SMA TECHNICAL MEMO
TM 153

TITLE: TRANSPORTER DESIGN STUDY REPORT

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DATE: 29 October 2004 Correction: 11/06/07 Page 14

Introduction:

A design study has been conducted to investigate possible solutions to two known SMA transporter problems. One is considered critical, while the other limits its drive capabilities (tractive effort). The critical problem is that the rear tires are operating significantly over their specified operating load capacity. Also, they have been in service over 10 years. This needs to be addressed before a tire failure or failures occur. Previous studies demonstrated that the transporter is safe when a tire failure (personnel and antenna) occurs, i.e. it will not roll over or harm the driver. However, tire repair/replacement will be difficult and poses safety concerns because the tire(s) require antenna removal to provide access for changing.

The second concern is the transporters' drive capabilities (tractive effort) when transporting an antenna. The transporters hydraulic system has been adjusted to its maximum operating pressure setting of ≅ 6000 psi. At this setting, the transporter is just able to climb the steepest road slope during antenna transport. This was reported previously in SMA-Technical memo number TM-146. Operating at this pressure setting has resulted in Hydraulic fluid leaks and could pose safety concerns as exposed hoses age and/or are damaged. A proposed design change is offered for consideration and is supported by a Rough Order of Magnitude (ROM) cost estimate.

An additional area investigated was re-designing the rear Hydraulic systems to improve performance, serviceability and replacement of the High Pressure rubber hosing with metal tubing (leaks & safety) were possible. A Rough Order of Magnitude (ROM) costing was estimated for this work. A design study is proposed to prepare a conceptual design with a detailed cost analysis.

Tire Study

The tire loads have been be computed (with good accuracy) by using antenna measurements made by Ant and transporter measurements by George and Roger. The tire load calculations are shown in **attachment 1**. These calculated loads are the basis for tires concerns.
2/2011 Attachment 1 is SMA p/n 10086010002 Rev B per ECO871

We selected only known and reputable manufacturers of Heavy Equipment tires of our required size. Those being:

Bridgestone/Firestone; Jim Van Orsdel, Manager Original Equipment Engineering
Goodyear Tire & Rubber Company; Dave Wright, NA/GDYR
Dunlop Tire; (No reply)
Michelin Tire; (No reply)

The following (worst case) information was provided to all manufacturers:

Tire size: 20.5-25 wide base type
Maximum load: 28,000 lb.
Maximum speed: 2 mph
Road surface: compacted shale and lava rock, not paved
Ambient temperature: 5 to 40^0 F
Elevation; 13,600 feet above sea level (high ultra-violent light exposure)

Information describing our application:

Average transporting distance: 1.5 miles
Maximum transporting distance: 2.0 miles
Average speed while under load: 1.5 mph
Maximum speed while under load: 2.0 mph
Maximum loads per day: 2
Maximum loads per 30-day period: 10

Additionally, a projected minimum tire life of 300,000 revolutions under a 28,000 load at 1.5 mph over a 5-year period was requested, which is the warranty period for this tire type.

The Tire & Rim Association (T&RA) publishes a yearbook, which provides specifications for nearly all tires manufactured within the USA as well as elsewhere in the world. These specifications provide dimensional guidelines and load capacity ratings for the different size and types of tires. Tire manufacturers follow these guidelines to build tires for the different industries and applications. They are responsible for building tires to meet these specifications. Manufacturers' also provide additional safety margin to guarantee tire performance. How this increases the load capacity was unattainable from the manufacturers. It is considered "Company Confidential". Knowledge of these additional margins would give us a better understanding of the true load capacity of the tires.

This report is based on the T & RA "OFF-THE-ROAD" section and its relevant design information are provided in **attachment 2**. This section is further divided to address more specific types of service. The transporters type of service is best defined as 'LOADER AND DOZER". This type of service restricts the loaded travel speed to no more than 5 mph. The distance traveled is limited to 250 feet, however the frequency of loaded transports is a large factor here. The transporters travel distance is greater but the frequency of loads is substantially less. For earthmover haulage and loader applications, a 15% excess load factor is applied to tires used in this type of service. When excess loads are encountered, tire inflation pressures must be increased 2% for each 1% increase in load.

The following tire data for the current size tire on the transporter is taken from table WB-5:

20.5-25 size, 20 ply; 20,900 lb. @ 65 psi inflation pressure
20.5-25 size, 24 ply: 22,700 lb. @ 76 psi inflation pressure

Note that the rating for the 20.5-25 size, 20-ply tire is 1360 lbs. greater than the old Bridgestone specifications (19,540 lbs.) given in **attachment 3**. This is the Bridgestone catalog page, which was used to purchase the current tires. The reason for this difference is not clear. Either the specifications were increased sometime after 1993 or Bridgestone's tire did not meet the Tire & Rim Associations specifications.

Reducing the maximum travel speed while under load allows the maximum load to be increased using the following factors:

5 mph	No change
2.5 mph	+15%
1.0 mph*	+18%
Creep	+30%
Stationary	+60%

* 1.0 mph is the measured transporter speed used in Hawaii for transporting antennas. Both manufacturers don't test tires at this speed; so therefore, we have used half the straight-line interpolation value between 5 and 2.5 mph as a conservative estimate.

Creep speed is defined as not more than 200 feet in 30 minutes.
Reducing the loaded travel speed to 1.0 mph allows an 18% increase in load capacity:

20.5-25 size, 20 ply; 24,662 lb. @ 65 psi inflation pressure
20.5-25 size, 24 ply: 26,786 lb. @ 76 psi inflation pressure

At this point, the 20-ply tire is still "overloaded" by 3,338 lb. (28,000 – 24,662) or 13.5%. Increasing the inflation pressure 27% (see above) to 82.5 psi will increase this tire's load capacity to 28,000 lb.

The 24-ply tire is also still "overloaded" by 1,214 lb. (28,000 – 26,786) or 4.5%. Increasing the inflation pressure 9% to 83 psi will increase the tire's load capacity to 28,000 lb.

Jim Van Orsdel of Bridgestone/Firestone has recommended a Firestone 20.5-25, 24 ply SRG DT, article 423181 tire for our transporter application. (Bridgestone does not build a 24-ply tire.) This is the preferred choice for a replacement tire of the current size. Jim has confirmed that reducing the travel speed to 2.5 mph, and increasing the inflation pressure to 87 psi would increase the load capacity to 28,000 lb.

Dave Wright of Goodyear Tire & Rubber Co. has recommended either of two tire designs:

20.5-25 HRL E/L 3A 20PR 4S Product code 125-903-563
20.5-25 SGL E/L 2A 20PR 4S Product code 125-903-560

Both of these tires are 20-ply construction; Goodyear does not build greater than 20 ply tires in this size. Dave has confirmed that reducing the travel speed to 2.5 mph, and increasing the inflation pressure to 86 psi would increase the load capacity to 28,000 lb.

The T&RA design information for the required rim is shown in **attachment 4.**

Other tire questions investigated:

1.0 Can a specially designed and manufactured tire of same physical size be made to satisfy the design requirements stated above?

Answer:
Bridgestone/Firestone and Goodyear are the only responders to this inquiry. In both cases, the quantities were not sufficient to warrant the engineering time to design a special tire that does not conform to the standards set by the Tire & Rim Association.

2. Can a solid metal tire with poly or rubber thread be made?

This was discouraged because it would result in high pressure loading on the hanger floor and asphalt surfaces. It would also result in higher forces transmitted to an antenna during transport.

3. Can a larger tire work within the current bogie arms.

It maybe possible; however, it will reduce the lift range and will make clearances with transporter structures uncomfortably close. A redesigned bogie arm would be recommended.

Next larger Tire size evaluation

The Tire & Rim Association lists specifications for a 23.5-25, size tire with the following ratings:

23.5-25 size, 16 ply; 20,900 lb. @ 44 psi inflation pressure
23.5-25 size, 20 ply; 24,000 lb. @ 54 psi inflation pressure
23.5-25 size, 24 ply; 27,600 lb. @ 69 psi inflation pressure

This size tire, in either the 20 or 24-ply rating, can be increased in load capacity to meet our 28,000-pound requirement by increasing the inflation pressure and/or reducing the travel speed. Reducing the travel speed to 2.5 mph allows a 15% increase in load capacity. This would take the 20-ply tire from 24,000 lbs. To 27,600 lbs., and a 3% increase in inflation pressure to 56 psi would increase the load capacity to 28,014 lbs. Reducing the travel speed for the 24-ply tire to 2.5 mph increases the load capacity to 31740 lbs., providing excess capacity.
This size tire is approximately 5 inches larger in diameter and 2.5 inches wider. Making a change to this larger tire requiring several transporter redesigns, those being:

- New load wheel bogie assemblies
- New tire rims

MOTOR REPLACEMENT ANALYSIS

Poclain manufactures a larger size wheel motor that uses the same mounting bolt pattern as the current motor. The model is MS35-2-D21-P35-1120-2. This motors' design information is shown in **attachment 5** along with the current motor for comparison. The model MS35 has a displacement of 256.2 CIR, and the wheel-mounting flange has the same dimensions as the existing motor. Retaining the current wheel motors on the front or steering "axle", and replacing the four load wheel motors with the larger motor above yields a 26.5% increase in tractive effort for the propel system at maximum propel system pressure. Making this change would also have the effect of developing the same tractive effort but at 26.5% lower propel system pressure. It would also reduce the maximum propel speed by 26.5%. The larger MS35 series motor is 2.43 inches longer between the mounting face and the wheel flange. This requires that the center section of the wheel be

moved inboard 2.43 inches to keep the center of the tire tread in its present location. The wheel motor housing is slightly larger than the current motor housing but it appears that it would fit into the motor mounting ring. The hydraulic ports are in approximately the same location, but may require enlarging or relocating the openings in the mounting ring to pass the hydraulic hoses through.

