01/2023

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NEWS

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ZEITENWENDE

Wolfgang Endrich

Die fast zweijährige Coronakrise hat uns gelehrt, dass es mit dem „Weiter so" nicht mehr so weiter gehen konnte. Und seit dem Beginn des Ukrainekrieges im Februar diesen Jahres haben wir schmerzlich fühlen dürfen, dass die Politik des „Weiter so" von Frau Merkel ein abruptes Ende gefunden hat. Der Leitsatz „Wandel durch Handel" entpuppte sich als großer Irrtum. Plötzlich hatten wir nur noch Krisen. Angefangen bei den Halbleitern, dann mit der Gasversorgung, Wohnungsnot, Flüchtlingen und so weiter...

Wir haben uns in den letzten Jahren mit der „Weiter so" Politik leider viel zu sehr „einlullen" lassen, d.h. die Hoffnung, es wird schon so weiter gehen, wir brauchen uns um nichts zu sorgen, war verhängnisvoll für uns alle. Unsere Regierungsmannschaft war nicht herausragend, aber es ging uns verhältnismäßig gut und wir haben uns leider nicht klar gemacht, in welche weltweiten Abhängigkeiten wir uns begeben hatten. Und zwar energie- und rohstoffmäßig von Russland, und von China und Indien z.B. von Vormaterialien für Impfstoffe und Medikamente.

Man hat die Gefahren entweder nicht gesehen oder nicht sehen wollen, denn Putin hatte zwar von seinen großen Visionen bereits vor vielen Jahren ganz öffentlich gesprochen, aber ernst genommen haben wir sie nicht wirklich, denn es lief ja alles so schön.

Das Erwachen aus dieser Schläfrigkeit oder besser Schlafmützigkeit war furchtbar und unsere neue Regierung hatte bereits in den ersten Stunden ihrer Tätigkeit alle Hände voll zu tun, um Krisen irgendwie abzuwenden oder abzumildern. Vielleicht waren wir all die Jahre nicht kritisch genug, die Krisen wenigstens als Möglichkeit in Betracht zu ziehen und entsprechende Vorsorgen oder Absicherungen zu treffen.

Mehr erfahren auf Seite 2

ZEITENWENDE

Unsere Verkehrssituation auf den Straßen und mit der Bahn, bei der Digitalisierung, Umweltschutz und -bewusstsein, der Ausbildung unserer Kinder und schließlich im Gesundheitssystem sind schwere Versäumnisse, die man mit einem Blick ins Ausland vielleicht hätte abmildern oder sogar vermeiden können. So hat uns die Coronakrise schonungslos gezeigt, wie altmodisch unsere Verwaltung heute noch arbeitet. Wir haben seit Jahrzehnten Mahner, die den Klimawandel vorausgesehen haben, aber wir haben nur halbherzig gehandelt und wir brauchten erst Katastrophen wie Überflutung, Dürre, Waldbrände usw., um zu merken, dass es ernst wird. Seit Jahren haben wir geschlafen und die Folgen nicht sehen wollen. Denken wir nur an die Weltmeere, die vom Plastikmüll überdeckt sind, die Pole schmelzen ab, die Gletscher in Europa ebenfalls. Selbst die Krankenkassen haben durch eine falsche Preispolitik die Arzneimittelhersteller gezwungen, die Arzneimittel im Ausland herstellen zu lassen. Dies sind nur wenige Beispiele unserer Versäumnisse und jetzt sind wir plötzlich unvorbereitet aus unserer Lethargie herausgerissen worden. All dies schmerzt sicherlich gewaltig, aber es ist gut, endlich aufgeweckt zu werden.

Was wir jetzt brauchen, ist eine Aufbruchstimmung und den Willen zur Veränderung und kräftig in die Hände zu spucken. In den letzten 10 bis 20 Jahre ging es uns zu gut. Aus diesen Lehren haben wir gelernt. Deshalb müssen wir jetzt gründlich all dies ändern, was in den letzten Jahren versäumt wurde. „MAKE GERMANY GREAT!“

Wir haben es versäumt, die Windenergie und die Solarenergie massiv zu fördern. Stromleitungen von der Nord- und Ostsee bis nach Bayern wurden von der Bevölkerung abgelehnt. Auch die Behörden haben dazu beigetragen, indem die Beantragungen nur langsam und zum Teil erst nach Jahren bewilligt wurden.

