders to social tolerance. Applied Animal Behaviour Science, 84, 197-212. 3. Lindberg, A.C. and Nicol, C.J., 1996. Space and density effects on group size preferences in laying hens. British Poultry Science, 37, 709-721.		In small groups, 15 hens (Keeling et al., 2003), a social hierarchy exists on the basis of a peck order (individual recognition). In large groups there is less aggression, but there a relationship exists between morphology (comb size, weigth) and aggressive behaviour. Social order exists on the basis of appearance and not on individual recognition (D'eath and Keeling, 2003). It seems that there is a transition with a group size of approximately 30 animals, no good peck order and also no tolerance.
LS2	Choice in the distance to conspecifics	Social distance during the performance of various behaviours	Sufficient space for social distance	-	Keeling, L.J., 1994. Inter-bird distances and behavioural priorities in laying hens: the effect of spatial restriction. Applied Animal Behaviour Science, 39, 131-140.		Furthermore hens prefer a small group size to a large group size given the same space (smaller density to larger density) and hens prefer a large group in a large space to a small group in a small space (same density). Groupsize is one of the factors that play a part in feather pecking.
LS3	Possibilities of synchronising behaviour	The simultaneously performance of specific behaviour by a number of laying hens (see explanation)	Sufficient space for synchronising	-			Hens synchronise a large part of their activities, it is however not possible to indicate which part of the animals want to or is performing the same activity simultaneously (this has not been examined!)
LS4	The performing of sexual behaviour?	See explanation		-			It is unclear whether sexual behaviour is a real need of the laying hen



