# INTERNATIONAL STANDARD ISO 1604

# Endless wide V-belts for industrial speed-changers and groove profiles for corresponding pulleys

*Courroies trapézoïdales larges sans fin pour variateurs de vitesse industriels et profil de gorge des poulies correspondantes*

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**Descriptors** : power transmission belts, V-belts, grooved pulleys, profiles, dimensions.

## FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

Prior to 1972, the results of the work of the Technical Committees were published as ISO Recommendations; these documents are now in the process of being transformed into International Standards. As part of this process, Technical Committee ISO/TC 41 has reviewed ISO Recommendation R 1604 and found it technically suitable for transformation. International Standard ISO 1604 therefore replaces ISO Recommendation R 1604-1970 to which it is technically identical.

ISO Recommendation R 1604 was approved by the Member Bodies of the following countries :

| | | |
|---|---|---|
| Austria | India | Spain |
| Belgium | Israel | Sweden |
| Brazil | Italy | Switzerland |
| Czechoslovakia | Netherlands | Thailand |
| Denmark | New Zealand | Turkey |
| Egypt, Arab Rep. of | Peru | United Kingdom |
| Finland | Portugal | U.S.S.R. |
| France | South Africa, Rep. of | Yugoslavia |

The Member Body of the following country expressed disapproval of the Recommendation on technical grounds :

Norway

The Member Body of the following country disapproved the transformation of ISO/R 1604 into an International Standard :

Belgium

# Endless wide V-belts for industrial speed-changers and groove profiles for corresponding pulleys

## 1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the principal dimensions of endless wide V-belts for industrial speed-changers[1] as well as the groove profile of corresponding fixed or variable diameter pulleys.

It does not concern speed-changer belts used either for the propulsion of self-propelled vehicles (motor-cycles, scooters, cars) or as parts of farm-machines (chiefly harvesters).

The wide V-belts are characterized by a "relative height" (ratio of the nominal height of the theoretical profile to its pitch width) of about 0,32.

## 2 DIMENSIONS AND TOLERANCES

### 2.1 Belt dimensions

The dimensions and the tolerances of the belts are given in millimetres in table 3.

#### 2.1.1 Designation

The proposed nine cross-sections are designated as follows :

W 16 – W 20 – W 25 – W 31,5 – W 40 –
W 50 – W 63 – W 80 – W 100

#### 2.1.2 Profile

The profile of the cross-section of the free stand of the belt under tension is not imposed; in particular, the angle of the sidewalls and their profile are left to the initiative of the manufacturers.

#### 2.1.3 Width

Values for the pitch width $l_p$ (expressed in millimetres) are nine consecutive terms from the R 10 series of preferred numbers.

Should this series of values be considered insufficient, it may be completed, outside the limits, with other terms from the R 10 series of preferred numbers.

#### 2.1.4 Belt height

The nominal belt height $T$, equal to $0,32\ l_p$, is divided as follows on both sides of the pitch line :

— above $(B) = 0,08\ l_p$

— below $(H) = 0,24\ l_p$

TOLERANCES

a) Belt ride-out, in the conditions specified in clause 3, should not exceed the value shown in table 1 (round value of the expression $0,36\ \sqrt{l_p}$, where $l_p$ is expressed in millimetres).

b) Height $H$ should not exceed the value shown in table 2 (round value of the expression $0,24\ l_p + 0,06\ \sqrt{l_p}$ where $l_p$ is expressed in millimetres).

TABLE 1 — Ride-out

| Designation of the sections | W 16 | W 20 | W 25 | W 31,5 | W 40 | W 50 | W 63 | W 80 | W 100 |
|---|---|---|---|---|---|---|---|---|---|
| Ride-out mm | 1,2 | 1,8 | 1,8 | 1,8 | 2,4 | 2,4 | 3,0 | 3,0 | 3,6 |

TABLE 2 — Maximum height $H$

| Designation of the sections | W 16 | W 20 | W 25 | W 31,5 | W 40 | W 50 | W 63 | W 80 | W 100 |
|---|---|---|---|---|---|---|---|---|---|
| $H$ max. mm | 4,0 | 5,1 | 6,3 | 7,8 | 10,0 | 12,4 | 15,5 | 19,7 | 24,6 |

[1] Owing to the need for compactness of such types of speed-changers, it is necessary to minimize pitch diameters. At the present level of techniques, the values given for the minimum pitch diameter should be used on the notched V-belts.