In diesem Sinne wünschen wir Ihnen allen einen guten Aufbruch, viel Erfolg im neuen Jahr, aber auch den Optimismus, dass mit Fleiß und Beharrlichkeit für uns und für unsere Kinder eine erstrebenswerte Zukunft erreicht werden kann!

3^3 SINGLE PAIR ETHERNET

Freedom of Choices and Budgets

What is Single Pair Ethernet?

ALTW's "3^3 SPE" mechanical interfaces are all designed and made according to IEEE 802.3 bp standard offering three mechanical mating interfaces all IP67 up and above, giving you the freedom to choose the interconnects suitable to your needs and requirements for industrial and ruggedized applications.

1. Single Pair Ethernet (SPE) cables simplify the process of connecting and powering edge devices by extending the range and bandwidth of a single twisted pair.

2. SPE cables allow stable, uninterrupted connectivity from remote field devices to the cloud, even in the roughest situations, thanks to excellent shielding and jacketing choices.

3. With the ability to integrate data and power delivery with Power over Data Line (PoDL), you can benefit from increased uptime, process efficiency, and operational benefits.

MPE vs SPE

	SPEED	DIRECTION	DATA RATE
FAST ETHERNET	100 Mbit/s per twisted pair	undirectional	100 BASE-TX
GBIT ETHERNET	250 Mbit/s or 2.5 Gbit/s per twisted pair	bi-directional	1 GBase-T or 10 GBASE-T
SINGLE PAIR ETHERNET	100 Mbit/s or 1 Gbit/s per twisted pair	bi-directional	100 BASE-T1 or 1 GBASE-T1

MPE means Multi Pair Ethernet which utilizes two or four wire pairs.

M12 SPE
(Screw & Push-Pull)

FLOS+ SPE
(Push-Pull)

X-Lok SPE
(Push-Lock)

APPLICATIONS

- 3 mechanical interfaces IP67 and above for industrial and ruggedized applications
- 3-dom of choices for your needs and requirements
- 3 budgets, pay for what you need

FEATURES

- ALTW's proprietary SPE interface integrated in M12 (screw threaded & push-pull) / FLOS+ (push-pull) / X-Lok (push-lock)
- Providing low power & simply networking on end-point sensors
- Cost-effective, smaller & lighter than standard 4 pairs ethernet cable
- Compatible 10/100/1000 Base-T1 data rates as existing technologies **
- Receptacle IPX8 UNMATED waterproof, also available in double ended and field installable
- Vibration resistance 20 g (10 ~ 2,000 Hz)
- Supports PoDL (power over data lines)

** 24~26 AWG standard length 15 m

Amphenol LTW
Innovation in Waterproof Solution

DESIGN OF SYSTEM COOLING USING DC AXIAL FANS

Cooling has a key role in today's electronics, as the lifetime expectancy of passive and active components is highly dependent on the way of transferring the heat generated by their electric current towards the surrounding environment. In some cases, the properly designed PCB and an additional heatsink provides adequate surface to remove the heat emitted by the components, in other cases the system needs active cooling e.g. by forced flow of air. The design of cooling is often not a part of the functional design of the electronic devices, however this has key role in supporting functionality. Usually, a fan used without proper selection may result in oversized mechanical measures, or - in worst case - undersized cooling efficiency. Today's miniaturization trends make it not possible to unnecessarily enlarge enclosure size, while the competition does not allow to produce unreliable products. Therefore, cooling design cannot be started early enough, just like without proper circuit protection, no electronics device can provide its primer functionality for long time without sufficient cooling. Our article is about some important selection criteria of the proper fan depending on the application conditions.

