

Method for

Calculation of operating power and tensile forces in belt conveyors with carrying idlers on continuous mechanical handling equipment —

[ISO title: Continuous mechanical
handling equipment — Belt conveyors
with carrying idlers — Calculation of
operating power and tensile forces]

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Chain Testers' Association of Great Britain	Metal Packaging Manufacturers' Association
Coke Oven Managers' Association	Sand and Gravel Association Limited
Electrical, Electronic, Telecommunications and Plumbing Union	Society of Dairy Technology

This British Standard, having been prepared under the direction of the Mechanical Engineering Standards Committee, was published under the authority of the Executive Board and comes into effect on 30 June 1980

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National foreword

This British Standard has been prepared under the direction of the Mechanical Engineering Standards Committee and is identical with ISO 5048:1979 *“Continuous mechanical handling equipment — Belt conveyors with carrying idlers — Calculation of operating power and tensile forces”*, developed by Technical Committee 101, Continuous mechanical handling equipment, of the International Organization for Standardization (ISO), and forms part of a series being developed by ISO/TC 101 dealing with continuous mechanical handling equipment.

Terminology and conventions. The text of the international standard has been approved as suitable for publication, without deviation, as a British Standard. Some terminology and certain conventions are not identical with those used in British Standards; attention is especially drawn to the following.

The comma has been used throughout as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

Wherever the words “International Standard” appear, referring to this standard, they should be read as “British Standard”.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 14 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

0 Introduction

In the design of belt conveyors, it is advisable first to calculate the required driving force on the driving pulley and the belt tensile stresses resulting therefrom, since these values will effectively determine the choice of driving system and the construction of the belt.

The operating power requirements are derived from the driving force on the driving pulley and from the speed of the belt.

The necessary belt width is calculated on the basis of the maximum capacity of the belt, and possibly of the particle size of the material to be handled.

Attention is drawn to the many varied factors which influence the driving force on the driving pulley and which make it extremely difficult to predict the power requirement exactly. This International Standard is intended to give a simple method of conveyor design calculation. Consequently it is limited in terms of precision but is sufficient in the majority of cases. Many factors are not taken into account in the formulae but details are provided on their nature and their effect.

In simple cases, which are the most frequent, it is possible to progress easily from the calculation of power requirements to those of the necessary and the real tensions in the belt, which are critical in the selection of the belt and in the design of the mechanical equipment.

However, certain conveyors present more complicated problems, for example those with multiple drives, or with an undulating profile in vertical elevation. For these calculations, which are not covered in this International Standard, it is advisable to consult a competent expert.

1 Scope and field of application

This International Standard sets out methods for the calculation of the operating power requirements on the driving pulley of a belt conveyor, and of the tensile forces exerted on the belt.

2 Symbols

Symbol	Description	Unit
a_o	Idler spacing on the carrying side of the conveyor	m
a_u	Idler spacing on the return side of the conveyor	m
b	Material-carrying belt width (i.e. width of the belt actually filled with, or bearing, material)	m
B	Belt width	m
C	Coefficient	—
e	Base of natural logarithms	—
f	Artificial friction coefficient	—
F_1	Tight-side tension at pulley according to Figure 2	N
F_2	Slack-side tension at pulley according to Figure 2	N
F_H	Main resistances	N
$F_{\max}$	Maximum belt tension	N
$F_{\min}$	Minimum belt tension	N
F_N	Secondary resistances	N
F_S	Special resistances	N
F_{S1}	Special main resistances	N
F_{S2}	Special secondary resistances	N
F_{St}	Resistance due to slope	N
F_U	Required peripheral driving force at the driving pulley(s)	N
g	Acceleration due to gravity	m/s ²
$(hla)_{zul}$	Admissible belt sag between idlers	—
H	Lift of the conveyor between the dumping area and the loading area	m
I_V	Capacity	m ³ /s
k	Slope factor	—
L	Conveyor length (distance between centres)	m
P_A	Operating power requirement on the driving pulley(s)	W
P_M	Operating power requirement on the driving motor(s)	W
q_B	Mass of the belt per metre along the carrying side and along the return side	kg/m
q_G	Mass of the handled material per metre	kg/m
q_{RO}	Mass of the revolving idler parts along the carrying side of the conveyor, per metre	kg/m
q_{RU}	Mass of the revolving idler parts along the return side of the conveyor, per metre	kg/m
S	Cross-sectional area of the material on the belt	m ²
v	Belt speed	m/s
γ	Density of the handled bulk material	kg/m ³
δ	Slope angle of the installation in the moving direction	degrees
η	Efficiency	—
λ	Angle between the side axis of the troughed carrying idlers and the horizontal	degrees
μ	Friction coefficient between driving pulley(s) and belt	—
ξ	Acceleration coefficient	—
ρ	Surcharge angle of the handled material	degrees
φ	Angle of the belt wrap on the driving pulley(s)	radians