INTERNATIONAL STANDARD

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Motorcycles — Test and analysis procedures for research evaluation of rider crash protective devices fitted to motorcycles —

Part 2: Definition of impact conditions in relation to accident data

Motocycles — Méthodes d'essai et d'analyse de l'évaluation par la recherche des dispositifs, montés sur les motocycles, visant à la protection des motocyclistes contre les collisions —

Partie 2: Définition des conditions de choc en fonction des données sur les accidents

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13232-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 22, *Motorcycles*.

This second edition cancels and replaces the first version (ISO 13232-2:1996), which has been technically revised.

ISO 13232 consists of the following parts, under the general title *Motorcycles — Test analysis procedures for research evaluation of rider crash protective devices fitted to motorcycles*:

— *Part 1: Definitions, symbols and general considerations*

— *Part 2: Definition of impact conditions in relation to accident data*

— *Part 3: Motorcyclist anthropometric impact dummy*

— *Part 4: Variables to be measured, instrumentation and measurement procedures*

— *Part 5: Injury indices and risk/benefit analysis*

— *Part 6: Full-scale impact-test procedures*

— *Part 7: Standardized procedures for performing computer simulations of motorcycle impact tests*

— *Part 8: Documentation and reports*

Introduction

ISO 13232 has been prepared on the basis of existing technology. Its purpose is to define common research methods and a means for making an overall evaluation of the effect that devices which are fitted to motorcycles and intended for the crash protection of riders, have on injuries, when assessed over a range of impact conditions which are based on accident data.

It is intended that all of the methods and recommendations contained in ISO 13232 should be used in all basic feasibility research. However, researchers should also consider variations in the specified conditions (for example, rider size) when evaluating the overall feasibility of any protective device. In addition, researchers may wish to vary or extend elements of the methodology in order to research issues which are of particular interest to them. In all such cases which go beyond the basic research, if reference is to be made to ISO 13232, a clear explanation of how the used procedures differ from the basic methodology should be provided.

ISO 13232 was prepared by ISO/TC 22/SC 22 at the request of the United Nations Economic Commission for Europe Group for Road Vehicle General Safety (UN/ECE/TRANS/SCI/WP29/GRSG), based on original working documents submitted by the International Motorcycle Manufacturers Association (IMMA), and comprising eight interrelated parts.

This revision of ISO 13232 incorporates extensive technical amendments throughout all the parts, resulting from extensive experience with the standard and the development of improved research methods.

In order to apply ISO 13232 properly, it is strongly recommended that all eight parts be used together, particularly if the results are to be published.

Motorcycles — Test and analysis procedures for research evaluation of rider crash protective devices fitted to motorcycles —

Part 2: Definition of impact conditions in relation to accident data

1 Scope

This part of ISO 13232 specifies minimum requirements for the collection and analysis of all motorcycle accident data, in order to provide:

- a standardized and representative sub-set of car/motorcycle accident data; and
- a sub-set of car/motorcycle impact conditions based on the analysis of this standardized accident data.

ISO 13232 specifies the minimum requirements for research into the feasibility of protective devices fitted to motorcycles, which are intended to protect the rider in the event of a collision.

ISO 13232 is applicable to impact tests involving:

- two-wheeled motorcycles;
- the specified type of opposing vehicle;

- either a stationary and a moving vehicle or two moving vehicles;
- for any moving vehicle, a steady speed and straight-line motion immediately prior to impact;
- one helmeted dummy in a normal seating position on an upright motorcycle;
- the measurement of the potential for specified types of injury by body region; and
- evaluation of the results of paired impact tests (i.e. comparisons between motorcycles fitted and not fitted with the proposed devices).

ISO 13232 does not apply to testing for regulatory or legislative purposes.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 13232-1, *Motorcycles — Test and analysis procedures for research evaluation of rider crash protective devices fitted to motorcycles — Part 1: Definition, and general considerations*

ISO 13232-7, *Motorcycles — Test and analysis procedures for research evaluation of rider crash protective devices fitted to motorcycles — Part 7: Standardized procedures for performing computer simulations of motorcycle impact tests*

AIS-90:1990, Association for the Advancement of Automotive Medicine (AAAM), Des Plaines, IL, USA *The abbreviated injury scale, 1990 revision*

3 Definitions

The following terms are defined in ISO 13232-1. For the purposes of this part of ISO 13232, those definitions apply. Additional definitions which could apply to this part of ISO 13232 are also listed in ISO 13232-1:

- cell;
- cell range;
- centre line of the OV or MC;
- corner of the OV;
- MC front unsprung assembly;
- MC contact point;
- MC impact speed;
- nominal values;
- OV contact point;
- OV impact speed;
- overall length of the OV or MC;
- relative heading angle (rha);
- structural element of the MC.

