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**Numericode –**
**A Code System for Thematic Incipits**

*By Ingmar Bengtsson*

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## PREFACE

The history of this code system for thematic incipits dates back twenty years, falling into three main stages. My first efforts were made in 1946–47; the second stage was in 1959–60, resulting in an essay which reached individual colleagues both in Sweden and elsewhere but—fortunately—was never published. The final phase has been in 1966–67 and for the first time has included group discussions, in

which several young Swedish musicologists have taken an active part.[1] It will be evident from several passages in the following that the system proposed by B. S. Brook and M. Gould was among the most important past examples we had before us.[1a]

I should like to emphasize that these discussions have been of extraordinary benefit, leading to substantial improvements and simplifications in the suggestions that I put forward in the autumn of 1966. Detailed views were advanced both orally during the meetings and in written correspondence between meetings. All suggestions and decisions of important principle were reached jointly, various conceivable alternatives being tested by several participants in the discussions. This means that the present proposal has been scrutinized by some dozen scholars and that they are agreed on the choice of symbols and rules etc. presented here.

In this respect I should like to offer special thanks to Bo Alphonce (expert on questions relating to data-processing machines and other matters), Georg Friberg, Axel Helmer, Cari Johansson (and the musicologists working under her leadership for RISM during the 1960's), Erik Kjellberg, Anders Lönn (responsible among other things for the name "Numericode", after I had suggested that "numeric" might be included), Krister Malm, Sune Smedeby, Jan Olof Rudén (who was particularly energetic in testing various alternatives in practice), and Margareta Jersild and Birgitta Hjelmström from Svenskt Visarkiv (The Swedish Centre for Folksong Research), who contributed their experience of coding folk songs. To account in detail for the contributions made by individual participants would take up an unreasonable amount of space; the most important, however, are given in footnotes.

In itself, "Numericode" could have been presented in a relatively limited space, perhaps about ten printed pages. The presentation is considerably longer, however, as on several occasions I have felt it desirable to deal with other possible alternatives and give reasons for the choice that was finally made. At first sight, a number of alternative solutions may appear better and more convenient than those recommended. It therefore seems reasonable to state why they have nevertheless been rejected.

[1] The discussions took place on four occasions: at two advanced seminars at the Institute of Musicology in Uppsala during the late autumn 1966, at a meeting in April 1967 arranged by the Swedish Society for Musicology and Svenskt Musikhistoriskt Arkiv (Swedish Archives of Music History), and on 19th May 1967 in connection with the annual conference of the Swedish Section of AIBM. Suggestions for discussion and information on new viewpoints, objections and proposals were circulated prior to each meeting. A draft of this essay was prepared in time for the last two meetings.

[1a] The important new information about code systems and "input languages" published in the volume Elektronische Datenverarbeitung in der Musikwissenschaft (Regensburg 1967) was not available when this paper was written.

# 1. INTRODUCTION

There is no need to make special mention of the advantages of thematic catalogues in ordinary notation. But neither should it be necessary nowadays to defend the use of a code system not employing note symbols, for the purposes of cataloguing and identification etc. Justifications for such systems have been advanced often and forcefully during the past half century and in recent years the subject has attracted great interest now that the mechanical processing of coded data is possible. (The abbreviation AD is used in the following for automatic data processing.)

I shall not go into the history of proposed code systems from around the turn of the century until 1967. That is more a subject for a completely different essay.[2] Neither does it appear necessary, or even meaningful, to list all the published texts on the subject, or to state in detail which individual parts of the present code coincide with, are similar to, or differ from corresponding parts of other systems.[3] Every code that is now introduced can be regarded as a contribution to an international debate and, at least indirectly, to teamwork. In many respects, the systems show points of contact with each other under any circumstances and their differences are dependent to a great extent on their special aims.

With this in mind, it would seem more important by way of introduction to state the aim of the present proposal rather than devote space to retrospective observations and summaries of other systems.

1.1. *Aims.* To begin with, it should be established that this is not meant to be a "complete" system capable of coding all the symbols used in conventional notation during recent centuries. Neither is it on or close to "graphic level", i.e. more or less faithfully translating the position of individual notes on staff systems, their exact mutual sequence, etc. (as for example with the

[2] A brief account of coding and registration methods used for folk music material, from Scheurleer, Krohn and Koller to the mid-1950's, is given in E. Dal: Nordisk folkviseforskning sedan 1800, Khvn 1956, pp. 389–398. An example of an internationally well-known alphabetical system is that used in Barlowe & Morgenstern's Dictionary of Musical Themes (1949, 1950). For later proposals, primarily intended for art music, see articles in Fontes Artis Musicae. I have also been able to examine certain codes and "input-languages" from stencilled material kindly forwarded to me directly by the authors.

[3] If special mention is to be made of anyone, it is B. S. Brook & M. Gould with their "Plaine and Easie Code System for Musicke", Fontes 1964/3 pp. 142–159, including commentaries by other researchers, a simplified version of which appeared in Fontes 1965/2–3 pp. 142–155, and J. LaRue's methods for "A Union Thematic Catalogue of 18th Century Symphonies" (which incidentally underwent alteration between different stages of development).

computer code DARMS). On the whole, suitability for AD has been regarded as a secondary, though important, desire.[4] The principal aim has been to create a system which is *easy to work with both manually and visually* and which can be used by anyone with musical training of some kind (at least able "to read") for excerpts, identification, library work and so on. The code must be easy to write, both by hand and on a typewriter. It should be easy to learn to read it and, if so desired, to obtain a grasp of the entire melodic *Gestalt;* it should thus be possible to see how the melody sounds and memorise it.

If such an objective is laid down, it is on the one hand necessary to make all manner of simplifications—the coding must not be so complicated that it is difficult to grasp—while on the other hand, partly for this very reason, it is necessary to carry out a great deal of the work of coding at the reading- and interpretation-levels respectively. Without AD, the system can be simple and effective only if it is accepted that certain of our rules and habits of reading may be incorporated. Systems of this kind presuppose, for instance, that it is possible to establish the tonic (finalis) of a melody, decide what is to be regarded as the "normal" or "main" octave, etc.[5]

1.2. *Types of repertoire.* Another important desire is to make the code usable for as many types of repertoire, style periods, etc. as possible. But the more that is demanded in this respect, the more complicated the system must become. If the desire is for a relatively simple system, it must be adapted in certain respects to repertoire areas which are delimited in a determined manner. The system presented here has been developed in Sweden and some consideration has been taken in its construction to the types of repertoire and source material in this country for which coding may be applicable. Naturally, such limitations do not lessen the demand for international readability.

What is particularly desired to achieve by coding is to simplify identification and other forms of comparison in extensive melodic material. The need for such a technique of recording arises with anonymous works, works whose authenticity is uncertain, in connection with parody technique, and so on. It also arises where there are different variants of a melody. This may occur in medieval church music, Protestant chorales and folk music, but also in art music which has been arranged, or where embellishments are indicated on one occasion by grace notes and on another by ornament symbols etc. Is it at all possible to construct a code system in which all these tasks can be fulfilled?

To decide what demands should and can be made of a code system in these varying respects, it would appear important to distinguish carefully between the actual coding process as a means of *translating symbols* on the one hand, and of *recording and classifying* on the other. It is not possible to make an a priori demand that the actual system for translating symbols shall be so constructed that it solves classification problems. This applies particularly to the problems arising with variants of the same melody.

On the other hand, of course, the principles for selecting relevant data to be coded (or to determine the construction of the system in some other way) can be so designed that they directly facilitate bringing different variants together, according to predetermined criteria of what is considered to be the "same melody", "same melody type", etc. Various proposals for such special systems have been put forward.[6]

There are also other kinds of recording and classification problems outside the actual code and its construction. An example is the choice between classifying solely by the alphabetical or numerical order of coded pitches or, in addition, taking the direction of melodic movement into account.

The present system is intended primarily for so-called art music, roughly speaking from the 16th to the 19th centuries inclusive. If it can also be used, for example for medieval church music (e.g. Gregorian chant) and certain types of folk music, so much the better.[7]

1.3. *General demands.* Various practical desiderata that a code which is easy to write and read should meet, have been listed in a number of essays.[8] With minor modifications, the principal requirements contained in a number of such lists can be summarised by saying that the code must:

1) permit simple, mechanical cataloguing in alphabetical or numerical order;

2) be easy to use and read, primarily for purposes of identification and other forms of comparison;

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[4] AD has been taken into account primarily in considering the selection and functions of the symbols used and the possibility of combining them all in one line (see under 6. below).

[5] It would not be impossible to construct a code system which was so simple and "mechanical" that it could be used by office staff etc. with no musical training. It is likely, however, that such a system would cause much inconvenience to the musicologists reading and using the coded material, as most of the implicit rules of reading, self-evident to persons with musical training, would have to be disregarded during the actual coding process and would therefore be of no assistance.

[6] One of those in Sweden who have suggested such a system is Jan Ling; for further details see J. Ling, Levin Christian Wiedes vissamling..., Uppsala 1955, p. 71 et seq., and J. Ling & Margareta Jersild: A Method of Cataloguing Vocal Folk Music, Stockholm 1965.

[7] As mentioned above, folk music researchers have taken part in the 1966–67 discussions and some attention has been paid to their experience of coding principles, choice of symbols, etc.

[8] See, for example, the list drawn up by Brook & Gould (1964), pp. 142–3.

3) be readable in one or more Western languages, including English;

4) be based on symbols found on a normal Western typewriter and also in AD;

5) permit the use of AD;

To this should be added that the system, if so desired, should:

6) permit reproduction of "the melodic *Gestalt*", with respect to both pitch and time values.