TABLE 3 — Belt dimensions

Values in millimetres

| Designation of the sections | W 16 | | W 20 | | W 25 | | W 31,5 | | W 40 | | W 50 | | W 63 | | W 80 | | W 100 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approximate top width | 16,6 | | 20,7 | | 25,9 | | 32,6 | | 41,5 | | 51,8 | | 65,3 | | 82,9 | | 103,7 | |
| Pitch width $l_p$ | 16 | | 20 | | 25 | | 31,5 | | 40 | | 50 | | 63 | | 80 | | 100 | |
| Belt height — Above the pitch line $B$ | 1,3 | | 1,6 | | 2 | | 2,5 | | 3,2 | | 4 | | 5 | | 6,3 | | 8 | |
| Belt height — Below the pitch line $H$ | 3,8 | | 4,8 | | 6 | | 7,5 | | 9,6 | | 12 | | 15 | | 19,2 | | 24 | |
| Belt height — Total $T$ | 5,1 | | 6,4 | | 8 | | 10 | | 12,8 | | 16 | | 20 | | 25,5 | | 32 | |
| Belt length ($L_e$ = Approximate outside length, $L_p$ = Pitch length) | $L_e$ | $L_p$ | $L_e$ | $L_p$ | $L_e$ | $L_p$ | $L_e$ | $L_p$ | $L_e$ | $L_p$ | $L_e$ | $L_p$ | $L_e$ | $L_p$ | $L_e$ | $L_p$ | $L_e$ | $L_p$ |
| | 458 | 450 ± 10 | 570 | 560 ± 12 | 722 | 710 ± 14 | 916 | 900 ± 18 | 1 140 | 1 120 ± 22 | 1 425 | 1 400 ± 28 | 1 832 | 1 800 ± 36 | 2 280 | 2 240 ± 44 | 2 850 | 2 800 ± 56 |
| | 508 | 500 ± 10 | 640 | 630 ± 12 | 812 | 800 ± 16 | 1 016 | 1 000 ± 20 | 1 270 | 1 250 ± 24 | 1 625 | 1 600 ± 32 | 2 032 | 2 000 ± 40 | 2 540 | 2 500 ± 50 | 3 200 | 3 150 ± 62 |
| | 568 | 560 ± 12 | 720 | 710 ± 14 | 912 | 900 ± 18 | 1 136 | 1 120 ± 22 | 1 420 | 1 400 ± 28 | 1 825 | 1 800 ± 36 | 2 272 | 2 240 ± 44 | 2 840 | 2 800 ± 56 | 3 600 | 3 550 ± 70 |
| | 638 | 630 ± 12 | 810 | 800 ± 16 | 1 012 | 1 000 ± 20 | 1 266 | 1 250 ± 24 | 1 620 | 1 600 ± 32 | 2 025 | 2 000 ± 40 | 2 532 | 2 500 ± 50 | 3 190 | 3 150 ± 62 | 4 050 | 4 000 ± 80 |
| | 718 | 710 ± 14 | 910 | 900 ± 18 | 1 132 | 1 120 ± 22 | 1 416 | 1 400 ± 28 | 1 820 | 1 800 ± 36 | 2 265 | 2 240 ± 44 | 2 832 | 2 800 ± 56 | 3 590 | 3 550 ± 70 | 4 550 | 4 500 ± 90 |
| | 808 | 800 ± 16 | 1 010 | 1 000 ± 20 | 1 262 | 1 250 ± 24 | 1 616 | 1 600 ± 32 | 2 020 | 2 000 ± 40 | 2 525 | 2 500 ± 50 | 3 182 | 3 150 ± 62 | 4 040 | 4 000 ± 80 | 5 050 | 5 000 ± 100 |
| | 908 | 900 ± 18 | 1 130 | 1 120 ± 22 | 1 412 | 1 400 ± 28 | 1 816 | 1 800 ± 36 | 2 260 | 2 240 ± 44 | 2 825 | 2 800 ± 56 | 3 582 | 3 550 ± 70 | 4 540 | 4 500 ± 90 | 5 650 | 5 600 ± 110 |
| | 1 008 | 1 000 ± 20 | 1 260 | 1 250 ± 24 | 1 612 | 1 600 ± 32 | 2 016 | 2 000 ± 40 | 2 520 | 2 500 ± 50 | 3 175 | 3 150 ± 62 | 4 032 | 4 000 ± 80 | 5 040 | 5 000 ± 100 | 6 350 | 6 300 ± 120 |