Code	Needs	Specific needs	Demand	Quantity	Source	Type source	Explanation
LR	**To rest**						
LR1	Performing of resting- and sleeping behaviour 	Sufficient resting space	Sitting space per hen	Width of 18 cm (dimension of an average sitting hen) of 0.035 * $W^{0.67}$ * 10,000 = allometric formula sitting hen = 538 cm^2 with W = 1.9 kg (Baxter)	1. Freeman, 1983, Veterinary Record, 113, 562-563 2. Bogner, H., Peschke, V., Seda, V. and Popp, K. (1979) Studie zum Flachenbedarf von Legehennen in Käfigen bei bestimmten Aktivaten. Berl. Munch. Tierarztl. Wschr., 92, 340-343. 3. Stamp Dawkins & Hardie (1989) Space needs of laying hens. British Poultry Science, 30 (413-416) 4. Appleby, 1998, Poultry Science 77, 1828-1832.(ook in Appleby, 1995, Perch length in cages for medium hybrid laying hens. British Poultry Science, 36, 23-31.		18 cm (width of a sitting hen) + left and right 5 cm 'personal space' (Savory et al., 2002)
LR2			Standing space per hen	Width of 15 cm (dimension of an average sitting hen) of 0.029 * $W^{0.67}$ * 10,000 = allometric formula sitting hen = 446 cm^2 with W = 1.9 kg (Baxter)	5. Newberry, R.C., Estevez, I. and Keeling, L.J. Group size and perching behaviour in young domestic fowl., Applied Animal Behaviour Science, 73, 117-129. 6. Savory, C.J., Percival, D., Yuill, I. ,2002, Influence of perch space allowance on perching behaviour of laying hens. British Poultry Science, 43, S22-S23. 7. Baxter, M.R., 1992. The space requirements of houses lifestock. In: Farm animals and the environment. Phillips, C. and Piggins (Eds.), Chapt 4, 67-81.		
LR3		Location	High situated sitting space	-			
LR4			Resting place is not situated on walking paths to food / water of laying nest (or other functional areas)	-			
LR5		Characteristics of the perch	Optimal heigth, shape, colour, structure, place, visibility of the perch	-	1. Appleby, 1998, Poultry Science 77, 1828-1832 2. Muiruri et al.,1990 Preferences of hens for shape and size of roosts. Applied Animal Behaviour Science, 27, 141-147. 3.Tayer, P.E., Scott, G.B. and Rose, P., 2003. The ability of domestic hens to jump between horizontal perches; effects of light intensity and perch colour. Applied Animal Behaviour Science, 83, 99-108. 4. Graham Scott., 1997. The SAC high-welfare perchery. Technical Note, Edinburgh.		Distance between horizontal perches <1m (rather 50 cm than 1 m) (greater chance of broken bones with larger distance), white colour perches are better compared to black or wood colours. A larger diameter of a perch makes the perch more stable (4 cm better than 3 cm). Round perches increase the chance on feet problems and breast fractures. Oval perches cause less feet problems ('bumble foot') and have a good grip (Tauson and Abrahamsson, 1994). Futhermore, the stability on a flattened perch is better compared to a round perch. Wood is harder to clean and may become a excellent place for micro organisms, mites etc.
					5. Tauson, R. and Abrahamsson, P., 1994. Foot and skeletal disorders in laying hens. Acta Agriculturae Scandinavica, Section A - Animal Science, 44, 110-119. 6. Tauson, R. and Abrahamsson, P., 1996. Foot and keel bone disorders in laying hens. Acta Agriculturae Scandinavica, Section A - Animal Science, 46, 239-246. 7. Lambe, N.R. and Scott, G.B., 1997, Perching behaviour and preferences for different perch designs among laying hens. Animal Welfare, 7, 203-216.		Plastic increases the chance on bumble foot
LR6		Day and night rhythm	The presence of a light/dark cycle: the presence of natural dusk periods	min. 8 hours continuously darkness	1. Prescot, Wathes and Jarvis, 2003. Light, vision and the welfare of poultry. Animal Welfare, 12, 269-288. 2. Manser, C.E. (1996). Effects of lighting on the welfare of domestic poultry: a review. Animal Welfare, 5, 341-360.		Solution could be to offer dusk on an illuminated perch
	Safety						
LV1	To flee	Fleeing space	Fleeing space per / hen	-			In the design we take into account sufficient space for the hens to escape around the facilities: perch, feeding troughs, laying nests, drinking nipples, foraging space etc.
LV2	Hiding 	Presence of roosters	Number of roosters per flock	1 rooster per 25 hens	Craig, J.V., Al-Rawi, B., Kratzer, D.D.,1977, Social status and sex ration effects on mating frequency of cockerels. Poultry Science, 56, 762-772.		Roosters mounting 5 times a day, space required for waltzing
LV3		Hiding possibilities	Number of hiding opportunities / flock	Similar to number of perches / flock = number of animals per flock			All hens should be able to hide, in principle we take into account hens to escape upwards and hide on the perches.
LV4		Hiding-place	Dimensions of the hiding-place	18 cm per laying hen (sitting space)			Dimensions of the sitting laying hen
LV5		Location of hiding-place	High hiding-places	-			Partitions / perches
LE	**Nesting behaviour**						
LE1	Performance of nesting behaviour and egg laying	nesting space	Space for nesting behaviour per hen	643 cm^2 / hen (see explanation)	1. Appleby, 1998, Modification of laying hen cages to improve behavior. Poultry Science, 77, 1828-1832 2. Stamp Dawkins & Hardie (1989) Space needs of laying hens. British Poultry Science, 30 (413-416)		Our calculations are based on a group nest of 5 animals: 3 animals are sitting and 2 animals are busy manipulating the nesting material, for which we used the dimensions of scraping. Furthermore, nestbox inspection is an important behaviour.
LE2		To determine the place of the laying nest in the area	Groundlevel is preferable to higher laying nests	-	1. Appleby, M.C. and McRae, H.E., 1986. The individual nest box as a superstimulus for domestic hens. Applied Animal Behaviour Science, 15, 169-176. 2. Wood-Gush, D.G.M. Environmental requirements for nesting behaviour. 1983. In: Farm animal Housing and Welfare, (Ed. Baxter, Baxter and McCormack), 91-95.		Laying nests need to be good visible and recognisable. Hens prefer a closed nest to a more open nesting box. Additionally, hens prefer a ground nest to a higher placed nest. They prefer litter to a slatted floor (Hughes et al., 1995). But equally important for the nest preference of the hen is the presence of other hens in that nest. In this the laying hen differs from the Bankiva hen that prefers to seperate herself from the flock for egg laying.
LE3		Maximal attractivity of the laying nest	Presence of other hens Groundlevel One side open to create corner effect	-	1. Appleby, M.C. and McRae, H.E., 1986. The individual nest box as a superstimulus for domestic hens. Applied Animal Behaviour Science, 15, 169-176. 2. Woodgush, D.G.M. and Murphy, L.B., 1970, Some factors affecting the choice of nests by the hen. British Poultry Science, 11, 415-417.		Light intensity in the nest seems to be less important than often thought. Protection (enclosed nest) is important. Laying nests have to be good visisble and recognisable. Hens prefer a closed nesting box to an open nesting box. They also prefer a ground nest to a higher place nest. They prefer litter to grills (Hughes et al., 1995). Hens prefer to lay their egges in a nest on the end of the row, in a corner. By placing partitions between the laying nests one can create this effect as well.
LE4		The approacheableness: to give opportunity for seeking laying nest	Sufficient space for the laying hens to walk alongside the laying nests	Double perches, grid			If you present the laying nest at a high place you have to offer nest entry perches. Naturally however the chicken is a ground breeder!
LE5		Shelter	To offer a laying nest that offers security	-			Hens prefer to lay their eggs in an enclosed and protected area. Furthermore, hens prefer laying nests on ground level to higher leverls (see Appleby en McRae, 1986). The material in the nest should not hurt the hens (specific types of 'astroturf' cause bald bottoms).
LE6		Light	Difference in light intensity between nest and environment	Light intensity in nest 0.5 lux	Expert opinion		
LE7		Nesting material	Manipulatable material	Loose straw with thickness > 5 cm	Expert opinion		