The most important method when taking heat away from components is convection, when the excess thermal energy is released by a flow of the surrounding medium (air/coolant) to the atmosphere. Convection may be natural, when the flow is generated by temperature difference, or forced, when the stream is created by external force such as the rotation of an impeller. Forced convection -provided by high volume airflow of axial fans- is extremely effective towards the cooling of electrical devices. The most important design aspect is to leave sufficient space for this flow around the most heat-critical components concerned, the fan and its power supply, paying special attention at least of the proper air-intake and exhaust vents. If these criteria are taken in consideration during functional design, an important step is taken into the direction of reaching the maximum performance of the application and to avoid later stage compromises between functionality and sufficient cooling: Although when designing a forced air-cooling system, the proper fan selection depends on many factors, the very first step is always to determine the required air flow volume. This is primarily defined by the total heat generation of the system, and the allowed maximum temperature rise.

In order to calculate the required airflow Q [m^3/min], we need to obtain the following values:

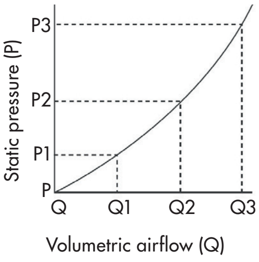
- The power dissipated within the systems (worst-case estimation) : P_{LOSS} [W]
- The k constant describing the packing density of the components that prevent the free flow of air (k = 80 - 95 rare placement, k = 60 dense components)
- The maximum allowed temperature rise that is defined by the operating temperature range of the used components (ΔT)

$$Q = \frac{P_{LOSS}}{C_p \cdot \rho \cdot \Delta T} \cdot k$$

Where, Q: required airflow [m^3/min] C_p: heat capacity of the air at constant air pressure: 1007 J / (kgK)
ϱ: Air density: 1.2 kg/m^3 @ 25 C°
Taking the usual experimental values of the constants in consideration the formula of the required airflow may be simplified like this:

$$Q = \frac{P_{LOSS}}{\Delta T} \cdot 0.05\ [m^3/min]$$

System impedance curve of an electrical device



In practice this means that a system dissipating 200 W requires 0.5 m^3 airflow a minute to keep at maximum 20 C° of temperature rise.

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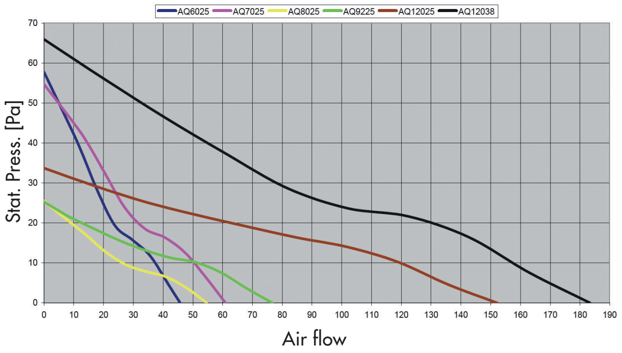
Although this theoretical calculation provides exact volumetric airflow requirement, it does not give adequate answer for the practical problem, whether the selected fan will provide this airflow or not, since it does not hold enough information about the interaction between the fan and the system to be cooled. It is much more complicated to calculate how a certain cooling fan acts in a specific system arrangement. The characteristics describing the real cooled system's obstruction against the airflow is called the system impedance curve (SIC -fig.1). The system impedance curve describes the static pressure rise over the airflow and can be described by a nearly quadratic equation: $P_s \sim Q^{1.75\ldots 2}$. It can be generated experimentally by applying various air flow rates to the system and measuring the enclosure pressure it generates.



To step forward we need to know the non-linear relationship between the fan's volumetric air flow and its static pressure represented by the characteristic on the 2nd figure. The static pressure is maximized when the airflow path is completely obstructed, at this point the volumetric airflow is zero (intersection with Y axis). The maximum possible airflow can be read out at the intersection of the characteristics with axis X, which point represents the case no obstructions at all, free flow of air is enabled (see fig. 3).

In forced convection cooled systems, the above two characteristics play important role. The point of intersection of the fan's air performance (P-Q) curve and the system impedance curve will define the operating point of the cooling solution (fig. 4).