The original transporter design basis was to set the maximum operating hydraulic pressure at 5500 psi with a desired operating pressure for worst-case conditions of 4000 psi. These design values therefore provided a drive safety margin of approximately 37% with a 500-psi reserve (Pump max. = 6000 psi). This was based on an antenna maximum weight of 65,000 pounds and a road slope of 15 degrees. Hydraulic pressure and drive power (Tractive effort) are directly related.

Transporter testing was performed in April of 2002 and reported in TM-146. The tests were conducted using an antenna base that was estimated to weigh approximately 65,000 pounds, which was the original design weight. The pressure readings from those tests indicated that the system had sufficient contingency designed into it for that transported weight. This is to say that with the pressure limiters set at 4000 psi, there was sufficient "reserve" to handle the expected worst-case conditions.

During testing, we projected an antenna weight of 87,000 pounds and calculated the desired pressure setting for all possible worst-case conditions. That table is presented below:

Pressure required to climb maximum grade (15.6%):	4453
Pressure allowance for turning:	500
Pressure allowance for roadbed conditions:	500
Pressure allowance for speed fluctuations;	310
Pressure required for anti-spin capability:	890
Pressure design contingency:	1000
Desired pressure level:	7653 psi

The maximum Hydraulic system pressure is 6000 psi and therefore the transporter is underpowered by 27.5% and 23 % for the recently measured antenna weight of 82,800-pounds. Replacing the four rear M25 motors with new M35 motors increases the drive system torque by 26.5%.

Therefore a system pressure setting of 5500 psi. and pressure limiter settings of ≈ 4000 (psi.) satisfies the worst-case conditions while re-establishing the original drive safety margins.

CONCLUSIONS:

This study revealed that large construction type tires could have their load capacity safely increased by reducing speed and increasing inflation pressure. The previous analysis demonstrated that a 24-ply tire of the current size could be safety used at our measured speeds and loads. Also, it will provide a reasonable margin of safety. However, it is not possible to describe the safety margin in real terms. We can only express it as follows:

- The current tires have performed without failure for ≈ 4 years in Hawaii and ≈6 years at Westford.
- The recommended tire has a 15% higher rating than the current tire.
- Proper inflation pressure will increase the load capacity to the desired level, which is ≈ 2% higher than the maximum expected load.

The reason for increasing inflation pressure is to maintain the tires design shape. Maintaining the proper shape reduces tire flexure as it rotates thereby reducing fatigue in the tires ply and outer material layers. The only higher-pressure drawback is that it makes the tire more susceptible to punctures. The summit roadbeds and other surfaces make this type failure less likely and therefore not a major concern.

Changing to the next larger tire would provide excess load capacity. However, its increased size would reduce the Transporter lifting range, although this would not be a problem. Also, we would need to evaluate how the transporter would operate with large rear tires and smaller front tires. These larger tires will not fit in the front wheel spaces and may cause steering problems. These are the main reasons for not recommending moving to the larger tire at this time.

ANALYSIS- TIRE REPLACEMENT ONLY

TIRE: 20.5-25 size, 24 ply: 26,105 lb.

RIM: Re-Use of present rims

DIRECT COSTS:

ITEM	PART COST ($)	COST ($)	VENDOR
Tire	1200/tire	4800	R&G tire
Rims	No cost		Hilo, HA.
Mounting	75		808-935-2966
O'rings	6		
Valve stems	13		
	94	376	
Scrapping	400/tire	1600	(rough estimate)
	Total direct cost estimate:	$6776	

IN-DIRECT COSTS:

SAO Transport round trip (Vendor-Summit)	1 man-day
Mechanical technician:	6 man days

Note: Tire lead-time is 19-23 weeks ARO.

We suggest that the present rims be used since they have not failed in service. However, during change over they can be inspected to evaluate their service rating.

Scrapping costs for the old tires is only a best guess estimate. The tires need to be removed from the Island since to large for Landfill.

COST ANALYSIS- TIRE AND MOTOR REPLACEMENT

TIRE: 20.5-25 size, 24 ply: 26,105 lb.
RIM: New rims required by motor change

DIRECT COSTS:

ITEM	PART COST ($)	COST ($)	VENDOR
Tire	1200/tire	4800	R&G tire
Rims	1425.00	5700 (4)	Hilo, HA.
Mounting	75		808-935-2966
O'rings	6		
Valve stems	13		
	94	376	
Scrapping	400/tire	1600	
Motors	10,366.23	41464.92	
Motor shipment (est)		500.00	
Elsass			
Design and vendor coordination:	2500		
Travel	2600		
Labor (10 days in Ha)	4000	9100.00	
TOTAL DIRECT COSTS:		63,540.92	

IN-DIRECT COSTS:

SAO Transport from Vendors to summit:	1 man-day
Mechanical technican:	14 man days
Nystrom	
Design	1 week
Travel	2-3 weeks
Labor	2-3 weeks

Note: Tire lead-time is 19-23 weeks ARO. Motor lead-time is not available at this time.

HYDRAULICS MODULES
COST ANALYSIS- HYDRAULIC MODULES

Foreword:

The present Hydraulics system components used for the rear drive motors and latching devices are attached to the two support arms. The design is difficult to service and uses rubber hosing to make all interconnections. Also the present covers are flimsy and don't provide any containment of leaking fluids. Their arrangement and controls can be improved for both operation and servicing, while also converting most interconnections to metal piping. Also, the amount of interconnections can be substantially reduced. However, the external connections requiring motion will need to remain as flexible high-pressure hose. We propose to package the Hydraulic systems in sealed modules. The modules would be constructed and tested before shipment to Hawaii. This would make the change over easier with limit transporter downtime.

Rough Estimate of Costs ($)

DIRECT COSTS:

ITEM		COST
Hydraulic components		$60,000
Elsass:		
Design	30,000	
Module		
Construction	150,000	
Testing	10,000	
Shipment	3,000	
Travel		
Installation and test	10,500	
TOTAL DIRECT COSTS:		$263,500

IN-DIRECT COSTS:

SAO Transport from Vendors to summit:	1 man-day
Mechanical technician:	30 man days

Nystrom

Design 2 man-month

Travel

Florida 3 Trips 4 days

Hawaii 1 Trip 10 days

ATTACHMENT 1
TRANSPORTER TIRE LOADING ANALYSIS
Please refer to SMA P/N 10086010002 for recent information.

Introduction:

The SMA antenna transporter was designed for an antenna weight of 65,000 pounds. The antenna weight has grown over its development to an antenna-transported weight requirement of 82,802 pounds. This is an increase of approximately 27 percent. This analysis studies the effect that this weight increase has on the transporters tires.

Known:

Transporter weight:	46879 lbs. G. Nystrom at Haystack
C.G. location:	X-X +73.4, Y-Y + 70.71
Antenna weight:	82,802 lbs. A. Schinckel at Mauna Kea 2/6/04
Antenna C.G. loc:	X-X +12.31, Y-Y +1.44 G. Nystrom 2/6/04 data
Transporter loc:	X-X + 137.96, Y-Y +75.99

The coordinate system is shown on the attached transporter drawing. Also, to determine tire loading, the transporters' hydraulic servo system designs need to be considered. The rear bogie arms hydraulic systems equalizes the tire loading on each tire per side with the auto leveling system equalizing the pressure side to side and front to back. This allows the transporter to remain level even thought the loads at the six tires are different.

The equations of static equilibrium required are:

$$\Sigma \text{ Forces up} = \Sigma \text{ Forces down}$$
And
$$\Sigma \text{ Moments} = 0$$

Assigning tire reaction forces:
Front tires = R1 left side and R4 right side
Rear tires = R2 & R3 left side and R5 & R6 right side

From above R2 = R3 and can be represented by R7 acting at the mid-point between the tires.
Similarly R8 represents R5 & R6

Moment distances are taken from the transporter drawings and/or from transporter measurements. Distances are measured in inches.

Determine location of combined C.G.

$\Sigma Moments_{R1, R4} = 0$

$\Sigma Moments_{R1, R4} = 83.5*(46879) + 179.31*(82802) + L*(46879+82802)$

$L = 144.68$ inches

$\Sigma Moments_{R1, R7} = 0$

$\Sigma Moments_{R1, R7} = (71–3.85)*(46879) + (71+1.44)*(82802) – L*(46879+82802)$

$L = 70.53$ inches

Note: The separation between tires side to side is 142 inches; therefore the center distance is 71.0 inches. We see that the combined C.G. is very close to the vehicle center and left hand side tires will carry a slightly higher load.

Or

$\Sigma Moments_{R1, R7} = 70.53*(129681) – 142*(R_4+ R_8)$

$(R_4+ R_8) = 64{,}411$

$(R_1+ R_7) = 129681\text{-}64411 = 65269$ lbs

From inspection the worst case tire loads are on the R1- R7 side and are:

$\Sigma Moments_{R1, R4} = 0 = 144.68*(65269) – 171.5*(R_7)$

$R_7 = 55062$ lbs.