Poultry farmer - Producer

Code	Needs	Demands	Quantity	Source	Source qualification	Explanation
P01	Continuity of management	Business development: increasing the scale	-			
P02		Business development: specialisation	-			
P03		Business development: diversification	-			
P04	Continuity (product consistency)	To meet quality demands	-			
P05		To meet demands for food safety	-			
P06		Being competitive with similar companies	-			
P07		Availability of labour, market and raw products	-			
P08		Earning capacitiy	-			
P09		Quick depreciation of the system	≤ 6 year			
P010		To meet demands of the IKB (tracking&tracing)	-			
P011		Reliable and consistent rules (EU, NL, WTO)	-			
P012		Commitment with turnover	-			
P013		Flexibility in the husbandry system. Space need to be suitable for different animal species inclusive feed- and watersystems	-			
P014	Income in €	Connected to a 'normal' working week of 40 hours	Above average			
P015		To provide family with necessaries of life	-			
P016	Profit	Family income + x €	110% of the familiy income			
P017	Minimum amount of labour	Maximum quantity of labour per egg or kg product	-			
P018	Producing as much as possible eggs	Minimum egg production per chicken / year	-			
P019	Entrepreneurship, way of living and acknowledgement	Innovation	-			
P020		Skilled labour	-			
P021		Entrepreneurship	-			
P022		Reliability / chain responsibility	-			
P023		Animal friendliness	-			
P024		Openness / transparancy of the husbandry system	-			
P025		Collaboration (media / poultry farmers, etc)	-			
P026		Communicate / information	-			
P027		Reasonable production	-			
P028	To produce undisturbed and manageable	Maximum numbers floor eggs	≤ 1% of the total egg production			
P029		Absence of cannibalism and feather pecking	-			
P030	Keeping productive laying hens alive	Hygienic animal house	0-30 number bacteria / cm^2 house floor, after desinfection			
P031		Exclude bacterium diseases	See health demands for the laying hen (PoD laying hen)			
P032		Exclude virus diseases				
P033		Exclude mold diseases				
P034		Exclude internal and external parasitical diseases				
P035		Suitable conditions for breeding and egg laying period	-			
P036		Sufficient locomotion space in animal house	See space demands for the laying hen (PoD laying hen)			
P037		No harmful pecking movements	No harmful pecking movements / time span			
P038		Maximum acceptable level of germs of disease in the water	< 100.000 Germs / ml water			
P039		Maximum acceptable concentration of solid particles in the air	Concentration solid particles ([x]) / m^3 water			
P040		Water on the right place and moment	Ad lib water / chicken / (t) on right spot			
P041		Exact quantity of water per chicken per day	3 gram water per degree per day			
P042		Exact water temperature	10 - 13 degrees Celcius			
P043		Exact proportion water / food	1.8 -1.9 gram water / gram food			
P044	Sufficient resources to keep animals healthy in a legal manner		-			
P045	Optimal housing climate for the productive laying hen	Exact environment temperature on each moment of the day on specific places	20 - 24 degrees Celcius / period of the day			
P046		Exact light intensity on each moment of the day on specific places	5 lux on time (t) on specific places			
P047		Optimal humidity per day shift	65% relative humidity			
P048		Minimum ventilation	1 m^3 / h per kg living weight	During normal outside temperatures		
P049		Maximum ventilation	3,6 m^3 / h per kg living weight	During high temperatures		
P050		Exact air movement pattern	0.2 air speed in m/s			
P051		Good facilities regarding the air outlet	2,5 cm^2 / m^3 animal house content	Both with roof-edge and side outlet		
P052		Maximum acceptable amount of dust	% dust particles / unit air			
P053	As much as possible first quality eggs	Acceptable % second quality eggs of the total egg production	≤8 % of total production			2nd quality eggs: eggs with a light damage / polution which still can be sold on the market
P054		Minimum % of the 1st quality eggs within the total egg production	≥92 % of total production			
P055		Exclude diseases negatively influencing the egg quality	0 % New Castle Disease (NCD)			
P056			0 % Infectious Bronchitis (IB)			
P057			0 % Egg drop Syndrome			
P058	Disposal of the remaining material	Amount of manure per chicken per year	75 kg / year per chicken	On the basis of wet manure		
P059		Sufficient storage capacity for the manure	6 m^3 / 1000 animals / month	On the basis of wet laying hen manure		
P060		Amount of water / chicken / year	[x] m^3 / chicken / year			
P061		Amount of air / chicken / year	[x] m^3 / chicken / year			
P062	To produce eggs	As much as possible eggs per chicken	300 eggs per chicken per year			