*1.4. Symbols.* The *number of symbols* available is limited both by the normal typewriter keyboard and by the use of signs normal in AD. The following rules must be observed:

(*a*) Only one symbol may be written at a time. Combinations such as $\underline{4}$ or $\underline{A}$ or ¢ must be avoided;

(*b*) Index signs, above or below the line, such as $6_n$ or $F^+$ or $G_2$ etc., cannot be used;

(*c*) Only the 26 capital letters from A to Z may be used, not lower case letters;

(*d*) The numerals 1–9 and 0 may be used;

(*e*) "Special signs" should be limited to:

( ) ' " , : . ? ! — + - = /

The semicolon may also be used, but on many typewriters it has to be formed by combining , and : . In addition, some keyboards have % and &, while the paragraph sign, asterisk and certain commercial symbols (e.g. pound and dollar signs) are found less frequently; for safety's sake all of these should be avoided. Some of the 14 special signs are missing from AD punch machines, but can easily be replaced in accordance with predetermined rules.

The symbols thus comprise 26 capital letters, 10 numerals and 14 special signs. To this must be added the special functions sometimes allotted to the space (blank position) in AD; for reasons that will be dealt with in greater detail below, the single and double blank space should *not* serve any purpose here other than to separate "compact" groups of symbols.

## 2. WHAT SHOULD BE CODED?

*2.1. General discussion.* It can be taken for granted under any circumstances that coding must include information on *all notated (relative) pitches* in the melodic material, thematic incipits, etc.[9] This can be done in many

[9] Here and in the following the term pitch is always taken to mean *notated* pitch (or to be more exact, notated tone positions) without the least regard to "absolute" pitches in

different ways. A complete system can be constructed using symbols for the diatonic degrees according to a certain scale structure, or for the twelve tone positions of a chromatic scale (in any sort of tuning) within the octave, symbols for accidentals and symbols either for octave position or direction of melodic movement. In addition, attention should be paid to ornament signs etc. in every respect in which they belong to the pitch variable and imply definite position values in it. Pitch coding is referred to in the following as P-coding (P for "position" and "pitch").

Furthermore, to facilitate orientation in the coded incipits, *bar lines* should always be coded. Their treatment will be dealt with in greater detail below, but it should be stated at once that the most common, and undoubtedly the best, symbol for the bar line is the / sign.[10]

For a *double bar* (rare in thematic incipits) // is recommended, with no space between the two strokes. Recommended for concluding *repeat signs within* a passage is :/ and for *repeats at the beginning and end* of a passage //: and ://
respectively, in each case with no intervening spaces.

In most cases, the coding of articulation and phrase marks, such as ties or slurs, dots, etc., and dynamic indications of various kinds, is likely to be superfluous. The same is true of performance marks etc. written in letters, which are associated with a thematic incipit. (Of course, there is nothing to prevent the addition of special symbols for these if it is considered desirable or necessary, e.g. for the purpose of describing styles. Several AD input-languages are complete in this respect.) No such symbols have been included in the present code.

There have been, and still are, divided opinions on whether the *time value relations* between the melody notes (note values) should be evident from the coded material. For many identification purposes, pitch-coding is obviously fully sufficient.[11] But it is then impossible to gain an appreciation of the melody's *Gestalt;* the coded material in no way represents a theme or the beginning of a melody that can be memorised and/or reproduced in ordinary notation.[12] Time-value coding is referred to in the following as D-coding (D for "duration").

the sense of physical fundamental frequencies, or to pitch as perceived. The term *position* coding is used in the following for the coding procedure in this respect and the symbols for notated pitch are therefore called position letters or numerals.

[10] The / sign is probably found on all typewriters. In print, it can, of course, if so desired be replaced by a vertical line. It is normally possible to use it in AD.

[11] It should be noted, however, that it may then be necessary to code a larger number of melody notes than if the time-values were also coded.

[12] Strictly speaking, coding of the pitch factor alone cannot be said to represent a "melody" on any reasonable definition of the term. In such a case, it is not "melody", but notated pitch or tone-position sequences that are coded.

The desire to code only pitch and the desire to code both pitch and time-values are not incompatible in constructing the system. The present code is designed to give a free choice in this respect. This has been made possible by writing pitch symbols (P-coding) and time-value symbols (D-coding) *on separate lines*, the former above the latter. When desirable, e.g. for AD, these two lines can be combined to form a single line by simple supplementary rules.

2.2. *"Heading", signatures, etc.* Every time a melody is coded, a number of data must normally be recorded which are outside the actual coding process. It would be convenient to deal with them and their treatment straight away.

Apart from such basic facts as the name of the composer and the title of the work, movement number if applicable, etc., every coded melody must normally be provided with a "heading", a Part I, containing information on *tempo mark, key* (or key signature) and *time-signature*. In addition, the name and octave position of the *first melody note* should be specially indicated. This information should be given in the order mentioned, which is normally the same as in the original. If themes are coded on small card files or the like it is particularly important to confine this information to the smallest possible space, i.e. to agree on suitable and uniform principles of abbreviation.

2.21. *Tempo marks* in many cases can be reproduced by easily understood abbreviations, e.g. ALL = Allegro, AND = Andante, MOD = Moderato, etc., in order to save space. Names of dances, for example, can be treated in the same way (MIN = Minuet, GAV = Gavotte, etc.). As tempo marks and the like are not related to the actual melody coding in the same direct manner as the key and time signatures, there is nothing to prevent their being moved to a special upper line (e.g. at the end of the line beginning with the composer's name and the title). This is particularly space-saving when using cards.

2.22. *Time signatures* too, can normally be recorded very simply and in close conformity with the original, e.g. 4/4, 3/8 etc. The sign C can be used, but combinations such as ¢ must be avoided with a view to AD. It may be of advantage to replace these symbols by 4/4 and 2/2 respectively. (Using / for something other than the bar line presents no problems in AD if certain supplementary rules are followed; see 2.26.)

2.23. The *key signatures* present considerably greater problems. In this respect, it is not necessary for the coding process to be dependent on the choice of designations in the actual picht coding. The main thing is to be able to obtain information on mode (diatonic structure) and key (transposition position) directly from the "heading".[13]

The question appears simple if a composition is unambiguously in a major or minor key that is indicated in the manuscript by a "normal" key signature. It would then be most convenient to follow traditional practice, with capital letters for major and small letters for minor (G = G major, g = G minor), but with regard to AD, a method should be chosen employing upper case letters exclusively.

*Comment.* If the signature has one fixed sign less than "normal" in contemporary notation (e.g. G minor with only one ♭), some form of warning symbol can be inserted, such as an exclamation mark in parentheses (!). As a rule, however, this is likely to be superfluous within the compass of the present code.

The choice of suitable indications for major and minor cannot and should not be separated from the corresponding choice when considering melodies in the church modes and the like. *All* these scale structures are *diatonic modes (modi)* in a broad sense, and may occur in different *transposition positions;* the term "key" is unfortunately often used as an unclear and imprecise name for both these characteristics.

In addition, there are melodies in which it is hazardous to establish or point out a definite tonal centre at all. What is to be done with them? With this question too, it must be emphasised that construction of the code system itself can never be expected to contribute towards a solution. On the other hand, a code can be constructed on a diatonic basis so mechanically that it is neutral in this special respect. But on closer inspection, such tonally neutral systems are seen to possess features which are less desirable from other points of view, of which more below.

It is thus a question of indicating both *mode* and *transposition position*. From the coding point of view, the difference between major and minor on the one hand and other modes (e.g. church modes) on the other, is primarily that the former appear in many transposition positions, the latter in few.

Detailed discussions have been held (1966/67) on this point and several alternatives tested. A suggestion that I have made is to use MAJ, MIN and

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[13] In certain codes it has been decided to code *sharps and flats in the key signature* directly and not give any additional indication of key. In this way, several points of interpretation are eliminated. As a result, these sharps and flats are not later included in actually coding the melody. Thus there are fewer symbols used, but at the same time it is much more difficult to read than if the sharps and flats are coded for each separate note to which the key signature applies.

MOD for major, minor and other modes respectively. The following, however, is a more concise and uniform method.[14]

Transposition position and mode are coded by *note letter* plus a *dot* plus a *numeral*. The note letter indicates *transposition position,* the numeral the *position of the tonic (finalis) in a major scale.* (1 indicates major, 6 minor, 2 D *modus,* 3 E *modus,* 4 F *modus,* etc.) Thus C. 1 means C major, C. 6 = C minor, D.2 means D *modus* with the tonic D, G.2 that the tonic is G and the scale structure of D-mode type (including Dorian etc.).

The Germanic H should be replaced throughout by the internationally more common B, and "our" B should thus be indicated by B plus a symbol for a flat.

This suggestion certainly differs greatly from traditional and familiar methods of designating modes and keys. Nevertheless, it is recommended here as both a consistent and space-saving solution.

It is also of importance in this context to establish how to code tonics *governed by a sharp or flat,* e.g. E flat major, F sharp minor. The rules chosen for doing this may also be used to indicate the first melody notes of this type in the "heading".

There are several alternatives to choose from. One possibility is to use endings such as -ISS and -ESS or -IS and -ES (or -IS and -SS). Another, (analogous with the use of B for H) is to follow English terminology and write SH (for sharp) and FL (for flat). A third is to use the same symbols for sharps and flats in the "heading" as those used in coding the melody.

It must be stated in advance that the symbols recommended in P-coding for sharping and flattening are the plus (+) and minus signs (−) respectively. After careful discussion, it was decided (in May 1967) that the third solution with these signs was to be preferred as it conforms most closely, with the use of symbols in the actual coding. Thus the key of E flat major should be coded E−.1; C sharp major becomes C+.1, G sharp minor G+.6 etc.