Since R_7 represents 2 tires, the load per tire then is 27,531 pounds with the front tire load being 65269 – 55062 = 10207 lbs. Using similar analysis results in the following loads for all tires.

Tire loads

$R_1 = 10208$, $R_2 = 27531$, $R_3 = 27531$

$R_4 = 10073$, $R_5 = 27169$, $R_6 = 27169$

Check

$\sum$ Weight = R_1-R_6 = Transporter + Antenna

120681 = 46879 + 82802

~~120681~~ = 120681 √

129681

OFF-THE-ROAD TIRE CODE NOMENCLATURE AND TYPE OF SERVICE

CODE NUMBER	TREAD TYPE	TYPE OF SERVICE	*MAXIMUM	
			SPEED	DISTANCE (ONE WAY)
C = COMPACTOR (Table No. CC-5)				
C-1	Smooth	Compactor	10 km/h (5mph)	Unlimited
C-2	Grooved	Compactor	10 km/h (5mph)	Unlimited
E = EARTHMOVING (Table Nos. C-30, WB-30, CR-30, WBR-30)				
E-1	Rib Regular	Haulage	65km/h (40mph)	4km (2.5 mi.)
E-2	Traction Regular	Haulage	65km/h (40mph)	4km (2.5 mi.)
E-3	Rock Regular	Haulage	65km/h (40mph)	4km (2.5 mi.)
E-4	Rock Deep Tread	Haulage	65km/h (40mph)	4km (2.5 mi.)
E-7	Flotation	Haulage	65km/h (40mph)	4km (2.5 mi.)
G = GRADER (Table nos. C-25, WB-25, CR-25, WBR-25, C-5TG)				
G-1	Rib Regular	Grader	40km/h (25mph)	Unlimited
G-2	Traction Regular	Grader	40km/h (25mph)	Unlimited
G-3	Rock Regular	Grader	40km/h (25mph)	Unlimited
G-4	Rock Deep Tread	Grader	40km/h (25mph)	Unlimited
L = LOADER AND DOZER (Table Nos. C-5, WB-5, WBR-5, 65-5, 65R-5, C-5TG)				
L-2	Traction Regular	Loader, Dozer	10km/h (5mph)	76m (250 ft.)
L-3	Rock Regular	Loader, Dozer	10km/h (5mph)	76m (250 ft.)
L-4	Rock Deep Tread	Loader, Dozer	10km/h (5mph)	76m (250 ft.)
L-5	Rock Extra Deep Tread	Loader, Dozer	10km/h (5mph)	76m (250 ft.)
L-3S	Smooth Regular	Loader, Dozer	10km/h (5mph)	76m (250 ft.)
L-4S	Smooth Deep Tread	Loader, Dozer	10km/h (5mph)	76m (250 ft.)
L-5S	Smooth Extra Deep Tread	Loader, Dozer	10km/h (5mph)	76m (250 ft.)
IND = INDUSTRIAL (See page 4-16)				
IND-3	Regular Tread	---	---	---
IND-4	Deep Tread	---	---	---
IND-5	Extra Deep Tread	---	---	---

*For Load and Carry Service or other conditions, consult tire manufacturer.

SELECTION OF TIRES FOR OFF-THE-ROAD VEHICLES AND DEFINITION OF TERMS

TIRE SELECTION

a) **NEW VEHICLE**

When vehicles are delivered, proper tire size and ply rating selection shall be based on gross tire load, cold inflation pressure and operating conditions specified in the table from which the tire is being selected. Gross tire loads shall be based on the highest individual wheel load determined by the Gross Vehicle Weight (GVW) distribution.

For new vehicle design, the maximum load per tire must not be greater than specified in applicable tables.

b) **EXCESS LOADS (VEHICLES IN OPERATION)**

The following guidelines apply to earthmover haulage and loader applications only (Tables C-30, WB-30, CR-30, WBR-30, C-5, WB-5, 65-5, 65R-5, CR-5 and WBR-5). These guidelines do not apply to off-the-road tires in mobile crane service (see page 4-16).

Excess loads may result from factors such as actual empty vehicle weight exceeding the manufacturer's specified empty vehicle weight, varying density of materials, field modifications to the equipment, accumulation of mud, load transfer, etc. **Only under these conditions may the actual in service tire load exceed the TRA load and inflation ratings in the tables for the tire by an amount not greater than that shown in the following table:**

TYPE TIRES	MAXIMUM EXCESS LOADS	
	LOAD	*PRESSURE
Diagonal (Bias) Ply	15%	30%
Radial Ply	7%	14%

* If excess loads are encountered, cold inflation pressures must be increased to compensate for higher loads. For each 1% increase in load, cold inflation pressure must be increased by 2%.

The above maximum excess loads may exceed the tire's capabilities resulting in reduced tire performance and must be approved by the individual tire manufacturer.

IMPORTANT - Since increased tire loads and inflation pressures might exceed the rim and wheel capacity, **RIM OR WHEEL MANUFACTURERS MUST BE CONSULTED.**

c) **TIRE COLD INFLATION PRESSURE LIMIT**

The maximum cold inflation pressure for all off-the-road tire applications, including pressure adjustments, shall not exceed 1000 kPa (145 psi).

DEFINITION OF TERMS FOR OFF-THE-ROAD TIRES

a) **GROSS TIRE LOAD**

Gross tire loads are based on the highest individual wheel load determined by the distribution of the Gross Vehicle Weight (GVW), including weight transfer. The maximum GVW shall include, but not be limited to, the following:

1) **Net Weight** - Actual weight of the vehicle with standard equipment including the maximum capacity of engine fuel, oil, coolant and operator.
2) **Accessory Weight** - The combined weight of all optional items installed on the equipment not previously considered in Net Weight. These include such items as air conditioners, special cabs, body liners, side-boards, special reinforcements, etc.
3) **Payload** - The total weight of the material being carried.
4) **Tire Ballast** - If used, must be included in determination of GVW.

SECTION 4

INDEX TO OFF-THE-ROAD SECTION

VEHICLES	TYPE SERVICE	TYPE OF TIRE	LOAD LIMITS		GENERAL DATA
			TABLE	PAGE	PAGE
Earthmoving and Logging	50 KM/H (30 MPH) Haulage	Diagonal (Bias) Ply	C-30	4-06, 4-07	4-27, 4-28, 4-29
			WB-30	4-08	4-30, 4-31
		Radial Ply	CR-30	4-18, 4-19	4-33, 4-34, 4-35
			WBR-30	4-20, 4-21	4-36, 4-37
Front End Loaders, Dozers, Lift Trucks & Straddle Carriers	10 KM/H (5 MPH)	65, 70 Series Diagonal (Bias) Ply	65-5	4-09	4-40
		Diagonal (Bias) Ply	C-5	4-10, 4-11	4-28
			WB-5	4-12, 4-13	4-30, 4-31
		Diagonal (Bias) Ply-TG	C-5TG	4-14	4-32
		Radial Ply	WBR-5	4-22, 4-23	4-36, 4-37
			CR-5	4-24	4-33, 4-34, 4-35
		65 Series (Radial Ply)	65R-5	4-25	4-41
Grader	25 MPH (40 KM/H)	Diagonal (Bias) Ply	C-25 WB-25	4-15	4-30, 4-32
		Radial Ply	CR-25 WBR-25	4-26	4-36, 4-38
Mobile Crane	On Site	All	4-16		
Industrial	Various Speeds	Diagonal (Bias) and Radial Ply	4-16		
Compactor	5 MPH (10 KM/H)	Diagonal (Bias) Ply	CC-5	4-17	4-39

Explanation of Tire Size Designations	4-02
Tire Type Nomenclature	4-03
Tire Selection Procedure and Definition of Terms	4-04, 4-05
Definition of Maximum Grown Tire Envelope	4-42
Mining and Logging Trucks (Intermittent Highway Service)	Section 3 and Supplementary Service Data Section

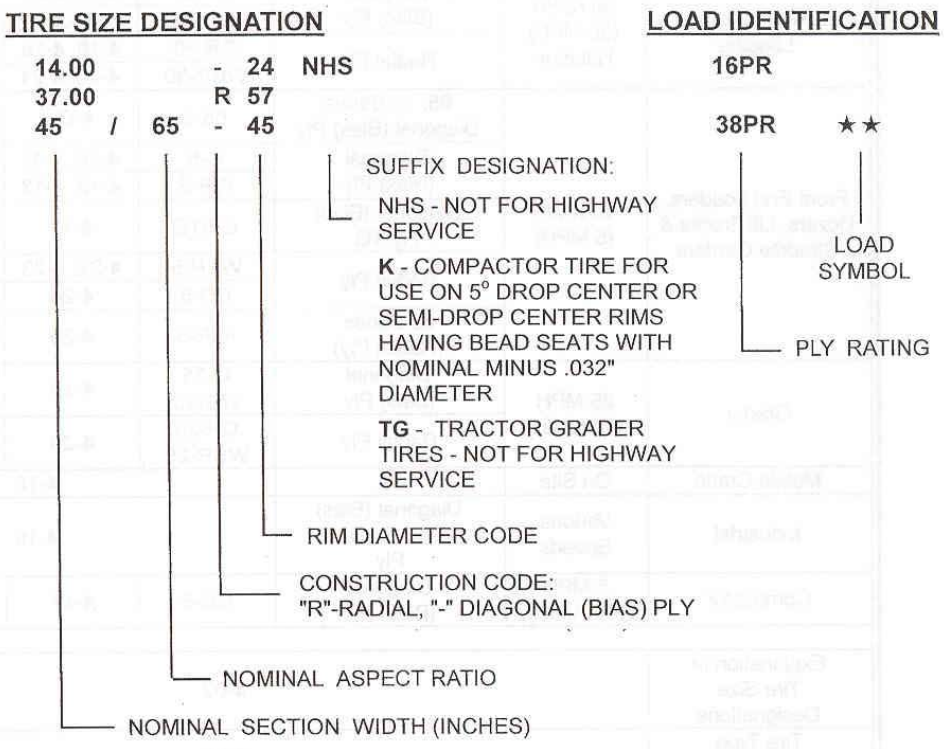
COLD INFLATION PRESSURES

The inflation pressures shown in this section are those taken with the tires at the prevailing atmospheric temperatures and do not include any inflation pressure build-up due to vehicle operation.