Poultry farmer - Animal keeper

Code	Needs	Demands	Quantity	Source [1]	Source qualification [2]	Explanation
PD1	Socially justified animal keeping (regarding animal welfare)	Meet the demands for welfare and environment	-			
PD2	Act responsibly		-			
PD3	Openness of the system (transparency)	Evidence of production laying hen	-			
PD4	Farmer dignified animal keeping	To develop or maintain self respect as an animal keeper	-			
PD5	Contact between animal and human	contact possibilities	-			
PD6	Working with animals, experience animals		-			
PD7	Be in contact with the nature (character) of the animal	Interest and notion in the character of the animal	-			
PD8	Be part of 'nature'; caught up in 'nature'	Presence of ' nature'; to choose immaterial matters above material matters; natural (work/living) habitat for humans and animals	-			
PD9	Keeping animals healthy	See health demands for the laying hen	-			
PD10	Taking care of the animals	To foresee in the basic needs of the animal	-			
PD11	To protect animals against harmful influences (pathogens, predation, congeners, elements)	Physical environment that offers protection	-			
PD12	To offer the animals possibilities to perform protective behaviour patterns (fleeing, hiding, resistance)		-			

(1) These needs and demands have been formulated by different citizen panels in the autumn of 2003 as well as during the designer day on the 3rd of February 2004
(2) The sources at these needs and demands can all be classified as being 'personal communications'