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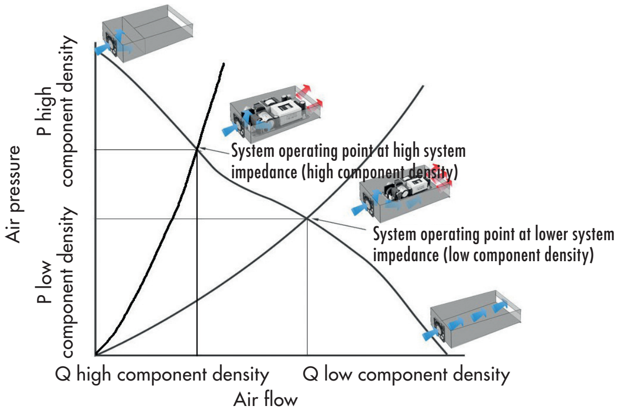
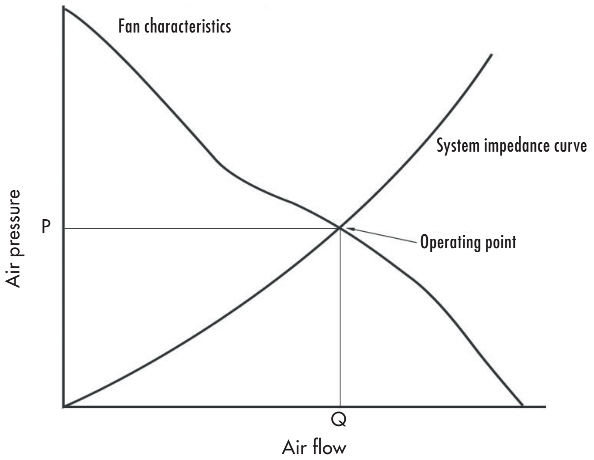
Fan´s P-Q characteristics and the operating points depending on component density



In case of blocked enclosure, the static pressure grows to the maximum value and the airflow is completely blocked. When there are no obstacles in the air flow path, the theoretical value of static pressure is zero, the volumetric air flow is at maximum. The usual operating point represents a dense packed system and a normal system. In the first case the high system impedance could be only compensated by applying higher pressure, resulting in lower air flow volume. In the other case as the static pressure is lower, higher volumetric airflow is possible, therefore more effective cooling could be done. In both cases we used the same fan, the operating points have been defined by the different system resistances.

Operating point: intersection of fan´s P-Q curve with the system impedance curve of the enclosure



By knowing above fact it is now possible to select the proper fan. Nowadays DC fans are more popular than AC versions as their power consumption is usually lower, lifetime is longer, and because their angular speed is proportional to their supply voltage, it is easy to apply speed control. The lower the speed the more silent the operation is, the lower the power consumption and the higher the lifetime will be (due to reduced wear out of the bearing). DC fans produce less EMI than AC versions, there are no geographical issues of supply voltages and frequencies, and price differences already disappeared. Therefore, we only write about DC axial fans in this paper. After calculating the required air flow rate, having the system impedance curve on hand, we define the static pressure interval, that should be overcome by the fan to provide the required air volume. Then using the fan manufacturers' catalogues, a specific device can be selected, that is able to provide the adequate airflow on the level of back pressure required by the SIC. It is advised to select the operating point out of the critical area marked by red on figure 5. This area is the so-called stall area, where the air flow stalls at the blade profile, which makes negative effects. Such an immediate disadvantage is the considerable increase in noise. For longer term negative effect is the vibration, which can reduce functionality and leads to lifetime issues. Therefore, fan should always be operated in the optimum operating area marked with green on figure.

Further reducing noise at even the optimum operating area can be also important selection criteria, it is advised to select the fan with the highest possible diameter. Bigger sizes mean lower speed, therefore less bearing noise. This is however against today's miniaturization trends, we should use small, thin fans wherever and whenever possible. It is important to consider size at the beginning, this is not only the question of design and technology trend but on long term influences price of the end-product.

If the desired operating area cannot be reached by a single small fan, it is possible to use multiple fans next to or behind each other. These arrangements will negatively influence noise and mathematical lifetime expectancy, but offer redundancy, which supports system reliability.