DEFINITION OF "NEW TIRE DIMENSIONS" AND "MEASURING PROCEDURE" (SEE PAGES XII AND XIII)

DEFINITIONS OF SUFFIX LETTERS USED IN TIRE SIZE DESIGNATIONS (SEE PAGE XV)

OFF-THE-ROAD TIRES
EXPLANATION OF TIRE DESIGNATION



DEFINITION OF TERMS FOR OFF-THE-ROAD TIRES (Continued)

b) **SERVICE CONDITIONS**

1) **Earthmover (Haulage)** - A haulage cycle where equipment self-loads or receives a load from loading equipment, then transports this load to another location and returns unloaded. Transportation usually occurs over unimproved surfaces at speeds up to 65 km/h (40 mph) and short distances, up to 4 km (2.5 miles), one way. Equipment in this category is mainly haulage trucks and scrapers.

2) **Loader -** This is a work cycle where the equipment is used to pick up material and relocate a short distance away. Tire loads fluctuate depending on the conditions involved when the equipment picks up the load. Transportation speeds are low, up to 10 km/h (5 mph), and distances are short, a maximum of 76 m (250 feet), one way.

3) **Load and Carry -** A work cycle where equipment primarily intended for loader service picks up a load and transports this load to another location and returns unloaded. Transportation usually occurs over unimproved surfaces at low speeds, up to 25 km/h (15 mph), and rather short distances, up to 600 m (2,000 feet). Equipment in this category consists mainly of loaders, log stackers and material handling equipment.

4) **Dozer -** A working condition where equipment is used to move materials (usually earth) by pushing, dragging or grading. Tire loads are relatively constant and speeds are low, up to 10 km/h (5 mph). Travel distances vary depending on work situations.

5) **Grader -** This is a working condition where equipment is used in construction and road maintenance. Tire loads are relatively constant during the work cycle. Equipment speeds are slow during working periods with maximum transportation speeds reaching 40 km/h (25 mph). Travel distances vary depending on work situations.

6) **Creep -** This is movement of equipment at very slow speed (not over 60 m (200 feet) in 30 minutes). During creep motion, loads on the tires are very high and consideration must be given to the type of surface over which the equipment is traveling.

7) **Drive Away -** This is a term used to define movement of a vehicle from one location to another under non-working conditions. This movement occurs during transportation of equipment from site to site. **LOAD/SPEED/DISTANCE TABLES IN THIS YEAR BOOK ARE NOT APPLICABLE TO DRIVE-AWAY CONDITIONS.** Consult tire manufacturers for specific conditions.

8) **Smooth Floors and Runways -** These are defined as paved or protected operating surfaces which are free of undulations, obstructions or discontinuities.

9) **Maximum Speed -** The peak speed attained by the vehicle during any part of a cycle (loaded or unloaded).

10) **Industrial Vehicle -** Consists of usage on vehicles such as counterbalanced lift trucks, container handlers, straddle carriers, aircraft tow tractors, mobile crushers, log stackers and rough terrain fork lifts.

c) **TIRE TYPE NOMENCLATURE**

1) **Conventional -** The cross-section shape of the tire has an aspect ratio (ratio of section height to section width) in the range of .95. Conventional tires are also referred to as narrow base tires.
2) **Wide Base -** The cross-section shape of this tire has an aspect ratio in the range of .85.
3) **"xx Series" -** This is a low profile tire with the aspect ratio in the range of xx, for example: "65 Series" has an aspect ratio of .65.

d) **NOMENCLATURE FOR LOAD TABLE DESIGNATION**

C = Conventional Tire
CC = Conventional (Compactor) Tire
WB = Wide Base Tire
R = Radial Tire
Number = Indicates Max. Speed (MPH)
WBR-30 = Wide Base, Radial for 30 MPH (50 km/h)
WB-30 = Wide Base, Diagonal (Bias) for 30 MPH (50 km/h)

RIM SELECTION - See Page **8**-03

OFF-THE-ROAD SLOW SPEED SERVICE - 10KM/H (5 MPH) MAXIMUM SPEED
WIDE BASE DIAGONAL (BIAS) PLY TIRES
TIRE AND RIM ASSOCIATION STANDARD

TABLE WB-5
DISTANCE - Up to 76m (250 FEET) one way

TIRE SIZE DESIG-NATION		TIRE LOAD LIMITS AT VARIOUS COLD INFLATION PRESSURES															
	kPa	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600
	psi	33	36	40	44	47	51	54	58	62	65	69	73	76	80	83	87
15.5-25	kg	4000	4250(8)	4500	4750	4875(10)	5150	5300	5600(12)								
	lbs.	8800	9350(8)	9900	10500	10700(10)	11400	11700	12300(12)								
17.5-25	kg	4750	5000	5300	5600	5800	6150(12)	6300	6700(14)	6900	7100	7300(16)	7500	7750	8000	8250(20)	
	lbs.	10500	11000	11700	12300	12800	13600(12)	13900	14800(14)	15200	15700	16100(16)	16500	17100	17600	18200(20)	
20.5-25	kg	6300	6700(12)	7100	7500	7750	8250(16)	8500	8750	9250	9500(20)	9750	10000	10300(24)			
	lbs.	13900	14800(12)	15700	16500	17100	18200(16)	18700	19300	20400	20900(20)	21500	22000	22700(24)			
23.5-25	kg	8000(12)	8500	9000	9500(16)	10000	10600	10900(20)	11200	11800	12150	12500(24)					
	lbs.	17600(12)	18700	19800	20900(16)	22000	23400	24000(20)	24700	26000	26800	27600(24)					
26.5-25	kg	10000(14)	10900	11500	12150	12500	13200(20)	13600	14000(24)	14500	15000(26)	15500(28)	16000	16500	17000(32)		
	lbs.	22000(14)	24000	25400	26800	27600	29100(20)	30000	30900(24)	32000	33100(26)	34200(28)	35300	36400	37500(32)		
26.5-29	kg	10900	11500	12150	12850	13600	14000	14500(22)	15000	15500	16000(26)	17000	17500	18000(30)			
	lbs.	24000	25400	26800	28300	30000	30900	32000(22)	33100	34200	35300(26)	37500	38600	39700(30)			
29.5-25	kg	12150	12850(16)	13600	14500	15000(22)	16000	16500	17000	17500(28)	18500	19000	19500	20000(34)			
	lbs.	26800	28300(16)	30000	32000	33100(22)	35300	36400	37500	38600(28)	40800	41900	43000	44100(34)			
29.5-29	kg	12850	14000	14500	15500	16000(22)	17000	17500	18000	19000(28)	19500	20000	20600	21200(34)			
	lbs.	28300	30900	32000	34200	35300(22)	37500	38600	39700	41900(28)	43000	44100	45400	46700(34)			
29.5-35	kg	14000	15000	16000	17000	17500	18500	19000	20000	20600(28)	21200	21800	22400	23000(34)			
	lbs.	30900	33100	35300	37500	38600	40800	41900	44100	45400(28)	46700	48100	49400	50700(34)			
33.25-29	kg	16000	17000	17500(20)	18500	19500	20600(26)	21200	21800	23000	23600(32)	24300	25000	25750(38)			
	lbs.	35300	37500	38600(20)	40800	43000	45400(26)	46700	48100	50700	52000(32)	53600	55100	56800(38)			
33.25-35	kg	17000	18000	19000(20)	20000	21200	22400(26)	23000	24300	25000	25750(32)	26500	27250	28000(38)			
	lbs.	37500	39700	41900(20)	44100	46700	49400(26)	50700	53600	55100	56800(32)	58400	60000	61500(38)			
33.5-33	kg	17500	18500	19500	20600	21800	22400	23600	24300	25750(32)	26500	27250	28000	29000(38)	30000	30000	30750(44)
	lbs.	38600	40800	43000	45400	48100	49400	52000	53600	56800(32)	58400	60000	61500	64000(38)	66000	66000	68000(44)
33.5-39	kg	19000	20000	21200	22400	23600	24300	25750	26500	27250	28000	29000	30000	30750(38)			
	lbs.	41900	44100	46700	49400	52000	53600	56800	58400	60000	61500	64000	66000	68000(38)			

(continued)