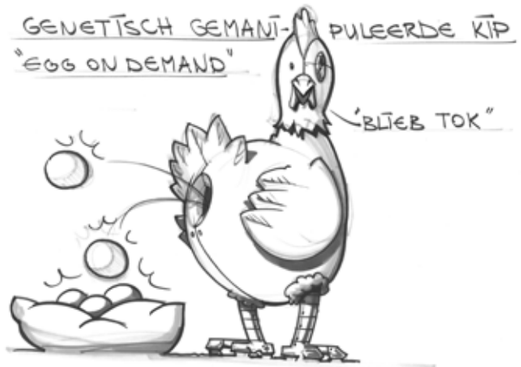
Poultry farmer - Worker

Code	Needs	Demand	Quantity	Source [3]	Source qualification [2]	Explanation
PA1	To secure an income	Wages	Above average			
PA2	To generate the farmer's satisfaction	Appreciation for the accomplished working activities	-			
PA3		To visualise the labour results	-			
PA4	To produce undisturbed and manageable	To guard against disturbances in the laying hen systems	-			
PA5		To avoid unnecessary labour	-			
PA6	Job security in the long term		-			
PA7	Job delight and working convenience	Labour	-	See Working Conditions Act		
PA8		Suitable animal house climate	-			
PA9		Interaction human / chicken	-			
PA10		Healthy chicken	-			
PA11		No ground eggs	≤ 1% of the total egg production			
PA12		Clean eggs	-			
PA13		Technical good working system	-			
PA14		Plannable working times	-			
PA15		Variation and diversity	-			
PA16	Social contact	Contact with colleague poultry farmers and other parties involved from the sector	-			
PA17	Social freedom	Space to leave the farm without something going wrong	-			
PA18	Efficient working environment	Ergonomic work space and access	-	See Working Conditions Act		
PA19		Good lighting	-	See Working Conditions Act		
PA20		To make thermo comfort possible	-	See Working Conditions Act		
PA21	Safe work environment	To have an overview	-			
PA22		Construction does not collapse during calamities	> 30 minutes	See Working Conditions Act		
PA23		Safe machinery / equipment and passage	-	See Working Conditions Act		
PA24		To offer protection against the chickens	-			
PA25		To offer protection against noise	< 80 dB(A)	See Working Conditions Act		
PA26		To offer protection against tremors	-	See Working Conditions Act		
PA27		To prevent too much bending over and lifting of too heavy loads	-	See Working Conditions Act		
PA28	Health	To offer protection against germs of diseases; pathogens; bacteries; viruses and chickens	-			
PA29	To offer protection against too much dust	Maximum concentration of total dust (particles > 10 micron)	< 2.4 mg / m^3	Handboek Pluimveehouderij		
PA30		Maximum concentration of respiratory dust (particles > 10 micron)	< 0.16 mg / m^3	Handboek Pluimveehouderij		
PA31		Maximum concentration of endotoxines - NEL value	< 4.5 ng / m^3	Handboek Pluimveehouderij		
PA32	To offer protection against ammonia and other gasses and vapours	MAC value, ammonia NH_3	< 18 mg / m^3	Handboek Pluimveehouderij		MAC = Maximum acceptable Concentration
PA33		MAC value, methane CH_4	< 16 mg / m^3	Handboek Pluimveehouderij		
PA34		MAC value, carbon monoxide CO	< 29 mg / m^3	Handboek Pluimveehouderij		
PA35		MAC value, carbon dioxide CO_2	< 9 g / m^3	Handboek Pluimveehouderij		
PA36		MAC value, hydrogen sulphide H_2S	< 15 mg / m^3	Handboek Pluimveehouderij		
PA37		MAC value, nitrogen dioxide NO_2	< 4 mg / m^3	Handboek Pluimveehouderij		

(3) Next to the 'handboek van de Pluimveehouderij', the sources for many needs and demands were the participants of the designer day of February 3rd 2004. For the farm-technical demands the Working Conditions Act has been used.

Citizen

Code	Needs	Demands	Source[4]
B1	Spatial classification	Fresh air, but no draft!	p.4
B2		Openings / windows	p.4
B3		Transparant materials	p.4
B4		View	p.4
B5		Place to seek shelter against rain	
B6	Freedom of movement	Free access to outside facilities	p.4
B7		Wide walking paths	p.39
B8	Friendly appearance	Round, friendly, organic shapes	p.4
B9		Splashing water	p.39
B10		From the outside recognisable egg or chicken shapes	p.39
B11		Elements from the 'farm in earlier times'	
B12		Shed shapes, for example for the egg laying	p.39
B13		Clean, but not sterile	p.39
B14		Warm, soft and fresh shapes, colours, sounds, smells and materials	p.4
B15	Nature within the living environment	Natural elements in the husbandry system	p.4
B16		Need for day and night rhythms	
B17	Natural order	Presence of rooster or alpha-hen	p.4
B18	Natural resistance (strong and healthy chicken, that survives longer)	The rearing should not longer produce a cages hen, but hens that are adapted to the new husbandry systems (hence a robust chicken)	
B19		Hardly any stress	
B20	Social structure within the flock	The possibility for the creation of surveable groups (not too big groups!)	p.4 en p.39
B21	Species specific behaviour	Possibilities for foraging	p.4
B22	Various places for specific activities	Feeding area, foraging area, sleeping area and playing area	p.4
B23	Facilities	Well working facilities	
B24		Well placed facilities	
B25		In- and outside areas	p.4
B26	Diversity	Different species of chickens	p.4
B27		Presence of other animal species	p.4
B28		Presence of other living elements (plants)	p.4
B29	***Need of the citizen himself:***		
B30	Transparency:	Understanding the management	
B31		Visibility of the chicken	
B32		Understanding the chicken activities	