4 Requirements

4.1 Impact variables

The following impact variables shall define an impact test or impact data for an accident:

- relative heading angle;
- opposing vehicle (OV) impact speed;
- motorcycle (MC) impact speed;
- OV contact point;
- MC contact point.

These variables shall be as defined in 4.3 for impact tests and in Annex A for accident reports.

4.2 Standardized accident configurations

Standardized accident configurations shall be used for overall evaluations of rider crash protective devices, for failure mode and effects analyses of such devices, and for full-scale impact tests intended to verify such analyses.

The standardized accident configurations and corresponding frequencies shown in Annex B, which are the result of applying the requirements of 4.2.2.1 and clause 5 to the combined accident data listed in Annex C, shall be used for such purposes.

NOTE The accident databases listed in Annex C were the only ones which met the requirements of this part of ISO 13232 and which were made available in a timely way to the group preparing ISO 13232.

4.2.1 Data collection for future revisions

In future revisions of ISO 13232, Annex B may be revised to account for different accident databases which may be included in Annex C. In this case, the requirements of 4.2 and clause 5, which are also subject to revision, shall be applied to the contents of Annex C. The results of such revisions to the standardized frequency of injury data, given in Annex D, along with the resulting frequency of occurrence data, given in Annex B, should be considered in potential revisions to the full-scale impact configurations, given in 4.3.

4.2.2 Accident sampling

The following impact configurations shall be used in defining impact conditions in relation to accident data.

4.2.2.1 Defining frequency of occurrence of various impact configurations

The accident database for each region shall include at least 200 MC accidents and shall be uniformly sampled data from all reporting facilities for a given region (i.e., a randomized sample). The samples shall be the result of in-depth investigations including on-site measurements and reconstructions. The subsample used, as determined in 5.1.1, shall consist only of those accidents involving impacts between motorcycles and passenger cars. The database shall include all of the impact variables listed in 4.1 and A.1 and shall be available for analysis and potential publication as part of ISO 13232.

4.2.2.2 Defining frequency of injury of various impact configurations

Additionally, for each accident the following injury data for each injury, as defined in A.2, shall be included:

- injury body region;
- injury type;
- injury severity, as defined by the AAAM abbreviated injury scale (AIS).

The database shall also include the variables listed in A.3 and should include the variables listed in A.4.

4.3 Impact configurations for full-scale tests

The following impact configurations shall be used for full-scale tests.

4.3.1 Required configurations

The impact configurations for full-scale tests shall include those shown in Figure 1 and listed in Table 1, as a preliminary assessment of the proposed protective device.