### 2.1.5 *Length*

Values for the pitch length $L_p$ are multiples of the pitch width figures, the multiplier coefficients being eight consecutive terms (28 to 63 inclusive) from the R 20 series of preferred numbers.

Should the above range of lengths be considered insufficient, it may be completed

— upwards or downwards, with other terms from the R 20 series of preferred numbers;

— exceptionally, between two consecutive lengths from the table, with terms from the R 40 series of preferred numbers (especially for box-type speed-changers).

Approximate outside lengths $L_e$ are computed by adding to pitch lengths the values shown in table 4.

TOLERANCE. The permissible deviation on the length shown in table 3 is about ± 2 %.

Box-type speed changers need a closer tolerance, which can be complied with by printing a conventional length symbol on the external face of the belt after checking.

### 2.2 Profile dimensions of the pulley grooves

### 2.2.1 *Groove angle*

The groove angle $\alpha$ of pulleys shall be 26 ± 1°.

### 2.2.2 *Profile dimensions*

Radial dimensions shown in figures 1 and 2, namely

— $b$ : groove height above the pitch line,

— $h$ : groove depth below the pitch-line, and

— $d_p$ : pitch diameter (minimum in the case of figure 1),

shall not be less, for any setting of the drive, than the corresponding values for $b$ min., $h$ min., $d_p$ min. given in table 5.

Profile dimensions are given in millimetres in table 5.

## 3 MEASURING AND CHECKING PRACTICE

### 3.1 Preliminary note

When a wide V-belt under tension passes round a grooved pulley, its cross-section undergoes considerable distorsion along the arc of contact. For this reason, the dimensions of such a belt can only be validly defined, and consequently checked, if the belt is placed under conditions as similar as possible to the average conditions for normal use.

TABLE 4 — Difference between pitch length and outside length

| Designation of the sections | W 16 | W 20 | W 25 | W 31,5 | W 40 | W 50 | W 63 | W 80 | W 100 |
|---|---|---|---|---|---|---|---|---|---|
| mm | 8 | 10 | 12 | 16 | 20 | 25 | 32 | 40 | 50 |

TABLE 5 — Pulley dimensions

Values in millimetres

| Designation of the sections | | W 16 | W 20 | W 25 | W 31,5 | W 40 | W 50 | W 63 | W 80 | W 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| Symbol | Approximate formula | | | | | | | | | |
| $l_p$ | | 16 | 20 | 25 | 31,5 | 40 | 50 | 63 | 80 | 100 |
| $b$ min. | $0{,}080\, l_p$ | 1,3 | 1,6 | 2 | 2,5 | 3,2 | 4 | 5 | 6,3 | 8 |
| $h$ min. | $0{,}335\, l_p$ | 5,3 | 6,7 | 8,5 | 10,6 | 13,2 | 17,0 | 21,2 | 26,5 | 33,5 |
| $d_p$ min.[1] | $1{,}80\, l_p$ | 28 | 36 | 45 | 56 | 71 | 90 | 112 | 140 | 180 |
| $d_e$ min. | $d_p$ min. + 2 $b$ min. | 30,6 | 39,2 | 49 | 61 | 77,4 | 98 | 122 | 152,6 | 196 |

1) Owing to the need for compactness of these types of speed-changers, it is necessary to minimize pitch diameters. At the present level of techniques, the values given for the minimum pitch diameter should be used on the notched V-belts.

