BELL SYSTEM PRACTICES
Outside Plant Construction and Maintenance

SECTION G56.135.1
Issue 1, May, 1959
AT&TCo Standard

BURIED CABLE PLACING
DRAW-BAR-PULL GENERAL

Contents **Page**

1. GENERAL

1.01 This section contains information designed to serve as a guide to successful and economical plowing. Judicious use of the information contained in this Section and G56.135.2 and G56.135.3 will eliminate much of the guesswork in plowing.

1.02 The depth of cover is defined as the distance from the top of the cable or wire to the original grade line. This depth is usually 2-5 inches less than the disturbed depth. A brief examination of the cable plow will reveal the approximate difference for any individual plow.

1.03 The soil on the surface and the structure of the soil under the surface may or may not be alike. A brief examination will reveal the broad category of subsurface and surface soil type.

2. ADJUSTMENT IN RATING OF WHEEL TYPE TRACTORS

2.01 The tractor data contained in G56.135.2 is, in general, based on the maximum recommended loading for an individual model tractor. Variations in weight on the driving wheels will, of course, cause variations in draw-bar-pull (DBP); less weight resulting in less DBP and more weight resulting in more DBP. However, **caution** should be exercised in "loading" a prime mover above the weights shown in the Section on Tractor Data.

2.02 To determine the expected draw-bar-pull from an individual tractor, if it is not weighted as shown in G56.135.2, it is necessary to know the weight on the driving wheels. This information can be easily obtained by weighing the tractor in the field at a suitable location, i.e., grain elevator, etc. It is only necessary to know the weight on the driving wheels. In most instances this will be the weight on the rear wheels; however, in the event a 4-wheel drive tractor is used it will then be necessary to weigh the entire tractor. An effort should be made to weigh the tractor as it will be during plowing operations. That is, the tractor should be weighed with the operator, the cable plow attached to the tractor, etc.

2.03 When a cable plow is directly-attached to a prime mover, the point of the plow exerts a downward force that results in an effective increase in the driving wheel weight of the tractor. This force results in an apparent increase of 1500 pounds in the weight on the driving wheels.

2.04 Paragraphs 2.02 and 2.03 discuss adjustments of the effective driving wheel weight for any wheel type tractor. The portion of the increase in weight that can be realized as an increase in draw-bar-pull is a function of the coefficient between the wheels and the surface. This varies depending on conditions but using a factor of 1/2 will prove sufficiently accurate.

2.05 The following examples illustrate a method of determining the recommended draw-bar-pull rating for a specific tractor.

EXAMPLE A—WHEEL TYPE TRACTOR (HAVING THE SAME WEIGHT AS THAT SHOWN IN G56.135.2) WITH A DIRECTLY-ATTACHED PLOW.

Assume an International 460 Utility Tractor is being used that weighs as follows:

On Front Wheels	2510 pounds
On Driving Wheels	5950 pounds
Total	8460 pounds

Section G56.135.2 lists the following data for the International 460 Utility Tractor:

Tractor Weight	Weight On Driving Wheels	Recommended Draw-Bar-Pull for Various Surfaces			
		Gravel Road	Dry Clay Loam	Wet Clay Loam	Sand
8495	5980	3900	4500	3200	2600

A comparison of the actual weights with the listed weights does not reveal any significant difference. Therefore, the only factor that will have an effect on the draw-bar-pull rating of the tractor, i.e., 1500 pounds (Par. 2.03) must be multiplied by 1/2 (Par. 2.04) to obtain the adjustment factor.

$$(1500)\ (1/2) = 750 \text{ say } 800 \text{ pounds}$$

This should be added to the recommended draw-bar-pull for the various surfaces.

	Recommended Draw-Bar-Pull for Various Surfaces			
	Gravel Road	Dry Clay Loam	Wet Clay Loam	Sand
From G56.135.2	3900	4500	3200	2600
Adjustment Factor	800	800	800	800
Adjusted Rating	4700	5300	4000	3400

EXAMPLE B—WHEEL TYPE TRACTOR (HAVING THE SAME WEIGHT AS THAT SHOWN IN G56.135.2) WITH A DIRECTLY-ATTACHED PLOW.