2.24. *Coding the first note.* Finally, the heading ("Part I") should contain the *name and octave position of the first melody note,* or in other words, from the point of view of notation, its "absolute" pitch value.[15] This can be done by using the letter together with any necessary plus or minus sign, with the addition of an "absolute" octave indication. How the octave indication is given must depend on the principles and symbols used for octave indication in the code itself. The simplest method would appear to be to choose the symbols recommended below (see 3.5) ′″ etc. and ,„ etc. and use them in conformity with our normal "octave names". In addition they should be placed in the normal manner immediately *after* the letter (as opposed to the P-coding, where it is suggested that they be placed immediately *before* the pitch symbol).[16] Thus:

| from | Contra C,, | Great C, | Small C | One-line C′ | Two-line C″ | Three-line etc. C′″ |
|---|---|---|---|---|---|---|

*Comment.* As can be seen from 3.5 below, an inconsistency in the use of symbols arises in that no octave can be left undesignated (as is the case here with the "Small" octave) in the actual code. The symbols suggested under 3.5, however, apply, to a "relative" system and cannot be combined with our ordinary names of "absolute" octaves. The only other solution would be to use that absolute system in the "heading", according to which the Contra octave is numbered 1, Great 2, One-line being 4 and Two-line 5 etc. However, this system would not yet seem to have gained necessary international recognition.

Thus according to this rule, the first melody note $g_1$ is coded in the heading as G′, $c_2$ becomes C″, $h$ is B, $c$ sharp$_1$ becomes C+′ and $a$ flat is coded A−, etc.

2.25. *Rules for writing the "heading".* The "heading" should be written in a uniform manner suited both to manual work and AD. If we assume that the tempo mark is moved up to a special upper line, there remain three items in the following order: (1) *key/mode,* (2) *time-signature* and (3) *first melody note.* In addition, the "heading" should be clearly separated from the coded melody.

A method which is practical in regard to AD, is to insert special labels or symbols for each of these items of information (cf. the input-language ALMA). But if the groups of symbols in the heading are always in a definite order and separated from each other by a given sign, such labels may be superfluous. Detailed discussion has taken place on this point, resulting in the following definitive suggestion:

The various groups of symbols in the heading are separated by a comma (,). The end of the heading (Part I) is indicated //. For the sake of clarity, there can be a space between each group of symbols; the spaces can be completely ignored in AD.[17]

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[14] Suggested by Bo Alphonce. The dot is used both to separate the letter from the numeral and to avoid confusion in AD with the pitch numerals.

[15] This information is indispensable if, as here, a "relative" octave designation principle is used. Reading is facilitated however, even if an "absolute" octave indication is used.

[16] This distinction was suggested by Jan Olof Rudén.

[17] The choice of symbols here was made with a view to those chosen in other instances, bearing in mind the desirability of avoiding as far as possible, the use of the same symbol

The following example may serve to illustrate the above. Suppose that we have a composition in E flat major, the time signature 3/4 and the first melody note *b* flat, (German $b_2$). (It is assumed that the tempo mark has been written on a special line above the coded melody.) The heading will then be:

E − .1, 3/4, B − ″ //

(Explanation:) The fundamental is E flat (Es) = E −, the key is a major one (1), the time-signature 3/4 and the first melody note is $b_2$ (according to German usage), i.e. B♭, in the two-line octave.

Some further examples. The melody is in transposed Dorian church mode (I or II) with the fundamental G, four-four time and the first melody note is $a_1$. The heading is:

G.2, 4/4, A′ //

The melody is in F sharp minor, 6/8 time and the first melody note is *a* in the Small octave. The heading is:

F + .6, 6/8, A //

(See also the headings in the examples of coded melodies given below.)

## 3. PITCH SYMBOLS AND PITCH CODING

*3.1. Letters or numerals?* The first and most important choice is that between letters (A–G) and numerals (1–7 or 1–12 or perhaps 1–9, x y z).

Letters have been used in many codes. They are easy to read and the coded material easy to classify (see, for instance, Barlowe & Morgenstern). Another reason in favour of letters is that numerals appear to be particularly suited to coding relative time-values. That *numerals* have nevertheless been chosen for the pitch factor in the present system is primarily because the problem of transposition is removed. If a melody occurs and is coded in several keys, it may find its way into several different places in the alphabetical classification if letters are used. With numerals, however, all transpositions will automatically end up in the same place.[18] In view of the repertoire limitations mentioned

for two or more purposes. Nevertheless, the heading contains the comma (used also for octaves) and the / sign (used also for bar lines). This does not cause any complications in AD, however, as the heading is separated from the coded melody by //, and neither should it cause any misunderstanding in manual work. Use of // to mark the end of the heading and for the double bar (extremely rare in thematic coding) does not present any problems.

[18] Full agreement was reached at the seminars and other discussions held in 1966–67, that numeral are to be preferred for this reason, to which great weight was attached, even though it is fully possible in AD to introduce special transposition programmes which remove the problem.

above, and of several other codes, there is no doubt that a *diatonic* base should be used for position coding, the numerals thus being confined to 1–7.[19]

*3.2. Diatonic reference of the numerals.* The seven "pitch class" numerals must represent either (1) one, and only one, fundamental diatonic structure, preferably that of the major scale, or (2) several such structures in accordance with established rules. Both possibilities will be discussed; they each possess advantages and disadvantages.

(1) The numerals 1–7 *always designate the structure of the major scale*, with the interval sequence 1 1 1/2 1 1 1 1/2. The sequence 1 3 thus always means *major* third, 1 7 always *major* seventh, etc. In that case, how are minor keys and other modes to be coded? In one of two ways: (a) The numerals directly giving the characteristic diatonic sequence of intervals of the mode, are used mechanically. The tonic of a minor scale would thus be 6, the finalis in the D-*modus* (including the first two church modes) would be 2, etc. Such a method is uniform and eliminates a number of the problems of interpretation referred to above. (It was *this* model that was chosen above for coding modes *in the heading*.) (b) The fundamental is always designed 1—whether in a major, minor or other mode—and the basic *major* structure 1–7 is in all other cases modified by the required accidentals.

The great disadvantage of (a) is that major and minor variants of the same melody will give very different numerical sequences, and naturally, the same is true for example of a D mode variant and one in a minor key (Ex. 1 *a*). The coded variants will be found in completely different places and even if this can be overcome in AD by means of a special programme, it would cause great inconvenience in manual work. Another, and perhaps less important, disadvantage is that coding minor melodies according to this method is complicated, especially if there are several sharps or flats in the key signature, as one is compelled to think all the time in terms of the parallel major key.[20]
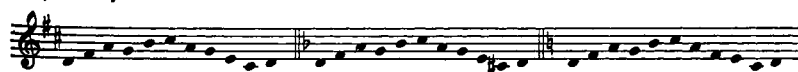


*a)* 1 3 5 4 6 7 5 4 2 7 1 // 6 1 3 2 4 5 3 2 7 5 6 // 2 4 6 5 7 1 6 5 3 1 2 //
*b)* 1 3 5 4 6 7 5 4 2 7 1 // 1 3?5 4 6?7?5 4 2 7?1 // 1 3?5 4 6 7?5 4 2 7?1 //
*c)* 1 3 5 4 6 7 5 4 2 7 1 // 1 3 5 4 6 7 5 4 2 7 1 // 1 3 5 4 6 7 5 4 2 7 1 //

Ex. 1. The reference of P-coding numerals. Various alternatives.

[19] Position coding using the numerals 1–12 is primarily suited to dodecaphonic and other 20th-century music. Its chromatic tone positions are unnecessarily far removed from notational practice and the function of tone positions in traditional music. (Moreover, the use of numerals both singly and in pairs is unsuitable; either 01, 02, 03 ... 11, 12 should be used, or a series of single symbols, e.g. 1 ... 9, x, y, z.)

[20] To some extent, a kind of double translation is involved: the notes in a C minor melody, for instance, must first be thought of as pitch positions in E flat major and then translated into numerals accordingly.

Alternative (b) can be discarded immediately as a theoretical case. The simplest experiments show that it leads to troublesome complications (Ex. 1 b).[21]

(2) The numerals 1–7 may designate *different basic diatonic structures* but *the tonic (finalis) is always represented by 1*. The diatonic structure in question must then be evident from the mode indication given in the heading. If it contains an agreed symbol for major, the numerals 1–7 indicate the structure of the major scale 1 1 1/2 1 1 1 1/2. If instead it shows minor, 1–7 indicate the structure of the "descending" melodic minor scale (A H = B C D E F G), with the intervals 1 1/2 1 1 1/2 1 1, starting from the bottom.

If this principle is extended to the other modes, the different possible meanings of the numerical series become decidedly troublesome. The same sequence, e.g. 1 3 6 5, can represent a large number of different interval series. However, *two basic diatonic structures the major and "descending melodic" minor*, are fully sufficient if the *third* (major or minor) above the tonic (finalis) is followed. D mode and E mode are thus always coded on the *minor* model, F mode and G mode always on the *major* model. The small modifications that must then be made by means of accidentals, are not likely to cause any great inconvenience (Ex. 1 c; modifying signs not yet introduced).

The greatest advantage of this last suggestion (2) is that the "musically" relevant positional functions of the melody notes always have the same numerals: a tonic is always coded 1, the third above it 3, the fifth 5 etc. As opposed to the preceding suggestion (1 b), the insertion of accidentals is not only simple, but *can be made uniform*, independently of transposition position (see 3.5 below). Neither do any problems arise concerning major and minor variants etc. of the same melody. Finally, the system would seem to be easier to work with than (1 a) and consequently there is less risk of mistakes being made in the coding. These reasons seem clearly to favour suggestion (2).[22]

The main reason for choosing this second alternative, however, is that all similar melodies can be found in roughly the same place in a numerical file or catalogue.

[21] In coding a melody in A minor, for instance, the third, sixth and perhaps also the seventh (?) must be shown as "flattened 3", "flattened 6" and perhaps also "flattened 7" respectively. If the A minor melody contains a C sharp, this should preferably become "sharpened 3", but this conflicts with the major model. The problems are even greater in other minor keys.