Need of the laying hen according different types of citizens

Cosmopolitans

Code	Need	Demand	Source[4]
K1	Dynamic	Variation in activities	p.42
K2		Possibilities to rest	p.4
K3		Possibilities for activities being performed on each moment of the day	
K4	Privacy	Possibilities for protection	p.4
K5		Individual laying nests	p.4
K6		Protected places to be alone	p.4
K7	Individuality (acknowledgement of the value of the individual chicken)	Environment in which the chicken can show its own species specific behaviour	p.42
K8		Choice in activities	p.42
K9	Wellness / feeling well	Healthy, strong and fit	p.42

Post-materialists

P1	Natural environment	Natural elements like running water, humus with living elements, trees and bushes, soil for scraping	p.12
P2		(running) water	p.15
P3		light	p.15
P4	Natural food	Varied food, including insects and humus with living elements	p.13
P5	Relative context	Synergy between different components	p.15
P6	Freedom	The possibility for the hen to go outside whenever it pleases	p.15
P7		Possibility for the hen to choose the place to be	p.15
P8	Natural principles and mechanisms	As less as possible humans	Drawings
P9		As less as possible interference	p.43

Traditional citizenry

T1	Care and attention for the animals	Healthy food	p.41
T2		Absence of stress	p.22
T3		The poultry farmer needs to pay attention whether the animals become ill or unhappy	p.23
T4	Respect(ful treatment) of animals	Undamaging the own character of the hen	p.41
T5		Good methods for slaughtering	p.22
T6		Short duration of transport	p.22
T7		No animal cruelty	p.22
T8		No use of grow hormones	p.22
T9	'Back to earlier times'	Chickens roam freely on the farmyard	p.41
T10		Housing system has elements of the farm in earlier days, like: farmyard, (open) fence, bushes, river, pond in the middle, barn	p.41
T11		Solid design of the building	p.41

(4) Source, unless differently indicated: Goenee, C en Le Goff, C, 2003, "Houden van Hennen - Articulatie van maatschappelijke ideaalbeelden leghennenhouderij" (Expressions of societal ideal views on poultry farming (of keeping) (In Dutch), Leiden, Innovaction BV

Consumer

Code	Needs	Specification of the needs	Demand	Source[5]
C1	Correct egg yolk	Colour	Dependent on type consumer and nationality	
C2	Good quality of the egg white	Thickness of the egg white	≥ 60 haugh-unit (in mm)	
C3		Transparency	not blurred	
C4	Correct dimension of the air chamber		< 6 mm	
C5	Nice smell		no fishy smell	
C6	Good quality of the egg shell	Colour	Full colour	
C7		Intact eggs	-	
C8		Firmness (whole eggs)	Strong	
C9		Source of contamination on the shell	None	
C10		Blood or meat spots	Absence	
C11		Nest rolling tracks	None	
C12	Clean egg	No manure	Dependent on type of consumer	
C13		No feathers	Dependent on type of consumer	
C14	Nice shape		Egg shaped egg	
C15	Nice size		Large eggs	
C16	Uniformity		Dependent on type of consumer	
C17	Freshness		Long preservability	
C18	Egg pealability		Good	
C19	Safe egg	Dioxine	Not present	
C20		Lasalocid	None, potential need / demand	
C21		Nitrophen	None, potential need / demand	
C22		Flumequine	None, potential need / demand	
C23		Caffein	None, potential need / demand	
C24		Salmonella enteritidis	-	
C25		Salmonella typhimurium	None, potential need / demand	
C26		Residuals of medicins	None, potential need / demand	
C27	Adequate packaging	Type of box	Dependent on type of consumer	
C28		Number of eggs per box	Dependent on type of consumer	
C29		Colour	Dependent on type of consumer	
C30		Visibility of the eggs	Dependent on type of consumer	
C31	Label	Layout	Dependent on type of consumer	
C32		Colour	Dependent on type of consumer	
C33		Information (origin, nutritional value, wieght, etc.)	Dependent on type of consumer	
C34	Good price		Dependent on type of consumer	
C35	Health	Natural high quality food (egg white) source	-	
C36	Taste	Quality	-	

(5) The sources belonging to these needs and demands can all be classified as 'personal communications'