DIAGONAL (BIAS) PLY WIDE BASE OFF-THE-ROAD TIRES

TIRE AND RIM ASSOCIATION STANDARD

GENERAL DATA

MILLIMETERS
INCHES

TIRE SIZE DESIGNATION	DESIGN RIM WIDTH	DESIGN NEW TIRE			*MAXIMUM GROWN TIRE			APPROVED RIM CONTOURS	
		SECTION WIDTH	OVERALL DIAMETER		OVERALL WIDTH	OVERALL DIAMETER		RIM CONTOURS	FLANGE HEIGHT
			REGULAR TREAD	DEEP AND EXTRA DEEP TREAD		REGULAR TREAD	DEEP AND EXTRA DEEP TREAD		
15.5-25	*12.00*	394 *15.50*	1278 *50.30*	1326 *52.20*	425 *16.74*	1316 *51.82*	1368 *53.84*	12.00, 12.00DC** (12 PR Max)	1.3
								13.00DC** (12 PR Max)	1.41
17.5-25	*14.00*	445 *17.50*	1348 *53.08*	1399 *55.08*	480 *18.90*	1391 *54.76*	1445 *56.88*	14.00, 14.00DC** (12 PR Max)	1.5
								13.00DC** (12 PR Max)	1.41
20.5-25	*17.00*	521 *20.50*	1493 *58.76*	1548 *60.96*	562 *22.14*	1544 *60.78*	1603 *63.12*	17.00,	2.0
								17.00 AL (16 PR Max)	1.7
23.5-25	*19.50*	597 *23.50*	1617 *63.68*	1673 *65.88*	645 *25.38*	1676 *66.00*	1736 *68.34*	19.50	2.5
26.5-25	*22.00*	673 *26.50*	1750 *68.90*	1798 *70.78*	727 *28.62*	1817 *71.54*	1867 *73.52*	22.00	3.0
26.5-29	*22.00*	673 *26.50*	1852 *72.90*	1899 *74.78*	727 *28.62*	1919 *75.54*	1969 *77.52*	22.00	3.0
29.5-25	*25.00*	749 *29.50*	1874 *73.76*	1921 *75.64*	809 *31.86*	1948 *76.68*	1998 *78.68*	25.00	3.5
29.5-29	*25.00*	749 *29.50*	1975 *77.76*	2023 *79.64*	809 *31.86*	2049 *80.68*	2100 *82.68*	25.00	3.5
29.5-35	*25.00*	749 *29.50*	2128 *83.76*	2175 *85.64*	809 *31.86*	2202 *86.68*	2252 *88.68*	25.00	3.5
33.25-29	*27.00*	845 *33.25*	2090 *82.28*	2143 *84.36*	912 *35.91*	2171 *85.48*	2227 *87.68*	27.00	3.5
33.25-35	*27.00*	845 *33.25*	2242 *88.28*	2295 *90.36*	912 *35.91*	2324 *91.48*	2379 *93.68*	27.00	3.5

**DC designates Drop Center rim contour.

(continued)

RL E3/G3/L3 CONTINUED

R-LUG (RL) TIRES FOR EARTHMOVING, MINING, LOGGING AND SHORT HAULS

	Ply Rating & Type		Carrying Capacity At Maximum Speed				Approximate Inflated Dimensions (Inches)				
Tire Size	TT	TL	30 MPH	40 MPH	PSI	Rim	Overall Diameter	Overall Width	Loaded Radius	Loaded Width	Minimum Dual Spacing
1800-25		32	18810	15920	80	13.00	63.3	20.0	28.6	22.5	23.1
1800-33		32	21820	18460	80	13.00	71.7	19.7	32.8	22.4	23.1
2100-35		32	26570	22480	70	15.00	78.3	22.7	35.9	23.6	27.6
2100-35		36	28730	24310	80	15.00	78.3	22.7	35.9	23.6	27.6
2400-35		36	32530	27530	65	17.00	84.4	26.1	38.9	27.5	31.3
2100-49		36	34800	29450	80	15.00	93.5	22.9	43.4	24.8	27.6
2400-49		36	39030	33020	65	17.00	97.8	26.1	45.4	26.8	31.3

R-LUG (RL) WIDE BASE TIRES FOR EARTHMOVING, MINING, LOGGING AND SHORT HAULS

	Ply Rating & Type		Carrying Capacity At Maximum Speed				Approximate Inflated Dimensions (Inches)			
Tire Size	TT	TL	30 MPH	40 MPH	PSI	Rim	Overall Diameter	Overall Width	Loaded Radius	Loaded Width
26.5-25		20	17340	14350	35	22.00	69.7	27.1	31.2	28.5
26.5-25		26	21360	17680	50	22.00	69.7	27.1	31.2	28.5
29.5-25		22	21770	18020	35	25.00	73.6	30.3	32.3	31.7
29.5-25		28	25210	20870	45	25.00	73.		32.3	31.7
29.5-29		22	23180	19180	35	25.00	77.8	30.5	35.0	32.5
29.5-29		28	26850	22220	45	25.00	77.8	30.5	35.0	32.5
29.5-29		34	30200	24990	55	25.00	77.8	30.5	35.0	32.5
33.5-33		32	35650	29500	45	28.00	88.6	33.5	38.9	36.4
33.5-33		38	40090	33180	55	28.00	88.6	33.5	38.9	36.4
37.5-33		36	43480	35980	45	32.00	95.6	38.6	43.0	—
37.5-33		42	48890	40460	55	32.00	95.6	38.6	43.0	—
29.5-35		28	29230	24190	45	25.00	84.1	28.8	38.0	34.5
29.5-35		34	32870	27200	55	25.00	84.1	28.8	38.0	34.5
33.25-35		32	34780	28650	45	27.00	87.8	33.7	38.7	36.7
33.25-35		38	39070	32200	55	27.00	87.8	33.7	38.7	36.7
37.25-35		30	39570	32600	40	31.00	94.2	37.4	42.1	39.4
37.25-35		36	42390	34930	45	31.00	94.2	37.4	42.1	39.4
33.5-39		38	43180	35730	55	28.00	95.9	33.7	41.7	38.9
37.5-39		44	52470	43420	55	32.00	99.9	38.3	45.2	41.1
37.5-39		52	57800	47850	65	32.00	99.9	38.3	45.2	41.1

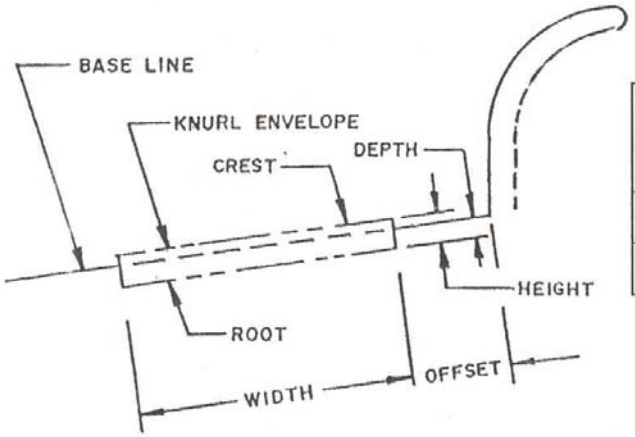
R-LUG (RL) WIDE BASE TIRES FOR SHOVELS, MINING CARS, FRONT-END LOADERS, DOZERS AND FORK LIFTS

		5 MPH						
15.5-25	12	11890	55	12.00	50.4	15.2	23.0	16.5
17.5-25	12	13570	50	14.00	53.0	17.2	23.3	18.7
17.5-25	16	15820	65	14.00	53.0	17.2	23.3	18.7
20.5-25	12	14930	40	17.00	57.2	20.9	26.4	22.5
20.5-25	16	17020	50	17.00	57.2	20.9	26.4	22.5
20.5-25	20	19840	65	17.00	57.2	20.9	26.4	22.5
23.5-25	12	17820	35	19.50	63.9	23.7	29.2	25.5
23.5-25	16	20650	45	19.50	63.9	23.7	29.2	25.5
23.5-25	20	23220	55	19.50	63.9	23.7	29.2	25.5

DEFINITION OF TRANSVERSE KNURLING FOR FULL TAPERED BEAD SEAT RIMS

DIMENSIONS IN INCHES

TIRE AND RIM ASSOCIATION STANDARD



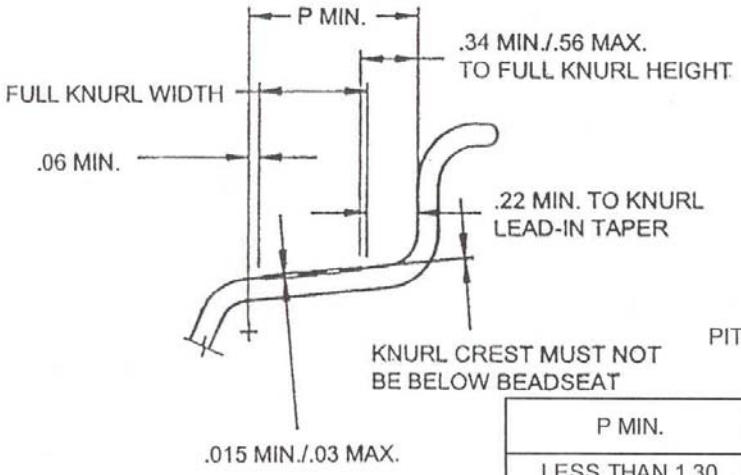
RIM WIDTH	KNURLING WIDTH	
	FIXED FLANGE SIDE	REMOVABLE FLANGE SIDE
11.25 thru 15.00	1.00 Min.	1.50 Min. 2.00 Max.
17.00 and Above	1.50 Min. 2.625 Max.	1.50 Min. 2.625 Max.