[22] Opinions were somewhat divided in this point during the 1966–67 discussions. One of the facts to emerge was that a considerable amount of melody coding had been carried out at Svenskt visarkiv (the Swedish Centre for Folksong Research) according to (1 a). Thus, for this purely practical reason, it appeared convenient at first to continue along this path. Several other participants in the discussions, however, including myself, had worked with (2) and preferred it. Representatives of the centre have since also said that they find (2) to possess advantages and are prepared to go over to it.

D.1,3/4,F+" // 3  3  3 / 3  3  4  3  4 / 5  5  5 / 5  4  5  6 /

**Ex. 2.** G. F. Händel, Water Music, Minuet.



A.6,3/4,E" // 5  4  3 / 4  2 / 3  2  3  1 / 5  4  3 / 4  2  5 / 1 :/

**Ex. 3.** L. Couperin, Menuet de Poitou.



Je - sus Chris - tus  un - ser Hei- - - -land,  der  den  Tod

G.2, 4/4,G" // "1   1 / ,7  "1   2   1 / ,7  6+ / 5   7 / "1   2 /

**Ex. 4.** "Jesus Christus unser Heiland", setting by M. Praetorius.

Finally, it should be pointed out that the choice of numerals rather than letters is in itself an indirect argument in favour of (2). The purpose of using numerals is that different transpositions of the same melody will be found in the same place; it would be inconsistent to devise a rule for major and minor variants etc. which made this more difficult.

Thus the basic rules for using the numerals 1–7 are that they represent the *structure of a major scale* if the coded melody is in a major key, in C mode, F mode or G mode, i.e. if the "mode" numeral in the heading is 1, 4 or 5, and the fundamental note sequence (type A H = B C D E F G), *of a minor scale* if the melody is in a minor key, D mode, E mode or A mode, i.e. if the "mode" numeral in the heading is 2, 3 or 6. (See Ex. 2–4.)

3.3. *One or two notes—one sound.* The duration of a dotted note, e.g. a quarter-note with a dot, can of course also be written with a tie, e.g. from a quarter-note to an eighth-note. In the former instance only one note symbol is used, in the latter two. In coding, there would thus be one numeral in the first instance and two numerals in the second, in which case the same melody may be found in quite different places solely because of the difference in orthography! Such consequences of different methods of notation must naturally be avoided.

The problem is easily solved in cases where the tie can be replaced directly by a dot (*i.e.* the time value-relationship 2:1), only one numeral being used. But not all situations are so simple, e.g. if a quarter-note is tied to a sixteenth-note, or if one of the two tied notes is already dotted.

The main rule in all such circumstances is that *a separate numeral is never used* for coding the tied note, i.e. the one *to* which the tie extends. If pitch

D.I, 4/4, D" '¦ = 1 3 5 / 5 4 4 0 4 2 /

Ex. 5. W. A. Mozart, K. 29, I.
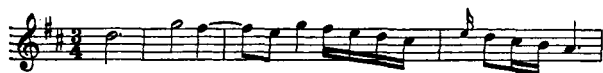


D.I, 3/4, D" '¦ / 4 3 / = 2 4 3 2 1 ,7 / '2 | ,7 6 5 /

Ex. 6. J. Haydn, Baryton Trio D.

coding alone is sufficient, no special symbol is needed, only the number of separate sounds (tones) being coded. For reasons which will be dealt with more fully below, however, it is necessary to indicate the uncoded tied note as soon as D-coding is carried out in addition. This can be done conveniently by the *equals sign* ( = ). (See Ex. 5 and 6.) The equals sign thus stands for both "note not representing a separate sound" and "tied to".

3.4. *Symbols for rests.* If only pitch is being coded, it may appear superfluous to insert a special symbol for rests; this, however, could substantially facilitate reading. If both pitch and duration are coded, rest symbols are necessary under any circumstances. Here, as with several other points, the rule applies that every duration symbol must correspond to a pitch symbol and vice versa.

The short dash ( − ) has been used in some code systems to indicate rests, regardless of their length, but often with one dash for each rest sign. As this symbol generally has two meanings (hyphen and minus sign) and the plus and minus signs have been reserved for a different purpose, the *numeral nought* (0) is recommended for rests in P-coding, regardless of whether time values are coded as well. (See Ex. 5, 9 ff.) This of course means that the sign 0 should not be used in P-coding.

3.5. *Octave position.* If the "absolute" position of the first coded melody note in the notation has been given, it could be sufficient merely to indicate the *direction of movement* of the melody line for intervals where this is not clear from the numerical sequence. There are several reasons, however, against using such a method.

Indication of the direction of movement, upwards or downwards, e.g. by + and −, seems easy and natural in relation to reading the music. But special rules must be laid down. The numerals 7 2, for example, mean either a descending sixth, viz. a movement *within* the sequence 1–7, or an ascending third, viz. the *"shortest path"*, the smallest interval. In the first case, a direction symbol must

be inserted with every transition to another octave (Ex. 7a), in the second case it should be included for all intervals greater than thirds (Ex. 7b). There must also be additional rules for dealing with large jumps. But if, for example, it is decided to double the direction symbol (e.g. + + for a certain jump upwards greater than an octave), two different principles have been applied simultaneously, one referring to direction, the other to change of octave. Thus, indicating direction is not quite so simple and obvious as it may at first appear.



a) C.1, C' // I    +1   −7   +2   −7   2    3 ++5   −−I   //
b) C.1, C' // I    +1    7    2    7   −2    3 ++5   −−I   //
c) C:I, C' // '¦   "I   '7   "2   '7    2    3   "5   'I   //

Ex. 7. Direction of movement or octave position?

As the position numerals 1–7 indicate *location,* it would be more consistent to count location rather than direction here too. In this way, reference to individual note symbols on one occasion and interval characteristics on another, is also avoided. Thus, *octave position* should be coded instead of direction of movement. (This has been done in the majority of fairly recent codes.) The symbols most commonly used for this purpose are ' " , „ as mentioned above. It would be convenient to accept them here too. They should be placed *immediately before* the respective position numerals.

*How* these octave symbols are to be used, however, is far from clear. There are the following choices: (1) To insert them either (*a*) for every tone or (*b*) only for octave changes; (2) To code either (*a*) according to a fixed reference system ("absolute" notated octave areas) or (*b*) with reference to octaves within the ambitus of the melody ("relative" octave locations); (3) If 2 (*b*) is chosen, (*a*) to establish a "normal" or "principal" octave for the melody, and (*b*) establish norms for what are to be the boundaries between the octaves.

(1) It is naturally simplest and most economical if symbols need only be used *on transition to another octave.* It should be observed, however, that this presupposes that no octave, e.g. the Small, is left undesignated. (Otherwise ambiguity will arise about whether the reference is to an undesignated octave or undesignated tone positions within an octave.)

(2) Octave indication according to a fixed reference system that is "absolute" in relation to the notation, e.g. the traditional C octave division used above for the "first melody note", is uniform and simple—apart from the difficulty of the "Small" octave. A disadvantage, however, is that a melody may get varying octave marks if it appears in different keys (transposition

positions). And as P-coding with numerals is a "relative" system, it would appear to be more consistent to use "relative" octave signs as well, according to 2 b.

(3 a) This requires a symbol for the coded melody's "normal" or "principal" octave (called *main octave* in the following) and suitable signs for the octaves above and below it. The symbol ′ is recommended for the main octave, ″ for the octave immediately above it, etc., for the one immediately below it, „ etc. The main octave is that within which the main part of the melody falls.[23]

(3 b) The numerals 1–7 must be taken as the evident starting point in establishing the location of the limiting notes or octave boundaries. Thus an octave should always be counted from 1 up to and including 7.[24] (See Ex. 7 c, 8 and 9.)

D.I, 4/4, D‴ // ‴| ″5 3 2 1 2 ′5 / 3 2 1 2 ,5 ″| 2 3 4 5 ″| /

Ex. 8. G. F. Händel, op. 3: 6, I.

C.I, 4/4, C‴ // ‴| 0 0 ″| / 1 0 ,5 6 7 / ″| 3 5 ″| /

Ex. 9. W. A. Mozart, K. 338, I.

3.6. *Accidentals*. In normal notation there are three types of accidentals (the sharp, the flat and the natural) plus the double-sharp and double-flat. At first sight therefore, it would appear reasonable to have the same number of code symbols. Three symbols will guarantee close conformity with the original notation.

Such a direct translation of all accidentals, however, is clearly unsuitable (Ex. 10 *a*).[25] Complications will arise even if the tones of the fundamental

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[23] No great inconvenience is caused by the fact that some melodies might be coded in different ways, if classification is solely by the P-class numerals. If guaranteed uniform octave indication is required, a supplementary rule referring to absolute octave position would appear necessary, e.g. that in cases of doubt preference should be given to the One-line octave or to $a_1$–$a_2$. However, no such rule has been incorporated in the present code.

[24] This is on the proviso that 1 is always the fundamental. This method conforms with our reading habits. If, however, the minor tonic is 6 etc. and the sequence 1–7 is retained for octave areas, a conflict will arise between calculation from a minor tonic and calculation from the numerical sequence. For this reason too, the main rule that 1 always equals the tonic appears preferable.

[25] For the purpose of demonstration, the symbols x, b and n have been used purely provisionally in example 10.

a) ″5 b7 x5 6 n7 n5 ″| // ″5 n7 x5 6 x7?n5 ″| // ″5 b7 n5 6 n7 b5? ″| //
b) ″5 b7 x5 6 7 5 ″| // ″5 n7 x5 6 7 5 ″| // ″5 b7 n5 6 7 5 ″| //
c) ″5 b7 x5 6 7 5 ″| // ″5 b7 x5 6 7 5 ″| // ″5 b7 x5 6 7 5 ″| //
d) ″5 7- 5+6 7 5 ″| // ″5 7- 5+6 7 5 ″| // ″5 7- 5+6 7 5 ″| //

**Ex.** 10. Coding accidentals; various alternatives.

diatonic structure are left undesignated, especially if a melody occurs in different keys, as the accidentals can then vary considerably (Ex. 10 *b*).