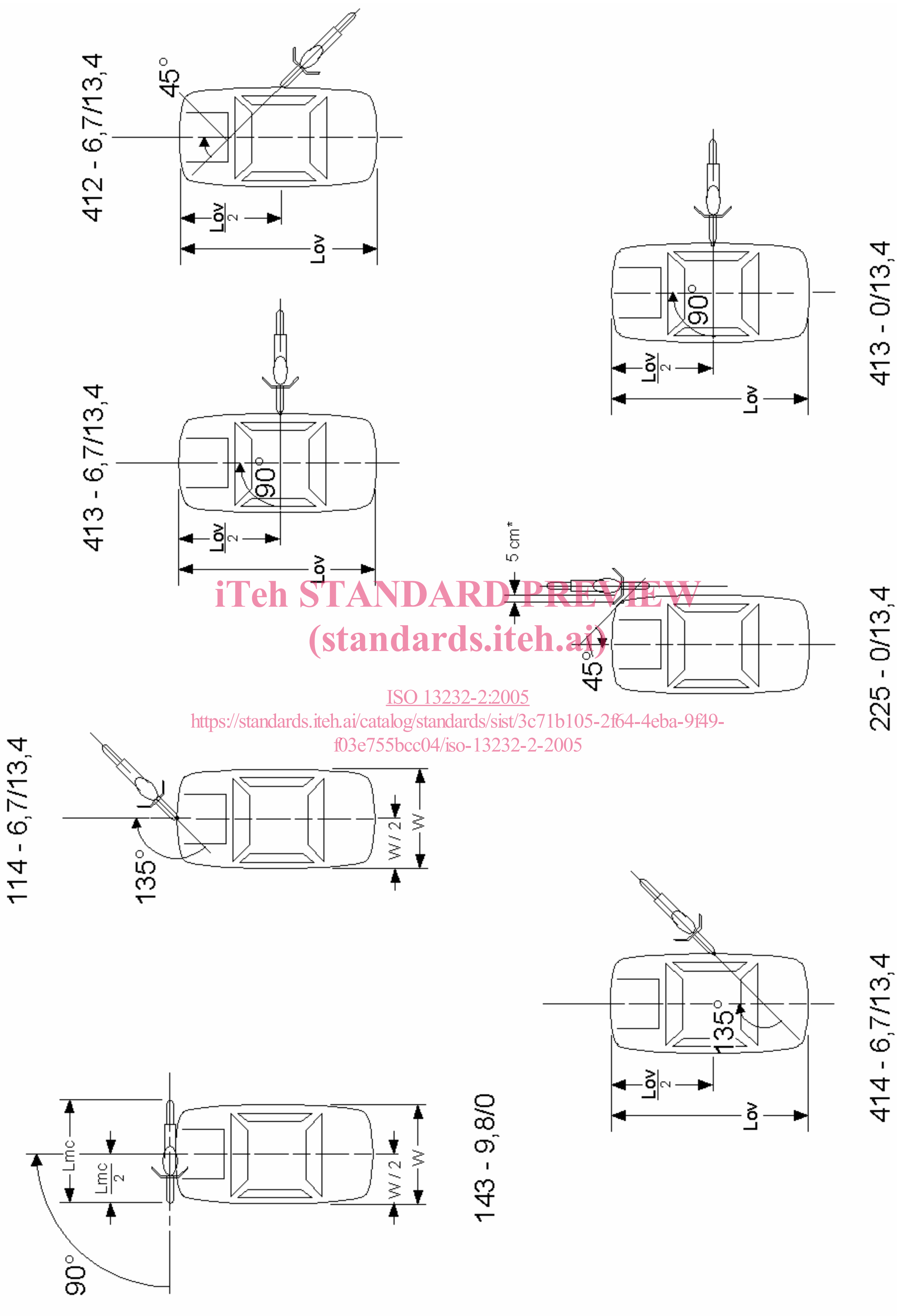


Figure 1 — Target impact geometries at first MC/OV contact for seven required impact configurations

Table 1 — Impact configurations for preliminary assessment

Configuration number	OV contact point code (Figure 2)	MC contact point code (Figure 3)	Relative heading angle code (Table 2 & Figure 4)	OV speed m/s	MC speed m/s
1	1	4	3	9,8	0
2	1	1	4	6,7	13,4
3	4	1	3	6,7	13,4
4	4	1	2	6,7	13,4
5	4	1	4	6,7	13,4
6	2	2	5	0	13,4
7	4	1	3	0	13,4

The impact configuration code shall comprise a series of three digits describing the OV contact point, the MC contact point, and relative heading angle, respectively, as generally defined in Figures 2, 3, and 4 and Table 2, followed by a hyphen (-), the OV impact speed, and the MC impact speed.

For OV corner contact (e.g., configuration 225-0/13,4 of Figure 1) the reference point on the MC shall be the most outboard structural element on the MC front unsprung assembly.

For testing purposes, the impact geometry may be reflected about the OV centre line (e.g., E45 instead of 225).

4.3.2 Permissible configurations from failure mode and effects analysis

Other impact configurations for which a proposed rider crash protective device might be harmful may be identified through computer simulation according to ISO 13232-7, or other analysis techniques, by analysing those configurations listed in Annex B. These failure mode configurations may be tested in order to verify the results of such analysis.

For full-scale tests and computer simulations, the impact geometries shall be as shown in Figures 1 and B.1, with the following general rules:

— OV corner contact points shall be the 45° tangent points, as shown in Figure 1;

— OV front and rear contact points shall be at the centre line of the OV;

— OV side front, side middle, and side rear contact points shall be the points corresponding to 1/4, 1/2 and 3/4 of the overall length of the OV, respectively, as measured from the foremost point on the OV;

— MC front contact point shall be such that the projection of the MC centre line, forward of the foremost part of the front wheel, at first contact between any portion of the MC or dummy and the OV, intersects a vertical line through the specified OV contact point;

— MC rear contact point shall be such that the projection of the MC centre line, rearward of the rearmost part of the rear wheel, at first contact between any portion of the MC or dummy and the OV, intersects a vertical line through the specified OV contact point;

— MC side contact shall use the conventions given in 4.3.1 and shown in Figure 1 (i.e., for OV front or rear contact use the 143-9,8/0 type of geometry; for OV corner contact use the 225-0/13,4 type of geometry);

— The relative heading angles shall be at the nominal values defined in Table 2 and Figure 4.

