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Ton Mile Per Hour Application Practice—SAE J1098 DEC83

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TON MILE PER HOUR APPLICATION PRACTICE—SAE J1098 DEC83

SAE Recommended Practice

Report of the Construction and Industrial Machinery Technical Committee, approved November 1975, last revised by the Off-Road Machinery Technical Committee December 1983.

*1. **Purpose***—Application of the tire TMPH rating value as determined by SAE J1015 test procedure for off-the-road tires.

*2. **Scope***—This recommended practice utilizing empirical data formula describes the procedure for evaluating and predicting off-the-road tire TMPH requirements as determined by work cycle analysis.

2.1 Loads, speeds, inflations, and rim configurations are assumed to be within acceptable industry or manufacturers' prescribed recommendations.

2.2 Other application parameters affecting tires are not included in the scope (for example: flotation, cut, bruise, wear, etc.) These parameters must also be considered for final tire selection, since a tire that maximizes desirable TMPH characteristics will normally compromise these other parameters.

2.3 Standards for the productivity of off-the-road machines or tires, are not included in the scope.

2.4 The formulae (see paragraphs 4.2 and 4.3) are applicable to transport type machines only (that is, trucks, tractor trailers, and scrapers) using Category E Earthmover Service Code Tires. See SAE J751 for Service Codes.

*3. **General (Introduction to TMPH)***—A tire operated at its J1015 TMPH rating will achieve a stabilized temperature under continuous operation without heat damage.

3.1 Origin of Tire Heat—The temperature described in Section 3 occurs at or near the interface of the undertread and carcass (see J751, Fig. 1). This results from the transitory load on the tire crown causing the tire to flex, producing the greatest stresses at or near the junction of the undertread and carcass. The TMPH rating of a tire is established from the maximum stabilized temperature along that interface.

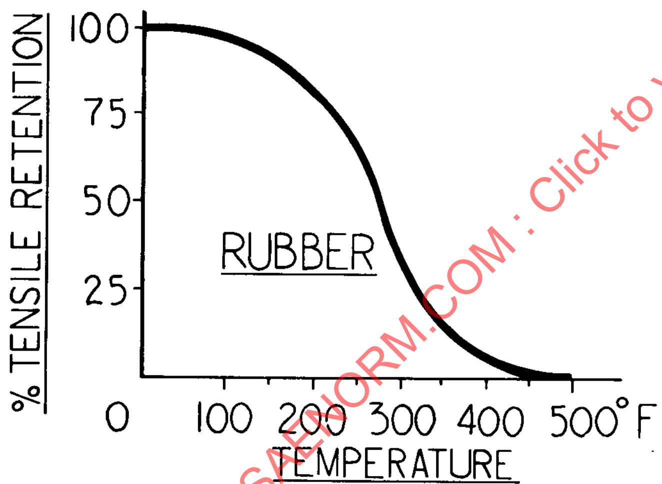

FIG. 1—TEMPERATURE EFFECTS

Variation in tire construction can result in substantial differences in TMPH rating.

3.2 Effect of Tire Heat—As a tire's temperature increases, its material strengths decrease (Fig. 1). Repeated or sustained exposure to excessive temperatures will ultimately produce tire damage. Heat damage is progressive. It may go undetected or become evident under operating conditions where no apparent cause exists.

3.3 Effect of Load and Inflation—Tire deflection is a function of its load and inflation pressure. When a tire is operated outside its normal deflection range due to incorrect inflation pressure related to the load carried (see paragraph 2.1), excessive heat build-up may take place in the tire. This will affect the tire's TMPH capabilities. ϕ

3.4 Work Cycle Influence on Tire Temperature—A tire performing within acceptable deflection limits will generally attain an equilibrium temperature within approximately 100 miles of service. Various combinations of empty and loaded machine hauls may be programmed to produce acceptable tire temperatures. However, if any operating parameter is altered so as to exceed the tire's TMPH rating, tire heat damage will result. Some examples are:

(a) Increase in operating cycle speed. (Consider individual driver practices.)

(b) Increase in machine loading due to change in material density and/or machine modification.

(c) Adverse weight distribution due to loading techniques or haul road grade.

3.5 Job Site Condition Influence on Tire Temperature—Other items not directly affecting the TMPH calculations, but increasing tire temperature are:

(a) Shift schedule increase where equilibrium temperatures had not previously been attained.

(b) Ambient temperature in excess of 100°F.

(c) Adverse road conditions (crown, curves, surface, etc.).

(d) Excessive brake heat.

(e) Vehicle configurations which limit tire cooling.

*4. **Determining the TMPH Job Rate***—This section defines the formulae with limitations for calculating the Ton Mile Per Hour Job rate of an individual tire based on work cycle analysis. For the working formula (paragraph 4.3), the tire with the highest average load must be considered.

4.1 Nomenclature

H = time, hours, total for the day from the beginning of the first shift to the end of the last shift.
J = job rate in TMPH.
M = length of round trip, miles.
M_L = length of loaded haul, miles.
M_E = length of empty haul, miles.
N = the number of round trips for the time (H) period.
N_E = the number of empty trips for the time (H) period.
N_L = the number of loaded trips for the time (H) period.
R = tire rating in TMPH as determined by SAE J1015.
T_L = tire load, tons, on the loaded machine.
T_E = tire load, tons, on the empty machine.
$T = \frac{T_L + T_E}{2}$ (for the tire with the highest average load).

4.2 General Formula—The general formula is:

$$J = \frac{\Sigma T_L M_L N_L + \Sigma T_E M_E N_E}{H}$$

(Refer to paragraph 4.1 for Nomenclature.)

Heat generation and retention in a tire is not simply a linear function of the Ton Mile Energy Rate. (Refer to paragraphs 3.1–3.5.) Hence, this formula is usable only within certain limitations as defined in paragraph 4.4.

4.3 Working Formula—The following working formula should be used with limitations in paragraph 4.4.

$$J = \frac{\text{Highest Avg. Load in Tons} \times \text{Miles Travelled}}{\text{Time (Hours)}}$$

$$J = \frac{T\,MN}{H}$$

4.4 Limitations—Application limitations vary from one tire manufacturer to another. Individual tire manufacturers should be consulted for deviations from the following general limitations.

4.4.1 LOAD—For loads per tire, refer to current T&RA Yearbook 30 mph Table, the tire manufacturer's 30 mph publication, or his specific application approval.

4.4.2 DISTANCE—Empty and loaded hauls should be equal and one way haul distance shall not exceed 10 miles.

The ϕ symbol is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.