If accidentals are to be treated uniformly and simply, it is necessary to consider not only the actual types of symbols in the notation, but their *function*. This certainly means that interpretation has to be made, but much is gained in the economic use of symbols and in consistency.

If the following rules for dealing with *naturals* are followed, it is possible to use *only two symbols*, one for sharpening and one for flattening:

(1) Any natural that means a return to the basic note in the major or minor scale (fixed signs for transposition positions of course included) *are not coded at all*; the position (pitch class) is indicated solely by a numeral.

(2) In all other situations, a natural which has the function of *raising* the note is indicated by the same symbol as that for the sharp, and one which *lowers* the note by the same symbol as the flat. Application of these rules in principle, can be seen from Ex. 10 *c–d* and other later examples.

In principle, similar rules must apply to the *double sharp or flat*: they are coded according to their function (normally by sharpening or flattening a note one step *beyond* the signs of the key signature).

Which symbols should be chosen? In making this choice it should be particularly noted that, as a result of the decisions just made, it is not simply a question of finding suitable symbols for ♯ and ♭ but for the *functions they perform* in a more general sense. Otherwise, the most obvious letters to use would be x and b. As only capital letters should be used, however, the letter B would then be used both as a note letter (representing the Germanic H) and as a flat symbol, which is inconvenient. (In addition, combinations such as X1, X5, B3, B6 or 1X, 5X, 3B, 6B are perhaps not as easy to read as x1, x5, b3, b6 or 1x, 5x, 3b, 6b.) To this must be added that letters may be required as symbols for other purposes, in which case X and B will perhaps not be so distinct from other letters in the coding as could be desired.

These disadvantages give reason to examine whether other suitable symbols are available; if possible, these should also symbolise a pair of opposites. As stated in advance above, such a pair of symbols exists in the form of the *plus and minus signs*, as they have not been used to indicate direction of movement

Ex. 11. Uniform coding of accidentals.



Ex. 12. R. Cambert, Pomone, Ouverture.

or for any other purpose. It is therefore recommended that the *plus sign be used for sharpening* and the *minus sign for flattening* a note.[26]

The next question must concern the *position* of the accidental symbols in relation to the numeral and possible octave mark. If they are placed *before* the numeral, this conforms with normal notation; placing them *after* the numeral can be regarded as a kind of translation of the names given to the notes -is, -iss, sharp, or -s, -es, ess, flat. Conforming with the original notation may certainly be considered an advantage (and if letters are chosen, the coding should definitely be X1, X5, B3, B6, and not the other way round). But as the symbols + and − in front of a numeral could be misinterpreted as referring to direction of movement, it would appear more convenient to place them *after* the position numeral, e.g. ′1−, ″3−, 5+, ′6+, etc (Ex. 10 *d*).

Thus it is recommended that + and − placed after the numeral be used for accidentals, indicating sharpening and flattening respectively. (See Ex. 11 and 12 and other later examples.)

3.7. *Other pitch symbols.* As a rule, P-coding should include all notated pitch changes. (See below in this section for certain conceivable exceptions.) A number of these changes may in the original be written out in "small" notes, e.g. in ornaments, cadenzas, coloratura, etc. Others are only indicated by special signs (graphic symbols or letters) for fixed types of ornament, e.g. trill, mordent, "Doppelschlag". But, as we know, there is not always a clear

[26] This method was particularly recommended by Jan Olof Rudén in the 1966–67 discussion group.

It is comparatively simple to replace X and B (if they are preferred) by + and − (even in AD), provided none of the four symboles is used in P-coding for some other purpose.

boundary between these two methods. An ornament that is written in small notes in one source may be indicated by a graphic symbol, letter, plus sign, etc. in another; in a third, the symbol may be omitted.

Before dealing with the choice of symbols for these phenomena, it would seem necessary to classify them according to our needs. For present purposes, it is probably sufficient to distinguish between three types:

(1) Fixed and frequently occurring signs that are seldom or never replaced by other signs or small notes (e.g. *tr*, ⟋⟍, ∿).

(2) Variable ornament signs. These include all cases where different symbols are used in different sources, where ornaments are sometimes written with small notes and where unusual and/or ambiguous signs occur.

(3) Small notes that are seldom or never replaced by other signs (and thus do not come under point 2). These include both individual small notes, e.g. appoggiatura, and groups of a few notes, and in particular, all more extensive cadenza or coloratura formations written in nothing but small notes.

It appears convenient to be able to distinguish these three types when necessary in coding.

With regard to (1), easily understood letters can be used to symbolise the most common ornaments, e.g. T = trill, M = mordent, P = "Pralltriller", D = "Doppelschlag", W = tremolo, etc. (Ex. 13).[27]



Ex. 13. Unequivocal and frequently recurring ornament signs.

The distinction between (2) and (3) seems to be important in the treatment of small notes. With regard to actual designation, consideration could be given either to the use of letters here too, or the use of parentheses.[28] There is much to be said against using parentheses, however: (a) it is not possible to distinguish between (2) and (3) by using parentheses alone; (b) there are reasons for using the parentheses in D-coding (see 4.6); (c) letters were recommended to symbolise ornaments etc. of type (1); (d) furthermore we are dealing with very real and unavoidable notated pitches, i.e. elements in the P-coding for which the use of parentheses may be considered unsuitable from

[27] Ornaments appearing between notes should be coded in a corresponding manner; cf. the last example under Ex. 13.

the purely visual point of view. Thus suitable *letter symbols* should be used in (2) and (3) as well.

In some of the more recent codes that have been proposed, the letter g(G) has been suggested as an abbreviation of "grace notes"; this, however, does not take into account the distinction between (2) and (3) discussed here. To make this distinction clear, it is suggested that *the letter G* (standing for the broader concept "grace") be used for all the varying ornament signs coming under (2) including such small notes that are sometimes replaced in the source material by special symbols or are often omitted and which it may therefore be found undesirable to code with separate numerals. A numeral following the letter G then always represents a note of normal size (Ex. 14).



C.| // G'5 // G'4 // G'3 //

Ex. 14. Ornament signs that are variable and/or difficult to interpret.

*The letter S* ("small notes") is suggested for all coded small notes.[29] The next task is to stipulate rules for using this S.

There are three possibilities: (a) the letter can be inserted for each individual small note; (b) the letter can be used to mark the beginning and end of groups of small notes; (c) one letter can be used to mark the beginning of the small notes and a different letter to indicate a return to notes of normal size.

Repeating the letter in larger groups of small notes is both copious and impractical. Instead, it is recommended that the beginning and end be indicated. One alternative is to use S at the beginning and SS at the end.[30] Using a double letter, however, is unnecessarily lengthy; instead, it is recommended that S be used to show the *beginning of small notes* and the letter Z to show where they *end*.[31]



C.| // '5 S4+5 6 5 4 3 2 | Z,7 '| /
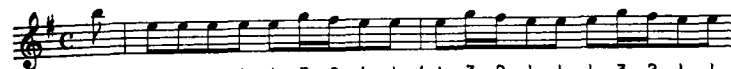
Ex. 15 (constructed example). Coding small notes.

[28] At the same time, parentheses could make clear that the small notes within them lack corresponding symbols in the D-coding. For treatment of small notes in D-coding see under 4.

[29] Ornaments (trills etc.) that are fully written out and comprise more than 3–4 notes should, by way of exception, always be replaced by a letter, whether G, T, M or some other, in order to save space.

[30] In AD, an S at both ends may be sufficient, but in direct reading a single S at beginning and end is clearly unsuitable because of its ambiguity.

[31] My original proposal was to use the letter N (for "normal") for a return to normal

Application of the symbols and other rules for P-coding recommended above is illustrated in the following examples, which also serve as the principal examples through the presentation below:



E.6, 4/4, B" // '5 / | | | | | 3 2 | | / | 3 2 | | | 3 2 | | /
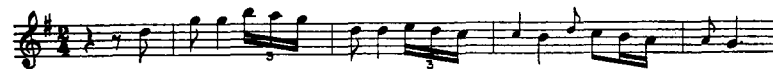
Ex. 16. A. Vivaldi, Op. 4: 2, I.



G.|, 3/4, G" // "| '5 3 | ,5 3 / | | | / "| '5 3 | ,5 3 / | | | /
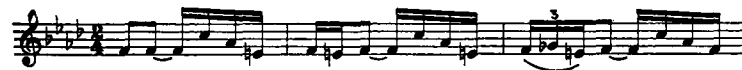
Ex. 17. A. Vivaldi, Op. 9: 10, I.



D.|, 4/4, D' // "| 0 3 2 | 5 0 5 6 7 / "| 0 | 2 '6 7 ,5 0 '5 /

Ex. 18. A. Corelli, Op. 6: 1, I.



G.|, 2/4, D" // 0 0 '5 / "| | 3 2 | / '5 5 6 5 4 / S4Z 3 S5Z 4 3 2    S2Z | /

Ex. 19. Anonymus, Sinfonia G, I.



F.6, 2/4, F' // "| | ▪ 5 3 ,7+ / '| ,7+ '| ▪ 5 3 ,7+ / '| 2- ,7+ '| ▪ 5 3 | /

Ex. 20. J. S. Bach, Concerto f, BWV 1056, I.