PITCH - .062 Min. - .188 Max.
HEIGHT - .015 Min. - .060 Max. – Crest to Root
DEPTH - .031 Min. - Base line to Root
OFFSET - .375 Min. - .625 Max. (49 Rim diameter code and below)
- .500 Min. – 1.500 Max. (51 Rim diameter code and above)

DEFINITION OF TRANSVERSE KNURLING FOR AGRICULTURAL RIMS

DIMENSIONS IN INCHES

TIRE AND RIM ASSOCIATION STANDARDS

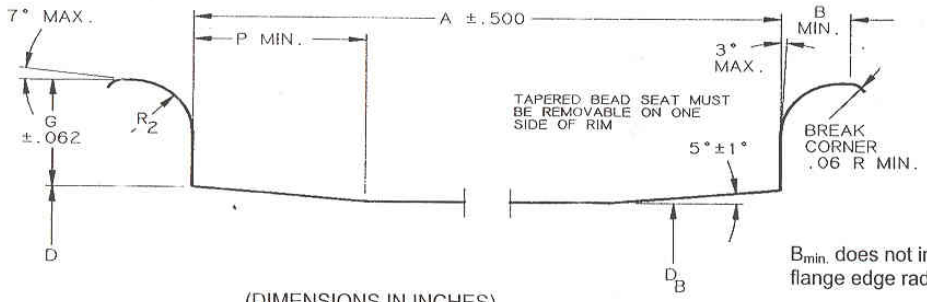


PITCH - .06 MIN. - .12 MAX

P MIN.	KNURL WIDTH
LESS THAN 1.30	.49 MIN
1.30 AND LARGER	.81 MIN. - 1.00 MAX.

5° FULL TAPERED BEAD SEAT CONTOURS FOR 21, 25, 29, 33, 35, 39, 43, 45, 49, 51 AND 57 RIM DIAMETER CODES

TIRE AND RIM ASSOCIATION STANDARD



(DIMENSIONS IN INCHES)

RIM CONTOUR	TIRE SIZE	A	B MIN.	G	P MIN.	R_2
11.25	16.00	11.25	1.25	2.00	4.00	1.25 ± .06
13.00	18.00	13.00	1.75	2.50	4.00	1.50 ± .06
13.00	18.00*49	13.00	1.88	2.75	4.00	1.875 ± .06
15.00	21.00	15.00	2.13	3.00	4.00,**4.625	1.75 ± .06
15.00	21.00*49	15.00	2.13	3.00	4.00,**4.625	2.00 ± .07
17.00	20.5	17.00	1.25	2.00	4.00	1.25 ± .06
17.00	24.00	17.00	2.25	3.50	5.50	2.00 ± .07
19.50	23.5	19.50	1.75	2.50	4.00	1.50 ± .06
19.50	27.00*49	19.50	2.56	4.00	5.50	2.25 ± .07
19.50	25/65R25	19.50	1.25	2.00	4.00	1.25 ± .06
20.00	25/65R25	20.00	1.25	2.00	4.00	1.25 ± .06
22.00	26.5	22.00	2.13	3.00	5.50	1.75 ± .06
22.00	27.00*33	22.00	2.56	4.00	5.50	2.25 ± .07
22.00	30.00*51	22.00	2.88	4.50	7.50	2.50 ± .07
24.00	30/65	24.00	2.13	3.00	5.50	1.75 ± .06
24.00	33.00	24.00	3.88	5.00	7.50	2.75 ± .07
25.00	29.5	25.00	2.25	3.50	5.50	2.00 ± .07
26.00	36.00*51	26.00	3.88	5.00	7.50	2.75 ± .07
27.00	33.25	27.00	2.25	3.50	5.50	2.00 ± .07
27.00	37.00*57	27.00	4.30	6.00	7.50	3.30 ± .09
28.00	35/65	28.00	2.25	3.50	5.50	2.00 ± .07
28.00	33.5	28.00	2.56	4.00	5.50	2.25 ± .07
29.00	40.00	29.00	4.30	6.00	7.50	3.30 ± .09
31.00	37.25	31.00	2.56	4.00	5.50	2.25 ± .07
32.00	40/65	32.00	2.56	4.00	5.50	2.25 ± .07
32.00	37.5	32.00	2.88	4.50	5.50	2.50 ± .07
32.00	40.5/75, 41.25/70	32.00	2.88	4.50	5.50	2.50 ± .07
36.00	45/65	36.00	2.88	4.50	5.50	2.50 ± .07
40.00	50/65	40.00	2.88	4.50	5.50	2.50 ± .07

*Tire size designation will include "R" (Radial Ply) or "-" (Diagonal or Bias Ply).
**For tires 32 PR and higher.

Notes:
1: See Page **8**-53 for valve slot.
2: See Section **9** for valve hole details for tubeless operation.
3: Knurling mandatory, see Page **8**-43 for knurling specifications.
4: See Supplementary Service Data section for alternate flange widths.

RIM DIAMETER CONTOUR	D	D_B
21	21.00 + .015 - .031	20.00 + .015 - .500
25	25.00 + .015 - .031	24.00 + .015 - .500
29	29.00 + .015 - .031	28.00 + .015 - .500
33	33.00 + .015 - .031	32.00 + .015 - .500
35	35.00 + .015 - .031	34.00 + .015 - .500
39	39.00 + .015 - .031	38.00 + .015 - .500
43	43.00 + .015 - .031	42.00 + .015 - .500
45	45.00 + .015 - .031	44.00 + .015 - .500
49	49.00 ± .031	48.00 + .015 - .500
51	51.00 ± .031	49.00 + .015 - .500
57	57.00 ± .031	55.00 + .015 - .500

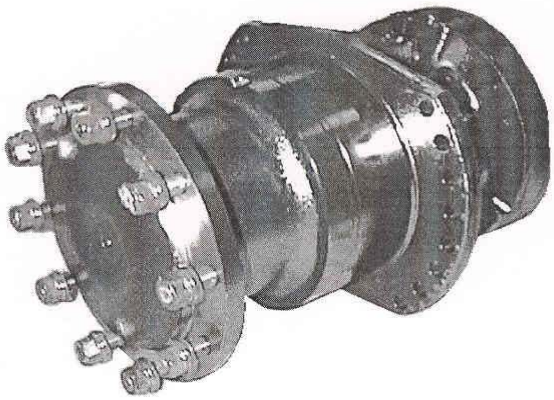
ATTACHMENT 5
M35 & M25 MOTOR INFORMATION

Moteurs hydrauliques
Hydraulic motors

MS35

Caractéristiques
Characteristics

MS35 - ☐ - ☐21 - P35 - 11☐0 - ☐☐☐☐



Moteur-roue
Wheel motor

2 cylindrées
2-displacement

Frein multidisques
Multidisc brake

5726

		MS35			
Cylindrée *Displacement*	cm^3/tr *cu.in/rev.*	3 143 à 4 198 *191.8 to 256.2*	1 572 à 2 099 *95.9 to 128.1*		
Couple à 100 bar *Torque @ 1000 PSI*	N.m *lbf.ft*	5 000 à 6 680 *2 550 to 3 390*	2 500 à 3 340 *1275 to 1 695*		
Puissance maximum *Maximum power*	kW *HP*	110 *150*	55 et 73 *75 and 100*		
Vitesse maximum *Maximum speed*	tr/min *RPM*	110 à 140 *110 to 140*	110 à 140 *110 to 140*		

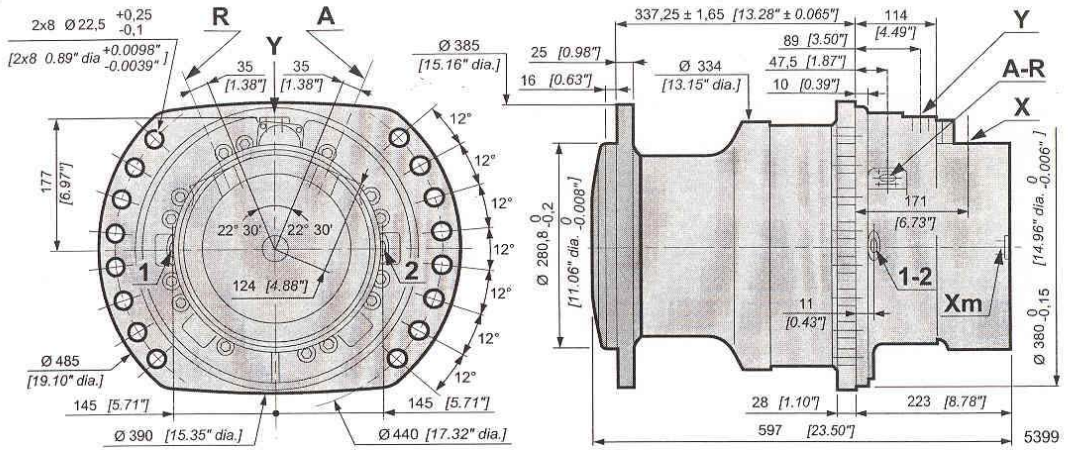
5446F

Car F MS35-2-F-11
Ref : 800478108H
Rev : Mai 1999

POCLAIN HYDRAULICS Industrie
B.P. 106
60411 VERBERIE CEDEX - FRANCE
Tel.: 33 3 44 40 77 77
Fax: 33 3 44 40 77 99
www.poclain-hydraulics.com