Assume an International 460 Utility Tractor is being used that weighs as follows:

On Front Wheels	2240 pounds
On Driving Wheels	8665 pounds
Total	10,905 pounds

Section G56.135.2 lists the following data for the International 460 Utility Tractor:

Tractor Weight	Weight On Driving Wheels	Recommended Draw-Bar-Pull for Various Surfaces			
		Gravel Road	Dry Clay Loam	Wet Clay Loam	Sand
8495	5980	3900	4500	3200	2600

A comparison of the actual weights with the listed weights, shows an excess Rear or Driving Wheel Weight of:

$$8665 - 5980 = 2685 \text{ pounds}$$

This is a significant difference; therefore, this weight (2685 pounds) must be added to 1500 pounds (Par. 2.03) and multiplied by 1/2 (Par. 2.04) to obtain the adjustment factor.

$$(2685 + 1500)\ (1/2) = 2093 \text{ say } 2100 \text{ pounds}$$

This should be added to the recommended draw-bar-pull for the various surfaces.

	Recommended Draw-Bar-Pull for Various Surfaces			
	Gravel Road	Dry Clay Loam	Wet Clay Loam	Sand
From G56.135.2	3900	4500	3200	2600
Adjustment Factor	2100	2100	2100	2100
Adjusted Rating	6000	6600	5300	4700

EXAMPLE C—WHEEL TYPE TRACTOR WITH A TRAILOR MOUNTED PLOW

Assume an International 460 Utility Tractor is being used that weighs as follows:

On Front Wheels	2240 pounds
On Driving Wheels	8665 pounds
Total	10,905 pounds

Section G56.135.2 lists the following data for the International 460 Utility Tractor:

Tractor Weight	Weight On Driving Wheels	Recommended Draw-Bar-Pull for Various Surfaces			
		Gravel Road	Dry Clay Loam	Wet Clay Loam	Sand
8495	5980	3900	4500	3200	2600

A comparison of the actual weights with the listed weights shows an excess Rear or Driving Wheel Weight of:

$$8665 - 5980 = 2685 \text{ pounds}$$

This weight must be multiplied by 1/2 to obtain the adjustment factor. (Note: The plow is not directly coupled to the prime mover; therefore, Par. 2.03 does not apply.)

$$(2685)\ (1/2) = 1343 \text{ say } 1300 \text{ pounds.}$$

This should be added to the recommended draw-bar-pull for various surfaces.

	Recommended Draw-Bar-Pull for Various Surfaces			
	Gravel Road	Dry Clay Loam	Wet Clay Loam	Sand
From G56.135.2	3900	4500	3200	2600
Adjustment Factor	1300	1300	1300	1300
Adjusted Rating	5200	5800	4500	3900

3. ADJUSTMENT IN RATING OF CRAWLER TYPE TRACTORS

3.01 Adjustments in the effective weight of any crawler type tractor can also be made as discussed in Paragraph 2.01-2.04 inclusive with the following exceptions:

A. Since the entire weight of the tractor is supported by the crawlers—the total tractor weight should be obtained.

B. The portion of the additional weight (the additional tractor weight plus the apparent increase in weight caused by a directly-attached plow) that can be realized as an increase in draw-bar-pull is a function of the coefficient between the tracks and the surface. This varies depending on conditions but using a factor of 2/3 will prove sufficiently accurate.

Variations in the DBP rating of a large tractor will, of course, be of less importance than the same change in DBP rating of a smaller and less powerful tractor. For example, a change of 1000 pounds in the DBP rating is relatively less important for the Caterpillar D-9 than it is for the Caterpillar D-2.

3.02 The following examples illustrate a method of determining the recommended draw-bar-pull rating for a specific tractor:

EXAMPLE A—CRAWLER TRACTOR WITH A DIRECTLY-ATTACHED PLOW

Assume that a John Deere 440IC Tractor is being used with a total weight of 8177 pounds including operator, cable plow, dozer blade and reel carrier. Section G56.135.2 does not list the 440IC, but it does list the following data for a similar model, the John Deere 420C.

	Recommended Draw-Bar-Pull for Various Surfaces			
Tractor Weight	Gravel Road	Dry Clay Loam	Wet Clay Loam	Sand
5079	3900	4400	3400	1700

A comparison of the actual weight with the listed weight shows an excess weight of:

$$8177 - 5079 = 3098 \text{ pounds}$$

This is a significant difference; therefore, this weight (3098 pounds) must be added to 1500 pounds (Par. 2.03) and multiplied by 2/3 (Par. 3.01 B) to obtain the adjustment factor.

$$(3098 + 1500)\ (2/3) = 3066 \text{ say } 3100 \text{ pounds}$$

This should be added to the recommended draw-bar-pull for the various surfaces.