3.8. *Use of abbreviations for repeated notes and groups of notes.* If certain note sequences or groups are repeated fairly extensively in a thematic incipit, it may at first sight appear advantageous to simplify the coding by inserting special repetition marks. Under no circumstances, however, should such aids be used in a manner which would complicate reading and classifying the coded melodies in numerical order. In considering repetition signs, it is also important to distinguish carefully between the *number of repeated notes* and *the number of times certain groups of notes are repeated;* separate signs are required for each so that they will not be confused. A discussion of this point

note size. The suggestion to use Z—a kind of reversed S—instead, comes from Bo Alphonce. Special mention should perhaps be made of the fact that the number of spaces in the P-coding is the same regardless of whether these letters or parentheses are used. See the examples.

can be based on Examples 16 and 17, from two concertos by A. Vivaldi. Note for note, the coding is:

*Ex. 16* E.6, 4/4, B″ // ′5 / 1 1 1 1 1 3 2 1 1 / 1 3 2 1 1 1 3 2 1 1 /
*Ex. 17* G.1, 3/4, G″ // ″1 ′5 3 1 ,5 3 / 1 1 1 / ″1 ′5 3 1 ,5 3 / 1 1 1 /

There are repetitions of three different kinds here. Ex. 16 begins with repetition of a note and then continues with two repetitions of a group of five notes. In Ex. 17, bars three and four faithfully repeat bars one and two.

With regard to the first series of ones (5 of them, 4 repetitions), all the numerals should be written out to facilitate reading and classification. Practical tests show that repetition signs should be avoided at the beginning of a melody and never used in the first bar.

On the other hand, the insertion of abbreviations could be considered in the other two cases. Here is a suggestion for those situations where a repetition sign would clearly save space.

The *letter R* (for "repetition") is used as the main sign. To this R must be added both information on the *number of notes repeated* and on the *number of repetitions*. To distinguish the first figure, the use of *parentheses* is suggested. Thus R(4) means direct repetition of the last four coded notes.[32]

The figure indicating the number of repetitions should consequently be placed immediately before the parentheses. Accordingly, R2(4) means repeating the immediately preceding group of four coded notes twice.

Ex. 16 can thus be written:

E.6, 4/4, B″ // ′5 / 1 1 1 1 1 3 2 1 1 / R2(5) /

Ex. 17 can be abbreviated in the same way by writing R(9) in place of bars 3 and 4. However, this means losing a bar line and also makes the coding more difficult to read.

Nevertheless, as repetition of the contents of *a whole bar* (sometimes two whole bars) is fairly common, it may be desirable to possess a special symbol for "contents of a notated bar". Suitable letters are B (for "bar") or M (for "measure").

This B, together with a figure for the bar (or bars) to be repeated, is written in parentheses and must always be preceded by the letter R. Thus a figure following directly after B (with no blank space) means *bar number*.

Accordingly, R(B) means repeat the bar immediately preceding, R(B1)

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[32] The use of parentheses in D-coding (see under 4.6) causes no inconvenience in AD as the "key" letter R is included. In programming, it can be stipulated that R always applies up to the end of the brackets immediately following.

bar 1 of the melody, R(B2) bar 2, etc. If several bars in succession are to be repeated, the bar numbers are given with a comma between them, but still without a space. Thus repetition of bars 1 and 2 in Ex. 17 can be abbreviated to R(B1,2).—(Bar-numbers should be "labeled" in AD.)

*3.9. Supplementary rules if time-values are not coded.*

No particular problems arise if it is decided to code only pitch. The following rules should always be observed, however. *Bar lines* (marked /) must always be included. This also should apply to *rests* (marked 0). In coding pitch only, several successive rest signs within a bar may be designated by a single nought if so desired. With regard to *ties*, see 3.3 above; the main point is that notes in the original which do not represent "separate sounds" are not coded by a separate numeral. The equals sign (=) suggested above should prove sufficient indication.

## 4. DURATION SYMBOLS AND CODING NOTATED TIME-VALUES

This section will deal with the choice of symbols and rules for coding (notated) time-value relations in a *separate lower line*. When necessary, it should be possible to combine the lines to form a single one, e.g. for AD.

*4.1. Letters or numerals?* If it has been decided to use numerals for P-coding, it may appear most convenient, or simply obvious, to use letters for D-coding; if this is not done, the numerals will be used with completely different meanings in the two code lines.[33] *Nevertheless,* the use of *numerals* is recommended for coding time values. Reasons must be given for this decision.

If it is desired to use letters for D-coding, there are several alternatives to choose from: (a) abbreviations of internationally used names of notated time values, e.g. (according to American terminology) W = whole, H = half, Q = quarter, E = eighth, S = sixteenth, etc., to which can be added L = Longa and B = Breve; (b) designation of the note values in alphabetical order, e.g. A = Longa, B = Breve, C = whole note, D = half note, E = quarter note, etc.; (c) a kind of "ideogram", using letters bearing the closest resemblance to the notes, e.g. a fourth note (with no branch from the stem) could be I, an eighth note (with one branch) L, a sixteenth note (two branches) F, etc.; the whole note would be O, half note U or C (?).

None of these suggestions seems to be easy to learn and easy to read, with the possible exception of (a), which has certain mnemonic advantages, at least for native English (American-English) speakers.

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[33] Thus in several recent codes and input-languages using letters for the pitch factor, it has been natural and convenient to use numerals for time values. The use of letters for the latter has seldom been suggested.

Any definition of the notated time-value relations is *numerical,* they represent fractions of a unit (the value of the whole note), which can be expressed as 1/2, 1/4, 1/8 etc. It is therefore convenient to symbolise these relative time values by the *numerals in their respective denominators:* 1 = whole note, 2 = half note, 4 = quarter note, etc. Proposals according to this model were put forward at about the same time (*c.* 1960) by myself and by Brook & Gould,[34] whose suggestion, under which all time values can be given by *a single numeral,* is recommended here. As the coding is done on separate lines, the risk of confusing the meaning of the numerals would appear negligible, at least when compared with the advantage of having time-value symbols that are easy to memorise and to read as they more or less directly reflect the note values to be coded.

Thus the following table (from Brook & Gould 1964, p. 147) is recommended; the numerals apply to *both note and rest time values:*

whole note = 1
half note = 2
quarter note = 4
eighth note = 8
sixteenth note = 6
thirty-second note = 3
sixty-fourth note = 5
hundred-and-twenty-eighth
    note = 7

Brook & Gould suggest 9 for Breve and o for Longa. It may be possible to retain Brevis = 9, but o for Longa should be avoided in the present code; to the extent that these symbols are needed at all, it would probably be just as well to use the letters L for Longa and B for Breve. — (About dots cf. 4.3.)

P- and D-coding Ex. 2–4 above, we get:



D.1, 3/4, F+″ || ′3 3 3 / 3 3 4 3 4 / 5 5 5 / 5 4 3 6 /
                    4 4 4 / 4 8 8 8 8 / 4 4 4 / 4. 6 6 4 /
Ex. 21. G. F. Händel, Water Music, Minuet.



A.6, 3/4, E″ || ′5 4 3 / 4 2 / 3 2 3 1 / 5 4 3 / 4 2 3 / 1 : /
                    4.8 4 / 4 2 / 4.6 6 4 / 4.8 4 / 4 4 4 / 2.: /
Ex. 22. F. Couperin, Menuet de Poitou.

[34] By myself in the unpublished essay "Proposal for a code system for theme registration



Je - sus Chris - tus  un - ser  Hei - - - - land,  der  den  Tod

G.2, 4/4, G′ || ′1 1 / ,7 ′1 2 1 / ,7 6+ / 5 7 / ′1 2 /
                    2 2 / 4 4 4 4 / 2 2 / 2 2 / 2 2 /
Ex. 23. "Jesus Christus unser Heiland", setting by M. Praetorius.

*4.2. Rests in the duration-line.* It was stated above that rests should always be marked (by o) in the P-code line if D-coding is included. All rests in the time-value line can therefore be coded directly by a numeral without special additional signs. That the numeral represents a rest can be seen from the o in the line above (Ex. 24).



D.1, 4/4, D′ || ′1 o 3 2 1 5 o 5 6 7 / ″1 o 1 2 ′6 7 ,5 o ′5 /
                    4 6 6 6 6 4 6 6 6 6 / 4 6 6 6 6 8 8 8 8 /
Ex. 24. A. Corelli, Op. 6: 1, I.

*4.3. Dotted notes.* All dotted note values are simply coded by a dot directly after the duration numeral. Thus 4. means a dotted quarter note, 8 . . a double-dotted eighth (Ex. 25).



D.6, 4/4, D″ || o ″1 1 1 ′7+ 7+ / ″1 ′7 ″1 ′6+ 7+ / ″1 2 / ′7+ 5
                    4 8.6 4 8.  6   / 4 8. 6 8.  6   / 8.6 / 8.  6
Ex. 25. R. Cambert, Pomone, Ouverture.

*4.4. Ties in the duration line.* The special problems caused by ties have been dealt with above in connection with P-coding (cf. 3.3). As far as ties are concerned in D-coding, the same applies as was said about rests. As an equals sign has been inserted in the upper line, it is sufficient to do nothing other than give the time-value numeral in the lower line[35] (Ex. 26, 27).



D.1, 4/4, D″ || ′1 = 1 3 5 / 5 4 4 0 4 2 /
                    2 8 8 8 8 / 8 8 4 4 8 8 /
Ex. 26. W. A. Mozart, K. 29, I.

without traditional notation", 1959/60, and by Brook & Gould in their "Plaine and Easie Code System for Musicke" (Fontes 1964/3 p. 147). In the former, the use was suggested of "16" for sixteenth notes, "32" for thirty-second notes etc. Brook & Gould improved on this by reducing all symbols to only one numeral, i.e. as recommended here.
[35] For a long time I experimented with an underlining (—) for ties in the D-code line. Thanks are due to Axel Helmer for pointing out that any such symbol is superfluous.