NOTE — The value $d_p$ min. = 1,80 $l_p$ is nearly equivalent to 5,6 times the nominal height of the belt sidewalls.

## 3.2 Principle of checking

The recommended device, shown in figure 3, consists basically of two pulleys of the same dimensions, one of which can be moved by translation in the plane of symmetry of the grooves, under the effect of the measuring force $F$ (see table 6).

In addition, a gauge is provided in one of the pulleys to check the section.

The belt should be checked only after it has made at least two complete revolutions.

## 3.3 Dimensions of the checking device

The dimensions of the pulleys and of the gauge are given in millimetres in table 6.

## 3.4 Checking belt cross-section

The method consists in checking the radial position of the belt in the gauge-pulley.

For this purpose (see figure 4), the rim of the gauge-pulley has two symmetrical radial slots, widening on the outside, which make it possible to locate the contact area between belt and groove.

When checking the radial position of the belt, the twin slots should first be located as shown in figure 3.

It should then be checked

— that belt ride out is below the limit indicated in 2.1.4;

— that the theoretical edge of the internal base is outside the circumference $H_2$.

For this purpose, the intersection of this circumference with the slots is marked, on the level flanges, by a thin engraved line, parallel to the bottom of the slot; if necessary, these engraved lines may be filled with paint, so that they can be seen more easily.

## 3.5 Checking belt length

Check the belt length as follows :

a) Calculate the pitch length $L_p$ by the formula

$$L_p = 2E + C_p$$

where

$E$ is the distance between axes, measured as specified in 3.1 and 3.2;

$C_p$ is the pitch circumference of the checking pulleys.

b) Calculate the outside length $L_e$ by the formula

$$L_e = 2E + C$$

where

$E$ is the distance between axes, measured as specified in 3.1 and 3.2;

$C$ is the sum of the pitch circumference ($C_p$) of the checking pulleys and the relevant length given in table 4.

TABLE 6 — Checking pulley dimensions

Dimensions in millimetres; force in newtons

| Designation of the sections | | | W 16 | W 20 | W 25 | W 31,5 | W 40 | W 50 | W 63 | W 80 | W 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Symbol | Approximate formula | | | | | | | | | |
| Pulleys | $l_p$ | | 16 | 20 | 25 | 31,5 | 40 | 50 | 63 | 80 | 100 |
| | $C_p$ | $12,5\, l_p$ | 200 | 250 | 320 | 400 | 500 | 630 | 800 | 1 000 | 1 250 |
| | $d_p$ | $4\, l_p$ | 63,7 | 79,6 | 101,9 | 127,3 | 159,2 | 200,5 | 254,6 | 318,5 | 398 |
| | $F^{1)}$ | $0,2\, l_p^2 + 100$ | 150 | 180 | 224 | 300 | 425 | 600 | 900 | 1 400 | 2 120 |
| | $d_e$ | $d_p + 2\,(0,08\, l_p - 0,24\sqrt{l_p})$ | 64,7 | 80,4 | 103,5 | 129,9 | 162,4 | 205,3 | 260,6 | 327,1 | 409,2 |
| Gauge | $h_2$ | $0,24\, l_p + 0,06\sqrt{l_p}$ | 4,0 | 5,1 | 6,3 | 7,8 | 10,0 | 12,4 | 15,5 | 19,7 | 24,6 |
| | $h_3$ | $0,32\, l_p$ | 5 | 6,5 | 8 | 10 | 13 | 16 | 20 | 25 | 32 |
| | $u$ | $0,10\, l_p$ | 2 | 2 | 2,5 | 3,2 | 4 | 5 | 6,5 | 8 | 10 |