	Recommended Draw-Bar-Pull for Various Surfaces			
	Gravel Road	Dry Clay Loam	Wet Clay Loam	Sand
From G56.135.2	3900	4400	3400	1700
Adjustment Factor	3100	3100	3100	3100
Estimated Rating	7000	7500	6500	4800

EXAMPLE B—CRAWLER TRACTOR WITH A TRAILER MOUNTED PLOW

Assume that a John Deere 440IC Tractor is being used with a total weight of 7689 pounds, including operator, dozer blade and reel carrier. Section G56.135.2 does not list the 440IC, but it does list the following data for a similar model, the John Deere 420C.

	Recommended Draw-Bar-Pull for Various Surfaces			
Tractor Weight	Gravel Road	Dry Clay Loam	Wet Clay Loam	Sand
5079	3900	4400	3400	1700

A comparison of the actual weights with the listed weights shows an excess weight of:

$$7689 - 5079 = 2610 \text{ pounds}$$

This weight must be multiplied by 2/3 to obtain the adjustment factor. (Note: The plow is not directly coupled to the prime mover; therefore, Par. 2.03 does not apply).

$$(2610)\ (2/3) = 1740 \text{ say } 1700 \text{ pounds}$$

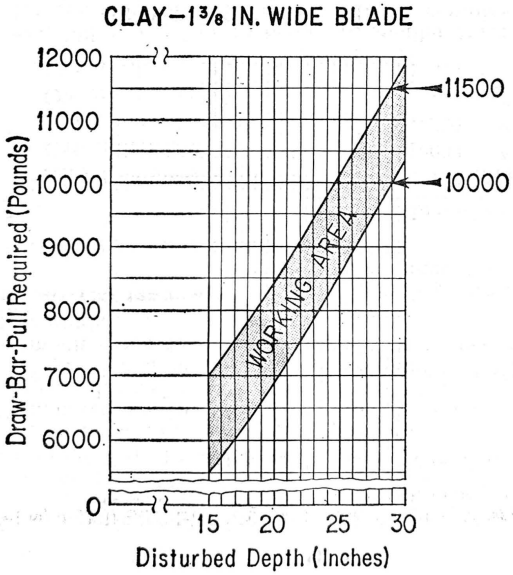
This should be added to the recommended draw-bar-pull for various surfaces.

	Recommended Draw-Bar-Pull for Various Surfaces			
	Gravel Road	Dry Clay Loam	Wet Clay Loam	Sand
From G56.135.2	3900	4400	3400	1700
Adjustment Factor	1700	1700	1700	1700
Estimated Rating	5600	6100	5100	3400

4. SELECTION OF THE PROPER PRIME MOVER

4.01 PROBLEM—WHAT PRIME MOVER SHOULD BE USED TO PLACE CABLE 24" DEEP (COVER) IN GRAVEL ROAD—CLAY SUBSURFACE—USING A TRAILER TYPE PLOW WITH A BLADE APPROX. 1-3/8" THICK?

4.02 Examination of the configuration of the plow being used reveals that the earth must be disturbed to a depth of 29 inches to secure 24 inches cover over the cable. G56.135.3 shows that plowing with a 1-3/8" blade through clay at a depth of 29 inches will require a draw-bar effort ranging from 10,000 to 11,500 pounds. See insert below.



4.03 Past experience plowing in an area will generally supply a good idea as to whether the soil in a locality runs to the high or low side of the working area in the curves shown in G56.135.3. In the absence of any experience in the area a prime mover should be selected that will provide the amount of DBP indicated by the "high" side of the curves. In this example it was decided that a prime mover would be selected that should provide a minimum of 11500 pounds DBP. It is, of course, much more desirable to provide an excess of power than not enough.

4.04 From G56.135.2 any of the following crawler-type tractors (or larger tractors of the same line) should prove satisfactory for this example:

	DBP Rating—Gravel Road
Allis-Chalmers HD-9	15200 pounds
Caterpillar D-6	14000 "
International TD-14	14200 "
Oliver-Cletrac DG	11700 "
Oliver-Cletrac DD	11800 "

Another possibility would be to team two smaller tractors such as two International T-6 Tractors with a combined DBP Rating on a Gravel Road of 14000 pounds.