D.1, 3/4, D″ // 'ɪ / 4 3 / = 2 4 3 2 1 ,7 / S'2Z 1 ,7 6 5 /
　　　　　　2./ 2 4 / 8 8 4 6 6 6 6 / 6　8　6 6 4./

Ex. 27. J. Haydn, Baryton Trio D.

4.5. *Repetition of the same time values.* It happens very often in thematic incipits that several—perhaps a majority—of the notes have the same time value. The simplest and most economic method of writing out two lines in such cases is to *mark only changes in the time value* and leave all repetitions undesignated, with the reservation that the first time value in each bar might be indicated by a new numeral to facilitate reading. Coded in this way, the first Vivaldi melody becomes (possible use of R being disregarded for the present):
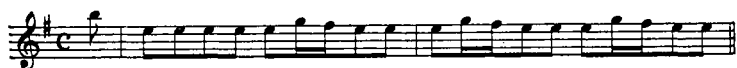


E.6, 4/4, B″ // '5 / ɪ ɪ ɪ ɪ ɪ 3 2 ɪ ɪ / ɪ 3 2 ɪ ɪ ɪ 3 2 ɪ ɪ /
　　　　　　　　8 / 8　　　　　6　8　/ 8 6　8　　6　8　/

Ex. 28. A. Vivaldi, Op. 4: 2, I.

This method is excellently suited to AD. (In AD, furthermore, no numerals need be repeated at all, even at the beginning of a bar.) It is not easy to read, however; among other inconveniences, it may be necessary on occasions to look back and see which was the last time value inserted.

Writing out the values in full is considerably easier to read and probably also quicker to write:

E.6, 4/4, B″ // '5 / ɪ ɪ ɪ ɪ ɪ 3 2 ɪ ɪ / ɪ 3 2 ɪ ɪ ɪ 3 2 ɪ ɪ /
　　　　　　　　8 / 8 8 8 8 8 6 6 8 8 / 8 6 6 8 8 8 6 6 8 8 /

Furthermore, it is realized immediately that there is little to gain by using a special repetition symbol for the single time-value numeral; this would not, of course, reduce the number of symbols used.

The situation is not the same, however, if repetition of groups of notes is shown by R in the P-code line. (As far as D-coding is concerned, such groups may contain either notes of the same or of different value.) If R is used in the upper line, it is suggested that a corresponding symbol be inserted in the lower one, although here it may be considered superfluous to indicate the number of repetitions once again. The Vivaldi theme can then be written:

E.6, 4/4, B″ // '5 / ɪ ɪ ɪ ɪ ɪ 3 2 ɪ ɪ / R2(5) /
　　　　　　　　8 / 8 8 8 8 8 6 6 8 8 / R /

No matter which method is chosen, when the two lines are combined only R2(5) should be inserted and the AD programming should be so designed that the designation covers both P- and D-coding.

4.6 *"Gruppetti" such as triplets, duplets, etc.* Coding time values which deviate from the regular 1:2:4 etc. division, has always been a stumbling-block. The most common groups belonging here are triplets, duplets, etc.

Several acceptable methods could quite certainly be suggested if it were necessary to take into account only "gruppetti" with notes of perfectly equal duration, e.g. triplets containing three and quadruplets containing four such notes, etc. However, attention must also be paid to "gruppetti" with notes of different lengths, such as ♩₃♪ etc.

A reasonable and simple method would be to insert separate letters for such groups, such as T for triplet, D for duplets, etc. In doing so, however, letters reserved for special ornament signs in the upper line will have completely different meanings in the lower line. Moreover, such letters do not immediately solve the problem presented by formations such as ♩₃♪, as long as the letter is not repeated for each note in the group; this would mean, however, that all three notes in an ordinary triplet are given the letter in question, which seems to be impractical.

A distinguishing feature of all note signs together forming a "gruppetto" of some kind is just that with regard to time division, they *belong together* and differ from the notes around them (or to be more precise, from the simple rules of time-value proportions on the 1:2 etc. pattern, applying to the notes around them). A clear and simple way of indicating this mutual connection and grouping is to put such time values in *parentheses.* (Parentheses have not yet been used in D-coding, and have otherwise only been used in P-coding together with the symbol R.) A triplet containing three eighth notes can be coded (8 8 8), and the irregular ♩₃♪ (4 8). No special indication is required to show the triple division: in both the illustrations, the numerals in parentheses show that they must represent triplets. At the same time, the parentheses can be considered to indicate that the numerals within them may not be added directly to other time-value numerals in the bar (which conforms well with our reading of such gruppetti according to traditional notation). Cf. Ex. 29 and 30.

4.7. *"Small notes."* With small notes (appoggiatura, ornaments and other forms) it is normally true that the time values with which they are notated are not included in the normal time-value total of the bar. This must also

C.1, 4/4, C''' // '''1 0 0 '1 / 1 0 ,5 6 7 / '1 3 5 ''1 /
         2 4 8. 6 / 4. 8. (3 3 3) / 4 4 4  4 /

Ex. 29. W. A. Mozart, K. 338, I.

G.1, 2/4, D'' // 0 0 '5 / ''1 1 3 2 1 / '5 5 6 5 4 / S4Z 3 S5Z 4 3 2 / S2Z 1 /
        4 8 8 /  8 4 (6 6 6) /  8 4 (6 6 6) /  4  4 8  8 6 6 /  8  4. /

Ex. 30. Anonymus, Sinfonia G, I.

be evident from the coding. A simple solution would be not to designate any small notes in the D-code line. Omission of numerals here, however, may be confused with omission of directly repeated time-value symbols in the normal D-coding (if this alternative is chosen), as long as no special indication is given.

It may be of interest, however, to be able to read from the code the notated time value of a small note, e.g. if a long appoggiatura has been written as an eighth or a quarter.[36] This is possible if the rule is followed that all duration numerals appearing between S and Z are not counted in the time-value total for the bar. (For the sake of clarity, these letters may also be inserted in the lower line, if so desired.) See Ex. 31. In addition, it may be convenient by way of exception, to insert only the first numeral for sequences of several small notes each having the same duration. Accordingly, Example 15 above (= Ex. 31) would be coded:

C.1, G'' // '5 S 4+ 5 6 5 4 3 2 1 Z ,7 '1 /
        4 S 8        6       Z 4.8 /

Ex. 31 (constructed example).

4.8. *Bar lines.* If both P- and D-coding are carried out, indication of the bar line may be considered to belong to the latter rather than the former, i.e. to the lower line. In other words, the bar line must always be included in D-coding. In the upper line, it may be included or excluded. Practical tests have shown, however, that inclusion in both lines has great advantages both in coding and reading. (If the bar line is omitted in the upper line, a space must nevertheless be allowed for the bar lines to be coded in the lower one. See further under 5 below.)

[36] Particularly pointed out by Georg Friberg.

In coding by hand, and especially when using a typewriter certain norms for positioning and transcribing the symbols should be followed.[31] In any event, the upper line must be so written that the necessary space is left for the time-value symbols in the lower line.

Unfortunately, the grouping of time values (with or without "beams") in normal notation, which facilitates reading, cannot be used here as a model to any appreciable extent. Instead, it must be accepted that each coded note symbol requires a certain normal space, to which must be added the necessary blank spaces between groups of symbols. All symbols needed to code a note sign in the original are called a *code group* in the following. Those in the upper line are referred to as P-code groups and those in the lower line as D-code groups.

The following suggested norms have been tested and found to work reasonably well:

(1) All symbols belonging to the same code group are written without a space between them. The sequence in a P-code group is: ornament letter (if applic.) plus octave mark (if applic.) plus position numeral plus accidental (if applic.). In a D-code group the sequence is: open group parentheses (if applic.) plus time-value numeral plus dot(s) (if applic.) plus close group parentheses (if applic.).

(2) A time-value numeral in a D-code group (lower line) should always be placed *directly under the position numeral* (or equals sign) in the P-code (upper line). The positioning of other symbols follows from this rule.

(3) There must be at least one space between each code group, or in other word a blank position at the same place in both lines.

As a position numeral in a P-code group may be preceded and/or succeeded by another symbol, it is unavoidable that the numerals will be at irregular distances from each other if it is attempted to write the code as compactly as possible. This can be seen from the following (imaginary) example:

'5 4– T''1 1– '4– 5 5– 6 = ''2– 6 5
8 8  8 8  6  6 6  6 8  8  8 8

The irregularities thus arising and the "apparent grouping" in the time-value line perhaps cause no great inconvenience, but apart from making reading somewhat more difficult, extra attention is required in transcribing the time value groups. If this is to be avoided, a *normal code-group format* must be established, by means of which it can be attempted to place the position numerals, as far as possible, at regular distances from each other, thereby making transcription of the lower line very much easier. There must, however, be special rules to cover accumulations of several symbols (3 or 4) in a P-code group. The following suggestions have been tested:

(4) The normal format of a code group comprises *three typewriter spaces.* The position numeral (as well as 0 for a rest and = for a tied note) is normally

[31] For transcription rules etc. in one line, see under 6 below.

inserted in *space two*. Space one is reserved for a possible octave mark and the last space is always blank. If no octave mark (or ornament sign) is required, the first space is left blank.

(5) Accidental symbols ( + or − ) always mean that the format of the group is increased, by way of exception, to *four spaces* (as these symbols come after the position numeral, which should always be in space two). The sequence here then becomes: poss. octave mark plus position numeral plus accidental symbol plus blank space. For the same reason, this rule must also apply to *dots* (which of course follow the time-value numeral), and be followed when writing the upper line. As soon as a symbol is required immediately after a numeral in either line, the format must be extended accordingly. The only symbols concerned are accidentals and dots, and in certain situations, parentheses at the end of gruppetti etc. Their placing can be seen from the following examples (with separate tones), in which the top line of numerals shows the group format and the space number in each group:

|  | 123 | 123 | 123 | 123 | 123 |
|---|---|---|---|---|---|
| P-coding | 6 | '5 | ,3 | T2 | "3 |
| C-coding | 4 | 8 | 2 | 4 | (8 |

|  | 1234 | 1234 | 1234 | 12345 | 12345 |
|---|---|---|---|---|---|
| P-coding | '5 + | 4 − | "4 − | T"3 − | G'1 |
| D-coding | 5 | 8 | 8) | 4. | 8) |

(6) Letters representing ornaments and the like are put in space one, provided no octave mark is necessary, in which case the position numeral must, as an exception, be moved to space three, followed by a blank in space four or five. (Cf. the last two examples above.)