POCLAIN HYDRAULICS
Certifié ISO 9001

Encombrement *Dimensions*



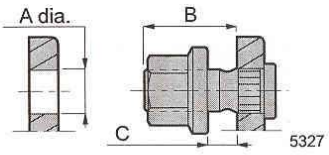
Partie fixe *Fixed part*

Partie tournante *Rotating part*

Les dimensions non tolérancées sont au maximum de tolérance. *Dimensions without tolerance shown at maximum tolerance.*

Ø A dia.	Ø 24 *[0.95" dia.]*
B	59 *[2.32"]*
C	25 maxi *[Max. 0.98"]*

5404



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Fixations

Fixation tournante *Rotating fixation*	10 goujons M 22 x 1,5 équidistants sur Ø 335 *[10 studs M 22 x 1.5 equally spaced on 13.19" dia.]*
Fixation châssis *Chassis fixation*	2 x 8 Ø 22,5 sur Ø 440 *[2 x 8 0.89" dia. on 17.32" dia.]*

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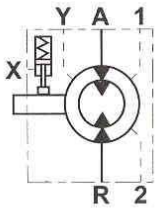
Connexions *Ports*

A - R	DN 25 PN 400 (NFE 48.055) *1" SAE 6 000 PSI (ISO DP 6162)*	450 bar maxi *[Max. 6 500 PSI]*
1 - 2	M 22 x 1.5 (DIN 3852)	1 bar maxi *[Max. 14 PSI]*
Y	M 18 x 1.5 (DIN 3852)	10 à 30 bar *[145 to 435 PSI]*
X	M 18 x 1.5 (DIN 3852)	12 à 30 bar *[175 to 435 PSI]*

5381F

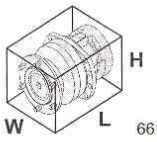


0441

Caractéristiques *Characteristics*

Poids *Weight*		269 kg *[594 lbs]*
Inertie *Inertia*		≈ 0.5 kg.m²
Capacité d'huile *Oil capacity*		4 litres *[240 cu.in]*
Dimensions avec goujons *Outlines with studs*	**L x W x H**	621 x 485 x 390 mm *[24.45 x 19.10 x 15.35 in]*

5408F



6617

Frein de service *Service brake*

L'arrêt d'un véhicule peut être assuré par son circuit hydrostatique. Certaines réglementations exigent l'installation d'un frein de service ou de parking supplémentaire (moteur avec frein).

The stopping of a vehicle can be assured by the hydrostatic circuit. Some regulations require the mounting of an extra service or parking brake (motor with brake).

5074F

Frein multidisques *Multidisc brake*

Freinage de parking (frein neuf) *Parking brake (new brake)*	20 500 N.m *[15 100 lbf.ft]*
Freinage de secours (au sens des normes et de la législation) *Secondary brake (as defined in braking standards and regulations)*	13 325 N.m *[9 820 lbf.ft]*
Freinage de parking résiduel * *Remaining parking brake **	15 375 N.m *[11 330 lbf.ft]*

Capacité *Capacity*		700 cm³ *[42.5 cu.in]*
Volume pour défreiner *Brake release displacement*		70 cm³ *[4.3 cu.in]*
Défreinage mécanique *Mechanical brake release*	**Xm**	M 16

* Après utilisation en frein de secours
** After use as secondary brake*

5383F

Options & adaptations

Fluides ininflammables (joints élastomère fluoré) *Non-flammable fluids (FPM seals)*	1
Capteur de vitesse à connecteur *Speed sensor (connected type)*	2
Prédisposition capteur de vitesse *Pre-disposition for speed sensor*	8

Ces options et adaptations sont les plus courantes. Veuillez nous consulter.

These options and adaptations are the most standard. Please consult us.

5211F

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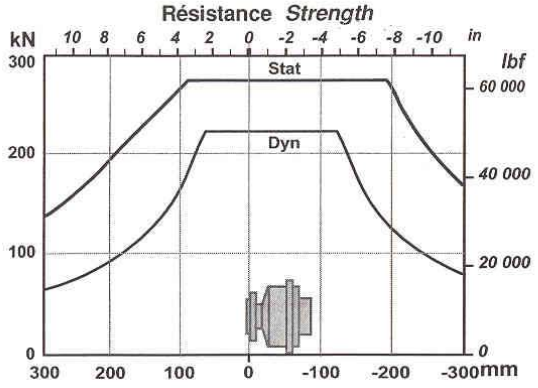
Module Couple *Torque module*	
Palier *Bearing*	
Couvercle - Connexions *Cover - Ports*	
Frein *Brake*	
Préconisations d'installation *Specifications of installation*	677777854V
Préconisations fluide hydraulique *Specifications of hydraulic fluids*	677777831V

MS35

Utilisation *Use*

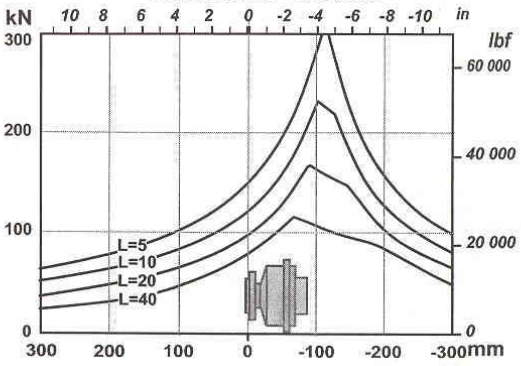
Résistance *Strength*



6594

Stat	0 tr/min *[0 RPM]* 0 bar *[0 PSI]*
Dyn	> 0 tr/min - 275 bar, cylindrée Code 0, sans charge axiale. *[> 0 RPM] - [4 000 PSI], displacement code 0, no axial load.*

Durée de vie *Life time*

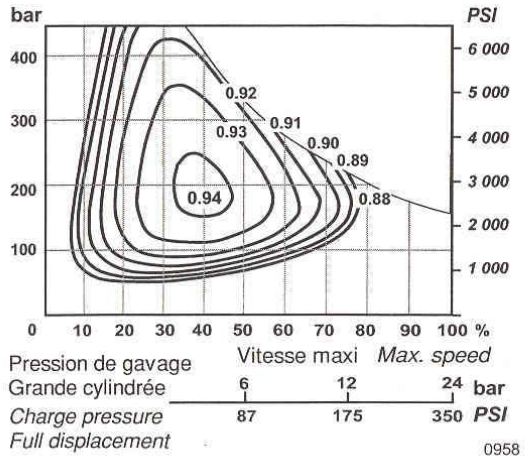


6595

L Millions de tours B10 à 150 bar (pression moyenne), avec fluide HV46 à 50°C, cylindrée Code 0, sans charge axiale.
L *Million rev. B10 @ 150 bar [2 175 PSI] (equivalent pressure) with HV46 hydraulic fluid @ 50°C [122°F], displac. code 0, no axial load.*

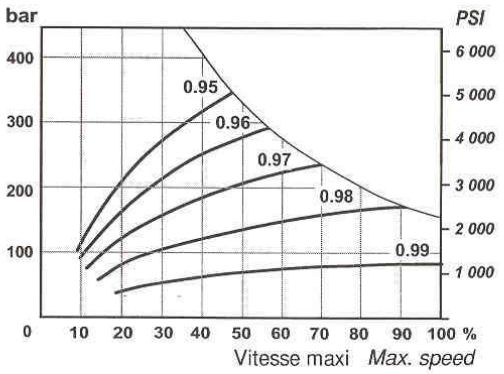
Rendement *Efficiency*

Total *Overall*



0958

Volumétrique *Volumetric*



0959

Valeurs moyennes données à titre indicatif pour la cylindrée code 0, après 100 heures d'utilisation avec du fluide hydraulique HV46 à 50°C.

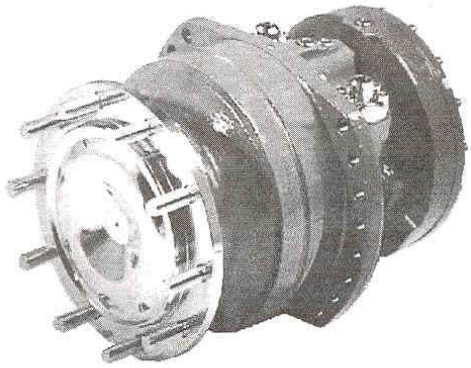
Mean values given as indication for displacement code 0, after 100 hours of use with HV46 hydraulic fluid @ 50°C [122°F].

