

Data Dictionary

Column Header	Definition
UDI/UID	Unique identifier ranging from 1 to 10000
Product ID	Consists of a letter L, M, or H for low (50% of all products), medium (30%) and high (20%) as product quality variants and a variant-specific serial number
Original Features/Variables	
Type	Product type L, M or H from Product ID
Air temperature [K]	Temperature of the air. Generated using a random walk process later normalized to a standard deviation of 2 K around 300 K
Process temperature [K]	Temperature of the process. Generated using a random walk process normalized to a standard deviation of 1 K, added to the air temperature plus 10 K.
Rotational speed [rpm]	How fast the machine is rotating. Calculated from a power of 2860 W, overlaid with a normally distributed noise
Torque [Nm]	Rotational force of the machine. Normally distributed around 40 Nm with a SD = 10 Nm and no negative values.
Tool wear [min]	Duration the tool has been used. The quality variants H/M/L add 5/3/2 minutes of tool wear to the used tool in the process.
Engineered Features/Variables	
Non-Failure	Label for machines that exhibit no failure cases.
Temperature difference [K]	The absolute temperature difference between the air temperature and process temperature for each machine.
Power [W]	Calculated using the product of rotational speed and torque for the process.
Strain [minNm]	Product of tool wear and torque.
Machine Failure Cases:	
Machine failure	Label that indicates whether the machine has failed in this particular datapoint for any of the following failure modes are true. If at least one of the above failure modes is true, the process fails and the 'machine failure' label is set to 1.
Tool Wear Failure (TWF)	The tool will be replaced or fail at a randomly selected tool wear time between 200- 240 mins (120 times in our dataset).
Heat Dissipation Failure (HDF)	Heat dissipation causes a process failure, if the difference between air- and process temperature is below 8.6 K and the tools rotational speed is below 1380 rpm.
Power Failure (PWF)	The product of torque and rotational speed (in rad/s) equals the power required for the process. If this power is below 3500 W or above 9000 W, the process fails.

Overstrain Failure (OSF)	If the product of tool wear and torque exceeds 11,000 minNm for the L product variant (12,000 M, 13,000 H), the process fails due to overstrain.
Random Failure (RNF)	An unknown failure which can occur, where each process has a chance of 0,1 % to fail regardless of its process parameters.