(7) As a result of the above rules, the time-value numeral in the lower line will normally be in space two. The opening bracket of gruppetto parentheses comes in space one. Single dots come in space three, and as has been mentioned, necessitate an expansion of the group format to four places. The same applies to the closing bracket of gruppetto parentheses. (Cf. the examples above.)

(8) Finally, it is important to stipulate how bar lines are to be treated, so that the necessary space is left in the upper line even when it is not desired to include them there. As in addition, it is not considered desirable to have any symbols immediately adjacent to the bar line, e.g. a closing bracket in the lower line or an octave mark in the upper), it is suggested that the bar line always have its own *three-space group* containing: blank plus / plus blank. As with the numerals in P-code groups, / thus always occupies space two. (If it is wished to omit the bar line in the upper line, three blanks are left.)

These suggestions are definitely not the most economical in terms of space. In coding themes which contain few or no accidentals, ornaments, rhythmical complications, etc., it should be possible to make the transcription considerably more compact. As a suggestion, the group format could be reduced to two spaces

(numeral plus blank) and, if desired, an attempt could be made to keep the groups of notes together so that the eye can easily distinguish them. The following illustration is the Vivaldi theme from Example 16 (without abbreviations):

E.6, 4/4, B″ // '5 / 1 1 1 1 1 3 2 1 1 / 1 3 2 1 1 1 3 2 1 1 /
8 / 1 1 1 1 8 6 6 8 8 / 8 6 6 8 8 8 6 6 8 8 /

The other Vivaldi example, number 17, can also be made more compact. Here it is coded both in accordance with the general rules suggested above and with a proposal for more compact transcription:

123123123123123123123123123123123123123123123123123123123123

G.1, 3/4, G″ // "1 '5 3 1 ,5 3 / 1 1 1 / "1 '5 3 1 ,5 3 / etc.
8 8 8 8 8 8 / 4 4 4 / 8 8 8 8 8 8 / etc.

G.1, 3/4, G″ // "1 '5 3 1 ,5 3 / 1 1 1 / "1 '5 3 1 ,5 3 / 1 1 1 /
8 8 8 8 8 8 / 4 4 4 / 8 8 8 8 8 8 / 4 4 4 /

The second transcription saves space, but takes somewhat longer.

The Bach theme (Ex. 20 = 32) can be coded:



F.6, 2/4, F' // '1 1 = 5 3 ,7+ / '1 ,7+ '1 = 5 3 ,7+ / '1 2 − ,7+ '1 = 5 3 1 /
8 8 6 6 6 6 / 6 6 8. 6 6 6 6 / (6 6 6) .8 6 6 6 6 /

Ex. 32. J. S. Bach, Concerto f, BWV 1056, I.

If *only* P-coding is undertaken, the code groups can of course be written with only a single blank space throughout:

F.6, 2/4, F' // '1 1 = 5 3 ,7+ / '1 ,7+ '1 = 5 3 ,7+ / '1 2 − ,7+ 1 = etc.

In any event, this discussion shows that in AD, the blank space should not be allotted any special significance other than to separate code groups. A degree of freedom is therefore possible in transcription and one soon becomes accustomed to leaving extra room as soon as the music contains particular complications, such as ornaments or triplets. This is of course also the case when vocal texts must be added below the D-coding line.

## 6. COMBINATION OF PITCH AND DURATION CODING IN ONE LINE

It is quite possible to retain the division into two lines in AD by introducing a particular system of labels. Nevertheless, it may be essential under certain circumstances to have a series of rules for combining the two lines. To a substantial extent, this is a matter of AD programming. A few guiding principles for such transcription (which in many cases will probably be done manually) are given here in conclusion, as briefly as possible.

In combining the two lines, a P-code group and a D-code group should together form one group per coded note sign. From the purely practical point of view, it is simplest to take the symbols in the upper line before the symbols in the lower one. Neither are there any technical obstacles for doing so.

All the symbols in these code groups—we can call them PD groups— should follow directly upon each other *without a space between them*. On the other hand, there must be at least one space between PD groups, indicating that further P-coding or a bar line is to follow.

Each PD group will, of course, contain at least two symbols, first a numeral (1–7 or 0) or equals sign, followed by a numeral. The framework of single line transcription thus consists of pairs of numerals, side by side, the first one indicating pitch and the other duration. From the point of view of AD, this is consistent and simple; with a little practice it is also possible to read the pairs of numerals comparatively easily, although naturally, two-line transcription is much more convenient in this respect.

Special problems arise on certain points. Some of them will be dealt with here to show what must be taken into account if "one line" is chosen.

Where symbols for the same phenomenon have been inserted in both lines, e.g. in indicating bar lines, one set must be removed, either in manual transcription (or punching) or as part of the AD programming.

There must be special rules for dealing with gruppetti. Take the triplets in Ex. 19, coded as  3  2  1  and  6  5  4  respectively. One possible method

(6 6 6)  .  (6 6 6)

is to split the triplet and write:

3(6) 2(6) 1(6) and 6(6) 5(6) 4(6)

But firstly, the many parentheses cause difficulties in AD, and secondly, there must be special sub-programmes to check whether the parentheses in such a series belong together. On the other hand, (36 26 16) and (66 56 46) are perfectly acceptable as the parentheses symbol has not been allotted any other function (unless directly connected with the label letter R).

Owing to the rules prescribed for the "heading", retrieval and classification for diverse purposes can easily be carried out by AD, e.g. sorting out all melodies in a particular key or metre, all minuets and so on.

Apart from this, the rules for one-line transcription are likely to depend substantially on the data processing equipment and the input and programming languages available at a particular place.

Finally, here are two examples of single-line transcription, taken from examples coded above:

Vivaldi, Ex. 28:

E.6, 4/4, B″ // ′58 / 18 18 18 18 18 36 26 18 18 / 18 36 26 18 18 etc.

Bach, Ex. 32:

F.6, 2/4, F′ // ′18  18  =6  56  36  ,7+6  /  ′16  ,7+6  ″18  =6  56  36  ,7+6 / etc.

## 7. SUMMARY

(*a*) A special "heading" indicates (1) key / mode (2) metre (time signature) and (3) first melody tone. The tempo mark could come at the beginning of the heading, but for reasons of space, should preferably be included in a special top line (e.g. farthest to the right, after the composer's name, title of the composition, etc.). Key and mode is shown by a letter for transposition position, a dot, and a numeral for mode (diatonic structure). Time signature is given by numerals around /. The first melody note is coded by a note letter (A–G) followed by an absolute octave mark. Accidentals belonging to the tonic and first melody tone are marked + and − for sharpening and flattening respectively. The three code groups are separated by a comma, possibly followed by a blank space. The end of the heading is marked //.

(*b*) The code system permits coding either of pitch alone (P-coding), or both pitch and duration (D-coding). In the latter case, coding is on two separate lines (with the P-coding above) which can be combined to form a single line in accordance with special rules.

(*c*) *Pitch* is coded by the numerals 1–7 (position numerals). The tonic (finalis) is always 1. The numerals 1–7 represent the diatonic structure of the *major scale* if the melody has the *major third* above the tonic (finalis) i.e. if the mode indication is 1, 4 or 5. The numerals 1–7 represent a diatonic *minor* structure (note sequence A–G) if the melody has the *minor third* above the tonic (finalis), i.e. if the mode indication is 2, 3 or 6. Tied notes, which do not represent "a separate sound", are symbolised not by a numeral, but the equals sign (=). Rests are marked 0, a nought being inserted in the P-coding for each separate rest sign in the music if D-coding is also undertaken.

(*d*) *Octave positions* are marked "*relatively*". The numerals 1–7 determine the octave boundaries. The "main octave" of the coded theme (in which most of the notes occur) is designated ′ the octave above ″, the octave below , etc. The mark is inserted only on transition to another octave. The symbols are placed immediately in front of the pitch numeral.

(*e*) Only two symbols are required for *accidentals,* representing sharpening or flattening. These symbols, + for sharpening and − for flattening, are placed immediately *after* the pitch numeral.

(*f*) Special letters are used for conventional *ornaments* (trill, mordent, etc.). Other ornament signs and ones written in small notes that it is not wished to code, are designated G. Other small notes are preceded by S and succeeded by Z.

(*g*) *Abbreviations* should be used sparingly and should always be avoided in

the first bar to be coded. Otherwise, repetition of *tone groups* may be abbreviated using the letter R followed by a numeral in parentheses indicating the number of tones repeated. If a tone group is repeated several times, the number of group repetitions is shown by a figure between R and the parentheses.

(*h*) The *bar line* is coded by /. This is always included in the lower (D-code) line, but for the sake of clarity, should also be inserted in the upper (P-code) line.

(*i*) *Time values* are represented by numerals: 1 = whole note, 2 = half note, 4 = quarter note, etc. Two-figure numbers are avoided: sixteenth note = 6, thirty-second note = 3, etc. Rests are coded as notes. The time value of tied notes is shown in the same way. Dots are coded as dots, directly after the numeral. Possible abbreviations are inserted in conformity with the use of R in the upper line.

(*k*) "*Gruppetti*", e.g. triplets, duplets, etc., are coded with the time value numerals in parentheses.

(*l*) Phrase marks, articulation signs and dynamic indications, as well as verbalized rendition signs, are normally omitted.