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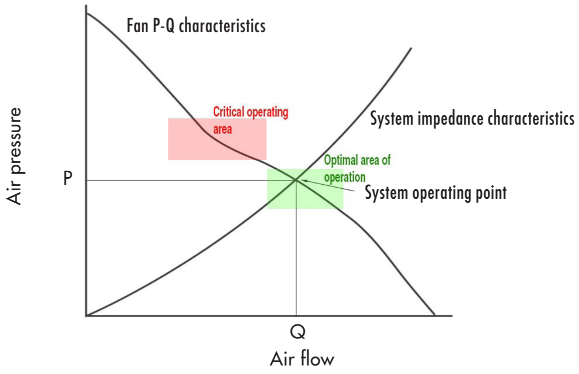
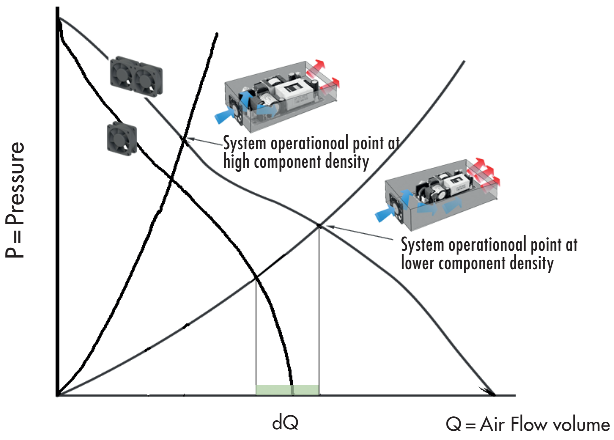
Area of operating points



Using multiple fans – parallel operation

When we switch several fans in parallel (side by side), then the joint system's air moving capacity is increased in the range of low static pressures. On the curve on fig.6, it can be observed that when used concomitantly, the idle air flow is increased. In practice, this means that we can operate with such an arrangement if the component density of the system to be cooled is low, so the operation point can be set at a low static pressure level. Of course, the new working point is also associated with a slightly higher air pressure, however, where a significant increase is observed it is the air flow. In the case of higher system impedance, this arrangement does not bring much benefit since the additional investment does not result in a significant increase in airflow.

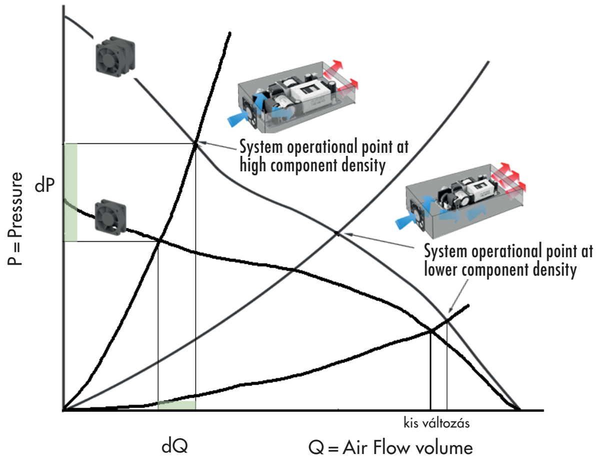
Characteristics of parallel fan organization



Using multiple fans – serial operation

When several fans are connected in series (behind each other), the airflow of the combined system increases significantly in the range of high static pressures, so with such an arrangement we can achieve a significant improvement in chassis with high component density and high system impedance. In this case, the operational point is in an area characterized by high static pressure, the serial arrangement is characterized by increased air flow even at higher air pressure. At low component densities, this additional pressure is not needed, so this arrangement cannot be applied economically, because the investment will not bring a significant increase in air flow (see fig. 7).