1) The values of $F$ are the nearest preferred numbers, in the R 40 series, to the values determined with the formula.
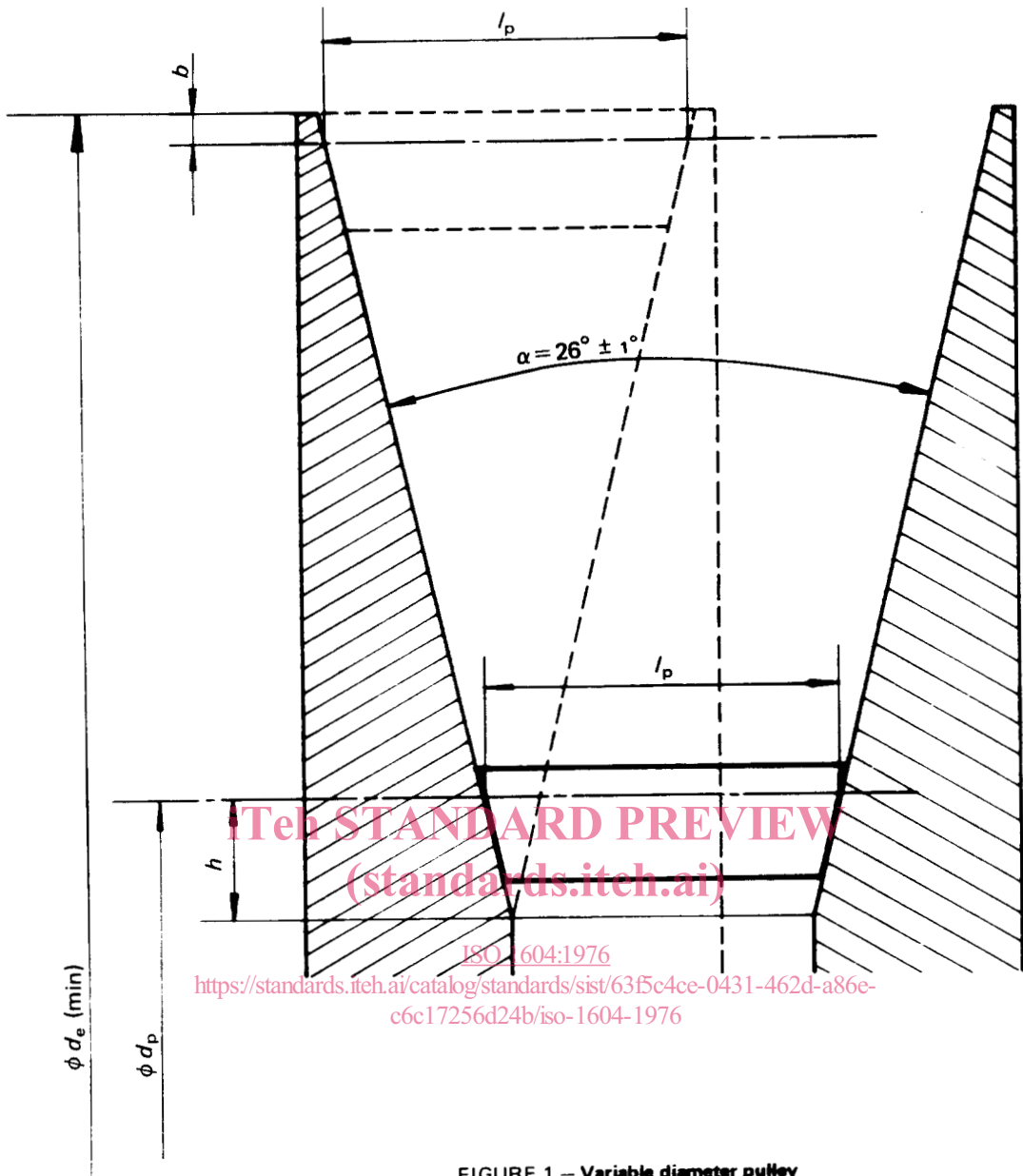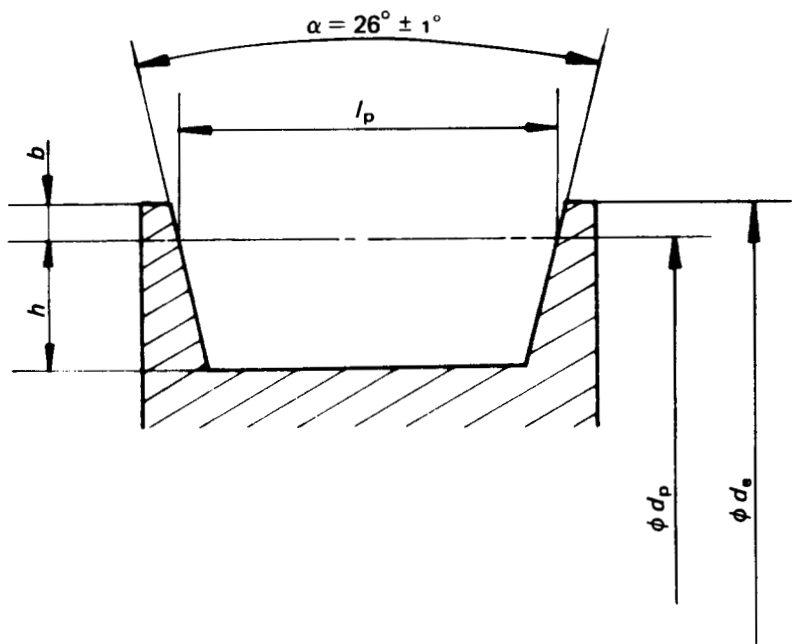
FIGURE 1 — Variable diameter pulley