For testing purposes, the impact geometry may be reflected about the OV centre line (e.g., E45 instead of 225).

5 Analysis methods

5.1 Using accident data to determine frequency of occurrence of various impact configurations

Use the following methods when determining frequency of occurrence and injury.

Sort the accident data as described below.

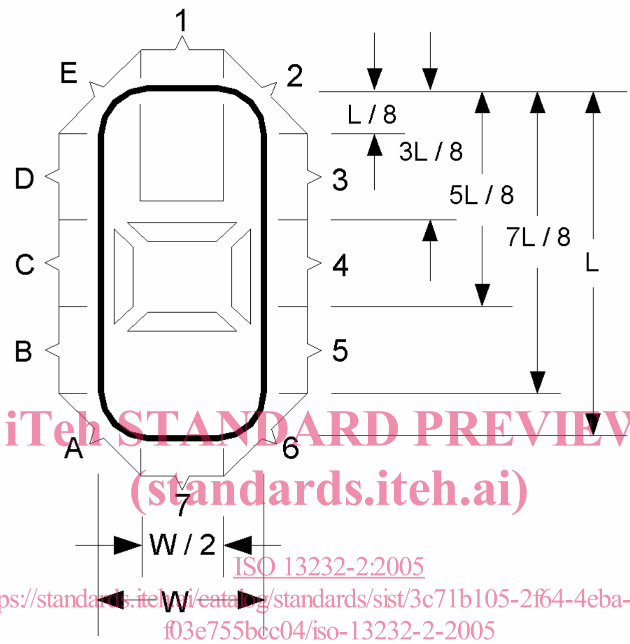


Figure 2 — OV contact point codes

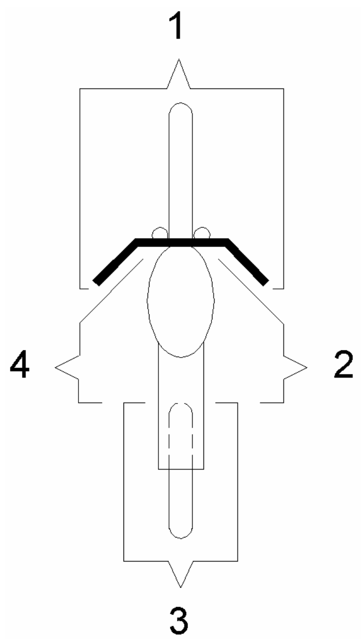


Figure 3 — MC contact point codes

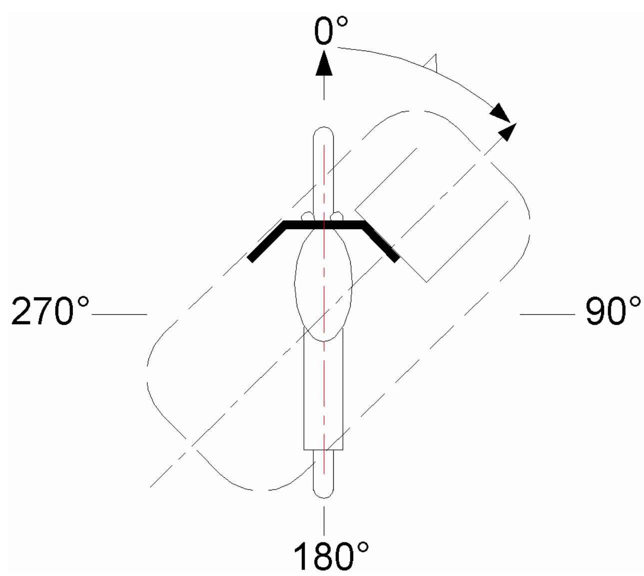


Figure 4 — Relative heading angle

Table 2 — Heading angle of OV relative to MC

Cell range deg	Nominal value deg	Code number
337,5 < rha ≤ 22,5	0	1
22,5 < rha ≤ 67,5	45	2
67,5 < rha ≤ 112,5	90	3
112,5 < rha ≤ 157,5	135	4
157,5 < rha ≤ 202,5	180	5
202,5 < rha ≤ 247,5	225	6
247,5 < rha ≤ 292,5	270	7
292,5 < rha ≤ 337,5	315	8

5.1.1 Sub-sample definition

Combine the databases listed in Annex C. From the combined, overall database, select all of the cases which have all of these conditions:

- passenger car impact;
- single rider;
- seated rider.