Moteurs hydrauliques
Hydraulic motors

MS25

Caractéristiques
Characteristics

MS25 - ☐ - ☐21 - P35 - 11☐0 - ☐☐☐☐



6624

Moteur-roue
Wheel motor

2 cylindrées
2-displacement

Frein multidisques
Multidisc brake

		MS25			
Cylindrée *Displacement*	cm^3/tr *cu.in/rev.*	2 004 à 3 006 *122.3 to 183.4*	1 002 à 1 503 *61.1 to 91.7*		
Couple à 100 bar *Torque @ 1000 PSI*	N.m *lbf.ft*	3 190 à 4 780 *1 620 to 2 430*	1 595 à 2 390 *810 to 1 215*		
Puissance maximum *Maximum power*	kW *HP*	90 *122*	45 et 60 *61 and 81*		
Vitesse maximum *Maximum speed*	tr/min *RPM*	115 à 145 *115 to 145*	115 à 145 *115 to 145*		

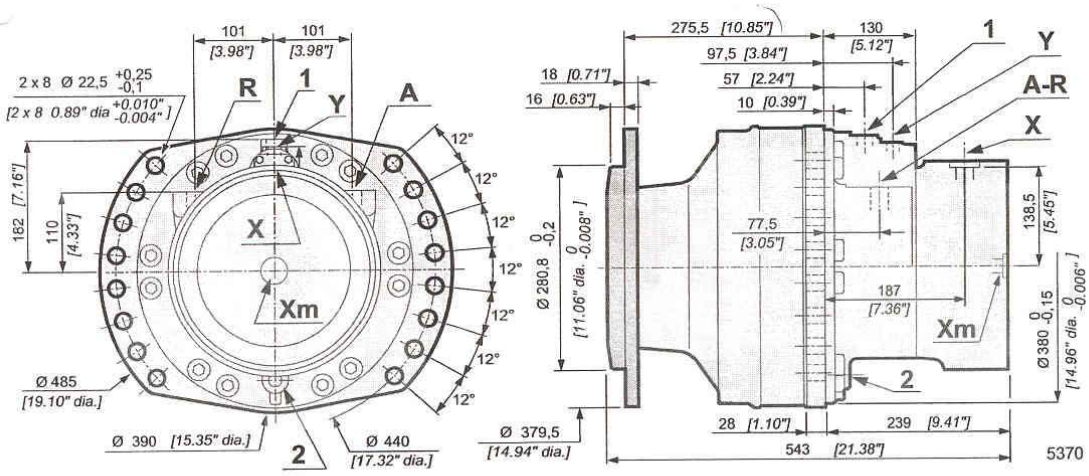
5442F

Car F MS25-2-F-11
Ref : 800378151J
Rev : Mai 1999

POCLAIN HYDRAULICS Industrie
B.P. 106
60411 VERBERIE CEDEX - FRANCE
Tel.: 33 3 44 40 77 77
Fax: 33 3 44 40 77 99

POCLAIN HYDRAULICS

Encombrement *Dimensions*



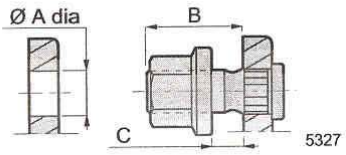
Partie fixe *Fixed part*

Partie tournante *Rotating part*

Les dimensions non tolérancées sont au maximum de tolérance. *Dimensions without tolerance shown at maximum tolerance*

Ø A dia.	Ø 24 *[0.95" dia.]*
B	62 *[2.44"]*
C	30 maxi *[Max. 1.18"]*

5328



5327

Fixations

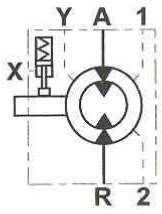
Fixation tournante *Rotating fixation*	10 goujons M 22 x 1,5 équidistants sur Ø 335 *[10 studs M 22 x 1.5 equally spaced on 13.19" dia.]*
Fixation châssis *Chassis fixation*	2 x 8 Ø 22,5 sur Ø 440 *[2 x 8 0.89" dia. on 17.32" dia.]*

5334F

Connexions *Ports*

A - R	DN 25 PN 400 (NFE 48.055) *1" SAE 6 000 PSI (ISO DP 6162)*	450 bar maxi *[Max. 6 500 PSI]*
1 - 2	M 22 x 1.5 (DIN 3852)	1 bar maxi *[Max. 14 PSI]*
Y	M 18 x 1.5 (DIN 3852)	10 à 30 bar *[145 to 435 PSI]*
X	M 18 x 1.5 (DIN 3852)	12 à 30 bar *[175 to 435 PSI]*

5381F

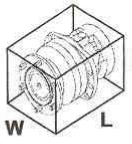


0441

Caractéristiques *Characteristics*

Poids *Weight*		270 kg *[595 lbs]*
Inertie *Inertia*		≈ 0.4 kg.m²
Capacité d'huile *Oil capacity*		4 litres *[240 cu.in]*
Dimensions avec goujons *Outlines with studs*	**L x W x H**	577 x 485 x 390 mm *[22.70 x 19.10 x 15.35 in]*

5378F

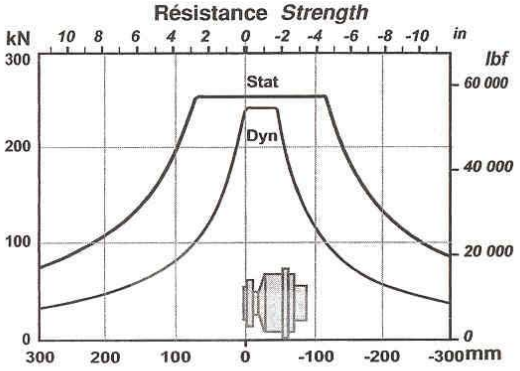


6617

MS25

Utilisation *Use*

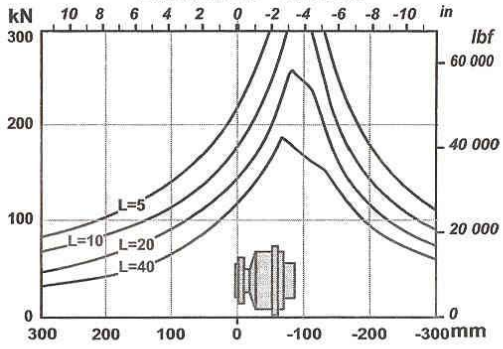
Résistance *Strength*



6586

Stat	0 tr/min *[0 RPM]* 0 bar *[0 PSI]*
Dyn	> 0 tr/min - 275 bar, cylindrée Code 0, sans charge axiale. *[> 0 RPM] - [4 000 PSI], displacement code 0, no axial load.*

Durée de vie *Life time*



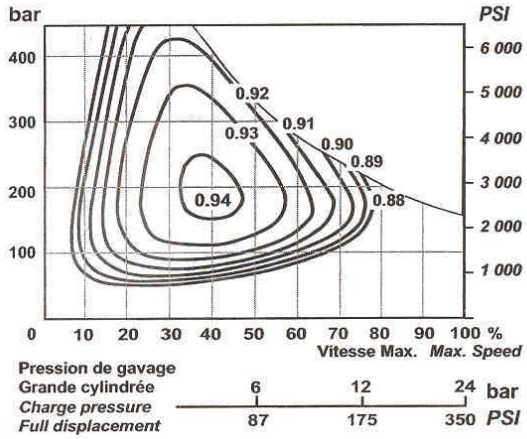
6587

L Millions de tours B10 à 150 bar (pression moyenne), avec fluide HV46 à 50°C, cylindrée Code 0, sans charge axiale.

L Million rev. B10 @ 150 bar [2 175 PSI] (equivalent pressure) with HV46 hydraulic fluid @ 50°C [122°F], displac. code 0, no axial load.

Rendement *Efficiency*

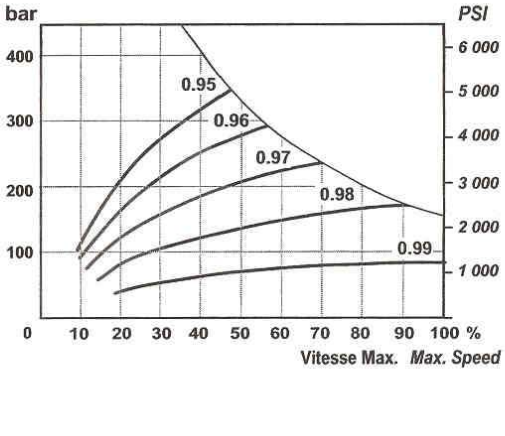
Total *Overall*



Pression de gavage
Grande cylindrée 6 12 24 bar
Charge pressure
Full displacement 87 175 350 *PSI*

Valeurs moyennes données à titre indicatif pour la cylindrée code 0, après 100 heures d'utilisation avec du fluide hydraulique HV46 à 50°C. 0465

Volumétrique *Volumetric*



Mean values given as indication for displacement code 0, after 100 hours of use with HV46 hydraulic fluid @ 50°C [122°F]. 0467

Frein de service *Service brake*

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5074F

Frein multidisques *Multidisc brake*

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Capacité *Capacity*		700 cm³ *[42.5 cu.in]*
Volume pour défreiner *Brake release displacement*		70 cm³ *[4.3 cu.in]*
Défreinage mécanique *Mechanical brake release*	**Xm**	M 16

* Après utilisation en frein de secours
** After use as secondary brake*

5383F

Options & adaptations

Fluides ininflammables (joints élastomère fluoré) *Non-flammable fluids (FPM seals)*	1
Capteur de vitesse à connecteur *Speed sensor (connected type)*	2
Prédisposition capteur de vitesse *Pre-disposition for speed sensor*	8

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Couvercle - Connexions *Cover - Ports*	
Frein *Brake*	800378116H
Préconisations d'installation *Specifications of installation*	677777854V
Préconisations fluide hydraulique *Specifications of hydraulic fluids*	677777831V