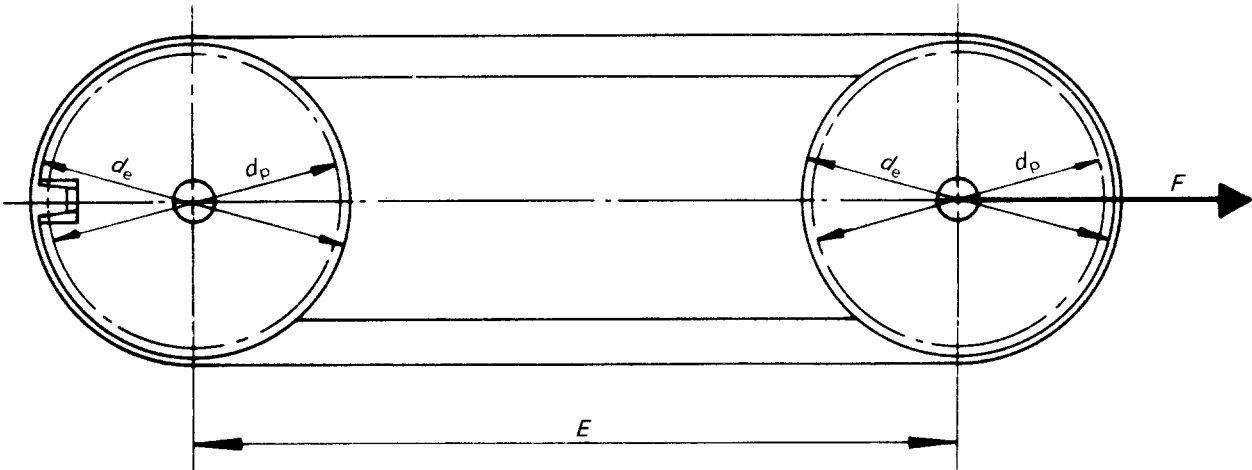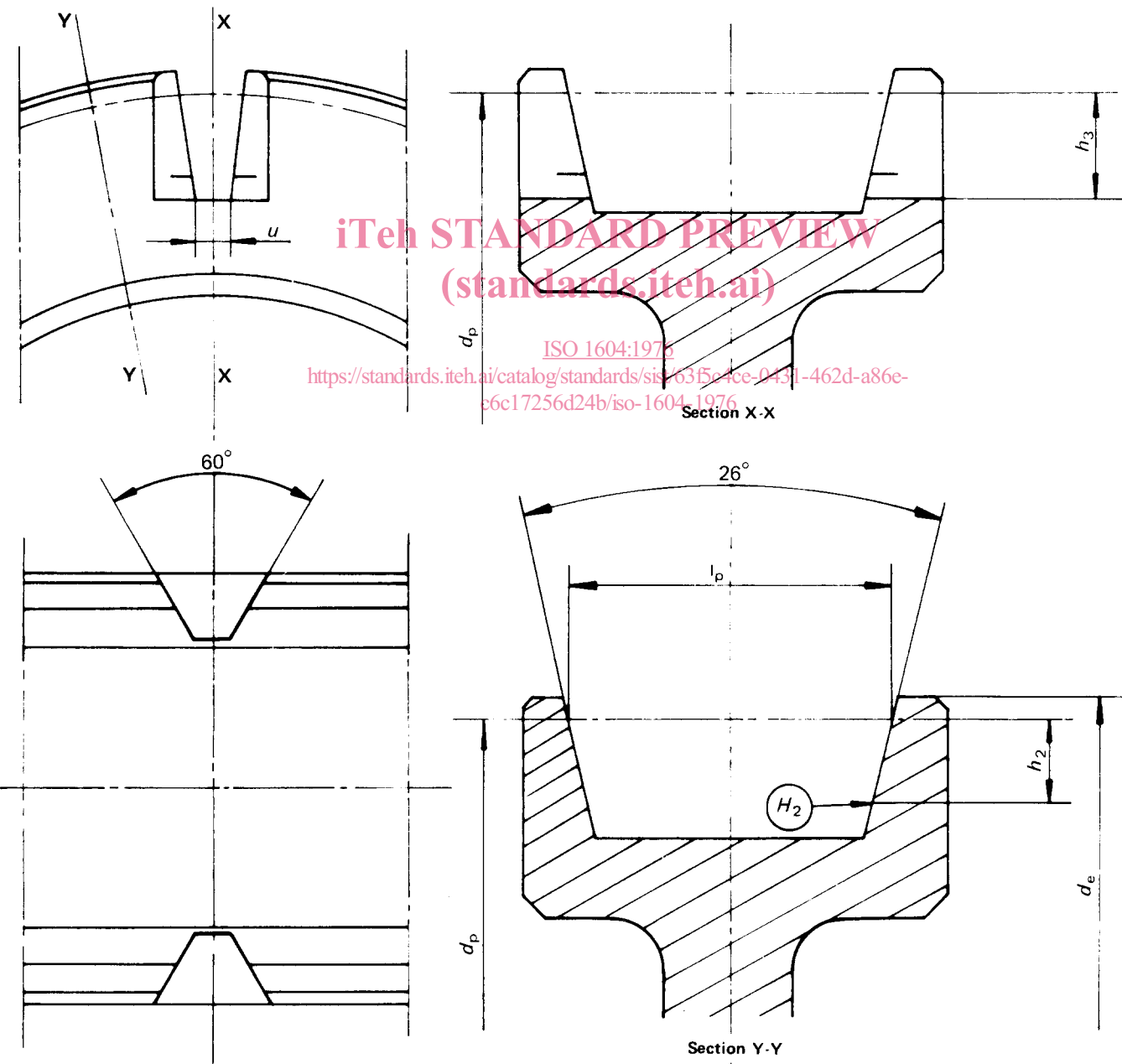FIGURE 2 — Fixed diameter pulley

FIGURE 3 — Checking device



Section X-X

Section Y-Y

FIGURE 4 — Checking pulley