5.1.2 Categorization

For each case selected in 5.1.1, and for each impact variable, determine within which cell range the case lies and assign code numbers for the OV and MC contact points and relative heading angle, and nominal values for the OV and MC speeds, based on Tables 2 and 3 and Figures 2, 3, and 5.

5.1.3 Sorting

Sort all the subsample accident data into a matrix describing the combinations of the above cells. Determine the number of accidents which lie within the boundaries of each of the cells.

If the OV contact point involves the left side of the OV, then reclassify the OV and MC contact points and relative heading angle according to Table 4. In addition, reclassify all accidents that occur in the sorted geometry codes to the reclassified geometry codes as listed in Table 5, in order to resolve minor inconsistencies which may be present in the original accident data.

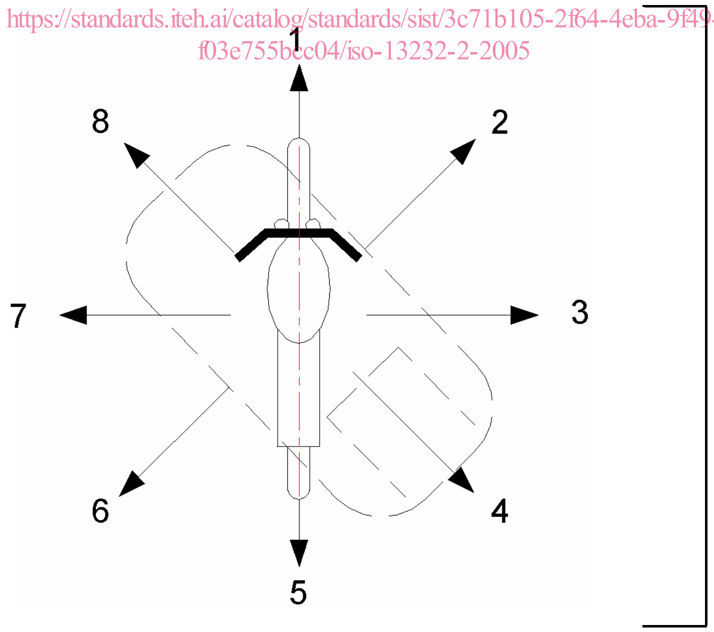
Remove all accidents in the cells listed in Table 6 which, as a result of categorization, correspond to untestable configurations.

5.1.4 Representation

Associate the number of accidents (frequency of occurrence) in each cell with the OV and MC contact point codes, relative heading angle codes, and OV and MC speed nominal values which will be considered to represent each cell.

Table 3 — OV and MC speed

Cell range m/s	Nominal value m/s
0 ≤ speed ≤ 4,0	0
4,0 < speed ≤ 8,5	6,7
8,5 < speed ≤ 13,3	9,8
13,3 < speed ≤ 17,5	13,4
17,5 < speed	20,1



Direction of OV x axis, relative to MC x axis, with MC x axis in direction 1 (a relative heading angle of "4" is shown)

Figure 5 — Diagram of relative heading angle (angle of OV x axis relative to MC x axis, regardless of relative positions of OV and MC) with code numbers

Table 4 — Reclassification for left side OV contact point codes

Sorted	Reclassified
OV contact point code	
A	6
B	5
C	4
D	3
E	2
MC contact point code	
2	4
4	2
Relative heading angle code	
2	8
3	7
4	6
6	4
7	3
8	2

Table 5 — Reclassification of geometry codes

Sorted	Reclassified	Sorted	Reclassified	Sorted	Reclassified
113	143	216	114	442	412
116	114	217	143	443	413
117	143	221	131	523	513
121	131	223	313	524	514
125	115	224	314	542	512
126	114	231	131	543	513
127	143	232	132	611	711
128	132	233	143	612	712
133	143	236	226	613	513
137	143	237	227	614	514
138	132	244	114	621	711
141	131	245	115	622	712
142	132	323	313	642	512
144	114	324	314	643	513
145	115	342	312	721	711
212	312	343	313	722	712
213	313	423	413	741	711
215	115	424	414	748	712