Characteristics of serial system

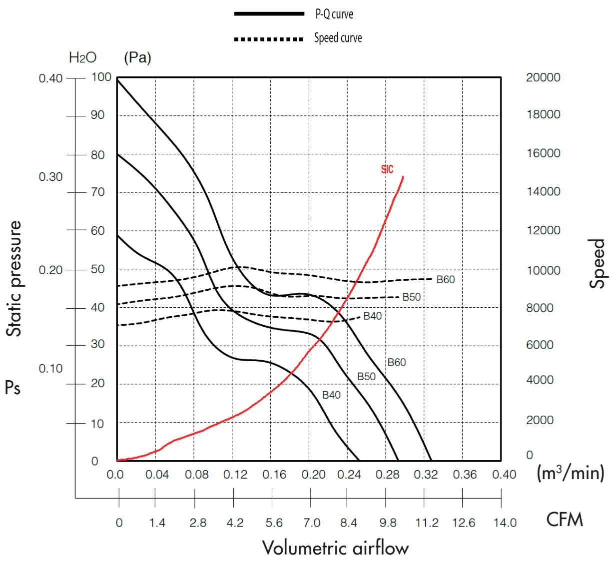


The effect of speed on air flow

DC axial fans have different P-Q characteristics for different nominal supply voltages, so they differ at nominal rotational speeds (see Fig. 8), so when applied to the same system at a higher rotational speed, they can be used to achieve greater air flow and pressure. Assuming the impedance curve being a square function, the working points that are output for each rotational speed can be assigned to higher static pressure and air flow values, respectively. Variable speed can be achieved with external voltage regulation for two-wire fans, but of course there are built in RPM control functions at three- or four-wire fans. In the case of the former, the third wire is used to receive a high-frequency pulse width modulation control signal (PWM), while in the case of the latter, a so-called additional tacho-pulse supplied by a (HALL) transmitter is received from the motor on the fourth wire. The fan returns data about its speed to the external control electronics. On this line, in addition to the usual data, a special distress signal, such as a warning of possible rotor jamming, may also be received. Pulse width modulation speed control is actually a supply voltage control, the essence of which is that the DC voltage applied to the fan terminals is periodically alternated between the values of 0 V and the rated voltage, using transistor or FET-based electronics. The effective value of the terminal voltage is determined by the ratio of times spent in the two states (fill factor).

From the foregoing, some very important conclusions can be made, which must necessarily be taken into account when choosing a cooling fan.

With an increase in speed
- (+) the airflow increases
- (+) squared increase in pressure occures
- (-) there is a significant increase in noise,
- (-) significantly increased engine heating
- (+) the bearing load reduces the service life



We would like to show their significance through an example. Figure 9 shows the P-Q characteristics of two cooling fans. The parameters of the fans are as follows:

A: 80 x 80 x 25 mm; 4200 rpm; 3.96 W; 44 dB(A)
B: 80 x 80 x 32 mm; 4600 rpm; 4.20 W; 46 dB(A)

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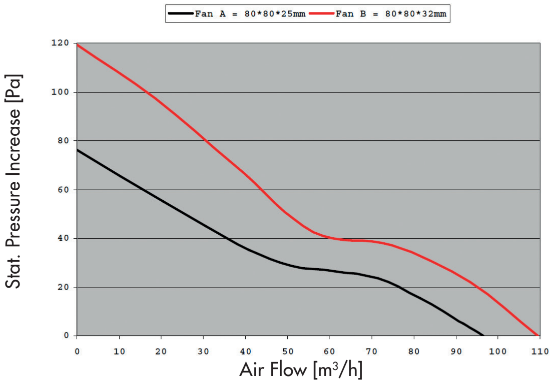
80 mm Fan Size



In the example above, in terms of the physical dimensions of the two devices, there is only a difference in their thickness. It is assumed that the device marked B would provide sufficient cooling for the system, but for space-saving reasons, we choose the thinner design (A). To ensure proper volumetric airflow and pressure levels, fan A is used at ~10 % higher RPM, which results in 31.4 % higher consumption, greater dissipation (heating), significant additional noise and significantly reduced service life due to the increased load on the bearing. The negative impact of warming further worsens life expectancy, which is really evident, when you consider the fact, that - according to some experts - the fan motor's 10 °C durable temperature increase causes 20,000 hours (approx. 40 %) reduction in lifespan.

From the above, it can be seen, when choosing cooling solutions for a particular system, it is worth making a reserve of the required airflow, using a cooling fan with the largest possible physical size, running at a speed even lower than the nominal one, if the design of the system allows it. If for some reason a higher static pressure or a larger volumetric air flow is required, depending on the layout, there are several options: you can raise the number of revolutions and/or apply more than one cooling fans (in serial or parallel arrangement). In all these cases, it is necessary to carefully examine the actual additional advantages of the given solution and how much investment it requires, because it often happens with poor designs that, for example, the self-heating of the applied several fans is greater than the extra cooling it offers for the system. In addition, the economy must also be examined, the price of the second, third fan, the increase in the mathematical probability of failure, the increase in consumption all affects the price and operating costs of the final product.

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